

ARAB REPUBLIC OF EGYPT

FEASIBILITY STUDY
FOR
NEW ALEXANDRIA INTERNATIONAL AIRPORT
CONSTRUCTION PROJECT

APPENDIX

JULY 1985

JAPAN INTERNATIONAL COOPERATION AGENCY

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ARAB REPUBLIC OF EGYPT

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APPENDIX

JULY 1985

JAPAN INTERNATIONAL COOPERATION AGENCY

国際協力事業団	
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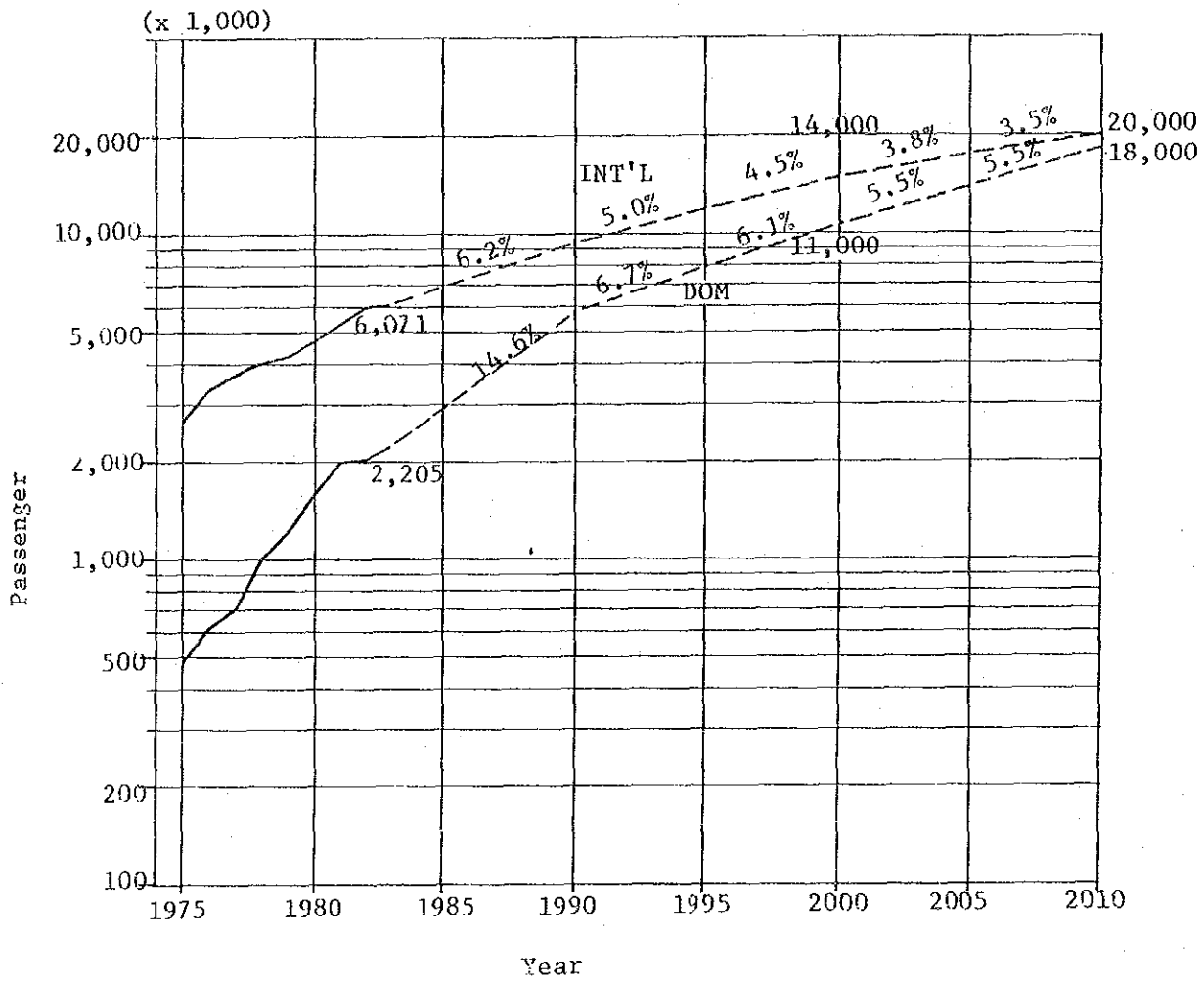
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APPENDIX TO CHAPTER 3

Appendix 3.1 Projected Air Traffic Demand in Egypt

Projected passenger and cargo demand in Egypt which are discussed in Sections 3.4 to 3.7, Main Report are illustrated in Figs. 3.1 and 3.2.

