Table 16.2.2 Typical Example of Complete land Uses around Airports

Examples of compatible land uses or developments	ZONE		
	A Unrestricted land uses and developments	B Some restrictions on land uses and developments	C Most land uses and developments not permitted
Agricultural - Crop farming			
Industrial - Machine shop			
Commercial - Warehouse and shipping - Office and banking			
Residential - low density housing			
Public Facilities - Schools			

Notes

1. The length of the bar indicates where the uses might be permitted without restriction in relation to aircraft noise exposure only and excluding other planning considerations. With respect to certain uses, e.g. housing, commercial, a development might be allowed in a zone of a higher restriction when other planning considerations indicate a need, and where suitable building techniques, sound insulation, etc., can reduce the aircraft noise exposure to an acceptable level.

2. In the special cases of activities dependent on speech communication, e.g. schools, or requiring more stringent standards, e.g. certain hospital activities, additional restrictions may be required to take account of absolute noise levels as well as total noise exposure, unless adequate noise reduction can be ensured in the building construction.

3. The zones will require to be defined against a noise exposure scale and in their application will need to take account of local and national needs.

Table 16.2.3 Land-use Compatibility Chart for Aircraft Noise

TABLE 15-2 FAA Noise and Land-Use Compatibility Guidelines

	Yearly day-night average sound level DNL, dB					
	Below 65	65–70	70–75	75–80	80–85	Over 85
Residential use						
Residential other than mobile homes and transient lodgings	Y*	N	N	N	N	N
Mobile home park	Y	N	N	N	N	N
Transient lodgings	Y	N	N	N	N	N
Public use						
Schools	Y	N	N	N	N	N
Hospitals and nursing homes	Y	25	30	N	N	N
Churches, auditoriums, and concert halls	Y	25	30	N	N	N
Government services	Y	Y	25	30	N	N
Transportation	Y	Y	Y	Y	Y	Y
Parking	Y	Y	Y	Y	Y	N
Commercial use						
Offices, business and professional	Y	Y	25	30	N	N
Wholesale and retail—building materials, hardware, and farm equipment	Y	Y	Y	Y	Y	N
Retail trade—general	Y	Y	25	30	N	N
Utilities	Y	Y	Y	Y	Y	N
Communication	Y	Y	25	30	N	N
Manufacturing and production						
Manufacturing, general	Y	Y	Y	Y	Y	N
Photographic and optical	Y	Y	25	30	N	N
Agriculture (except livestock) and forestry	Y	Y	Y	Y	Y	Y
Livestock farming and breeding	Y	Y	Y	N	N	N
Mining and fishing, resource production and extraction	Y	Y	Y	Y	Y	Y
Recreational						
Outdoor sports arenas and spectator sports	Y	Y	Y	N	N	N
Outdoor music shells, amphitheaters	Y	N	N	N	N	N
Nature exhibits and zoos	Y	Y	N	N	N	N
Amusements, parks, resorts, and camps	Y	Y	Y	Y	Y	Y
Golf courses, riding stables, and water recreation	Y	Y	25	30	N	N

*Note:

Y (yes) Land use and related structures are compatible without restrictions.

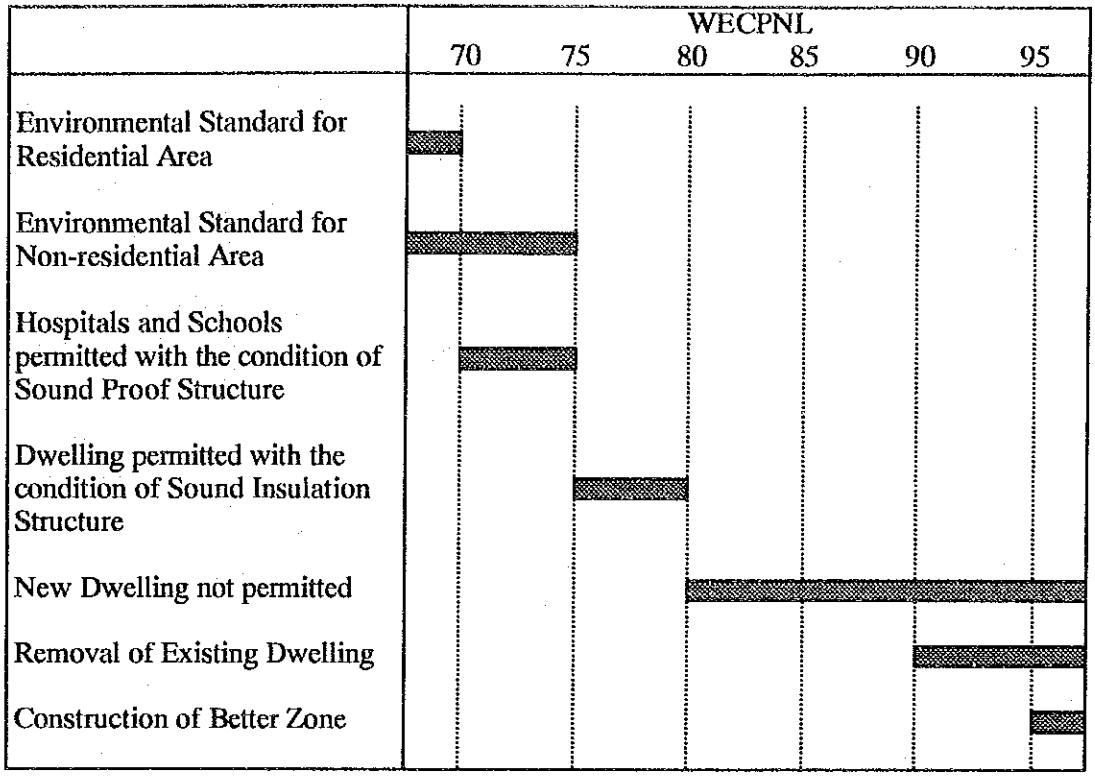
N (no) Land use and related structures are not compatible and should be prohibited.

25, 30, or 35 Land use and related structures generally compatible; measures to achieve outdoor-to-indoor noise level reduction of 25, 30, or 35 dB must be incorporated into design and construction of structure.

There are special provisions pertaining to many of the compatibility designations that are not included here; refer to FAR part 150 [6] for details.

SOURCE: Federal Aviation Administration [36].

Table 16.2.4 Japanese Land Use Control for Aircraft Noise



CHAPTER 17

PROJECT IMPLEMENTATION SCHEDULE AND COST ESTIMATES

CHAPTER 17 PROJECT IMPLEMENTATION SCHEDULE AND COST ESTIMATES

17.1 General

This chapter describes the implementation schedule and cost estimates of the Short-term Modernization plan based on the preliminary design in Chapter 14.

In this study, the Air Safety Improvement Plan is excluded from consideration, as it is not appropriate to be studied in this manner.

17.2 Project Implementation Schedule

The implementation schedule of the Short-term development project is shown in Figure 17.2.1.

The next stage of the project implementation after this Study are the financial arrangements for the project. Other preparatory items to be completed prior to the commencement of the construction work are the engineering services including topographic surveys, soil investigations, basic design and detailed design. Tendering will follow the studies.

The construction work will take approximately three years for completion. As shown in Figure 17.2.1, the construction works are expected to commence early in 1998 and to be completed at the end of 2000.

While the design target year of the Short-term modernization plan is 2003, the proposed facilities will accommodate the air traffic demand up to the years around 2007 or 2008. The level of service will be lowered beyond the year 2003.

17.3 Project Cost Estimates

17.3.1 Assumptions for the Cost Estimates

The costs are estimated based on the following assumptions :

(1) The costs are based on the price index of November 1993.

(2) The exchange rates are 49 Nepal Rupees per US Dollar, 110 Japanese Yen per US Dollar, and 2.3 Japanese Yen per Nepal Rupee.

(3) The costs are estimated in Nepal Rupees.

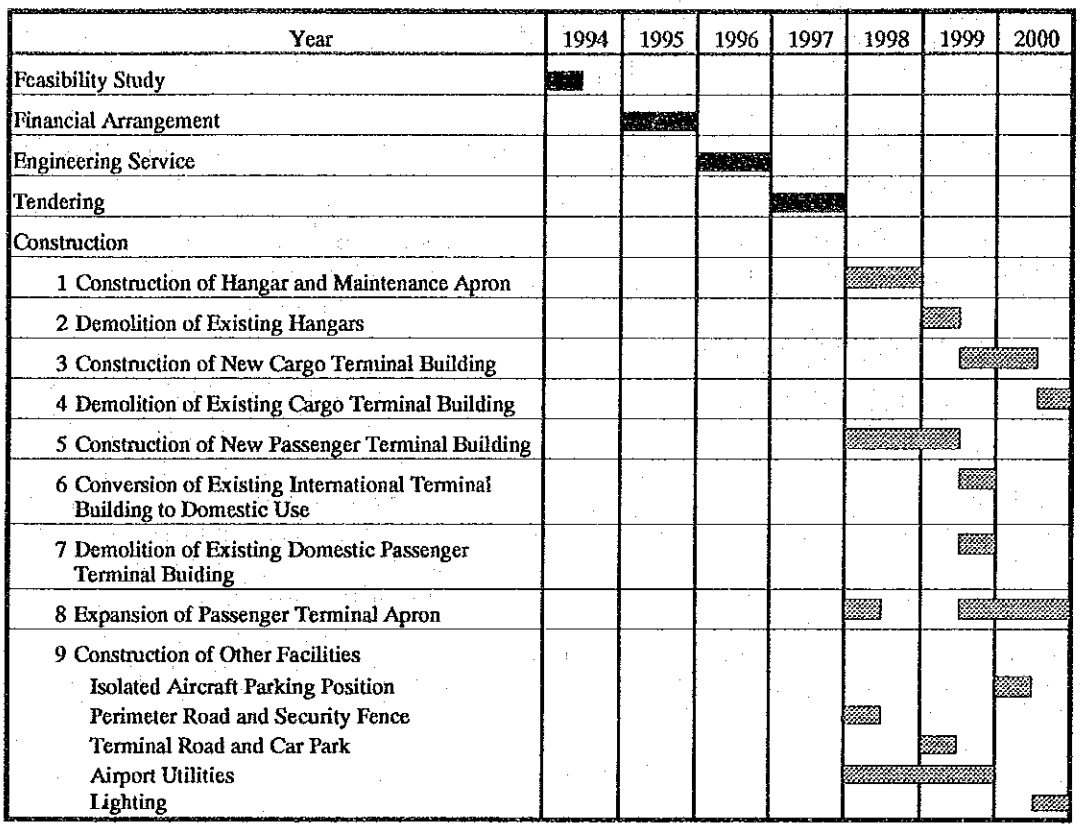
(4) No price escalation is included in the cost estimates because this cost estimate has been made primarily for the economic analysis which is made in current prices.

(5) The facilities to be provided by organizations other than DCA, such as the fuel supply facilities, are not included in the project cost.

(6) The contingency is estimated at about 10% of the construction cost.

(7) The cost of the engineering services consisting of soil investigations, topographical surveys, basic design, detailed design and construction supervision is estimated at 10% of the total construction cost including the above contingency.

Figure 17.2.1 Project Implementation Schedule of Major Works for Ground Facilities Improvement Plan



(8) The foreign currency portion of the project costs includes the following items :
- Procurement costs for the imported materials and equipment
- Procurement costs for the imported construction equipment
- The general expenses and profits for the foreign contractors and engineering firms
- Wages for foreign staff

(9) The Nepali currency portion of the project costs includes the following items :
- Operational costs of the construction equipment including fuel and lubricants
- Procurement costs of the construction materials which are available in Nepal such as most of civil work materials
- Transportation costs for procured materials and labor employed in Nepal
- The general expenses and profits for the Nepali contractors and engineering firms
- Wages for Nepali laborers

17.3.2 Project Cost

The cost of the Short-term modernization plan is shown in Table 17.3.1. The total cost of the project is estimated to be about 7,400 million Rupee (US$ 150 million).

Table 17.3.1 Cost Estimates for the Short-term Modernization Plan of Ground Facilities

Item	Local Portion Amount (US$1,000)	Foreign Portion Amount (US$1,000)	Total Amount (US$1,000)
A. Construction Cost			
1.Civil Works			
a. Passenger Terminal Apron	4,314	16,600	20,914
b. Aircraft Maintenance Apron	414	1,290	1,704
c. Isolated Aircraft Parking Position	772	2,066	2,838
d. Perimeter Road	216	579	795
e. Security Fence	31	83	114
f. Terminal Road and Car Park	307	819	1,126
Sub Total	6,054	21,437	27,491
2. Architectural Works			
a. International Terminal Building	4,875	37,625	42,500
b. Domestic Terminal Building	540	2,160	2,700
c. Cargo Terminal Building	781	5,282	6,063
d. Aircraft Maintenance Hangar	3,900	35,100	39,000
e. Relocation of Royal Enclosure	78	522	600
Sub Total	10,174	80,689	90,863
3. Airport Utilities			
a. Electrical Power Supply	115	2,179	2,294
b. Water Supply	41	785	826
c. Sewage Disposal	440	661	1,101
d. Solid Waste Disposal	18	165	183
Sub Total	614	3,790	4,404
4. Others			
a. Fire Engine	0	1,500	1,500
b. Lighting	129	302	431
Sub Total	129	1,802	1,931
Total Construction Cost	**16,971**	**107,718**	**124,689**
B. Physical Contingency (10% of construction cost)	1,697	10,772	12,469
C. Engineering Services (10% of Items A + B)	1,372	12,344	13,716
Total of Project Cost	**20,040**	**130,834**	**150,874**

Exchange Rate : US$ 1.0 = Rs.49.0 = Yen 109
Rs 1.0 = Yen 2.3

CHAPTER 18

ECONOMIC ANALYSIS

CHAPTER 18 ECONOMIC ANALYSIS

18.1 General

18.1.1 Purpose of the Economic Analysis

This chapter examines the economic feasibility of the Ground Facilities Improvement Plan in the Short-term Modernization Plan.

The main purpose of the economic analysis is to show the effect of the Short-term Modernization Plan for Tribhuvan International Airport (TIA) from the nation's economic well-being viewpoint, and to examine the economic viability of the Project.

The evaluation of quantified economic costs and benefits follows the conventional discounted cash flow methodology in determining the economic internal rate of return (EIRR), net present value (NPV) and benefit cost ratio (B/C ratio).

18.1.2 Basic Assumptions

The following basic assumptions for economic analysis are made:

1) With Project and Without Project

The economic analysis is conducted comparing the project costs and the project benefits between the "With Project" and "Without Project' situations. "With Project" means the implementation of the investment for the proposed Short-term Modernization Plan, and in this case the operation and maintenance costs for the improved airport facilities are disbursed. "Without Project" means the condition without such an investment for airport improvement works, and in this case the operation and maintenance costs for the existing airport facilities are spent.

2) Project Costs

The project cost in the case of the "With Project' stands for the total of construction cost for the Short-term Modernization Plan.

The operation and maintenance costs in the case of the "Without Project' is treated as a negative cost for the "With Project'.

3) Project Benefits

The following quantified project benefits are assumed:

a) Benefits due to accommodation of the overflowing Nepalese domestic passengers
b) Benefits due to accommodation of the overflowing Nepalese international passengers
c) Benefits due to accommodation of the overflowing foreign domestic passengers
d) Benefits due to accommodation of the overflowing foreign international passengers
e) Benefits due to accommodation of the overflowing foreign airline aircraft

4) Incremental Analysis

In this economic analysis, the incremental analysis is made on the basis of the incremental benefits and the incremental costs which are the difference between those in the "With Project" and "Without Project" respectively.

5) Implementation Schedule

The period for the project implementation of the short-term airport modernization plan is programmed during 1996 - 2000, and the inauguration of the Short-term Modernization Plan is scheduled for 2000.

6) Project Life

The project life is assumed to be 25 years after the inauguration of the Short-term Modernization Plan.

7) Life Time of Assets

The life times for the assets are assumed to be 50 years for civil works, 20 years for architectural works and 10 years for equipment/utilities works. The reinvestments for each asset are assumed to be made in accordance with its life time.

At the end of the project life, the residual value (undepreciated value of assets) is treated as a negative cost.

8) Prices

All the costs and benefits are estimated in constant 1993 prices. The standard conversion factor for converting financial prices to economic prices is assumed to be 0.88 for the Project costs on the basis of the report of the previous JICA Study ("Development Study of Civil Aviation in Nepal, 1989, JICA").

9) Exchange Rate

The exchange rate used is assumed to be Rs. 49.0 / US$.

18.2 Traffic Demand Overflow

18.2.1 Airport Capacity Limit for Traffic Demand

According to the results of the traffic demand forecast study and the engineering study, the existing airport facilities in TIA, particularly the passenger terminal facilities are evaluated as follows:

- The international passenger terminal facilities are evaluated to be saturated in 1991.
- The domestic passenger terminal facilities are evaluated to be already saturated at present.

In the case that the airport is not be redeveloped, this will lead to serious saturation conditions in airport operations as a whole. (In this economic analysis, this is defined as "Without Project".)

The implementation of the Short-term Modernization Plan will increase the passenger handling capacity. The new passenger terminal facilities (the inauguration of the new passenger terminal facilities is scheduled for 2000) are designed to accommodate the passenger demand anticipated in 2003. However, it is assumed that if lower levels of operation service are accepted, the planned modernized facilities will be able to endure the passenger demand up to 2005. (This implies "With Project".)

18.2.2 Traffic Demand Overflow

The traffic demand overflow is estimated from the difference between the traffic demand in the "With Project" case (equivalent to that in 2000 and 2005) and that of the "Without Project" case (equivalent to that in 1992 for domestic passengers and that in 1999 for international passengers). It is noted that although the saturation condition has been already reached for the domestic passenger terminal facilities, year 1992 is assumed to be the saturation year from the traffic data available.

Traffic demand overflows for international and domestic passengers and aircraft movements are estimated as shown in Table 18.2.1.

Table 18.2.1 Traffic Demand Overflow

(Passengers: 1,000 persons/year)
(Aircraft: Aircraft movements/year)

	Traffic Demand Projected			Traffic Demand Overflow	
(1) International	1999 (*1) (a)	2000 (b)	2005 (c)	in 2000 (b) - (a)	in 2005 (c) - (a)
Passengers	1,180	1,250	1,570	70	390
Aircraft	9,800	10,200	10,400	400	600
(2) Domestic	1992 (*2) (d)	2000 (e)	2005 (f)	in 2000 (e) - (d)	in 2005 (f) - (d)
Passengers	292	370	450	78	158
Aircraft	14,200	17,100	16,900	2,900	2,700

Note: (*1).... Estimated by interpolation between 1995 and 2000.
(*2).... Although saturation condition has been already involved at present, year 1992 is assumed to be the saturation year from the traffic data available.

18.3 Estimation of Benefits

18.3.1 Benefits Due to Accommodation of the Overflowing Nepalese Domestic Passengers

1) Project Effect

In the "Without Project" case, the overflowing domestic passengers cannot satisfy the necessity for air travel. If the air transport service at Tribhuvan Airport is restricted due to airport capacity saturation, it will bring about frequent disturbances or hampering of business activities in Nepal, and will result in a loss of business opportunities. This means an inefficient usage of national resources and a disadvantage for the national welfare.

The implementation of Project will be beneficial to the overflowing Nepalese domestic business passengers. This benefit will be evaluated by their willingness to pay for their trips. Their willingness to pay for their trips is assumed to be measured by airfare plus departure tax, since an airfare plus departure tax will represent the minimum benefit derived from a business trip.

2) Benefit Estimation

(a) Benefit Calculation

The benefit is calculated by the following equation:

(Number of overflowing domestic passengers) x (Share ratio of Nepalese domestic passengers to total domestic passengers) x (Share ratio of business purpose passengers to total Nepalese domestic passengers) x (Willingness to pay)

(b) Number of Overflowing Domestic Passengers

The numbers of overflowing domestic passengers are assumed to be 78,000 persons in 2000 and 158,000 persons in 2005. (Refer to Table 18.2.1.)

(c) Share Ratio of Nepalese Domestic Passengers to Total Domestic Passengers

According to the analysis results of a passenger interview survey conducted by the Study Team in July 1993, the share ratio of Nepalese domestic passengers to total domestic passengers is estimated to be about 75%. (Refer to Table 18.1 in the Appendix.)

(d) Share Ratio of Business Purpose Passengers to Total Nepalese Domestic Passengers

The share ratio of business purpose passengers to total Nepalese domestic passengers is assumed to be approximately 40%, based on the above interview survey. (As for details of the estimation, refer to Table 18.2 in the Appendix.)

(e) Willingness to Pay

According to the latest air tariffs and recent data of numbers of domestic passengers to major sectors from Kathmandu, the weighted average domestic airfare for Nepalese from/to Kathmandu (one way) is estimated to be approximately Rs. 1,100 per passenger. (As for details of estimation, refer to Table 18.3 in the Appendix.)

The domestic departure tax from Kathmandu is Rs. 50 per passenger. Adding one half of departure tax to the above airfare, the total amount of willingness to pay is assumed to be Rs. 1,125.

(f) Estimated Benefit

Based on the above equations and factors, the benefits due to accommodation of the overflowing Nepalese domestic passengers in the years 2000 and 2005 are estimated to be Rs. 26,325 thousand and Rs. 53,325 thousand respectively.

18.3.2 Benefits Due to Accommodation of the Overflowing Nepalese International Passengers

1) Project Effect

Similarly to the benefits due to accommodation of the overflowing Nepalese domestic passengers, for the overflowing Nepalese international business passengers benefit is expected.

Benefits due to the overflowing Nepalese international business passengers can be quantified by an analogous method as that for domestic business passengers.

Unit benefit per passenger is assumed to be equivalent to the willingness to pay for their trip and is measured by the total of the international airfare and departure tax.

2) Benefit Estimation

(a) Benefit Calculation

The benefit is calculated by the following equation:

(Number of overflowing international passengers) x (Share ratio of Nepalese international passengers to total international passengers) x (Share ratio of business purpose passengers to total Nepalese international passengers) x (Willingness to pay)

(b) Number of Overflowing International Passengers

The numbers of overflowing international passengers are assumed to be 70,000 persons in 2000 and 390,000 persons in 2005. (Refer to Table 18.2.1.)

(c) Share Ratio of Nepalese International Passengers to Total International Passengers

According to the results of the international passenger traffic demand forecast by the Study Team, the share ratio of Nepalese international passengers to total international passengers is estimated to be about 30%. (Refer to Table 18.4 in the Appendix.)

