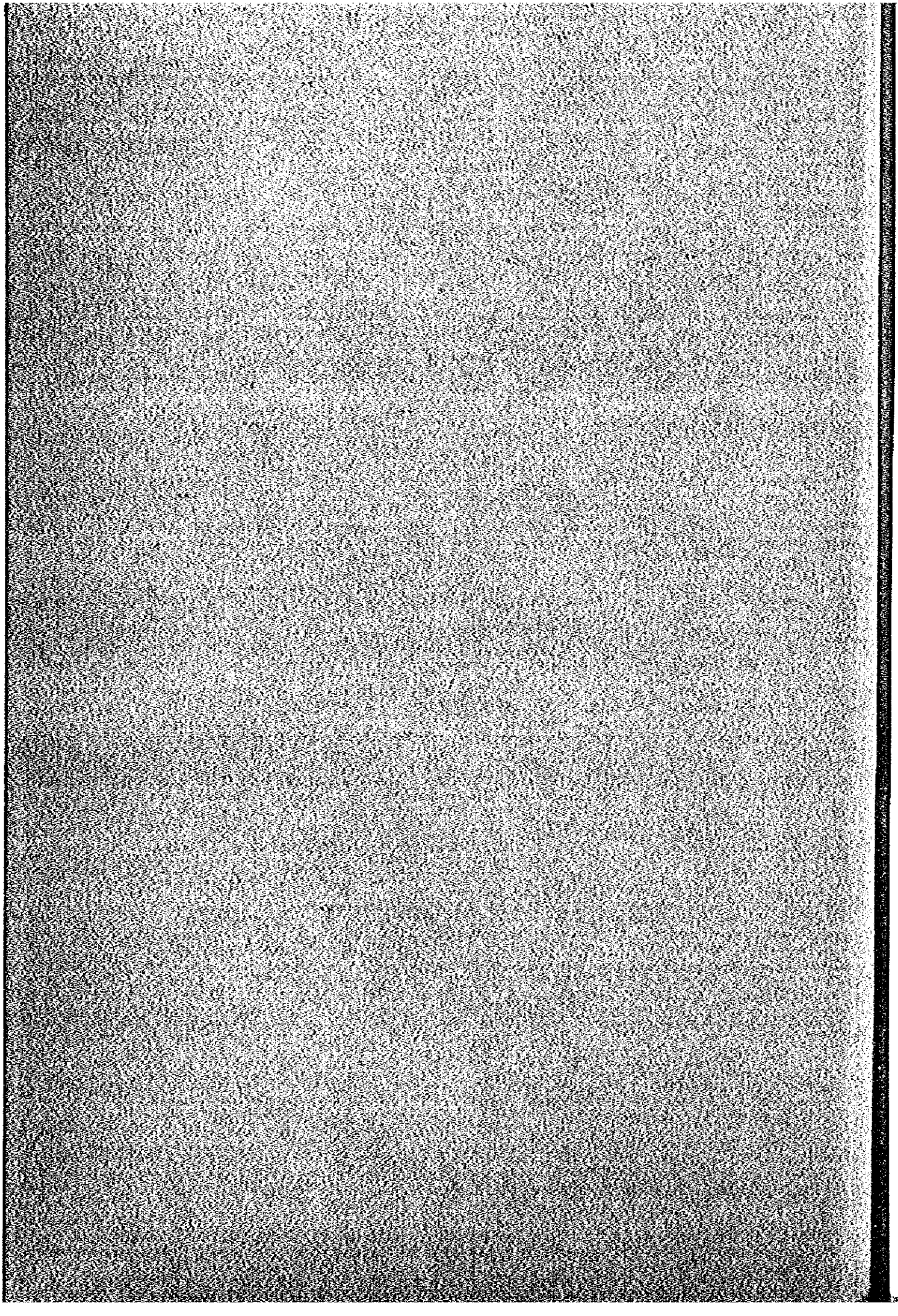
CHAPTER 3

AIR TRAFFIC FORECAST



CHAPTER 3

AIR TRAFFIC FORECAST

3.1 METHODOLOGY AND PREMISES OF FORECAST

3.1.1 Air Transport and Economic Activities

Air transport demand in Morocco is considered to be closely related to the level of economic activities of the country and the European countries as stated in Chapter 2. As the country develops economically, the social, economic and cultural interchanges with foreign countries become increasingly more active, with a growing number of foreigners visiting the country and Moroccans going abroad, hence resulting in increased international air passenger traffic. Similarly, as the levels of individual income and of economic activities of the country rise, so do the time value of Moroccans, domestic inter-city passenger traffic, and the share of air passenger within the domestic transport system in virtue of its great time saving effect in preference to road transport and railway transport, which are virtually the only alternative means of passenger transport available within the domestic transport system of Morocco.

Along with the economic growth of the country, increase in imports of consumer goods resulting from improved consumption standards, and of capital goods necessary for the industrialization of the country, as well as increase in exports of manufactured Moroccan products, altogether result in greater utilization of air transport for commodities that can bear higher freight charges. By the same token, the share of air transport within the domestic cargo transport system is also expected to increase.

3.1.2 Outline of Methodology

Usually an air traffic forecast for construction of an airport is made by estimating the future traffic demand of all transports by surface and air in the sphere of influence of the airport and by comparing it with the increase rate of such economic indices as the gross domestic product (GDP). The correlation between the economic indices and the total traffic volume is analysed by regression model. Then, future air passenger demand will be derived from the forecasted total traffic volume by applying a gravity model, of which parameters include time value, distance of each route, transportation cost, etc.

In this study, as data showing the aggregate traffic volume of all transportation means were not available, the traffic forecast for the Nador New Airport was made based indirectly on the passenger and cargo traffic volumes of other existing airports in Morocco by the following procedures (See Fig. 3-1).

The first step of forecasting the future traffic of the Nador New Airport was to analyze by regression model the correlation between the population within the sphere of influence of existing airports in Morocco and respective volume of air traffic in order to estimate the potential demand of the new airport. The second step was to determine the increase rate of air traffic volume of the new airport based on the correlation between the air traffic volume of existing airports and GDP. Finally, the traffic volume of the envisaged airport in the future was projected from the potential traffic demand obtained from analysis in the first step and the traffic increase rate estimated in the second step as mentioned above.

3.1.3 Premises of Forecast

1) Span of Forecast

The target year based on which all the planning will be made was set at the year 2000, but the span of forecast was determined to be 30 years from 1986 to 2015 for the financial and economic evaluation.

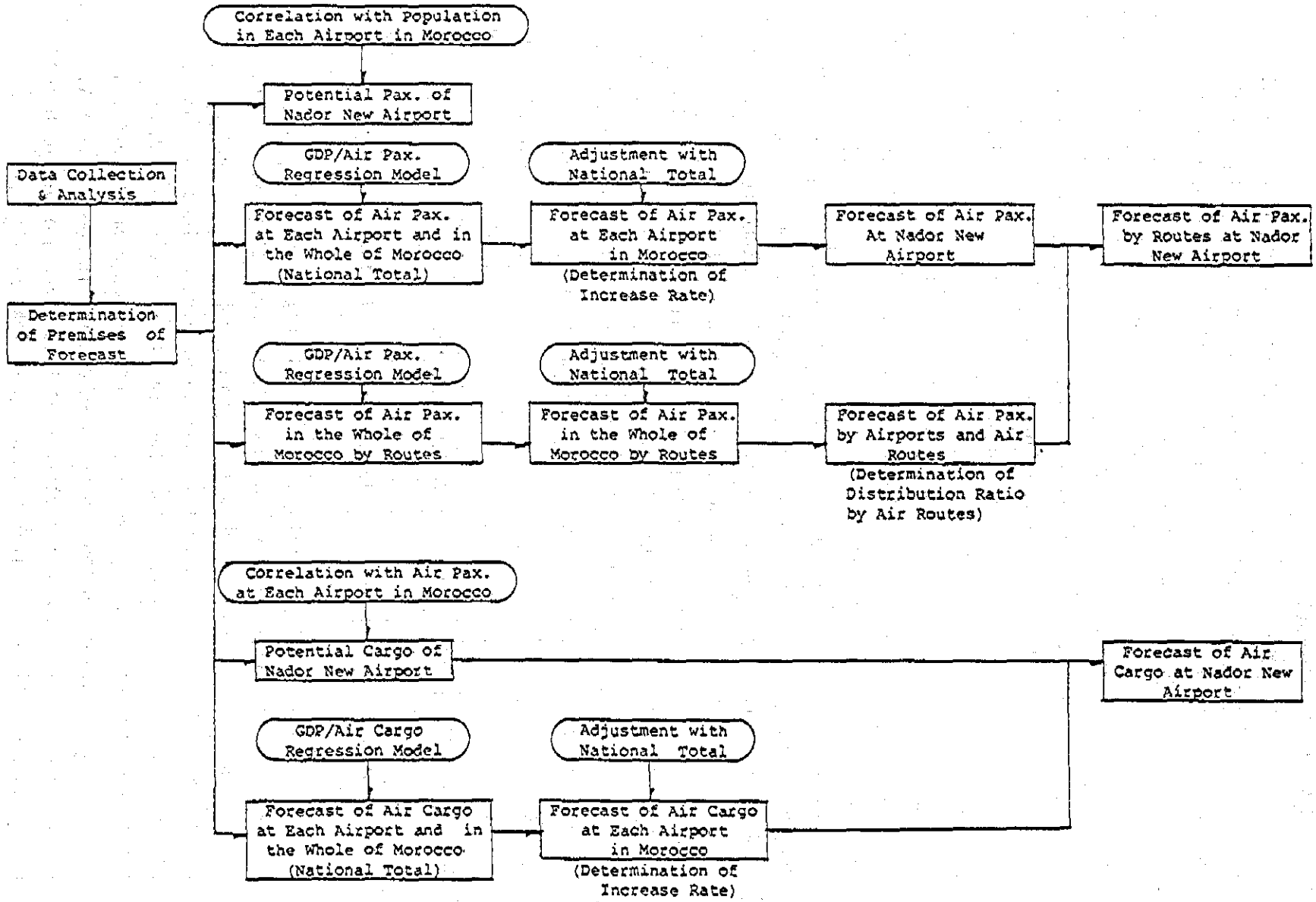


Fig. 3-1 AIR TRAFFIC FORECAST PROCEDURES

2) Estimation of Population

In 1982, the population of Morocco was 20,421,000 and that of the Province of Nador was 593,000. The growth rate of the population of the whole Morocco was 2.6% since 1971 upto 1982 and the same growth rate is expected thereafter (Table 3-1).

3) Estimation of Gross Domestic Product (GDP)

According to the Moroccan Socio-Economic Development Program for the period from 1981 to 1985, GDP is planned to grow at a rate of 6.5% per year, which is higher than the actual growth rate of 5.2% in the period from 1971 to 1982 (Table 3-1).

In this Study, a long term GDP forecast of Morocco made in "The Global 2000 Report to the President" shown in Table 3-1 was referred to. In the said report, the GDP of Morocco is forecasted in three (3) growth scenarios, i.e. high, middle and low growths. As the forecasted middle growth rate approximately corresponds to the historical growth rate from 1971 to 1982, the passenger forecast was carried out by adopting the middle growth scenario. The passenger forecast based on the high and low growth of GDP was also made for project evaluation purpose. The growth of GDP thus adopted in this Study ranges from 4.5 to 6.6% per year for the period of 1982-1985 and 3.9 - 4.9 %for 1985-2000 (Table 3-1).