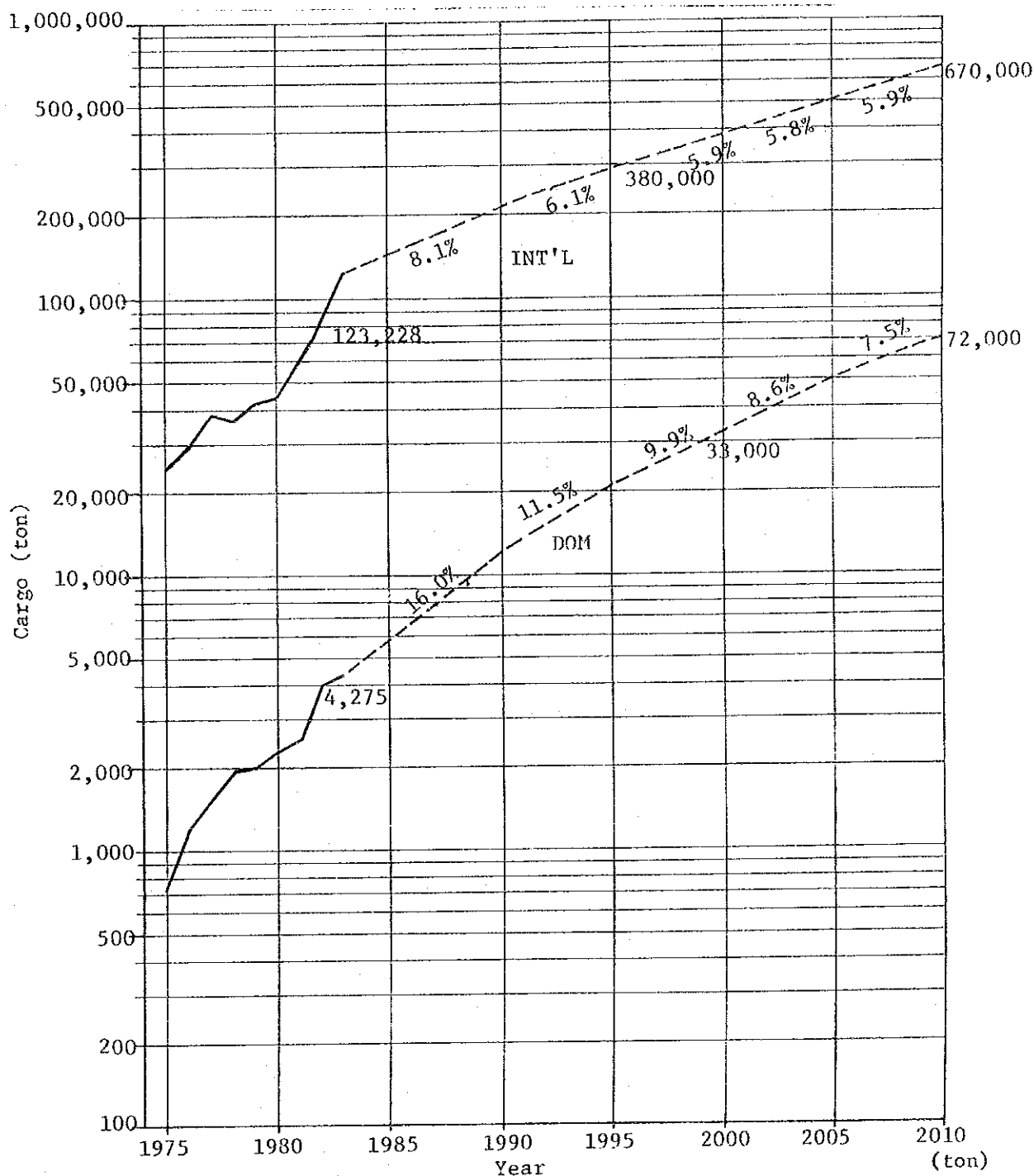
APPENDIX 3.1



(x 1,000)

Year		Actual		Projected				
		1975	1983	1990	1995	2000	2005	2010
Embarcked and Disembarcked	Domestic	491	2,205	5,700	7,900	11,000	14,000	18,000
	Int'l	2,360	6,071	8,600	11,000	14,000	17,000	20,000
	Total	2,851	8,276	14,000	19,000	25,000	31,000	38,000
Transit		74	93	300	390	480	580	690

Fig. 3.1 Projected Passenger Demand in Egypt



Year / Category		Actual		Projected				
		1975	1983	1990	1995	2000	2005	2010
Loaded and Unloaded	Domestic	743	4,275	12,000	21,000	33,000	50,000	72,000
	Int'l	24,781	123,228	210,000	290,000	380,000	500,000	670,000
	Total	25,524	127,503	222,000	310,000	410,000	550,000	740,000

Fig. 3.2 Projected Cargo Demand in Egypt

Appendix 3.2 Actual Records of Air Traffic Demand in Egypt

Actual records of air traffic demand at the airports in Egypt are shown in the following tables and figures.