(d) Share Ratio of Nepalese Business Purpose Passengers to Total Nepalese International Passengers

Based on the survey previously mentioned, the share ratio of Nepalese business purpose passengers to total Nepalese international passengers is assumed to be approximately 52%. (As for details of the estimation, refer to Table 18.5 in the Appendix.)

(e) Willingness to Pay

According to the latest international air tariffs (economy class) and recent data of numbers of international passengers to major sectors from/to Kathmandu, the weighted average airfare from/to Kathmandu (one way) is estimated to be approximately Rs. 9,560 per passenger. (As for details of the estimation, refer to Table 18.6 in the Appendix.)

The international departure tax for Nepalese is estimated to be about Rs. 530 per passenger. (For details of the estimation, refer to Table 18.7 in the Appendix.)

Adding one half of the Nepalese departure tax estimated above to the above airfare, the total amount of willingness to pay is assumed to be Rs. 9,825.

(f) Estimated Benefit

Based on the above equations and factors, the benefits due to accommodation of the overflowing Nepalese international passengers in the years 2000 and 2005 are estimated to be Rs. 107,289 thousand and Rs. 597,753 thousand respectively.

18.3.3 Benefits Due to Accommodation of the Overflowing Foreign International Passengers

1) Project Effect

The implementation of the Project will increase foreign currency revenues generated by the overflowing foreign visitors. The foreign currency revenues due to foreign visitors are composed of the following:

a) International airfares paid to Royal Nepal Airlines and the departure tax as international passengers (called as "Benefit 3-1")

The total amount of the above cost is counted as a benefit to Nepal's economy by the Project.

b) Expenses generated other than domestic airfares in Nepal by foreign visitors (called as "Benefit 3-2")

The above costs are possibly counted as a benefit to the Nepal economy with a partial contribution to the Nepal economy by the Project. In this case some contribution factor is assumed for the benefit calculation.

The amount of domestic airfares paid by foreign visitors as domestic passengers is treated as another benefit and described later in the following Section 18.3.4 (as the benefits due to accommodation of the overflowing foreign domestic passengers).

2) Benefit Estimation for "Benefit 3-1"

(a) Benefit Calculation

The benefit is calculated by the following equation:

(Number of overflowing international passengers) x (Share ratio of foreign international passengers to total international passengers) x [(Weighted average international airfare) x (Share ratio of Royal Nepal Airlines to international passengers transportation) + (International departure tax for foreigners) / 2]

(b) Number of Overflowing International Passengers

The numbers of overflowing international passengers are assumed to be 70,000 persons in 2000 and 390,000 persons in 2005. (Refer to Table 18.2.1.)

(c) Share Ratio of Foreign International Passengers to Total International Passengers

According to the results of the international passenger traffic demand forecast by the Study Team, the share ratio of foreign international passengers to total international passengers is estimated to be about 70%. (Refer to Table 18.4 in the Appendix.)

(d) Weighted Average International Airfare

The weighted average international airfare from/to Kathmandu (economy class) is estimated to be approximately Rs. 9,560 per passenger. (Refer to Table 18.6 in the Appendix.)

As for this benefit factor, the following adjustment is taken into account:

- According to recent financial information from Royal Nepal Airlines, the total share ratio of cost items of "fuel" (18%), "depreciation of aircraft" (11%) and the half of the "landing charge" (4%) to total revenue (100%) shows approximately 33%. (In the financial statement, the breakdown to international and domestic is unknown.)

- The above cost items are considered as foreign currency output for Royal Nepal Airlines. The revenue excluding the above costs is considered as a net foreign currency revenue.

- Consequently, for the setting up of the net international airfare, an efficiency factor of 65% is assumed.

(e) Share Ratio of Royal Nepal Airlines to International Passenger Transportation

According to recent data of international passengers related to Kathmandu by major sectors, the share ratio of Royal Nepal Airlines to total international passengers transportation is estimated to be approximately 42%. (As for details of the estimation, refer to Table 18.8 in the Appendix.)

(f) International Departure Tax

The international departure tax for foreigners is estimated to be about Rs. 630 (As for details of the estimation, refer to Table 18.7 in the Appendix.)

(g) Estimated Benefit

Based on the above equations and factors, the benefits due to accommodation of overflowing foreign international passengers in the years 2000 and 2005 are estimated to be Rs. 143,325 thousand and Rs. 798,525 thousand respectively.

3) Benefit Estimation for "Benefit 3-2"

(a) Benefit Calculation

The benefit is calculated by the following equation:

(Number of overflowing international passengers) x (Share ratio of foreign international passengers to total international passengers) x (Expenses generated other than for domestic airfares in Nepal per foreign international passenger) x (Contribution factor for the Project)

(b) Number of Overflowing International Passengers

The numbers of overflowing international passengers are assumed to be 70,000 persons in 2000 and 390,000 persons in 2005. (Refer to Table 18.2.1.)

(c) Share Ratio of Foreign International Passengers to Total International Passengers

According to the results of the international passenger traffic demand forecast by the Study Team, the share ratio of foreign international passengers to total international passengers is estimated about 70%. (Refer to Table 18.4 in the Appendix.)

(d) Expenses Generated Other Than Domestic Airfares per Foreign International Passenger

The average expenses generated other than for domestic airfares in Nepal by foreign international passenger is estimated to be Rs. 14,990, based on the available data from the Nepal Tourism Statistics and the estimated weighted average domestic airfare for foreigners. (As for details of the estimation, refer to Table 18.9 in the Appendix.)

(e) Contribution Factor of the Project

It is considered that the benefits from foreign international passengers is derived by implementation of various projects including the airport modernization project. Therefore, a contribution factor is assumed as below:

(Estimated total investment cost of the Project) / (Planned total development expenditure for the infrastructure sectors related to "Transport and Communication", "Other Economic Services including Tourism" and "Water Resources & Electricity" out of the total development expenditure of the national "Eighth Plan")

The total investment cost of the Project is estimated to be approximately Rs. 7,400 million.

The planned total development expenditure for the infrastructure sectors related to "Transport and Communication", "Other Economic Services including Tourism" and "Water Resources & Electricity" out of the total development expenditure of the national "Eighth Plan" is estimated to be Rs. 58,013 million. (Refer to Table 2.4.2.)

Therefore, the contribution factor is assumed to be 12%.

(f) Estimated Benefits

Based on the above equations and factors, the benefits due to accommodation of the overflowing foreign international passengers in the years 2000 and 2005 are estimated to be Rs. 88,141 thousand and Rs. 491,072 thousand respectively.

18.3.4 Benefits Due to Accommodation of the Overflowing Foreign Domestic Passengers

1) Project Effect

The implementation of the Project will increase foreign currency revenues generated by the overflowing foreign visitors. In this Section, the foreign currency revenues due to foreign visitors as domestic passengers are described.

2) Benefit Estimation

(a) Benefit Calculation

The benefit is calculated by the following equation:

(Number of overflowing domestic passengers) x (Share ratio of foreigners to total domestic passengers) x [(Weighted average domestic airfare for foreigners) + (Domestic departure tax for foreigners) / 2]

(b) Number of Overflowing Domestic Passengers

The numbers of overflowing domestic passengers are assumed to be 78,000 persons in 2000 and 158,000 persons in 2005. (Refer to Table 18.2.1.)

(c) Share Ratio of Foreign Domestic Passengers to Total Domestic Passengers

Based on the results of the passenger interview survey previously mentioned, the share ratio of foreign domestic passengers to total domestic passengers is assumed to be about 25%. (Refer to Table 18.1 in the Appendix.)

(d) Weighted Average Domestic Airfare for Foreigners

The weighted average domestic airfare from/to Kathmandu for foreigners is estimated to be approximately Rs. 2,860 per passenger. (As for details of the estimation, refer to Table 18.10 in the Appendix.)

Similarly, for the case of the international airfares (refer to Section 18.3.3), the efficiency factor for net domestic airfare is assumed to be 70%. (As for the setting up of the net domestic airfare, cost items for "fuel" and "depreciation of aircraft" are taken into consideration.)

(e) Domestic Departure Tax

The domestic departure tax from Kathmandu for foreigners is assumed to be Rs. 50. (According to information from TIA office, while the normal domestic departure tax is Rs. 50, no tax is levied for foreigners' mountain flights. However, considering the share ratio of foreign passengers for mountain flights in the total number of domestic passengers and for calculation convenience, the domestic departure tax is assumed to be fixed at Rs. 50 in this economic analysis.)

(f) Estimated Benefit

Based on the above equation and factors, the benefits due to accommodation of the overflowing foreign domestic passengers in the years 2000 and 2005 are estimated to be Rs. 39,527 thousand and Rs. 80,067 thousand respectively.

18.3.5 Benefits Due to Accommodation of the Overflowing Foreign Airline Aircraft

1) Project Effect

By accommodating the overflowing aircraft of foreign airlines, Nepal's economy can increase its foreign currency revenues in terms of air landing/navigation charges.

2) Benefit Estimation

(a) Benefit Calculation

The benefits related to air landing/navigation charges are calculated by the following equation:

(Number of overflowing international aircraft movements) x (Share ratio of foreign airline aircraft to total international aircraft movements) x (Aircraft landing/navigation charges)/2

(b) Number of Overflowing International Aircraft Movements

The number of overflowing international aircraft movements are estimated as the difference between the aircraft movements in 1999 and those in 2000/2005. (Refer to Table 18.2.1.)

The numbers of overflowing international aircraft movements by aircraft category are estimated as shown in Table 18.3.1.

Table 18.3.1 Estimated Overflowing International Aircraft Movements by Aircraft Category

(Aircraft movements/year)

Aircraft Category	International Aircraft Movements			Overflow	
	1999 (a)	2000 (b)	2005 (c)	in 2000 (b) - (a)	in 2005 (c) - (a)
J	0	0	520	0	520
L	1,420	1,530	1,560	110	140
M	928	1,020	1,300	92	372
N	2,403	2,550	2,860	147	457
S	5,049	5,100	4,160	51	-889
Total	9,800	10,200	10,400	400	600

Note: 1) The 1999 numbers of aircraft movements by aircraft category are estimated by interpolation between 1995 data and 2000 data. (Refer to Table 4.7.1.)
2) As for the aircraft category of S, the numbers of annual aircraft movements after 2003 decreases compared to 1999, hence the overflow number in 2005 shows a negative value.

(c) Share Portion of Foreign Airline Aircraft to Total International Aircraft Movements

Based on data from the 1992 international aircraft movements, the share ratio of foreign airline aircraft to total international aircraft movements is estimated to be about 60% (refer to Table 3.5.9). This value is applied also as the future share portion.

(d) Unit Charge of Aircraft Landing and Navigation

As for the estimation of the unit charge for aircraft landing and navigation, representative aircraft and aircraft weights are assumed by aircraft category, and the related latest tariff system is applied. The results of the estimation of unit charge by aircraft category are shown in Table 18.11 in the Appendix.

(e) Estimated Benefit

Based on the above equations and factors, the benefits due to accommodation of the overflowing foreign airline aircraft in the years 2000 and 2005 are estimated to be Rs. 4,709 thousand and Rs. 25,745 thousand. (As for the details of benefit calculation, refer to Table 18.12 in the Appendix.)

18.3.6 Total Benefit

Total benefits are summarized as shown in Table 18.3.2.

Table 18.3.2 Summary of Estimated Benefits

(Rs. thousand)

Benefit Items	Benefit Amount	
	2000	2005
1) Nepalese Domestic Passengers	26,325	53,325
2) Nepalese International Passengers	107,289	597,753
3) Foreign International Passengers		
3-1) International Airfare	143,325	798,525
3-2) Expenses Generated	88,141	491,072
4) Foreign Domestic Passengers	39,527	80,067
5) Foreign Airline Aircraft	4,709	25,745
Total	409,316	2,046,487

18.4 Project Costs

18.4.1 Investment Costs

According to the study results of the project implementation schedule and project cost estimates previously mentioned in Chapter 17, the investment costs for the Short-term Modernization Plan for Tribhuvan International Airport are estimated to be disbursed as shown in Table 18.4.1.

Table 18.4.1 Annualized Investment Costs (Financial and Economic Costs)

(Rs. thousand)

Year	Financial Price	Economic Price
1996	336,042	295,717
1997	0	0
1998	3,958,024	3,483,061
1999	1,861,069	1,637,741
2000	1,237,691	1,089,168
Total	7,392,826	6,505,687

18.4.2 Operation and Maintenance Costs for the "Without Project" Case

The operation and maintenance costs for the "Without Project" case means the required costs for supporting the functions of the existing airport facilities.

According to recent data of the operation and maintenance costs obtained from TIA office, the annual operation and maintenance costs for the planned budget for 1993/94 are approximately Rs. 57,000 thousand. This amount is assumed to be equivalent to the annual operation and maintenance costs for the "Without Project" case in terms of financial price.

By applying the assumed conversion factor from financial price to economic price (= 0.88), the annual operation and maintenance costs for the "Without Project" case in terms of economic price are estimated. (See Table 18.4.2.)

Table 18.4.2 Estimated Annual Operation and Maintenance Costs for the "Without Project" case (Financial and Economic Prices)

(Rs. Thousand)

Items	Amount
Annual O/M Costs in Terms of Financial Price	57,000
Annual O/M Costs in Terms of Economic Price	50,160

Note: 1) Estimated based on recent data of O/M costs in TIA obtained from TIA office
2) Conversion factor from financial price to economic price is assumed to be 0.88.

18.4.3 Operation and Maintenance Costs for the "With Project" Case

The operation and maintenance costs for the "With Project" case means the costs for supporting the functions of modernized airport facilities.

The operation and maintenance costs for the "With Project" case are estimated as follows:

- The operation and maintenance costs for the "With Project" case are assumed to be the total amount of the following cost items:

  a) operation and maintenance costs for the "Without Project" case excluding personnel costs

b) personnel costs (personnel costs are assumed to be estimated in accordance with the future traffic demand of passengers.)

c) additional operation and maintenance costs for the invested facilities related to the short-term modernization plan.

- Based on recent data obtained from the TIA office, the operation and maintenance costs for the "Without Project" case excluding personnel costs are estimated to be Rs. 44,900 thousand.

- The unit personnel costs per passenger are estimated as shown in Table 18.4.3. The unit annual personnel costs are assumed to be Rs. 10.0 per passenger.

Table 18.4.3 Estimated Unit Personnel Costs per Passenger

	1991	1992
Personnel Costs of TIA (Rs. thousand) in F.Y. 1991/92 and 1992/93	8,377	10,032
Number of Passengers (1,000 persons) in 1991 and 1992	997	1,072
Unit Personnel Costs per Passenger (Rs.)	8.4	9.4

Note: 1) Personnel costs : Obtained from TIA office
2) Number of Passengers : Total of International and domestic passengers

- The additional annual operation and maintenance costs are estimated in accordance with the assumed ratio of operation and maintenance costs (at 1% of the investment costs for civil and architectural works and at 5% of the investment costs for equipment/utilities), and the estimated results are shown in Table 19.4.4.

Table 18.4.4 Estimated Additional Annual Operation and Maintenance Costs (Financial and Economic Prices)

(Rs. million)

	Investment Cost		Additional Annual O/M Costs	
	Financial	Economic	Financial	Economic
Civil Works	1,376	1,212	13.76	12.11
Architectural Works	4,199	3,695	41.99	36.95
Airport Utilities	534	470	26.72	23.51
Total			82.47	72.57

The results of the estimation of the operation and maintenance costs for the "With Project" case are shown in Table 18.13 in the Appendix.

18.5 Economic Evaluation

18.5.1 Evaluation Results

The calculation results of economic evaluation indicators, i.e. EIRR (Economic Internal Rate of Return), NPV (Net Present Value) and B/C (Benefit Cost Ratio) are summarized as below. The annualized cash flow is shown in Table 18.5.1.

- EIRR : 17.1%
- NPV : 2,362 (Rs. million)

Table 18.5.1 Economic Cash Flow for EIRR Calculation

EIRR : 17.1%
B/C : 1.47
NPV : 2,362 (Rs. million)
(Discounted Rate = 12%)

(Rs. 1,000)

	Year	Benefits	Costs				Net Cash Flow
			Invest.	O/M (With)	O/M (Without)	Total Costs	
1	1995		0			0	0
2	1996		295,717			295,717	-295,717
3	1997		0			0	0
4	1998		3,483,061			3,483,061	-3,483,061
5	1999		1,637,741			1,637,741	-1,637,741
6	2000	409,316	1,089,168	126,342	50,160	1,165,350	-756,034
7	2001	564,740		126,984	50,160	76,824	487,916
8	2002	779,182		127,662	50,160	77,502	701,680
9	2003	1,075,051		128,366	50,160	78,206	996,845
10	2004	1,483,266		129,096	50,160	78,936	1,404,330
11	2005	2,046,487		129,862	50,160	79,702	1,966,785
12	2006	2,046,487		129,862	50,160	79,702	1,966,785
13	2007	2,046,487		129,862	50,160	79,702	1,966,785
14	2008	2,046,487		129,862	50,160	79,702	1,966,785
15	2009	2,046,487		129,862	50,160	79,702	1,966,785
16	2010	2,046,487	470,180	129,862	50,160	549,882	1,496,605
17	2011	2,046,487		129,862	50,160	79,702	1,966,785
18	2012	2,046,487		129,862	50,160	79,702	1,966,785
19	2013	2,046,487		129,862	50,160	79,702	1,966,785
20	2014	2,046,487		129,862	50,160	79,702	1,966,785
21	2015	2,046,487		129,862	50,160	79,702	1,966,785
22	2016	2,046,487		129,862	50,160	79,702	1,966,785
23	2017	2,046,487		129,862	50,160	79,702	1,966,785
24	2018	2,046,487		129,862	50,160	79,702	1,966,785
25	2019	2,046,487		129,862	50,160	79,702	1,966,785
26	2020	2,046,487	4,165,392	129,862	50,160	4,245,094	-2,198,607
27	2021	2,046,487		129,862	50,160	79,702	1,966,785
28	2022	2,046,487		129,862	50,160	79,702	1,966,785
29	2023	2,046,487		129,862	50,160	79,702	1,966,785
30	2024	2,046,487	-3,612,095	129,862	50,160	-3,532,393	5,578,880
Total Costs (Initial)			6,505,687				
Total Costs			7,529,164	3,235,690	1,254,000	9,510,854	

- B/C : 1.47

(Note: NPV and B/C : at 12% discounted rate)

As the opportunity cost of capital in Nepal is estimated to be approximately 12% according to the report of the previous JICA Study ("Development Study of Civil Aviation in Nepal, 1989, JICA"), the above value of EIRR shows that this Project can be evaluated as economically viable.

18.5.2 Sensitivity Test

The sensitivity is examined by varying the Project costs and Project benefits, and the results are shown in Table 18.5.2.

In the severest case (costs +20% and benefits -20%), the calculation results show a slightly lower value than the level of 12%.

Table 18.5.2 Sensitivity Test

(EIRR : %)

Costs	Benefits		
	Base	-10%	-20%
Base	17.1%	15.6%	14.1%
+10%	15.7%	14.3%	12.8%
+20%	14.5%	13.1%	11.7%

18.6 Qualitative Economic Benefits

Besides the quantified economic benefits previously mentioned, the following qualitative economic effects treated as unquantified benefits in this economic analysis are expected to be also realized from the implementation of the Project:

- Upgrading of passenger service levels in the passenger terminal building by improvement of passenger handling facilities (i.e. possible reduction of passenger processing time in the passenger terminal building).
- Possible higher efficiency of air cargo handling by the improvement of air cargo handling facilities, which will contribute to control qualities and promote exports.
- Additional short-term job creation effects during the period of construction works.
- Additional long-term job creation effects for operational staff by the expanding of the passengers terminal buildings.
- Favorable impression effects for foreign visitors to Nepal by upgrading the national gateway and resultant incentive effects to international tourism development.
- Enhancing the national pride effects for Nepalese through developing a symbolic infrastructure of a national entrance and exit abroad.

CHAPTER 19

FINANCIAL ANALYSIS

CHAPTER 19 FINANCIAL ANALYSIS

19.1 General

19.1.1 Introduction

This chapter examines the financial feasibility of the Ground Facilities Improvement Plan in the Short-term Modernization Plan.

The principal objective of the financial analysis is to evaluate the financial viability of the implementation of the Short-term Modernization Plan (the Project) from the viewpoint of the management body of TIA.

The analysis will be made based on an estimation of the operating revenues and investment and the operation/maintenance costs of the Project. As an evaluation indicator of financial viability, the financial internal rate of return (FIRR) will be demonstrated according to the conventional discounted cash flow methodology.

19.1.2 Basic Assumptions

The following basic assumptions for financial analysis are made:

1) With Project and Without Project

The financial analysis is conducted comparing the project costs and the project revenues between the "With Project" and "Without Project" situations. The incremental revenues and costs between "With Project" and "Without Project" are examined, because the project viability should be evaluated based on costs and revenues which exclude those derived from the existing facilities.

"With Project" means the implementation of the investment for the proposed Short-term Modernization plan, which will be able to endure passenger demand up to the year 2005.

"Without Project" means the condition without such an investment for the airport modernization works, and in this case the saturation conditions for the international and domestic passenger terminal facilities are evaluated as follows:

- The international passenger terminal facilities are evaluated to be saturated in 1999.
- The domestic passenger terminal facilities are evaluated to be already saturated at present.

(As for details of the description about the "saturation" condition, refer to Section 18.2.)

2) Project Costs

The project cost in the case of "With Project" means the total of construction costs for the Short-term Airport Modernization Plan.

The operation and maintenance costs in the case of "Without Project" is treated as a negative cost for the "With Project".

3) Implementation Schedule

The period for the project implementation of the short-term airport modernization plan is programmed during 1996 - 2000, with the inauguration scheduled for 2000.

4) Project Life

The project life is assumed to be 25 years after the inauguration of the short-term modernized airport.

5) Life Time of Assets

The life times for the assets are assumed to be 50 years for civil works, 20 years for architectural works and 10 years for equipment/utilities works. The reinvestments for each asset are assumed to be made in accordance with its life time.

At the end of project life, the residual value (undepreciated value of assets) is treated as a negative cost.

6) Prices

The prices for the financial analysis are estimated in terms of market prices. All the costs and revenues are estimated at constant 1993 prices.

7) Exchange Rate

The exchange rate used is Rs. 49.0 / US$.

19.2 Outlook of the Present Financial Condition in TIA

Table 19.2.1 shows the outlook of the present financial conditions focused on the operational revenues and operation and maintenance costs of TIA, based on recent financial data in the fiscal year 1992/93 obtained from TIA office.

