CHAPTER 4 EVALUATION OF EXISTING AIRPORT FACILITIES

CHAPTER 4 EVALUATION OF EXISTING AIRPORT FACILITIES

4.1 Airside Facilities

4.1.1 Runways

(1) General

The dimensions of the runways are shown in Table 4.1.1.

Table 4.1.1 Dimensions of the Existing Runways

Runway	Runway Designation	True Bearing	Dimensions	Pavement Strength	Longi-tudinal Slope	Remarks
Main-RWY	09R/27L	092/272	4,000 m x 46 m	PCN 46 R.A.X.U	1.55%	Precision approach Cat.-I
Cross-wind	04/22	042/222	1,940 m x 30 m	- *	2.01%	* Not Paved
Sub-RWY	09L/27R	099/279	2,280 m x 30 m	- *	1.6%	* Not Paved

The operations of runways 04/22 and 09L/27R are not made for civil aviation and very few for general aviation, etc., for the following reasons:

- The runways are not paved.
- The runways are non-instrument runways.
- Longitudinal slope of runway 04/22 exceeds two (2) percent.
- Runways 09L and 04 take-offs are not authorized due to the longitudinal slope and obstacles.
- The portion of intersection between runway 09R/27L and runway 04/22 has a large slope change.
- A military firing exercise was conducted on the southern area of runway 04/22, thus the possibility of explosion of misfired bullets remains.

As explained in the subsequent wind coverage study, the improvement in percent of the wind coverage due to the cross-wind runway 04/22 is very small.

For the two major reasons stated above, it is considered that runways 04/22 and 09L/27R could be abandoned if the development of the terminal area conflicts with those runways.

(2) Runway 09R/27L

a) Runway 09R/27L was originally constructed in the early 1960's for the operation of DC-6 aircraft and the length was 3,300 meters. The runway was extended to 4,000 meter in 1963 for the introduction of DC-8-62 aircraft and the 4,000 meter length runway was inaugurated in 1966.

b) The runway operations are preferential for 09R landing and 27L take-off. Commercial airlines permit landing and take-off operations of jet aircraft up to 10 Kt of tail wind in order to perform preferential operations.

The ratio of landing operations in 1986 was as follows:

RWY 09R landing = 90 %
RWY 27L landing = 10 %

The preferential operations are made for the following reasons:

- Since the longitudinal slope of the runway is minus 1.55 percent in the runway 27L take-off direction, aircraft have better performance on runway 27L for take-off and runway 09R for landing.

- Aircraft must approach above La Paz city for runway 27L landing. A windshear tends to occur on the approach course, however due to the west down wind from the highland to La Paz city. The runway 27L landing is more difficult than runway 09R landing.

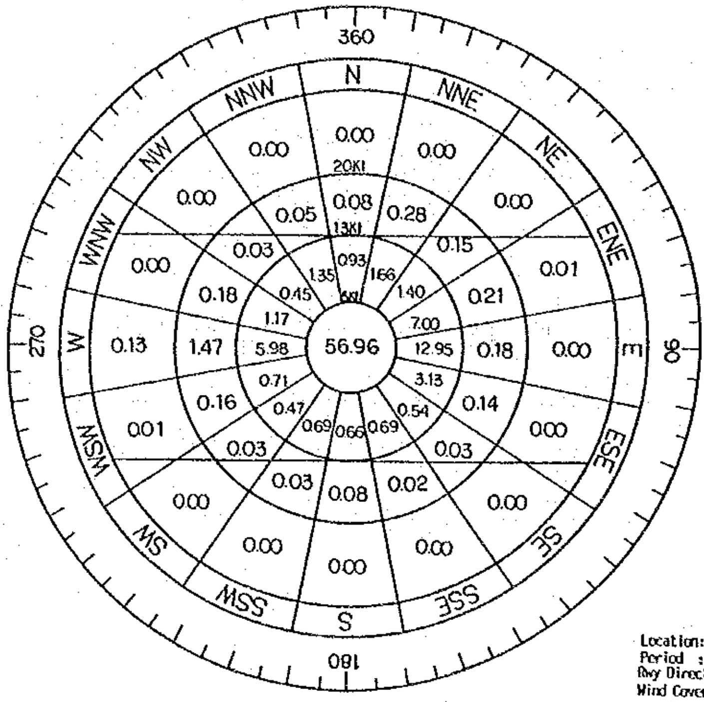
(3) Wind Coverage Analysis

The wind coverage has been analyzed based on data observed for the past three years (1984 through 1986) at El Alto airport.

Table 4.1.2 summarizes the cross wind coverage. These wind roses are shown in Figures 4.1.1 through 4.

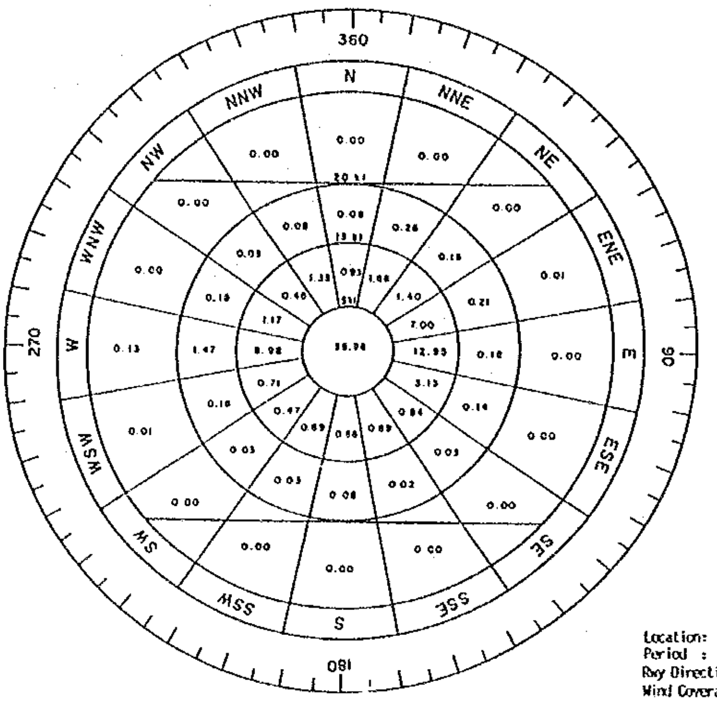
Table 4.1.2 Cross-wind Coverage of the Existing Runways

Runway	Cross-wind Coverage	
	Cross-wind Component of Less than 13 Kt	Cross-wind Component of Less than 20 Kt
Runway 09R/27L	99.44%	100%
Runway 04/22	98.69%	99.89%
Runways 09R/27L and 04/22	99.89%	—



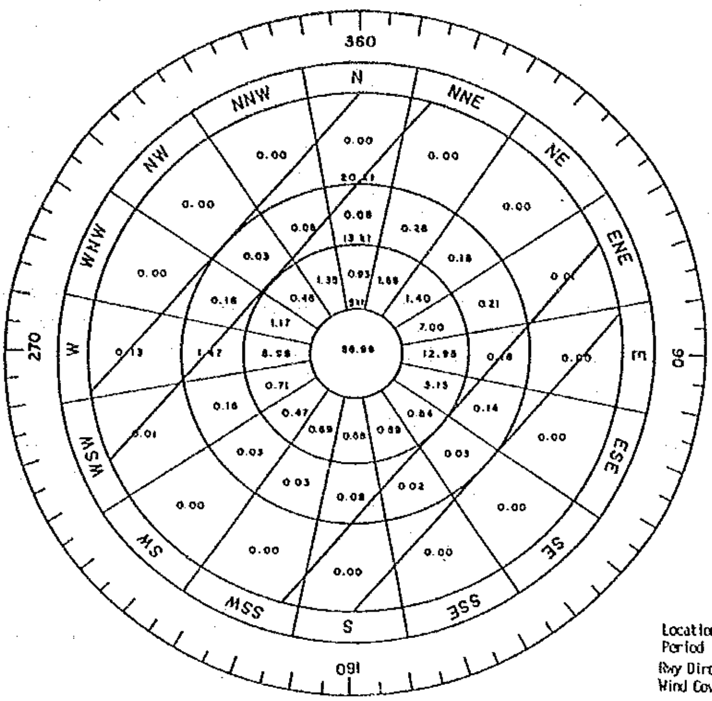
Location: El Alto Airport/Met.Observation Station
Period : 1984-1986 (Recent 3 years average)
Rwy Direction: N 092° E (Rwy 09R/27L)
Wind Coverage: 99.44% (Cross-wind 13 kt)

Figure 4.1.1 Wind Coverage (1)



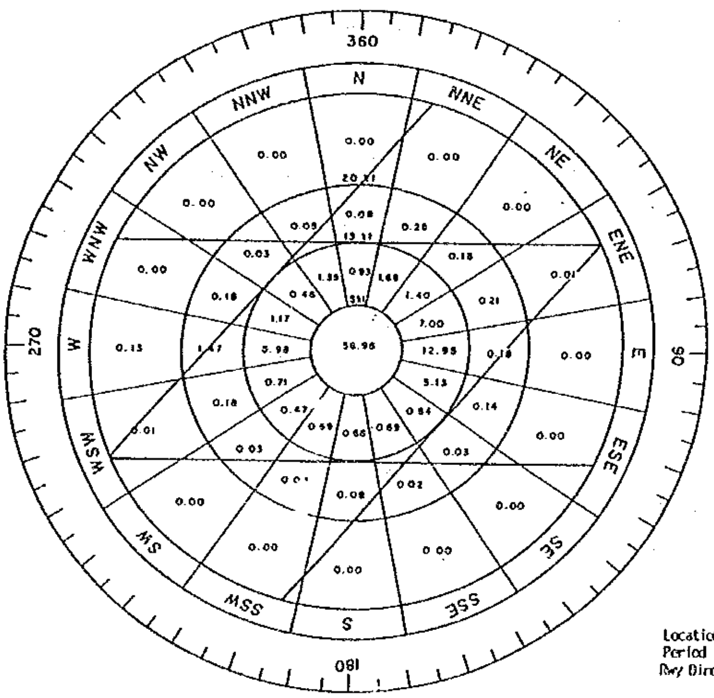
Location: El Alto Airport/Met.Observation Station
Period : 1984-1986 (Recent 3 years average)
Rwy Direction: N 092° E (Rwy 09R/27L)
Wind Coverage: 99.996% (Cross-wind 20 kt)

Figure 4.1.2 Wind Coverage (2)



Location: El Alto Airport/Met.Observation Station
Period : 1984-1986 (Recent 3 years average)
Rwy Direction: N 012° E (Rwy 01/22)
Wind Coverage: 98.69% (Cross-wind 13 kt)
99.84% (Cross-wind 20 kt)

Figure 4.1.3 Wind Coverage (3)



Location: El Alto Airport/Met.Observation Station
Period : 1984-1986 (Recent 3 years average)
Rwy Direction: N 092° E (Rwy 09R/27L)
N 012° E (Rwy 01/22)
Wind Coverage : 99.89% (Cross-wind 13 kt)

Figure 4.1.4 Wind Coverage (4)

Figure 4.1.5 shows cross-wind coverage compared to runway orientation.

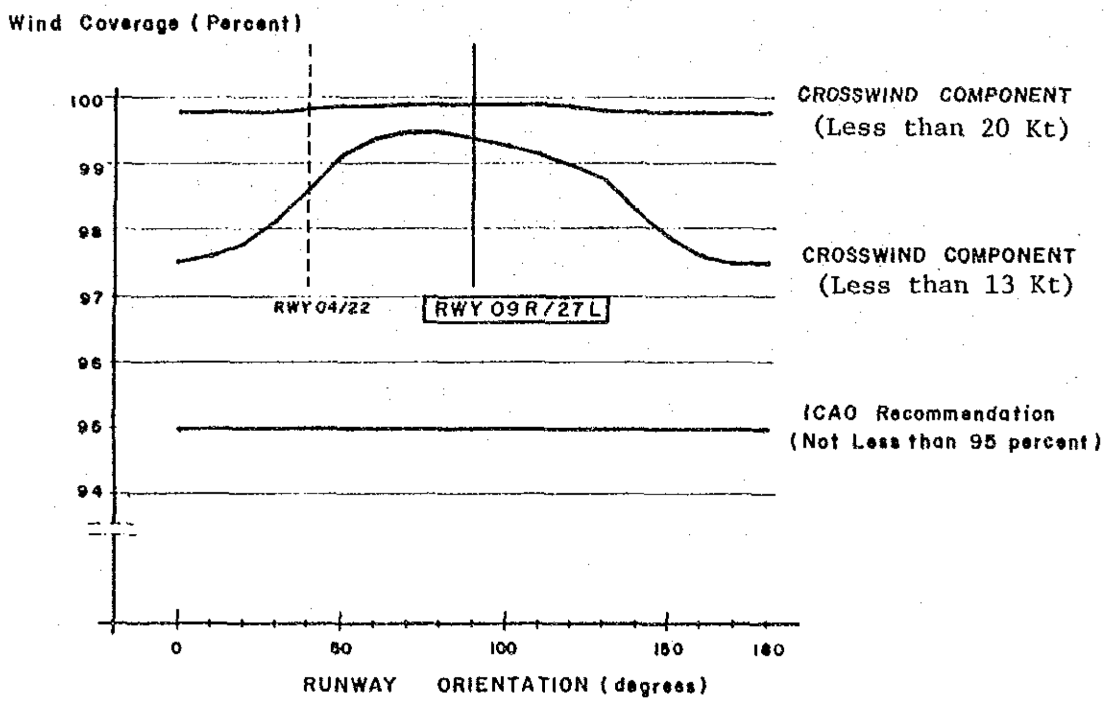
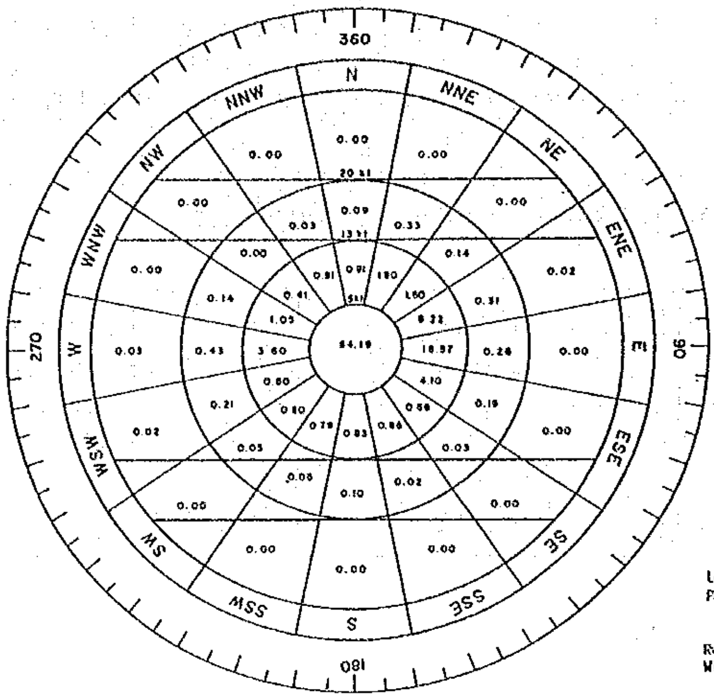


Figure 4.1.5 Runway Orientation V.S Wind Coverage

The east wind prevails between January and April and September through December, and the west wind, from May through August. Table 4.1.3 shows the wind coverages of east and west wind in the prevailing seasons. Those wind coverages are shown in Figures 4.1.6 and 7.

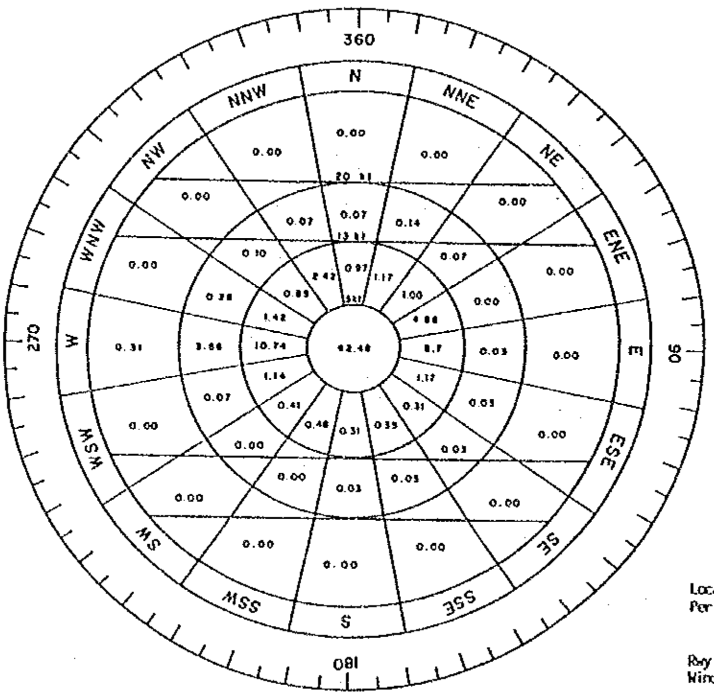
Table 4.1.3 Wind Coverage by Season (RWY 09R/27L)

Cross-wind Component	East Wind Prevailing Season	West Wind Prevailing Season
13 Kt	99.35%	99.63%
20 Kt	99.99%	100.00%



Location: El Alto Airport/Met.Observation Station
Period : 1984-1986 (Recent 3 years Average)
East Wind Prevailing Months
(Jan.Feb.Mar.Apr.Sep.Oct.Nov.Dec.)
Rwy Direction: N 092° E
Wind Coverage: 99.35% (Cross-wind 13 kt)
99.99% (Cross-wind 20 kt)

Figure 4.1.6 Wind Coverage (5)



Location : El Alto Airport/Met.Observation Station
Period : 1984 - 1986 (Recent 3 years Average)
West Wind Prevailing Months
(May, Jun, Jul, Aug.)
Rwy Direction: N 092° E
Wind Coverage: 99.63% (Cross-wind 13kt)
100 % (Cross-wind 20 kt)

Figure 4.1.7 Wind Coverage (6)

Tables 4.1.4 and 5 show the results of analysis on the possibility of preferential operations during the east and west prevailing wind seasons. The corresponding wind roses are shown in Figures 4.1.6 through 11.

It is noted that this analysis is made based on the conditions of a cross-wind component of less than 13 Kt and tail wind of less than 10 Kt.

Table 4.1.4 Possibility of Preferential Runway Operations (East Wind Prevailing Season)

(Unit in Percent)

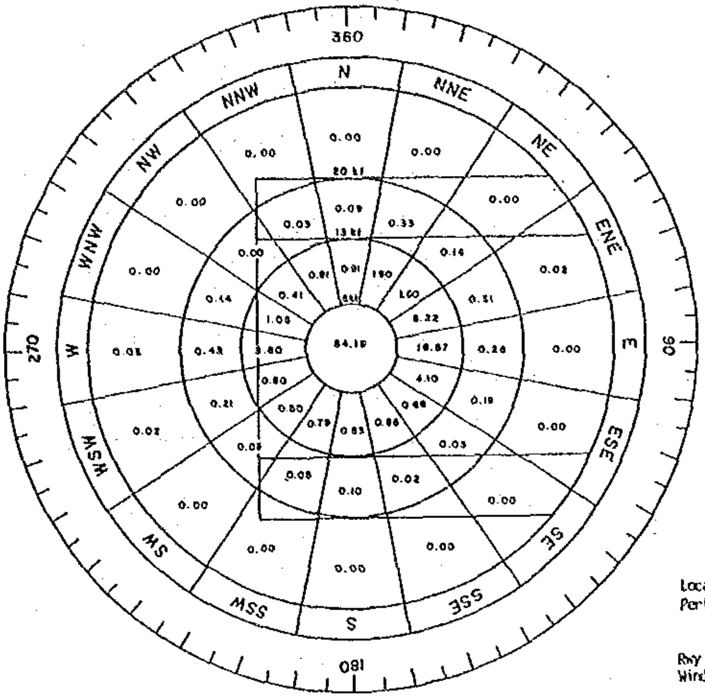
	Preferential RWY	Others	Total
Landing RWY	RWY09R	RWY27L	
Wind Coverage	96.25	3.1	99.35
Take-off RWY	RWY27L	RWY09R	
Wind Coverage	86.38	12.97	99.35
Probability of RWY use	91.9	8.1	100

Table 4.1.5 Possibility of Preferential Runway Operations (West Wind Prevailing Season)

(Unit in Percent)

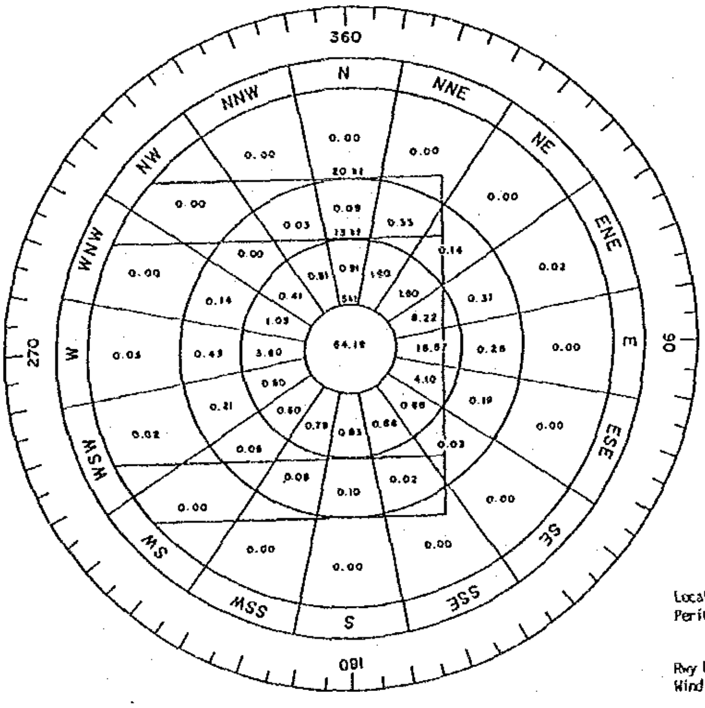
	Preferential RWY	Others	Total
Landing RWY	RWY09R	RWY27L	
Wind Coverage	89.41	10.22	99.63
Take-off RWY	RWY27L	RWY09R	
Wind Coverage	94.82	4.81	99.63
Probability of RWY use	92.5	7.5	100

From these tables, it was determined that preferential operations can be performed at a probability of more than 90 percent both in the east and west wind prevailing seasons.



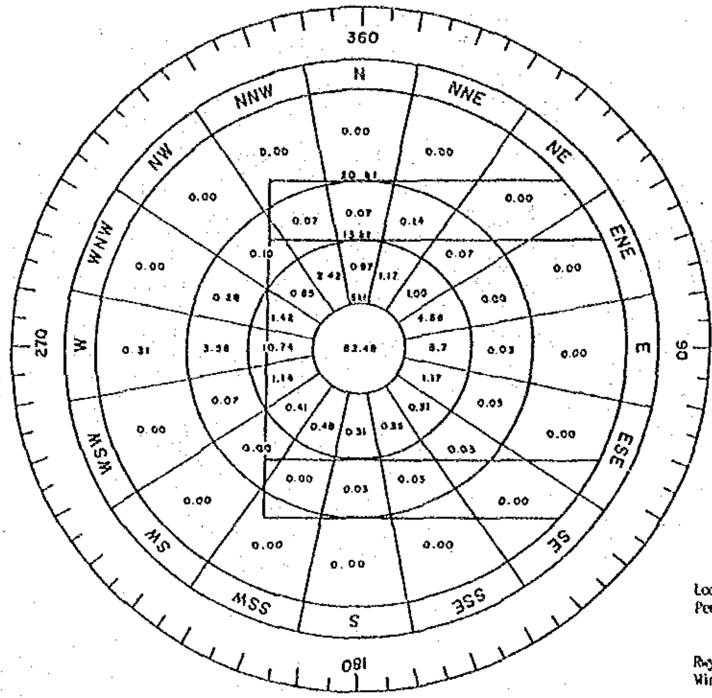
Location: El Alto Airport/Met.Observation Station
Period : 1984-1986 (Recent 3 years Average)
East Wind Prevailing Months
(Jan.Feb.Mar.Apr.Sep.Oct.Nov.Dec.)
Rwy Direction: N 092° E/Rwy 09 R. OPERATION
Wind Coverage: 96.29% (Cross-wind 13 kt/tail 10 kt)
96.80% (Cross-wind 20 kt/tail 10 kt)

Figure 4.1.8 Wind Coverage (7)



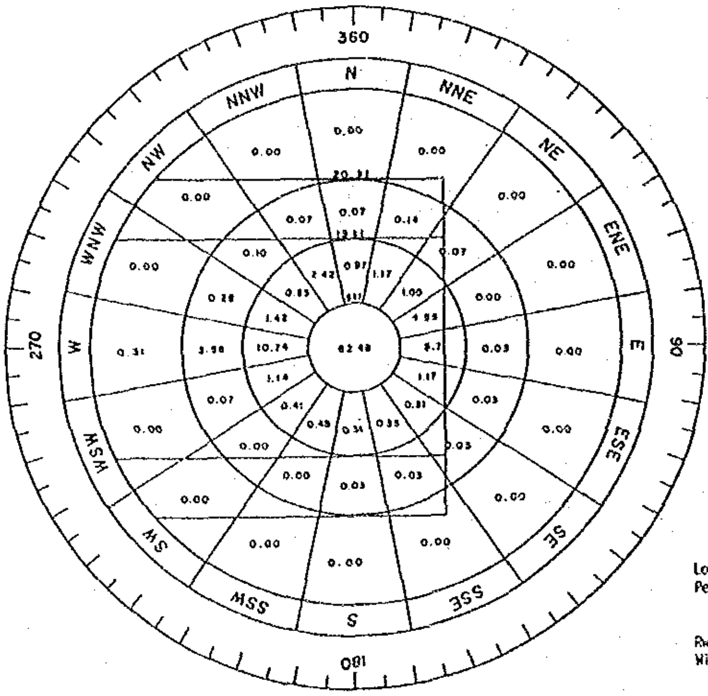
Location: El Alto Airport/Met.Observation Station
Period : 1984-1986 (Recent 3 years Average)
East Wind Prevailing Months
(Jan.Feb.Mar.Apr.Sep.Oct.Nov.Dec.)
Rwy Direction: N 092° E/Rwy 27L OPERATION
Wind Coverage: 86.38% (Cross-wind 13 kt/tail 10 kt)
86.95% (Cross-wind 20 kt/tail 10 kt)

Figure 4.1.9 Wind Coverage (8)



Location : El Alto Airport/Met.Observation Station
Period : 1984 - 1986 (Recent 3 years Average)
West Wind Prevailing Months
(May, Jun, Jul, Aug.)
Rwy Direction: N 092° E/Rwy 09 OPERATION
Wind Coverage: 89.41 (Cross-Wind 13 kt/tail 10 kt)
89.75 (Cross-Wind 20 kt/tail 10 kt)

Figure 4.1.10 Wind Coverage (9)



Location : El Alto Airport/Met.Observation Station
Period : 1984 - 1986 (Recent 3 years Average)
West Wind Prevailing Months
(May, Jun, Jul, Aug.)
Rwy Direction : N 092° E/Rwy 27 OPERATION
Wind Coverage : 91.82 (Cross-wind 13kt/tail 10 kt)
95.16 (Cross-wind 20kt/tail 10 kt)

Figure 4.1.11 Wind Coverage (10)

(4) Runway Capacity

Since the runway is a preferential one and a complete parallel taxiway is not justified in terms of aircraft operations and cost, the runway capacity has been studied.

The capacity calculations are based upon the following conditions and assumptions:

a) Runway and taxiway configuration

Existing configuration

b) Take-off and landing procedures

Take-off procedures are modified as shown in Appendix 4.1 in order to obtain the separation clearance between aircraft approaching and taking-off.

c) Air traffic control

ATC is based on a radar control with a minimum horizontal separation of 3 NM.

d) Ratio of take-offs and landings

Landings/take-offs
during a peak hour = 1:1

e) Separation minima due to wake turbulance

Approach

Heavy (*1) aircraft following Heavy aircraft	= 4 NM
Medium (*2) aircraft following Heavy aircraft	= 5 NM
Heavy aircraft following Medium aircraft	= 3 NM
Medium aircraft following Medium aircraft	= 3 NM

Take-off

Heavy or Medium aircraft following
Heavy aircraft : 120 sec
Heavy or Medium aircraft following
Medium aircraft : 60 sec

Note *1 Maximum take-off weight of more than 300,000 Lbs.
Note *2 Maximum take-off weight of more than 15,500 Lbs. and less than 300,000 Lbs.

f) Aircraft Mix

Aircraft mix anticipated in the year 2010 is used. Propeller driven aircraft are also added to the above mix.

The number of the propeller driven aircraft is calculated based on the present peak hour ratio and the forecast annual number of movements in the year 2010.

Table 4.1.6 Aircraft Mix

Aircraft	Movement	Heavy/Medium	Jet/Propeller
JJM/JJP	0.3	Heavy	Jet
LJ	3.0	Heavy	Jet
MJ	0	Medium	Jet
NJ	2.2	Medium	Jet
SJ	2.3	Medium	Jet
Propeller *1	0.2	Medium	Propeller
Propeller *2	6.0	Medium	Propeller
Total	14.0		

Note *1 Regular civil air transport
Note *2 General aviation or air force

g) Landing clearance point

Landing clearance is issued at 4 NM before the runway threshold.

h) Approach speed (1.3 Vs)

Jet: 140 KIAS x 1.2884 (ISA + 30°C/13,000 ft)
= 180 KTAS

Propeller: 110 KIAS x 1.2884
= 142 KTAS

i) Take-off speed (V2 + 10 KT)

Jet: 150 KIAS x 1.2884 = 193 KTAS
Propeller: 140 KIAS x 1.2884 = 180 KTAS

j) Runway occupancy time (Refer to Appendix 4.1)

The detailed calculations are attached in Appendix 4.1.

The results are shown in Table 4.1.7.

Table 4.1.7 Runway Capacity

Runway Operations	Allowable Operations per Peak Hour
Preferential Operation	23 operations
Runway 09 Landing and Take-off	15 operations
Runway 27 Landing and Take-off	16 operations

(5) Runway Operational Category

Table 4.1.8 shows the comparison of the facilities required for operation of the precision approach category-I and the existing facilities provided in El Alto airport.

Table 4.1.8 Facilities Required for CAT-I v.s Existing Facilities

Facilities Required for Precision Approach Category - I	Existing Facilities (0 : Provided) (X : Not Provided)
- Runway edge lights	0
- Runway threshold lights	0
- Runway end lights	0
- Taxiway edge lights	0
- Precision approach category - I lighting system	0 (CAT-II performance)
- VASIS (PAPI)	0
- Aerodrome beacon	X
- Category - II ILS signals	0
- VOR/DME	0
- RVR meter	X
- Ceilometer	X
- Power supply requirements (Radio aids : 10 sec) (Visual aids : 15 sec)	0

Upgrading of the operation category from Category-I to Category-II can not be economically justified for the following reasons:

a) The probabilities of occurrence of visibility and ceiling height below the operation minima of Category-I and -II are calculated to be 0.17 and 0.01 percent, respectively as shown in Tables 4.1.9 and 10. The difference in the probability is 0.16 percent (equivalent to 14 hours in a year), which is not considered a significant difference.

Table 4.1.9 Co-relation Between Visibility and Cloud Height
(Jan - Dec, 1986)

Category - I Operations Minima (DH=60m, VIS=800m)

Cloud Height (m) / Visibility (m)	0 - 29	30 - 59	60 - 89	90 - 119	120 - 149	150 - 179	180 - 239	240 - 299	300 - 449	450 - 899	900 - 2399	X	Total
0 - 199													
200 - 299													
300 - 399	Below CAT-I Minima						1						1
400 - 499													
500 - 599								1	1	1		8	11
600 - 799				1					1			1	3
800 - 999							1	2		1		2	6
1,000 -1,119					1		1	3		1		3	9
1,200 -1,599								1		1			2
1,600 -2,099					4		4	7		4	1	5	25
2,100 -2,499				1			1		1	1		7	11
2,500 -4,799				2		5	7	33	14	11	10	51	133
4,800 -8,999				2	2		22	46	116	98	52	213	551
9,000 -							31	107	277	780	482	6,325	8,002
T o t a l				6	7	5	68	200	410	898	545	6,615	8,754

Source : Met. Division/OPS Dept
AASANA

Possibility of Below Cat-I Operations Minima = $\frac{15}{8,754}$ = 0.17 percent

Table 4.1.10 Co-relation Between Visibility and Cloud Height (Jan - Dec, 1986)

Category - II Operations Minima (DH=30m, VIS=400m)

Visibility (m) \ Cloud Height (m)	0 - 29	30 - 59	60 - 89	90 - 119	120 - 149	150 - 179	180 - 239	240 - 299	300 - 449	450 - 899	900 - 2399	X	Total
0 - 199	Below CAT-II Minima												
200 - 299													
300 - 399							1						1
400 - 499													
500 - 599								1	1	1		8	11
600 - 799				1					1			1	3
800 - 999							1	2		1		2	6
1,000 -1,119					1		1	3		1		3	9
1,200 -1,599								1		1			2
1,600 -2,099					4		4	7		4	1	5	25
2,100 -2,499				1			1		1	1		7	11
2,500 -4,799				2		5	7	33	14	11	10	51	133
4,800 -8,999				2	2		22	46	116	98	52	213	551
9,000 -							31	107	277	780	482	6,325	8,002
Total				6	7	5	68	200	410	898	545	6,615	8,754

Source : Met. Division/OPS Dept AASANA

Possiblity of Below Cat-II Operations Minima $= \frac{1}{8,754} = 0.01$ percent

b) Category-II operations will require the following facilities in addition to those required for the category-I operations.

- Category-II ILS signals
- Precision approach category-II lighting system
- Runway touch down zone lights
- Runway centerline lights
- Stop bars and taxi-holding position lights

c) More strict performance is required for the power supply system for category-II facilities as shown in Table 4.1.11. An emergency generator does not meet the category II requirements, but non-interrupted power supply equipment with batteries are required for both radio and visual aids.

Table 4.1.11 Power Supply Requirements

Facility	Minimum Switchover Time	
	Category - I	Category - II
Radio aids	10 sec	0 sec *1
Visual aids	15 sec	1 sec *2

Note *1 : ILS GS/LLZ 0 sec
ILS IM/MM 1 sec
*2 : Except runway edge lights (15 sec)

d) Additional costs necessary for upgrading the operational category from Category-I to II and compliance of Category-II power supply requirements are preliminarily estimated to cost about US$6.5 million and additional operations and maintenance costs will be required every year.

e) Since the probability of weather conditions which lower the operation minima of Category-I is very low at El Alto airport, the upgrading of the operation minima from Category-I to Category-II will result in very small improvement in availability of continuous airport operation while the upgrading will require large investment, and operation and maintenance costs. Thus, the upgrading can not be justified economically.

(6) Runway Length

Main Runway 09R/27L is 4,000 meters long with 300 meter and 700 meter length of clearway for take off Runways 09R and 27L, respectively. A 90 meter length of stopway is provided for take-off runway 09R. At present, B-747, B-707 and B-727 aircraft operate at El Alto airport. Among these jet aircraft, B-727 is the most critical for performance.

In B-747 operations on the existing route between La Paz and Lima, there is essentially no payload reduction because of the short distance.

Table 4.1.12 shows the allowable payload for a flight from La Paz to Lima using B-747 aircraft.

Table 4.1.12 Allowable Payload for Flight from La Paz to Lima by B-747

Structural Maximum Take Off Weight (Lbs)	Gross Take Off Weight At El Alto(Lbs)	OEW + 2hr Reserve Fuel (Lbs)	Distance La Paz ~ Lima(NM)	Fuel Consumption (Lbs)	Structural Payload (Lbs)	Allowable Payload (Lbs)
785000	(1) 593000	414000	606	32700	(2) 160700	(3) 146300

Note (1): OAT 16°C, ALT 13,000ft, wind calm, Flap 10°
Runway 4,000 m, TKOF RWY 27L
(2): Pax. 220 lbs x 500 + Cargo 50,700 lbs
(3): Pax. 220 lbs x 255 + Cargo 90,200 lbs

Table 4.1.13 shows the payload reduction ratio for B-727-200 for respective routes from La Paz.