- (1) Domestic Passengers Table 3.1, Fig. 3.3
- (2) International Passengers Table 3.2, Fig. 3.4
- (3) International Transit Passengers Table 3.3, Fig. 3.5
- (4) Domestic Cargo Table 3.4, Fig. 3.6
- (5) International Cargo Table 3.5, Fig. 3.7

Table 3.1 Actual Record of Domestic Passenger Demand in Egypt

Airport	Year	1975	1976	1977	1978	1979	1980	1981	1982	1983
Cairo		168,971	191,907	206,366	275,049	369,659	489,703	547,278	538,828	643,299
Aswan		163,092	208,426	250,345	326,202	443,511	591,098	628,969	615,210	564,923
Luxor		145,357	190,787	224,628	331,580	341,916	438,041	429,937	426,647	483,408
Abu Simbel		8,946	14,705	20,847	25,101	32,674	35,521	274,092	312,799	350,397
Alexandria		4,634	-	-	-	4,079	-	16,312	39,283	81,436
Hurghada		-	-	-	10,659	16,210	29,511	36,306	54,954	43,251
New Valley		-	-	-	14,006	4,871	4,835	6,870	4,623	13,218
Asyut		-	-	-	-	-	-	895	1,282	42
Port Said		-	-	-	-	-	-	4,332	3,236	3,821
St. Catherine		-	-	-	-	-	-	-	12,224	11,224
Ras Nasrani		-	-	-	-	-	-	-	3,572	3,609
El-Arich		-	-	-	-	-	-	-	1,076	6,585
Mersa Matruh	49	-	-	-	-	-	-	-	-	-
Total		491,049	605,825	702,186	982,597	1,212,920	1,588,709	1,944,991	2,013,734	2,205,213