Table 19.2.1 Outlook of the Present Financial Condition of TIA in Fiscal Year 1992/93

(Rs. thousand)

Items	1992/93	(%)
(a) Revenues		
1) Aircraft Landing/Navigation Charges	88,508	(28.9%)
2) Passengers Service Charges (Airport Tax)	197,440	(64.5%)
3) Entrance Fees	2,297	(0.8%)
4) Parking Fees	125	(0.0%)
5) Oil Throughput	885	(0.3%)
6) Space Rental (Room/Land)	14,156	(4.6%)
7) Advertisements	940	(0.3%)
8) Others	1,777	(0.6%)
(Revenue Total)	306,128	(100.0%)
(b) O/M Costs		
1) Salary/Wages etc.	10,032	(28.4%)
2) Utilities (Electricity, etc.)	11,503	(32.6%)
3) Operational Materials	2,437	(6.9%)
4) Fuel	1,584	(4.5%)
5) Maintenance	8,614	(24.4%)
6) Others	1,133	(3.2%)
(O/M Costs Total)	35,303	(100.0%)
(a) - (b)	270,825	

Source: TIA office

Out of the above revenue items, the two major items of aircraft landing/navigation charges and the passenger service charges (airport tax) occupy a share ratio of about 94% to total revenues. Therefore, it can be said that the revenue level of TIA is influenced greatly by these two major revenue items.

TIA to date has been managed under the government administration. Consequently, the cash flow in TIA is duly controlled under the state treasury. As for expenditure, all expenses for the operation and maintenance of the airport is financed out of the government budget appropriation. That is, the fund for all payments of expenses is provided by the state treasury of the Ministry of Finance through an annual budget appropriation. Whereas, for revenues, all incomes, namely all cash related to the revenues derived from the offering of services are deposited in the state treasury as state receipts.

According to information from the TIA office, a plan for reforming the organization of TIA into a "financially more independent organization" has been recently proposed, and this has been under deliberation for legislation among the governmental authorities. However, detailed information about this plan is still unknown.

19.3 Estimation of Revenues in TIA

19.3.1 Assumptions on the Estimation of Revenue Items

The following assumptions on the estimation of revenue items mentioned previously in Section 19.2 are made:

1) Aircraft Landing/Navigation Charges

   The revenues from the aircraft landing/navigation charges are estimated by aircraft category and international/domestic flights as below:

   (Number of aircraft movements) x (Unit charge by aircraft category) x 0.5

   The estimated unit aircraft landing/navigation charge by aircraft category is referred to in Table 18.11 in the Appendix.

2) Passenger Service Charges (Airport Tax)

   The revenues from the passenger service charges (airport tax) are estimated for international/domestic flight as below:

   (Number of passengers) x (Unit charge of airport tax) x 0.5

   The estimated weighted average unit international departure tax is referred to in Table 18.7 in the Appendix. The assumed unit domestic departure tax is referred to in Section 18.3.4.

3) Entrance Fees

   The revenues from entrance fees is related to the international passenger terminal building. At present, the tariff for entrance fee into the international passenger terminal building is Rs. 10 per entry (Currently, no charge is levied for an entrance to the domestic passenger terminal.)

   However, since it is considered to be difficult to estimate directly the total number of visitors, the revenue from entrance fees is assumed to be estimated in accordance with the number of international air passengers in this financial analysis.

The unit revenue from entrance fees per international passenger is estimated as shown in Table 19.3.1. The unit revenue from entrance fees per international passenger of Rs. 3.0 is assumed to be applied for the revenue estimation.

Table 19.3.1 Estimated Unit Revenue from Entrance Fees per International Passenger

Item	Amount
Revenue from Entrance Fees in F.Y. 1992/93 (Rs. thousand) (a)	2,297
Number of International Passengers in 1992 (1,000 persons) (b)	780
Unit Revenue from Entrance Fees per International Passenger (Rs.) (a)/(b)	2.9

4) Parking Fee

The revenue from parking fees is related to both the international and domestic passenger terminal facilities. The current tariff for parking fees by vehicle category is shown below:

- Truck & Bus : Rs. 20.0
- Minibus : Rs. 10.0
- Passenger Car : Rs. 4.0
- Motorcycle : Rs. 2.0

However, since it is considered to be difficult to estimate directly the total number of parking vehicles by category, the revenue from parking fees is assumed to be estimated in accordance with the total number of international and domestic passengers in this financial analysis.

The unit revenue from parking fees per passenger (international and domestic) is estimated as shown in Table 19.3.2. The unit revenue from parking fees of Rs. 0.2 per passenger is assumed to be applied for the revenue estimation.

Table 19.3.2 Estimated Unit Revenue from Parking Fees per Domestic/International Passenger

Item	Amount
Revenue of Parking Fee in F.Y. 1992/93 (Rs. thousand) (a)	125
Total Number of International and Domestic Passengers in 1992 (1,000 persons) (b)	1,072
Unit Revenue of Parking Fee per Passenger (Int'l.+ Dom.) (Rs.) (a)/(b)	0.12

5) Oil Throughput

According to information from TIA's office, "oil throughput" means commission fees for oil charges paid by oil companies to the TIA office. The details of information of the unit charge for oil throughput are unavailable. In this financial analysis, the revenue from oil throughput is assumed to be estimated in accordance with the total number of international and domestic passengers.

The unit revenue from oil throughput per passenger (international and domestic) is estimated as shown in Table 19.3.3. The unit revenue from oil throughput of Rs. 1.0 per passenger is assumed to be applied for revenue estimation.

Table 19.3.3 Estimated Unit Revenue from Oil Throughput per Domestic/International Passenger

Item	Amount
Revenue from Oil Throughput in F.Y. 1992/93 (Rs. thousand) (a)	885
Total Number of International and Domestic Passengers in 1992 (1,000 persons) (b)	1,072
Unit Revenue of Oil Throughput per Passenger (Int'l.+ Dom.) (Rs.) (a)/(b)	0.83

6) Space Rental

According to information from TIA's office, "space rental" revenue means revenue derived from the concessions for room space (for restaurants, shops, etc.) in the passenger terminals, and land space related to TIA's right of way.

Details of information about the existing conditions of rental area and rental fee per square meter by kind of space usage are unavailable. Also in the short-term modernization plan, the floor usage plans, especially for floor space for rental, of the new international passenger terminal and the rehabilitated domestic passenger terminals are not designed in detail. Accordingly, in this financial analysis, the revenue estimation for space rental is assumed to be made in accordance with the total floor area of the international and domestic passenger terminals.

7) Advertisements and Others

In this financial analysis, the revenues from "advertisements" and "others" are assumed to be fixed, which are equivalent to the existing revenues in the fiscal year 1992/93.

19.3.2 Estimation of Revenues for the "Without Project" Case

The "Without Project" case is assumed to accommodate the traffic demand of international passengers as of 1999 and that of domestic passengers as of 1992. (Refer to Section 19.1 and 18.2)

In this section, revenues for the "Without Project" case are estimated as shown as follows, based on the assumptions mentioned previously in Section 19.3.1:

1) Aircraft Landing/Navigation Charges

The estimated revenue from aircraft landing/navigation charges is referred to Table 19.1 in the Appendix.

2) Passenger Service Charges (Airport Tax)

The estimated revenue from passenger service charges (airport tax) is referred to Table 19.2 in the Appendix.

3) Entrance Fees

The revenue from entrance fees is estimated as below:

Number of International Passengers in 1999	Assumed Unit Revenue from Entrance Fees per Passenger (Int'l.)	Estimated Revenue
1,180 (1,000 persons)	Rs. 3.0	Rs. 3,540 thousand

4) Parking Fees

The revenue from parking fees is estimated as shown below:

Total Number of International Passengers in 1999 and Domestic Passengers in 1992	Assumed Unit Revenue from Parking Fees per Passenger (Int'l. + Dom.)	Estimated Revenue
1,472 (1,000 persons)	Rs. 0.2	Rs. 294 thousand

5) Oil Throughput

The revenue from oil throughput is estimated as shown below:

Total Number of International Passengers in 1999 and Domestic Passengers in 1992	Assumed Unit Revenue from Oil Throughput per Passenger (Int'l. + Dom.)	Estimated Revenue
1,472 (1,000 persons)	Rs. 1.0	Rs. 1,472 thousand

6) Space Rental

The revenue from space rental is assumed to be the same as the existing revenue in the fiscal year 1992/93, and is estimated to be Rs. 14,156 thousand.(Refer to Table 19.2.1.)

7) Advertisements and Others

The revenues from advertisement and others are estimated to be the same as the existing revenues in the fiscal year 1992/93, and are estimated to be Rs. 940 thousand and Rs. 1,777 thousand respectively.(Refer to Table 19.2.1.)

The estimated revenues for the "Without Project" case are summarized in Table 19.3.4.

Table 19.3.4 Summary of Estimated Revenues for the "Without Project" Case

(Rs. thousand)

Item	Amount
1) Aircraft Landing/Navigation Charges	
(International)	(118,306)
(Domestic)	(1,788)
(Total)	120,094
2) Passenger Service Charges (Airport Tax)	
(International)	(354,000)
(Domestic)	(7,300)
(Total)	361,300
3) Entrance Fees	3,540
4) Parking Fees	294
5) Oil Throughput	1,472
6) Space Rental	14,156
7) Advertisements	940
8) Others	1,777
Total Revenue	503,573

19.3.3 Estimation of Revenue for the "With Project" Case

In this section, revenue for "With Project" case are estimated as follows, based on the assumptions mentioned previously in Section 19.3.1:

1) Aircraft Landing/Navigation Charges

The estimated revenue from aircraft landing/navigation charges is referred to in Table 19.1 in the Appendix.

2) Passenger Service Charges (Airport Tax)

The estimated revenue from passenger service charges (airport tax) is referred to in Table 19.2 in the Appendix.

3) Entrance Fees

The revenue from entrance fees is estimated as shown below:

Year	Number of International Passengers (1,000 persons)	Assumed Unit Revenue from Entrance Fees per Passenger (Int'l.) (Rs. 3.0)	Estimated Revenue (Rs. thousand)
2000	1,250		3,750
2003	1,430		4,290
2005	1,570		4,710

4) Parking Fees

The revenue from parking fees is estimated as shown below:

Year	Total Number of International and Domestic Passengers (1,000 persons)	Assumed Unit Revenue from Entrance Fees per Passenger (Int'l.+ Dom.) (Rs. 0.2)	Estimated Revenue (Rs. thousand)
2000	1,620		324
2003	1,850		370
2005	2,020		404

5) Oil Throughput

The revenue from oil throughput is estimated as shown below:

Year	Total Number of International and Domestic Passengers (1,000 persons)	Assumed Unit Revenue from Entrance Fee per Passenger (Int'l.+ Dom.) (Rs. 1.0)	Estimated Revenue (Rs. thousand)
2000	1,620		1,620
2003	1,850		1,850
2005	2,020		2,020

6) Space Rental

According to the results of the engineering study, the estimated floor areas of the passenger terminals are shown in Table 19.3.5.

Table 19.3.5 Estimated Floor Areas of the Passenger Terminal Buildings

	Floor Area (square meter)		Ratio
	Existing (1992) (a)	Short-term Modernization Plan (b)	(b) / (a)
International	10,750	25,000	
Domestic	700	10,750	
Total	11,450	35,750	3.1

Note: 1) Refer to Table 5.1.1.
2) In the short-term modernization plan, the existing international passenger terminal building will be converted to be used as the domestic passenger terminal.

In this financial analysis, the revenues from space rental is assumed to be as shown below:

(Existing revenue in the fiscal year 1992/93) x (Growth factor)

Here, the growth factor is assumed to be equivalent to the ration of floor area of the existing terminal building to that in the short-term modernization plan, and which is assumed to be 3.0 as a maximum value. The growth factor by planning year is assumed as shown below:

- Year 2000 : 2.0
- Year 2003 : 2.5
- Year 2005 : 3.0

As a result, the revenues from space rental are estimated as shown below:

- (For 2000) Rs. 14,156 thousand x 2.0 = Rs. 28,312 thousand
- (For 2003) Rs. 14,156 thousand x 2.5 = Rs. 35,390 thousand
- (For 2005) Rs. 14,156 thousand x 3.0 = Rs. 42,468 thousand

7) Advertisements and Others

The revenues from advertisements and others are estimated to be the same as the existing revenues in the fiscal year 1992/93, and are estimated to be Rs. 940 thousand and Rs. 1,777 thousand respectively.(Refer to Table 19.2.1.)

The estimated revenues for the "With Project" case are summarized in Table 19.3.6.

Table 19.3.6 Summary of Estimated Revenues for the "With Project" Case

(Rs. thousand)

Item	2000	2003	2005
1) Aircraft Landing/Navigation			
(International)	(126,155)	(148,013)	(161,215)
(Domestic)	(2,350)	(3,152)	(3,709)
(Total)	128,505	151,165	164,924
2) Passenger Service Charges (Airport Tax)			
(International)	(375,000)	(429,000)	(471,000)
(Domestic)	(9,250)	(10,500)	(11,250)
(Total)	384,250	439,500	482,250
3) Entrance Fees	3,750	4,290	4,710
4) Parking Fees	324	370	404
5) Oil Throughput	1,620	1,850	2,020
6) Space Rental	28,312	35,390	42,468
7) Advertisements	940	940	940
8) Others	1,777	1,777	1,777
Total Revenue	549,478	635,282	699,493

The estimated revenues related to the major revenue items of "Passenger service charges (airport tax)" and "Aircraft landing/navigation charges" represent portions of about 70% and about 24% respectively of the total estimated revenue for each planning year

19.4 Project Costs

19.4.1 Investment Costs

The annualized financial investment costs for the Short-term Modernization Plan for Tribhuvan International Airport are shown in Table 19.4.1. (Refer to Section 18.4.1.)

Table 19.4.1 Annualized Financial Investment Costs

(Rs. thousand)

Year	Amount
1996	336,042
1997	0
1998	3,958,024
1999	1,861,069
2000	1,237,691
Total	7,392,826

19.4.2 Operation and Maintenance Costs for the "Without Project" Case

The method of estimation of the operation and maintenance costs for the "Without Project" case is referred to in Section 18.4.2. The financial annual operation and maintenance costs for the "Without Project" case are estimated to be Rs. 57,000 thousand.

19.4.3 Operation and Maintenance Costs for the "With Project" Case

The manner of estimation of the operation and maintenance costs for "With Project" is referred to Section 18.4.3.

The results of the estimation of the financial annual operation and maintenance costs for the "With Project" case are shown in Table 18.13 in the Appendix.

19.5 Estimation of FIRR

19.5.1 Estimated FIRR

For the FIRR (Financial Internal Rate of Return) calculation, incremental revenue, investment cost for Short-term Modernization Plan and incremental operation and maintenance costs are included in the factors as explained previously in Sections 19.3 and 19.4.

As a result, the FIRR is calculated to be -6.2% (Base Case FIRR). The details of FIRR calculation is shown in Table 19.5.2.

19.5.2 Examination of Revenue Levels

As the value of FIRR for the Base Case shows a negative value, the examination of varying revenue levels compared with the base level revenue is tried.

The base level revenue which is used for the Base Case FIRR calculation is estimated on the basis of tariff levels at the 1993 constant price, that is, in this case no raise of tariff level is assumed.

The sensitivity test by varying revenue levels compared with that of the base level is examined, and trial results are shown in Table 19.5.1.

Table 19.5.1 Examination of Revenue Levels

Revenue Level	FIRR
Base (+0%)	-6.2%
+10%	-4.4%
+20%	-2.7%
+30%	-1.1%
+40%	0.4%
+45%	1.1%
+50%	1.7%
+60%	3.0%
+100%	7.4%
+120%	9.3%
+130%	10.2%

These results show that the turning point to a positive value of FIRR is about +40% revenue to the base level; and for attaining an FIRR value over the assumed loan's interest rate (1.0%; refer to Section 20.6), a revenue level increase of approximately 50% is required. Moreover, for attaining an FIRR value over the interest rate of 10% which is assumed to be equivalent to the current interest rate on deposits in commercial banks in Nepal (based on the information of the Nepal Rastra Bank), a revenue level increase of approximately 130% is required.

In case of revenue levels rising by 50% and 130%, the total increased revenues, incremental revenues and incremental revenues per passenger for the year 2000 are shown in Table 19.5.3.

Table 19.5.2 Financial Cash Flow for FIRR Calculation (Base Case)

FIRR : -6.2%

(Rs. 1,000)

	Year	Revenues			Costs				Net Cash Flow
		(With)	(Without)	(Incre-mental)	Invest.	O/M (With)	O/M (Without)	Total Costs	
1	1995				0			0	0
2	1996				336,042			336,042	-336,042
3	1997				0			0	0
4	1998				3,958,024			3,958,024	-3,958,024
5	1999				1,861,069			1,861,069	-1,861,069
6	2000	549,478	503,573	45,905	1,237,691	143,570	57,000	1,324,261	-1,278,356
7	2001	576,708	503,573	73,135		144,300	57,000	87,300	-14,165
8	2002	605,287	503,573	101,714		145,070	57,000	88,070	13,644
9	2003	635,282	503,573	131,709		145,870	57,000	88,870	42,839
10	2004	666,615	503,573	163,042		146,700	57,000	89,700	73,342
11	2005	699,493	503,573	195,920		147,570	57,000	90,570	105,350
12	2006	699,493	503,573	195,920		147,570	57,000	90,570	105,350
13	2007	699,493	503,573	195,920		147,570	57,000	90,570	105,350
14	2008	699,493	503,573	195,920		147,570	57,000	90,570	105,350
15	2009	699,493	503,573	195,920		147,570	57,000	90,570	105,350
16	2010	699,493	503,573	195,920	534,296	147,570	57,000	624,866	-428,946
17	2011	699,493	503,573	195,920		147,570	57,000	90,570	105,350
18	2012	699,493	503,573	195,920		147,570	57,000	90,570	105,350
19	2013	699,493	503,573	195,920		147,570	57,000	90,570	105,350
20	2014	699,493	503,573	195,920		147,570	57,000	90,570	105,350
21	2015	699,493	503,573	195,920		147,570	57,000	90,570	105,350
22	2016	699,493	503,573	195,920		147,570	57,000	90,570	105,350
23	2017	699,493	503,573	195,920		147,570	57,000	90,570	105,350
24	2018	699,493	503,573	195,920		147,570	57,000	90,570	105,350
25	2019	699,493	503,573	195,920		147,570	57,000	90,570	105,350
26	2020	699,493	503,573	195,920	4,733,400	147,570	57,000	4,823,970	-4,628,050
27	2021	699,493	503,573	195,920		147,570	57,000	90,570	105,350
28	2022	699,493	503,573	195,920		147,570	57,000	90,570	105,350
29	2023	699,493	503,573	195,920		147,570	57,000	90,570	105,350
30	2024	699,493	503,573	195,920	-4,104,661	147,570	57,000	-4,014,091	4,210,011
Total Costs (Initial)					7,392,826				
Total Costs					8,555,861	3,676,910	1,425,000	10,807,771	

Table 19.5.3 Incremental Revenue per Passenger in Case of Increased Revenue in 2000

Revenue Level Increase		Year 2000 Number of Passengers 1,620 (thousand)	
		(Rs. thousand)	Per Passenger (Rs.)
+50%	Revenue at Base Level	549,478	(339)
	Revenue after Increase	824,215	(509)
	Incremental Revenue	274,737	(170)
+130%	Revenue in Base Level	549,478	(339)
	Revenue after Increase	1,263,799	(780)
	Incremental Revenue	714,321	(441)

In the case of revenue levels increasing by 50% and 130%, the incremental revenues per passenger in 2000 are estimated to be Rs. 170 and Rs. 441 respectively.

19.5.3 Examination of Tariff Level Rising

1) Examination of Tariff Level Rising as a Whole

When supposing no new further revenue items, the "increase in revenue" discussed above has the same meaning as "tariff rising as a whole".

Accordingly, in this case, the above increased percentages in revenue level are equivalent to the rise percentage in tariff levels as a whole.

In case of the tariff levels rising by 50% and 130% from the base level (year 1993), the estimated average annual growth rates of tariff levels for the period of seven (7) years during 1993 - 2000 are equivalent to about 6% and 13% respectively.

2) Examination of Tariff Level Rising for "Airport Tax Charges"

Here, for example, the case assuming that the incremental revenue required is provided only by "airport tax charges", which is the largest revenue item, is tested.

Assuming the incremental revenues in the case of revenue level increases by 50% and 130% are burdened only to the revenue item of "airport tax", the tariff level of "airport tax" is estimated to be about 1.714 times and 2.857 times compared to the base level respectively; and these are equivalent to about 8.0% and 16.2% respectively of the average annual growth rates of tariff levels for the period of seven (7) years during 1993 - 2000.

Accordingly, the required "airport tax" tariffs for international and domestic passengers are estimated to be Rs. 1,023 and Rs. 86 for a revenue level increase by 50%, and Rs. 1,715 and Rs. 143 for a revenue level increase by 130% respectively.

Moreover, when focused only on the international airport tax, the tariff level of "airport tax" is estimated to be about 1.732 times (Rs. 1,040) and 2.904 times (Rs. 1,742) compared to the base level (Rs. 600, as a weighted average value, refer to Table 18.7 in the Appendix) respectively; and these are equivalent to be about 8.2% and 16.5% respectively of the average annual growth rates of tariff levels for the period of seven (7) years during 1993 - 2000.

(As for the details of above estimation, refer to Table 19.3 in the Appendix.)

3) Concluding Remarks

Taking the above examinations into consideration, the tariff rise for the case of a revenue level increase by 130% is very hard. The tariff level rise in terms of the annual growth rate basis (during 1993 - 2000) of about 13% as a whole, or about 16% when focused only on "airport tax" is considered too high a tariff level rise.

Too high a tariff level rise burdened by air passengers, for example "airport tax", will be a disturbing to air travelers. Of course, there is room for introducing new charges such as charges/levies to the airport beneficiaries (hotels, travel agents, transport service operators, etc.) However, the magnitude of the contribution to revenue increases produced by such charges is considered not to be much, and such a charge for beneficiaries will result in the air traveler finally being burdened.

On the other hand, if assuming the FIRR value is over 1.0% (which is equivalent to the interest rate of assumed loans for financing investment costs of the Project), the revenue level increase of 50% is considered sufficient for supporting the financial viability of the Project.