3.2 FORECAST OF AIR PASSENGER TRAFFIC

3.2.1 Potential Passengers of Nador New Airport in 1982

The correlation between the number of air passengers and the population within the sphere of influence of the existing airports in Morocco in 1982 is shown in Table 3-2 and Fig. 3-2. The spheres of influence of the adjacent existing airports were determined by means of joining such places from where the required times to get to both of these airports are the same. The spheres of influence of the existing airports and their population are shown in details in Appendix III-1. All the airports in Morocco are classified into three (3) groups based on the characteristics of airport location in 1982 as follows:

Table 3-1 ESTIMATED FUTURE POPULATION AND GDP

Year	Population			GDP (Constant 1980)					
	Morocco (1,000)	Nador Prov. (1,000)	New Airport Sphere of Influence (1,000)	(Billion DH)			Per Capita (DH)		
1971	15,379			43.32			2,817		
1972	15,781			44.23			2,803		
1973	16,193			45.92			2,836		
1974	16,616			52.49			3,159		
1975	17,050			54.66			3,206		
1976	17,495			58.49			3,343		
1977	17,952			62.28			3,469		
1978	18,420			64.39			3,496		
1979	18,901			67.31			3,561		
1980	19,395			70.02			3,610		
1981	19,901			72.82			3,659		
1982	20,421	593	778	75.73			3,708		
				High	Middle	Low	High	Middle	Low
1985	22,056	640	840	91.7	89.06	86.41	4,158	4,038	3,918
1990	25,076	728	955	116.5	110.4	104.6	4,646	4,403	4,171
1995	28,510	828	1,086	147.9	136.9	126.7	5,188	4,802	4,444
2000	32,414	941	1,235	187.9	169.8	153.5	5,797	5,238	4,736
2005	36,853	1,070	1,404	238.6	210.6	185.8	6,474	5,715	5,042
2010	41,900	1,217	1,596	303.0	261.1	225.0	7,232	6,232	5,370
2015	47,638	1,384	1,815	384.8	323.7	272.5	8,078	6,795	5,720

Rates of Increase :

Population of Morocco[1)]	1971-1982		2.6% p.a.
	1982-2015		2.6
GDP of Morocco[2)]	1971-1982		5.2 (Average of Actual Ratio)
	1975-1985	High	6.6
		Middle	5.55
		Low	4.5
	1985-2000 (2015)	High	4.9
		Middle	4.4
		Low	3.9

Sources : 1) World Development Report 1983, The World Bank
2) The Global 2000 Report to the President, Government of USA

Group I : Airports located in the cities having the function of a regional center in the Atlantic coastal regions where port facilities are available. These include Mohammed V, Agadir, Tanger and Laayoune airports.

Group II : Airports located in the cities in the inland regions or in those which have small hinterland, where there is less possibility of development, or in those which are now at the initial stage of development. They include Marrakech, Oujda and Al Hoceima, etc.

Group III: Domestic airports such as Fès-Saiss, Rabat-Salé, Tetouan and Ouarzazate, etc., which are located in the vicinity of the large scale airports of Group I and II. These airports serve only the domestic routes and most of their passengers have a tendency to be absorbed by the large airports.

Since Nador City is now at the initial stage of its development, the Nador New Airport was categorized into Group II. According to the regression curve of Group II shown in Fig. 3-2, the number of potential passengers of the Nador New Airport is estimated to be 100,000 in 1982. In this study, this estimate was adopted as the basis of future passenger forecast for the Nador New Airport.

According to an investigation made in 1981 by the Administration of Air Bureau, it was found that out of 90,000 passengers originating from Nador City, 70,000 passed through Oujda-Angads Airport and 20,000 through Melilla Airport.

Meanwhile, one of the characteristics of the air passengers in Nador Province is that a considerable portion is occupied by the emigrants to Europe from this area. It is estimated that out of 150,000 emigrating passengers in total, 50,000 travel by air.

Therefore, 90,000 passengers in total in 1982 were those who, if the Nador New Airport were in operation, would have utilized the new airport. Consequently, the above mentioned 100,000 potential passengers of the Nador New Airport in 1982 derived from the regression curve are considered to include some incremental passengers who are newly generated by the construction of the new airport.

Table 3-2 AIR PASSENGERS AND POPULATION IN 1982

(Unit : Person)

Airport	Population	Air Passengers
Agadir	2,019,880	626,464
Al Hoceima	426,309	55,390
Marrakech	2,550,908	297,761
Oujda-Angads	1,360,365	140,447
Rabat-Salé	2,655,931	110,050
Tanger	755,377	432,159
Fès-Saiss	3,177,230	82,363
Mohammed V	5,559,658	1,385,210
Laayoune	142,372	182,363
Tetouan	693,979	4,517
Ouarzazate	1,055,950	1,207
Total	20,419,955	3,297,932
New Nador	777,528	100,000

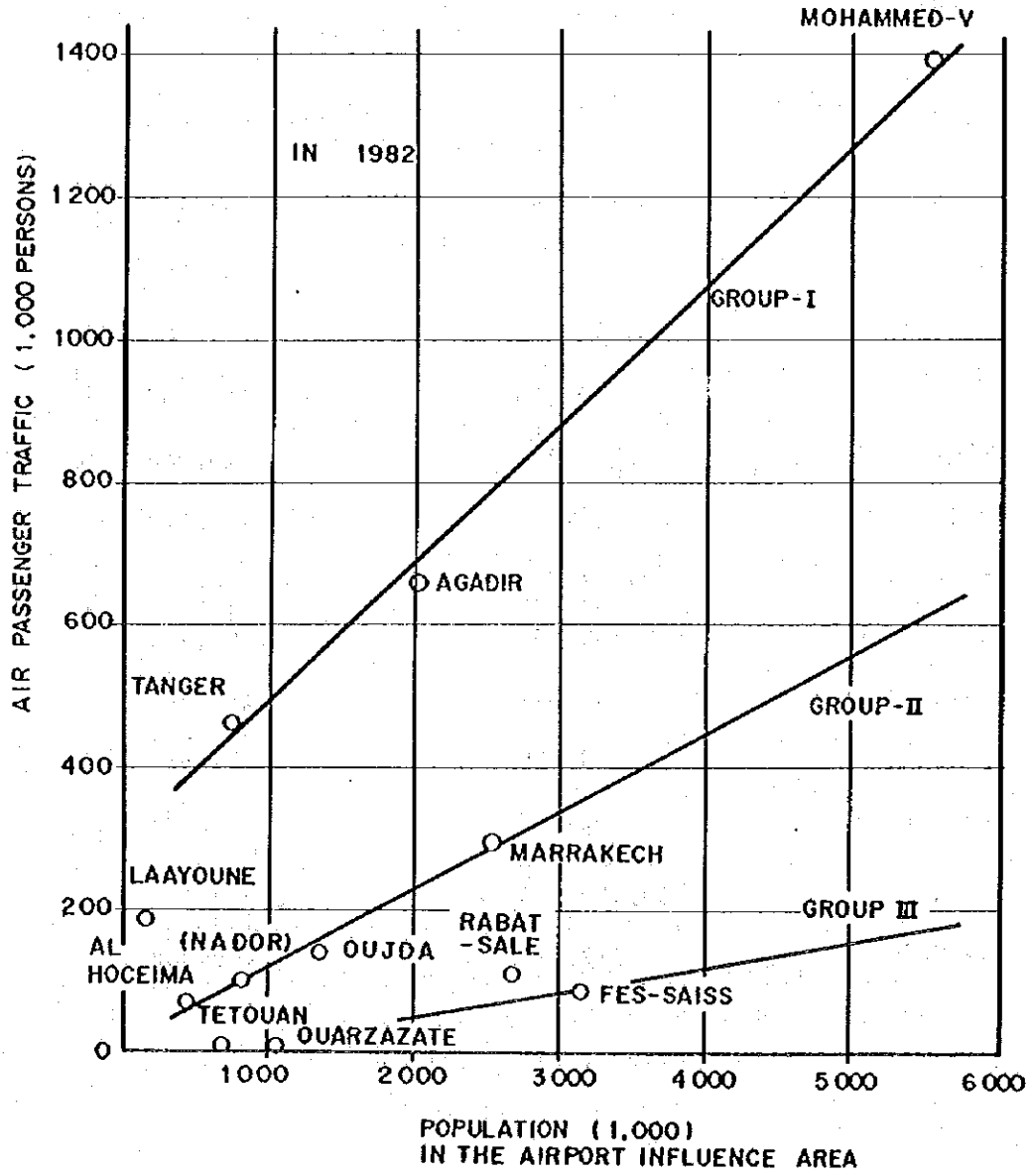


Fig. 3-2 AIR PASSENGERS AND POPULATION IN 1982

3.2.2 Air passenger Forecast of Nador New Airport

Air passenger forecast of the Nador New Airport was made based on the estimated number of potential passengers of 100,000 in 1982 and by applying the growth rates which were derived from the procedures mentioned hereunder.

Firstly, air passenger forecast of whole Morocco and of the existing airports was made based on the regression correlation between the historical GDP and the air passengers in the period from 1973 to 1982. The least square method was applied to obtain the above regression. At this stage, all the forecasted passengers of each airport were aggregated and adjusted, as needed, to the whole total of Morocco. The formula of regression model is shown in Appendix III-2.

Secondly, among air passengers thus forecasted for each airport, those of five (5) airports were selected from the viewpoint of similarity in characteristics of the respective cities concerned and Nador as well as their adjacency to Nador City: Agadir, Mohammed-V, Laayoune, Fès-Saiss and Oujda-Angads airports. The increase rates of these five airports' passengers in future were averaged to obtain the increase rate of air passengers of the Nador New Airport. The said growth rates are presented in Table 3-3 in minimum and maximum values for the period of 1985-2015, with respective GDP growth scenarios.

Table 3-3 ESTIMATED INCREASE RATES OF AIR PASSENGERS OF NADOR NEW AIRPORT

Airport	Rate of Increase of Passengers (%)	GDP
Agadir	6.9 - 8.0	(High)
Mohammed V	6.3 - 7.3	(Middle)
Laayoune	5.6 - 6.6	(Low)
Oujda-Angads	6.2 - 7.5	(High)
Fès-Saiss	5.6 - 6.7	(Middle)
	4.9 - 5.6	(Low)
New Nador	6.9 - 7.9	(High)
	6.3 - 7.2	(Middle)
	5.6 - 6.5	(Low)

Finally, the passenger traffic of the Nador New Airport was projected up to 2015 by applying the above growth rates respectively for the years of 1985, 1990, 1995, 2000 and 2015 to the base of 100,000 potential passengers as estimated for 1982. The result of the air passenger estimate for the new airport is as shown in Table 3-4 and Fig. 3-3. In case of the middle growth of GDP, the air passengers of the Nador New Airport are estimated at 438,000 in 2000 and 1,110,000 in 2015. The details of estimation are shown in Appendix III-2.