Table 4.1.13 Payload Reduction for B-727-200 by Route

Route From La Paz	Distance (NM)	Climb Limit (Lbs)	Field Length (m)	OEW + 2hr Fuel or 1.25hr Fuel (Lbs)	Fuel Consumption (Lbs)	Allowable Payload (Lbs)	Nr of PAX. 220Lbs INTL	Weight Limit Ratio %
ARICA	163	F/P 5° 1559001bs or F/P 15° 1495001bs	When F/P 5° 1559001bs TOA 14100 (4297m) TOD 14900 (4511m) When F/P 15° 1495001bs TOA 11000 (3352m) TOD 11650 (3551m)	119765	4100	25635	116 (145)	30 12
JUJUY	553				13941	15794	71 (100)	57 39
LIMA	606				15309	14426	65 (94)	60 43
ASUNCION	869				22006	7729	35 (64)	79 61
SANTIAGO	1093				27610	2125	9 (38)	95 77
CALI	1391				35265	–	– (3)	100 98
VIRU VIRU	314			112835	7928	21807	143 (164)	13 0
COCHABAMBA	140				3554	33111	164 (164)	0 0
TARIJA	403				10251	26414	132 (164)	20 0
SUCRE	248				6287	30378	151 (164)	7 0

Note:

(1) The values in parentheses in the column of Nr. of Pax indicate the allowable number of passengers if the take off gross weight is 155,900 lbs.

(2) Structural maximum take off weight of B-727-200 is 197,700 lbs.

(7) Pavement

The existing main runway was constructed as a 3,300 m long runway in 1963. After that the runway was extended to 4,000 m.

The surface condition of the existing runway pavement is summarized as follows based on the results of the visual observations.

- In the 1,740 m length from runway 09 threshold, the pavement surface condition is seriously damaged.

- In this same portion, there are some transverse and longitudinal cracks. In addition, the surface of the concrete slab spalled at spots near the joints.

- Most of the joint material is already determinated or hardened, and in some cases completely gone.

The pavement structure of the existing runway is illustrated in Figure 4.1.12, based on the data collected and the soil and pavement investigation carried out in February 1987.

The thickness required for the cement concrete pavement slab to accommodate B-747 class aircraft is estimated to be approximately 34 cm in a critical area and 31 cm is a non-critical area. These estimated thicknesses are based on the following approximate assumptions:

Design load	: B-747
Repetition of design load	: 3,000 times
Subgrade K value	: 7 kg/cu.cm

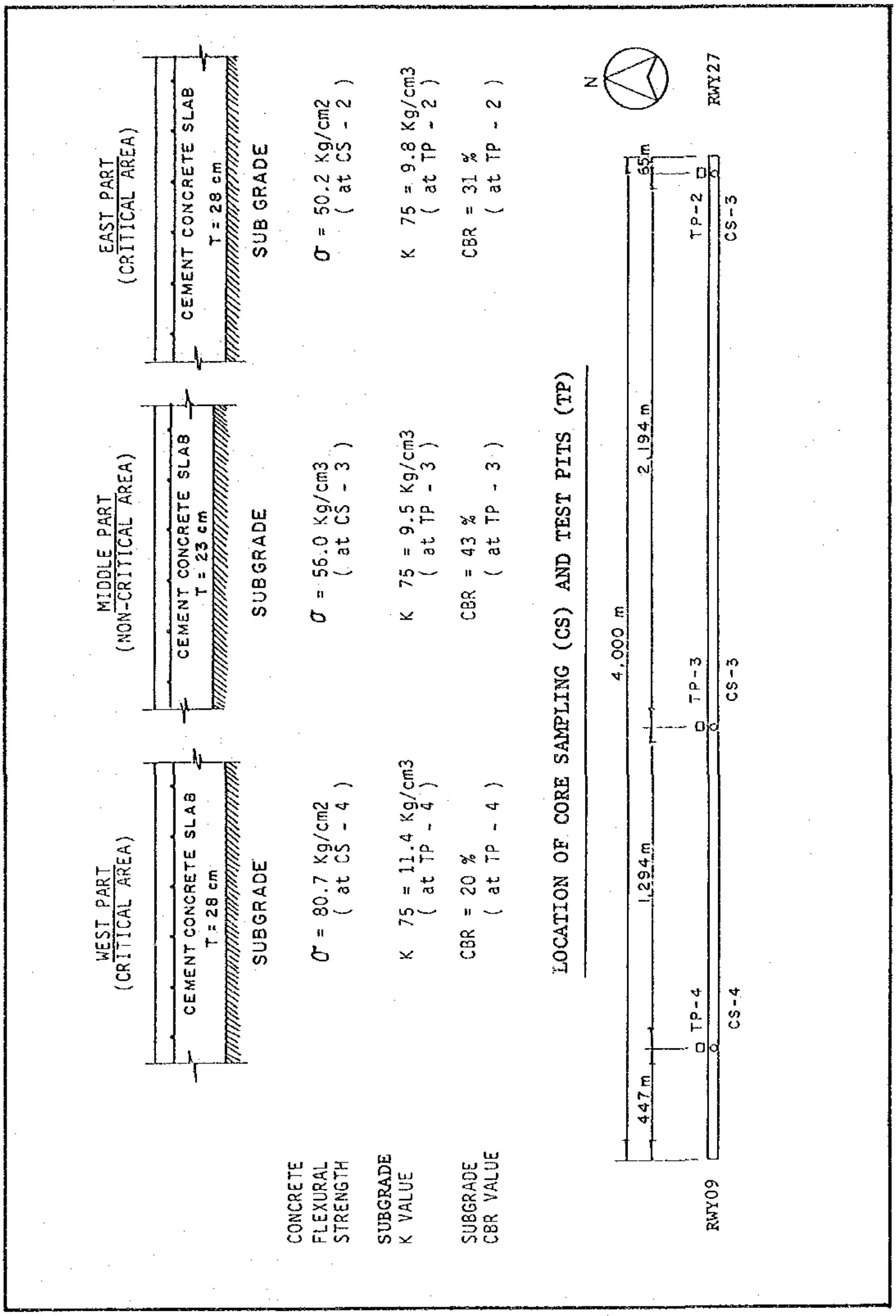


Figure 4.1.12 Existing Runway Pavement

4.1.2 Runway Strip

The runway 09R is a precision approach category-I runway, and a runway strip of 4,090 m x 300 m has been established.

In addition to the evaluation described in Main Report, the existing runway strip is described as follows:

(1) The transverse slope of the strip is in compliance with the ICAO recommendation, viz., less than 2.5 percent.

(2) The strip is completely graded and no problem with respect to the grading is noted.

(3) The existing storm water drainage system consists of excavated open ditches, a pipe culvert crossing under the main runway and the Tunari river flowing into the Seco river.

There has been no serious problem related to the drainage except that the area in the vicinity of the runway 09R threshold was covered with water caused by the flood of the Tunari river four years ago. This river is scheduled to be diverted away from the airport property area this year in order to resolve such a problem.

4.1.3 Taxiways

There are two exit taxiways at the runway 27L threshold side. The location is adequate for preferential runway operations.

Figure 4.1.13 shows the existing aircraft operations on the taxiways.

In addition to the evaluation described in Main Report, the existing taxiways are described as follows:

(1) Table 4.1.14 shows the locations of the exit taxiways which are calculated by the FAA criteria and corrected by the altitude of El Alto airport. According to this table, landing aircraft of the group D (B747, DC-10, L-1011, etc.,) have to utilize No. 1 exit taxiway (eastern taxiway), while the other aircraft can utilize No. 2 taxiway.*

Note *: Landing aircraft usually utilize No.2 exit taxiway for high-speed exit configuration. Large aircraft for landing utilize No.1 taxiway only under tail wind conditions.

(2) Existing taxiway was constructed in 1963. The surface conditions of the existing No. 1 and No. 2 taxiways are not so good. At some locations on these taxiways, there are corner cracks and the tortoise shell like deterioration. Along the shoulders of these taxiways, there are some longitudinal cracks. The pavement structure of the existing taxiway is the same as the critical area of the runway.

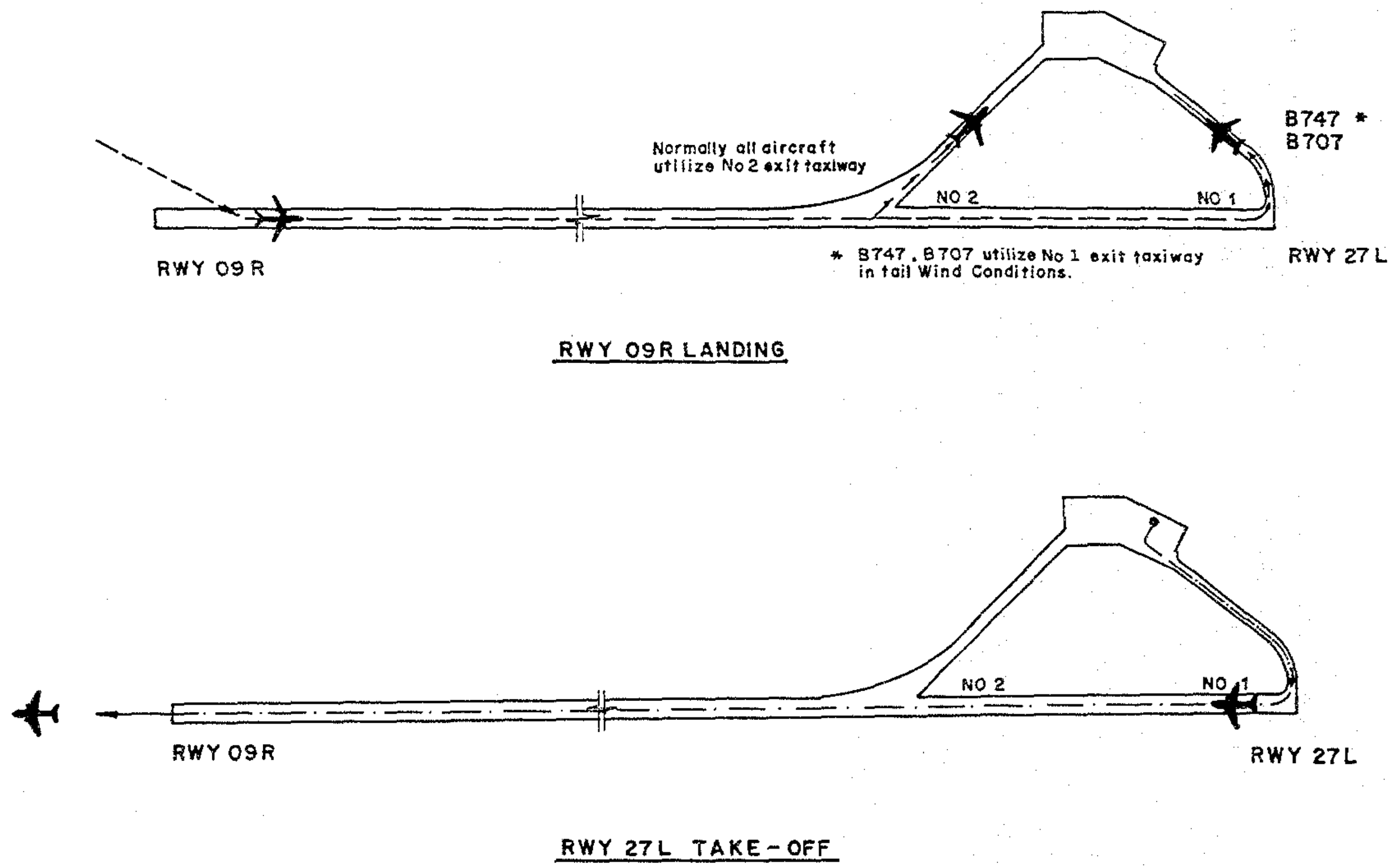


Figure 4.1.13 Existing Taxiway Operation

Table 4.1.14 Location of Exit Taxiways

(Rapid Exit Taxiway)

	GROUP A	GROUP B	GROUP C	GROUP D
Aircraft	C - 240 DC- 3	C - 600 DC- 6 F - 27	B - 707 B - 727 DC- 8	B - 747 DC- 10 L - 1011
Average Distance from Threshold to Touchdown (feet)	1,000	1,000	1,500	1,500
Threshold Speed (km/H)	169	196	242	284
Deceleration (m/sec^2)	1.524	1.524	1.524	1.524
Initial Exit Speed (km/H)	93	93	93	93
Exit Taxiway Distance from Threshold (m)	1,011	1,360	2,226	3,009

(90^o Exit Taxiway)

Initial Exit Speed (Km/H)	30	30	30	30
Exit Taxiway Distance from Threshold (m)	1,285	1,635	2,501	3,284

4.1.4 Aprons

(1) Scheduled Aviation Apron

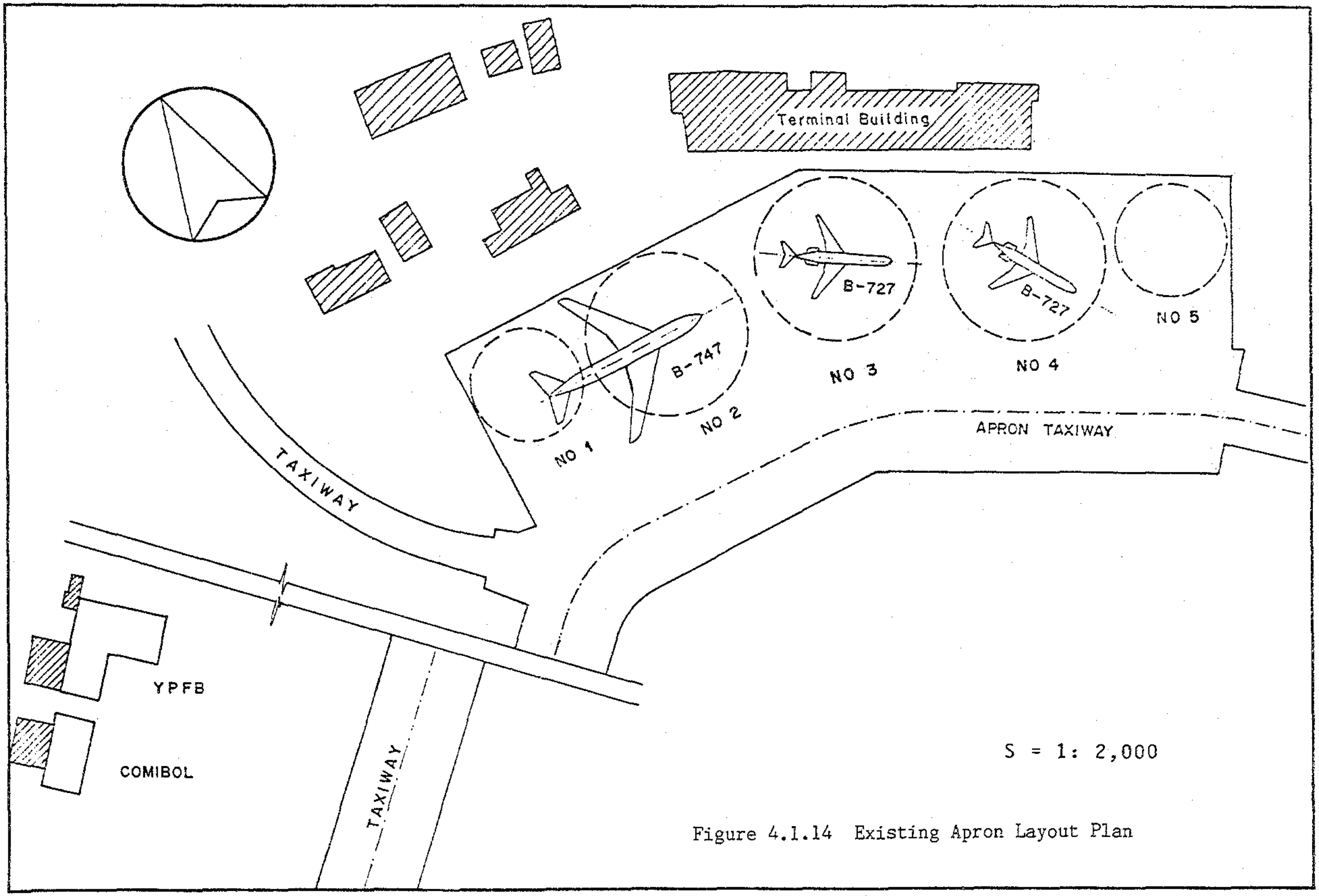
The existing apron layout plan is shown in Figure 4.1.14, and an outline of the existing apron is as follows:

The existing apron has a total area of 33,600 sq.m. Three and two parking positions for medium and small aircraft respectively are provided on the apron. The No.5 spot is used for general aviation, however and No.1 and No.2 apron are used for B-747 or C-141.

The existing apron was constructed in 1963.

The surface condition of existing apron pavement is also not good. There are many initial cracks and some transverse cracks, especially at aircraft stands No. 3 and No. 4. In addition, the surface of the concrete slab is spalled in spots near the joint. At the apron shoulder, there are also many tortoise shell like deteriorations.

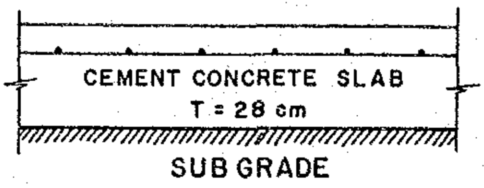
Most of the joint material is already deteriorated and hardened. Some of the material is competely gone.



S = 1: 2,000

Figure 4.1.14 Existing Apron Layout Plan

The structure of the existing apron pavement is illustrated in Figure 4.1.15.



CONCRETE FLEXURAL STRENGTH	σ = 49.0 Kg/cm2 (at CS - 1)
SUBGRADE K VALUE	K 75 = 9.5 Kg/cm3 (at TP - 1)
SUB GRADE CBR VALUE	CBR = 29 % (at TP - 1)

LOCATION OF CORE SAMPLING (CS) AND TEST PIT (TP)

S = 1 : 4,000

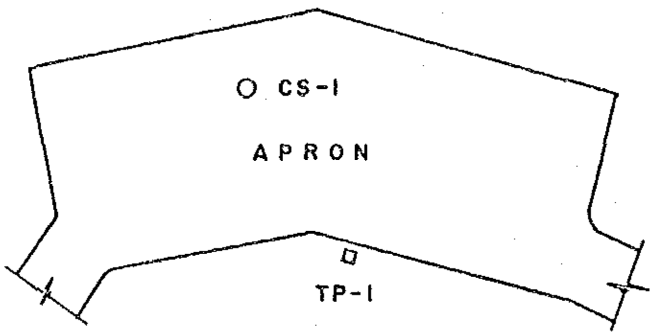


Figure 4.1.15 Existing Apron Pavement

(2) General Aviation Apron

At the present time, 9 general aviation aircraft are stationed at this airport. The parking area for the general aviation is provided at the No.1 spot and in front of the hangar for COMIBOL and YPFB (Note 1) as shown in Figure 4.1.14.

Note 1, COMIBOL:
Corporacion Minera de Bolivia,
Bolivian Mining Corporation

YPFB:
Yacimientos Petroliferos Fiscales Bolivianos,
Bolivian National Petroleum Corporation

An exclusive apron for general aviation should be provided to accommodate future demand as shown in Table 3.1.16.

(3) Cargo Apron for Small Carriers

The aircraft parking area for small carriers which transport meat to La Paz from the rural areas is provided at the east end of the airport along the access road. At the present time, 16 aircraft from 16 carriers are stationed in this area.

The number of stationed aircraft is anticipated to gradually decrease in the future as shown in Table 3.1.15. The existing aircraft parking area is therefore, considered to be adequate to accommodate the future demand.

4.2 Airspace Use

4.2.1 Airspace Configuration in Bolivia

(1) Flight Information Region (FIR)

The air space over the territory of the Republic of Bolivia which is surrounded by the borders with Brazil, Paraguay, Argentina, Peru and Chile is designated as La Paz FIR as shown in Figure 4.2.1 and in Table 4.2.1.

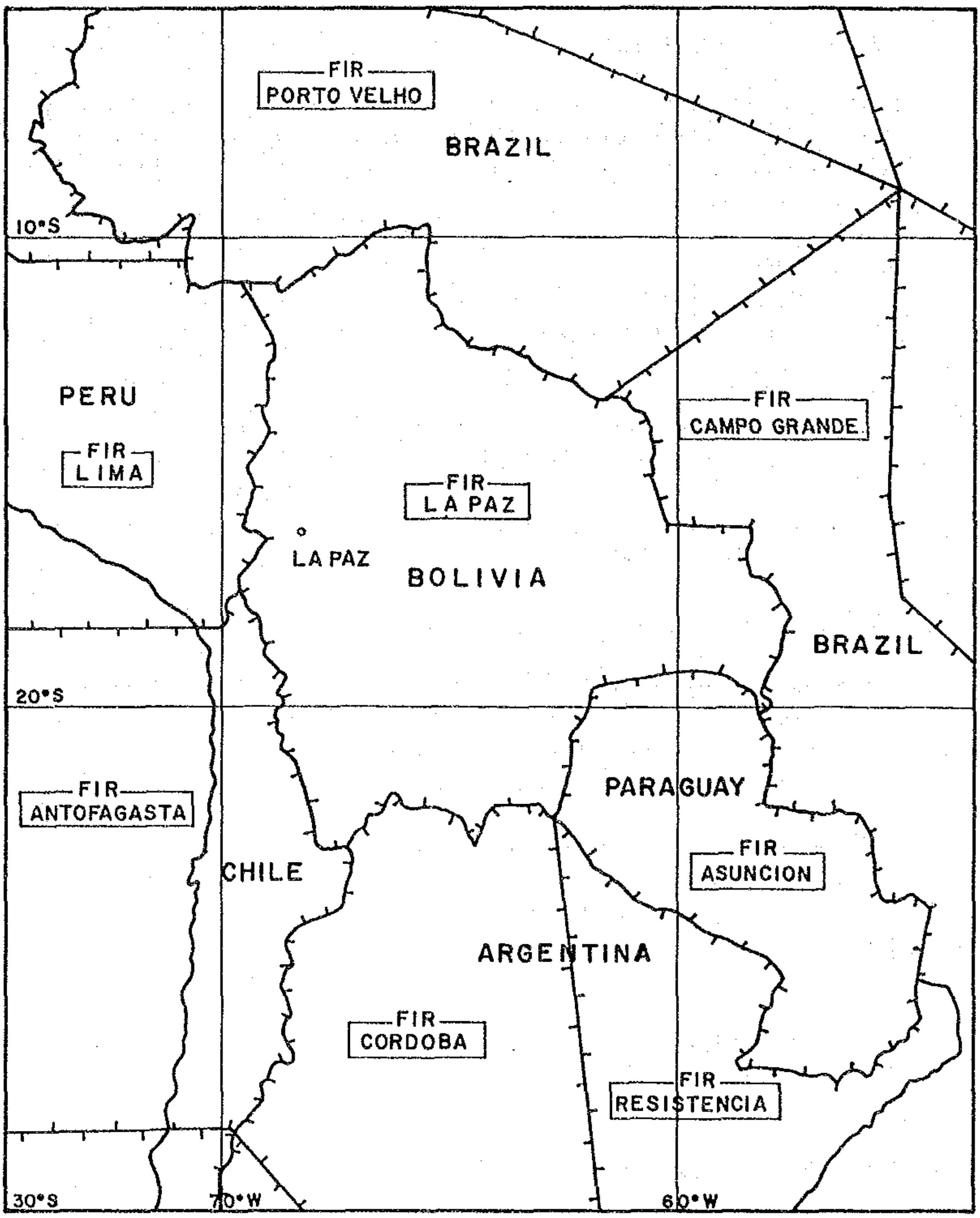


Figure 4.2.1 La Paz Flight Information Region (FIR)

Table 4.2.1 La Paz Flight Information Region

AIP BOLIVIA

REGIONES DE INFORMACION DE VUELO Y AREAS DE CONTROL				
NOMBRE Y LIMITES LATERALES	LIMITE SUP / LIMITE INF	DEPENDENCIA QUE PROPORCIONA EL SERVICIO	SEÑAL DE LLAMADA (IDIOMA)	OBSERVACIONES
1	2	3	4	5
<u>REGION DE INFORMACION DE VUELO LA PAZ FIR-SLIP</u> Región de información de vuelo La Paz FIR-SLIP comprende el espacio aéreo delimitado por las fronteras de Bolivia con Brasil, Paraguay, Argentina, Chile y Perú.	UNL / GND	ACC/FIC/La Paz	La Paz Control Es/En	

The Area Control Center, i.e., La Paz Control which is located at El Alto airport has the responsibility for the control enroute IFR operations on a 24 hour basis within the airspace from ground level up to unlimited altitude/flight level in La Paz FIR.

Radar control service for air traffic control has not yet been introduced.

(2) <u>Terminal Control Area</u>

A terminal control area for El Alto airport which is controlled by La Paz Approach Control is established for international and domestic operations as shown in Figure 4.2.2 and Table 4.2.2.

Table 4.2.2 La Paz Terminal Control Area

AIP BOLIVIA

REGIONS DE INFORMACION DE VUELO Y AREAS DE CONTROL				
NOMBRE Y LIMITES LATERALES	LIMITE SUP / LIMITE INF	DEPENDENCIA QUE PROPORCIONA EL SERVICIO	SEÑAL DE LLAMADA (IDIOMA)	OBSERVACIONES
1	2	3	4	5
<u>AREAS DE CONTROL DENTRO DE LA FIR - LA PAZ</u> 1. Area de Control Terminal La Paz Area delimitada por un círculo cuyo radio es de 55 NM centrado en el VOR PAZ (163030S 0681354W) que se extiende desde el punto 161224S - 0690724W hasta el punto 163812S 0690942W siguiendo el límite de frontera Bolivia - Perú.	UNL / 2000 Ft AGL	ACC/La Paz	La Paz Control Es/En	

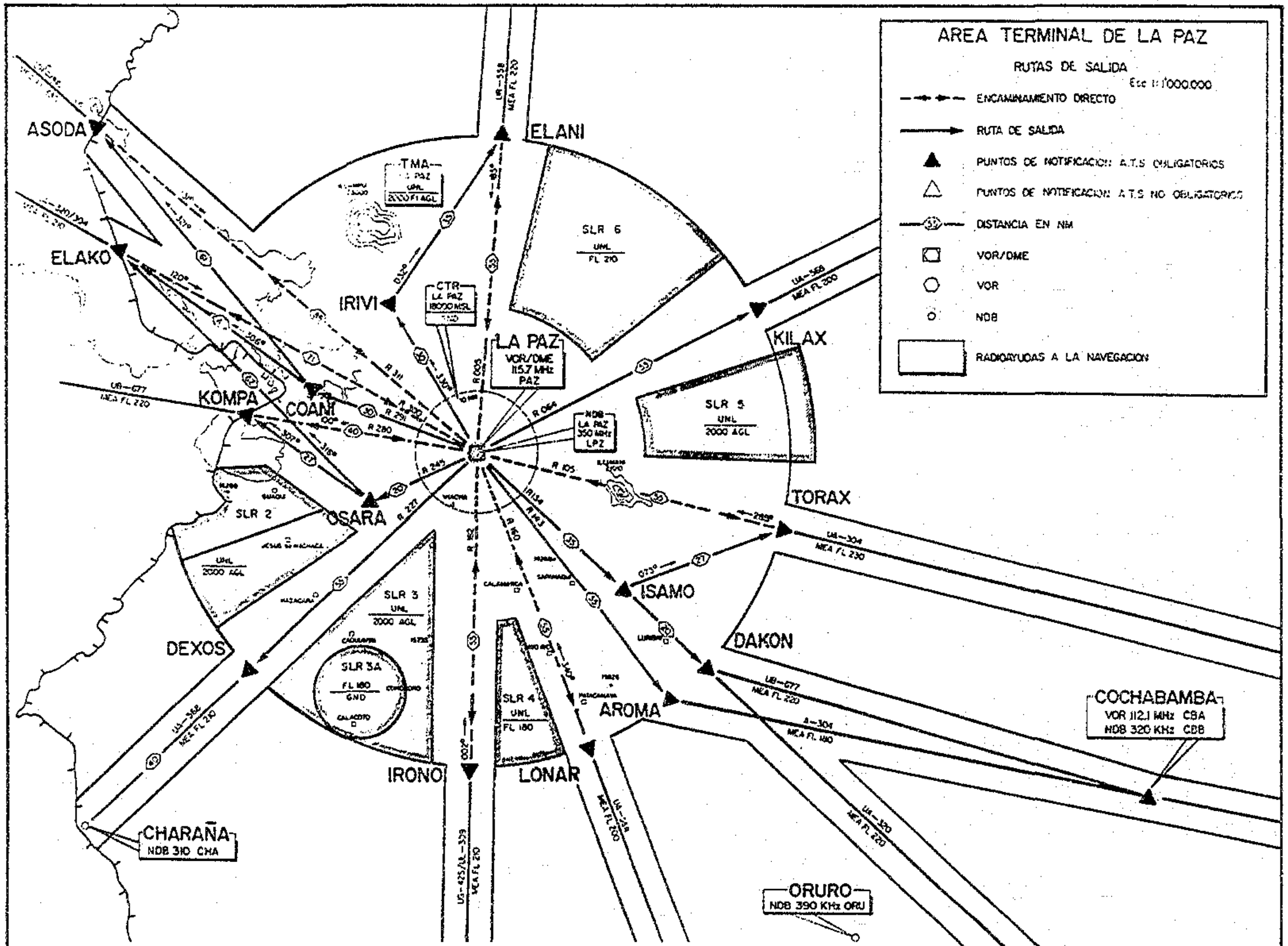


Figure 4.2.2 Terminal Control Area for El Alto Airport

La Paz VOR/DME (PAZ 115.7 MHZ, CH 40X, operating 24 hours) situated about 3 nm west of ARP of El Alt airport and is the converging point for the ATS routes UA 320/304, UA 558, UA 568, UB 677, UG 425, UR 558, etc.

Based on the existing conditions of La Paz TMA, AASANA has a plan to install a SSR (Secondary Surveillance Radar) at El Alto airport for terminal radar control services. To actuate these services by SSR, aircraft operating in La Paz TMA under IFR are required to be equipped with a transponder prior to the commencement of terminal radar control service.

In Bolivia, three more terminal control areas are established at Cochabamba, Trinidad and Santa Cruz for the purpose of expeditious control of air traffic as shown in Table 4.2.3 and in Figure 4.2.3.

In Bolivia, nine more control zones and aerodrome traffic zones (ATZ) are established for the purpose of aerodrome control services as shown in Table 4.2.4.

Table 4.2.3 Terminal Control Area Other than La Paz TMA established in Bolivia

AIP BOLIVIA

REGIONS DE INFORMACION DE VUELO Y AREAS DE CONTROL				
NOMBRE Y LIMITES LATERALES	LIMITE SUP / LIMITE INF	DEPENDENCIA QUE PROPORCIONA EL SERVICIO	SEÑAL DE LLAMADA (IDIOMA)	OBSERVACIONES
1	2	3	4	5
AREAS DE CONTROL DENTRO DE LA FIR-La Paz				
2. Area de Control Terminal Cochabamba Area delimitada por un círculo cuyo radio es de 25 NM centrado en el VOR CBA (172457S 0661041W).	FL195 / 2500 FT AGL	APP/Cochabamba	Cochabamba Aproximación Es/En	Operación HJ
3. Area de Control Terminal Trinidad Area delimitada por una línea recta que comenzando en el punto LOBAL (150635S - 0653326W), une tangencialmente este a un arco de 10 NM centrado en el NDB ANA -- (134552S - 0652448W) continuando con otra línea recta que une tangencialmente este arco con un otro de 45 NM centrado en el VOR TRI (144744S - 0645612W) hasta el punto IRECO (152624S - 0643206W); de ahí una línea recta hasta el punto EKARI (153927S 0652019W) a 57 NM R 209 del VOR TRI para terminar con otra línea recta al punto LOBAL.	FL195 / 1000 FT AGL	APP/Trinidad	Trinidad Aproximación Es	Operación HJ
4. Area de Control Terminal Santa Cruz Area delimitada por un arco centrado en el VOR VIR (173729S - 0630854W) de 85 NM de radio que se extiende desde el punto SINOR (171918S - 0643548W) hasta el punto SUDAN (161340S - 0625403W) y desde ahí sigue una línea recta hasta el punto SACON (174936S 0621242W); de ahí sigue un acro centrado en el VOR VIR de 55 NM de radio hasta el - punto LOBAR (182912S - 0631906W) y desde ahí sigue una línea recta hasta el punto EGASO (181524S - 0640700W) para concluir con una línea recta hasta el punto SINOR.	FL245 / 2000 FT AGL	ACC/Santa Cruz	Santa Cruz Control Es/En	

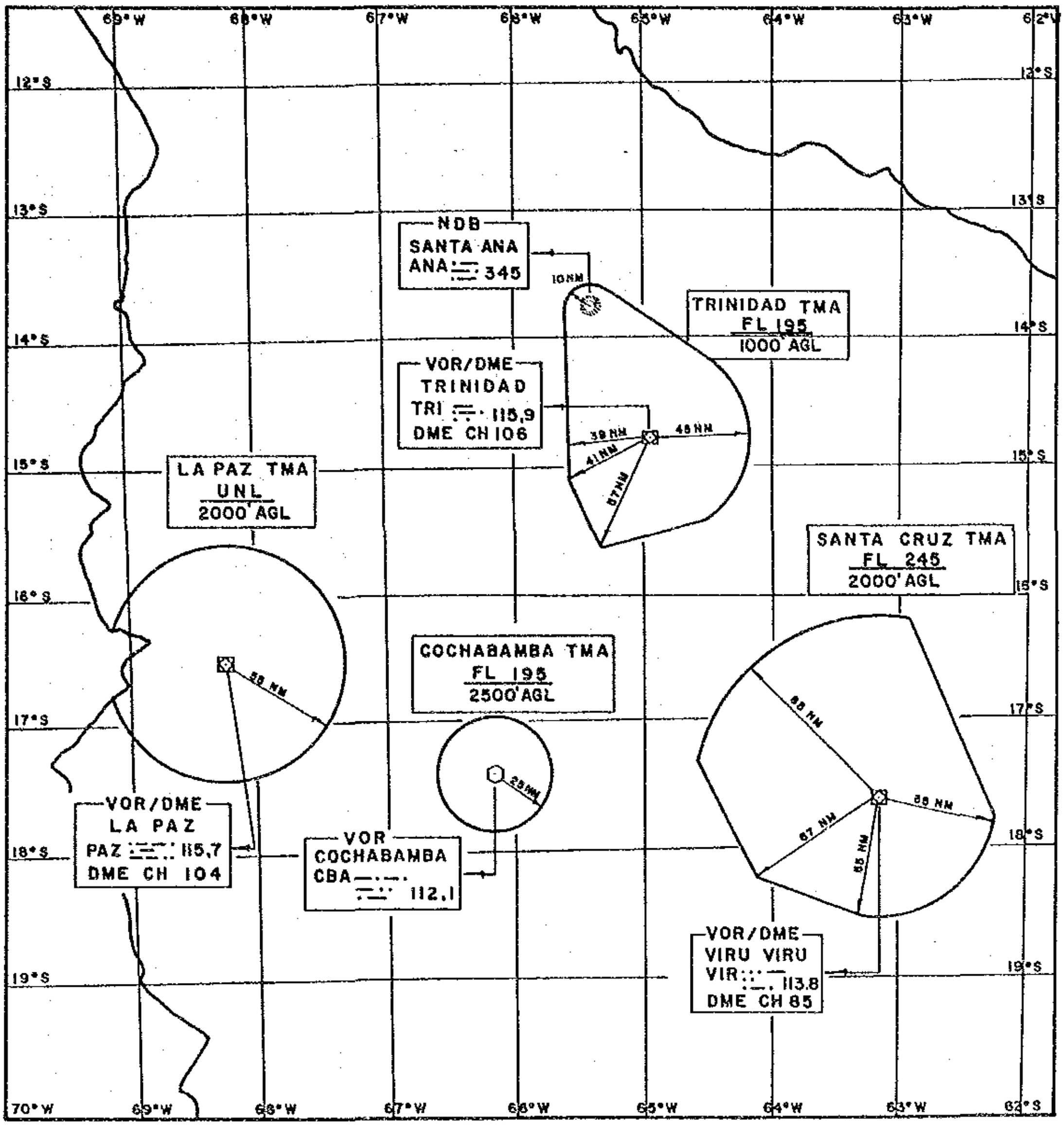


Figure 4.2.3 Terminal Control Area Established in Bolivia

Table 4.2.4 Dimensions of Aerodrome Control Zone and Aerodrome Traffic Zone Other than La Paz CTR/ATZ Established in Bolivia

A E R O D R O M O S C O N T R O L A D O S — AIP BOLIVIA

T O R R E	HORAS (UTC)	LIMITES LATERALLES	LIMITE SUPERIOR (FT)	IDIOMAS	OBSERVACIONES
1	2	3	4	5	6
CAMIRI TORRE	HJ	ATZ: 5 NM de radio con centro en el ARP 200001S-0633139W	2500 HGT	ES	INSTRUMENTOS/VISUAL
COCHABAMBA TORRE	HJ OPR NOCT. O/R	CTR: 10 NM de radio con centro en el VOR/CBA 172459S-0661035W	18000 ALT	ES-EN	EXCEPTO EL VUELO VISUAL
		ATZ: 5 NM de radio con centro en el ARP 172458S-0661028W	2500 HGT	ES-EN	INSTRUMENTOS/VISUAL
EL TROMPILLO TORRE	SEP/JUN 0900-2400 JUN/SEP 1000-2400	ATZ: 5 NM de radio con centro en el ARP 174802S-0631038W	2000 HGT	ES-EN	INSTRUMENTOS/VISUAL
PUERTO SUAREZ TORRE	HJ	ATZ: 5 NM de radio con centro en el NDB 185642S-0574901W	2000 HGT	ES	
SANTA ANA TORRE	HJ	CTR: 10 NM de radio con centro en el NDB/ANA 134552S-0652448W	5000 ALT	ES	EXCEPTO EL VUELO VISUAL
		ATZ: 5 NM radio con centro en el ARP 134600S-0652700W	2000 HGT	ES	
SUCRE TORRE	HJ	CTR: 10 NM de radio con centro en el VOR/SUR 190026S-0651710W ATZ: 5 NM de radio con centro en el ARP 190035S-0651738W	18000 ALT	ES	EXCEPTO EL VUELO VISUAL
TARIJA TORRE	HJ	CTR: 10 NM de radio con centro en el VOR/TAR 213232S-0644240W ATZ: 5 NM de radio con centro en el ARP 213251S-0644226W	18000 ALT	ES	EXCEPTO VUELO VISUAL
TRINIDAD TORRE	HJ OPR NOCT. O/R	CTR: 10 NM de radio con centro en el VOR/TRI 144744S-0643612W	5000 ALT	ES	EXCEPTO VUELO VISUAL
		ATZ: 5 NM de radio con centro en el ARP 144906S-0645468W	2000 HGT	ES	
VIRU VIRU TORRE	H24	CTR: SANTA CRUZ: 2 circulos de 10 NM uno centrado en el VOR/TCZ 174842S-0630959W y otro centrado en el VOR/VIR 173729S-0630854W unidos tangencialmente	5000 ALT	ES-EN	EXCEPTO EL VUELO VISUAL
		ATZ: 5 NM de radio con centro en el ARP 173828S-0630802W	2000 HGT	ES-EN	INSTRUMENTOS/VISUAL

(3) Aerodrome Control Zone and Aerodrome Traffic Zone

An aerodrome control zone for El Alto airport which is centered at La Paz VOR (16° 30' 30" S/068° 13' 54" W) with a radius of 10 nautial miles is established for the aerodrome control services.