In this case, a tariff level rise in terms of the annual growth rate basis (during 1993 - 2000) of about 6% as a whole, or about 8% when focused only on "airport tax" (Rs. 600 to about Rs. 1,000 for international flights in the case of being burdened only by international airport tax) is required, and this is considered to be an endurable increase. In other words, if the tariff level rise above mentioned is accepted, the resulting FIRR value will attain the level of over 1.0%.

19.6 Cash Flow Tabulation

The investment cost of the Project for the Short-term Modernization Plan is approximately Rs. 7,300 million and is assumed to be funded wholly by the loan with the following conditions :

- Interest rate : 1.0% per annum
- Capital repayment schedule : thirty (30) years
- Grace period : ten (10) years

- Also the interest during construction period is assumed to be funded by this loan.

The basic assumptions other than mentioned previously are made as described below:

- Financial Source

  As for items of financial source, revenues ("incremental") and loan.

- Financial Usage

  As for items of financial usage, investment costs for the Short-term Modernization Plan, operation and maintenance costs ("incremental"), loan capital repayment and interest payment.

The annualized cash flows for the "Base Case" and "Revenue Increased by 50% Case" are tabulated in Table 19.4 and Table 19.5 in the Appendix respectively.
In the "Base Case", financial deficits in cash flow are represented. In this case, supplementary finance for the deficits will be required. On the other hand, the "Revenue Increased by 50% case" shows a sound financial cash flow.

19.7 Evaluation

As mentioned previously in Chapter 19, the results of the economic analysis are favorable. On the other hand, as observed in the above Sections, the results of the financial analysis (for the base case) are not optimistic.

Basically, this Project is not so commercially attractive. For the total evaluation of the Project, however, the economic analysis results should be appraised. In other words, it can be emphasized that an airport project as an important transport infrastructure can be generally justified by the economic benefits from the viewpoint of national welfare such as the convenience for Nepalese air passengers and increases in foreign currency income.

Accordingly, it can be considered that the Project is viable from an overall appraisal viewpoint.

When considering reasonable tariff level rises, financial aspect will show a turn for the better, resulting in attaining an FIRR value over 1.0% (which is equivalent to the level of interest rate of the assumed loan funded for investments of the Project) and indicates sound financial cash flow.

PART D.

URGENT PROJECT

CHAPTER 20

URGENT PLAN

CHAPTER 20 URGENT PROJECT

20.1 General

The urgent plan that is specified in Chapter 10 is required to be implemented within a short period in order to provide the services immediately.

In view of this point, the system configuration should be made as simple as possible for easy construction and maintenance.

20.1.1 Scope of the Urgent Project

By comparison with the items of the Urgent Improvement Plan described in Chapter 10, the most important factor is the period of program implementation in terms of overall program management.

The ASR/SSR System will require the longest construction period on the construction schedule due to necessity of a long lead time for the manufacturing of the equipment.

Therefore, the installation of ASR/SSR is selected as an Urgent Project to be initiated in the early stage of the Urgent Improvement Plan. Construction of a training facility which is required for radar controllers and maintenance technicians' training is also required.

A human resource development plan for the radar system's operation and maintenance should be planned at the same time.

The basic Design for practical construction is described in the following Section 20.2 and the human resource development plan concerning the Basic Design is in given Section 20.3.

20.2 Basic Design

20.2.1 Design Principles

(1) Basic Concept

This facility shall be completed in a short period to allow the immediate operation in consideration of the importance and urgency of the project. On the system design therefore, a simple configuration for the system shall be considered as much as possible, and to avoid the new development of a system and equipment. For the design and construction of a building for the radar equipment, the environmental impact must be minimized by avoiding large-scale earthwork.

(2) Design Policy

The subjects of the design will be selected from the agreed items between the Nepal Government and the Study Team from the selected items of the urgent project given in Chapter 10. The actual subjects of design are the airport surveillance radar system and training facilities for the operation and maintenance of this system.

The following points are to be considered in the Basic Design.

- System performance and the configuration of the radar system must comply with the operational requirements.
- The airport surveillance radar system and its training facility must be coordinated with the current airport function and its future plans.
- The radar facility can be constructed within a short duration with easy methods of construction, operations and maintenance desirable.
- The equipment of the radar system must consist of simple components as much as possible. Easy maintenance and low operation and maintenance costs are also required.

20.2.2 Design Condition for the Radar System

The design condition for the radar system is as follows:

In the site selection process, a number of factors should be considered.

Siting requirements for the ASR/SSR facilities are identified for the following categories:

(1) Specific coverage requirements

- Navigation fixes

  All of the navigational fixes and air routes within the terminal area are desired to be located within the line of sight (LOS) from the selected radar site.

- Runway approach/departure coverage

  Coverage of the final approach should be provided up to the missed approach point, and departure aircraft should be picked up at least 1 NM from the exiting runway edge (probably 300 feet above the extended runway surface).

(2) Requirements for facilities construction

The following items should be considered in terms of the construction costs and maintainability:

- Extensive and/or unusual road construction or improvements
- Special installation of water and/or electrical power
- Requirements for remote control and monitoring cable or microwave link
- Grading, landscaping or other property improvements
- Drainage
- Road access

(3) Technical requirements

It is desirable to keep the minimum separation between the ASR/SSR antenna and any above ground structure and radio generating equipment such as radio navigation aids, communication facilities.

The ground clutter effect, and lobbing, and large reflection objects which may cause false targets should be analyzed.

20.2.3 Design Condition for Buildings Construction

(1) Natural Conditions

Monthly average temperatures in the Kathmandu Basin are between 10 to 24 degrees C. and there are big differences with the season. Rainy and dry seasons are clearly divided and most of the annual precipitation is concentrated in the rainy season between May and September. Accordingly, the natural conditions for the design are settled as follows:

- The data for hot and cold weather for the design of buildings shall be considered from the prevailing weather conditions at the site.
- The condition of the drainage system in the rainy season and soil improvements shall be considered for designing of the type of foundations for buildings and facilities.
- Maximum wind velocity for the design of the tower and buildings shall be 30 m/sec based on past meteorological data.
- External finishing material for buildings shall be brick in consideration of the standard material in Nepal and for harmonization with the surroundings.

The normal operating condition of the equipment shall be as follows:

Ambient temperature :	Indoor equipment	: 0°C to 45 °C
	Outdoor Equipment	: -10°C to 60°C
Relative humidity :	Indoor equipment	: 90% at 40°C
	Outdoor Equipment	: 95% at 40°C
Duty		: 24 hours continuous operation

All equipment shall have electromagnetic compatibility and anti-electrostatic features.

(2) Consideration for Social Circumstances

Measures against the intrusion by domestic animals shall be taken because there is cattle grazing around the radar site. The protection of cables from gnawing by field mice also shall be considered.

As a special consideration for the construction schedule control, the numerous national holidays and festivals in Nepal, especially in October and November, should be made.

(3) Construction

The Japanese architectural standard shall be referred to for technical decisions on building works in cooperation with local conditions.

There will be no difficulties or trouble in general construction work under good construction management inferred from the last terminal building construction works.

Common laborers can be obtained easily, but skilled laborers and technicians must be arranged in advance. It is necessary to recognize the difficulties of the implementation of outdoor works during the rainy season. Local contractors may join in limited fields of work in consideration of components of the project. Most of the construction materials and equipment should be obtained from Japan or other countries.

Heavy construction equipment for civil, architectural works and erection towers can be obtained from local contractors except for some special kinds of machines.

Most of the construction materials, excluding aggregate, timber, cement and brick, must be arranged in advance since they will depend on imports from India or other countries. The materials produced in the country also will be required to be arranged in advance because supplies are not stable.

20.2.4 Governability of Executing Agency

As for the Executing Agency, the airport surveillance radar and the training facility will be the full responsibility of DCA.

After completion of the facilities, they will be handed over to Tribhuvan International Airport and the Civil Aviation Training Center respectively.

The airport authority of Tribhuvan International Airport seems to have good management ability, inferred from the operation and maintenance activities of the current systems and equipment, and they can arrange a budget for the operation and maintenance for the radar system which will be provided by this project. However, the maintenance capability for the radar system must be trained in advance because of the special techniques that are required.

Since the radar system and the training facility will require high technical levels to maintain the equipment in good condition, it is essential to arrange a sufficient budget and to provide technical staff for the system management and operation.

Necessary expendable materials and important spare parts for the operation and maintenance will be provided at the handover time with the new equipment, but the budget arrangement to supply additional parts after these parts have been consumed is also very important.

(1) Construction Period

The equipment for system provided by the project will be custom-made and will require a long periods for the manufacturing. Thus, it will take a major portion of the total construction period, and special considerations will be required in the implementation program control of the project.

Implementation will be specified into the following stages:

- System and equipment design
- Manufacturing and inspection
- Installation, adjustment and commissioning tests.

The standard period of each phase is estimated as follows and does not include any design development time:

- Design	:	about 1 month
- Manufacturing and inspection	:	about 10 months
- Installation, adjustment and testing	:	between 3 ~ 6 months

The construction period of the building to accommodate the equipment will require about 10 months, and ancillary facilities such as air conditioning plant or electric voltage transformer, etc. should be manufactured and transported in advance of the installation of equipment. However, they are easy to adjust on the schedule due to a shorter manufacturing period than the radar equipment production. The details will be explained in "20.2.8 Implementation Plan".

(2) Undertakings by the Nepal Side

The following works shall be executed as undertakings by the Nepal side in cooperation with the construction schedule of the project.

- Radar Site
  - The power supply shall be fed from the existing Main Substation by 3 phase 11 KV. The Nepal side shall prepare floor space for installation of high tension voltage switching gear in the main substation.
  - Branching work of the existing water distribution line.
  - Preparation for the new telephone trunk lines at the existing PABX.
- Operations Building
  - Preparation to supply low tension voltage electric power for essential loads.
  - Branching work of the existing water distribution line.
  - Preparation for the new telephone trunk lines at the existing PABX.
- Training Center
  - The extension works' public telephone line to the telephone terminal box at the training center building.
  - Improvement of the existing access road to the site.
  - Water supply to a reservoir tank on the site
- Flight Inspection

20.2.5 Site Selection

(1) Siting of the Facility

The airport surveillance radar consists of two major functions, the transmitter/receiver installed at the radar equipment building, and the signal processor and display unit installed at the radar operations building.

The Radar operation building is preferably to be located near the current operating facility, but the location of the transmitter and receiver facilities shall be decided in consideration of radar coverage, siting conditions and construction conditions.

The Department of Civil Aviation has plans to relocate the existing Aviation Training Center (CTAC) to the previous receiving station site in the near future. If so, the new radar training facility provided by the project should be constructed at the previous receiving station site so as to coordinate with the future plan. The construction site for the radar equipment building was studied based on the design criteria. The results are shown as follows. The most suitable site was selected on the airport site. The locations of alternative sites are shown in Figure 20.2.1.

- Mt. Phulchauki Site

  The low angle area is not covered due to the characteristics of the radar antenna. This means that a departing or arriving aircraft with a low flying level can not be detected.

- Mt. Nagarkot Site

  Horizontal coverage is insufficient due to the shadow of Mt. Phulchauki. The deficient coverage overlaps with the Shara approach which is the main approach route from the south.

  The coverage chart is shown in Figure 20.2.2.

- Changunarayan Site

  Near screened obstruction is anticipated on this site. Therefore a 25 m or higher antenna tower will be required to clear this obstacle. Improvement of the access road and installation of a radio link between the airport and the site would be required.

  The coverage chart is shown in Figure 20.2.3.

- Torebhir Site

  The site survey was not carried out because of the difficulty of access due to road conditions. Judging from the actual conditions, large scale construction works for the access road would be required.
  The coverage chart is shown in Figure 20.2.4.

- Airport Site

  Part of the radar coverage is screened by Mt. Phulchauki and Chandragili, but surveillance for approaches from the south is possible.
  The coverage chart is shown in Figure 20.2.5.

(2) Facility Layout Plan

Facility layout plan of the radar operations building, radar equipment building and training facility at Tribhuvan International Airport was studied as shown in Figure 20.2.6 to Figure 20.2.10 in consideration of easy construction, short construction period, and coordination with the future plan.