Table 3-4 FORECAST OF AIR PASSENGERS OF NADOR NEW AIRPORT

(Unit: 1,000 Passengers)

Year \ GDP	High	Middle	Low
1985	170	162	155
1990	249	229	212
1995	359	318	285
2000	508	438	379
2005	716	600	502
2010	1,004	818	662
2015	1,402	1,110	869

The on-going Five-Year National Development Plan (1981-1985) emphasizes the importance of the development of the Oriental Region, especially the Nador Province, though the rate of development is not clearly stated. The new airport is going to be constructed at one of the most promising centers of the Oriental Region where seaport facilities are available. This fact will accelerate further economic and social development of the Nador Province and bring about more demand for air passengers. The number of air passengers estimated in this study, therefore, seems to be rather conservative.

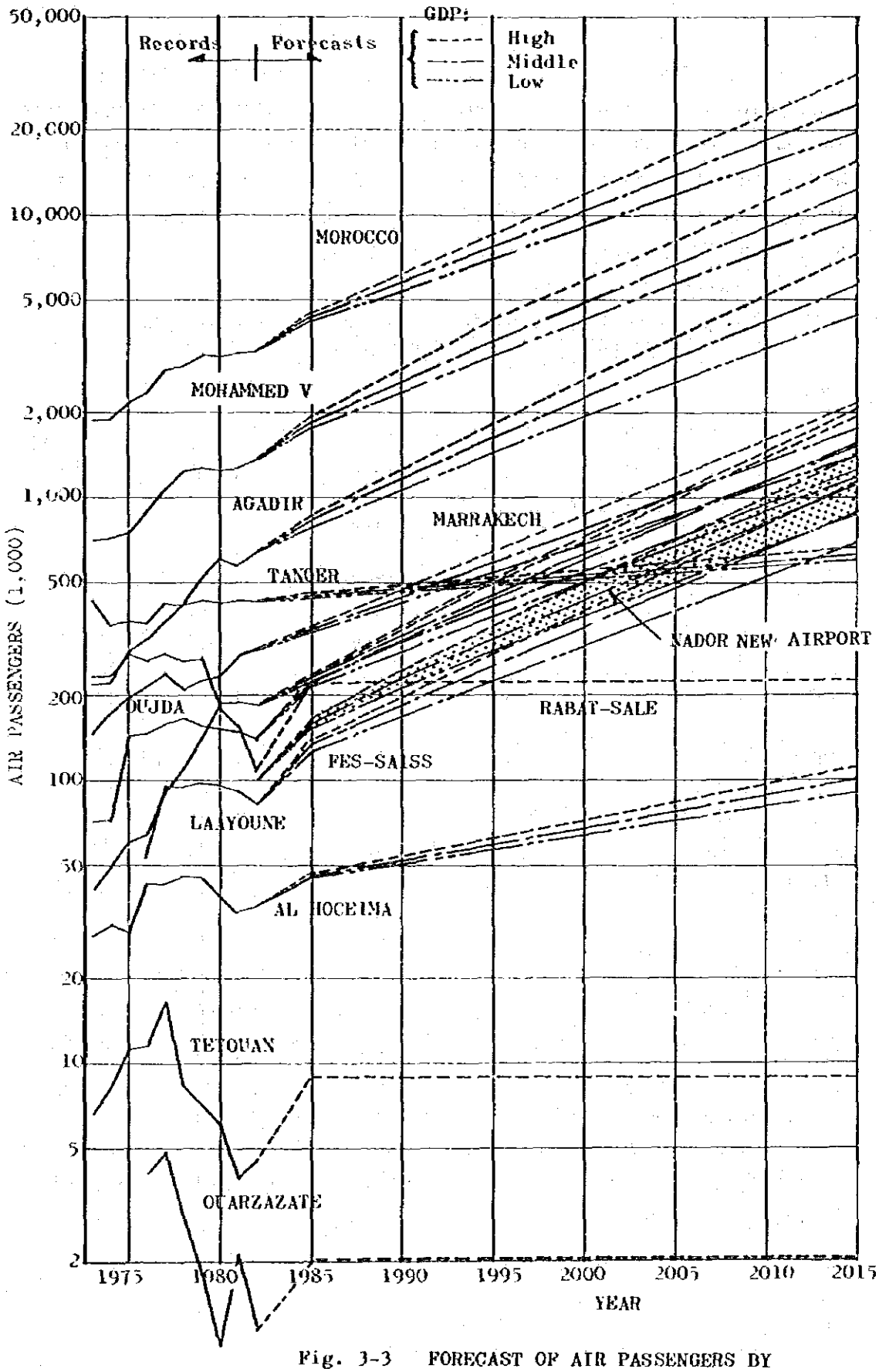


Fig. 3-3 FORECAST OF AIR PASSENGERS BY AIRPORTS

Table 3-5 shows the historical growth rates of air passengers in some regions and countries. Though the actual increase rate of Morocco is rather lower than those of the developing countries (10-15%) in Asia, South America and Africa, the rate is still almost equal to those in European countries (7%), which have the closest relations with the Kingdom of Morocco.

Table 3-5 INCREASE RATES OF AIR PASSENGERS BY CONTINENTS AND COUNTRIES (Total of International and Domestic Passengers)

(%)

	1963-1970	- 1975	- 1980	- 1982
North America	14.2	4.9	9.2	-0.5
South America	16.5	13.9	11.6	2.2
Europe	25.1	7.3	7.2	2.2
Africa	12.8	14.2	10.9	0.3
Orient	16.0	17.0	17.5	6.7
Asia, Pacific	18.3	17.6	13.1	8.0
Japan	-	11.1	10.6	1.4
India	-	10.7	11.5	12.7
Indonesia	-	26.3	14.9	9.8
Korea	-	12.4	11.7	8.5
Philippines	-	7.3	3.3	9.1
Thailand	-	22.7	8.8	13.3

3.2.3 International Passenger Forecast by Air Routes of Nador New Airport

In the year 1982, the total number of the annual air passengers in the whole of Morocco was 3,300,000, distributed as follows: 2,070,000 international passengers (63%), 760,000 domestic passengers (23%) and 470,000 transit passengers (14%). The international passengeres were predominant among the whole passengers, and were in greater part from and to France, especially Paris, and other European countries.

The numbers of the international passengeres by regions were broken down as follows:

		% of whole annual PAX
Paris:	650,000 persons	20%
France (except Paris):	310,000 persons	9.3%
Other European Countries:	810,000 persons	25%
Oriental countries:	100,000 persons	3%
Maghreb:	50,000 persons	1.4%
Africa:	80,000 persons	2.5%
North America:	50,000 persons	1.5%
South America:	20,000 persons	0.5%

The air passenger traffic demands by routes in the whole of Morocco was estimated based on the analysis by regression model of the correlation between the actual demands of international, domestic and transit passenger traffic by routes in the whole of Morocco and the increase rate of GDP in the same manner as for the estimate of "number of air passengers by airports" in Sub-section 3.2.2. As for the international routes, the study was made on the assumed routes connecting the whole of Morocco with such regions as Maghreb, Orient, Africa, France, Europe, North America and South America.

The future air passenger traffic demands of the international routes connecting Morocco with various cities all over the world are as shown in Fig. 3-4. The data concerning air passenger traffic by routes, the regression model formula and the forecasted passengers are shown in Appendix III-3.

As shown in Fig. 3-4, the increase rates are rather large on the domestic routes and on those between France, North America, South America and Orient, but are rather small on the routes between Maghreb, Africa and Paris as compared to the increase rates of the total number of air passengers.

The expected distribution ratios of air passengers by routes have been derived from the expected increase rates of air passengers by airports and those by air routes of the whole Morocco. The formula applied to calculate the above mentioned ratios for the years of 1982, 2000 and 2015 is shown in Appendix III-4.

The distribution of forecasted passengers by routes at Nador New Airport is as shown in Table 3-6. In the said forecast, the employed distribution ratio is the weighted average of those of nearest four airports: Oujda-Angads, Al Hoceima, Fès-Saiss and Tanger. The calculation of weighted average was made taking into account the respective distances from the Nador New Airport to these four airports.

In assumption of the routes to serve, those connecting with such cities which have a large number of passengers from and to Oujda-Angads, Al Hoceima, Fès-Saiss, Tanger and Melilla Airports, have been picked up as shown in Table 3-7. The detailed traffics per origin and destination of existing airports in Morocco in 1982 are shown in Appendix III-5.

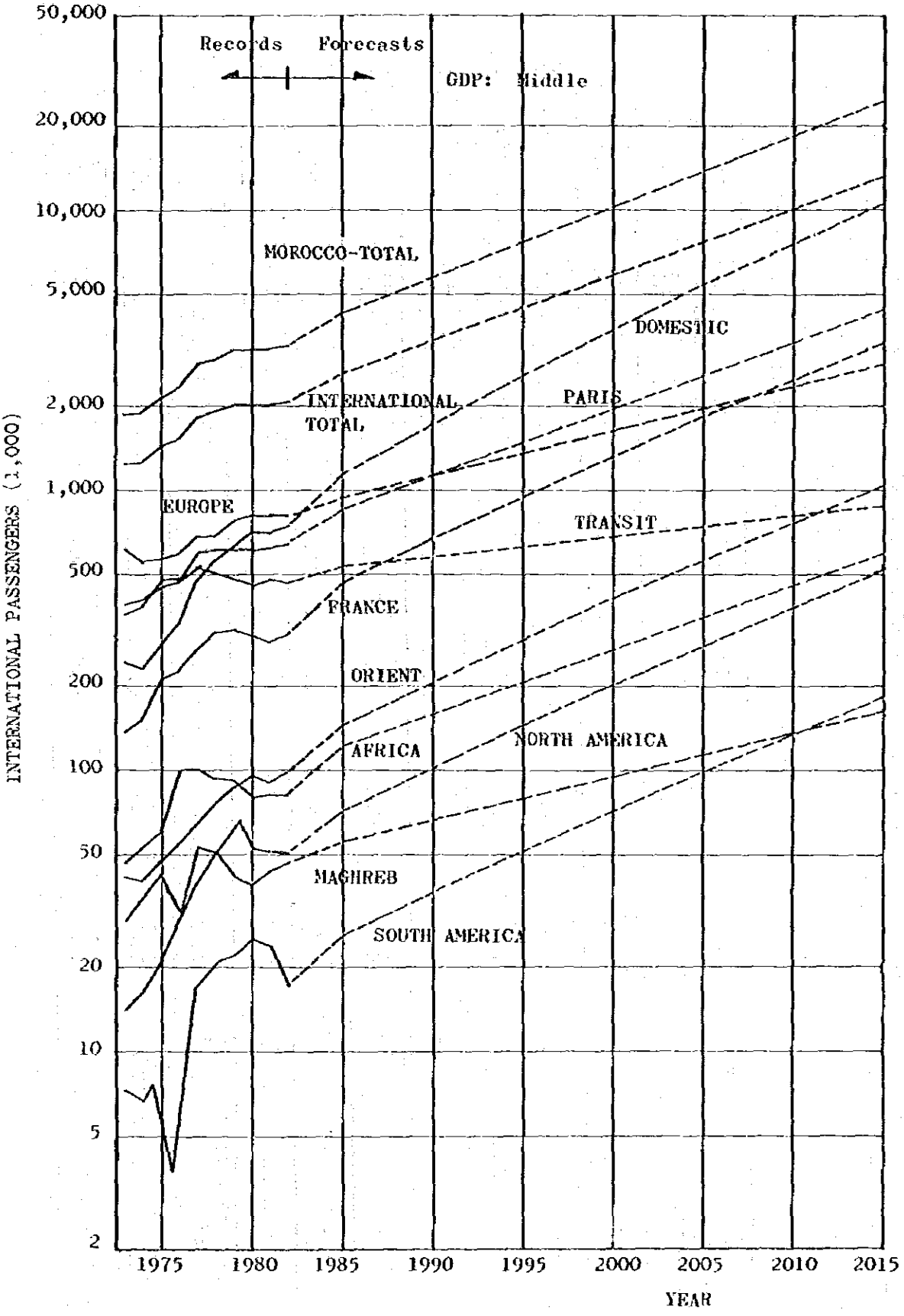


Fig. 3-4 FORECAST OF INTERNATIONAL AIR PASSENGERS BY AIR ROUTES

Table 3-6 DISTRIBUTION OF FORECASTED PASSENGER TRAFFIC AT NADOR NEW AIRPORT

Upper: Passengers (1,000)
Lower: Distribution Ratio (%)