An aerodrome traffic zone which is a circular area centered at the aerodrome reference point (16° 30' 36" S/068° 10' 52" W) with a radius of 5 nm is established for the purpose of aerodrome control services at La Paz Tower as shown in Table 4.2.5.

Table 4.2.5 Dimension of La Paz Aerodrome Traffic Zone and Aerodrome Traffic Zone

AERODROMOS CONTROLADOS

AIP BOLIVIA

TORRE	HORAS (UTC)	LIMITES LATERALES	LIMITE SUPERIOR (FT)	IDIOMAS	OBSERVACIONES
1	2	3	4	5	6
LA PAZ TORRE	H24	CTR: Area delimitada por una circunferencia de 10 NM de radio, tomando como centro el VOR/PAZ 163030S-0681354W	18000 ALT	ES-EN	EXCEPTO EL VUELO VISUAL
		ATZ: 5 NM de radio con centro en el ARP 163036S-0681052W	2000 HGT	ES-EN	INSTRUMENTOS/VISUAL

(4) Restricted Area

In Bolivia, 48 restricted areas in total are established for the purpose of training for civil/military aircraft. In the vicinity of El Alto airport, five (5) restricted areas have been newly established as shown in Figure 4.2.4.

SLR2, SLR5 and SLR6 are used for military training. SLR3 is used for military firing and SLR4 for civil training.

All restricted areas which are defined by La Paz VOR/DME are used based on close coordination between La Paz Approach Control and military authorities. Training aircraft, operating in the restricted area can easily recognize their positions utilizing La Paz VOR/DME which provides information on both orientation and distance.

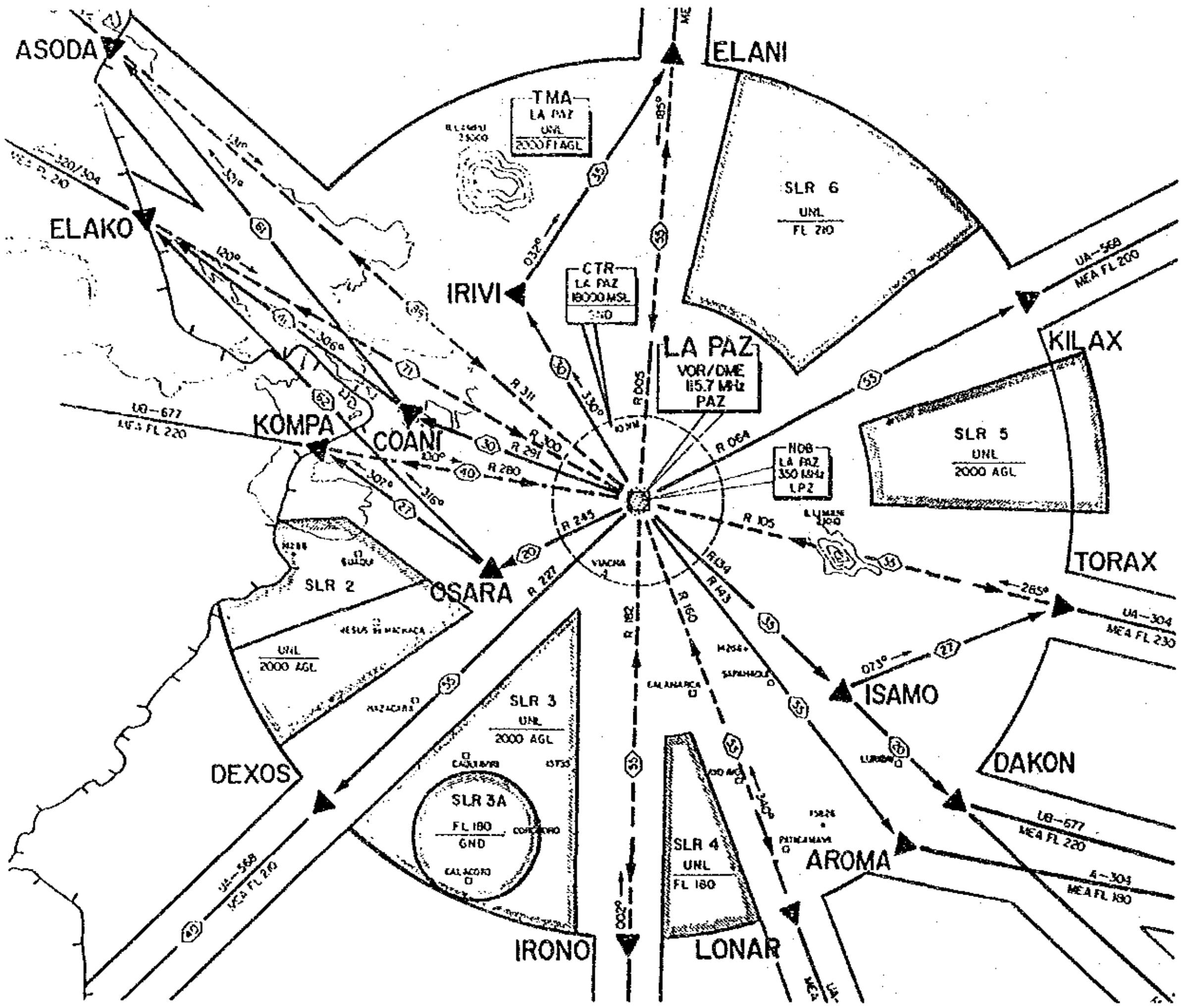


Figure 4.2.4 Restricted Areas Established in La Paz TMA

4.2.2 Obstacle Limitation Surfaces

(1) Runway 09R/27L

Figure 4.2.5 shows the obstacle limitation surfaces which are established at El Alto airport.

The main runway 09R/27L is provided as a precision approach category I runway. A 300 m length of clearway for take off runway 27L with 90 m of stopway, and 700 m of clearway for take off runway 09R are established.

This runway has a down slope from east side to west side of 1.55 % and a difference in elevation between 09R and 27L thresholds of 61.95 m. There is no obstacle in the approach and take off climb areas. The inner horizontal surface is centered at the aerodrome reference point (16° 30' 36" S/068° 10' 52" W) with a radius of 4,000 m. The ceiling of inner horizontal surface is established at an elevation of 45 m above the elevation of the runway 27L threshold.

(2) Runways 09L/27R and 04/22

Both unpaved runways are non-instrument and used only for landing on runways 04 and 09L during VFR emergency operations. The width of the landing strip for runway 04/22 is established as 300 m.

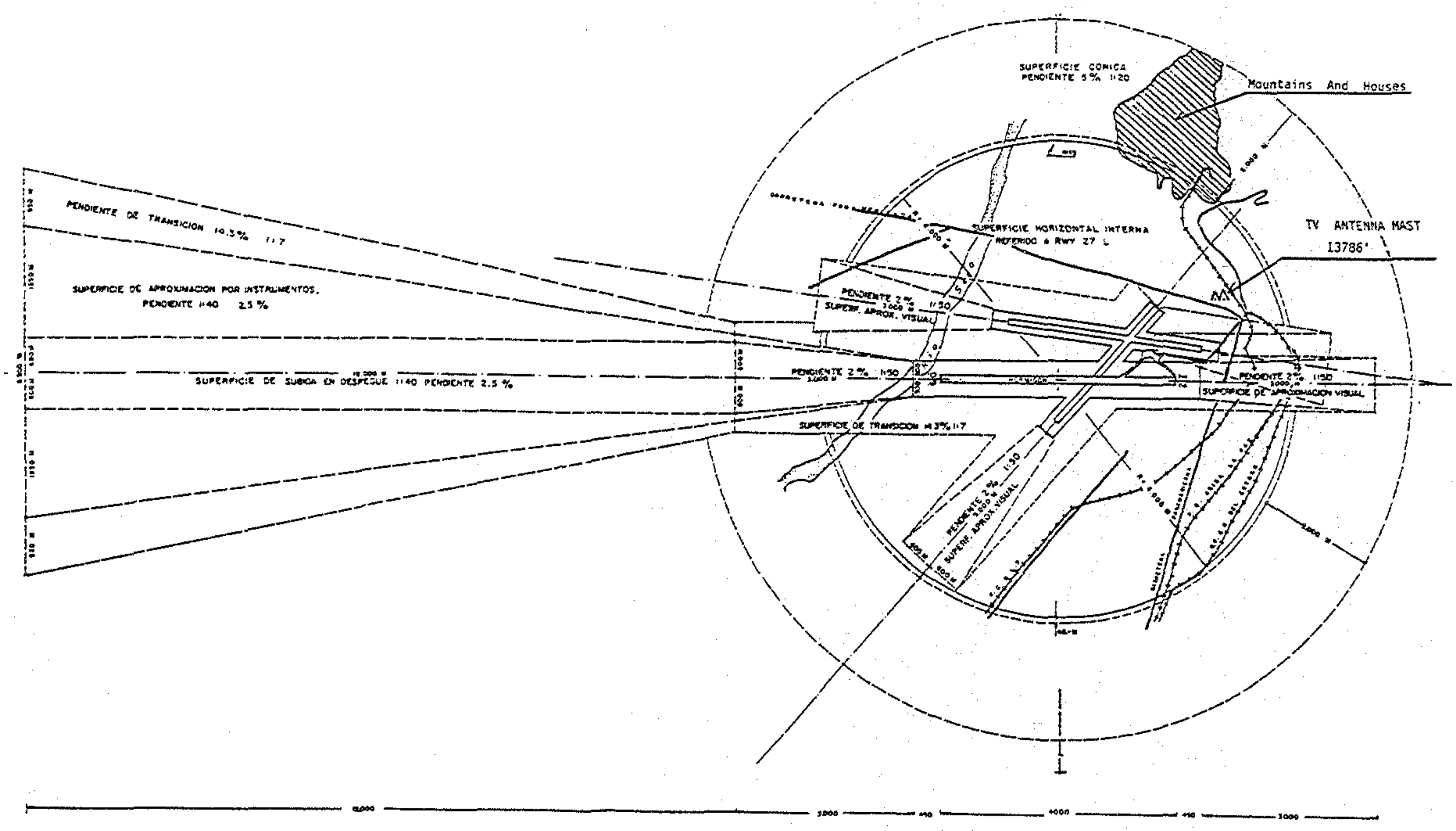


Figure 4.2.5 Obstruction Chart for El Alto Airport

4.2.3 Aircraft Operation Procedures

Five instrument approach and holding procedures including ILS/DME RWY 09R and eleven standard instrument departures (SID) are established for El Alto airport as shown in the figures below. These procedures are based on La Paz VOR/DME principally:

1) Figure 4.2.6 ILS/DME RWY 09R
2) Figure 4.2.7 VOR/DME 1 RWY 09R
3) Figure 4.2.8 VOR/DME 2 RWY 09R
4) Figure 4.2.9 HI/VOR RWY 09R
5) Figure 4.2.10 NDB/LM1 RWY 09R
6) Figure 4.2.11 IDR ISAMO DOS, DAKON DOS, KILAX UNO
7) Figure 4.2.12 IDR IRONO UNO, LONAR DOS, AROMA DOS
8) Figure 4.2.13 IDR IRIVI DOS, COANI DOS, ELANI UNO
9) Figure 4.2.14 IDR OSARA DOS, DEXOS DOS

(1) Instrument Approach Procedure

All straight-in approaches to this airport are established on runway 09R taking into account the runway slope and wind coverage.

(2) Standard Instrument Departure

There is a high mountain, Illimani 21,010 feet AMSL which is located about 27 nm SE of the airport.

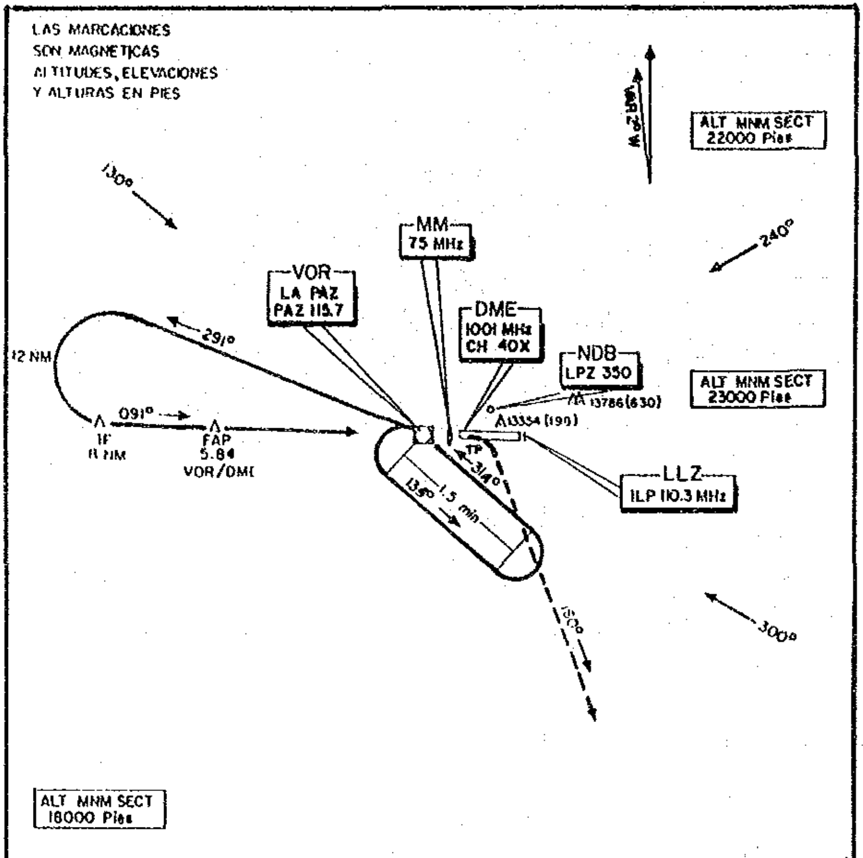
SE bound such as AROMA DOS and ISAMO DOS are established with sufficient clearance above this mountain.

CARTA DE APROXIMACION POR INSTRUMENTOS OACI
ILS/DME

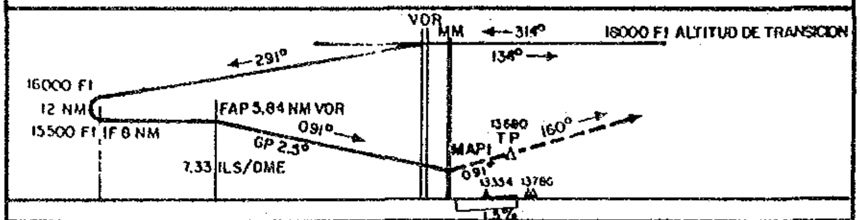
ELEV. AERODROMO 13313 Pies
UMBRAL 09 ELEV. 13106 Pies
ELEV. TDZ 13156 Pies

TWR 118.3
APP 119.5

JOHN F KENNEDY—LA PAZ
BOLIVIA—SLLP RWY 09
CAT AVION A—B—C—D



APROXIMACION FRUSTRADA SUBIR EN EL RADIAL 160° HASTA 17000 PIES Y SOLICITAR INSTRUCCIONES AL CONTROL

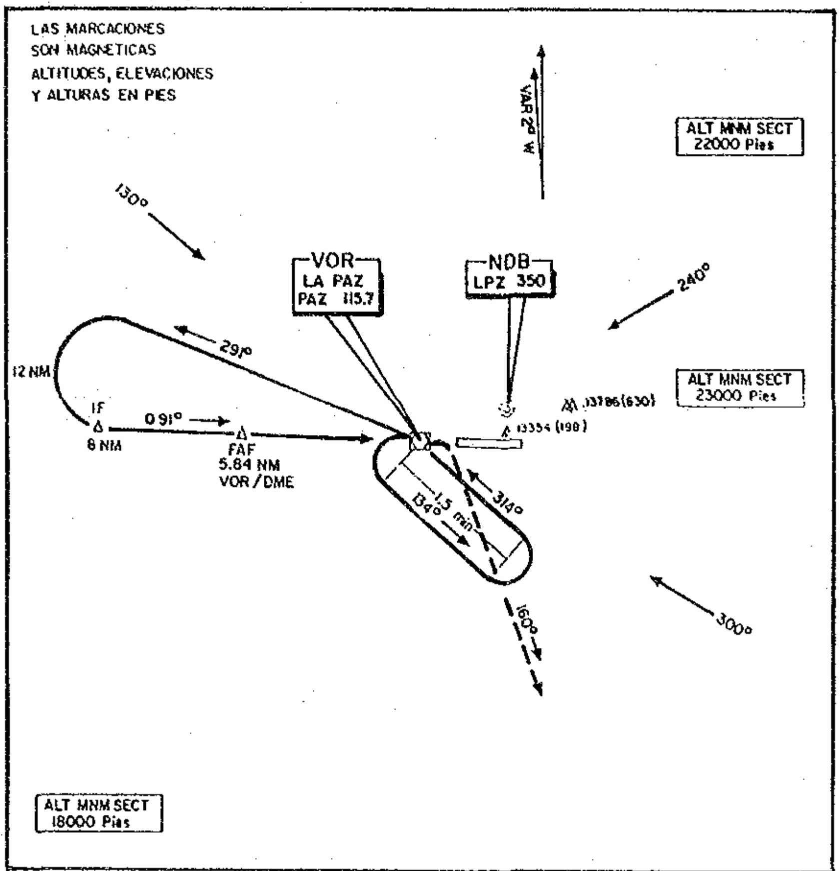


OCA/H					
CAT AVION		CAT A	CAT B	CAT C	CAT D
DIRECTA	CAT I	13341/185	13355/199	13365/209	13378/222
	CAT II	——	——	——	——
	GP.INOP	13431/275	13431/275	13431/275	13431/275
EN CIRCUITO		14081/768	14081/768	14180/867	14180/867
VISIBILIDAD		1.6 KM	2.0 KM	4.0 KM	4.4 KM

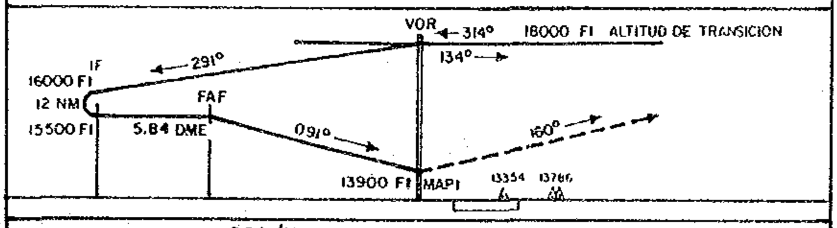
DIST FAP/THR 7.13 NM				
V. SUELO	90	120	140	165
TIEMPO m/s	4/45	3/34	3/03	2/35
REGIMEN DE DESCENSO Pies/min	399	531	620	731

Figure 4.2.6 ILS/DME RWY 09R

CARTA DE APROXIMACION ELEV. AERODROMO 13313 Pies | TWR 118.3 | JOHN F KENNEDY–LA PAZ
POR INSTRUMENTOS OACI UMBRAL 09 ELEV. 13106 Pies | APP 119.5 | BOLIVIA–SLLP RWY 09
VOR/DME 1 ELEV TDZ 13156 Pies CAT AVION A-B-C-D



APROXIMACION FRUSTRADA SUBIR EN EL RADIAL 160° HASTA 17000 PIES Y SOLICITAR INSTRUCCIONES AL CONTROL



OCA/H					DIST FAF a THR 7.13 NM				
CAT AVION	CAT A	CAT B	CAT C	CAT D	V. SUELO	90	120	140	165
DIRECTA	13900/744	13900/744	13900/744	13900/744	TIEMPO m/s	4/45	3/34	3/03	2/35
VISIBILIDAD	1.6 Km	1.6 Km	3.2 Km	3.6 Km	REGIMEN DE DESCENSO Pies/min	355	473	553	653
EN CIRCUITO	14081/768	14081/768	14180/867	14180/867					
VISIBILIDAD	1.6 KM	2.0 KM	4.0 KM	4.4 KM					

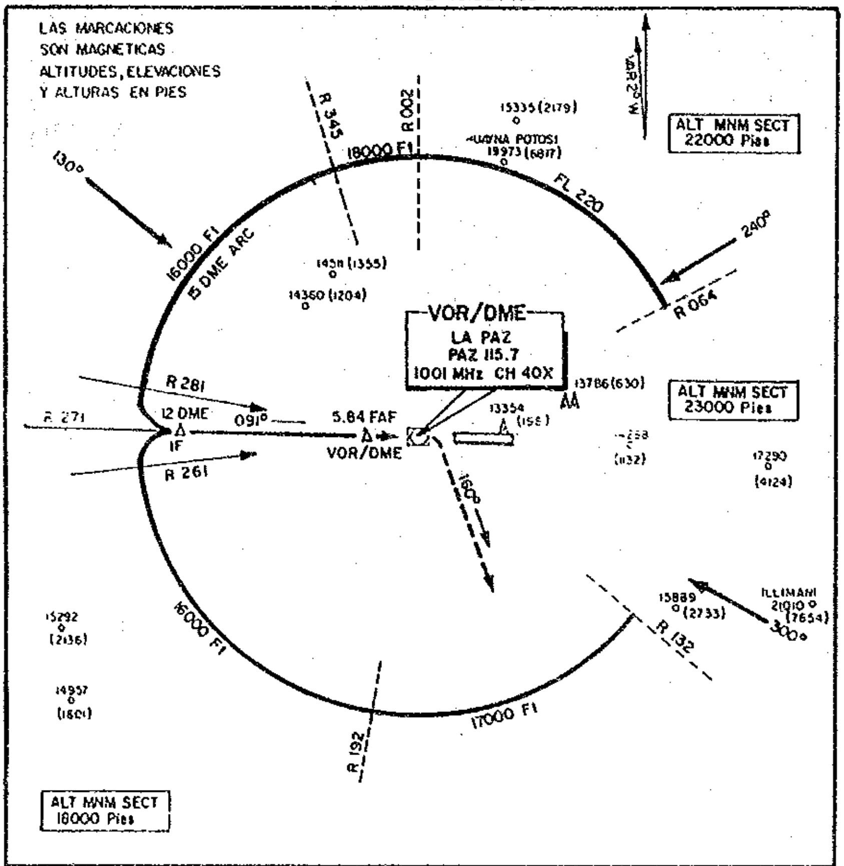
Figure 4.2.7 VOR/DME 1 RWY 09R

CARTA DE APROXIMACION POR INSTRUMENTOS OACI
VOR/DME 2

ELEV. AERODROMO 13313 Pies
UMBRAL 09 ELEV. 13106 Pies
ELEV. TDZ 13156 Pies

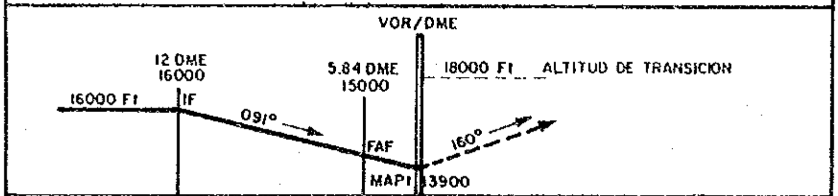
TWR 118.3
APP 119.5

JOHN F KENNEDY—LA PAZ
BOLIVIA—SLLP RWY 09
CAT AVION A—B—C—D



APROXIMACION FRUSTRADA

SUBIR EN EL RADIAL 160° HASTA 17000 PIES Y SOLICITAR INSTRUCCIONES AL CONTROL



OCA/H

CAT AVION	CAT A	CAT B	CAT C	CAT D
DIRECTA	13900/744	13900/744	13900/744	13900/744
VISIBILIDAD	1.6 Kms	1.6 Kms	3.2 Kms	3.6 Kms
EN CIRCUITO	14081/768	14081/768	14180/867	14180/867
VISIBILIDAD	1.6 KM	2.0 KM	4.0 KM	4.4 KM

DIST FAF a THR 7.13 NM

V. SUELO	90	120	140	165
TIEMPO m/s	4/45	3/34	3/03	2/35
REGIMEN DE DESCENSO Pies/min	355	473	553	653

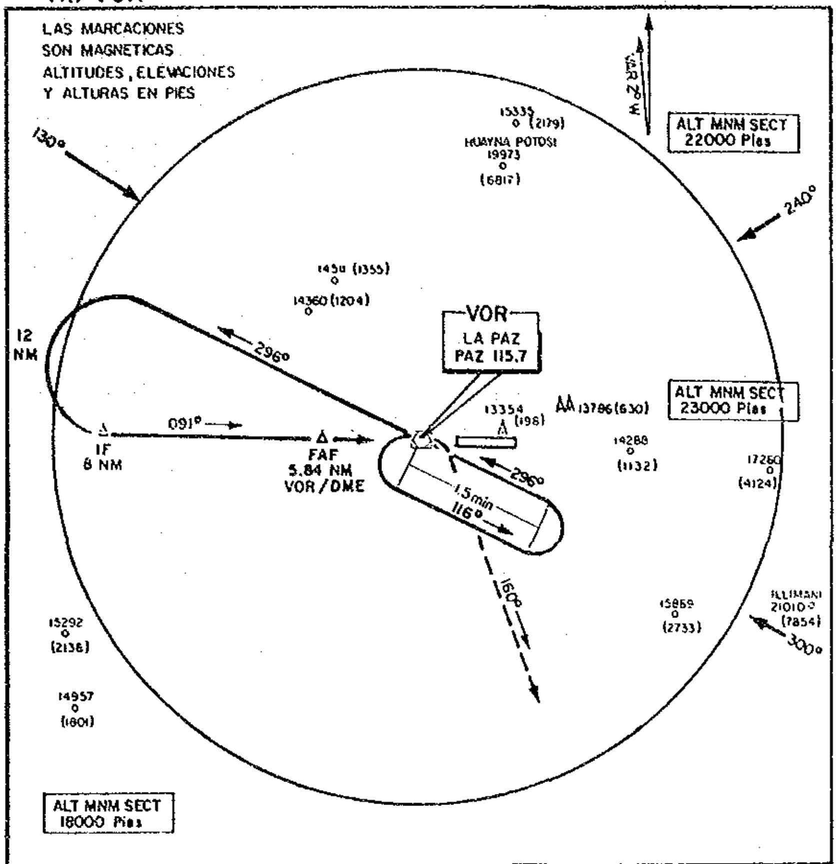
Figure 4.2.8 VOR/DME 2 RWY 09R

CARTA DE APROXIMACION POR INSTRUMENTOS OACI
HI/VOR

ELEV. AERODROMO 13313 Pies
UMBRAL 09 ELEV. 13106 Pies
ELEV. TDZ 13156 Pies

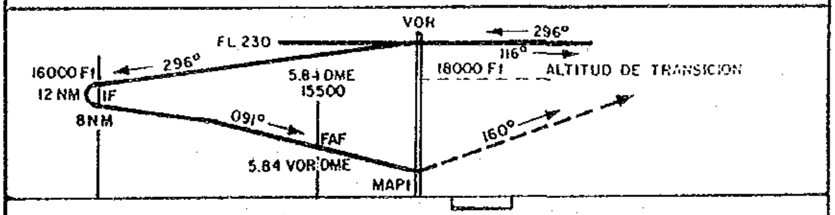
TWR 118.3
APP 119.5

JOHN F KENNEDY—LA PAZ
BOLIVIA—SLLP RWY 09
CAT AVION C—D—E



APROXIMACION FRUSTRADA

SUBIR EN EL RADIAL 160° HASTA 17000 PIES Y SOLICITAR INSTRUCCIONES AL CONTROL



OCA/H

CAT AVION	CAT B	CAT C	CAT D	CAT E
DIRECTA	NA	13900/744	14200/1044	14200/1044
VISIBILIDAD	——	1.6 Kms	3.2 Kms	3.6 Kms
EN CIRCUITO	NA	14081/768	14180/867	14180/867
VISIBILIDAD	——	3.2 KM	3.2 KM	3.2 KM

DIST FAF a THR 7.13 NM

V. SUELO	90	120	140	165
TIEMPO m/s	4/45	3/34	3/03	2/35
REGIMEN DE DESCENSO Pies/min	355	473	553	653

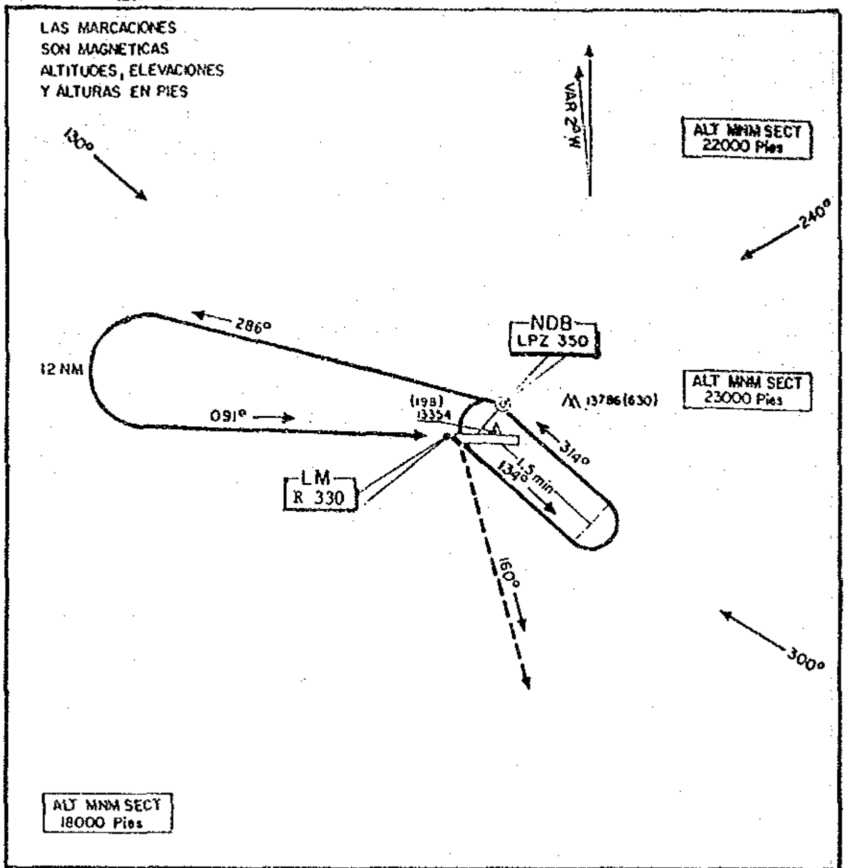
Figure 4.2.9 HI/VOR RWY 09R

CARTA DE APROXIMACION POR INSTRUMENTOS OACI
NDB/LM 1

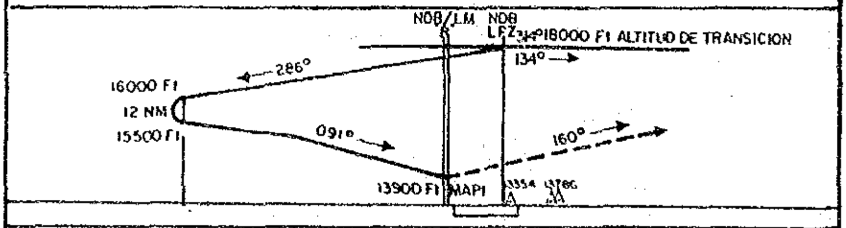
ELEV. AERODROMO 13313 Pies
UMBRAL 09 ELEV. 13106 Pies
ELEV. TDZ 13156 Pies

TWR 118.3
APP 119.5

JOHN F KENNEDY- LA PAZ
BOLIVIA-SLLP RWY 09
CAT AVION A-B-C-D



APROXIMACION FRUSTRADA SUBIR EN EL RADIAL 160° HASTA 17000 PIES Y SOLICITAR INSTRUCCIONES AL CONTROL



OCA/H					DIST FAFoTHR 7.13 NM				
CAT AVION	CAT A	CAT B	CAT C	CAT D	V. SUELO	90	120	140	165
DIRECTA	13900/744	13900/744	13900/744	13900/744	TIEMPO m/s	4/45	3/34	3/03	2/35
VISIBILIDAD	1.6 Km	1.6 Km	3.2 Km	3.6 Km	REGIMEN DE DESCENSO Pies/min	355	473	553	653
EN CIRCUITO	14081/768	14081/768	14180/867	14180/867					
VISIBILIDAD	1.6 KM	2.0 KM	4.0 KM	4.4 KM					

Figure 4.2.10 NDB/LM 1 RWY 09R

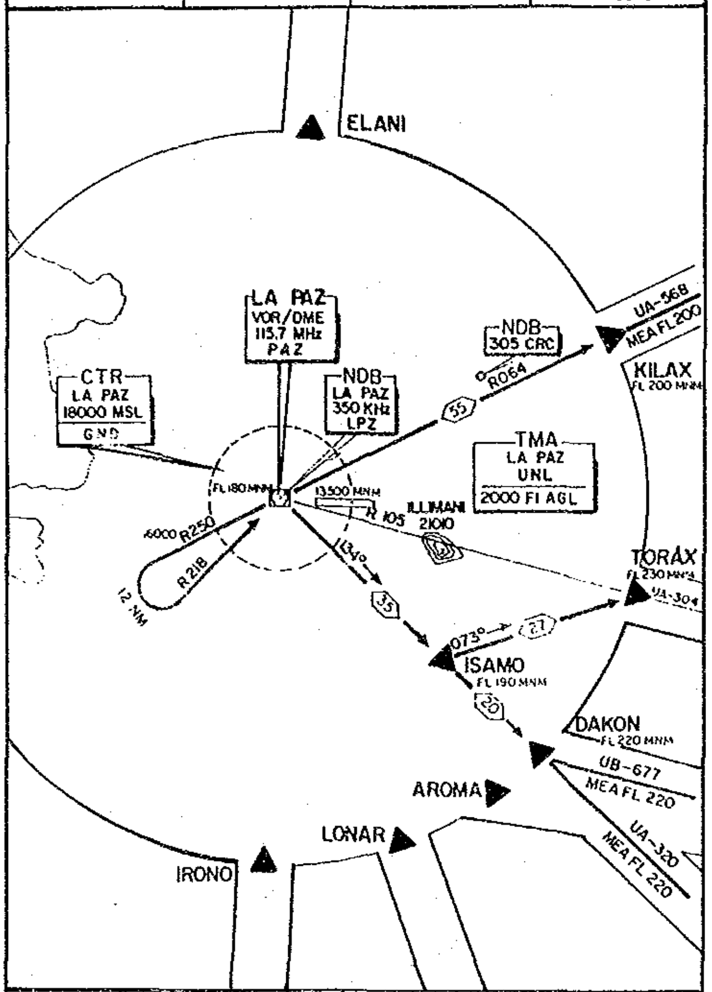
AIP–BOLIVIA

CARTA DE SALIDA
POR INSTRUMENTOS OACI

ISAMO DOS
DAKON DOS
KILAX UNO

JOHN F KENNEDY– LA PAZ
BOLIVIA

TORRE	APROXIMACION	CENTRO DE CONTROL	RADIO
LA PAZ 118.3 MHz	LA PAZ 119.5 MHz	LA PAZ 123.9 MHz 128.2 MHz	8855 10096 6638 10024 6649