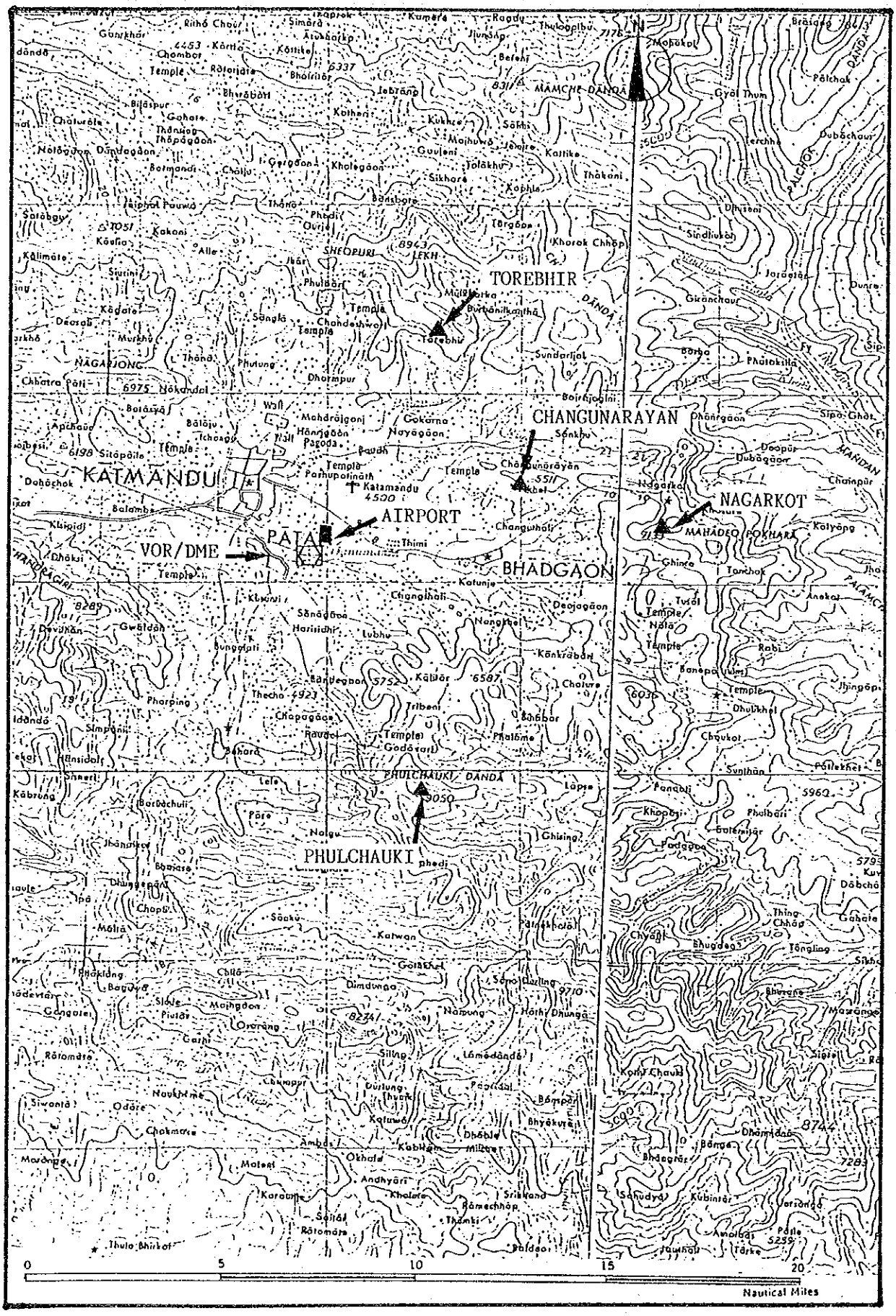


Figure 20.2.1 Alternate Radar Site Locations

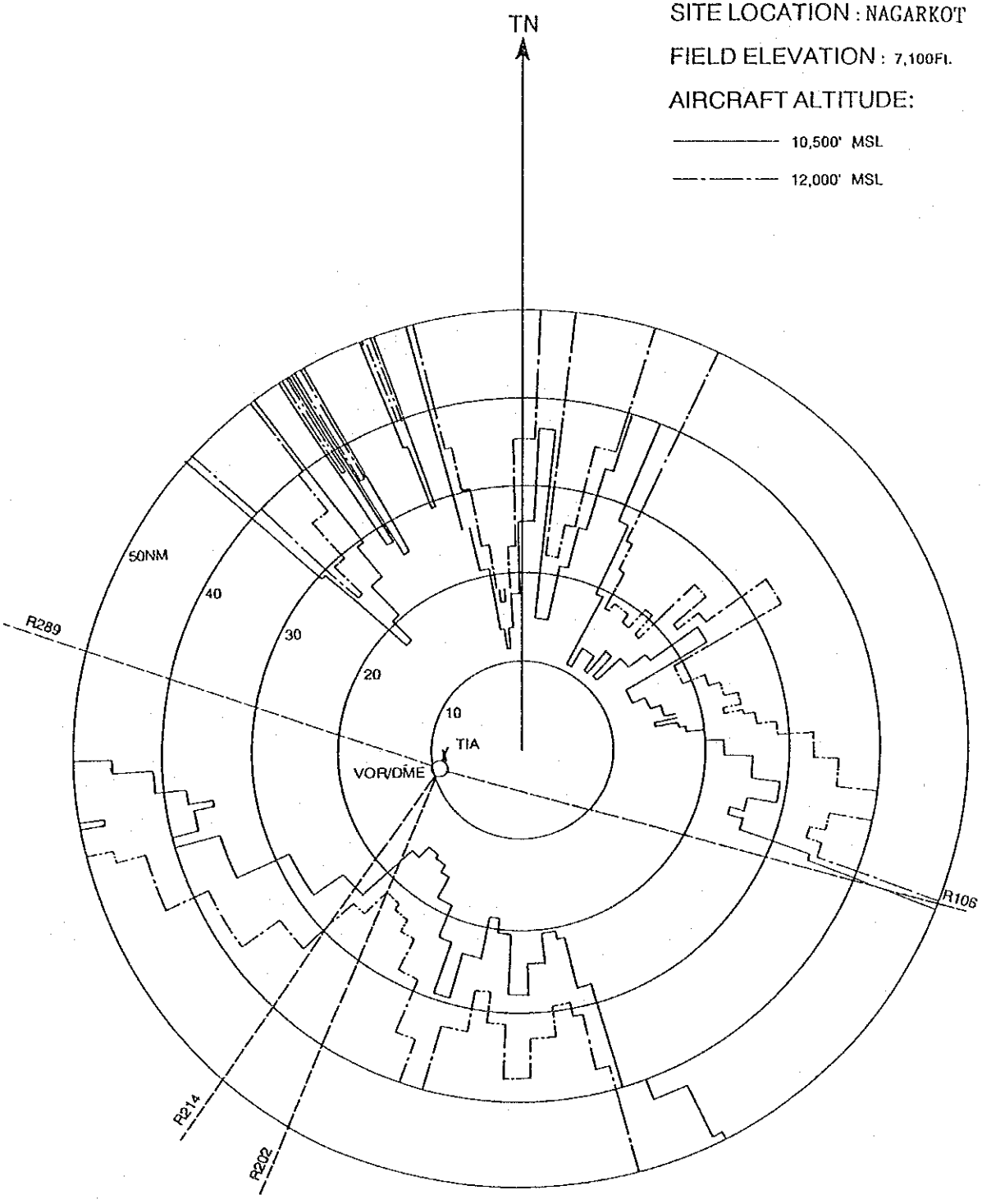


Figure 20.2.2 Coverage Chart for the Mt. Nagarkot Site

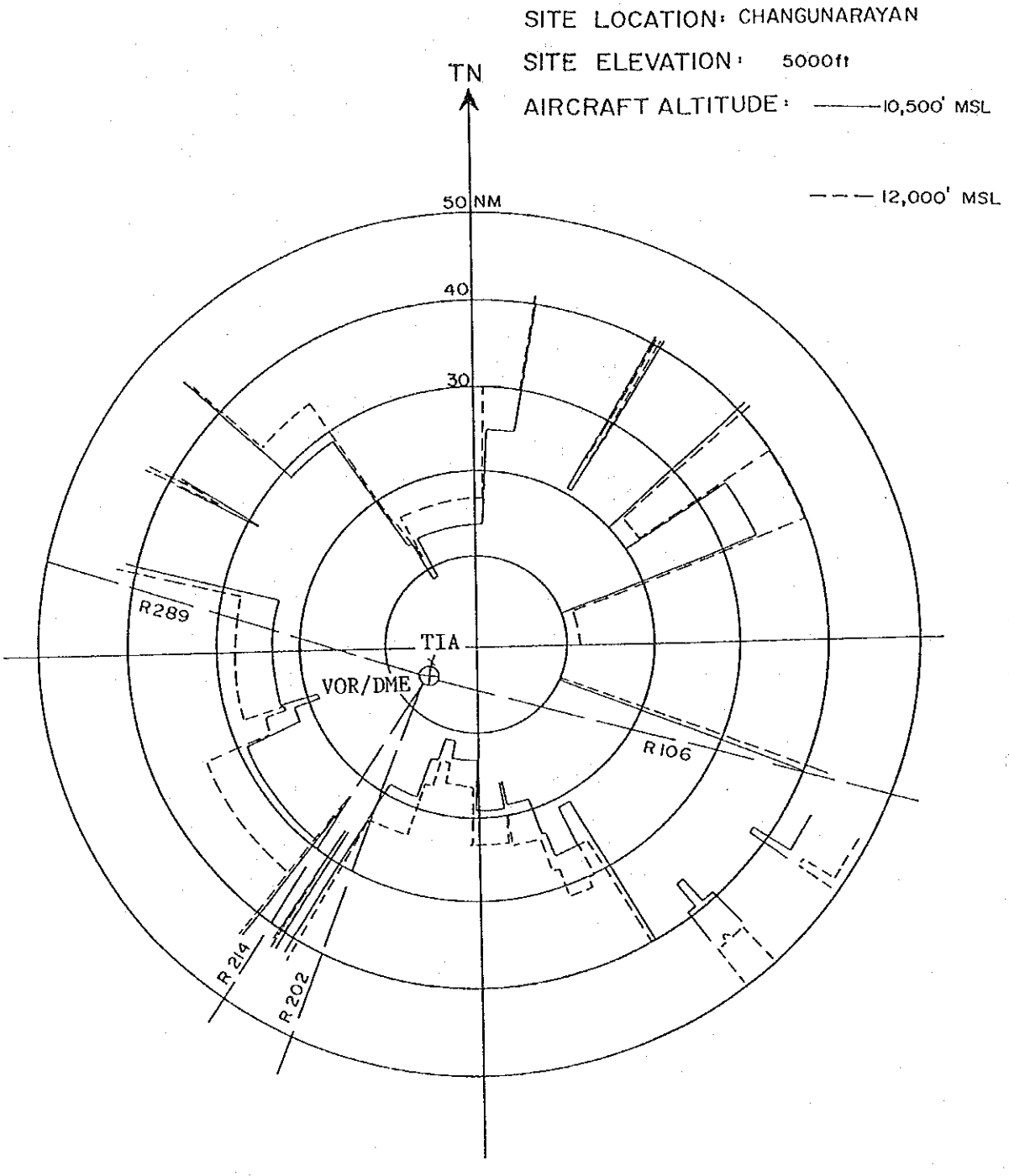


Figure 20.2.3 Coverage Chart for the Changunarayan Site

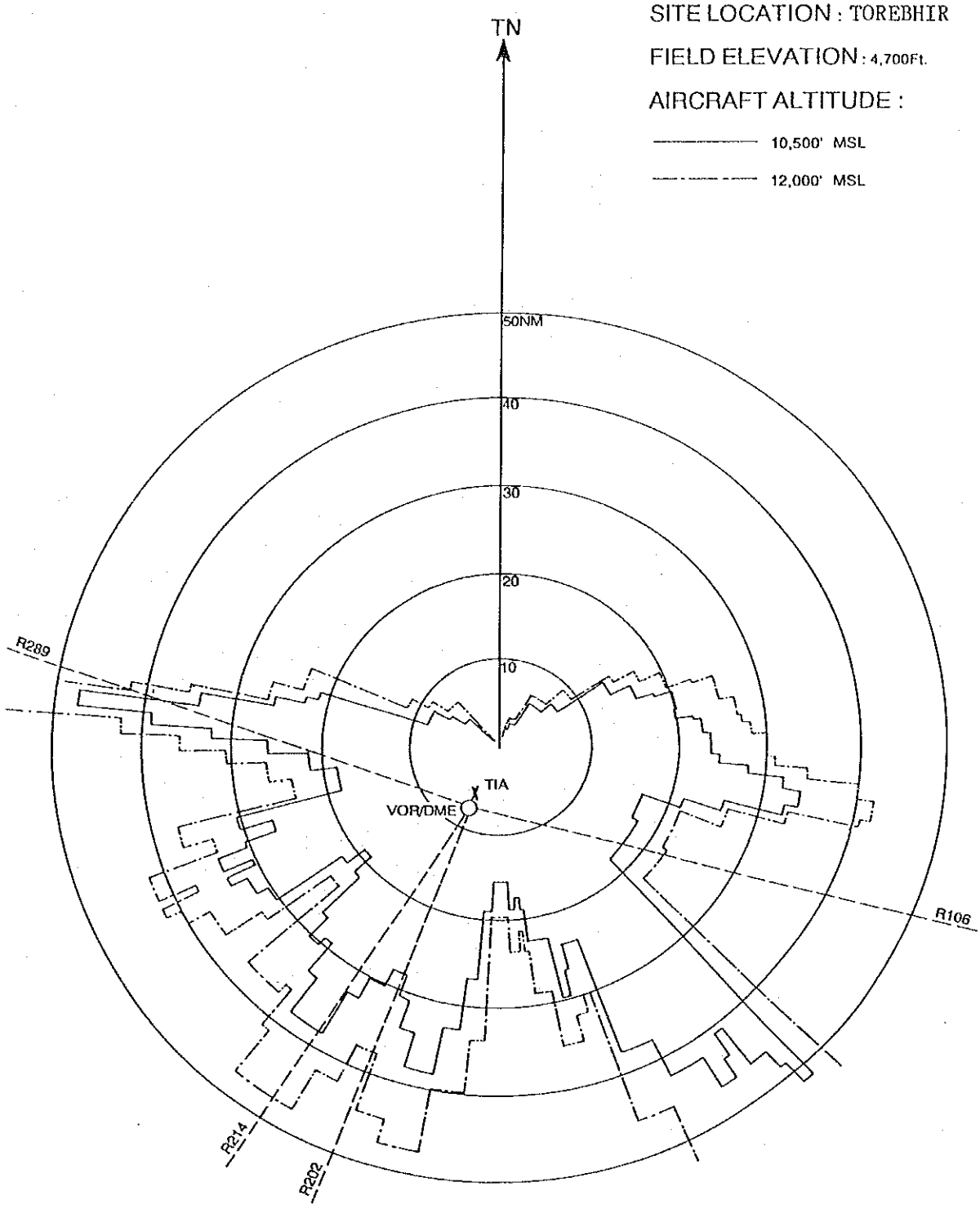


Figure 20.2.4 Coverage Chart for the Torebhir Site

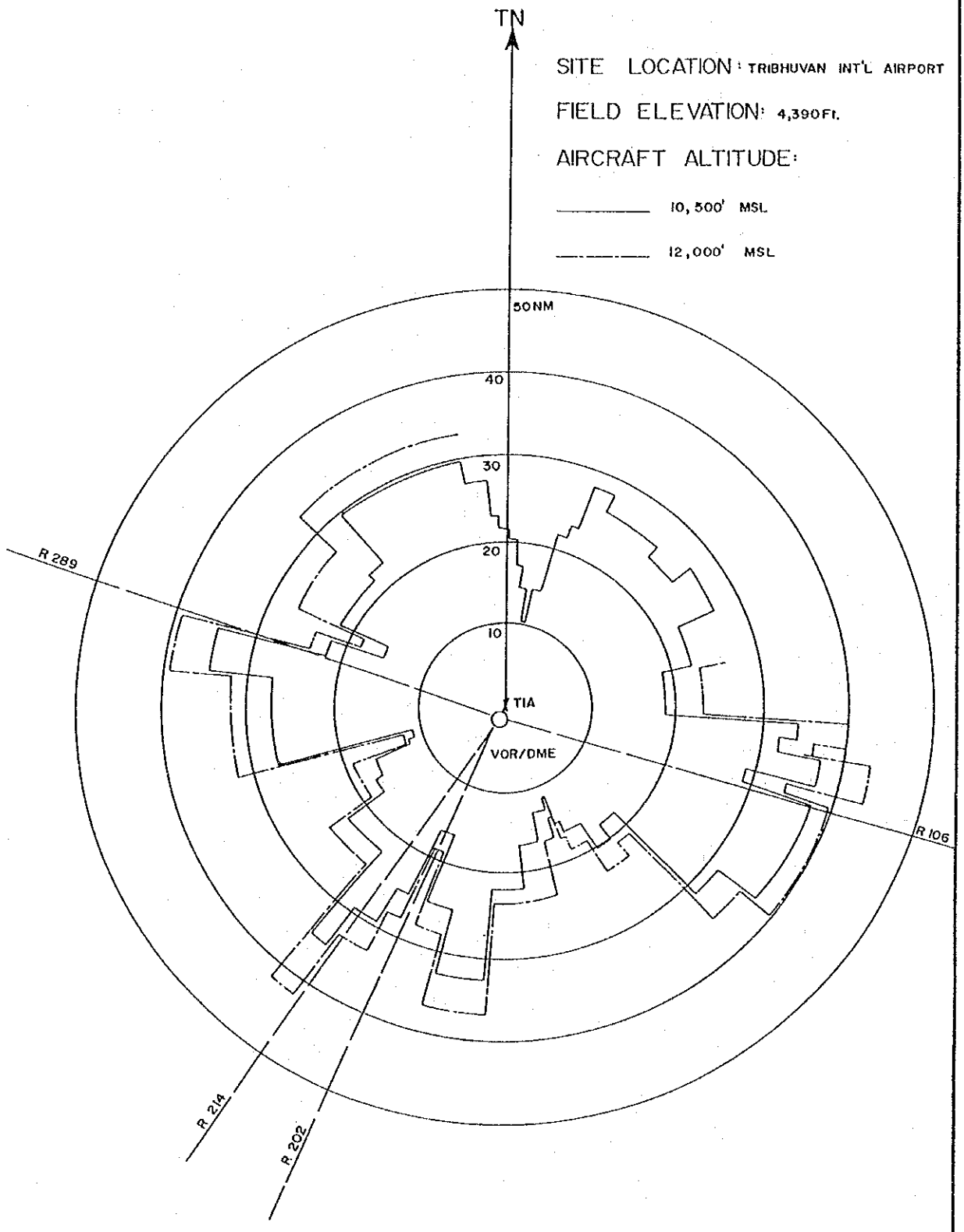


Figure 20.2.5 Coverage Chart for the Airport Site

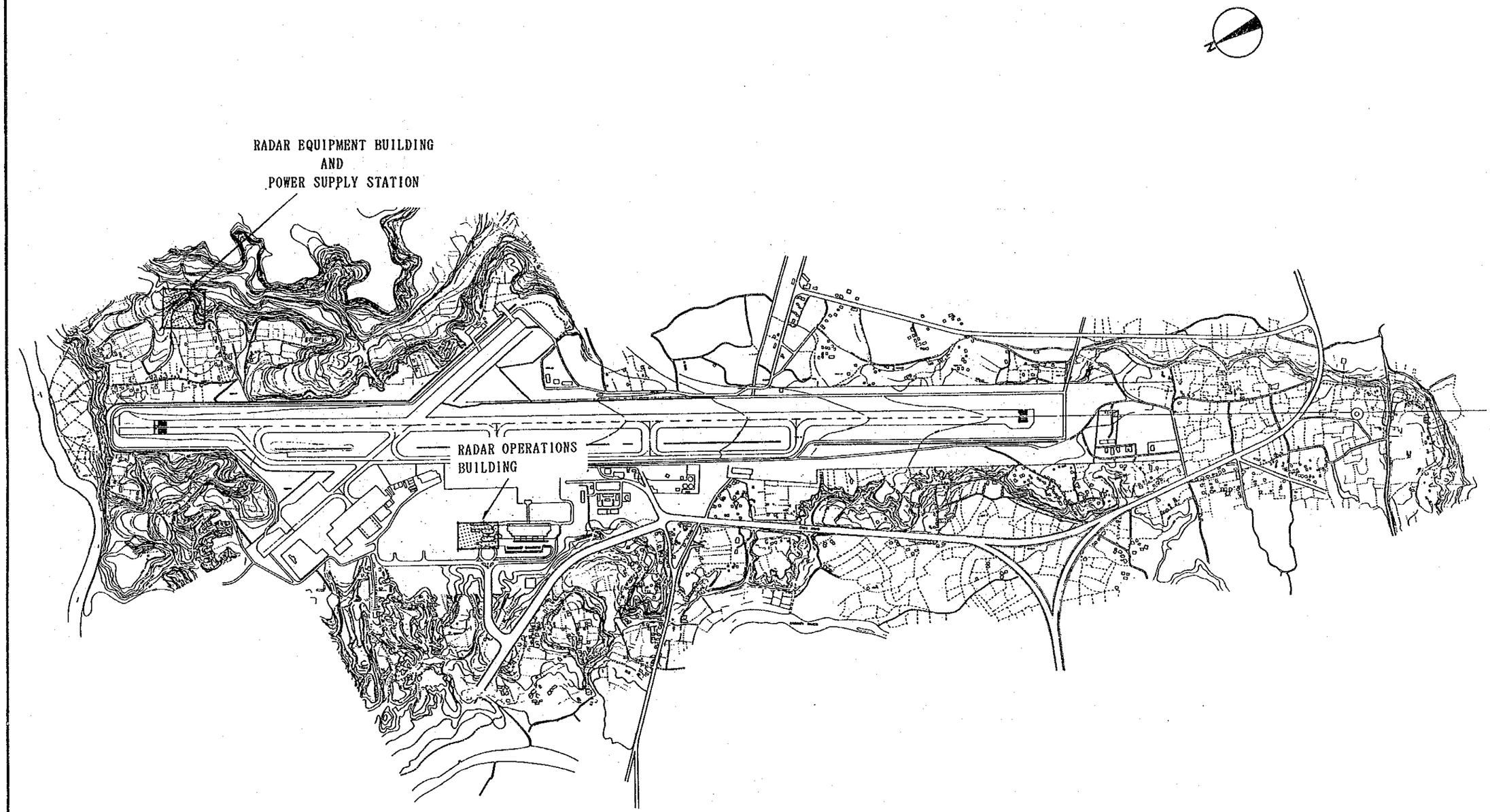


Figure 20.2.6 Radar Facilities Location Map

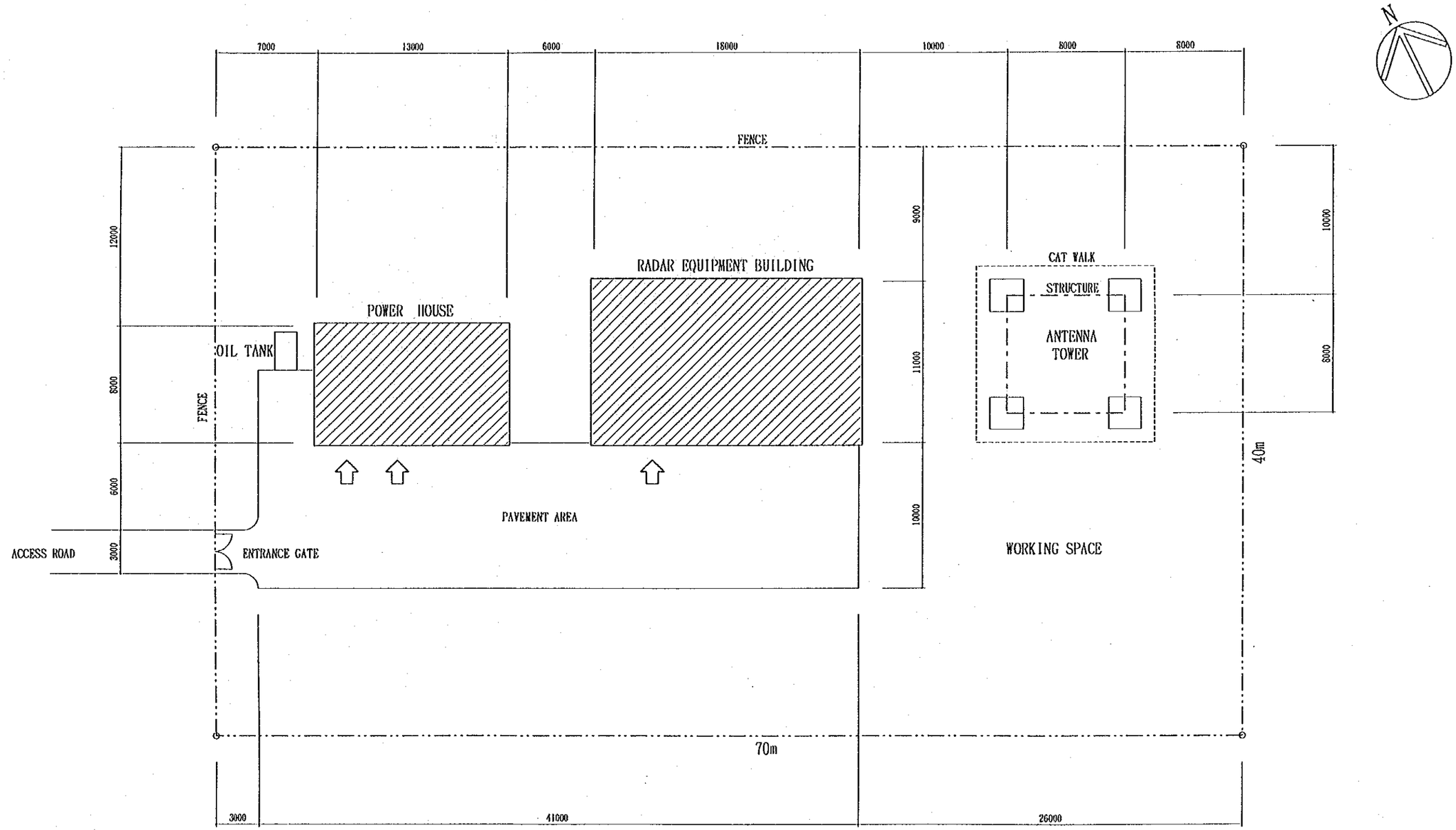


Figure 20.2.7 Radar Site Layout Plan

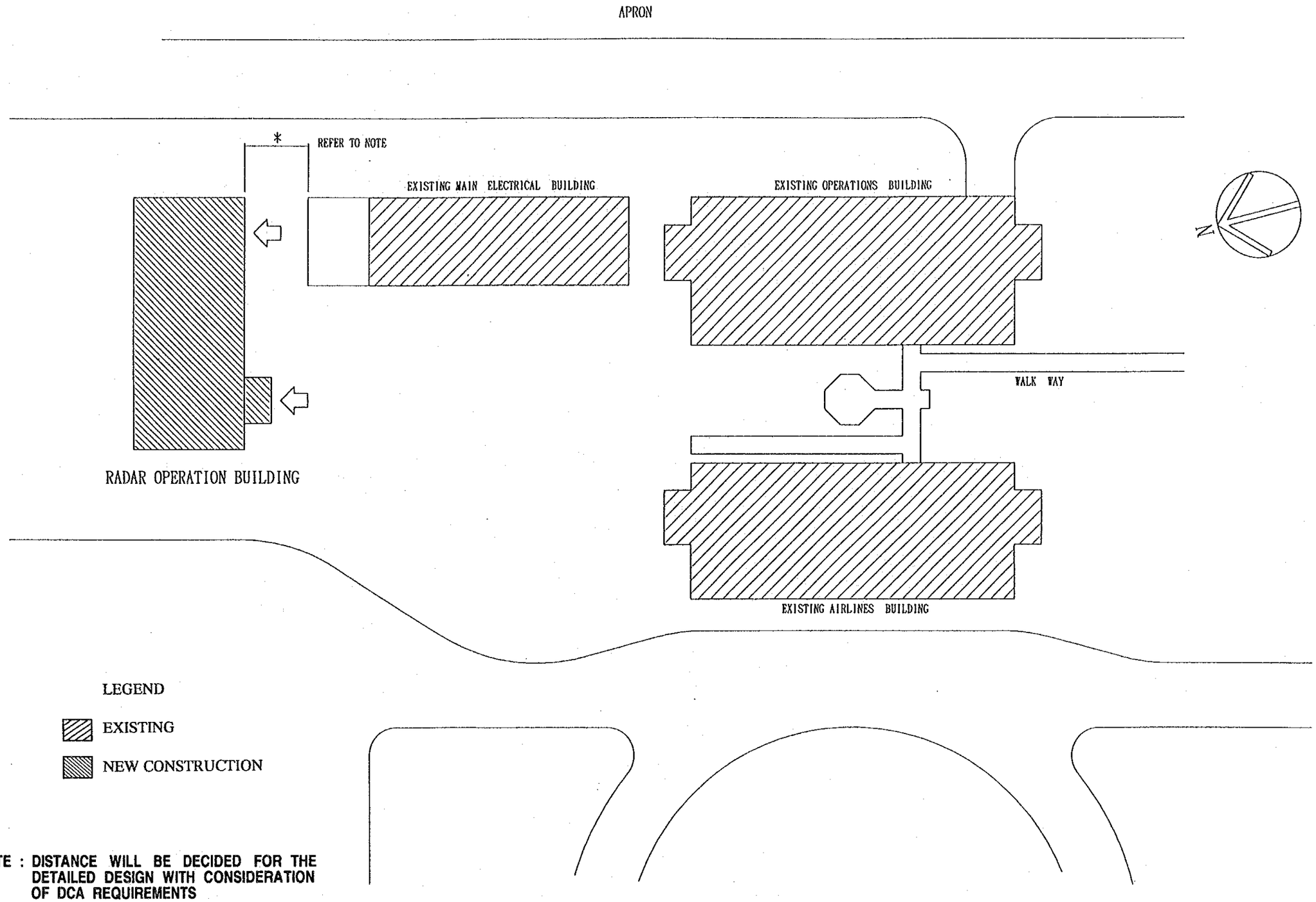


Figure 20.2.8 Radar Operation Building Site Layout Plan

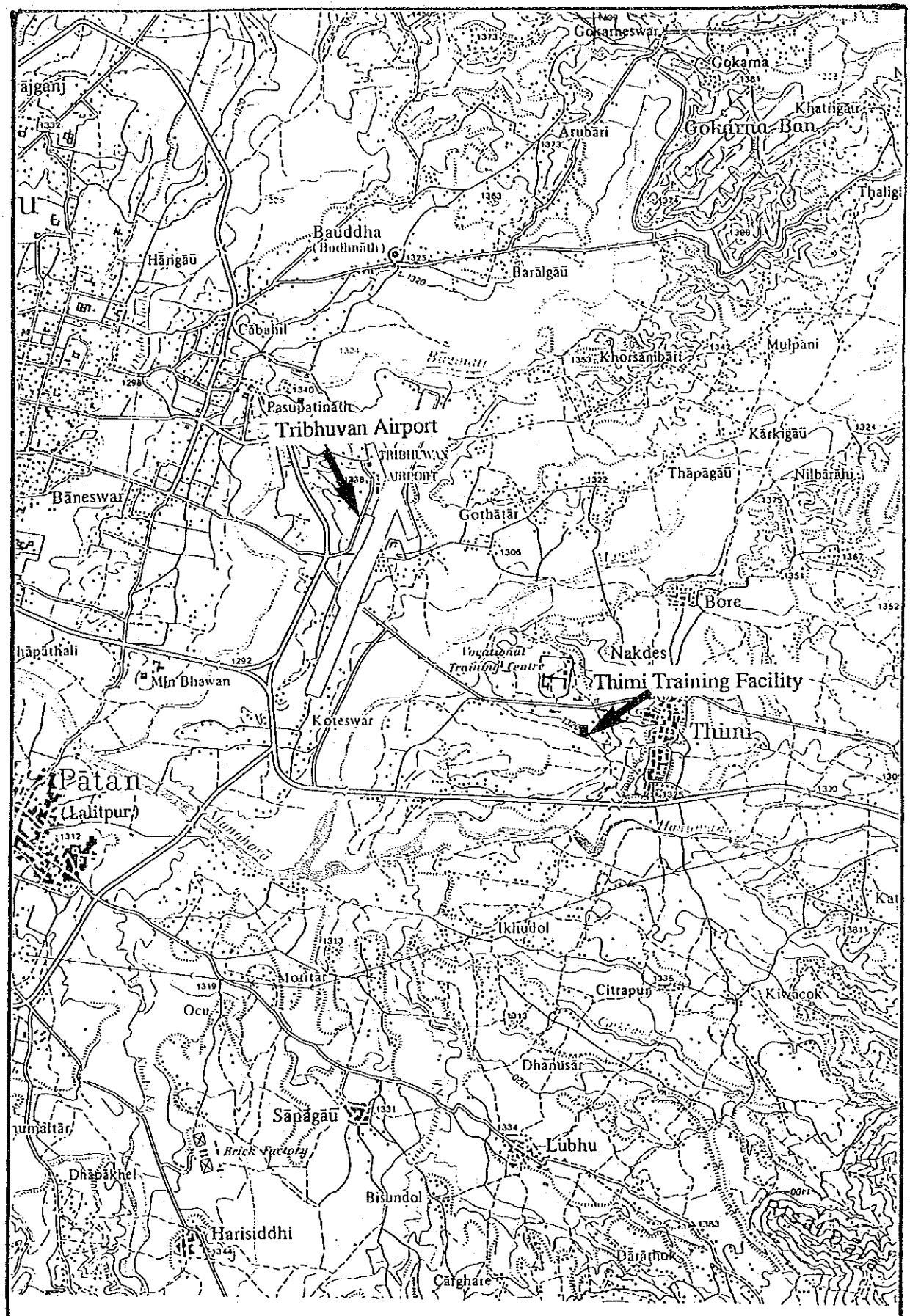


Figure 20.2.9 Radar Training Building Location Map

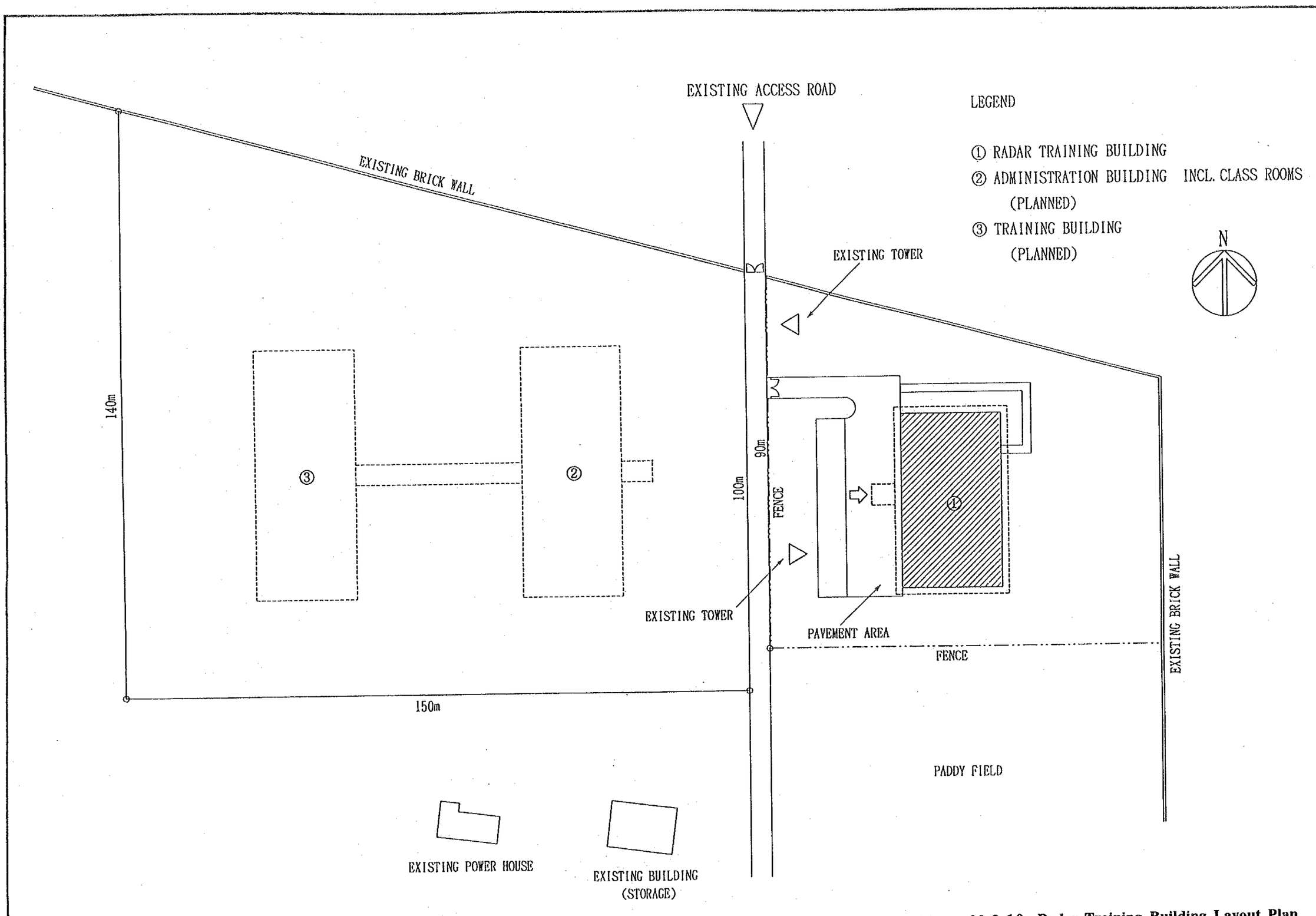


Figure 20.2.10 Radar Training Building Layout Plan

20.2.6 Facility Plan

(1) Basic Function of Airport Surveillance Radar

The Airport Surveillance Radar (ASR) system, which consists of a primary radar and secondary beacon radar will be divided into two parts; one is the radar head for the transmitting and receiving of radar signals and beacon signals. Another is the operation unit with signal analyzing, processing and display for the operations.

The components of the radar head and antenna will be installed in the radar equipment building at the radar site, and the signal analyzing, processing and display unit will be in the operations building.

These two units are connected with the communication and control cable for the signal transmitting and remote monitoring and controlling.
The following performance shall be considered for the system design.

- Radar Coverage

  The requirements of radar coverage shall be satisfied with the following conditions at 25,000 feet vertical coverage and 60 nautical miles in the azimuth range.

  - Target Reflection Area : 2 m^2
  - Detection Probability : more than 80 %
  - False Alarm Rate : 10^{-6}

- Measures for clutter

  The special measures for the occurrence of ground clutter shall be considered due to the topographical condition of Kathmandu Valley. The following measures shall be studied.

  - application of MTD (moving target detection) based on the I.Q. logic.
  - elimination of reflection by ground obstacles by STC.

- Warning by Secondary Radar Signal

  The following warning functions shall be provided by the processing signal data processing of the secondary radar.

  - MSAW (Minimum Safe Altitude Warning)
  - CN (Conflict Alert)

The allocation of a frequency for VHF air to ground communication and communication equipment is required for the radar operation. This communication equipment shall be installed at Mt. Phulchauki to maintain sufficient coverage. Stand-by equipment shall be installed at the existing operations center.

Other than the above communication system, inter-communication circuits between the radar consoles and ACC consoles, control tower consoles are indispensable for the effective operation of the radar system.
The System Concept is shown in Figure 20.2.11

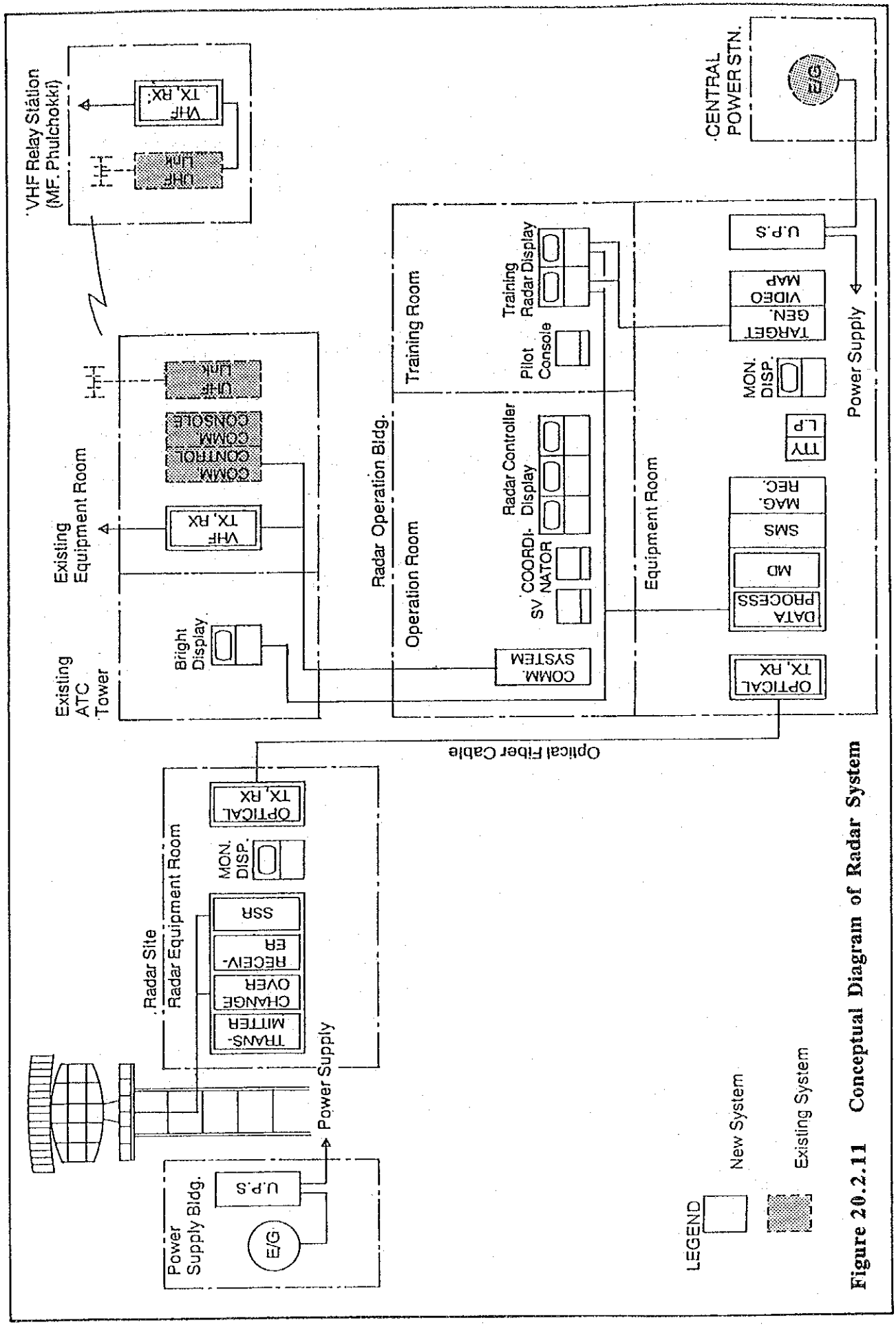


Figure 20.2.11 Conceptual Diagram of Radar System

(2) Facility Layout Plan

A radar equipment room, a power supply building and a radar operations building for the accommodation of the new radar system shall be newly constructed within the airport property because of the lack of space in the current airport buildings.

The facility for the training of radar controllers and maintenance technicians shall be provided in Chimi at the previous receiving site.

(3) Outline of Facility

- Radar Equipment Room and Power Supply Building
  - Floor area
    - Radar equipment room : 198 m^2
    - Power supply building : 104 m^2
    - Height of antenna tower : 25 m
  - Single-story building
- Radar Operations Building
  - Total floor area : 648 m^2
  - Two-story building
- Training Center
  - Total floor area : 690 m^2
  - Single-story building

(4) Main Equipment

The main equipment in each building is shown in Table 20.2.1, and shall include necessary spare parts, test equipment and special tools.

(5) Outline of the Specification

- ASR

Output power	:	500 Kw
Frequency	:	S band (2,700 ~ 2,900 MHz)
Type of Amplifier Tube	:	Klystron
Noise Figure	:	Less than 4.0 dB
Range Resolution	:	Not more than 200m at 25 nm
Azimuth Resolution	:	Not more than 1.5 degrees at 25 nm
Accuracy	:	Not more than 50m and 0.5 degrees

- SSR

Interrogation modes (ground-to-air)

Mode A - to elicit transponder replies for identification and surveillance. (8 ± 0.2 microseconds)

Mode C - to elicit transponder replies for automatic Pressure - altitude transmission and surveillance. (21 ± 0.2 microseconds)

Performance and characteristics shall conform with ICAO, Annex 10 specification.

- Signal Processing

Range	About 60 NM
Radar Processing Data	Primary Surveillance Radar Data
	Secondary Surveillance Radar Data
Number of Displays	max. 6 displays
Processing Capacity	120 Aircraft (Number of Tracks)
Response Time	within 1.5 sec.
Display of Data Block	Beacon Code
	Aircraft Identification
	Altitude / Coast / Hand off Symbol /
	Speed / Aircraft Type / Emergency
	Indication / Category
Display of List	26 lines (maximum)
RDP Interface	Option
Operation	Dual

The radar system should have compatibility with the other SSRs which may be located outside of the airport.

Power Supply System

The electric power supply to the radar operations building and radar equipment building shall be fed from the main power substation of the airport. Low tension voltage supply to radar operations building and high tension voltage supply to radar equipment building shall be designed taking cable losses into consideration. The system shall be backed up by the central engine generator of the airport or the local engine generator. The essential load should also be supported by uninterrupted power supply system (U.P.S).

Performance of Power Supply System

Radar Site	:	UPS: 50 KVA 15 minutes support
		Emergency Generator: 120 KVA
Operation Building	:	UPS: 30 KVA 15 minutes support

The power supply system of the training center shall be by high tension voltage from the main cable and stepped down by a transformer in a cubicle.

- Training System

Controller Simulator

Scale of Simulation	More than 10 training area settings
	More than 20 training programs available

Training Conditions	Wind Direction 360 degrees
	Wind Velocity up to 200 knots
	Ground Clutter
	Equipment Failure
Aircraft Movement Control	