	1982	1985	1990	1995	2000	2005	2010	2015
Maghreb	(0.6) 0.6	1 0.6	1 0.5	1 0.4	1 0.3	2 0.3	2 0.2	2 0.2
Orient	2 1.7	3 1.8	5 2.0	7 2.1	10 2.3	14 2.3	20 2.4	27 2.4
Africa	(0.3) 0.3	(0.5) 0.3	(0.7) 0.3	1 0.2	1 0.2	1 0.2	2 0.2	2 0.2
France	17 16.7	29 17.7	45 19.4	67 21.0	100 22.7	139 23.2	193 23.6	269 24.1
Paris	29 29.0	45 27.8	59 25.8	76 23.7	95 21.7	124 20.6	160 19.5	204 18.4
Europe	29 29.0	45 27.8	59 25.8	76 23.7	95 21.7	124 20.6	160 19.5	204 18.4
North America	(0.3) 0.3	(0.5) 0.3	(0.7) 0.3	(0.7) 0.2	1 0.2	1 0.2	1 0.2	2 0.2
South America	0 0.02	0 0.02	0 0.02	0 0.02	(0.1) 0.02	(0.1) 0.02	(0.2) 0.02	(0.2) 0.02
International Total	75 75.1	121 74.6	169 73.9	233 73.3	318 72.6	432 72.0	583 71.3	785 70.7
Domestic	10 10.2	19 11.7	32 14.1	53 16.6	83 19.0	124 20.6	182 22.2	264 23.8
Transit	15 14.8	22 13.7	28 12.0	32 10.2	37 8.4	44 7.4	53 6.5	61 5.5
Total	100 100.0	162 100.0	229 100.0	318 100.0	438 100.0	600 100.0	818 100.0	1,110 100.0

Table 3-7 INTERNATIONAL AIR ROUTES AND AIR PASSENGERS AT NADOR NEW AIRPORT

		Pax. (1,000)		Distribution Ratio (%)	
Year		2000	2015	2000	2015
France	- Paris	110	279	25.1	25.1
	- Other Cities	100	269	22.7	24.1
	- Marseille - Bordeaux - Lyon - Toulouse				
Europe (Long Range)		57	122	13.0	11.0
	- London - Amsterdam - Brussels - Frankfurt - Dusseldorf - Rome, Geneva				
Europe (Short Range)		38	82	8.7	7.4
	- Madrid - Malaga - Lisbon				
Orient		10	27	2.3	2.4
	- Jeddah - (Baghdad, Kuwait, Amman)				
Maghreb		1	2	0.3	0.2
	- (Tunis, Tripoli, Algiers)				
Africa		1	2	0.3	0.2
	- (Dakar, Cairo, Las Palmas)				
North America		1	2	0.2	0.2
	- (New York)				
South America		(0.1)	(0.2)	(0.02)	(0.02)
	- (Rio de Janeiro)				
International Sub-total		318	785	72.6	70.7
(Domestic		83	264	19.0	23.8)
(Transit		37	61	8.4	5.5)
(Total		438	1,110	100.0	100.0)

3.2.4 Domestic Passenger Forecast by Air Routes of Nador New Airport

The domestic air passenger traffic demands by routes in the whole of Morocco were estimated based on the same analysis prodedures employed in Sub-section 3.2.3. The analysis of domestic passengers by air routes of the Nador New Airport was made on the assumed routes connecting it with the Northern, Metropolitan, Central and Southern areas. The future air passenger traffic demand of the domestic air routes is shown in Fig. 3-5 and in Appendix III-3.

Among the domestic routes, the numbers of air passengers at the airports in the Southern area (Agadir and Laayoune) have been noticeably increasing, and those on the routes connecting the cities within the Southern area and on the routes connecting with the cities in Metropolitan area or with the cities in the Northern area have a tendency of increase.

On the other hand, at the airports in the Northern area (Oujda-Angads, Al Hoceima, Fès-Saiss, Tanger and Tetouan), the numbers of air passengers on the routes connecting with the cities in Metropolitan area or with the cities in the Southern area are increasing but the shares occupied by the passengers on the routes connecting the cities within the Northern area or connecting with the Central area are rather small.

The shares occupied by the passengers on the routes connecting the cities within the Metropolitan area (Rabat-Salé and Mohammed V) and the shares occupied by those from and to the Central area are also rather small.

The numbers of domestic passengers including transit passengers by routes in the years 1982, 2000 and 2015 were estimated based on the increase rates by routes and by airports as shown in Appendix III-4.

The number of domestic passengers at Nador New Airport was assumed by means of allocation of a weighted average of numbers of passengers at Oujda-Angads, Al Hoceima, Fès-Saiss and Tanger Airports as shown in Table 3-8.

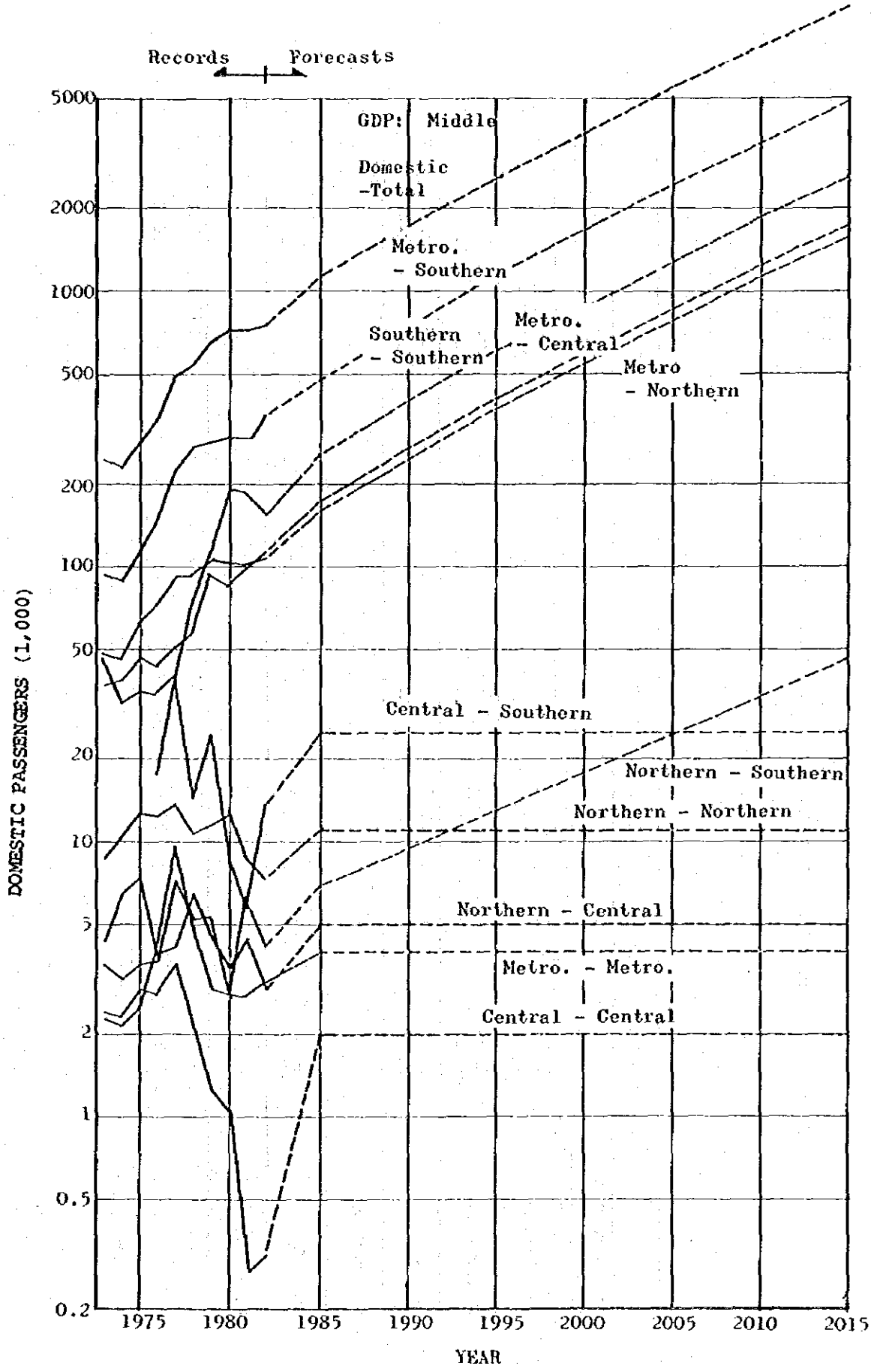


Fig. 3-5 FORECAST OF DOMESTIC AIR PASSENGERS BY AIR ROUTES

Table 3-8 DOMESTIC AIR ROUTES AND AIR PASSENGERS AT NADOR NEW AIRPORT

Upper: Passengers (1,000)
Lower: Distribution Ratio (%)

Year / Airport	1982	1985	1990	1995	2000	2005	2010	2015
North Morocco (Tanger, Tetouan)	1 12.3	2 11.6	3 10.3	5 9.1	7 7.9	9 6.8	11 6.8	13 4.7
Rabat-Salé	1 4.1	1 4.1	1 4.0	2 3.9	4 3.8	4 3.1	4 2.3	4 1.6
Mohammed-V	8 80.5	16 81.2	27 82.4	45 83.6	71 84.8	107 86.0	160 88.0	237 89.6
Marrakech	(0.3) 2.5	(0.4) 2.1	(0.5) 1.6	(0.5) 1.0	(0.3) 0.4	(0.4) 0.3	(0.5) 0.3	(0.5) 0.2
Ouarzazate	-	-	-	-	-	-	-	-
Agadir	(0.1) 0.6	(0.2) 1.0	1 1.6	1 2.3	2 2.9	4 3.1	6 3.3	9 3.5
Laayoune	0 0	0 0	0 0.1	(0.1) 0.1	(0.2) 0.2	(0.4) 0.3	1 0.3	1 0.4
Total	10 100.0	19 100.0	32 100.0	53 100.0	83 100.0	124 100.0	182 100.0	264 100.0

It is anticipated that the main domestic routes will be those connecting the North-Eastern part of Morocco with the Metropolitan Area. The most likely links will be between Nador and :

Mohammed V
Tanger
Tetouan
Rabat-Salé
Agadir
Marrakech

Regarding the direct connection with the Southern and Western parts of Morocco, the problem is that the volume of air traffic seems too small for the time being. These connections could be envisaged at later stages :

Laayoune
Ouarzazate

3.3 FORECATS OF AIR CARGO

The handling volume of air cargo in Morocco, including airmail, amounted to approximately 35,000 tons in 1982. The major items to be exported by air cargo are fresh products such as citrus fruits, vegetables, flowers, fishes and meats; the major items to be imported by air cargo are machinery, electric products and various apparatuses. Mohammed V Airport handled 27,000 tons of cargo or 76 % of the total while the balance was shared by other airports which handled less than 3,000 tons each.