DESPEGUE DIA	TECHO	VISIBILIDAD	DESPEGUE NOCHE	TECHO	VISIBILIDAD
	0.00 M	A–200 B–300		0.00 M	2 ENG 400 M
		C–300 D–400			

Figure 4.2.11 IDR ISAMO DOS, DAKON DOS, KILAX UNO

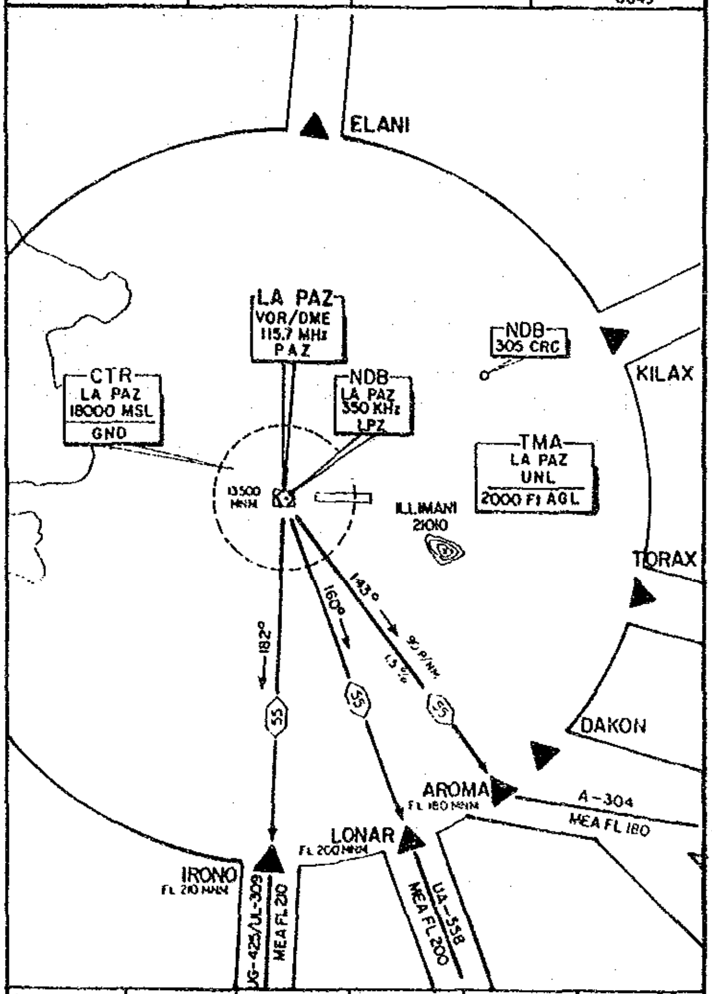
AIP – BOLIVIA

CARTA DE SALIDA
POR INSTRUMENTOS OACI

IRONO UNO
LONAR DOS
AROMA DOS

JOHN F KENNEDY – LA PAZ
BOLIVIA

TORRE	APROXIMACION	CENTRO DE CONTROL	RADIO 8855
LA PAZ 118.3 MHz	LA PAZ 119.5 MHz	LA PAZ 123.9 MHz 128.2 MHz	10096 6638 10024 6649



DESPEGUE DIA	TECHO	VISIBILIDAD	DESPEGUE NOCHE	TECHO	VISIBILIDAD
	0.00 M	A-200 B-300 C-300 D-400		0.00 M	2 ENG 400 M

Figure 4.2.12 IDR IRONO UNO, LONAR DOS, AROMA DOS

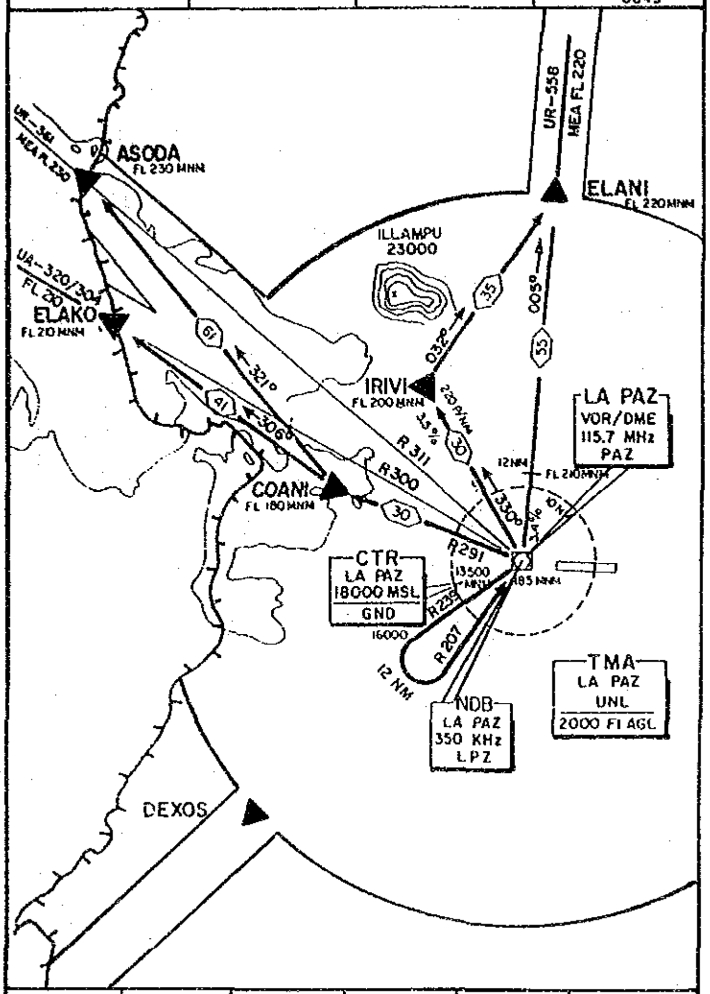
AIP—BOLIVIA

CARTA DE SALIDA
POR INSTRUMENTOS OACI

IRIVI DOS
COANI DOS
ELANI UNO

JOHN F KENNEDY—LA PAZ
BOLIVIA

TORRE	APROXIMACION	CENTRO DE CONTROL	RADIO
LA PAZ 118.3 MHz	LA PAZ 119.5 MHz	LA PAZ 123.9 MHz 128.2 MHz	8855 10096 6638 10024 6649



DESPEGUE DIA	TECHO	VISIBILIDAD	DESPEGUE NOCHE	TECHO	VISIBILIDAD
	0.00 M	A—200 B—300 C—300 D—400		0.00 M	2 ENG 400 M

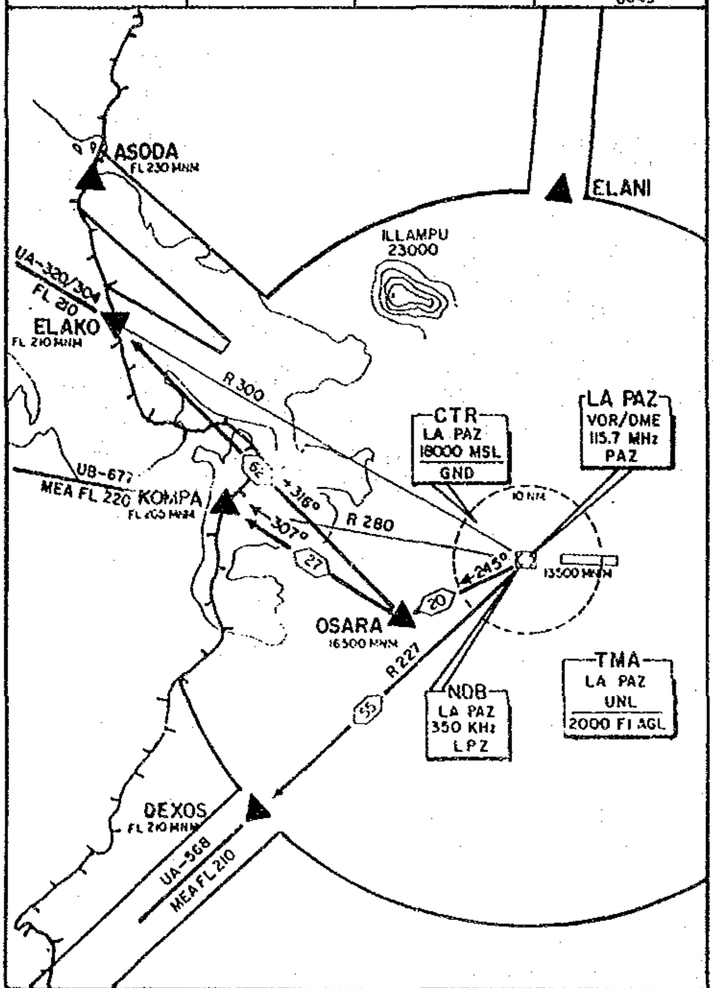
Figure 4.2.13 IDR IRIVI DOS, COANI DOS, ELANI UNO

CARTA DE SALIDA
POR INSTRUMENTOS OACI

OSARA DOS
DEXOS DOS

JOHN F KENNEDY-LA PAZ
BOLIVIA

TORRE	APROXIMACION	CENTRO DE CONTROL	RADIO
LA PAZ 118.3 MHz	LA PAZ 119.5 MHz	LA PAZ 123.9 MHz 128.2 MHz	8855 10096 6638 10024 6649



DESPEGUE DIA	TECHO	VISIBILIDAD	DESPEGUE NOCHE	TECHO	VISIBILIDAD
	0.00 M	A-200 B-300 C-300 D-400		0.00 M	2 ENG 400 M

Figure 4.2.14 IDR OSARA DOS, DEXOS DOS

4.3 Passenger Terminal and Other Buildings

4.3.1 Passenger Terminal Building

The existing passenger terminal building accommodates both domestic and international passengers, the administration department, operation department and control tower.

The central area of the building including control tower was built in 1952. After that year, the international check-in area was extended to the east and the international arrival area to the west of the central area.

The building is a reinforced concrete structure with one basement floor and four stories with a control tower. The total floor area is 7,610 sq.m.

At the present time, an extension of 310 sq.m on the east side of the existing building is in progress for the domestic arrival hall and baggage claim area.

The passenger boarding of and unboarding from the aircraft is actually accomplished by walking through the apron.

This building is considered to have principal deficiencies in both capacity and function as a passenger terminal building for the following reasons:

(1) Quantitative Analysis

a) The unit floor area of 15 sq.m/peak hour passenger for the domestic area and 30 sq.m/ peak hour passenger for the international area are considered for subsequent evaluation. Five percent of the reduction of the total floor area is also considered for the evaluation since the existing building has combined usage for both domestic and international passengers.

   The peak hour passengers at present are estimated to be 290 domestic and 110 international.

The floor area required for a combined domestic and international terminal building is 7,200 sq.m while the existing floor area is only 4,800 sq.m which does not satisfy the present demand.

b) The result of the traffic survey indicates that the capacity of the tax payment counter, immigration counters and security check points in the international departure area is only 84 passengers/hour and the above peak hour passengers can not be handled. It is necessary therefore to decrease the inspection time and increase the number of counters.

c) The capacity of the arrival immigration area is only 30 passengers and the rest of passengers must wait outside the building in long queues. This is not satisfactory and provides the worst service for passengers.

d) The international baggage claim area is also defective. There is only one linear belt conveyer at the west side of the area and the effective conveyer length facing passengers is only 10 meters long. Passengers who can not pick up baggage from the conveyer are forced to look around for baggage in the congested area.

The maximum processing capacity of the baggage claim area which has a floor area of only 90 sq.m is considered to be 50 passengers.

There is insufficient space between the immigration counters and the customs area.

(2) Other Defective Points

a) Passenger cross flows intersect at many points in the international and domestic areas which causes congestion and confusion.

b) There is neither a flight information system nor direction or information signs for the passengers.

c) There is no belt conveyer in the domestic baggage claim area and luggage is handled by manpower.

d) The international baggage claim area has no toilet facilities for passengers, and the passengers have to go back to the toilet located in the arrival immigration area after obtaining permission from the immigration officer.

e) The customs tax counter is located before the customs counter and close to the baggage claim area, therefore, the passengers who have to pay taxes must return to the tax counter carrying their baggage.

   The customs tax counter should be provided immediately after the customs counter.

f) There is no fire alarm, fire hydrant or fire extinguishers.

g) Due to the repeated extension of the building, the electrical and mechanical systems are not adequately designed and there are problems in function, operation and maintenance.

h) All the piping and wiring for electrical, mechanical and plumbing facilities should be installed new if the existing building is to be re-utilized.

i) The existing curb length is insufficient for the present demand.

Floor plans of the existing passenger terminal buildings are shown in Figures 4.3.1 through 5.

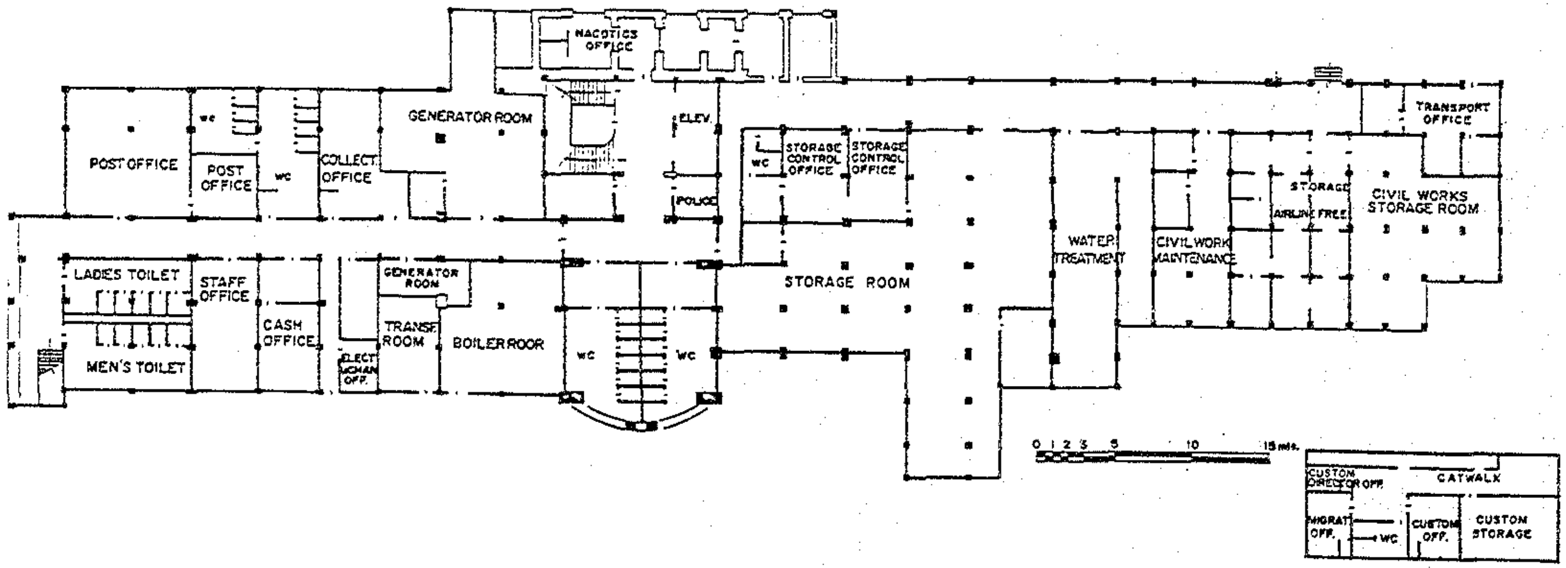


Figure 4.3.1 Basement Floor Plan of Existing Passenger Terminal Building

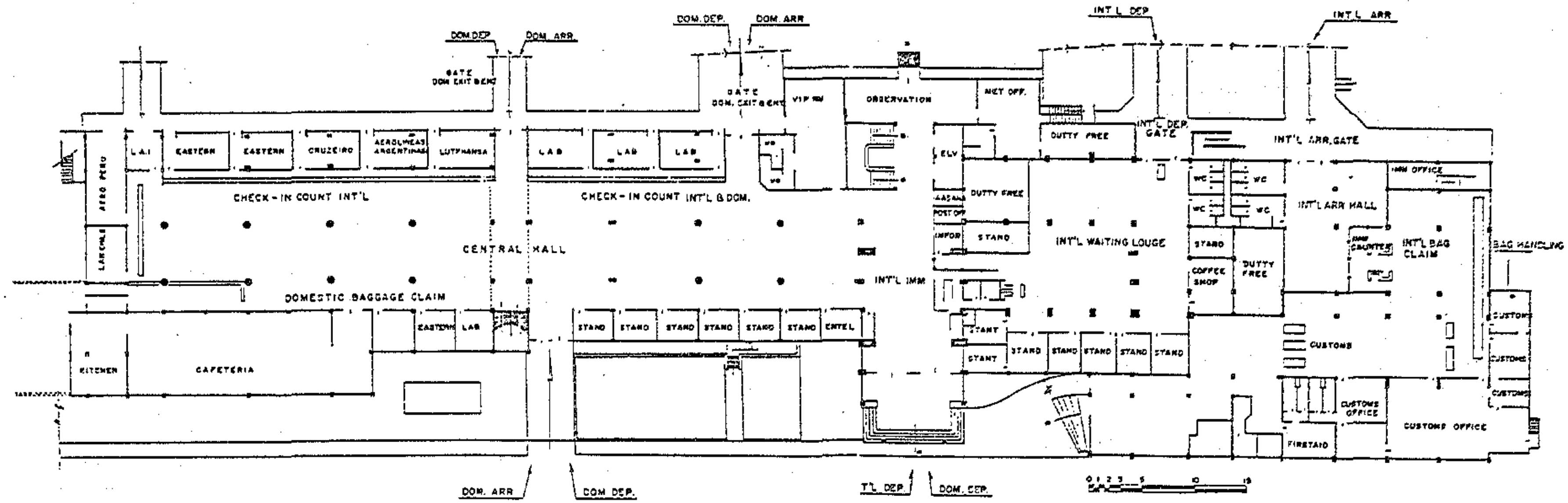


Figure 4.3.2 Ground Floor Plan of Existing Passenger Terminal Building

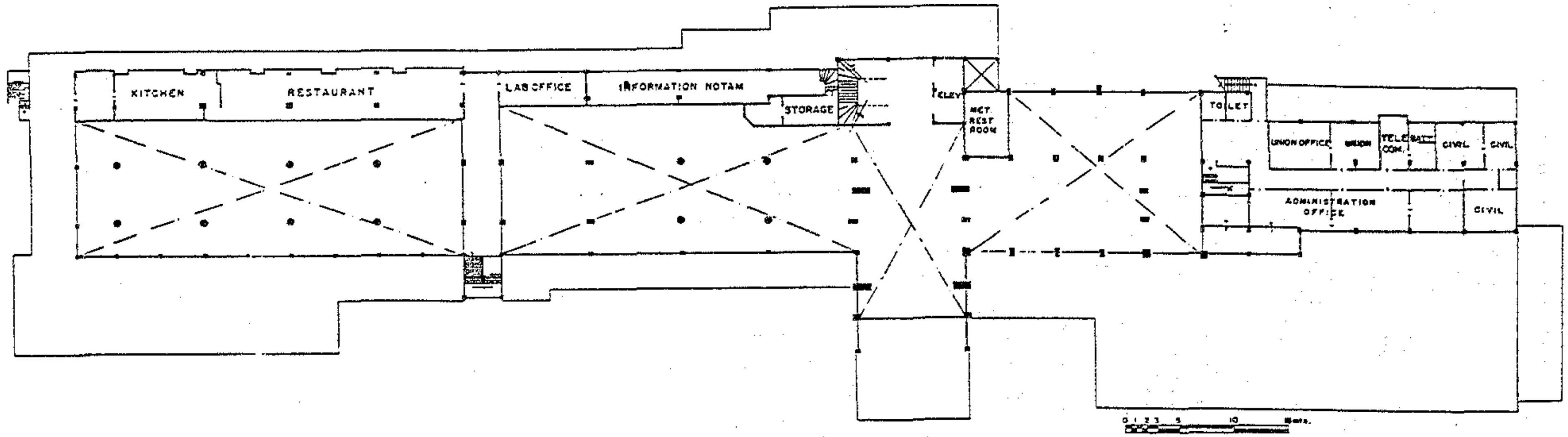
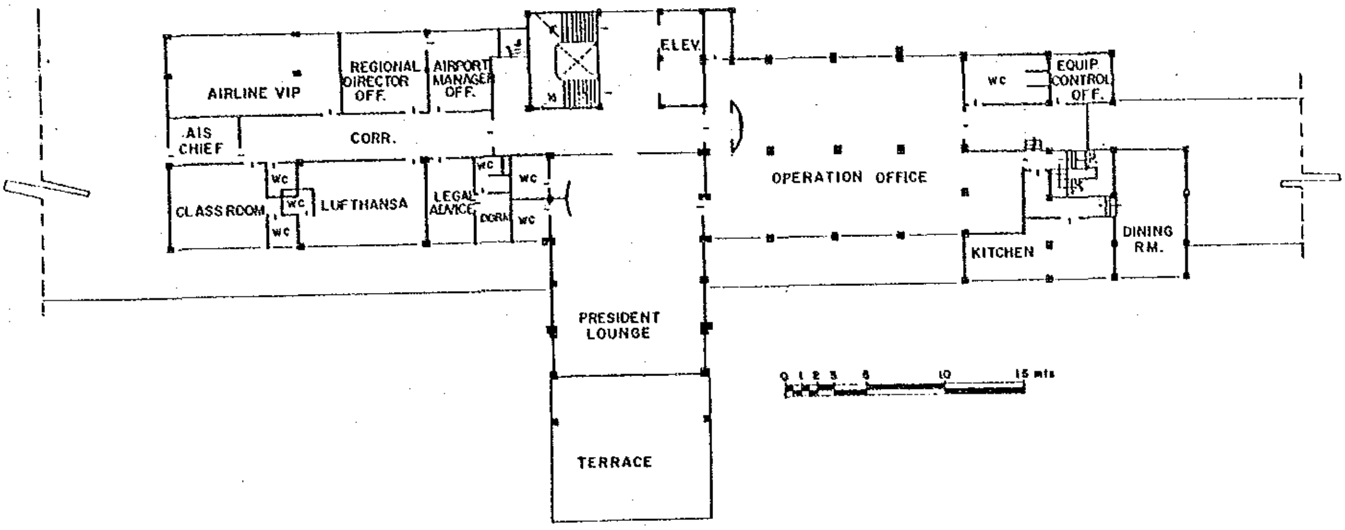


Figure 4.3.3 M1F Floor Plan of Existing Passenger Terminal Building



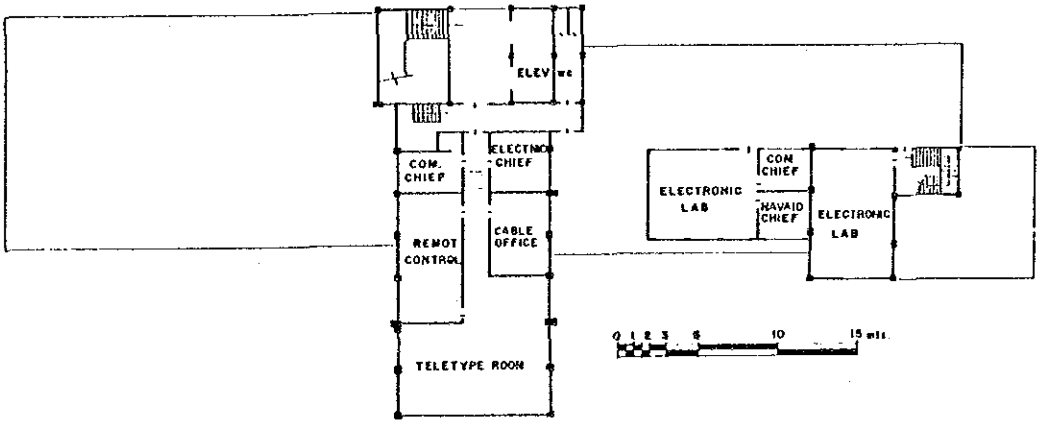


Figure 4.3.4 1st and 2nd Floor Plans of Existing Passenger Terminal Building

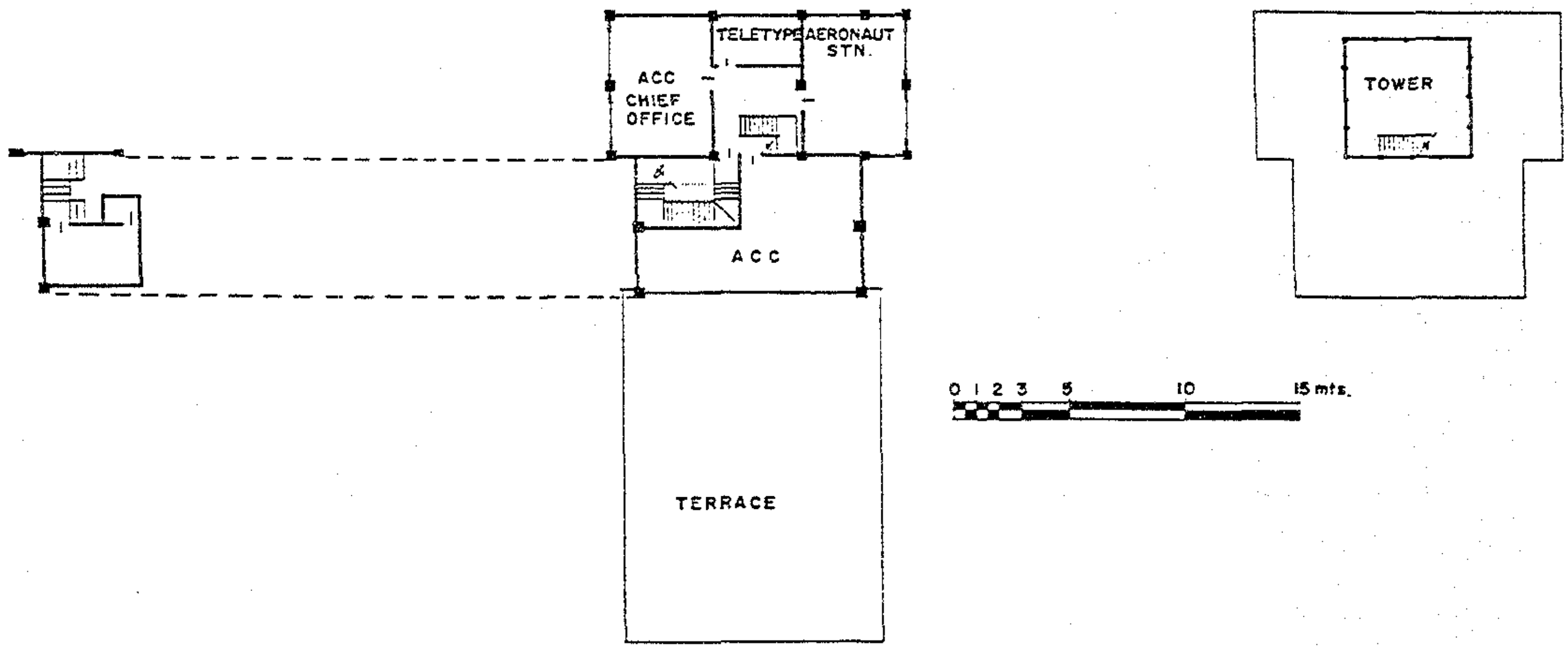


Figure 4.3.5 3rd Floor and Tower Plan of Existing Passenger Terminal Building

4.3.2 Cargo Terminal Building

There are, at the present time, three cargo buildings described as follows:

- One building with a floor area of 500 sq.m is commonly used by Lufthansa, Eastern and LAB. This building was constructed 15 years ago and is now very obsolete.

- LAB has a cargo building with a floor area of 600 sq.m, which is used only once a year.

- Lufthansa has a cargo building with a floor area of 200 sq.m. This building has been used for more than 10 years. It is considered still possible however to continue to use it from the architectural view point.

There are no government facilities in these buildings and customs officers have to visit when inspection is necessary.

The floor plan of the existing LAB cargo terminal building is shown in Figure 4.3.6.

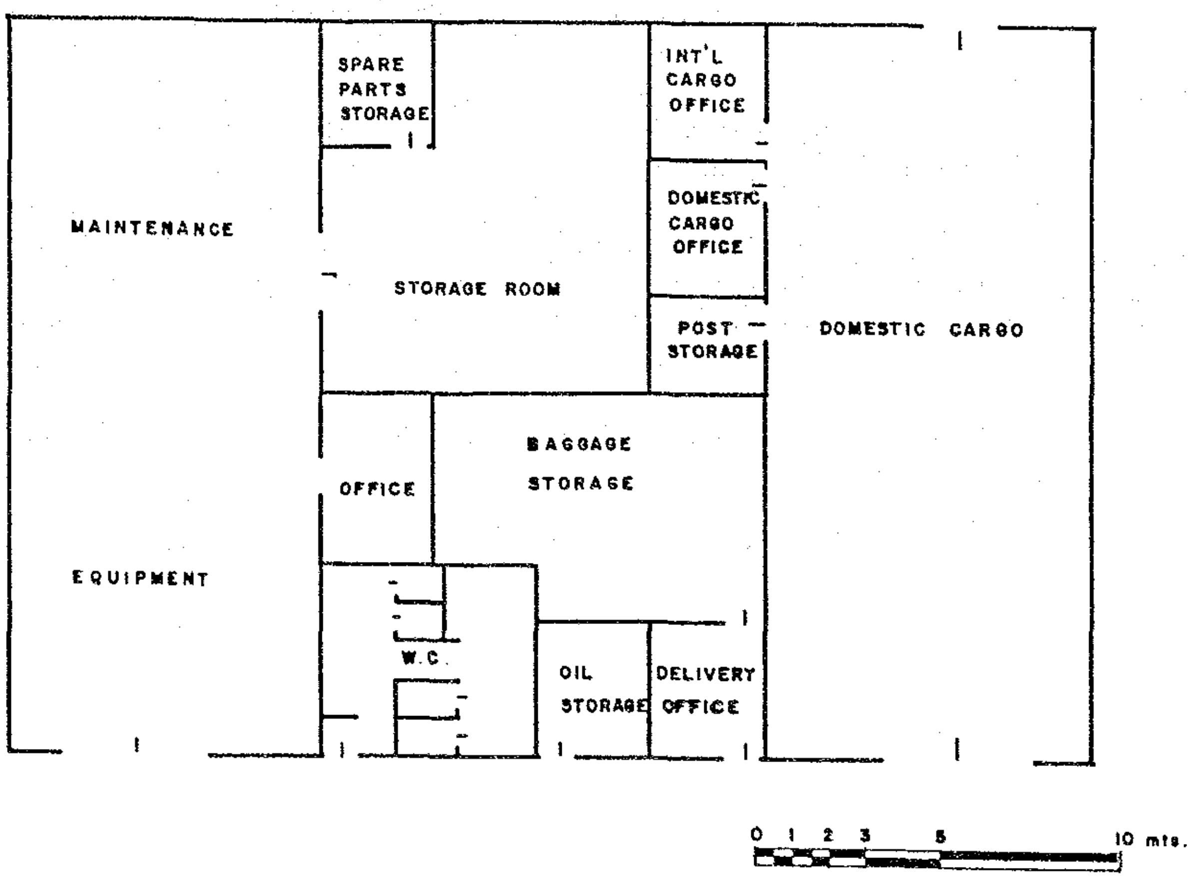


Figure 4.3.6 Floor Plan of LAB Cargo Terminal Building

4.3.3 Administration Building and Control Tower

The administration (operations) building and control tower are accommodated in the passenger terminal building.

The basement is mainly used for mechanical rooms and storage. The mezzanine and second floor are used for offices. The third and fourth floors are used for electronics and ACC sections.

This building is obsolete in capacity and function.

4.4 Landside Facilities

4.4.1 Car Parking

The existing car parking area is about 4,600 sq.m and can accommodate approximately 100 cars. AASANA has an expansion plan for the car parking. This expansion work will be carried out in 1987 and 1988. The area to be expanded is planned to be about 8,000 sq.m. After this expansion, 150 cars will be able to be accommodated. The required number of parking spares in the lot is estimated to be about 200, however based on the results of the traffic survey at the present time.

Only three catch basins for storm water drainage exist at the internal road west of the car parking area and in its vicinity. The flow end of the existing drainage system is closed and this system is not functioning.

Some of the existing drainpipes for the stormwater on the roof of the terminal building are connected with the sewer pipe and actually reduce the capacity of the existing sewer system.

4.4.2 Access Road

The existing access road is shown in Figure 4.4.1. The existing access road in the airport property area is connected to the Defensores del Kilometro 7 and Autopista (Toll highway).

These roads have the following number of lanes:

Existing Number of Lanes (for each direction)

Access road in the airport property area:	1
Defensores del Kilometro 7:	1
Autopista:	2

The maximum capacity of a road is usually considered to be approximately 1,000 cars per hour for one lane (each direction). Based on the facility requirements shown in Table 3.3.2, the existing access road in the airport property area is assumed to meet the demand until year 1995.

The saturation times of the Defensores del Kilometro 7 and the Autopista should be estimated based on a consideration of the future traffic volume other than airport users. Data concerning this matter is not available however, only the data on the present traffic volume of Autopista shown below is available.

Present Traffic Volume of Autopista: 12,600 cars/day as of year 1985 (for two directions)

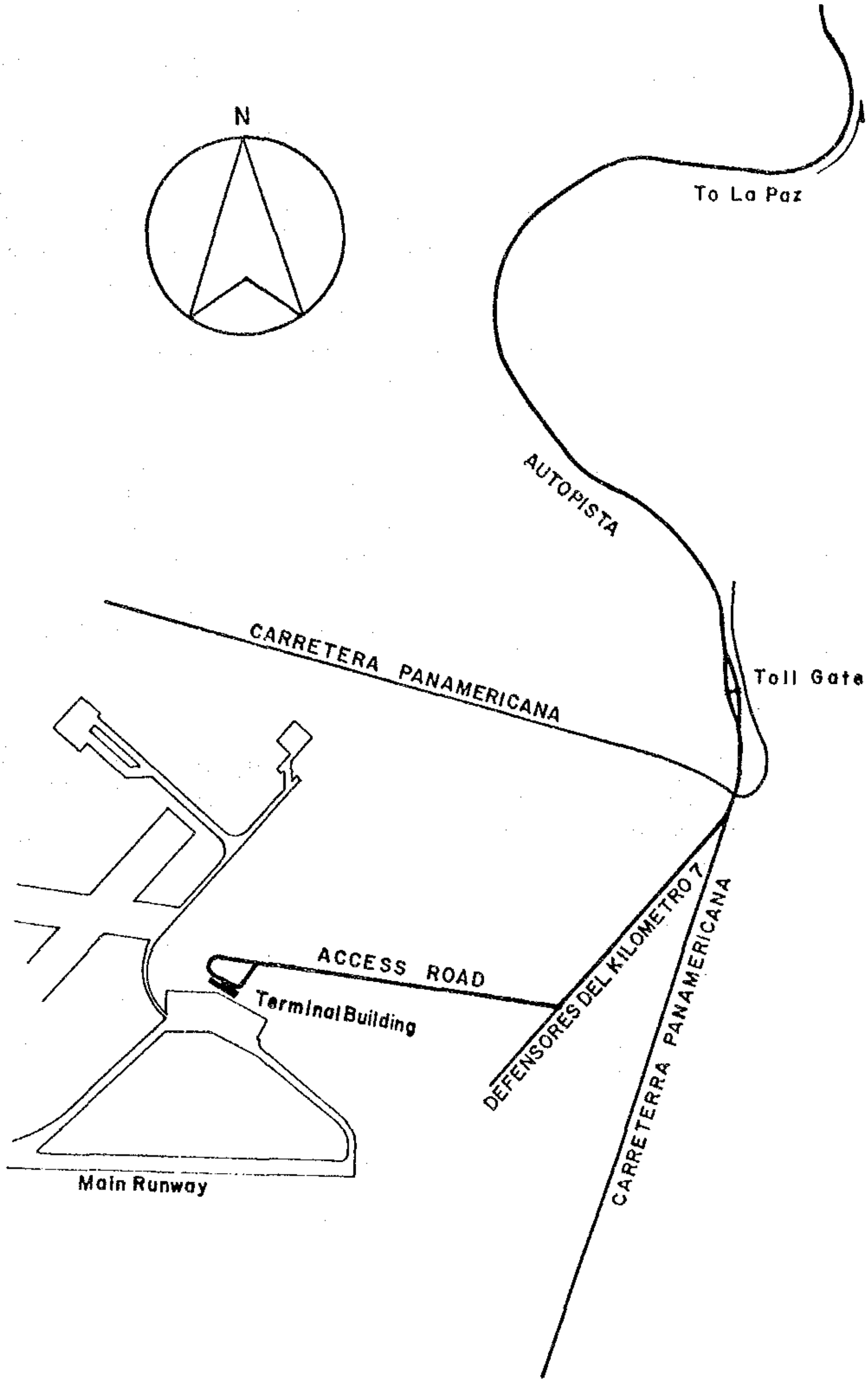


Figure 4.4.1 Existing Access Road and Connecting Highway

S = 1: 20,000

4.5 Air Navigation Systems

4.5.1 General

Air navigation systems include radio navigational aids, an air traffic control system, aeronautical telecommunications system, aeronautical ground lights, meteorological system and power supply system.