	Flight plan setting; more than 100 tracks
	Presetting track number; more than 20 tracks
	Controlled track number; more than 10 tracks
Maintenance Training Equipment	
	ASR(Single Configuration) Same as airport
	ASR radar
	SSR(Single Configuration) Ditto
	Training kits for practice

Table 20.2.1 Equipment List

Building	Room Name	Equipment	Q'ty
Radar Operations Building	Radar Operations Room	Radar Display Console	3
		Coordinator Console	1
		Supervisor Console	1
		DEDS/TTY Terminal	1
	Simulator Training Room	Radar Display Console	2
		Pilot Console	2
	Equipment Room	Radar Data Processor	1
		Video Recorder	1
		Reproducer	1
		Monitor Display	1
		System Management Console, DEDS, TTY	1
		Comm. Control System	1
		Optical Control	1
	Power Supply Room	U.P.S.	1
		Battery	1
Radar Head Equipment Building	Radar Head Equipment Room	ASR TX/RX	2
		SSR TX/RX	2
		Signal Processor	2
		Change Over Unit	1
		Monitor Display	1
		Optical System Terminal	1
	Power Supply Room	U.P.S.	1
		Battery	1
		Engine Generator	1
Training Building	Simulation Room	Radar Display Console	3
		Comm. Console	3
		Pilot Console	3
	Computer Room	Computer System	1
		Video Generator	1
		Comm. Control System	1
		Video Recorder	1
		Video Reproducer	1
		System Management Console, VDU/TTY	1
		Power Supply	1
	Radar Laboratory	ASR TX/RX	1
		SSR TX/RX	1
		Monitor Display	1
	Data Digital Laboratory	Digital Circuit	1
		Training set	3
		Personal Computer	

20.2.7 Building Construction

The building facilities design will be carried out based on the following design plans:

(1) Site Layout Plan

- Radar Site

  Radar equipment building, local power station and radar antenna tower will be provided at the radar site. The distance between the equipment building and the antenna tower should be close in order to minimize feeder losses of RF. A working area should be provided around the tower.

  A carpark and turning area for vehicles will be required in front of the building. Fencing around the site and outdoor lighting facilities should be provided. Layout of the equipment building and the local power station should be taken into consideration for accessibility.

- Radar Operations Building

  The radar operations building will be located near the existing airport operations building and be connected by a path. A carpark in front of the building, and an access road to the airport main road shall also be provided.

- Training Facility

  The location of the training building will be planned on the previous radio receiver site close to the access road. Landscaping should be considered around the building.

(2) Layout Plan

- Radar Site

  The radar equipment building and local power station will be designed individually, and the entrance for the each building shall be planned to have an adequate opening to carry in/out the equipment. A radar equipment room, maintenance office, toilet and serving room will be provided in the equipment building. An engine system generator with a fuel tank, uninterrupted power supply system (U.P.S) with battery will be accommodated in the local power station building. On the antenna tower, a working space shall be provided and a ladder.

- Radar Operations Building

  The radar operations building shall be planned in a two-story configuration consisting of a radar operations room on the first floor and an equipment room on the ground floor. Heavy weight equipment such as the radar equipment, U.P.S and lead acid batteries will be installed on the ground floor. A toilet and serving room will also be provided. The radar operations room and the On-the-Job Training room, located close to the operations room, will be provided on the first floor in consideration with the flow of staff. An office room on each floor of the building which has a relation with the room's functions shall be provided.

- Training Building

The training building, with a detached single-story configuration, has two functions; an area for radar controller training and for radar maintenance technician training. The building space is divided into two areas, the left half and right half roughly, and each function will be provided in the zoning plan.

A practice training room and class rooms are located close to each other to maintain a short traffic line. Additionally a cafeteria, conference room, library, chief of training center room, administration room, watch man room and storage room shall be provided. Adequate space will be provided for toilets and an entrance to the building based on the requirement of the training facilities generally.

The floor area of the training center should be sufficient so that training can be conducted for at least 12 trainees of the radar operations and maintenance respectively, at the same time.

An inner court and corridors are provided at the center of the building.

(3) Sectional Plan

- Radar Equipment Building

On the assumption that the maximum height of the equipment will be 2,500 mm, the clear space between the ceiling and top surface of the equipment will be 1,000 mm, a total effective height of more than 4,500 mm above floor level will be required for the equipment installation.

- Local Power Station Building

In the same manner, a maximum height of 1,800 mm for the engine generator will be required. The exhaust muffler of the engine will be suspended from ceiling slab, and an effective height of 2,700 mm will be required. In this height , the U.P.S. may be installed as the maximum height of the U.P.S. is assumed within 2,300 mm.

- Operations Building Ground Floor

The maximum height of the equipment is assumed to be 2,000 mm. Since more than 500 mm effective space is required, 2,500 mm above floor level to the ceiling will be required. All of the necessary cables will be installed in floor pits or floor ducts but it will not be necessary for cable ladder access.

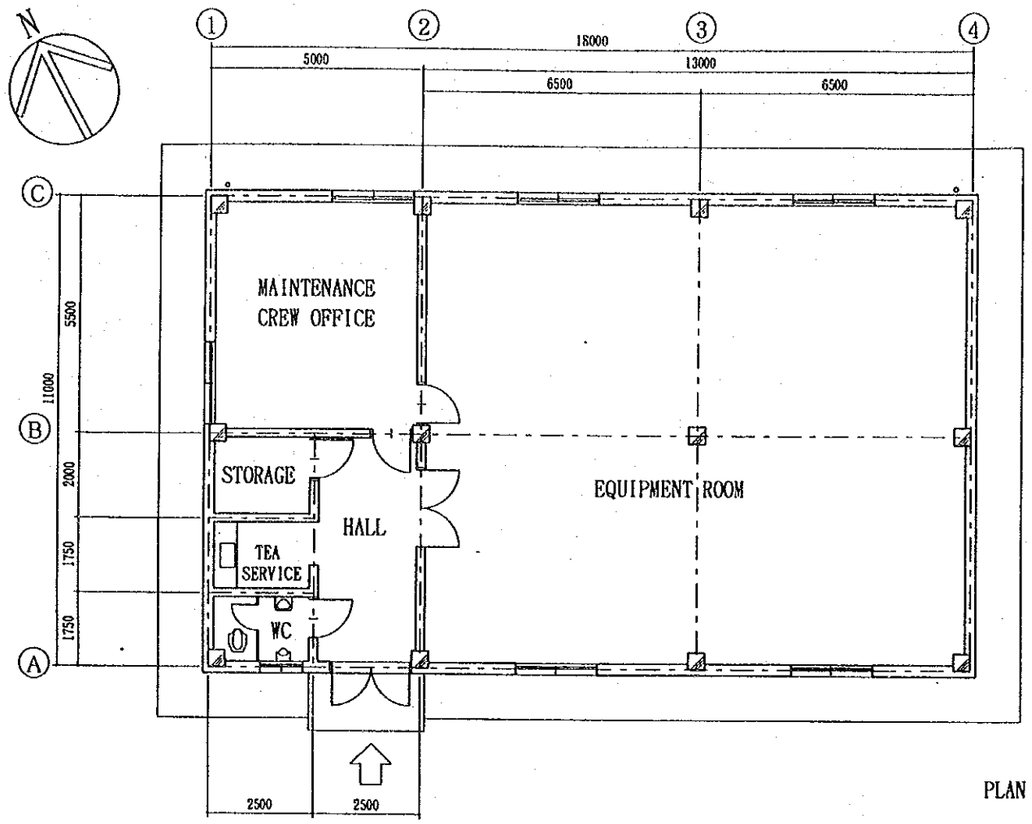
- Operations Building First Floor

No tall equipment will be installed in this room and cable access will be planned using floor pits or floor ducts. Thus, the ceiling clearance height above floor level is determined to be 2,500 mm.

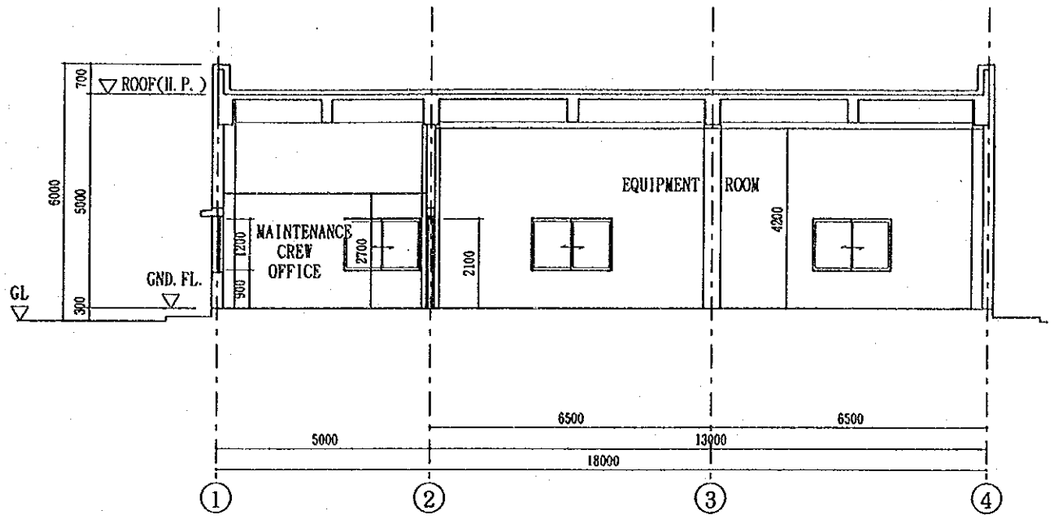
- Training Building

The equipment installed in the building will be the same as the equipment which is installed in the radar equipment building and radar operations building. Although the maximum height of the equipment is assumed to be 2,500 mm, dummy load installation space above the equipment top surface will be required instead of wave guide and cable ladder space. Thus, a maximum height of 3,500 mm above the floor will be required.