Accordingly, the airports except Mohammed V and Rabat-Sale will deal with mainly berry cargo of which increase rate is assumed to be the same as that of air passengers.

Since Nador City has no products with high value added which are able to bear the high cost of air transportation, the air cargo handling volumes at Nador New Airport in the year 2000 and 2015 are estimated at 834 tons and 2,116 tons of berry cargo respectively (see Table 3-9 and Fig. 3-6).

The data concerning air cargo demand and the formula of the regression model employed in the study are shown in Appendix III-6.

Table 3-9 FORECAST OF AIR CARGO OF NADOR NEW AIRPORT

Year	Volume (t)	Rate of Increase (%)
1985	308	7.2
1990	436	7.2
1995	606	6.8
2000	834	6.6
2005	1,143	6.5
2010	1,559	6.4
2015	2,116	6.3

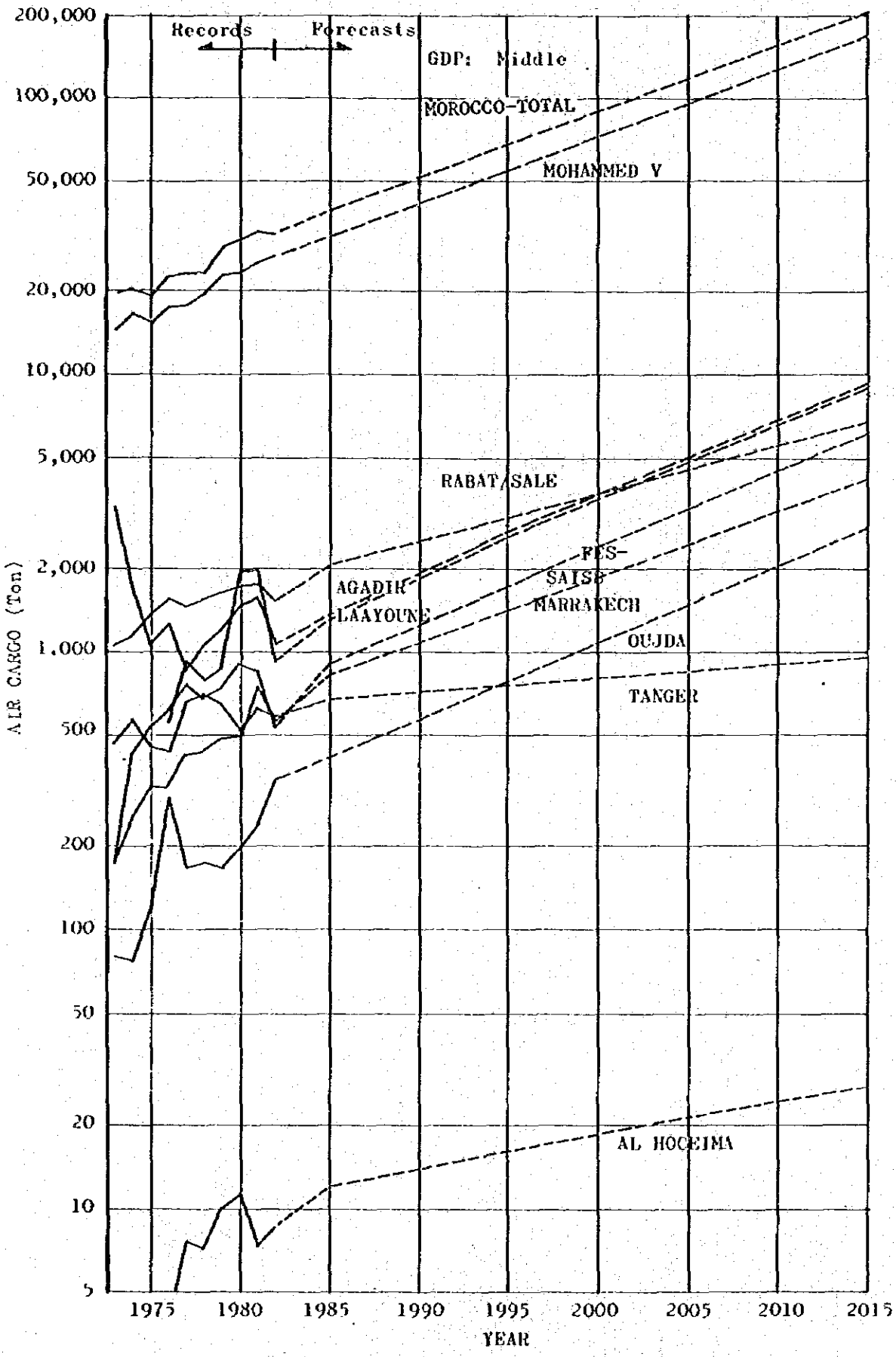
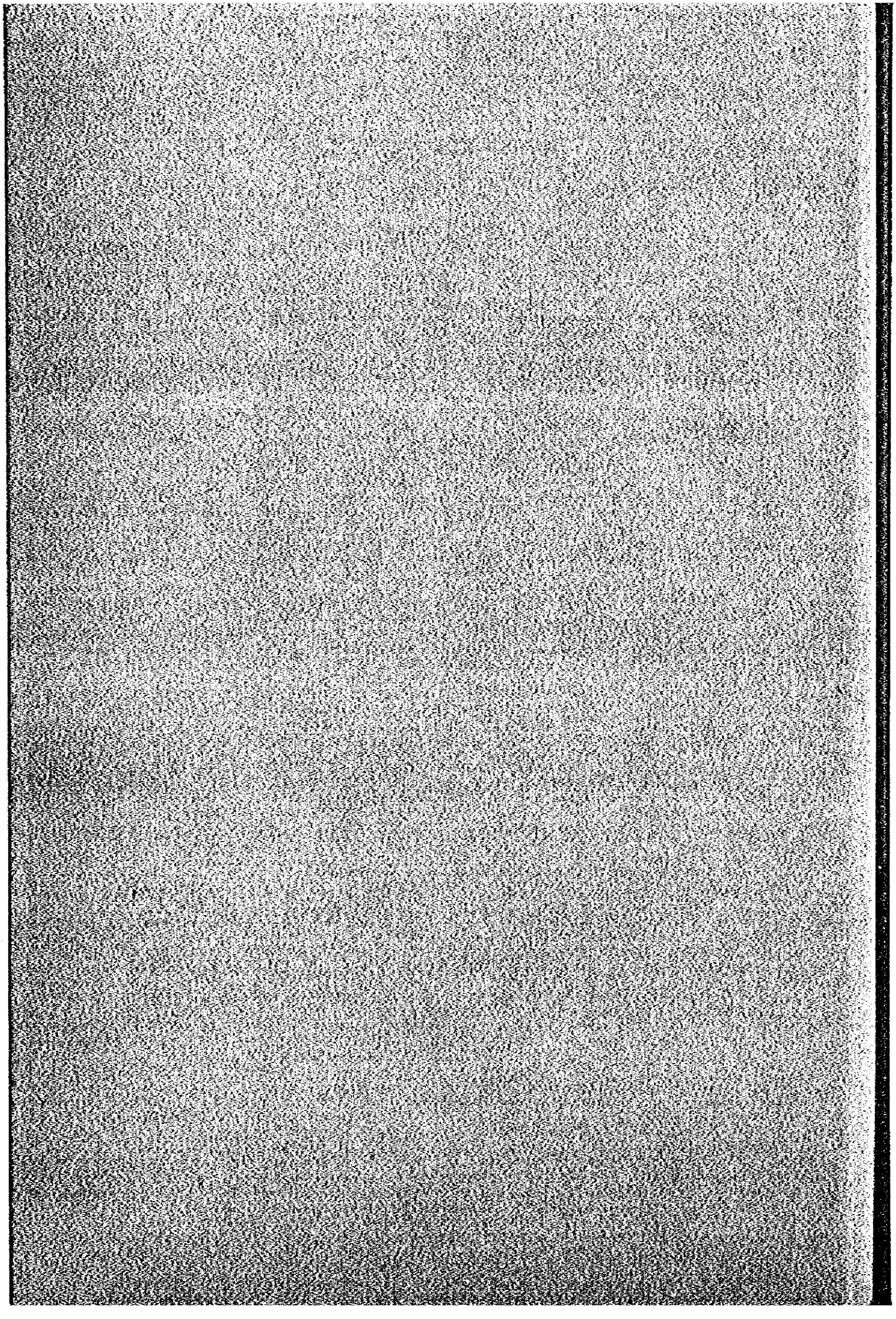


Fig. 3-6 FORECAST OF AIR CARGO BY AIRPORTS

CHAPTER 4

AIRPORT FACILITIES REQUIREMENTS



CHAPTER 4

AIRPORT FACILITIES REQUIREMENTS

4.1 GENERAL

The features of the facilities required for the Nador New Airport were determined to meet the requirements of the air traffic forecast up to the year 2000. Examination of further requirements up to the year 2015, which will eventually be required because of further increase of air traffic demand, was also made.

The ICAO's and FAA's "Standards and Recommended Practices for Aerodromes" were mainly applied in determination of the required facilities for the Nador New Airport, and JCAB's figures for airport planning also were referred to as needed. The envisaged features of the required airport facilities are shown in Table 4-1.

Judging from the estimated rate of increase of air passengers employed in this planning, the expansion of certain airport facilities would be required to adequately accommodate the overflowed passengers after the target year 2000.

Table 4-1 SUMMARY OF REQUIRED AIRPORT FACILITIES

Facilities		Development Plan (Projected Year 2000)		Remarks
Airfield Facilities	Runway	2,700 m x 45 m		
	Runway Strip	2,820 m x 300 m		
	Taxiway	227 m x 30 m		
	Apron (Int'l/Dom.)	23,100 m^2 (3 berths)		
Terminal Facilities	Int'l/Dom. Passenger Terminal Building	4,800 m^2		Note: These facilities are housed in one building.
	Administration/ Operation Building with Control Tower	1,200 m^2		
	Maintenance Center Building with Garage for Ground Service Equipment	1,400 m^2		
	Rescue and Fire Fighting Station	450 m^2		
	Power Substation	600 m^2		
Radio Navaids, Telecommunications, Meteorological Service Facilities	Radio Navigation Aids	Cat-I ILS	1 set	
		VOR/DME (200W)	1 set	
		NDB	1 set	
	Aeronautical Telecommunications	VHF Transmitter	3 units	
		VHF Receiver	3 units	
		Direct Hot Line	1 set	
		Teletypewriter	2 sets	
	Meteorological Service	Weather Data Collecting Eqpt.	1 set	
		Rwy Visual Range (RVR)	1 set	
		Ceilometer	1 set	
		Weather Facsimile Receiver	2 units	

(to be continued)

(Continued)

Facilities		Development Plan (Projected Year 2000)		Remarks
Airfield Lighting Facilities	Airfield Lighting	Approach Lighting System	1 set	
		Approach Lighting Beacon	1 set	
		Visual Approach Slope Indicator	2 sets	
		Runway Edge Lights	1 set	
		Runway Threshold Lights	1 set	
		Rwy Threshold Wing Bar Lights	1 set	
		Taxiway Edge Lights	1 set	
		Aerodrome Beacon	1 unit	
		Wind Direction Indicator Lights	2 units	
		Apron Flood Lights	1 set	
Service Facilities	Electric Power	PAX Terminal Bldg. with Adm/Operation Bldg.	650 kVA	
		Maintenance Center Bldg.	160 kVA	
		Airfield Lighting	300 kVA	
		Radio Navaids	50 kVA	
		Others	150 kVA	
		Total	1,310 kVA	
	Water Supply	Terminal Building with Adm/Operation Bldg.	100 Kl/day	
		Maintenance Center & Others	50 Kl/day	
		Total	150 Kl	
	Sewage Treatment	- do -	140 Kl/day	
	Telephone Circuits		50 Nos.	
Land Transport Facilities	Access Road	1-lane (one direction)		
	Car Parking	7,200 m^2	(205 Nos.)	