The existing conditions of the air navigation systems are summarized in Table 4.5.1. Figure 4.5.1 shows the system block diagram of the existing air navigation systems.

As evaluated in the subsequent sections, almost all the equipment and systems for air navigation are obsolete. Positive investment for maintenance and replacement of the old equipment has not been made but new equipment was installed when the need arose.
The obsolete equipment and systems necessitate inconvenient operations, difficulty of maintenance and increase in maintenance cost.

The operations rooms such as the aerodrome control tower, area control center, aeronautical equipment room, maintenance workshop, etc., are insufficient in floor areas and do not have good interconnection or access between them. The tower also does not meet recommended height requirements.

It is accordingly considered necessary to plan a new operations and administration building with an aerodrome control tower. At the same time, complete modernization of the air navigation systems will be required in order to ensure flight safety, ease of operations and maintenance.

Table 4.5.1 Outline of the Existing Air Navigation Systems

Item	Description	Remarks
AIR NAVIGATION SYSTEMS		(Date of installation)
Navaids		
- Non-directional radio beacon (NDB)	350KHz, 1KW Coverage:250NM	1945
- VHF omnidirectional radio range (VOR) and co-located	115.7MHz, 100W Coverage: 180NM	1982
Distance Measuring Equipment (DME)	104x,1KW	1975
- Instrument Landing system (ILS)		
.Localizer	110.3MHz One freq.	
.Glide Path	335.0MHz Null Reference Gp=2.5deg.	1983
.Middle Marker	75MHz	
.Outer Marker	Not provided	
.DME	40X	
- Locator	330KHz, 100W	1968
Air Traffic Control and Telecommunications		
- Secondary Surveillance radar (SSR)	Terminal SSR Planned (1030MHz, 1.2KW MODE 1,2,3/A<B<C<D)	CESELSA, SPAIN 1987
- Air-ground VHF communication system	Emergency (121.5MHz) SMC (121.9MHz)	
	La Paz Inf.(127.1MHz) La Paz Control (128.2/123.9MHz) La Paz App.(119.5MHz) La Paz TWR.(118.3MHz)	About 1971

Table 4.5.1 (Cont.)

- Air-ground UHF communication system	Nil	
- Automated terminal information system (ATIS)	Nil	
- Control consoles	.Aerodrome/Approach Control Console .ACC consoles (3pos)	
- VHF / UHF link		
.VHF link	Between El Alto airport and Huaricollo/Juno VHF remote stations	1976
.UHF link	Between El Alto airport and Achachicala ENTEL* station.	*National Telephone Company
- HF A/G Comm.	La Paz control (6 HF frequencies) La Paz radio (1 HF frequency)	1971
- HF-ISB/SSB point to point telecom	El Alto - Santa Cruz El Alto - Cochabamba El Alto - Trinidad El Alto - Duplex El Alto - Simplex El Alto - Antofagasta/ Cordoba El Alto - Campo Grande/ Porto Belho/ Asuncion El Alto - Buenos Aires	
- AFTN message exchange and teletypewriters	Intl/Dom circuits	1974
- Magnetic tape recorder	20 channel	1965
- ATC intercommunication	Provided	
- Time distribution system	Nil	

Table 4.5.1 (Cont.)

Meteorological Equipment		
- Runway surface sensors	Conventional type	
	. Anemometers	1973
	. Thermometers	1984
	. Precipitation Guages	1973
	. Barometers	1969
- Runway visual range equipment	Nil	
- Ceilometer	Not usable	1969
- WX data processing and recorders	Nil	
- HF receiver and WX facsimile	From Brazil and Argentina	1976
- WX Teletypewriters		
- Radiosonde	Not operated	
- Weather Satellite Receiver	NOAA	1979
	Not operated	
- Weather radar	Nil	
Aeronautical Ground Lights		
- Aerodrome beacon	Nil	
- Simple approach lighting system	Nil	
- Precision approach category - II lighting system	RWY09R OPS;CAT-I	1981
- Visual approach slope indicator system	2 BAR VASIS for RWY09R	1969
- PAPI	RWY09R/27L	1985
- Runway threshold identification lights	RWY09R/27L	
- Runway threshold lights	Provided (RWY09R, not Cat-I)	
- Runway edge ligts	Provided	1968
- Runway end lights	Provided	
- Runway centerline lights	Nil	

Table 4.5.1 (Cont.)

- Runway touchdown zone lights	Nil	
- Stopway lights	Nil	
- Taxiway centerline lights	Nil	
- Taxiway edge lights	Provided	1968
- Taxiway guidance system	Nil	
- Taxi-holding position lights	Nil	
- Apron floodlights	8 poles	
- Visual docking guidance system	Nil	
- Wind direction indicator lights	Not illuminated	
- Obstruction lights		
- Emergency generator	470 Kw for all electric loads	1986

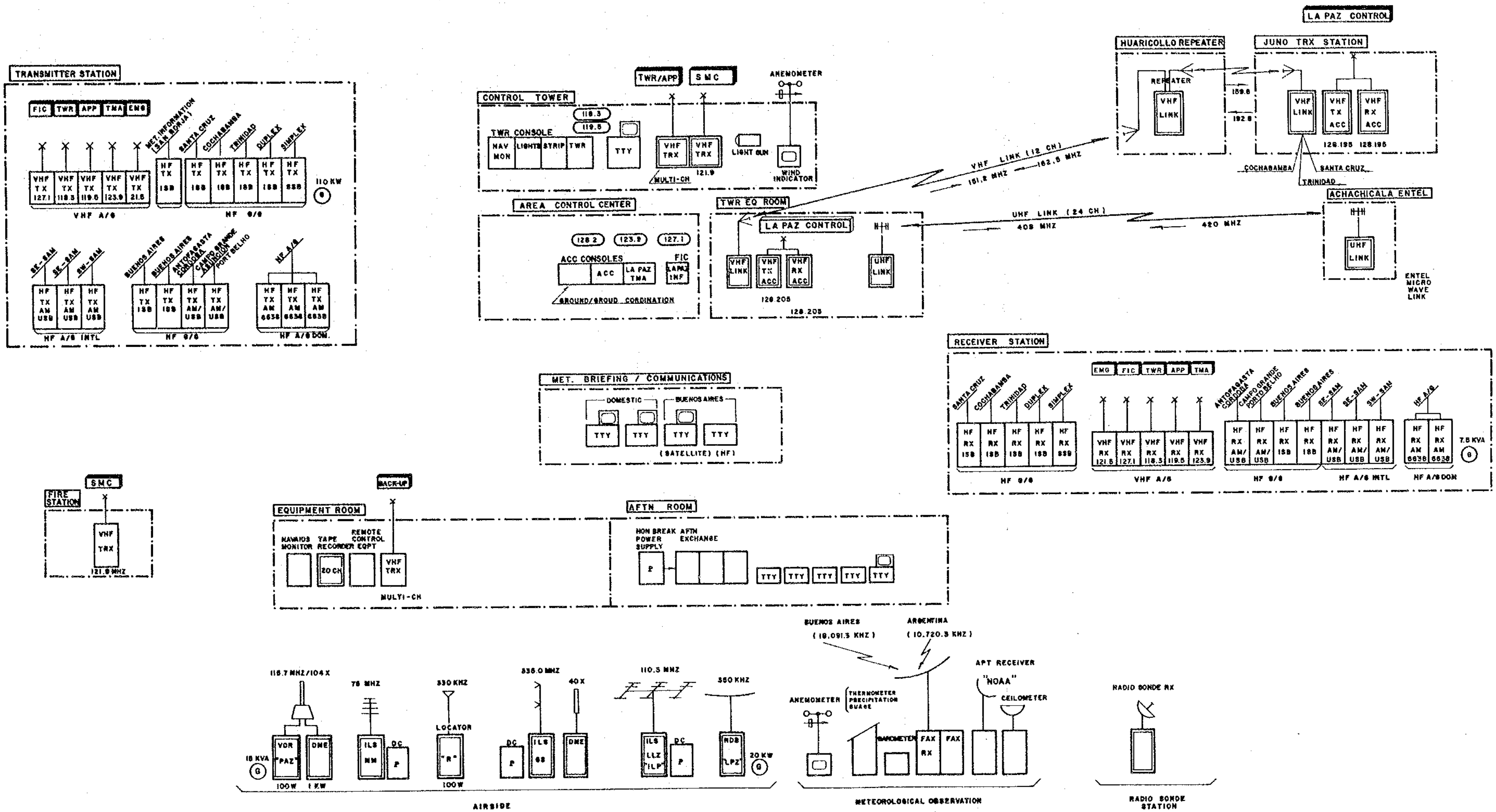


FIGURE 4.5.1 BLOCK DIAGRAM OF EXISTING AIR NAVIGATION SYSTEMS

4.5.2 Radio Navigational Aids

Figure 4.5.2 shows the existing layout of the radio navigational aids.

(1) The ILS of category II radio signals, and the terminal DME co-located with glide path facilities were installed in 1983. The ILS/DME equipment are new, one manufactured by Philips and no problem has been noted.

(2) The VOR and co-located DME were replaced in 1982 and 1975, respectively. The VOR/DME are operated by AC power and backed up by the 15KVA emergency generator. A non interrupted power supply to VOR/DME is preferable in order to meet the change-over time of 10 seconds.

(3) The NDB and locator were installed in 1945 and 1968, respectively. These are considered obsolete pieces of equipment. The locator with a 20 meter high vertical antenna is installed 1000 m west of the runway 09 threshold and on the extended runway centerline. The antenna was broken by aircraft taking-off twice in the past. Relocation of the locator or change of antenna type will be required.

4.5.3 Air Traffic Control System

(1) No radar control system is provided at the present time. A radar project is proceeding however and the construction of SSR is scheduled to be completed by Jan. 1988. The SSR (IRS-10, Ceselsa of Spain) has been donated by Spain and is to cover the La Paz Terminal, viz., area of 55NM radius from the La Paz VOR/DME.

The antenna is to be installed at a distance of 450 m from the runway 09R/27L centerline and 250 m from the runway 04/22 centerline. The radar scope is to be installed in the area control center.

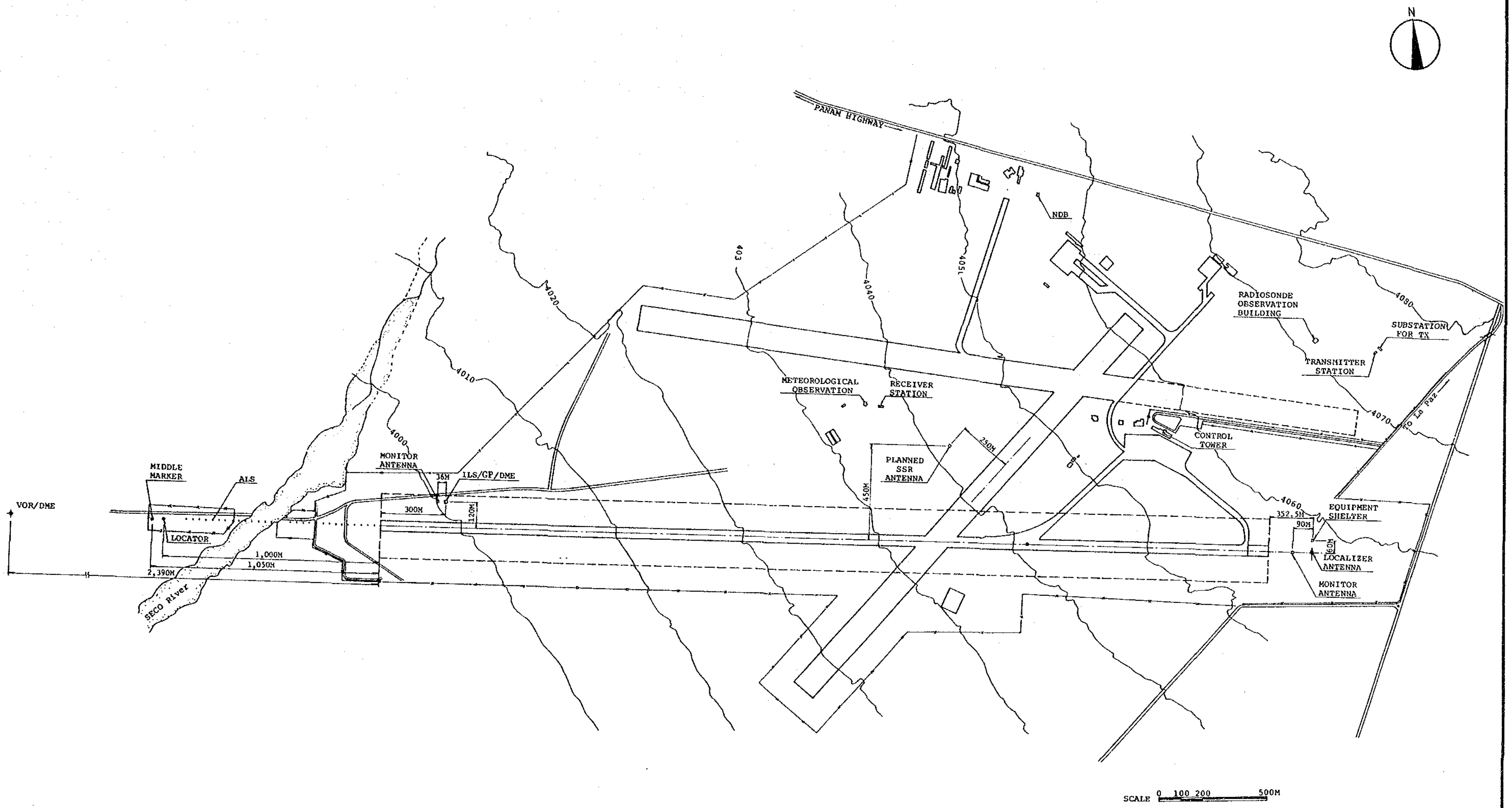


FIGURE 4.5.2 LAYOUT OF EXISTING NAVIGATIONAL AIDS

(2) The control panels were partially and additionally mounted and the wiring was changed in recent years. It takes a long time to repair a communications line failure due to the non-availability of existing wiring cables which creates a troublesome situation.

4.5.4 Aeronautical Telecommunications System

(1) The HF air-ground radio (6,638 KHZ) which is used for back-up of VHF radio for La Paz Control has poor communication quality. This is because of HF propagation characteristics however and there is no way to improve it. Improvement to ensure high reliability of VHF radio for La Paz control and VHF link will be a first priority.

(2) The VHF link equipment connecting El Alto airport and Huaricollo/Juno remote controlled VHF air-ground stations are old one (installed 1976) and one channel of dual transmitters and receivers is not usable. Moreover, the interference with taxi radio is observed. Replacement of the VHF link equipment with UHF link is required.

(3) Several of the VHF air-ground equipment units do not have full dual configurations. All the VHF air-ground equipment should have dual equipment.

4.5.5 Meteorological Observation System

(1) The wind vanes are located on the roof of the control tower and meteorological observation station. Other airport surface sensors are installed at the meteorological observation station which is located at a distance of 600 m from the runway, thus the observed data does not always indicate the meteorological conditions on the runway.

Two observation sites near both the runway touch-down zones are normally required for a 4,000 m runway.

(2) Upper air observation by radiosonde have been suspended because hydrogen for balloon can not be produced. Accordingly, the upper air observation is not performed in Bolivia (* 1) at this time and weather forecasting relies only on the data from Argentine (which does not cover the entire whole area of Bolivia), Brazil and New York (very seldom) by HF facsimile receiver.

Recently, hydrogen production equipment using electrolysis was donated by the WMO and the observation will start soon.

Note *1: Viru Viru airport has radiosonde facilities, but no hydrogen production equipment is provided.

4.5.6 Aeronautical Ground Lights

Figure 4.5.3 indicates the wiring diagram of the existing aeronautical ground lights.

(1) The lights were installed in four stages:

Year 1968 = Runway edge lights, taxiway edge lights
1969 = VASIS
1981 = Precision approach category-II lighting system
1985 = PAPI

(2) The approach lighting system is designated for the precision approach category-II. However, the longitudinal slope of lights are minus 1.52 percent in the first 300 m section from the threshold which does not meet the category-II requirements. The negative slope is not permitted within 450 m of the threshold for a precision approach category-II.

4.5.7 Power Supply System

Figure 4.5.4 indicates the existing power supply system for visual aids and radio aids.

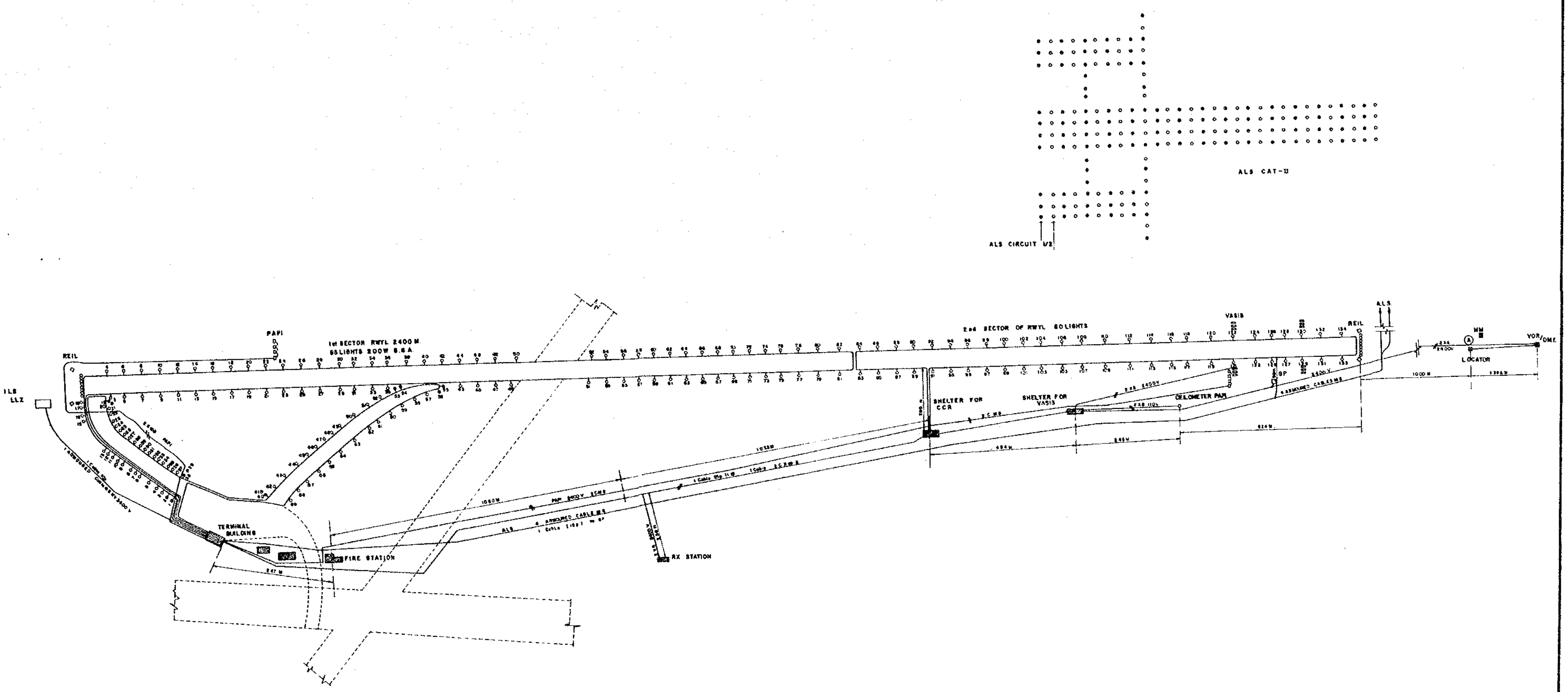


FIGURE 4.5.3 LAYOUT OF EXISTING AERONAUTICAL GROUND LIGHTS

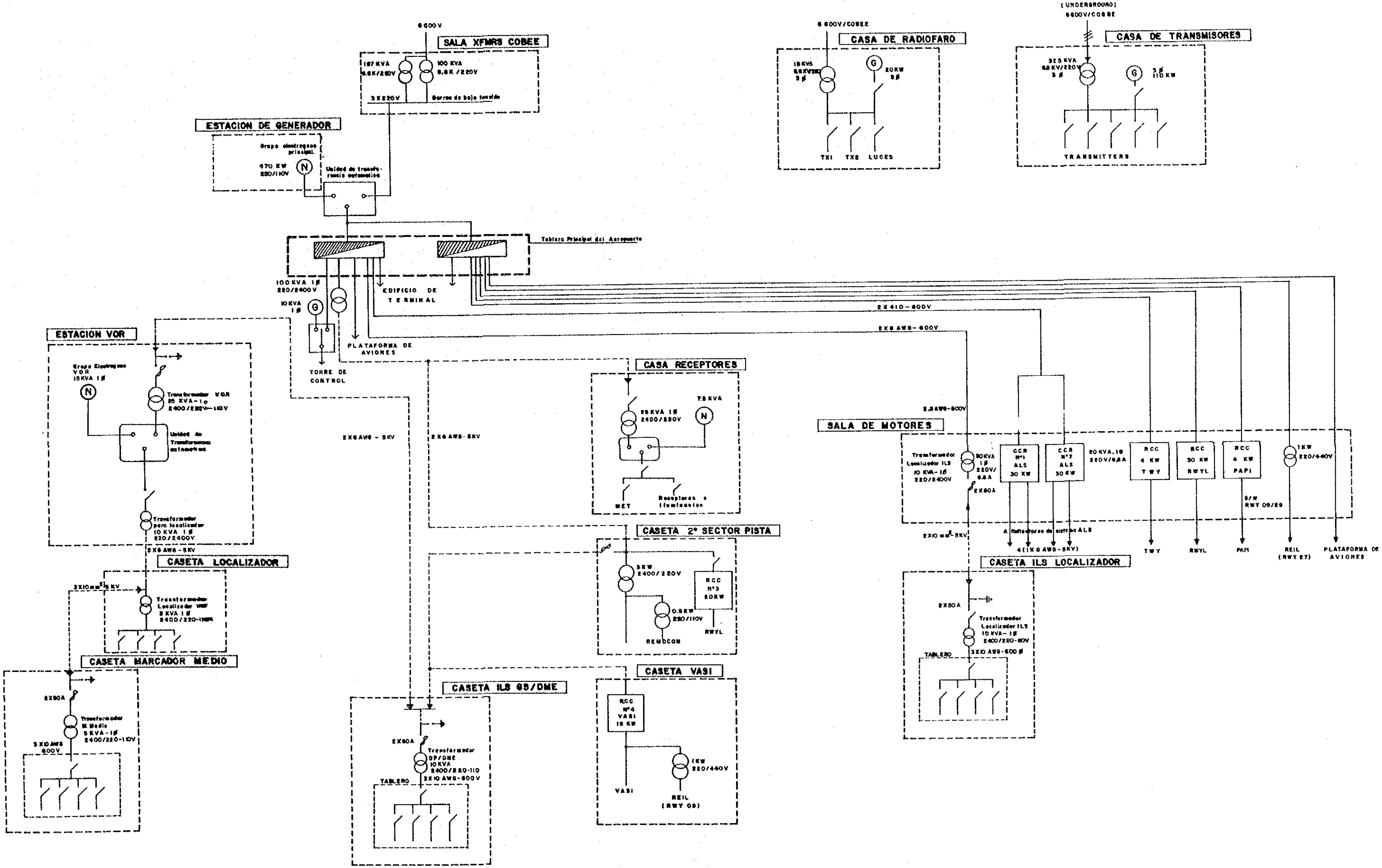


FIGURE 4.5.4 POWER SUPPLY SYSTEM FOR NAVAIDS AND AERONAUTICAL GROUND LIGHTS (EXISTING)

4.6 General Services

4.6.1 Rescue and Fire Fighting Facilities

The analysis of the aircraft movements in the busiest consecutive three months indicates that the existing airport category for rescue and fire-fighting services corresponds to category 7.

The outline of the existing rescue and fire-fighting services is as follows:

(1) Major Vehicle (2 vehicles)

- Manufactured in 1979 by Ford
- Water for protein foam (L) = 9,000 x 2
- Protein foam (L) = 1,000 x 2
- Discharge rate (L/minute) = 3,500 x 2

(2) Rapid intervention vehicle (1 vehicle)

- Manufactured in 1979 by Ford
- Dry chemical powders (Kg) = 225
- Ready mixed aqueous film forming foam (L) = 200
- Discharge rate (L/min) = 240

(3) No ambulance is provided at the present time.

(4) The layout of the existing fire station is shown in Figure 4.6.1.

(5) The working operations are conducted by 2 teams, each consisting of ten members (1 supervisor, 3 vehicle operators and 6 firemen). One shift is 24 hours continuous duty.

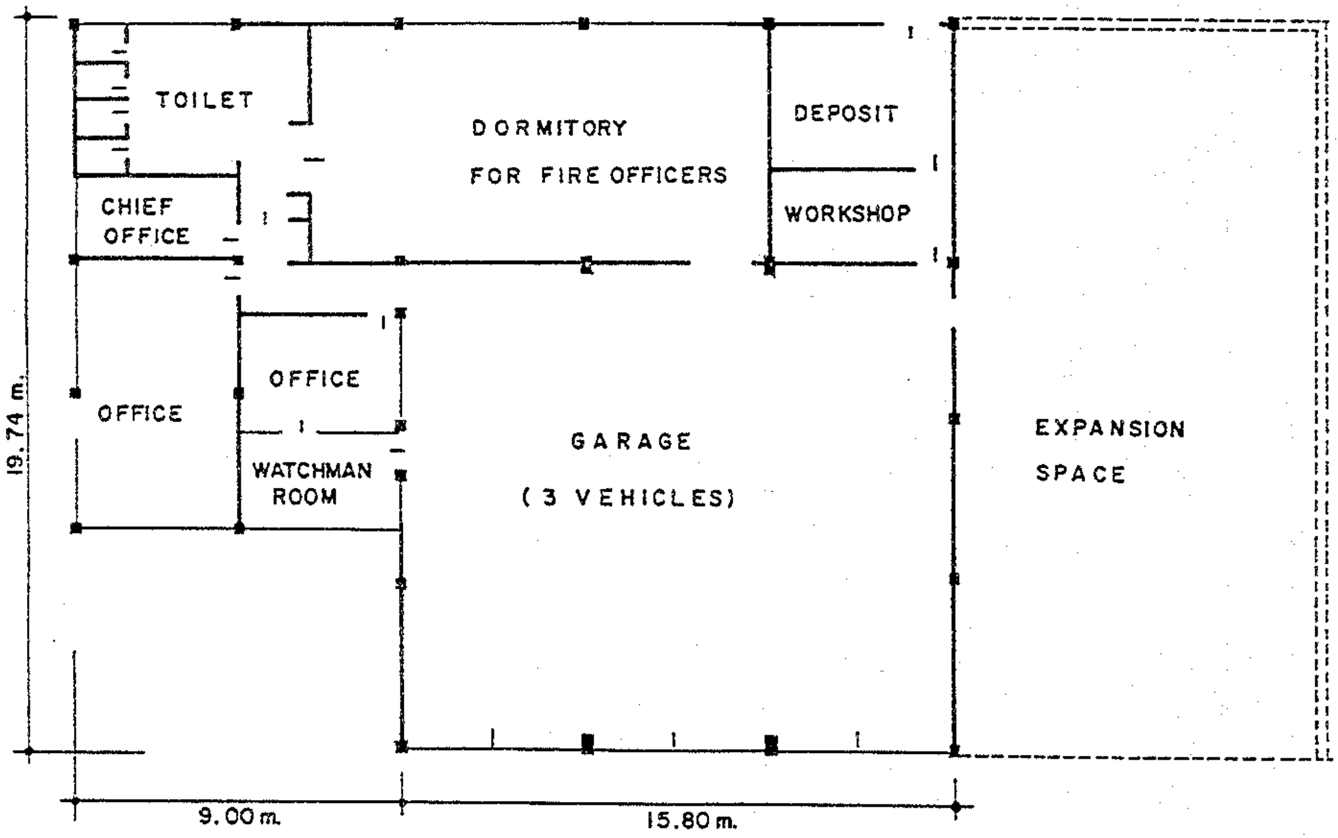


Figure 4.6.1 Layout of the Existing Fire Station

4.6.2 Fuel Supply System

Aviation fuel and oil are supplied by YPFB (Yacimientos Petroliferos Fiscales Bolivianos, or Bolivian National Petroleum Corporation).

Jet fuel and gasoline are transmitted from the oil refinary in Cochabamba to the regional distribution center in La Paz by pipe lines. Avigas is carried by train. The regional distribution center is located north of El Alto airport, which supplies Jet fuel A-1 and Avigas to the airport fuel yard using two pipe lines as shown in Figure 4.6.2.

The regional distribution center has three tanks (2,056 Kl) for Jet A-1 and two tanks (1,662 Kl) for avigas.

The average daily consumption of jet A-1 and Avigas are currently 68Kl and 15Kl, respectively. Since YPFB has a practice to store 15 days consumption volume, the existing tank capacity is sufficient for the present demand and even for the demand up to the year 1990.

Jet fuel A-1 is supplied to three gate positions on the apron using a hydrant system. Jet A-1 and/or avigas are supplied by refuelling cars to gate positions for small aircraft on both edges of the apron, and in the general aviation and air force areas.

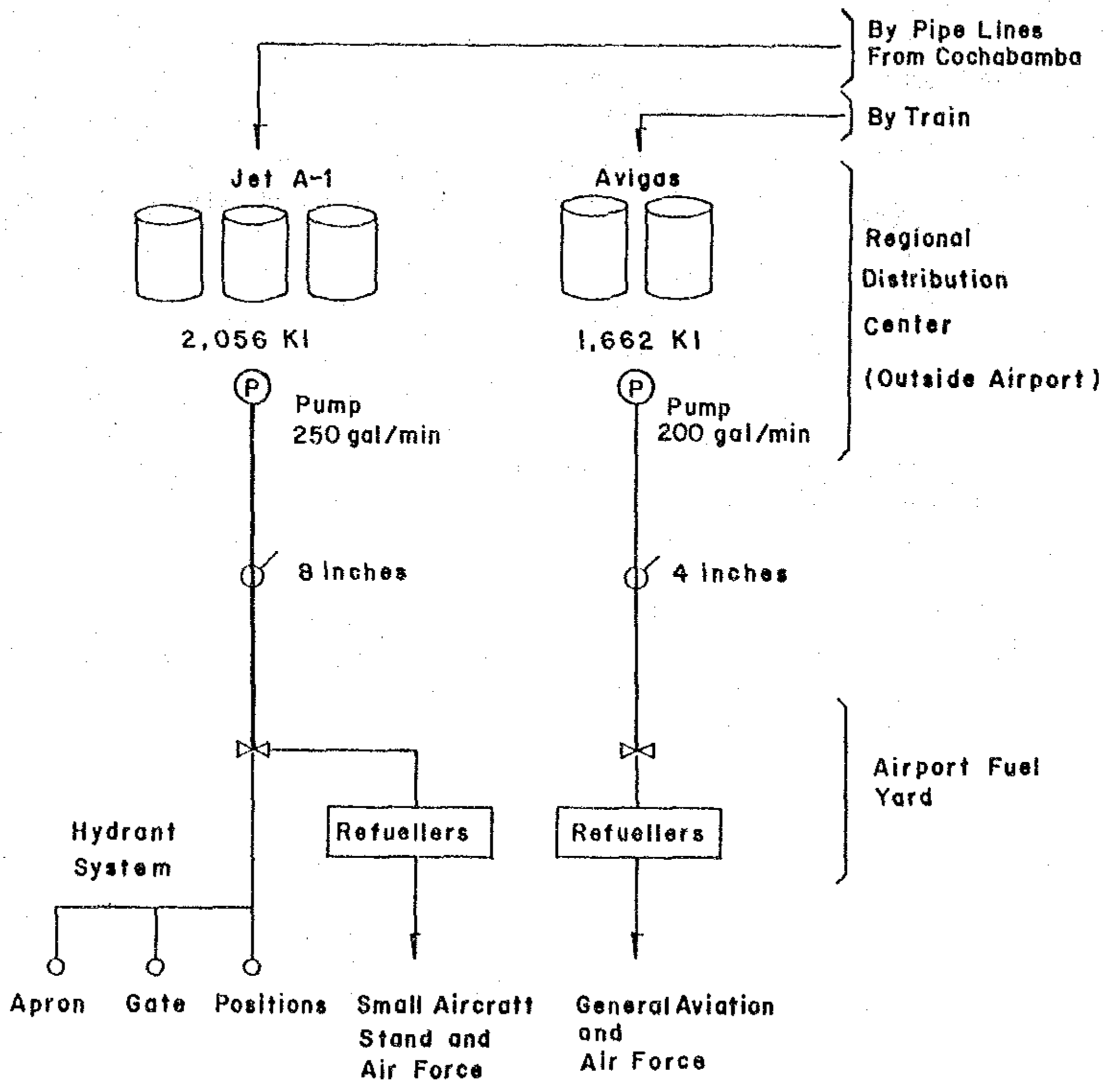


Fig 4.6.2 Fuel Supply System

4.7 Airport Utilities

4.7.1 Power Supply System

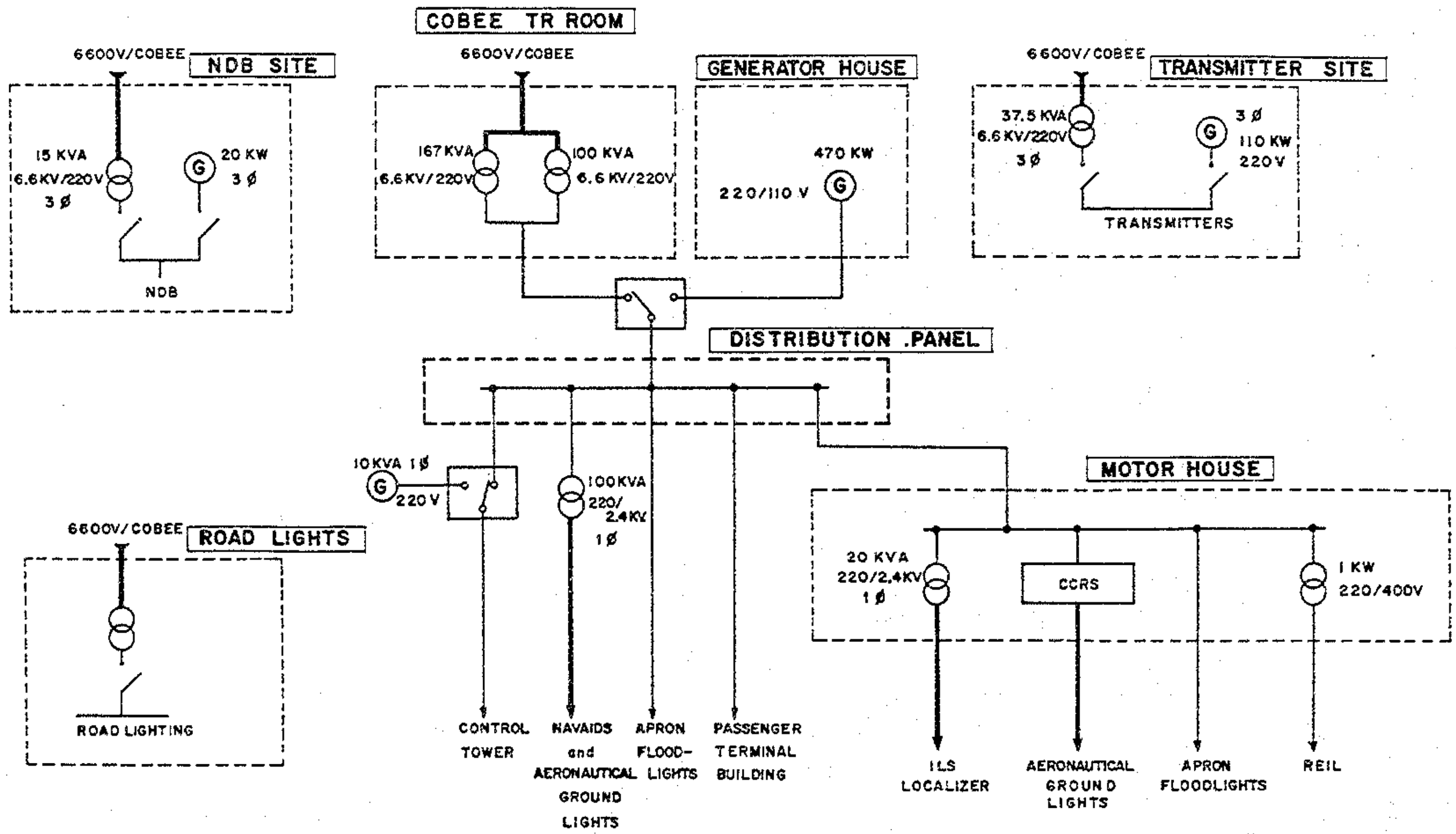
The existing power supply system is shown in Figure 4.7.1.