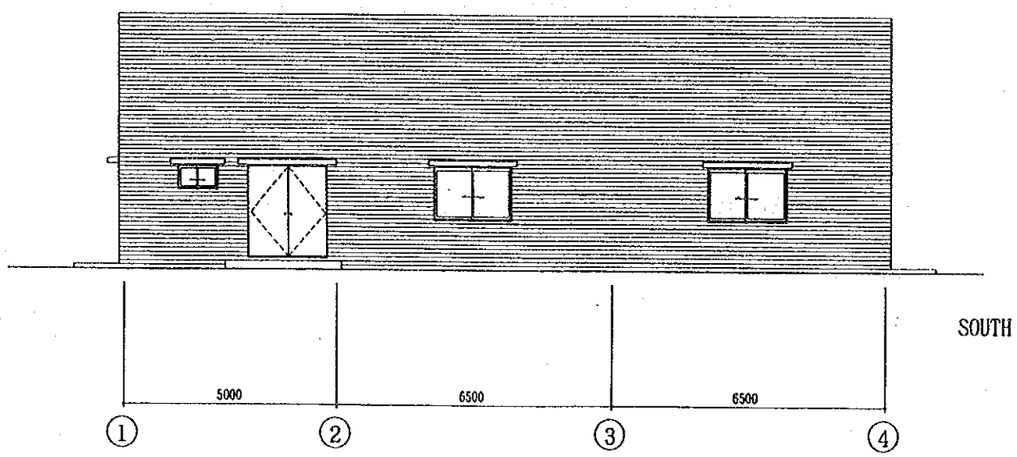
Since the necessary space between the bottom of the roof beam and floor surface of the room is dependent on the requirements of equipment installation and maintenance, the sectional plan of the building should be reviewed at the detailed design phase. Layout plan and section / elevation of the buildings are shown in Figure 20.2.12 to Figure 20.2.19.



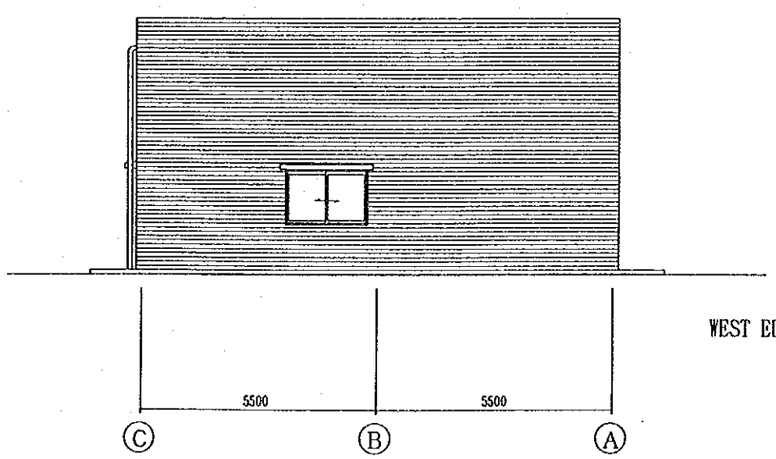
PLAN



SECTION

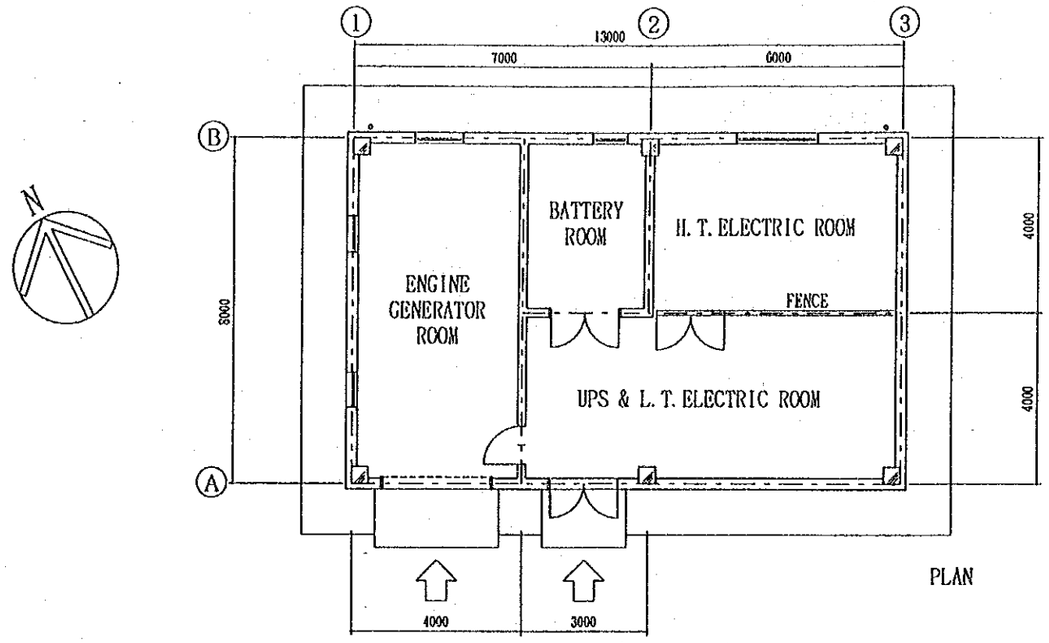


SOUTH ELEVATION

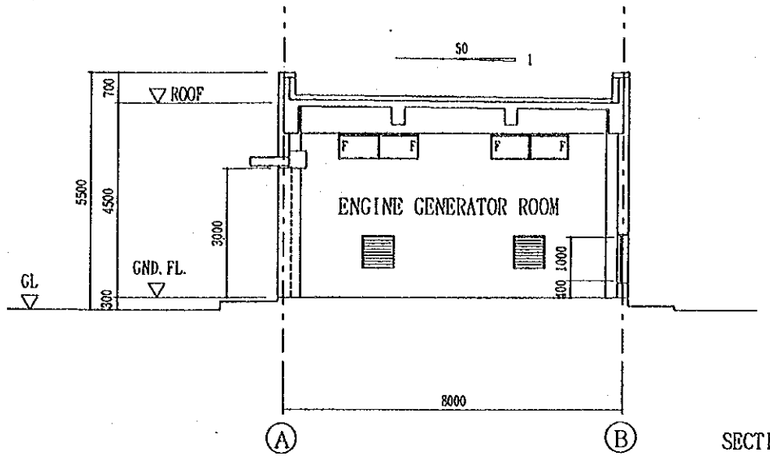


WEST ELEVATION

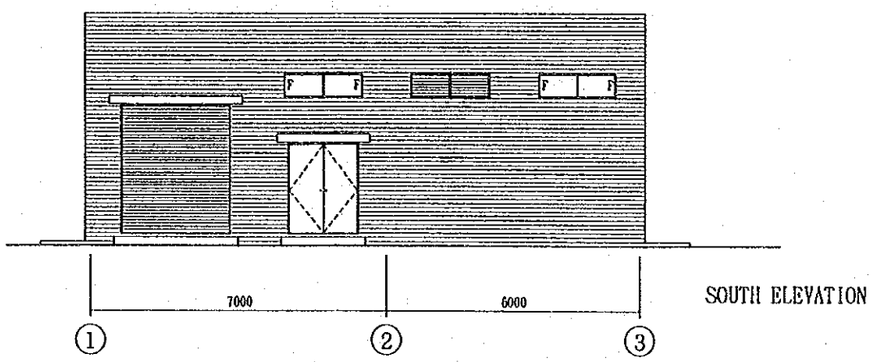
Figure 20.2.12 **Radar Equipment Building**
Layout Plan and Section / Elevation



PLAN



SECTION



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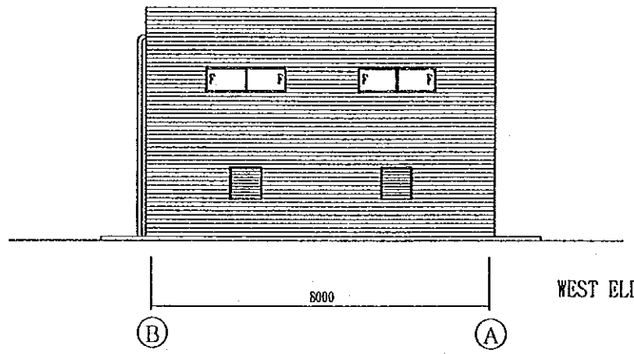
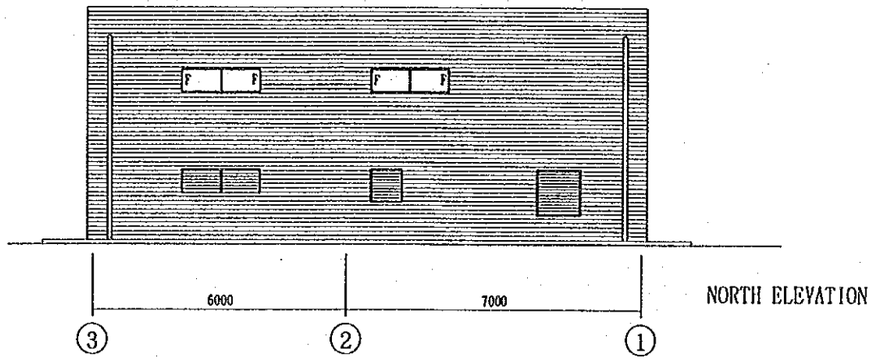
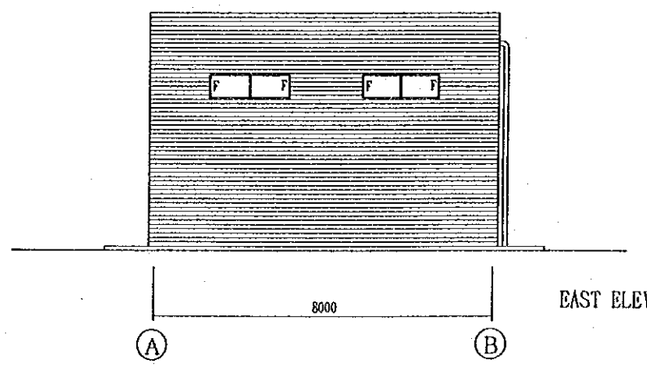