4.2 AIRFIELD FACILITIES

4.2.1 Runway and Landing Strip

1) Length of Runway

The required runway length is to be determined by the expected stage length of the air route and aircraft category to be in service, and in this study, the runway length was calculated on the following conditions.

a. Stage Length

The air routes of the new airport were assumed as shown in Fig. 4-1(a) and 4-1(b), and the route connecting Nador and Amsterdam of 2,020 km (1,091 nm) in distance was assumed to be the maximum stage length. The air route between Nador and Rio de Janeiro of 7,900 km (4,266 nm) was assumed to be the maximum stage length in the future judging from the air routes in service up to today by Royal Air Morocco.

b. Classification Categories of Aircraft

The aircraft to be in service in the early stage after opening of the proposed airport were assumed to be of B-727-200 type, judging from the number of aircraft possessed by the airline agencies and the types of aircraft which are in service now on various routes. The aircraft envisaged to be in service in the target year (2000) were assumed to be of A-300, B-767 and D-9S types, taking into consideration the change of aircraft being in service and the trend of the airline agencies' policy, etc. Thus, the aircraft of A-300B type was taken as a model in the study of the airfield requirements in the year 2000.

ROUTE	STAGE LENGTH (Km)
AMSTERDAM	2 020
PARIS	1 590
BRUSSELS	1 870
DUSSELDORF	1 960
FRANKFURT	1 950
LONDON	1 880
LYON	1 380
MADRID	620
MILAN	1 570
LISBON	720

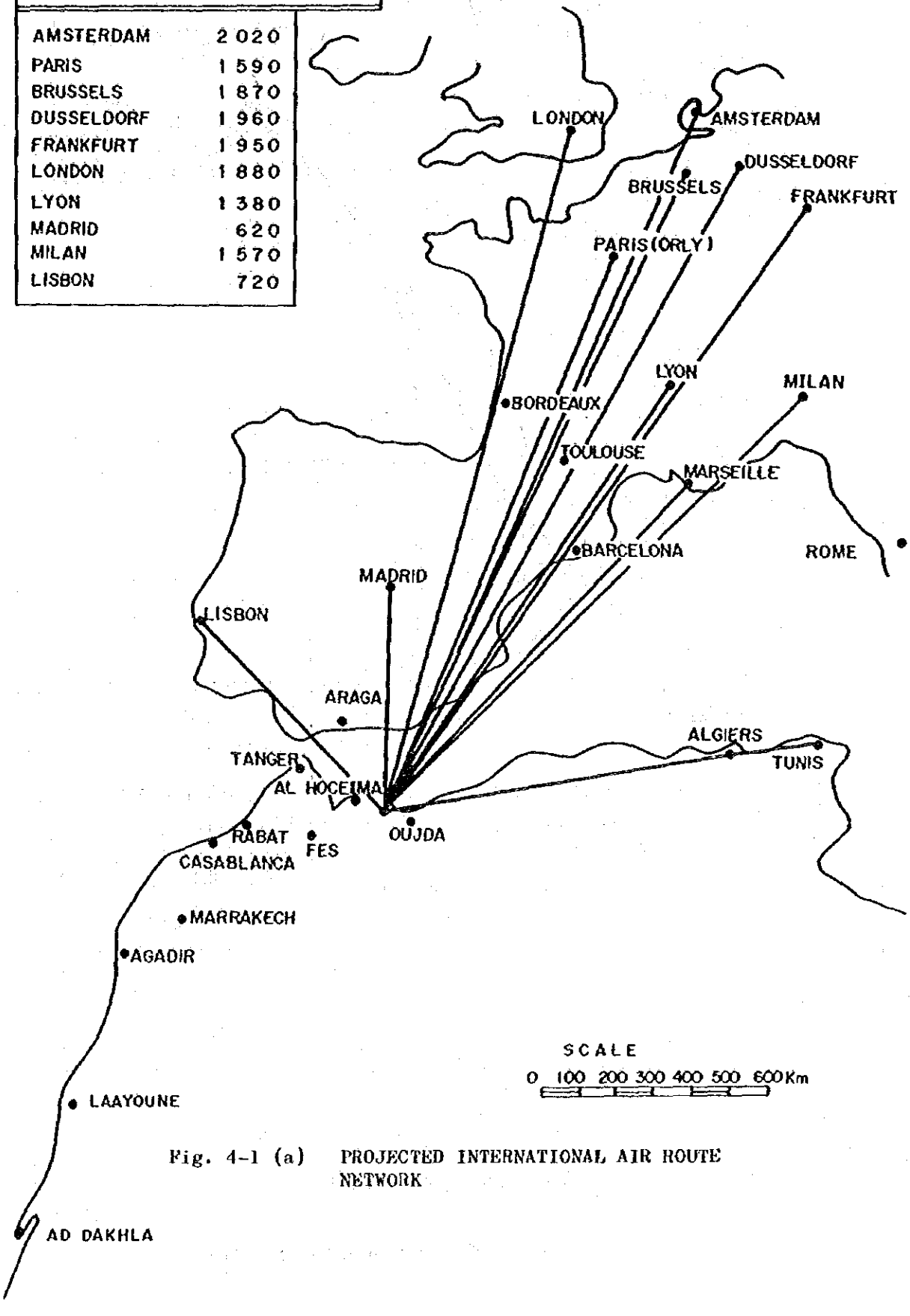
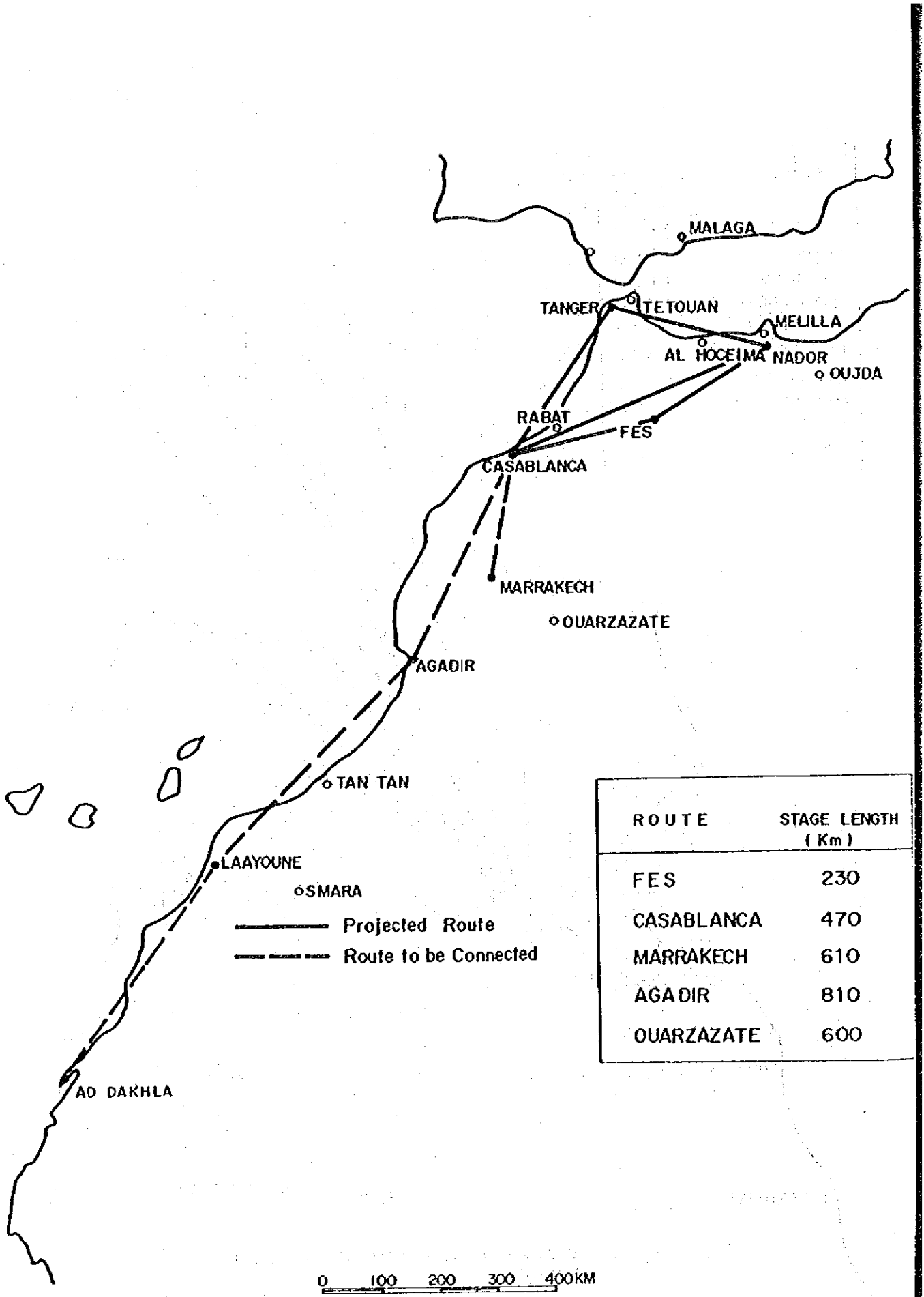


Fig. 4-1 (a) PROJECTED INTERNATIONAL AIR ROUTE NETWORK



ROUTE	STAGE LENGTH (Km)
FES	230
CASABLANCA	470
MARRAKECH	610
AGADIR	810
OUARZAZATE	600

Fig. 4-1 (b) PROJECTED DOMESTIC AIR ROUTE NETWORK

c. Alternative Airports

It was assumed that Oujda-Angads and Tanger-Boukhalf Airports, which have the capacity for landing of aircraft of B-707 and B-747 types, will take the place of the proposed airport in case of emergency. In the internaional air routes, Dusseldorf, Brussels and London International Airports will take the place of Amsterdam International Airport as the alternative ones.

d. Airfield Data

The airfield data required in calculation of the runway length are:

- Reference temperature : 28.2°C.
- Runway elevation : EL. 182 m
- Average longitudinal slope of runway : 0.25%

Out of the above-mentioned types, the aircraft of B-727-200 type was selected to be employed in calculation of the required runway length because it needs the longest distance for taking-off among those intended to serve.