Electricity is supplied by COBEE (Compania Boliviana de Energia Electrica or Bolivian Electricity Company) with 6,600 V distribution lines.

There is no central airport substation and the power supply to the various airport facilities is from independent and different 6.6KV distribution lines.

The existing capacity of the power supply system for the passenger terminal building, navigational aids, aeronautical ground lights, etc., is 270 KW, while the actual consumption is 198 KW as shown below:

- Passenger terminal building (Incl. ATC communications facility inside the terminal)		: 70 KW
- Aeronautical ground lights		: 121 KW
RWYL	(30 KW)	
TWYL	(4 KW)	
Apron fllodlights	(32 KW)	
VASI	(11 KW)	
PAPI	(4 KW)	
ALS	(40 KW)	
- Car Park lights		: 7 KW
Total Consumption		198 KW



NOTE

1. COBEE IS BOLIVIAN ELECTRICITY COMPANY
2. COBEE TR ROOM, DISTRIBUTION PANEL AND MOTOR HOUSE ARE INSIDE THE PASSENGER TERMINAL BUILDING

Figure 4.7.1 Power Supply System

4.7.2 Water Supply System

The existing water supply system is shown in Figure 4.7.2.

The potable water is presently supplied by SAMAPA (Servicio Autonomo Municipal de Agua Potable y Alcantarillado).

The diameter of the supply main to the airport terminal is 4 inches and its capacity is estimated to be 17,000 ton/month based on information obtained.

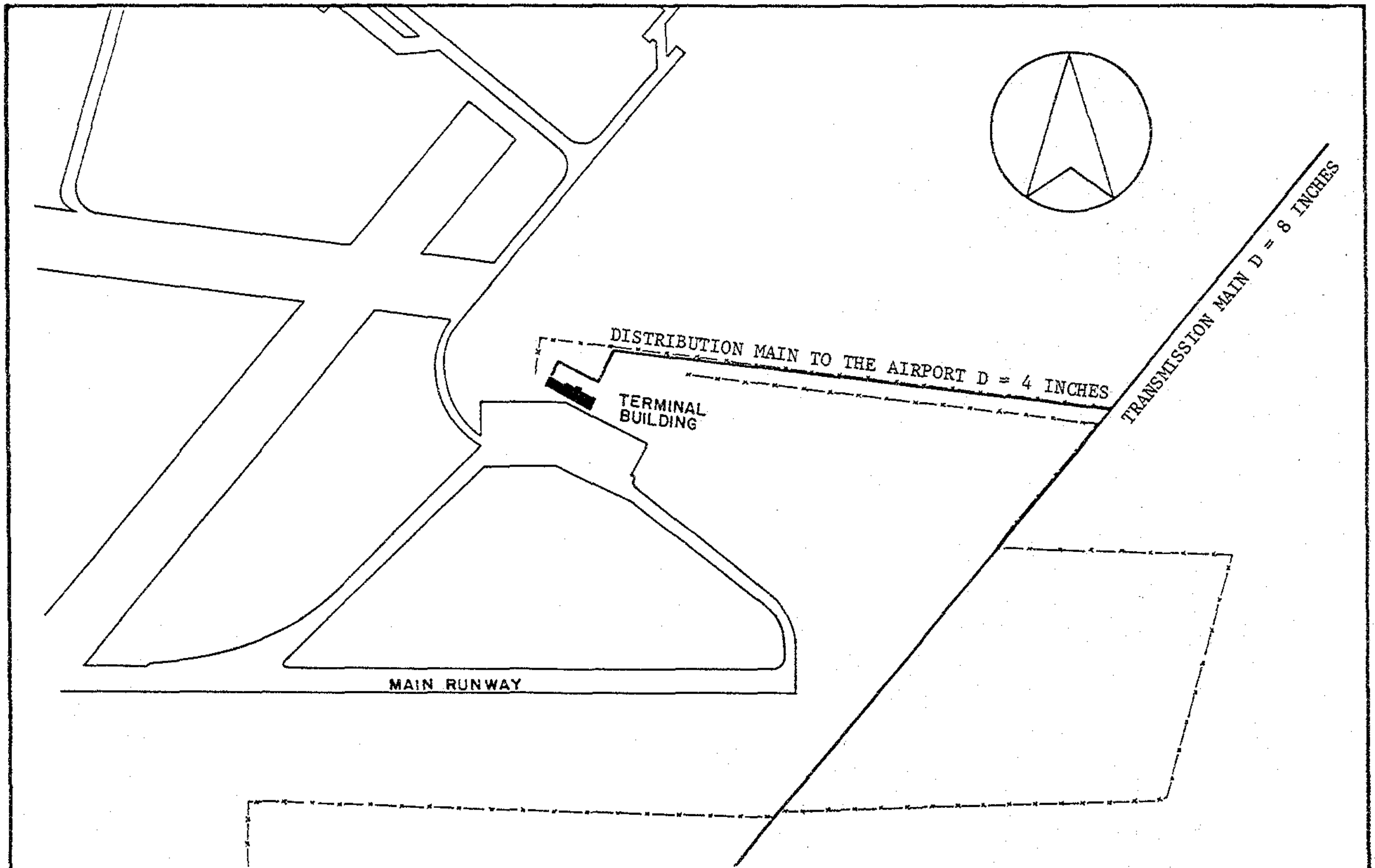


Figure 4.7.2 Existing Water Supply System S= 1: 10,000

4.7.3 Sewage System

Existing sewer system is shown in Figure 4.7.3.

At present, the sewage generated from the terminal area is transmitted to the reservoir located at the south end of the main runway and is infiltrated into the ground naturally without any treatment.

AASANA has a partial improvement plan to replace the existing sewer pipe with a pipe of 12 inch diameter between the terminal building and manhole No.24 as shown in Figure 4.7.3.

The capacity of the sewer pipe after this improvement is estimated to be 25,000 ton per month based on the diameter and the gradient of the pipe.

With regard to the infiltration capacity of the reservoir, no data could be collected.

4.7.4 Waste Disposal

At present, the waste generated from the terminal area is estimated to be approximately 30 ton per month based on the information collected from AASANA.

The waste is presently disposed of in an area outside the airport along the Seco river or buried in the ground within the airport property by AASANA.

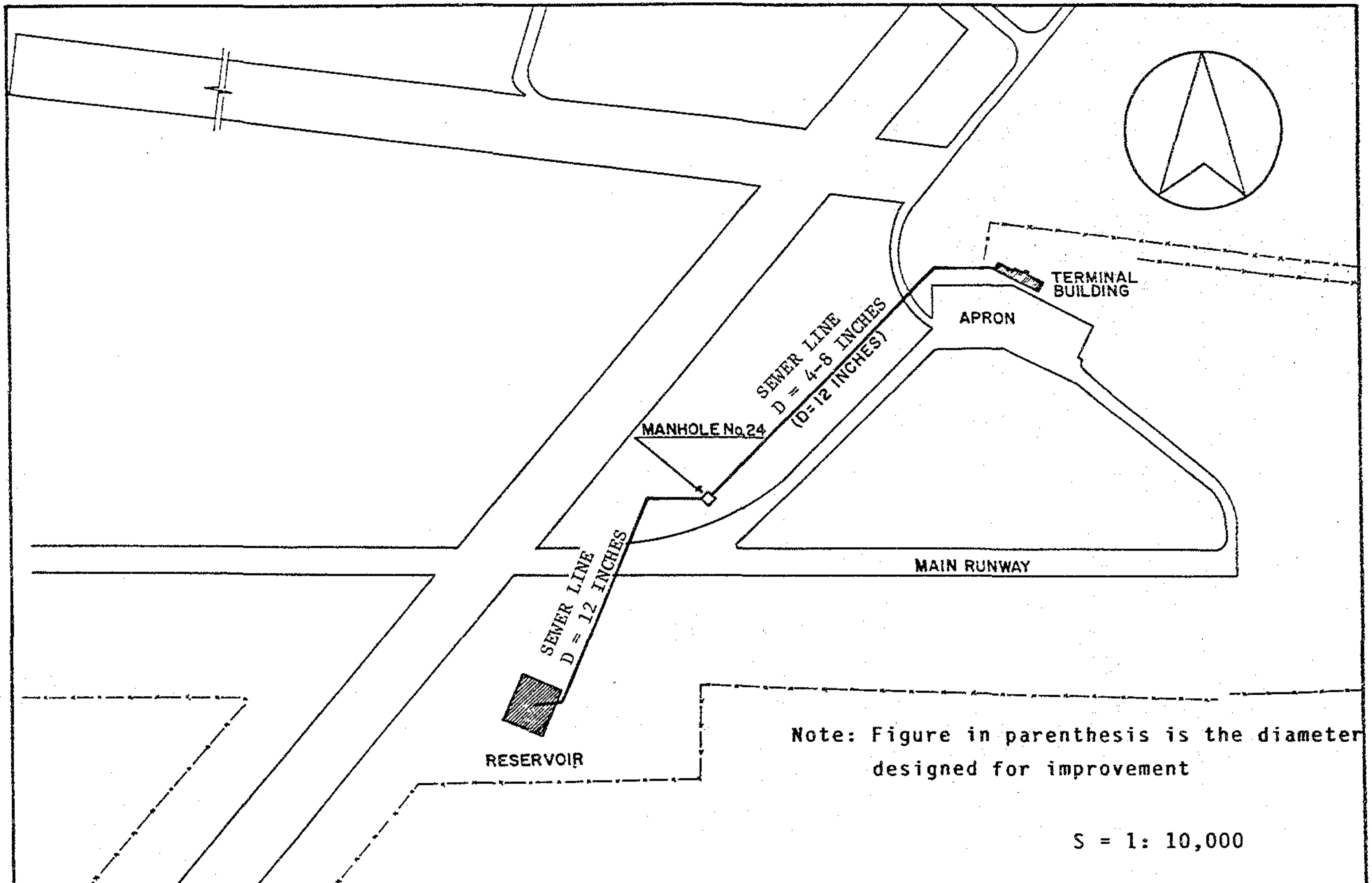


Figure 4.7.3 Existing Sewage System

4.8 Natural and Social Conditions in Vicinity of the Airport

4.8.1 Present Land Use Condition

Present condition of land use surrounding the airport is illustrated in Figure 4.8.1.

The area surrounding the airport is in an advanced stage of urbanization. East and north of the airport, the area is densely populated in particular. At Villa Adela southwest of the airport, there is also a residential area provided by CONAVI (Concejo Nacional de Vivienda, the National Housing Bureau of the Ministry of Urbanization and Housing).

4.8.2 Existing Land Use Plan

With regard to the land use plan, only an urban development plan of La Paz (Note 1) exists, which was prepared by a French consultant under the Municipal Office of La Paz in 1977. This plan however has not yet been carried out.

Note 1: Honorable Alcaldia Municipal de La Paz, Plan de Desarrollo Urbano-Ciudad de la La Paz, 1977

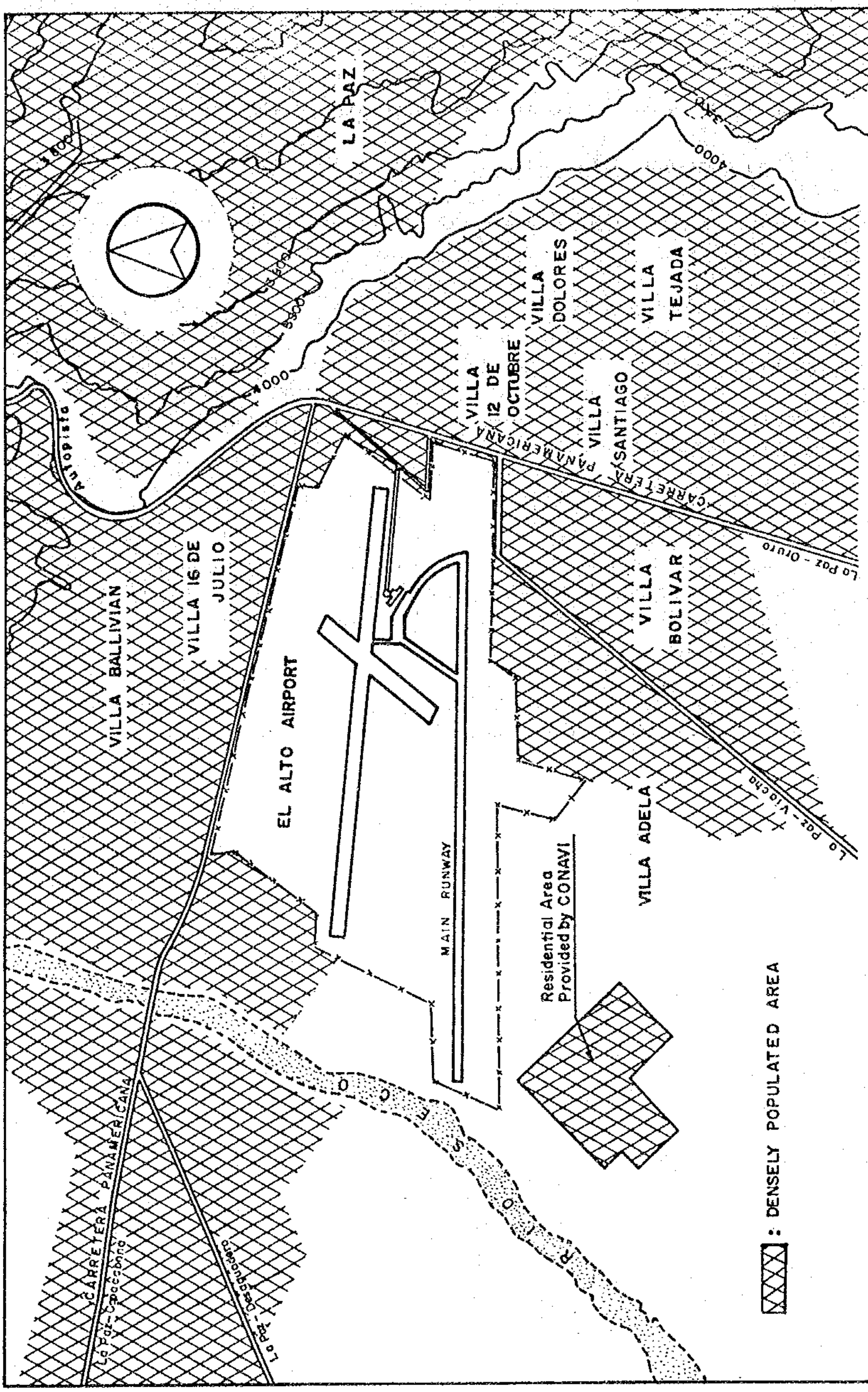


Figure 4.8.1 Present Land Use

S = 1:40,000

Appendix 4.1 Runway Ccpacity Calculation

For the conditions of the calculation, refer to section 4.1.1 (4).

1. General

(1) Share of heavy and medium aircraft is calculated from the aircraft mix.

Heavy aircraft:	PH = 0.236
Medium aircraft:	PH = 0.764

(2) Average take-off time due to the wake turbulence is calculated as follows:

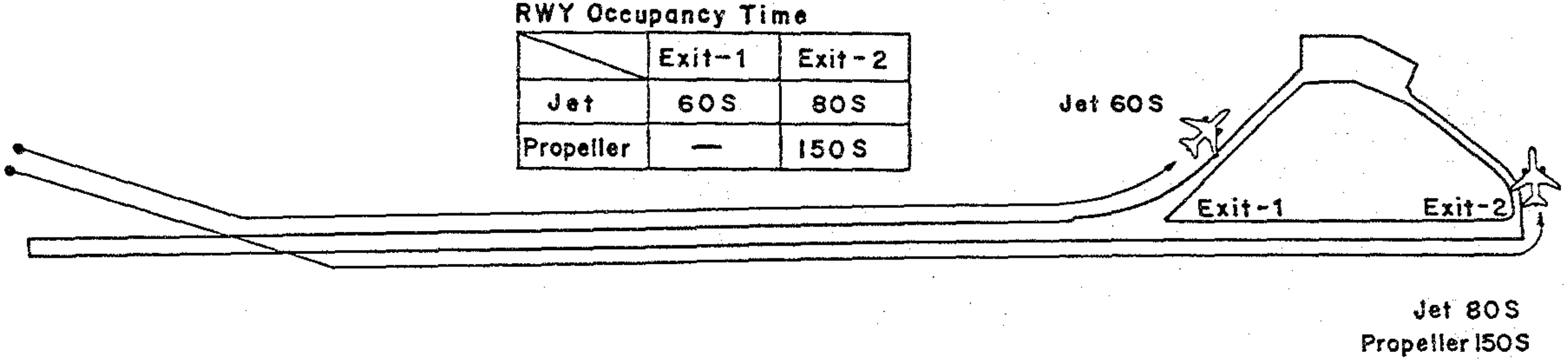
Heavy/Medium aircraft following Heavy:	120S x PH = 120 x 0.236 = 28.32
Heavy/Medium aircraft following Medium:	60S x PM = 60 x 0.764 = 45.84
Average	74 sec

(3) Share of jet and propeller driven aircraft is calculated from the aircraft mix.

Jet aircraft:	P_j = 0.56
Propeller aircraft:	P_p = 0.44

(4) Runway Occupancy Time

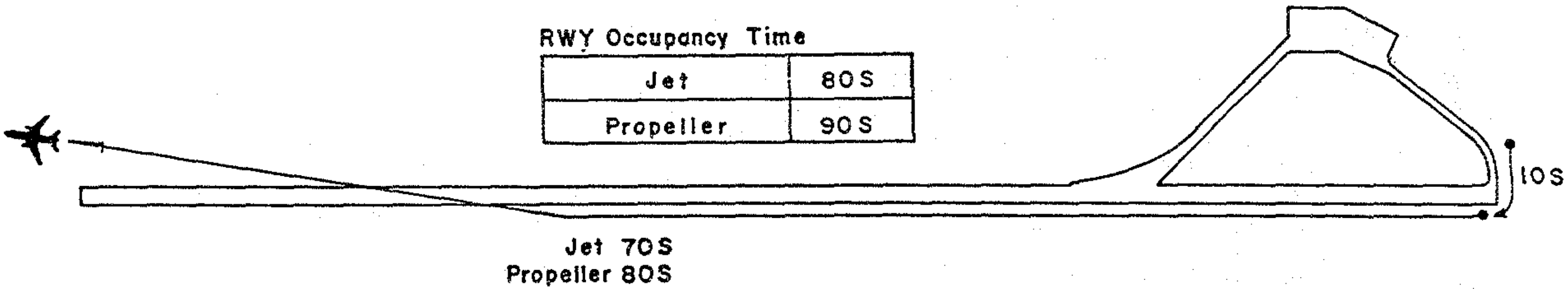
The runway occupancy time has actually been surveyed and is summarized in Figures A.4.1.1 through 4.



RWY Occupancy Time

	Exit-1	Exit-2
Jet	60S	80S
Propeller	—	150S

Figure A.4.1.1 Runway Occupancy Time for RWY 09 Landing



RWY Occupancy Time

Jet	80S
Propeller	90S

Figure A.4.1.2 Runway Occupancy Time for RWY 27 Take-off

RWY Occupancy Time

Jet	270S
Propeller	270S

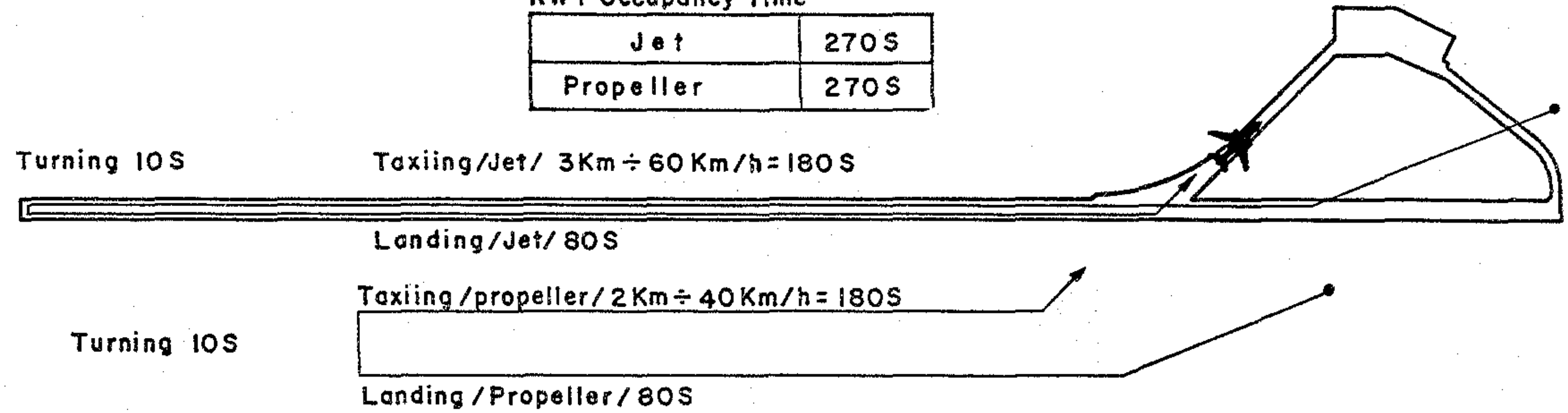


Figure A.4.1.3 Runway Occupancy Time for RWY 27 Landing

RWY Occupancy Time

Jet	260S
Propeller	360S

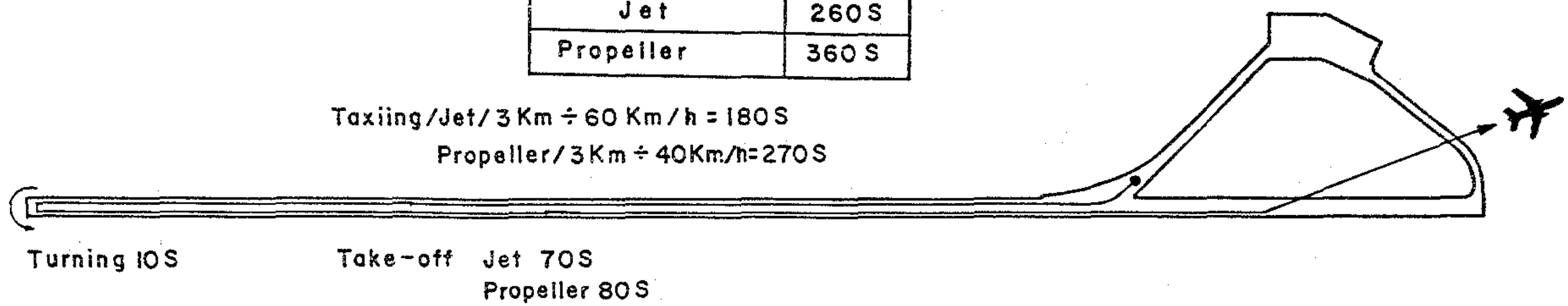
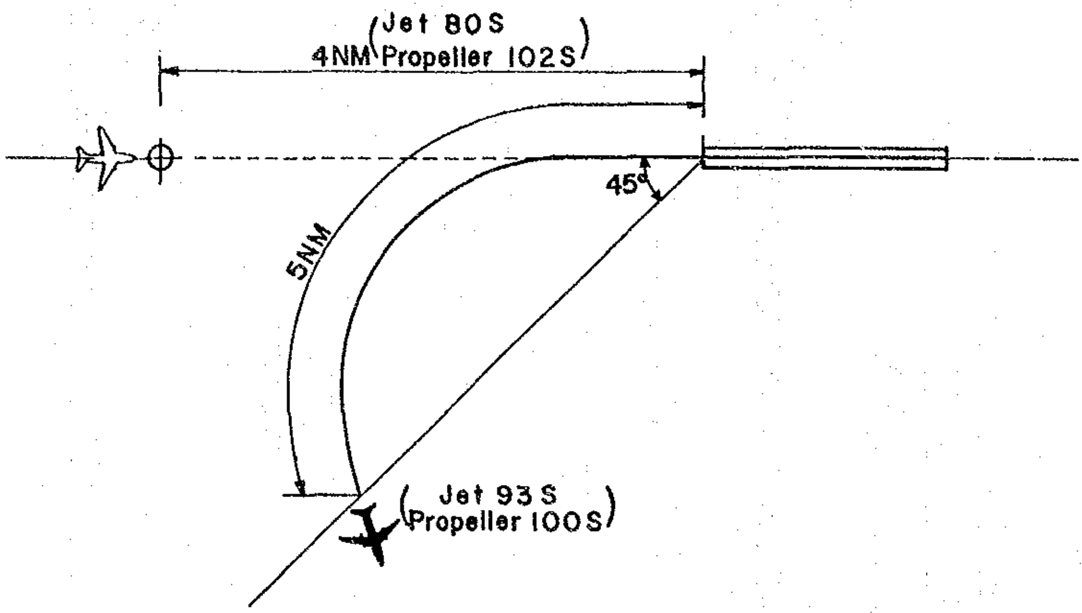
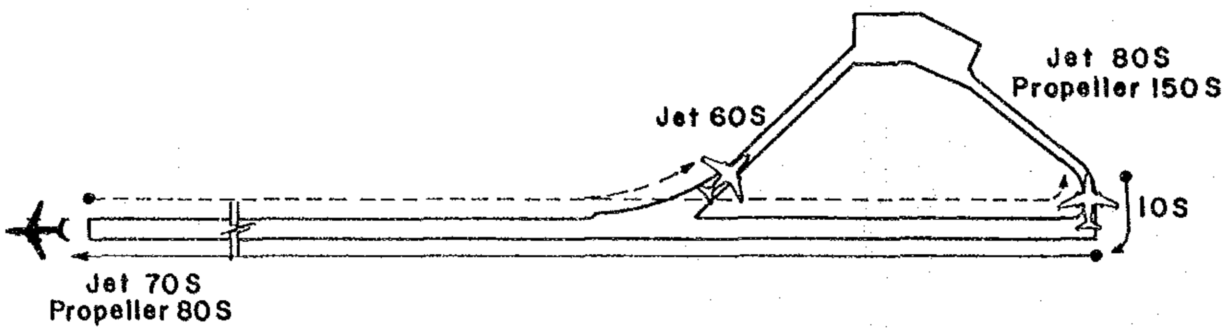


Figure A.4.1.4 Runway Occupancy Time for RWY 09 Take-off

2. CASE - I (RWY09LDG/RWY27TOF)

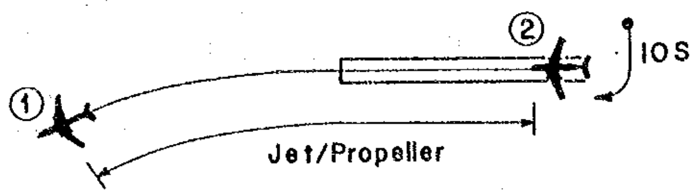
(1) Procedures





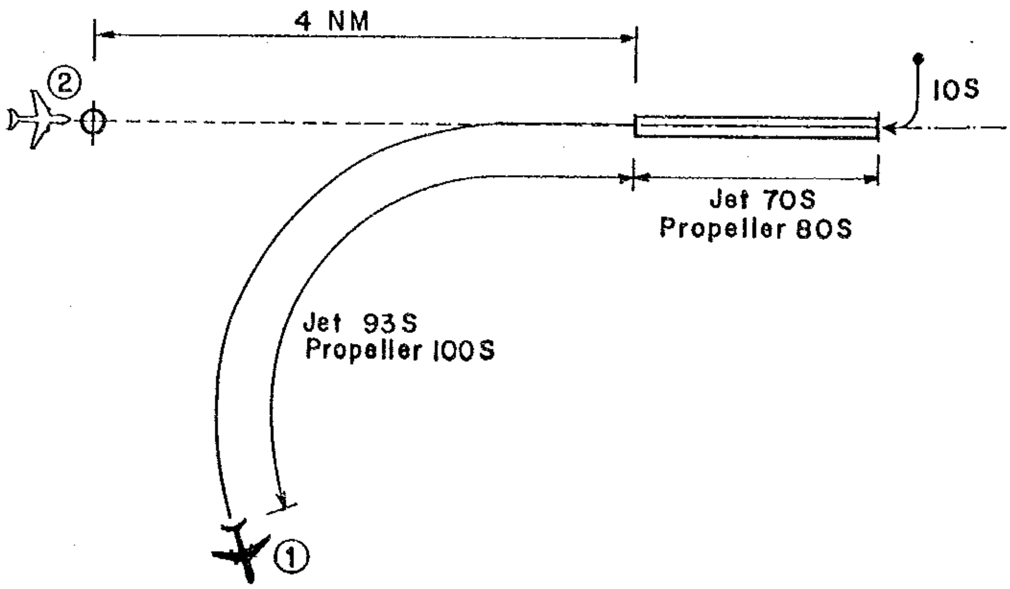
(2) Occupancy Time

a) Take-off followed by Take-off



(Determined by Wake Turbulence minima)
71sec

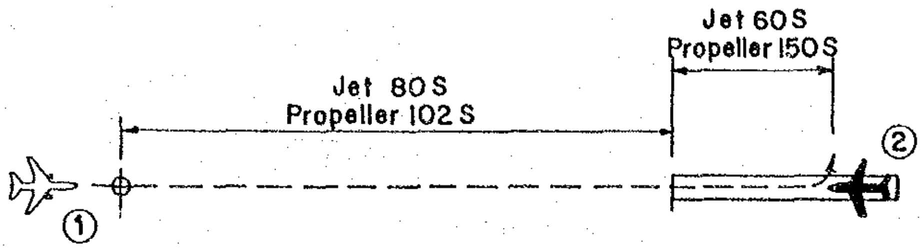
b) Take-off followed by Landing



Jet 173S P_j =0.65
Propeller 190S P_p =0.35

178.95 sec

c) Landing followed by Take-off



Jet 140S P_j =0.65
Propeller 252S P_p =0.35

179.2 sec

d) Landing followed by Landing

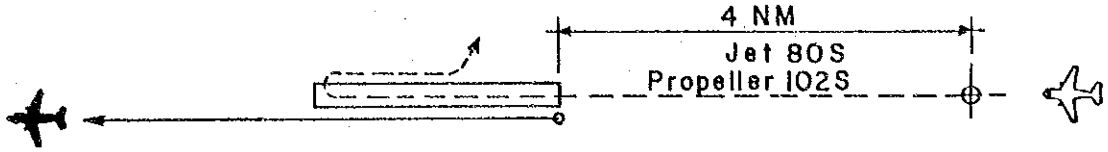
Same as "c"   179.2 sec

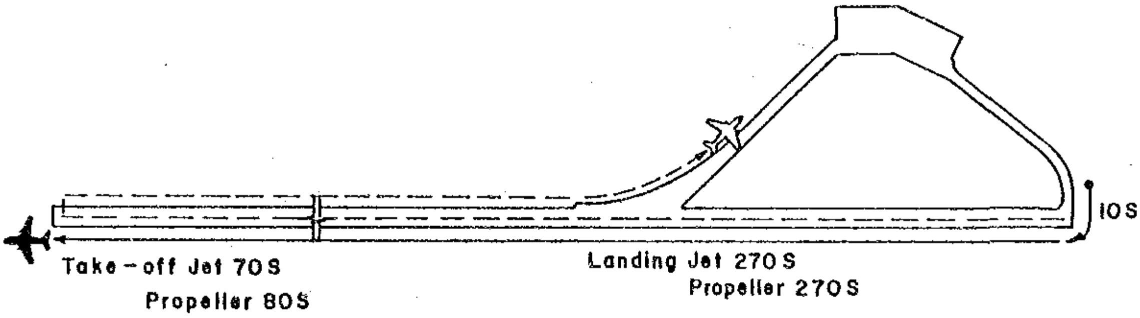
Average of a,b,c and d
(Required time for one take-off
or landing operation) = 152 sec

Allowable number of aircraft
operations during a peak hour = 23 operations/peak hour

3. CASE - II (RWY27LDG/RWY27TOF)

(1) Procedures



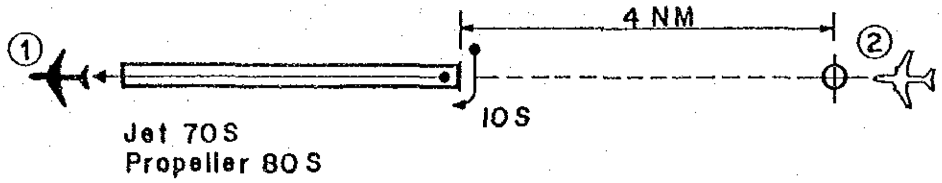


(2) Occupancy time

a) Take-off followed by Take-off

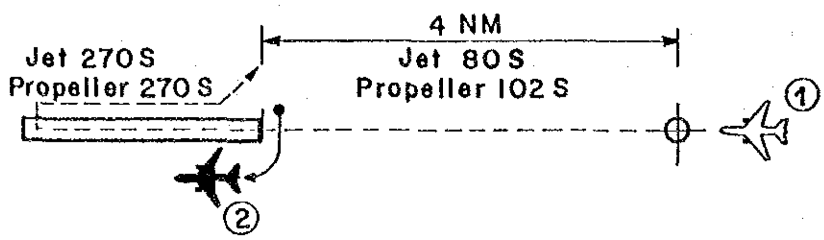
Same as "a" of Case-I

b) Take-off followed by landing



Jet 80S Propeller 90S	$P_j = 0.65$ $P_p = 0.35$	83.5 sec

c) Landing followed by take-off



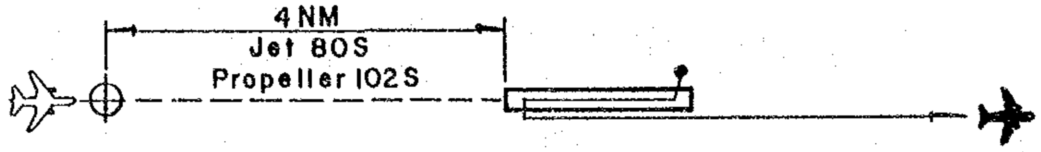
Jet 350S Propeller 372S	$P_j = 0.65$ $P_p = 0.35$	357.7 sec

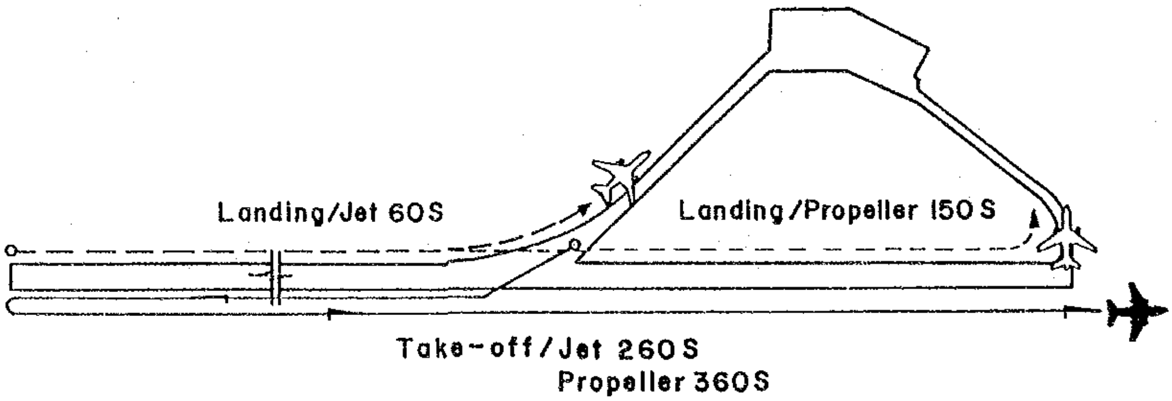
d) Landing followed by Landing

Same as "c" above		375.7 sec
Average of a,b,c and d (Required time for one take-off or landing operation)	=	217.5 sec
Allowable number of aircraft operations during a peak hour	=	16.5 operations/peak hour

4. CASE - III (RWY09LDG/RWY095OF)

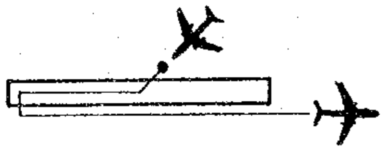
(1) Procedures





(2) <u>Occupancy time</u>

a) Take-off followed by Take-off

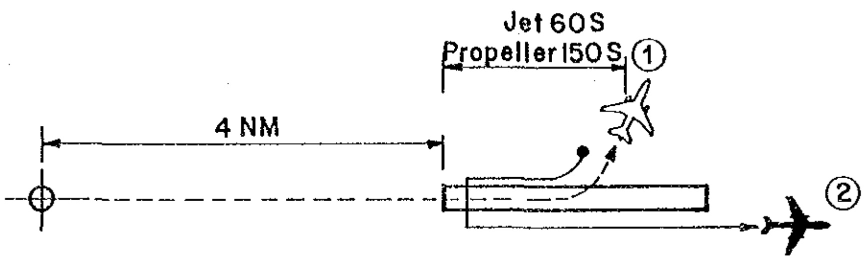


Jet 260S	P_j =0.65	
Propeller 360S	P_p =0.35	295 sec

b) Take-off followed by Landing

Same as "a" above 295 sec

c) Landing followed by Take-off



Jet 140S	P_j = 0.65	
Propeller 252S	P_p = 0.35	179.2 sec

d) Landing followed by Landing

Same as "c" above 179.2 sec

Average of a,b,c and d
(Required time for one take-off
or landing operation) ≈ 237.1 sec

Allowable number of aircraft
operations during peak hour ≈ 15.2 operations/peak hour

Appendix 4.2 Results of Topographical Survey

1. Outline of the Survey

The topographical survey was executed so that the following drawing can be made:

(a) Profile along the centerline of the runway
Scale V = 1 : 100, H = 1 : 5,000

(b) Cross-sections right angled against the centerline
Scale V = 1 : 100, H = 1 : 1,000

The surveying work consisted of the following items:

(a) Establishment of Principal Points
(b) Centerline Survey
(c) Profile Levelling
(d) Cross-section Levelling

The location for this work is shown in the Figure A.4.2.1.