WEST ELEVATION

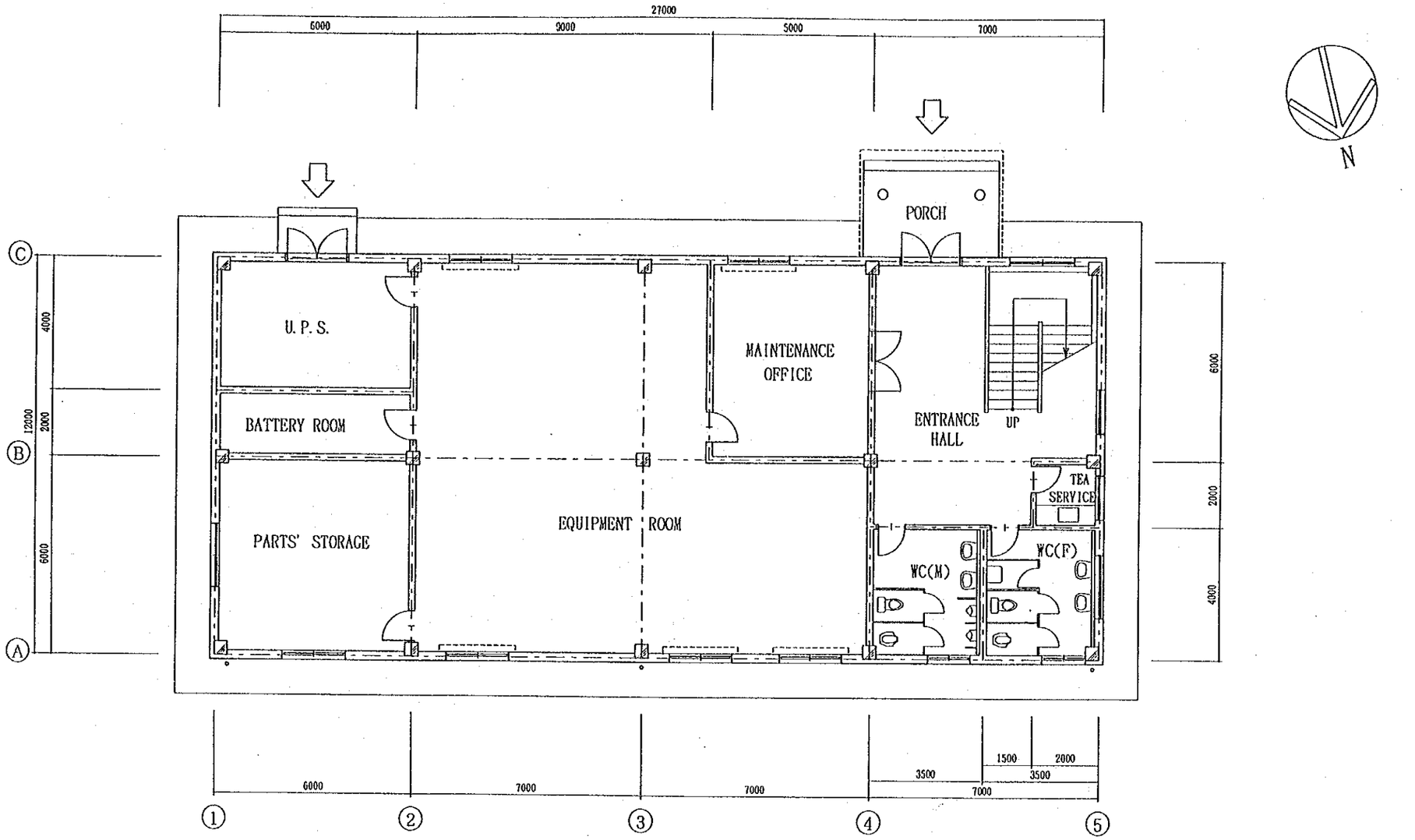


NORTH ELEVATION



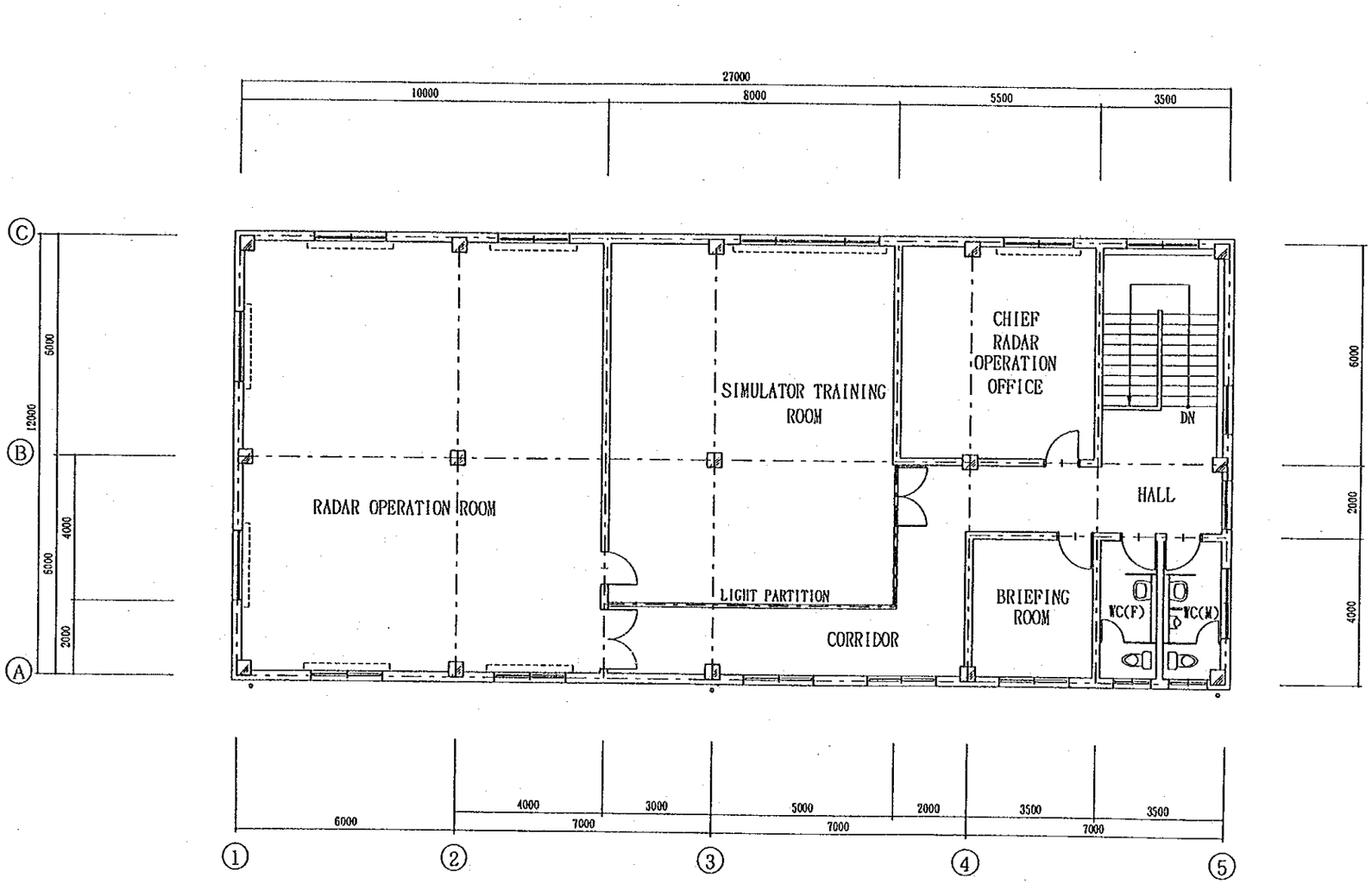
EAST ELEVATION

Figure 20.2.13 Power House Layout Plan and Section / Elevation



GROUND FLOOR PLAN

Figure 20.2.14 Radar Operations Building Ground Floor Plan



FIRST FLOOR PLAN

Figure 20.2.15 Radar Operations Building First Floor Plan

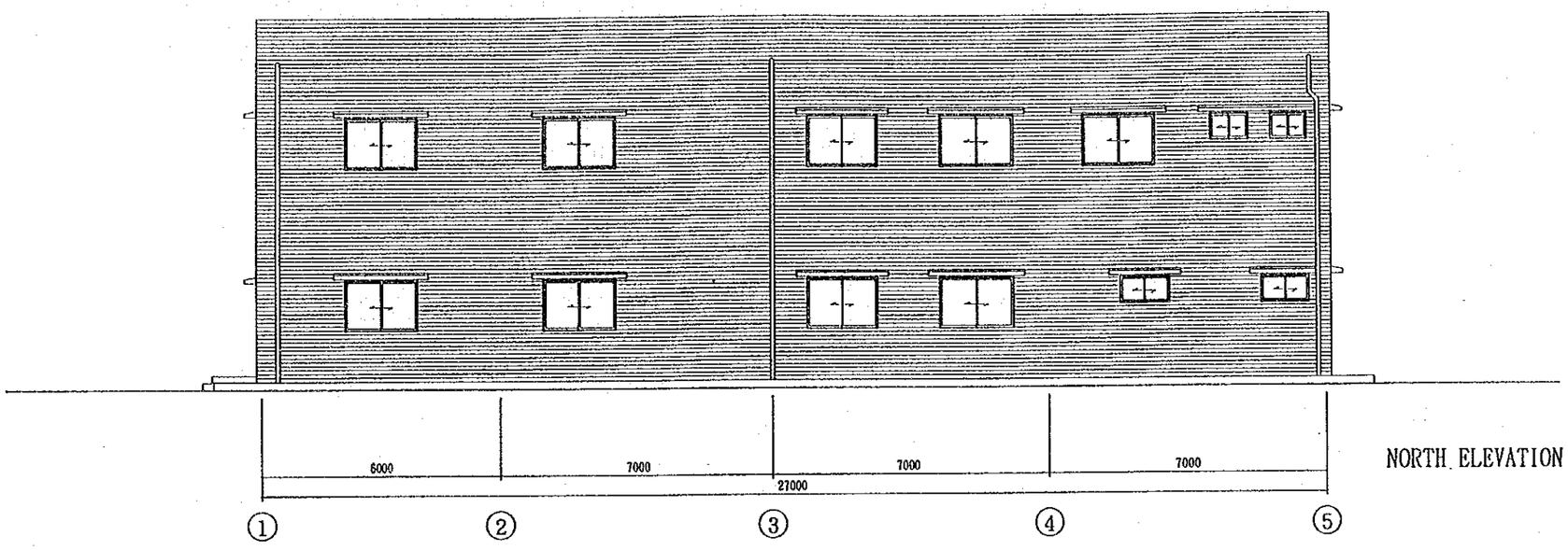
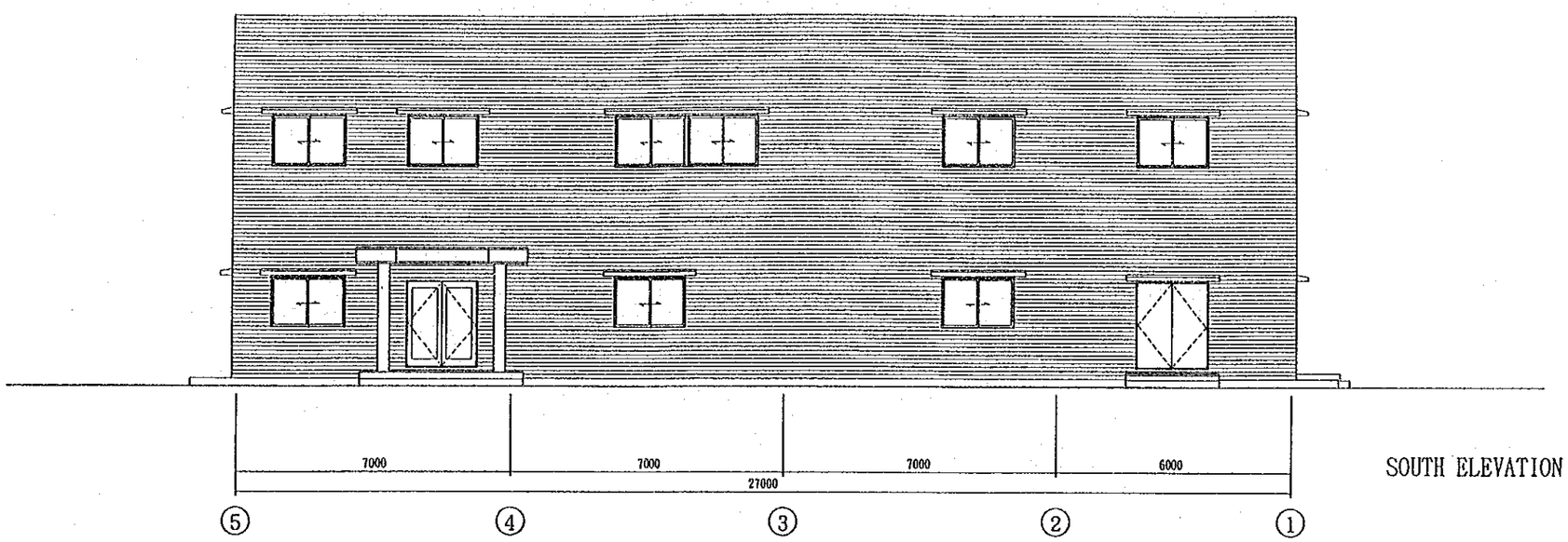
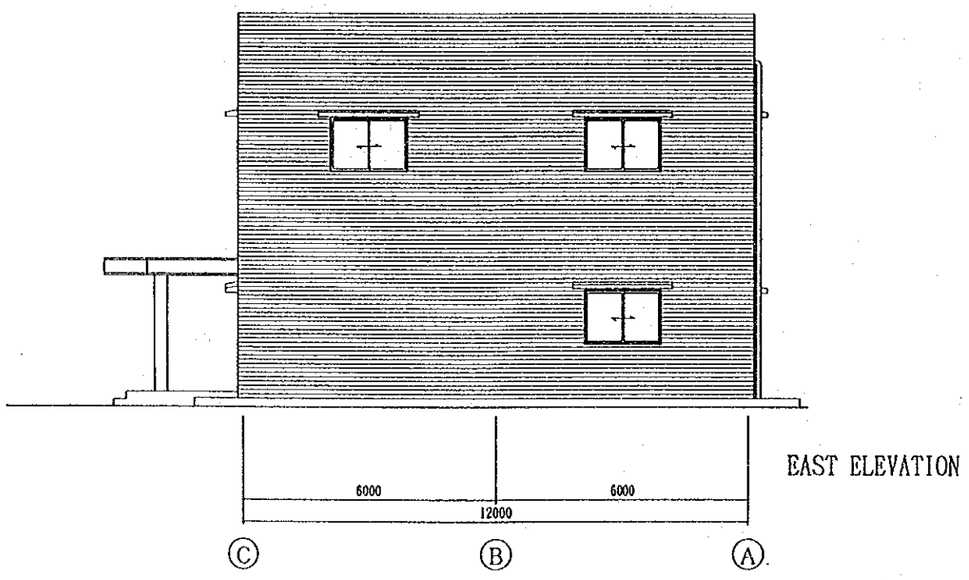


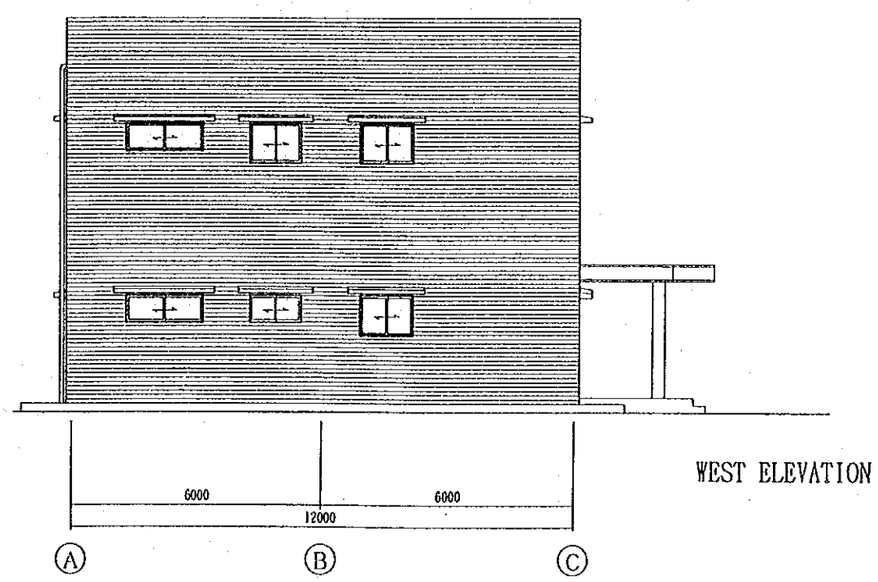
Figure 20.2.16 Radar Operations Building Section / Elevation (1)



SOUTH ELEVATION



EAST ELEVATION



WEST ELEVATION

Figure 20.2.17 Radar Operations Building Section / Elevation (2)

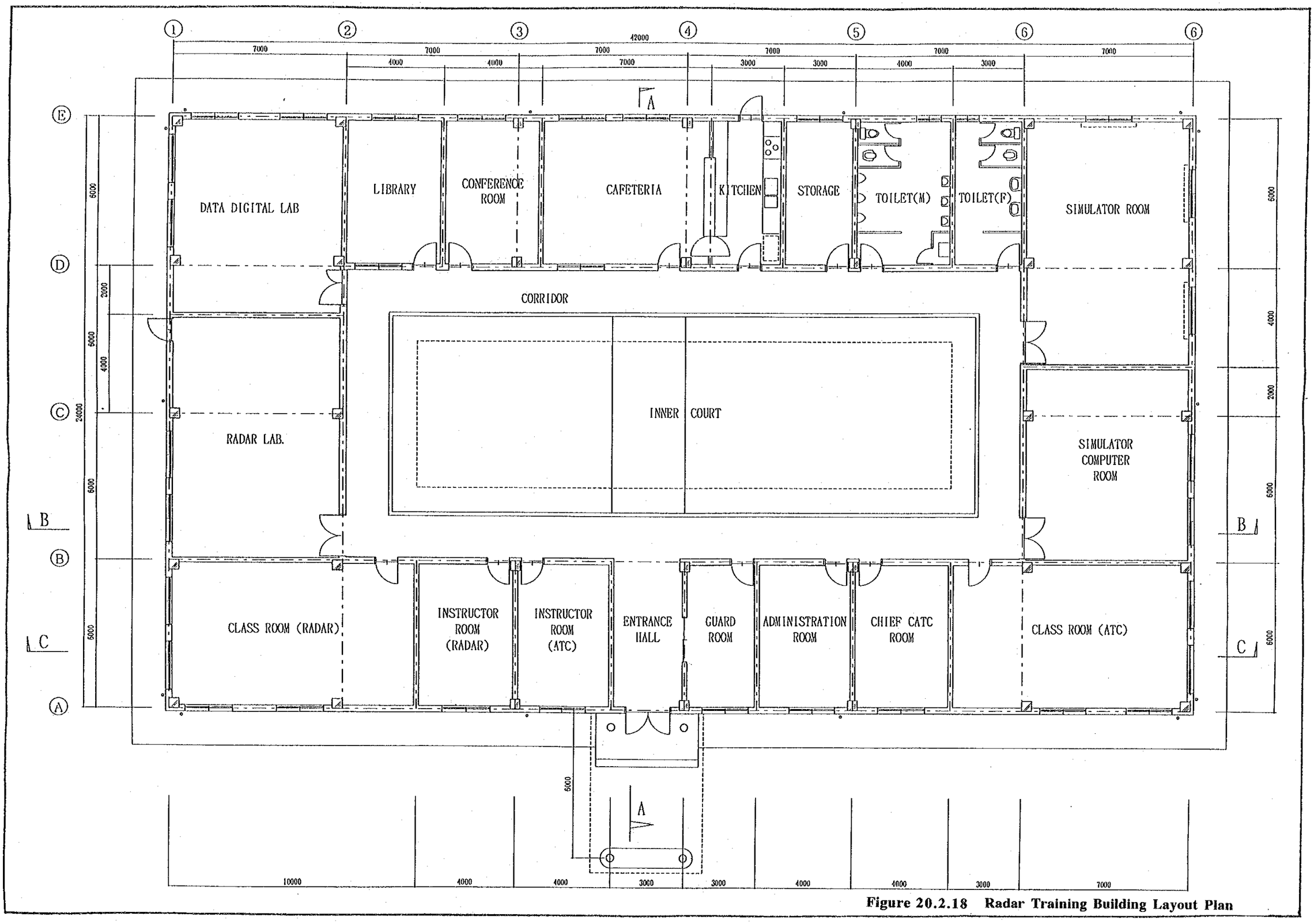
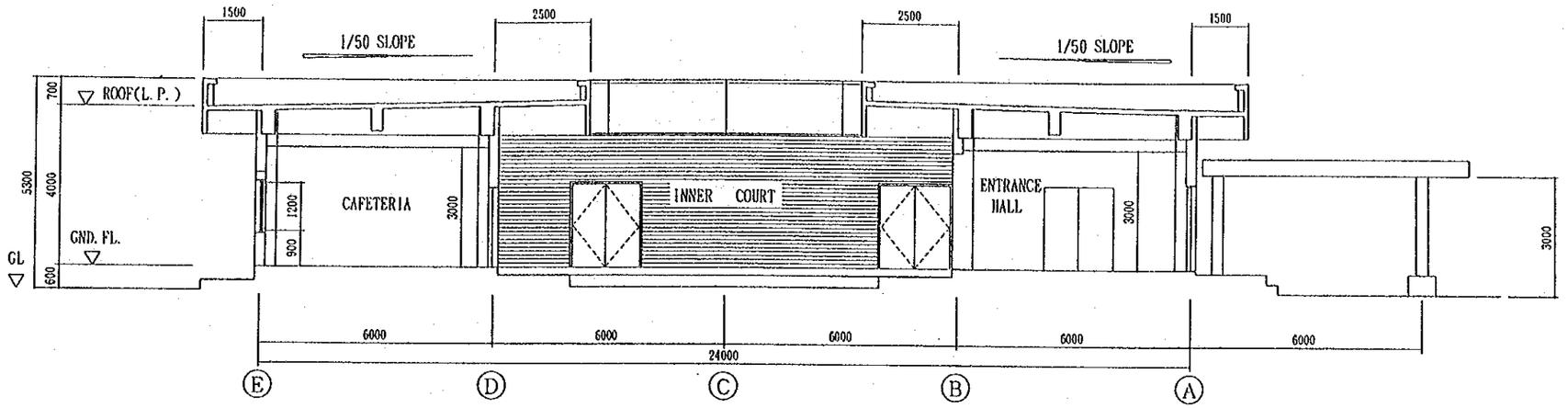
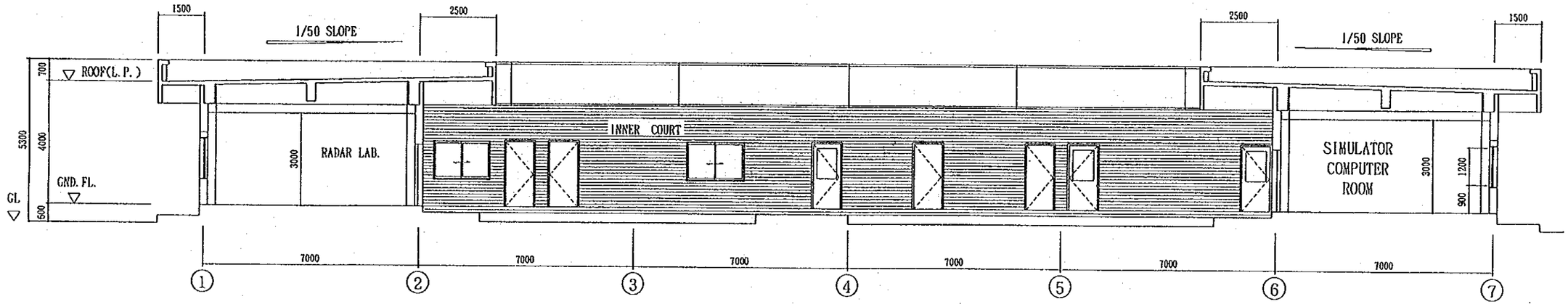


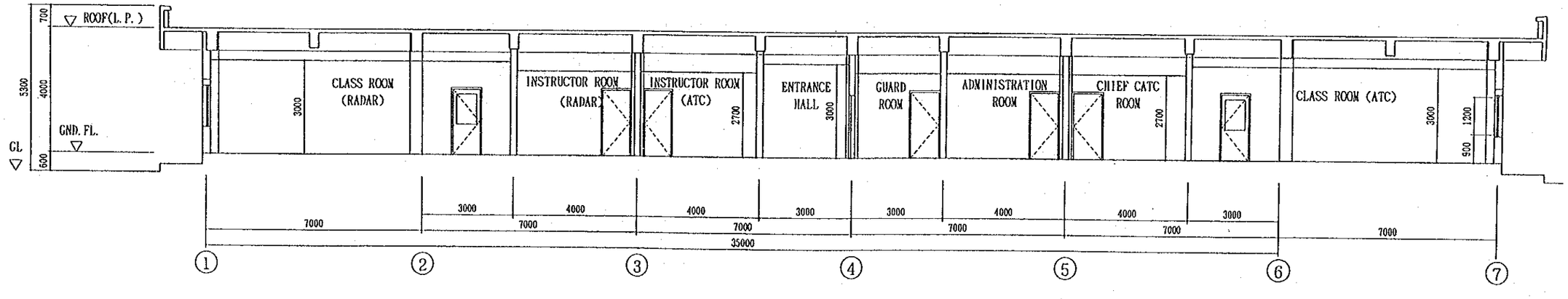
Figure 20.2.18 Radar Training Building Layout Plan



A-A SECTION

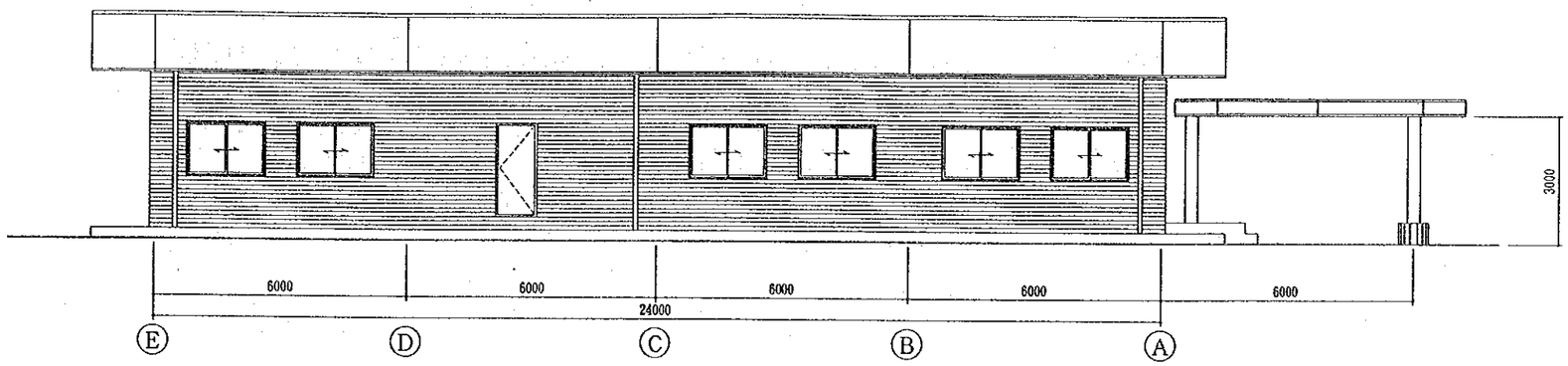


B-B SECTION

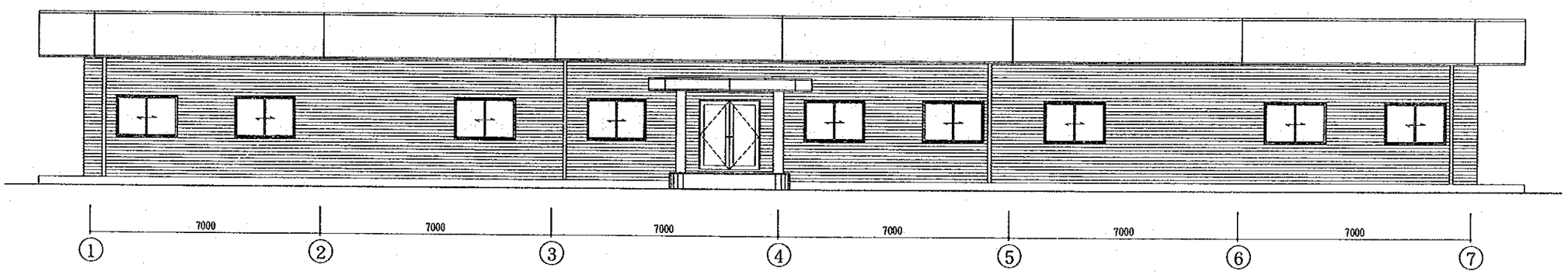


C-C SECTION

Figure 20.2.19 Radar Training Building Section / Elevation



NORTH ELEVATION



WEST ELEVATION

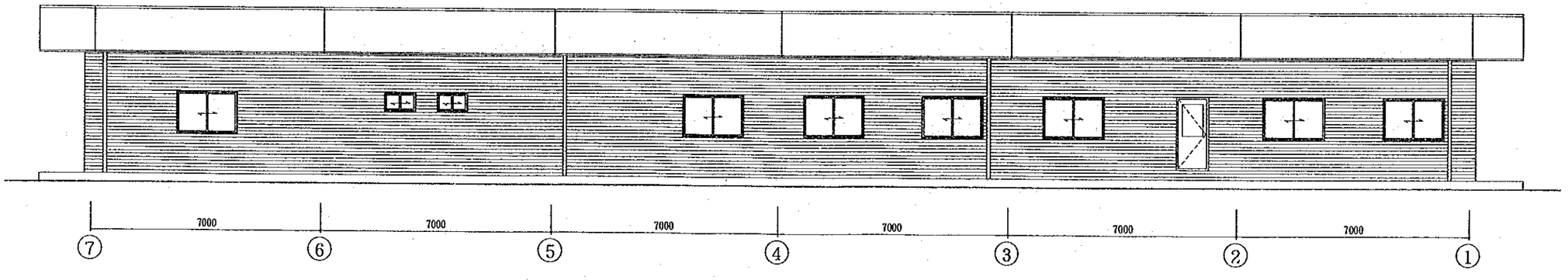


Figure 20.2.20 Radar Training Building Section / Elevation

(4) Architectural Design

The buildings should be designed for the application of fair-faced bricks to exterior finishes with simple designs.

Particularly for the design of radar operations building there should be harmony with the existing surrounding buildings.

(5) Structural Design

All of the buildings should be designed in accordance with AIJ Code (Architectural Institute of Japan code) and shall be of R.C. (Reinforced Concrete) rigid frame structure with fair-faced brick walls produced locally.

Foundations for the buildings will be designed based on the soil boring tests with standard penetration tests etc. R.C. roof structures should be flat roof with a 1/50 pitch roof.

- Natural Conditions	10 ~20 t/m^2
	(Depending on soil investigation results)
Soil Bearing Capacity	
Wind Velocity	30 m/sec. max.
Seismic Load	Seismic Factor for earthquake K=0.15
- Material Condition	
Reinforced concrete	Fc = 210 kg/m^2
Leveling concrete and non-structural slabs	Fc = 135 kg/m^2
Reinforcing Bar	SD30/JIS

(6) Utility Plan

- Air-conditioning

  The room temperature of the radar equipment room, simulator room, operations room and U.P.S. room will be controlled by packaged type air-conditioners. Ventilation fans of the explosion proof type will be provided for the battery room.

  No louvers should be provided where the building faces outdoors for dust proof and corrosion control.

- Water Supply, Waste Water and Plumbing

  All of the buildings should be provided with a toilet and water service except the local power station building. Soiled water and waste water are to be connected to a septic tank at the site and discharged to drainage pipes installed by plumbing.

  Soiled water pipe for the operations building should be connected to the soiled water main trunk line of the airport. Storm water for the operations building should be connected to the storm drains of the airport.

  Interior finishes are shown in Table 20.2.2.

Table 20.2.2 Interior Finishing Schedule (1)

Radar equipment building

Room	Equipment	Floor	Ceiling	Baseboard	Wall	Door	Lighting	Special Installation
Equipment room	Radar transmitter, receiver, change-over unit Optical cable Monitor display	Vinyl tile	Concrete slab Emulsion paint spray Insert plug in ceiling slab to pull down cable ladder H=2,800	Vinyl H=100	Mortar Plaster +Emulsion paint Insert plug for fix W/G and cable ladder	Double glazed Wood door	Ceiling suspender type Office standard	Air conditioning Switch board Terminal box Telephone cable Elect. cable
Maintenance room		Plastic tile	Suspended ceiling Plaster board H=2,500	Vinyl H=100	Mortar Plaster +Emulsion paint	Wood door with fixed glass	Office standard	Telephone Air conditioning Bookshelf
Toilet		Ceramic tile	Flexible board Suspended ceiling +Vinyl paint H=2,500		Ceramic tile H=1.5M Mortar Plaster +Vinyl paint	Wood door	About 300 LX	Water closet: Nepal Style Sewerage system 2 persons
Service room		Ceramic tile	Ditto		Ditto		About 200 LX	Water supply Sewerage
Store		Mortar trowel	Mortar	Mortar trowel H=100	Mortar	Wood door	Ditto	
Entrance		Terrazzo	Plaster board Suspended ceiling +Emulsion paint H=2,700	Terrazo H=100	Mortar Plaster +Emulsion paint	Steel locked door	Ditto	Portable fire extinguisher Elect. cleaner