The required runway length calculated on the above-mentioned basis is 2,700 metres in round number as shown in Table 4-2. The aircraft intended to serve for the air route between Nador and Rio de Janeiro will be of B-747-200 B type and the runway will be required to have 3,100 metres in length. The payload employed in calculation was assumed to be equal to the full passenger and cargo loads for B-727-200 and A-300B type aircraft, and was to be a little smaller than the full passenger and cargo loads for B-747-7-200B type.

Table 4-2 RUNWAY LENGTH REQUIREMENTS

(Unit: Metre)

Aircraft	Required Lengths		Proposed Length
	Take-off	Landing (wet)	Project
B-727-200 (Advanced)	2,652 (Flap 25°)	1,803 (Flap 30°) 1,658 (" 40°)	2,700
A-300-B (101 type)	2,043 (" 8°)	2,038 (" 25°)	
B-747-200B	2,505 (" 20°)	2,364 (" 25°)* 2,241 (" 30°)*	

* Improved type

The calculation of the runway length is shown in details in Appendixes IV-1 and IV-2.

2) Width of Runway

The widths of the runway and runway shoulders were determined to be 45 metres and 7.5 metres respectively in accordance with ICAO Annex 14 Recommendations.

3) Length and Width of Runway Strip

A strip of 60 metres is to be provided as over-run at both ends of the runway (total length including runway: 2,820 m). The strip width was determined to be 300 metres to serve the instrument landing system (category I).

4.2.2 Taxiway

An exit taxiway was planned to be constructed at a right angle with and at nearly middle part of the runway, because the number of assumed daily aircraft movements are not so great. The width of the taxiway should be more than 23 metres in accordance with ICAO's Recommendations. In this study, the widths of the taxiway and its shoulders were determined to be 30 metres and 7.5 metres respectively to permit expeditious handling of the airfield traffic.

The installation of a parallel taxiway will be required in the future in order to appropriately cope with the increased airfield traffic.

4.2.3 Apron

The required total area of the passenger loading apron is to be calculated based on the assumed air traffic movements, the aircraft categories, the pattern of parking and the estimated parking time, etc. In this study, the calculation was made by the procedures shown in Fig. 4-2 on the following conditions.

a. Classification Categories of Aircraft

The types of aircraft which will be placed in service at every projected air route in 2000 were assumed as shown in Table 4-3.

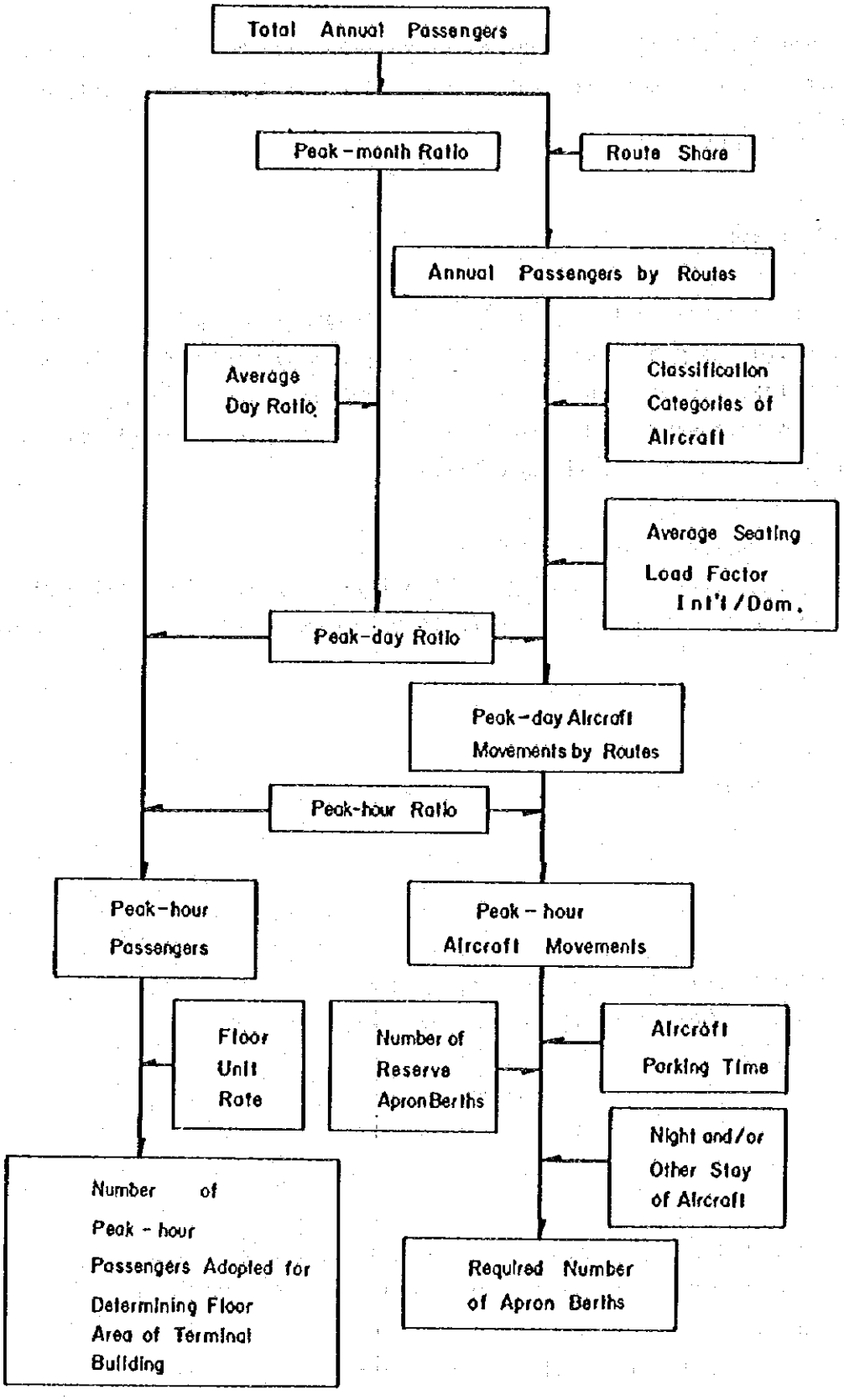


Fig. 4-2 FLOW CHART FOR DETERMINING SIZE OF APRON AND AREA OF PASSENGER TERMINAL BUILDING

Table 4-3 AIRCRAFT CATEGORIES

Service Line	Origin / Destination		Aircraft Category
International Services	Nador	- Paris - Marseille - Lyon	A type (Middle Jet) 240-seater
	Nador	- Amsterdam - Brussels - London - Madrid - Lisbon - Tunis	B type (Small Jet) 120-seater
Domestic Services	Nador	- Casablanca - Fès - Cas. - Others - Tanger - Cas.- Others	C type (Non-Jet) 60-seater

The composition of the aircraft intended to serve was analysed based on the actual composition of aircraft by types at present and that in the year 2000 is assumed as shown in Table 4-4.

Table 4-4 COMPOSITION OF AIRCRAFT

Aircraft Category*	Proportion (%)
A type	50
B type	40
C type	10

Note: * Refer to Table 4-3.

b. Average Seating Load Factors

The average seating load factors for both international and domestic flights were estimated at 60 % considering some increase of the actual average seating load factors of about 50% in Morocco. The actual seating load factors derived from the aircraft movements and the number of air passengers at the existing airports are shown in Appendix IV-3.

c. Ratio of Peak-day Passengers

The air passengers at the existing airports in Morocco are rather concentrated in July and August because of the seasonal traffic demands which seem to be caused by the movements of foreign tourists, Moroccan emigrants and religious followers.

The actual ratio of the number of peak month passengers in these months to the annual total passengers at the airports in service now ranges between 11 and 15 % in case of international flights and between 9 and 13 % in case of domestic ones.

The ratio of peak-day passengers is assumed to be 10 % of the average daily passengers in the peak-month. The ratios of peak-day and peak-month passengers to the annual total passengers are assumed as shown in Table 4-5. The actual ratio of peak-month passengers to annual total passengers is shown in Appendix III-7.

Table 4-5 RATIOS OF PEAK-DAY AND PEAK-MONTH PASSENGERS TO ANNUAL TOTAL PASSENGERS

Passenger	Peak-month	Peak-day*
International Passengers	0.12	0.00420
Domestic Passengers	0.09	0.00315

* The peak-day ratio to annual PAX. is obtained by the following formula:

Peak-day Ratio = (Peak-month Ratio) x (1.10/Average days in a month)

d. Aircraft Parking Time

The aircraft parking times on the apron of the through and turn-round flights were determined as shown in Table 4-6 referring to the actual parking times at the airports in Morocco and the trend in the future.

Table 4-6 AIRCRAFT PARKING TIME

Aircraft Category*	Through-flight	Turn-round-flight
A type	45 minutes	90 minutes
B type	45 minutes	90 minutes
C type	30 minutes	45 minutes

Note: * Refer to Table 4-3.

The projected annual and peak-day aircraft movements in the target year 2000 were analysed based on the above-mentioned conditions as shown in Table 4-7.

Table 4-7 PROJECTED AIRCRAFT MOVEMENTS BY ROUTES IN THE YEAR 2000

Route	Annual Passengers	Aircraft Movements						Total	
		240-seater Jet		120-seater Jet		60-seater Non-Jet			
		Annual	Peak-Day	Annual	Peak-Day	Annual	Peak-Day	Annual	Peak-Day
Nador - Paris	110,000	764	3					764	3
- Amsterdam & Others	76,000			1,056	4			1,056	4
- Lyon & Others	25,000	174	1					174	1
- Brussels & Others	75,000			1,042	4			1,042	4
- Madrid & Others	32,000			441	2			441	2
Sub-Total	318,000	938	4	2,539	10			3,477	14
Nador - Casablanca & Others	54,000			750	2			750	2
- Fès & Others	66,000					1,833	6	1,833	6
Sub-Total	120,000			750	2	1,833	6	2,583	8
Total	438,000	938	4	3,289	12	1,833	6	6,060	22

The number of berths required for passenger loading apron was derived from the peak-day aircraft movements as shown in Table 4-8.

Table 4-8 NUMBER OF PASSENGER AIRCRAFT IN PARKING POSITION

Aircraft * Category	International & Domestic Flights	Reserve	Total
A type	1	-	1
B type	1	-	1
C type	1	-	1
Total	3	-	3

* Refer to Table 4-3.

The reserve berth will not be provided in this project, because it is judged that the proposed apron has enough capacity for daily aircraft movements as well as for parking of extra aircraft, if required. Parking of two or three general aviation aircraft is to be considered, but the provision of exclusive parking lot for such aircraft will not be needed for the same reasons as mentioned above.

The annual demands of cargo traffic will be very small as shown in the forecast of cargo traffic demands (Section 3.3), and therefore no provision of the cargo loading apron for the freighters will be required.

The width of the passenger loading apron was determined to be 210 metres in order to secure safe interval between aircraft and to permit their nose-in and self-maneuvering-out movements. Its length from the center-line of expected parallel taxiway was determined to be 180 m (177.4 m) so as to permit parking by selfmaneuvering of large-sized aircraft (B-747) in future. The relationship between required area of the apron and the length are shown in details in Appendix IV-6.

4.3 TERMINAL FACILITIES

4.3.1 Passenger Terminal Building

The magnitude of passenger terminal building was determined to meet the requirements for the annual number of aircraft movements, the number of passengers at peak-hour and the pattern of pasenger processing, etc.