2. Result of the Survey

Bentch mark "A-PE-1-A UMBRAL 27", which is located at the runway 27L threshold on the runway center line, was used as the datum point for the levelling survey in accordance with the instructions from AASANA. The altitude of this bentch mark is defined to be 4,057.826 m.

Based on the result of the survey, profile of the existing runway and cross-sections of runway strip and terminal area were prepared.

The copy of the profile and cross-sections was separately submitted to AASANA on March, 1987.

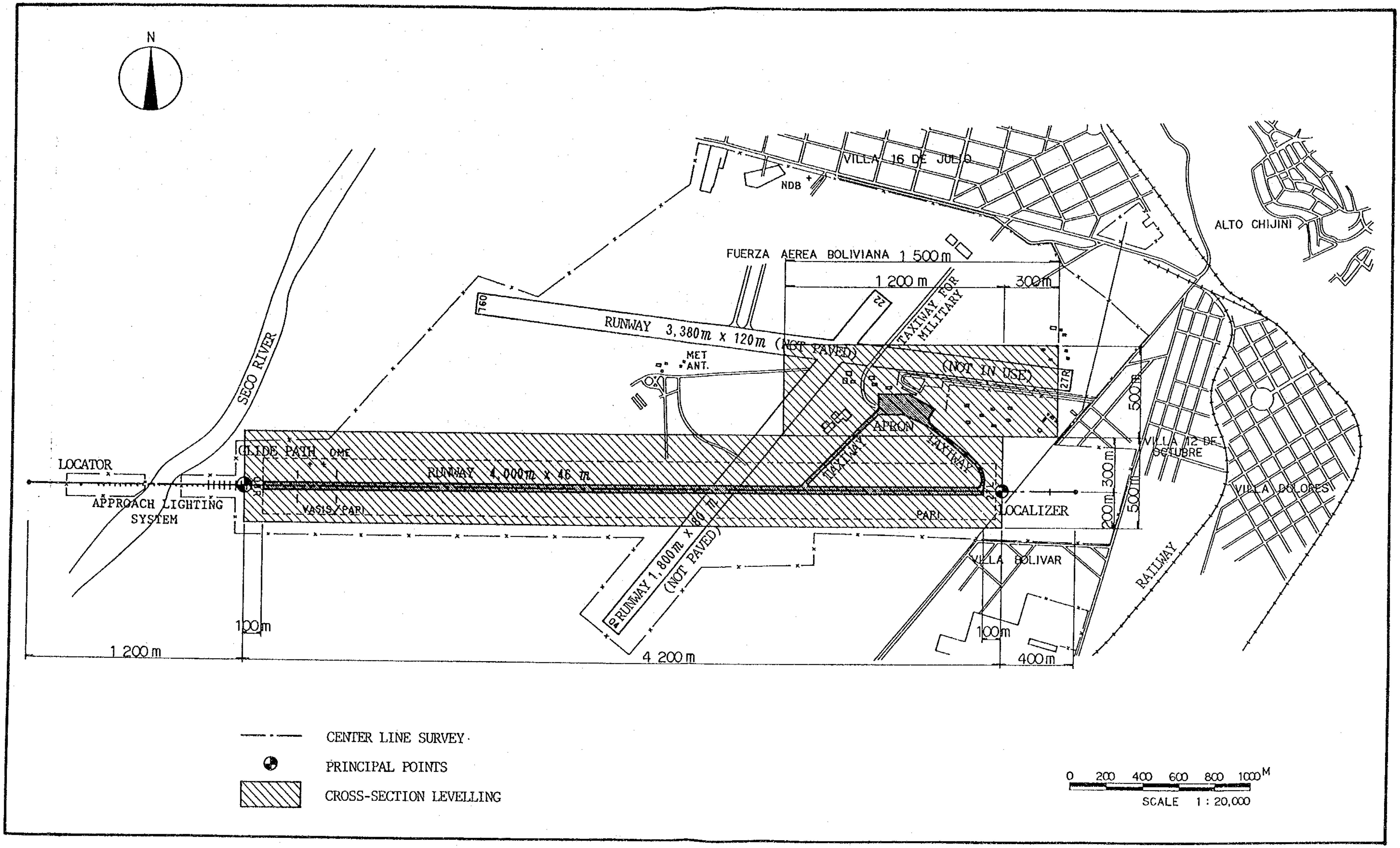


Figure A.4.2.1 Location Map of Topographic Survey

Appendix 4.3 Results of Soil Investigation

1. Outline of the Soil Investigation

The soil investigation included both field tests and laboratory tests.

The tests covered the following items:

<u>Field Tests</u>

(a) Test pit excavation
(b) Field CBR test
(c) Plate bearing test
(d) Field density test
(e) Sampling of soil materials
(f) Boring
(g) Standard penetration test including physical property test of soil samples

<u>Laboratory Tests</u>

(h) Physical properties test

Locations and number of test pits and borehole and core are shown in Figure A.4.3.1.

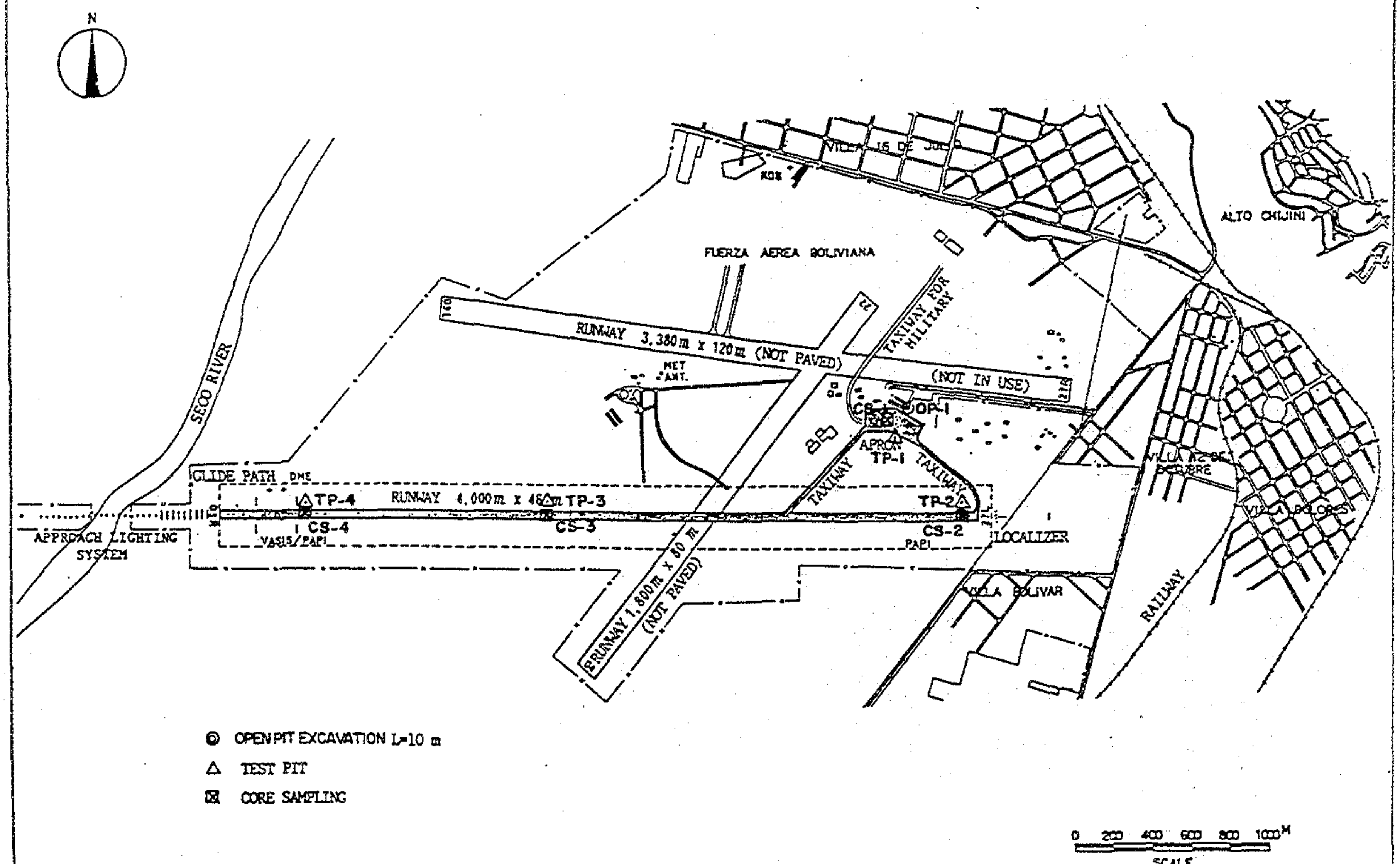


Figure A.4.3.1 Location Map of Soil Investigation

2. Result of the Soil Investigation

The result of the soil investigation is shown in Table A.4.3.1 and Figure A.4.3.2 and is summarized as follows:

(1) Field CBR tests, plate bearing tests, field density tests, etc. were conducted on the layer of 1.5 meter deep of 4 test pits shown in Figure A.4.3.1. As a result, soil conditions of 4 test pits are nearly same as below:

Classification of soil	:	Gravel
Plastic Index	:	Approximately less than 6%
CBR value	:	More than 20%
K value	:	More than 9 kg per cu.cm
Field density	:	2.0 g per cu.cm

From the above results, the subgrade of existing pavement is considered to have enough density and bearing strength.

(2) Borehole was drilled to the depth of 10 m and a standard penetration test was conducted at each 1 m level at the location shown in Figure A.4.3.1.

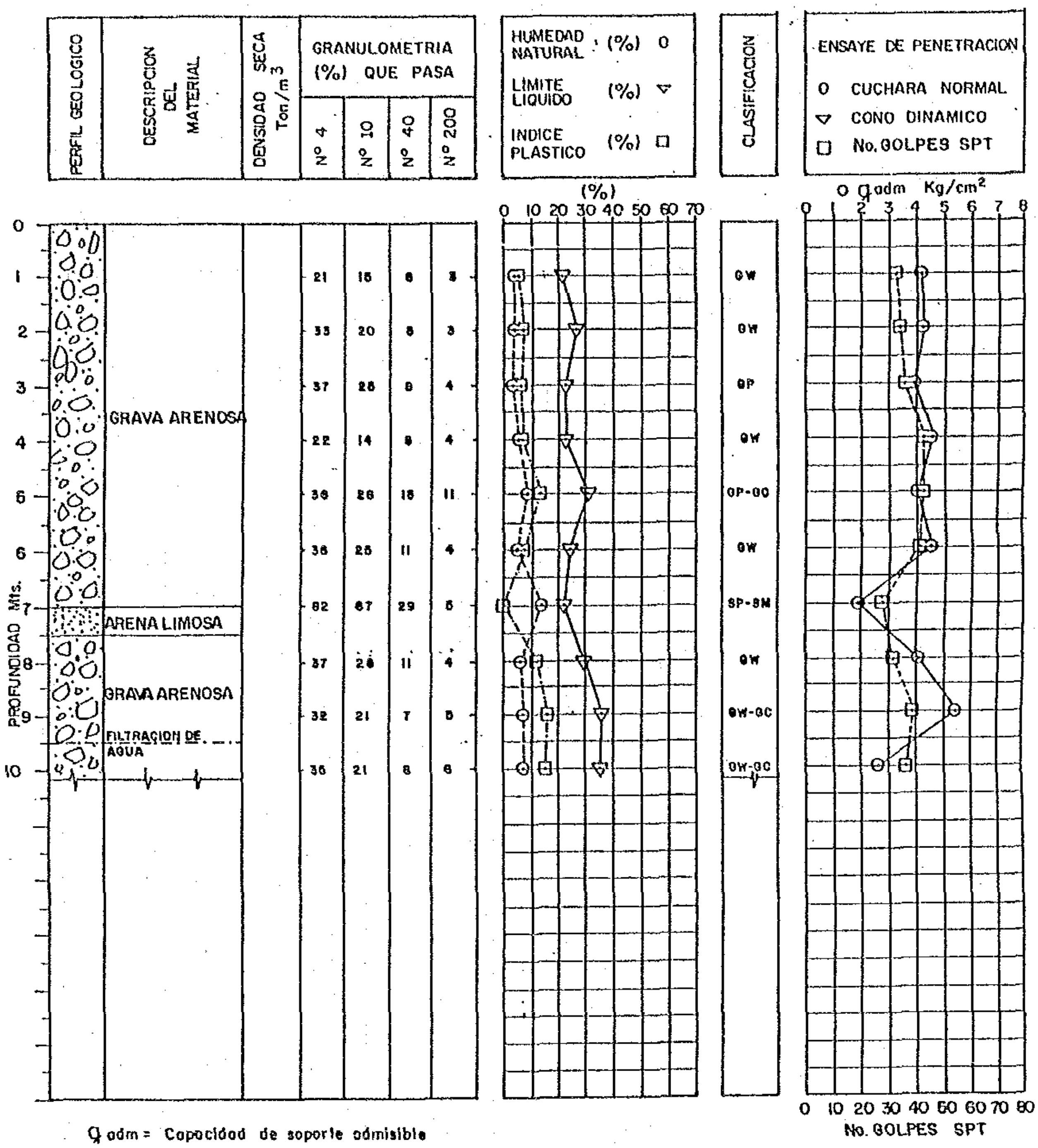
As a result, soil conditions at all depth up to 10 m were nearly same as below:

Classification of soil	:	Gravel
Number of blow in standard penetration test	:	28 to 43

From the above results, this soil condition is considered to be favorable for the foundation of airport architectural structures and no pile will be required.

Table A.4.3.1 Result of Soil Investigation

PROGRESIVA	LADO	POZO No.	PROFUNDIDAD [m]	HUMEDAD NATURAL [%]	GRANULOMETRIA – PORCENTAJE QUE PASA DEL TOTAL 3"	2"	1.5"	1"	3/4"	3/8"	No 4	No 10	No 40	No 200	LL [%]	IP [%]	CLASIFICACION UNIFICADA	CLASIFICACION F.A.A.	PESO ESPECIFICO [Kg/dm3]	DENSIDAD NATURAL [Kg/dm3]	NUMERO DE GOLPES SPT -	TENSION ADMISIBLE [Ton/m2]	C.B.R. DE CAMPO [%]	MODULO DE REACCION DEL SUELO [Kg/cm3]
—	—	DP-1	1.00	3.28	71	55	49	44	38	27	21	15	6	3	21.20	4.09	GW	E-3	2.704	—	32	41.70	—	—
—	—	DP-1	2.00	3.74	88	88	76	70	64	45	33	20	5	3	28.18	6.64	GW	E-4	2.730	—	33	42.10	—	—
—	—	DP-1	3.00	2.89	100	94	86	73	63	49	37	25	8	4	21.96	5.29	GP	E-2	2.770	—	36	39.70	—	—
—	—	DP-1	4.00	4.72	100	81	70	55	45	31	22	14	8	4	22.00	6.32	GW	E-3	2.743	—	43	46.10	—	—
—	—	DP-1	5.00	8.71	100	92	83	73	64	48	36	28	15	11	30.64	11.79	GP-GC	E-5	2.722	—	43	41.20	—	—
—	—	DP-1	6.00	4.54	100	98	94	80	72	48	36	25	11	4	23.71	7.13	GW	E-7	2.744	—	41	45.30	—	—
—	—	DP-1	7.00	12.82	—	—	100	98	96	90	82	67	29	5	20.90	—	SP-SM	E-1	2.699	—	28	18.70	—	—
—	—	DP-1	8.00	6.35	100	83	80	69	59	47	37	26	11	4	29.55	11.22	GW	E-5	2.708	—	31	41.30	—	—
—	—	DP-1	9.00	7.50	92	83	79	69	61	43	32	21	7	5	36.49	16.03	GW-GC	E-5	2.772	—	39	54.60	—	—
—	—	DP-1	10.00	8.24	—	100	95	85	73	51	35	21	8	6	36.21	15.75	GW-GC	E-5	2.754	—	38	27.00	—	—
P.Rodad	Izq.	TP-1	1.50	3.92	80	62	54	48	41	27	21	15	7	4	20.56	3.59	GW	E-3	2.710	2.017	—	—	29	9.51
3+925	Izq.	TP-2	1.50	4.65	100	81	76	68	61	48	38	30	18	12	21.15	4.04	GP-GC	E-2	2.700	2.648	—	—	31	9.76
1.741	Izq.	TP-3	1.50	3.63	100	92	85	71	62	45	32	21	8	4	17.91	3.62	GW	E-2	2.721	2.041	—	—	43	9.45
0+432.5	Izq.	TP-4	1.50	4.49	100	86	79	68	62	48	34	23	10	6	21.85	6.15	GW-GC	E-2	2.699	2.035	—	—	20	11.39



Profundidad (m)	Nº 4	Nº 10	Nº 40	Nº 200	Clasificación
1	21	15	6	3	GW
2	33	20	8	3	GW
3	37	28	9	4	GP
4	22	14	8	4	GW
5	36	26	15	11	GP-GC
6	36	25	11	4	GW
7	82	67	29	5	SP-SM
8	37	26	11	4	GW
9	32	21	7	5	GW-GC
10	36	21	8	6	GW-GC

Figure A.4.3.2 Boring Logs

Appendix 4.4 Results of Pavement Investigation

1. Outline of Pavement Investigation

This investigation consisted of the concrete flexural strength test and the visual investigation of the pavement surface condition.

The core sampling was carried out at the locations shown in Figure A.4.3.1 of Appendix 4.3.

The visual investigation of the pavement surface condition was carried out in terms of the crack and the broken joint.

2. Result of Concrete Flexural Strength Test

The result of concrete flexural strength test is shown in Table A.4.4.1. As shown in this table, concrete flexural strength of existing pavement is more than 49 kg per sq.cm. As a result, existing pavement is considered to still have sufficient strength.

Table A.4.4.1 Concrete Flexural Test

Sample	Diameter	Total Length	Distance Between Supports cm	Breaking Load kg	Flexural Strength kg/cm^2	Remarks
1	8.30	28.0	22.0	500	49.00	Apron
2	8.35	27.6	22.5	510	50.15	Runway 27
3	8.34	22.5	17.5	730	56.03	Slab No. 376
4	8.34	28.0	23.0	800	80.70	Runway 09

3. Result of Visual Investigation of Pavement Surface Condition

The result of visual investigation of pavement surface condition is tabulated as shown in Table A.4.4.2.

In addition to the result shown in Table A.4.4.2, the following was found:

- The runway pavement located at 1,740 m from runway 09 threshold is seriously damaged and requires the improvement as soon as possible.

From the above results, the following was considered about present condition of existing pavement.

- As a whole of the existing pavement, many cracks were found. On the other hand, the bearing strength of the subgrade and flexural strength of cement concrete slab are still favorable as described in Appendix 4.3. Therefore, the cracks appeared on the existing pavement are supposed to have been caused by shortage of pavement thickness to accommodate the large jet aircraft, such as B-747 operating at El Alto airport at present.

Table A.4.4.2 Surface Condition of Existing Pavement

Item	Runway 09 threshold	Runway at 1,740m from 09 threshold	Runway 27 threshold	No. 2 Taxiway	No. 1 Taxiway	Apron
A. Crack						
1. Initial crack	X		X		X	X
2. Corner crack			X		X	
3. Longitudinal crack		X	X			X
4. Transversal crack		X	X		X	X
5. Tortoiseshell crack				X	X	X
6. Flaked		X			X	X
B. Joint						
1. Obsolescence and hardenning of seal	X	X	X	X	X	X
2. Jutting out of seal						
3. Coming off of seal		X				X
4. Broken corner of joint					X	X
5. Oozing out of water			X			X
C. Difference of Level						
1. At joint	-	2mm	2mm	-	8mm	5mm

Note: Mark "X" means "appeared".

CHAPTER 5 ALTERNATIVE AIRPORT MASTER PLANS

CHAPTER 5 ALTERNATIVE AIRPORT MASTER PLANS

5.1 Basic Concepts for Alternative Airport Master Plans

The basic concepts for airport master planning are discussed in this section. The section includes the policy for the improvement of runway slope, clarification related to problems of the existing terminal facilities for future utilization and preparation of alternative terminal area locations.

5.1.1 Improvement of Runway Slope

This section outlines the policy for the improvement of runway 09R/27L, which is a prerequisite for the preparation of airport master plans for El Alto.

As explained in Chapter 4, the runway 09R/27L will satisfy the capacity requirements beyond the year 2005 and its direction is adequately oriented for the cross-wind coverage.

The longitudinal slope of the runway is, however, 1.55 percent which exceeds the maximum slope of 1.0 percent defined in Annex 14, ICAO, thus, requests for the improvement of slope have been submitted by the airline companies operating at El Alto airport. This is the most outstanding deficiency of the runway and the improvement of the slope is considered mandatory in order to ensure safety and efficiency of aircraft operations.

The study provided runway improvement alternatives and made a comprehensive comparison.

(1) Alternatives for Runway Slope Improvement

Four alternatives as shown in Figure 5.1.1 can be considered in order to improve the longitudinal slope of the runway 09R/27L to less than 1.0 percent. These alternatives have the following characteristics:

Alternative - R1: A scheme to improve the existing runway to a longitudinal slope of less than 1.0 percent.

Alternative - R2: A scheme to construct a new runway parallel with and located 150 to 350 meters distant from the existing runway.

Alternative - R3: A scheme to construct a new runway oriented at 110/290 degree in order to decrease the earth work volume quantities.

Alternative - R4: A scheme to construct a new runway utilizing the existing non-paved runway 09L/27R.

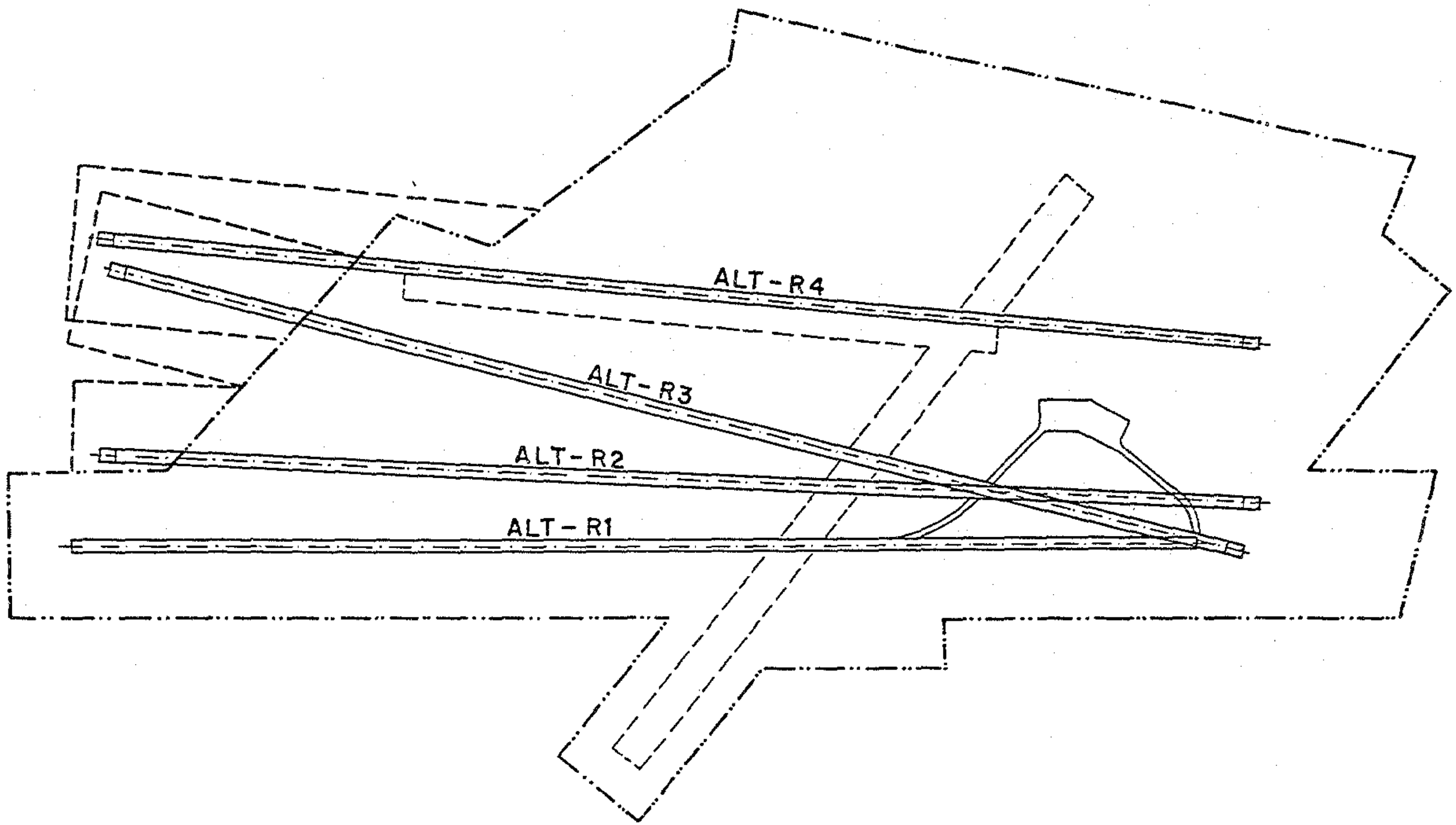


Figure 5.1.1 Runway Alternatives for Improvement of the Longitudinal Slope

(2) Problems of Runway Slope Improvement

A preliminary study has been made on the four alternatives and the results are shown in Table 5.1.1.

The alternatives pose the following problems which are considered substantially impossible to solve.

Although the longitudinal slope of the existing runway 09R/27L does not meet the ICAO requirements, it must be left as it is.

Alternative - R1:	The pavement surface of runway 09R threshold should be raised approx. 30 meter. It is, however, impractical to conduct extensive earth work on the existing runway while operating it 24 hours continuously.
Alternatives - R2 and R4:	Since each runway in these and other alternatives requires connection to the existing taxiway and terminal facilities at the east, no earth cut operations are allowed in the terminal area. For this reason, these alternatives require the same embankment of more than 30 meter at the runway 09 side as Alternative R1. The required earth fill quantities are estimated to be approx. 20 - 22 million cu.m. Alternative R4 requires an additional 62 ha of land acquisition from the already urbanized area regardless of the existing extensive airport property area.
Alternative - R3:	The earth fill quantitites are estimated to be approx. 7 million cu.m. This scheme requires an additional 47 ha of land acquisition from the already urbanized area.

Table 5.1.1 Comparison of the Alternatives for Runway Slope Improvement

Item	Alternatives			
	R1	R2	R3	R4
1. Influence on the present airport operations	Very Severe(Consruction is considered almost impractical)	Small	Small	Small
2. Maximum height of embankment (approximately)	30 m	30 m	30 m	30m
3. Quantity of embankment	19 Million m3	22 Million m3	7 Million m3	20 Million m3
4. Area of land acquisition (urban area)	Nil	17 ha.	47 ha.	62 ha.
5. Quantity of asphalt concrete mix for runway overlay	2.7 Million m3	Nil	Nil	Nil
6. Influence of aircraft noise	RWY 27 Side: Same as existing RWY 09 Side: Same as existing	RWY 27 Side: Same as existing RWY 09 Side: Extended to the urbanized area		
7. Others			The required area compete with Seco river	The required area compete with Seco river
8. Cost required for embankment, land acquisition and runway overlay(Unit:Million US$) Embankment: Land acquisition: Runway overlay:	 285 - 540	 330 1.7 -	 105 4.7 -	 300 6.2 -
Total:	825	332	110	306

(3) Conclusion for Improvement of the Longitudinal Slope

Although the results of the comparative study in Table 5.1.1 show that Alternative - R3 is the most preferable among the four alternatives, it has the following major problems:

- Land acquisition of a 47 ha urbanized area is necessary.

- US$110 million is required just for the improvement of the runway slope, which is prohibitive because this amount is more than 70 % of the overall construction cost for the airport development of approx. US$150 million considering the use of the existing runway without slope improvement.

- The US$110 million stated above is required for the Phase I development.

As recognized based on the necessary cost required for the runway slope improvement, these problems substantially influence the basic policy of airport development in terms of investment efficiency.

The existing runway has been used for more than 20 years with 1.55 percent slope, however and no capacity problem is foreseen for the next few decades even if preferential runway operations are continued.

The use of the existing runway without slope improvement is therefore judged to be the most practical solution.

5.1.2 Problems of the Existing Terminal Facilities

Utilization of the existing terminal facilities is a key factor for the preparation of the airport master plans. Among the existing terminal facilities, the existing passenger terminal building and apron particularly have several problems related to future utilization. These problems are clarified in this section and the results will be incorporated in the alternative airport master plans.

a) No GSE access road is provided between the apron and the building. The GSE access road should be established on the edge of the apron in order to permit efficient ground service activities.

b) There is a 1.5 meter difference in elevation between the apron surface and the ground floor of the passenger terminal building. Accordingly, large trucks must be used for baggage handling at present.

Although this difference should be corrected in order to use the standard tag-cars, which can realize efficient baggage handling, it is impractical to correct as explained in the item f) below.

c) The existing terminal building was constructed 20 to 35 years ago and it is extremely obsolescent.

Mechanical, electrical and plumbing systems parcicularly are obsolete and involve many problems in operations and maintenance. Major improvement works for these systems would be required in order to utilize the existing passenger terminal building. The construction cost of such systems usually accounts for 40 percent of the total cost of a new terminal building construction as listed below:

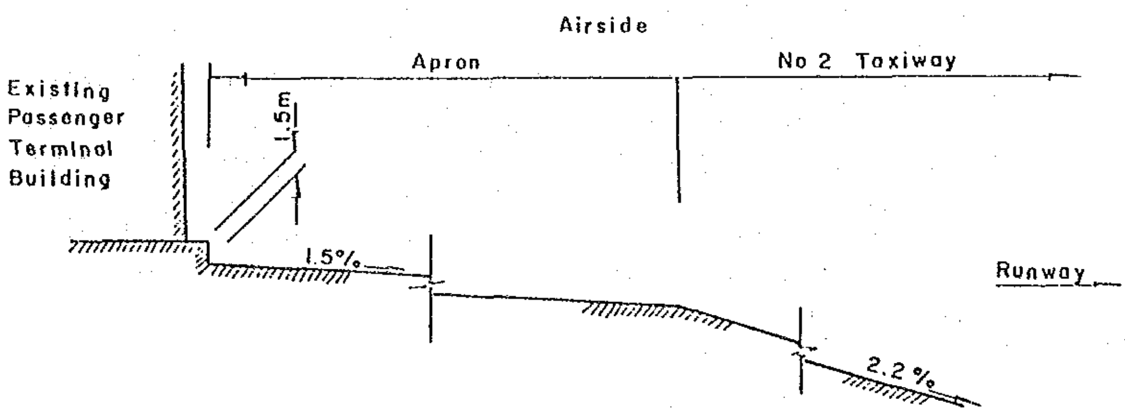
- Building structure	= 25 %
- Exterior and interior finish	= 35 %
- Electrical, mechanical, plumbing systems	= 40 %
T o t a l	= 100 %

If the modernization of the building could be made as a full scale renovation of the existing building including extension and interior finish, approx. 75 percent of the cost necessary for the construction of a new building would be required.

d) Most of the air navigation systems are obsolete and operation rooms including the control tower and area control center, etc. are insufficient with regard to space requirement. Major improvement of these sytems and operation rooms are required, thus, a complete operations/administrations building together with aeronautical equipment would be necessary.

e) There is basement floor on the western two-third area of the building. Reinforcement of the floor slab on the ground floor will be required if the building is converted to a cargo terminal building.

f) The pavement surface of the apron has a 1.5 percent down slope toward the runway and the No.2 taxiway has a longitudinal down slope of 2.2 percent toward the runway.



If the apron and taxiway slopes are corrected to meet the figures recommended by ICAO, the difference in elevations between apron surface and floor level of the building will increase. The correction of the apron slope will therefore be difficult.

5.1.3 Location of Terminal Area

(1) Layout of Existing Airport Facilities

The entire airport property area of 850 ha is owned by AASANA.

In this area, the airport facilities for both civil aviation and Bolivian air force are accommodated. The facilities for the air force are located north of the non-paved runway 09L/27R. The boundary line between the civil aviation area and the air force area is not established and is not scheduled to be established in the future.

The area between runways 09L/27R and 09R/27L is used for the terminal facilities for civil aviation, the meteorological station and a general aviation hangar. The remaining area is wide and is not in use.

AASANA has a housing plan for its staff at the northwest part of the airport property area.

(2) <u>Location of Future Terminal Area</u>

The effective use of the area between runways 09L/27R and 09R/27L shown in Figure 5.1.2 for the future terminal area is justified for the following reasons:

- There is enough space for future terminal facility development.

- This area is located on the north side of the main runway just the same as the existing terminal area. This location is therefore adequate for the connection between the new and existing terminal facilities and also for the effective use of the existing terminal facilities.

- The terminal development plan at this location does not require relocation of the existing main facilities of the air force.

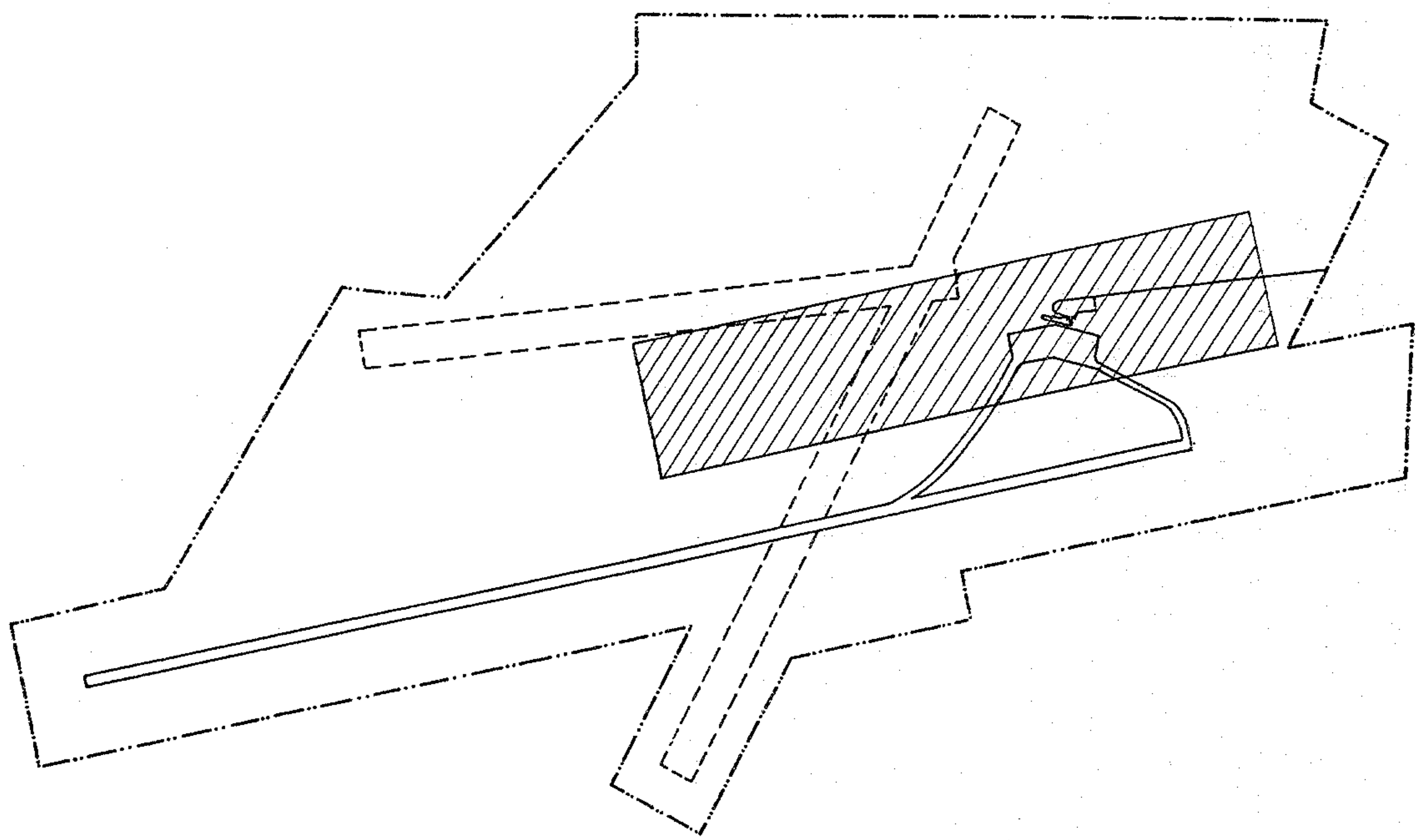


Figure 5.1.2 Location of Terminal Area Development

5.2 Runway and Runway Strip

The existing runway will be utilized without slope improvement as discussed in Section 5.1.1. Nonpaved runways 09L/27R and 04/22 are considered adequate to close for the following reasons:

- Runways 09L/27R and 04/22 conflict with the terminal area development and are preferred to be demolished to permit future terminal area expansion.

- Runway 09R/27L will satisfy the capacity requirements beyond the year 2005 and no complete parallel runway is required. No advantage to develope the runway 09L/27R has been identified. (Discussion for parallel taxiway is given in Section 5.3)

- The actual number of aircraft operations on runways 09L/27R and 04/22 is limited and the movements are negligible compared with those of runway 09R/27L.

- Runway 04/22 does not contribute to improvement in the cross-wind coverage.

Necessary improvements for runway 09R/27L are listed as follows:

- Construction of turning pad at the end of runway 09, which is designed for B-747.

- Construction of 120 m long blast pad at each end of the runway.

- Provision of runway end safety areas beyond each end of the runway strip. (90 m in length and 92 m in width)

- Strengthening of runway pavement.

- Provision of 7.5 m wide shoulders on each side of the runway.

For the runway strip, the following improvements are required.

- The existing runway strip 4,090 m long and 300 m wide should be extended to 4,120 m to comply with ICAO recommendations.

- Many rocks scattered on the runway strip should be removed from the area in order to mimimize the damage to aircraftrunning off the runway.

5.3 Taxiways

The hourly capacity of the runway with the existing taxiway system is estimated to be more than 15 operations as shown in Table 4.1.7. Peak hour aircraft movements on the design day of year 2005 are estimated to be 13 and lower than the existing runway capacity. The improvement of the existing taxiway system for the purpose of increasing the runway capacity therefore is not required based on the above estimation.

The hourly capacity listed in Table 4.1.7 however was calculated based on the assumption that an aircraft starts landing or takeoff operation at an ideal time separation. Aircraft delay cannot therefore be avoided even if the aircraft movements are less than hourly capacity. These situations are observed even at present.

For planning the taxiway system, two alternatives are considered based on aircraft operational efficiency and safety.

Alternative - T1: A scheme to provide another exit taxiway at RWY09 end and a partial parallel taxiway (in Figures 5.3.1 and 2).

These taxiways are planned to relieve the congestion on No.1 taxiway and apron taxiway which are presently utilized bidirectionally under preferential runway operations as illustrated in Figure 5.3.3. These operations account for more than 90% of annual and RWY 09 LDG/RWY 27 TKOF (east wind) operations.

Alternative - T2: A scheme to provide a complete parallel taxiway in order to improve runway capacity under RWY 27 LDG/RWY 27 TKOF (west wind) and RWY 09 LDG/RWY 27 TKOF (east wind) operations.

Although Alternative-T2 can considerablly improve the hourly capacity of the runway, these runway operations account for less than 10% of the annual operations and the construction cost is approximately twice as high as Alternative-T1.

It is recommended therefore to choose Alternative-T1 considering the importance of operational safety for increased aircraft movements in the future.

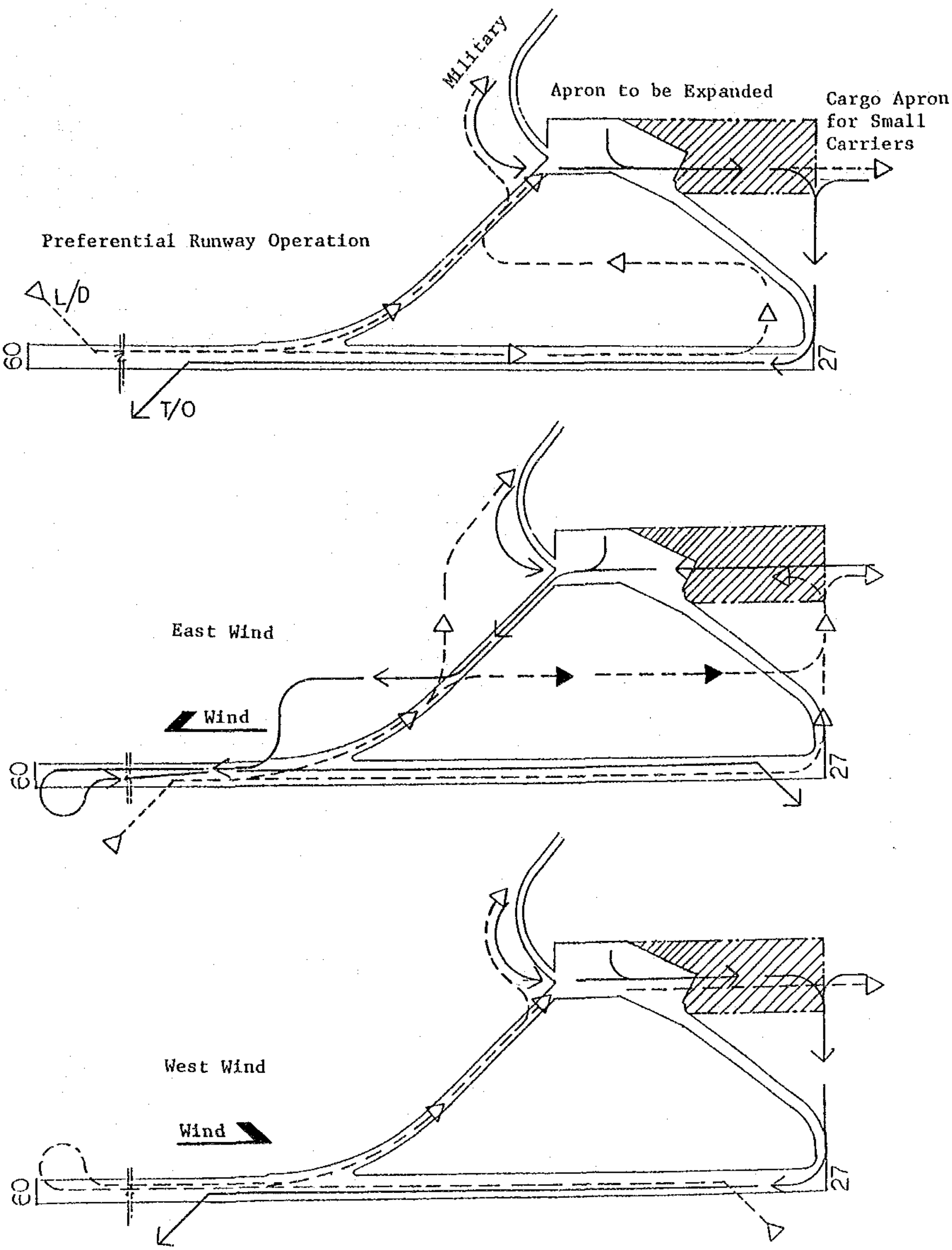


Figure 5.3.1 Taxiing Flow
(Case-1: Apron to be Expanded to the East)

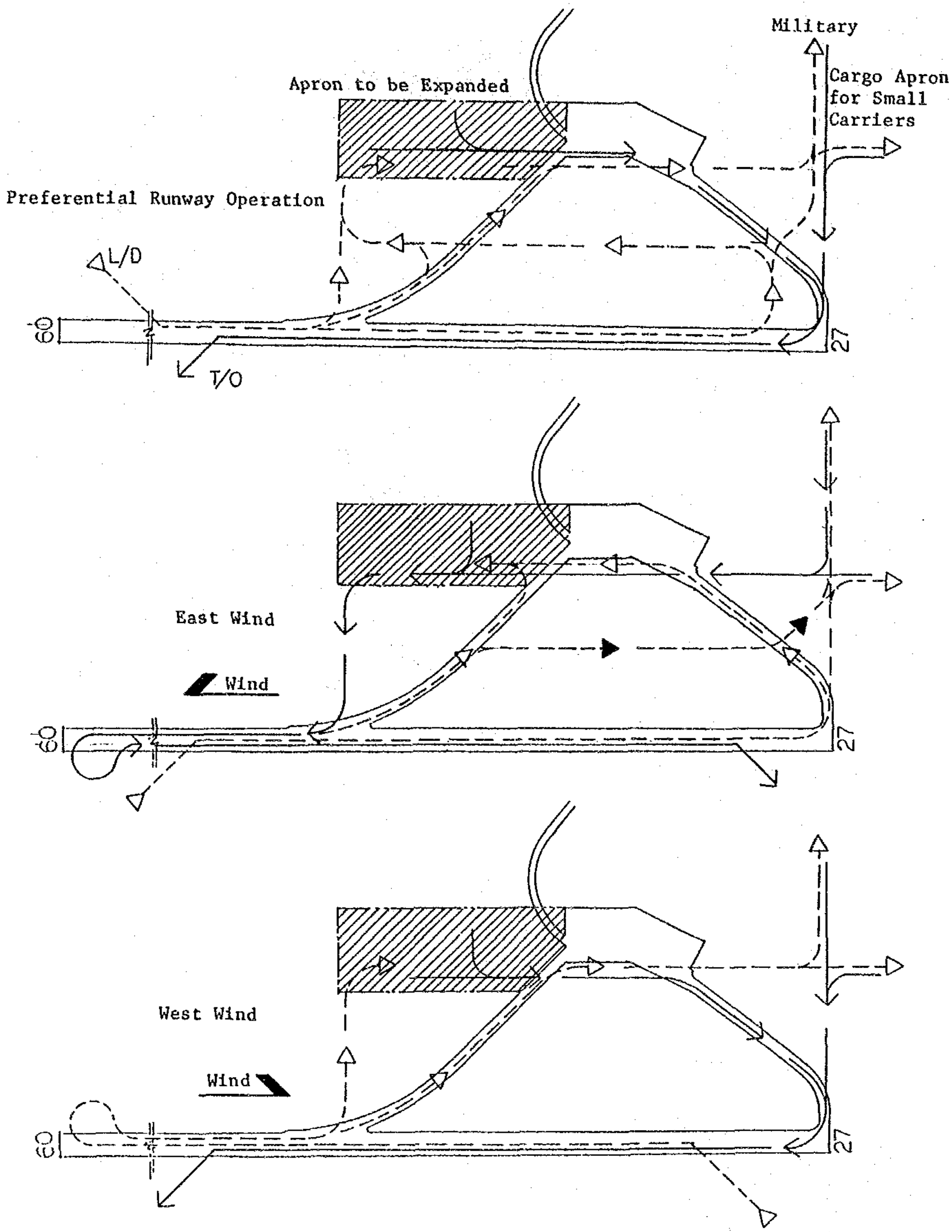
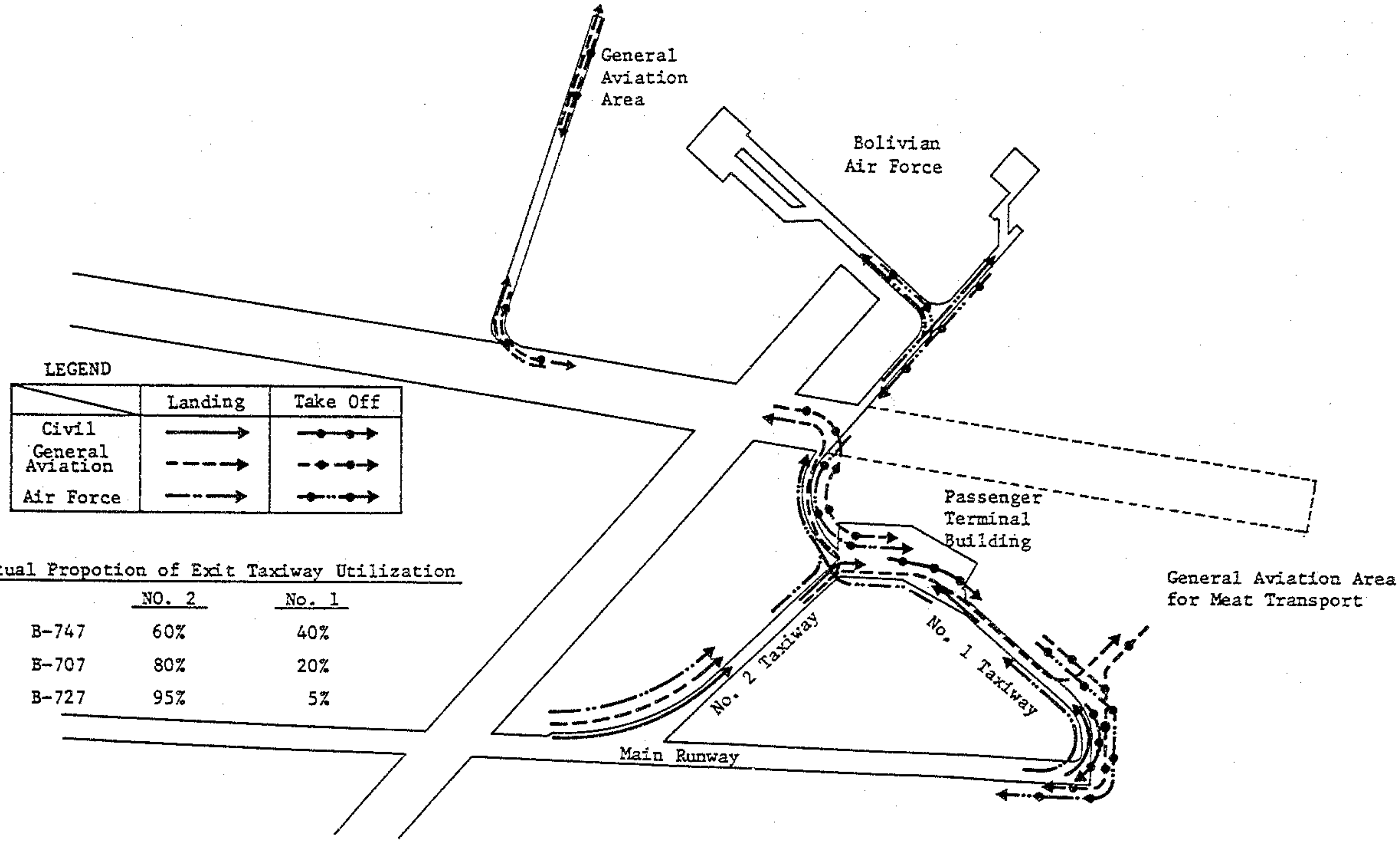


Figure 5.3.2 Taxiing Flow
(Case-2: Apron to be Expanded to the West)



Actual Propotion of Exit Taxiway Utilization

	NO. 2	No. 1
B-747	60%	40%
B-707	80%	20%
B-727	95%	5%

Figure 5.3.3 Existing Taxiway Utilization under Preferential Runway Operations

Other than addition of a runway end exit planned in Alternative-T1, two rapid exits are considered necessary in order to minimize the runway occupancy time and to permit rapid access to the terminal for landing aircraft. The location of these taxiways are determined based on FAA criteria as shown in Table 4.1.14.

5.4 Terminal Area Layout Plan

5.4.1 Basic Conditions for Terminal Area Layout

The following points should be considered as basic conditions for the terminal area layout plans.

(1) Taxiway Layout

In Section 5.3 Taxiways, it was stated that a one directional operation is planned in order to avoid taxiway congestion caused by bidirectional operation and also based on a consideration of operational safety.

(2) Control Tower

The control tower should have adequate height to realize the pavement surface at RWY 09 threshold. In compliance with this requirement, the necessary height of the tower at the existing location is 40.5 m, which is approximately, 1.9 times the height of the existing control tower.

(3) Cargo Apron for Small Carriers

Existing cargo apron for small carriers is considered adequate to accommodate the small carriers for meat transport up to the year 2005.

(4) Criteria for Facility Layout

The facility layout has been planned in accordance with ICAO Standards or Recommendations, related particularly to the physical characteristics required for facilities.

5.4.2 Alternative Concepts for Terminal Area Layout

The location of a future terminal area was studied and described in Section 5.1 and shown in Figure 5.1.2. In this section, the concept for terminal facility development in this area, which is characterized by the utilization of the existing facilities, is discussed.

The area studied which is described in Section 5.1, includes various existing facilities. Some of them can be used continuously in the future with improvement work and others should be modified for other functions.

A concept which is aimed at the effective utilization of the existing facilities should therefore be considered to provide the most cost-effective planning.

The existing facilities, however, are obsolete and to some extent have defects related to the maintenance of airport functions. They also do not meet the ICAO criteria and their modification to meet these standards will not be easy. Consequently, another concept which upgrades most of the terminal facilities should be considered.

In this study, the following three alternative concepts are presented based on the degree of utilization of the existing facilities.

- Concept for effective utilization of existing facilities
  - Alternative - TA
    Maximum utilization of existing facilities
  - Alternative - TB
    Partial utilization of existing facilities
- Concept for upgrading most of the terminal facilities
  - Alternative - TC

5.4.3 Alternative Terminal Area Layout Plans

Six alternative terminal area layout plans have been prepared based on the concepts described in the previous section of this study. They are presented in the following airport master plan figures.

Alternative Concepts	Alternative Layout Plans	Master Plan Figures
Alternative - TA	Alternative - TA1	Fig 5.3.1 in Main Report
Alternative - TB	Alternative - TB1	Fig 5.3.2 in Main Report
	Alternative - TB2	Fig 5.3.3 in Main Report
Alternative - TC	Alternative - TC1	Fig 5.3.4 in Main Report
	Alternative - TC2	Fig 5.3.5 in Main Report
	Alternative - TC3	Fig 5.3.6 in Main Report

(1) Alternative Terminal Area Layout Plan - TA1

a) The existing passenger terminal building will be used for one part of the domestic passenger terminal building. The international terminal and the remaining domestic facilities will be accommodated in a new building which will be constructed as an expansion of the existing building. Arrival facilities and a portion of the gate lounge will be moved to the new building.

b) The existing passenger terminal building will be utilized in the following manner:

- The international and domestic check-in lobby and check-in counters (1F) will be used for a domestic check-in lobby and check-in counters respectively.

- The international gate lounge and CIQ facility space (ground floor) will be converted to a domestic gate lounge

- The first floor offices will be used for offices, meeting rooms, canteen, storage, etc. for Airlines, CIQ, AASANA, etc.

c) The grades of the existing apron and No.2 taxiway (1.5 % and 2.2 % respectively) and 1.5 m difference in elevation between the existing building and the apron will not be changed.

d) The existing apron will be used as a self-manoeuvering area for the aircraft, as existing at the present time. No boarding bridge is therefore planned.

(2) <u>Alternative Terminal Area Layout Plan - TB1</u>

a) The new passenger terminal area will be located adjacent to the west end of the existing area.

b) The passenger terminal building will accommodate both domestic and international facilities. Since the present LAB operations for mixed flights are expected to continue in the future, this building plan will permit the easy handling of passengers from/to mixed flights.

c) The existing passenger terminal building will be expanded and modified in the following manner so that it can be utilized as a cargo terminal building.

- The existing departure lobby and check-in lobby will be utilized for storage. The ceiling height in this area is 4.7 m and is considered sufficient for operation of forklifts, etc.

- The existing international departure facilities (ground floor) and offices (1st floor) will be used for offices, meeting rooms, canteen, storage space for airlines, CIQ, AASANA, etc.

- The existing cargo building will be expanded in both the east and west directions, and these expanded areas will accommodate both international and domestic cargo handling facilities respectively. The floor level of the expanded areas will be the same as that of the apron, for efficient cargo handling.

(3) <u>Alternative Terminal Area Layout Plan - TB2</u>

The existing terminal building will be utilized as follows:

- Head office for AASANA
- Storage and equipment workshop for AASANA
- Offices and storage for airlines
- Offices for general aviation companies
- Garage for AASANA
- Other uses

(4) Alternative Terminal Area Layout Plan - TC1

This plan is as described in Section 5.3 in the Main Report.

(5) Alternative Terminal Area Layout Plan - TC2

This plan is as described in Section 5.3 in the Main Report.

(6) Alternative Terminal Area Layout Plan - TC3

Alternative concept-TC consists of a plan for new construction of all airport terminal facilities except for the runway. This concept therefore should have sufficient expansion potential to meet the long term passenger demand after year 2005, considering economics.

CHAPTER 6 EVALUATION COMPARISON FOR ALTERNATIVE AIRPORT MASTER PLANS

CHAPTER 6 EVALUATION COMPARISON FOR ALTERNATIVE AIRPORT MASTER PLANS

6.1 Relative Comparison

(1) Convenience for Airport Users

a. Passenger Convenience

With regard to passenger convenience, there is little difference among the five alternatives except for Alternative-TA1 which has the disadvantages mentioned below:

In Alternative-TA1, a domestic departure lobby will be provided in the existing passenger terminal building. In order to install the boarding bridges from the existing building, a corridor must be constructed on the apron side and large-scale upgrading of the building is also necessary. Taking obsolescence of the building into account, however, installation of boarding bridges which is a much more costly upgrading of the building is not recommended as the most economical. Boarding bridges will therefore not be provided. As a result, the domestic passenger will continue to be inconvenienced as they are at present.

b. Efficiency of Airline Operations

The efficiency of airline operations are quantified based on the aircraft taxiing distance from runway to apron and vice versa, and also judged by aircraft taxi flow. The taxiing distance and flow under preferential operation is summarized in Table 6.2.1 in Main Report. For the reduction of taxiing distance, it is desirable for the apron to be located to the east and close to the runway 27 threshold. With regard to the taxiing distance for passenger aircraft, Alternatives-TA1 and TC1 are considered excellent, and Alternatives-TB1, TC2 and TC3 are good. With respect to taxi flow, Alternatives-TC1, TC2 and TC3 in which all taxiways are constructed new are considered excellent.

c. Efficiency of Airport Operation

It is desirable for good airport operations that the terminal facilities viz. passenger terminal, cargo terminal, administration facility, etc. are located close together in order to facilitate communication between them and supplement each of their functions with each other. In order to ensure the future expansion potential for these facilities, their layout should be separated to a certain extent.

Alternative-TB2 has disadvantages because the terminal facilities will be more separated compared with the other alternatives. Alternative-TC3 is also slightly less favorable in this respect.

(2) Expansion Potential

Since the existing El Alto airport has ample space for the new terminal, alternatives other than Alternative-TA1 have been prepared in order to maintain flexibility and to cope with the unexpected demand and any other possible future facility requirements. Although Alternative-TA1 has adequate space to accommodate the forecast demand up to the year 2005, it will be difficult to cope with any unexpected demand because the terminal area is limited due to the connecting taxiway for the military which must be relocated.

The five alternatives other than Alternative-TA1 have a greater potential for expansion as discussed above.

(3) Construction Considerations

The major differences in the construction scope of work among the alternatives are as follows:

- Necessity, quantity, the period of night work which will be required for the pavement overlay in order to carry out the construction without interruption of airport operations.

- Construction period required for the temporary facilities during the period of the original construction if new terminal facilities are planned at the same location as the existing facilities.

Although all alternatives require a pavement overlay on the existing runway, Alternatives-TB1 and TB2 also require it on the existing taxiway, and Alternative-TA1 also requires it in addition on the existing taxiway and the apron. Only Alternative-TC1 requires a temporary passenger terminal building and an additional time period of one year for the temporary building construction in the Phase I development.

Alternatives-TC2 and TC3 are therefore considered superior to the other alternatives because they require neither much work at night nor temporary facilities which are necessary for the other alternatives.

(4) Economy in Project Cost

The preliminary project cost estimated for the alternatives is shown in Table 6.2.1 in the Main Report. The breakdown of the project cost is shown in Appendix 6.1. The cost for Alternative-TC1 is the highest among the alternatives because a temporary terminal building will be required. Although the cost for Alternative-TA1 is lowest, however, its cost does not differ greatly from the cost for the other alternatives.

Alternatives-TC2 and TC3 are therefore considered relatively superior to the other alternatives except for Alternative-TA1.

Note: The cost of TC-3, which is selected as a most suitable master plan, shown in Table A.6.1.6 is revised in Chapter 12 based on the preliminary design for Phase I development. The cost of Phase I development in finally estimated to be 138 million US dollars based on 1987 prices as shown in Appendix 12.1.

(5) Other Considerations

A simple layout for the terminal facilities will make it possible for airport users to gain access to the facilities easily and will convey a comfortable atmosphere to them. In this respect Alternatives-TB2, TC1, TC2 and TC3 are superior to the other alternatives.

Although the existing passenger terminal building is very obsolete it will remain and be used for some purposes if Alternatives-TB2, TC2 and TC3 are considered. In terms of use, it can be used as the head office for AASANA and this diversion will save the cost of rental charges paid for the existing head office.

Appendix 6.1 Estimated Project Cost for Six Alternatives

Project cost for six alternatives are estimated as shown in Tables A.6.1.1 through 6.

Table A.6.1.1 Estimated Project Cost for Alternative-TA1

Exchange Rate: US$1.00=Bs1.95=¥150
(As of March, 1987)
Cost estimate based on 1987 prices

Unit: US$1,000

Item		Phase I	Phase II	Total
Land Acquisition and Compensation		-	-	-
Temporary Terminal Facilities		-	-	-
Civil Works		49,320	9,170	58,490
Architectural Works including Electrical and Mechanical		40,210	16,770	56,980
Air Navigation Systems		24,670	10,410	35,080
Airport Utilities		2,630	1,430	4,060
General Services *1		1,890	670	2,560
Other Facilities *2		2,580	670	3,250
Sub-total	(1)	121,300	39,120	160,420
Construction Supervision	(1)x10% (2)	11,700	3,880	15,580
Total Construction Cost	(1)+(2) (3)	133,000	43,000	176,000
Engineering Services *3	(1)x10% (4)	12,000	4,000	16,000
Sub-total	(3)+(4) (5)	145,000	47,000	192,000
Contingency	(5)x10% (6)	14,000	5,000	19,000
Total Project Cost	(5)+(6)	159,000	52,000	211,000

Note, *1: Including rescue and fire fighting vehicles
*2: Including boarding bridge, CIS and ASS, and lighting for apron, car parking and road
*3: Including basic design, detailed design and preparation of tender documents

Table A.6.1.2 Estimated Project Cost for Alternative-TB1

Exchange Rate: US$1.00=Bs1.95=¥150
(As of March, 1987)
Cost estimate based on 1987 prices

Unit: US$1,000

Item		Phase I	Phase II	Total
Land Acquisition and Compensation		-	-	-
Temporary Terminal Facilities		-	-	-
Civil Works		52,670	8,130	60,800
Architectural Works including Electrical and Mechanical		40,970	16,770	57,740
Air Navigation Systems		24,670	10,410	35,080
Airport Utilities		2,630	1,430	4,060
General Services *1		1,890	670	2,560
Other Facilities *2		3,900	1,330	5,230
Sub-total	(1)	126,730	38,740	165,470
Construction Supervision	(1)x10% (2)	12,270	4,260	16,530
Total Construction Cost	(1)+(2) (3)	139,000	43,000	182,000
Engineering Services *3	(1)x10% (4)	13,000	4,000	17,000
Sub-total	(3)+(4) (5)	152,000	47,000	199,000
Contingency	(5)x10% (6)	15,000	5,000	20,000
Total Project Cost	(5)+(6)	167,000	52,000	219,000

Note, *1: Including rescue and fire fighting vehicles
*2: Including boarding bridge, CIS and ASS, and lighting for apron, car parking and road
*3: Including basic design, detailed design and preparation of tender documents

Table A.6.1.3 Estimated Project Cost for Alternative-TB2

Exchange Rate: US$1.00=Bs1.95=¥150
(As of March, 1987)
Cost estimate based on 1987 prices

Unit: US$1,000

Item		Phase I	Phase II	Total
Land Acquisition and Compensation		-	-	-
Temporary Terminal Facilities		-	-	-
Civil Works		51,020	9,970	60,990
Architectural Works including Electrical and Mechanical		41,970	16,770	58,740
Air Navigation Systems		24,670	10,410	35,080
Airport Utilities		2,630	1,430	4,060
General Services *1		1,890	670	2,560
Other Facilities *2		3,900	1,330	3,250
Sub-total	(1)	126,080	40,580	166,660
Construction Supervision	(1)x10% (2)	12,920	3,420	16,340
Total Construction Cost	(1)+(2) (3)	139,000	44,000	183,000
Engineering Services *3	(1)x10% (4)	13,000	4,000	17,000
Sub-total	(3)+(4) (5)	152,000	48,000	200,000
Contingency	(5)x10% (6)	15,000	5,000	20,000
Total Project Cost	(5)+(6)	167,000	53,000	220,000

Note, *1: Including rescue and fire fighting vehicles
*2: Including boarding bridge, CIS and ASS, and lighting for apron, car parking and road
*3: Including basic design, detailed design and preparation of tender documents

Table A.6.1.4 Estimated Project Cost for Alternative-TC1

Exchange Rate: US$1.00=Bs1.95=¥150
(As of March, 1987)
Cost estimate based on 1987 prices

Unit: US$1,000

Item		Phase I	Phase II	Total
Land Acquisition and Compensation		-	-	-
Temporary Terminal Facilities		5,720	-	5,720
Civil Works		46,110	10,320	56,430
Architectural Works including Electrical and Mechanical		43,040	16,770	59,810
Air Navigation Systems		24,670	10,410	35,080
Airport Utilities		2,630	1,430	4,060
General Services *1		1,890	670	2,560
Other Facilities *2		3,900	1,330	3,250
Sub-total	(1)	127,960	40,930	168,890
Construction Supervision	(1)x10% (2)	13,040	4,070	17,110
Total Construction Cost	(1)+(2) (3)	141,000	45,000	186,000
Engineering Services *3	(1)x10% (4)	13,000	4,000	17,000
Sub-total	(3)+(4) (5)	154,000	49,000	203,000
Contingency	(5)x10% (6)	15,000	5,000	20,000
Total Project Cost	(5)+(6)	169,000	54,000	223,000

Note, *1: Including rescue and fire fighting vehicles
*2: Including boarding bridge, CIS and ASS, and lighting for apron, car parking and road
*3: Including basic design, detailed design and preparation of tender documents

Table A.6.1.5 Estimated Project Cost for Alternative-TC2

Exchange Rate: US$1.00=Bs1.95=¥150
(As of March, 1987)
Cost estimate based on 1987 prices

Unit: US$1,000

Item		Phase I	Phase II	Total
Land Acquisition and Compensation		-	-	-
Temporary Terminal Facilities		-	-	-
Civil Works		48,310	8,870	57,180
Architectural Works including Electrical and Mechanical		41,970	16,770	58,740
Air Navigation Systems		24,670	10,410	35,080
Airport Utilities		2,630	1,430	4,060
General Services *1		1,890	670	2,560
Other Facilities *2		3,900	1,330	5,230
Sub-total	(1)	123,370	39,480	162,850
Construction Supervision	(1)x10% (2)	12,630	3,520	16,150
Total Construction Cost	(1)+(2) (3)	136,000	43,000	179,000
Engineering Services *3	(1)x10% (4)	12,000	4,000	16,000
Sub-total	(3)+(4) (5)	148,000	47,000	195,000
Contingency	(5)x10% (6)	15,000	5,000	20,000
Total Project Cost	(5)+(6)	163,000	52,000	215,000

Note, *1: Including rescue and fire fighting vehicles
*2: Including boarding bridge, CIS and ASS, and lighting for apron, car parking and road
*3: Including basic design, detailed design and prepara tion of tender documents

Table A.6.1.6 Estimated Project Cost for Alternative-TC3

Exchange Rate: US$1.00=Bsl.95=¥150
(As of March, 1987)
Cost estimate based on 1987 prices

Unit: US$1,000

Item		Phase I	Phase II	Total
Land Acquisition and Compensation		-	-	-
Temporary Terminal Facilities		-	-	-
Civil Works		48,410	9,380	57,790
Architectural Works including Electrical and Mechanical		41,970	16,770	58,740
Air Navigation Systems		24,670	10,410	35,080
Airport Utilities		2,630	1,430	4,060
General Services *1		1,890	670	2,560
Other Facilities *2		3,900	1,330	5,230
Sub-total	(1)	123,470	39,990	163,460
Construction Supervision	(1)x10% (2)	12,530	4,010	16,540
Total Construction Cost	(1)+(2) (3)	136,000	44,000	180,000
Engineering Services *3	(1)x10% (4)	12,000	4,000	16,000
Sub-total	(3)+(4) (5)	148,000	48,000	196,000
Contingency	(5)x10% (6)	15,000	5,000	20,000
Total Project Cost	(5)+(6)	163,000	53,000	216,000

Note, *1: Including rescue and fire fighting vehicles
*2: Including boarding bridge, CIS and ASS, and lighting for apron, car parking and road
*3: Including basic design, detailed design and preparation of tender documents

CHAPTER 7 SCOPE OF THE PHASE I DEVELOPMENT PROJECT

CHAPTER 7 SCOPE OF THE PHASE I DEVELOPMENT PROJECT

7.1 Construction Items for Immediate Improvement

The contents of the immediate improvement are as follows:

(1) Improvement of Runway Pavement

The existing runway pavement for a length of approximately 1,740m from the runway 09R threshold is seriously damaged. The existing cement concrete pavement in this area therefore must be partially replaced by an asphalt concrete pavement with the required thickness.

(2) Construction of Runway Shoulder and Blast Pads at the Runway Threshold

The existing main runway 09R/27L has no paved shoulders and blast pads at both thresholds. Around this runway, large jet aircraft raise clouds of dust that cause damage to the runway edge lights and engine trouble for following aircraft. In order to solve these problems, the runway shoulders and blast pads must be paved.

(3) Renovation of the Existing Passenger Terminal Building

Since the area handling international passengers in the existing passenger terminal building is very small and is quite crowded, this area must be expanded and renovated using simple relocation so that the passengers can be handled more smoothly and efficiently.