1) Number of Passengers at Peak-hour

As discussed in Chapter 3, the ratio of the number of peak-hour passengers was assumed to be 15% of that of peak-day passengers following the actual data of other airports in Morocco. The actual peak-hour ratio is shown in Appendix IV-3.

The number of passengers at peak-hour is thus figured out in Table 4-9.

Table 4-9 NUMBER OF PASSENGERS AT PEAK-HOUR

Passenger Category	Number of Passengers at Peak-Hour
International	200
Domestic	54
Total	254 ≒ 250

2) Average Stay Time of Passengers

Hourly distribution of pasengers staying in the terminal building was assumed as shown in Table 4-10 through the discussion with the Moroccan Authorities concerned.

Table 4-10 AVERAGE STAY TIME OF PASSENGERS

Passenger Category	Stay time of Passenger
International	
Departing	60 minutes until departure
Arriving	30 minutes after arrival
Domestic	
Departing	45 minutes until departure
Arriving	15 minutes after arrival

3) Required Floor Area

The required floor area of the terminal building was roughly calculated by the following formula.

$S = A \times B$

A: 250 (number of passengers at peak time)

B: 20m^2 (floor area per one passenger)

$= 250 \times 20$

$= 5{,}000\ m^2$

The 20 m^2/PAX was decided through the discussion with the Moroccan Authorities concerned, referring to the following figures:

- Moroccan Government standard : 12 m^2 - 20 m^2
- Airports in France (of middle size): about 20 m^2
- ICAO (IATA) Recommendations: about 20 m^2 - 25 m^2

Besides, in order to handle adequately the volume of air passengers after the year 2000 as forecasted in Chapter 3, it has been planned that the floor area of the terminal will be extended twofold, i.e. up to 10,000 m^2 from that year.

Usually, in an international airport with the facilities for domestic air services, the passengers movements are to be completely separated by international and domestic services as well as by departure and arrival in the terminal building. In case of the Nador New Airport, however, usage for the international service will be quite more important than for the domestic service and the volume of the expected air passengers will not be so great judging from the forecast of the air traffic demands.

The daily flight schedule for an airport of this magnitude is basically to be determined so that the simultaneous stay of the passengers of various flights will not happen as much as practically possible in the terminal building. On the other hand, such duplications of international and domestic passengers, or of both international passengers or of both domestic passengers may happen on occasions caused by the delay of scheduled flight and others.

Accordingly it was planned that the handling of both international and domestic passengers will be made by a gate lounge and a baggage claim area in case of no duplication of these passengers in the terminal building.

In case of duplication of the international and domestic passengers in the terminal building, the spaces for the domestic passengers separated by simple partitions, which may be easily removed, were planned in the gate lounge and the baggage claim area. In normal case, these separated spaces may be used as one without partitions. Thus the over-design of the floor area of the terminal building will be avoided.

As such, the terminal building can commonly function both for international and domestic passengers. This system, therefore, will become more economical with regard to the construction cost. The planned flow of passengers movements is shown in Fig. 5-4.

4.3.2 Cargo Terminal Building

As mentioned in sub-section 4.2.3 no provision of cargo loading apron will be required because of small cargo traffic demand forecasted for the new airport, but the provision of the cargo terminal building will be required in the future.

4.4 AIRFIELD LIGHTING SYSTEMS

The provision of the airfield lighting systems required for instrument landing system category-I specified in ICAO ANNEX 14 was planned in the proposed airport.

4.5 RESCUE AND FIRE FIGHTING FACILITIES

The proposed airport is to be classified in Category 8 for rescue and fire-fighting according to ICAO ANNEX 14. On the other hand, it is recommended that the airport category may be lowered to Category 7 during anticipated periods of reduced activity.

Thus the required numbers of rescue and fire fighting vehicles were determined in conformity with the requirements of Category 7 of the ICAO Recommendations as follows:

Rapid Intervention Vehicle: 1
Major Vehicle : 2

It is recommended to prepare also one ambulance as many airports in Morocco have.

A garage of 450 m^2 was planned to be provided for the above-mentioned vehicles.

4.6 ADMINISTRATION FACILITIES

4.6.1 Administration Offices

The administration offices are to house the headquarters of the Nador New Airport. They are to be located on the first floor of the terminal building since a separate building is not recommendable from economical viewpoint. The required total floor area of the administration offices was estimated at about 1,200 m^2 referring to the existing airports in Morocco.

4.6.2 Navigation Control Tower and Communication Facilities

Details of the control tower and communication facilities required for the safe aircraft movements are explained in Chapter 6.

4.6.3 Maintenance Center Building and Other Buildings

It is essential to keep all the airport facilities and equipment in good condition for the smooth operation of the airport. For the Nador New Airport, it was planned to build a maintenance center building which is to be staffed with technical workers for all works such as civil, architectural works and to be provided with the garage for ground service equipment and vehicles, a restaurant and a day-room of drivers. The required total floor area of this building was estimated to be approximately 1,400 m^2.

4.7 SERVICE FACILITIES

The following service facilities and utilities with the capacities shown in Table 4-11 were planned to be provided in order to ensure the required function of the airport.

Table 4-11 REQUIREMENTS OF SERVICE UTILITIES

Utilities	Facilities	Capacity
Electricity (kVA)	Terminal Building, etc.	960
	Lighting & Radio Navaids	350
Water Supply (kl/day)	Terminal Building, etc.	150
Sewage (kl/day)	Terminal Building, etc.	140

4.7.1 Aviation Fuel Storage Facilities

Since the new airport is considered to be a transit airport to Casablanca Base Airport and aircraft of B-727 type, which are intended to serve the route of the maximum stage length, are able to operate without refueling at the new airport, the provision of the aviation fuel storage facility of large capacity will not be required. The aviation fuel storage facilities of small capacity are provided at the neighboring airports in service now, and therefore a fuel storage facility of small capacity only was planned to be provided at the proposed airport.

4.7.2 Electric Power Supply Facilities

The electric power supply to the proposed airport facilities is possible by means of tapping-off a new electric power line at Selouane from the existing 30kV transmission line to the main substation to be installed within the proposed airport site to step down the voltage to 6.0 kV.

The down-stepped electric power of 6.0 kV will be distributed to such facilities as the terminal building, the control tower and the navigational aids systems, etc. The required electric power for the airport facilities is shown in Table 4-1.

Provision of a secondary power supply system equipped with automatic operation device was also planned. This system will be capable of supplying enough power required at least by such important airport facilities as navigational aids, airfield lighting and emergency lighting of the buildings, etc. to keep these facilities in operationable conditions in the event of failure of the normal power supply. The electric power distribution system is illustrated in Fig. 4-3.

4.7.3 Water Supply

The estimated water consumption is approximately 4.5 l/s as shown in Table 4-1. Since the water supply from Djebel El Arouit, the nearest town, is limited to 2 l/s, the installation of a reservoir in the basement of the terminal building, with pumping system and an elevated water tank on the rooftop of the terminal building was planned for water delivery to the facilities and for easy maintenance.

4.7.4 Sewage Treatment

Since the required treatment capacity was estimated at 140 kl per day as shown in Table 4-1, the installation of a sewage treatment plant with a capacity of 140 kl/day was planned which is capable of cleansing sewage to BOD 90 ppm by single septic tank treatment method.

4.7.5 Telephone Circuits

The Nador City Authority concerned is ready to provide about 50 telephone circuits which are estimated to be required for the operation of the proposed airport judging from its magnitude.

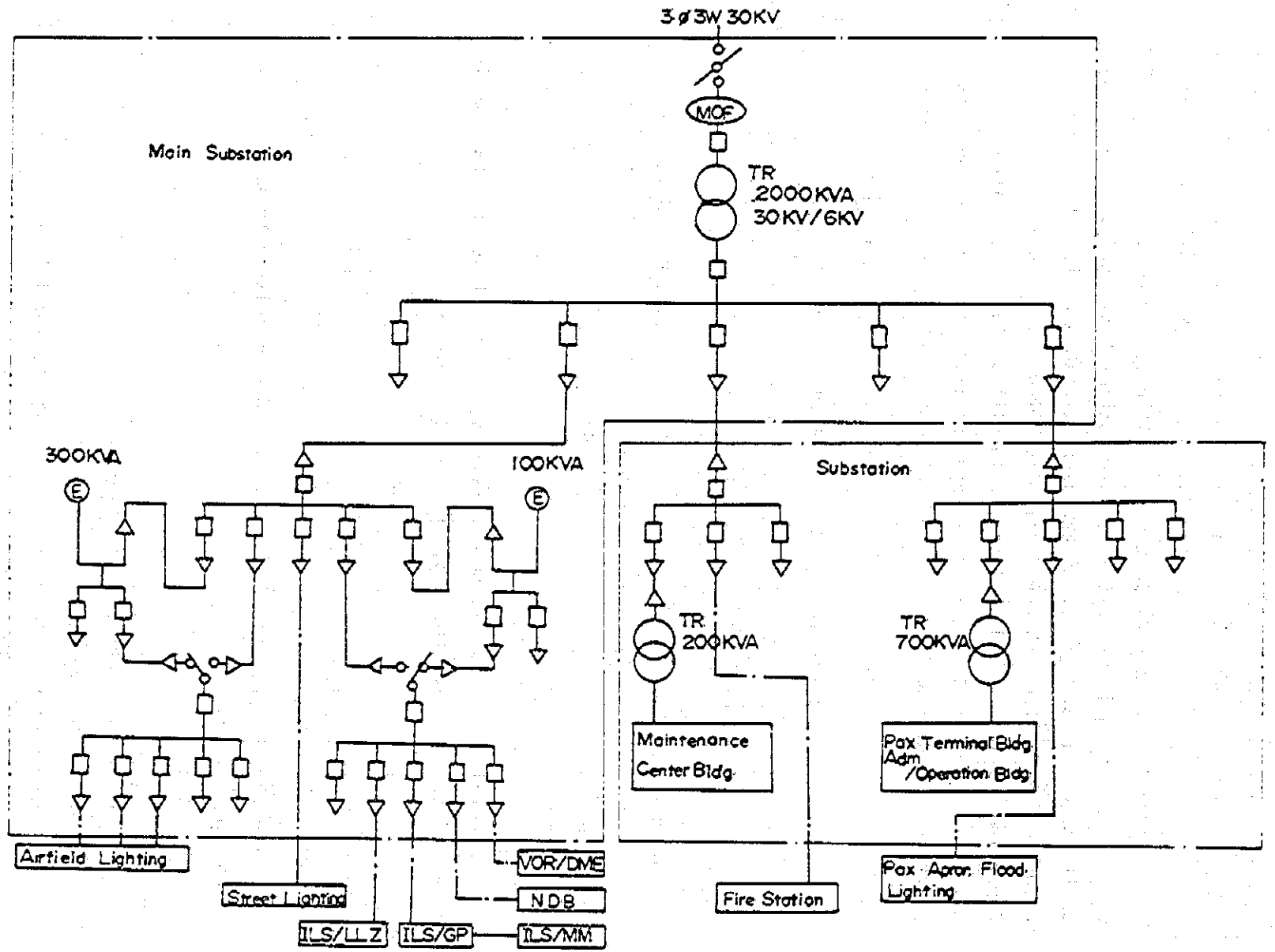


Fig. 4-3 ELECTRIC POWER DISTRIBUTION SYSTEM