Source : Annual Statistical Report, ECAA

APPENDIX 3.2

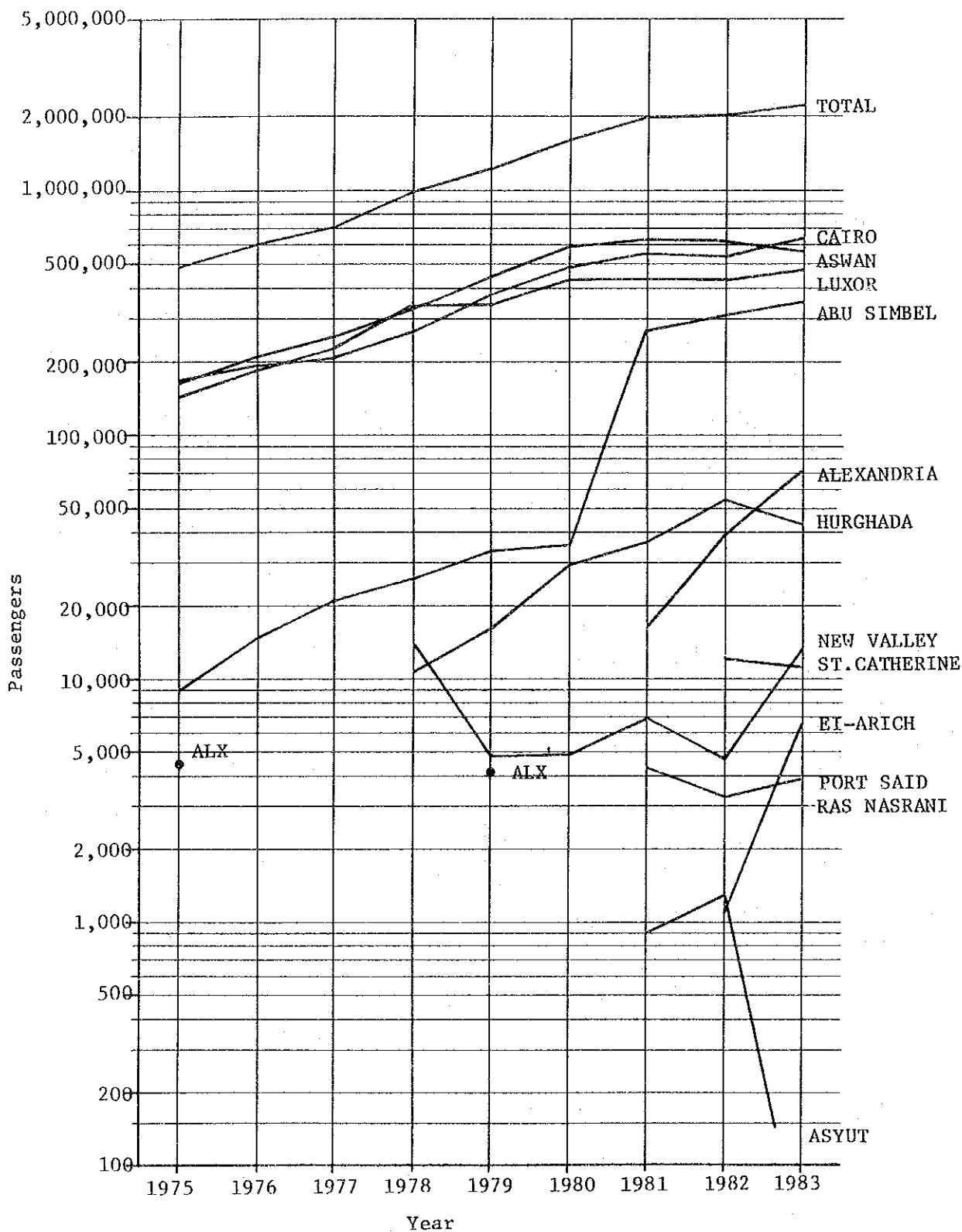


Fig. 3.3 Actual Record of Domestic Passenger Demand in Egypt

Table 3.2 Actual Record of International Passenger Demand in Egypt

Airport	Year	1975	1976	1977	1978	1979	1980	1981	1982	1983
Cairo		2,359,750	2,959,703	3,331,604	3,652,325	3,823,746	4,308,418	4,823,523	5,593,087	6,018,951
Aswan		48	536	-	679	955	144	5,161	-	18,994
Luxor		-	-	-	-	10,488	-	10,068	-	30,957
Alexandria		-	-	-	-	-	-	-	-	1,705
Total		2,359,798	2,960,239	3,331,604	3,653,004	3,835,189	4,308,562	4,838,752	5,593,087	6,070,607

Source : Annual Statistical Report, ECAA

Note : Excluding Transit Passengers

Table 3.3 Actual Record of International Transit Passenger Demand in Egypt

Airport	Year	1975	1976	1977	1978	1979	1980	1981	1982	1983
Cairo		157,608	179,099	170,963	188,651	204,325	189,153	197,142	185,329	N.A.
Aswan		12	-	-	-	-	-	-	-	-
Luxor		254	-	176	-	-	-	-	-	-
Total		157,874	179,099	171,139	188,651	204,325	189,153	197,142	185,329	-

Source : Annual Statistical Report, ECAA

Note : Transit passenger is counted once

APPENDIX 3.2

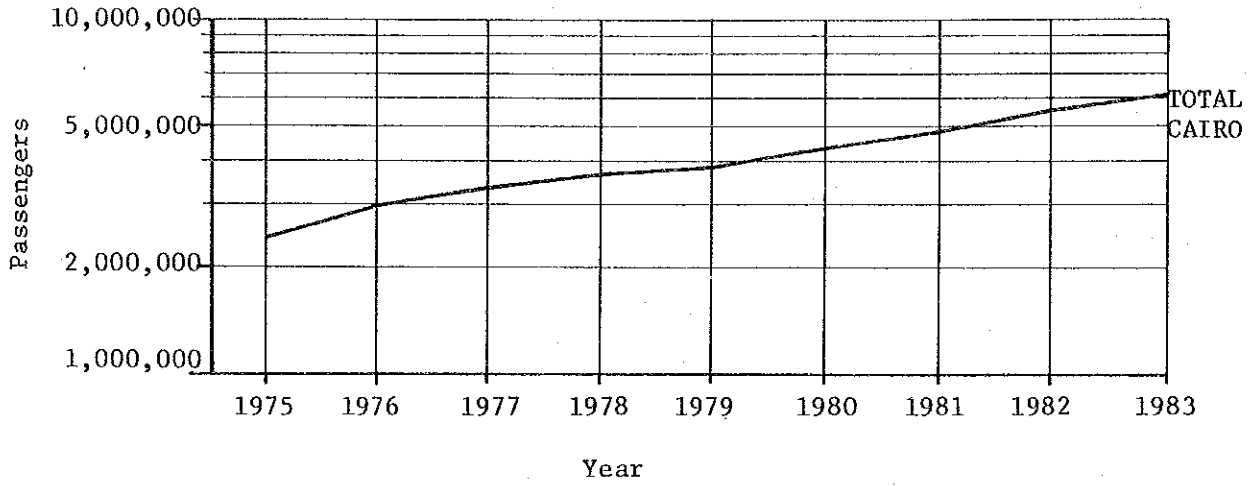


Fig. 3.4 Actual Record of International Passenger Demand in Egypt

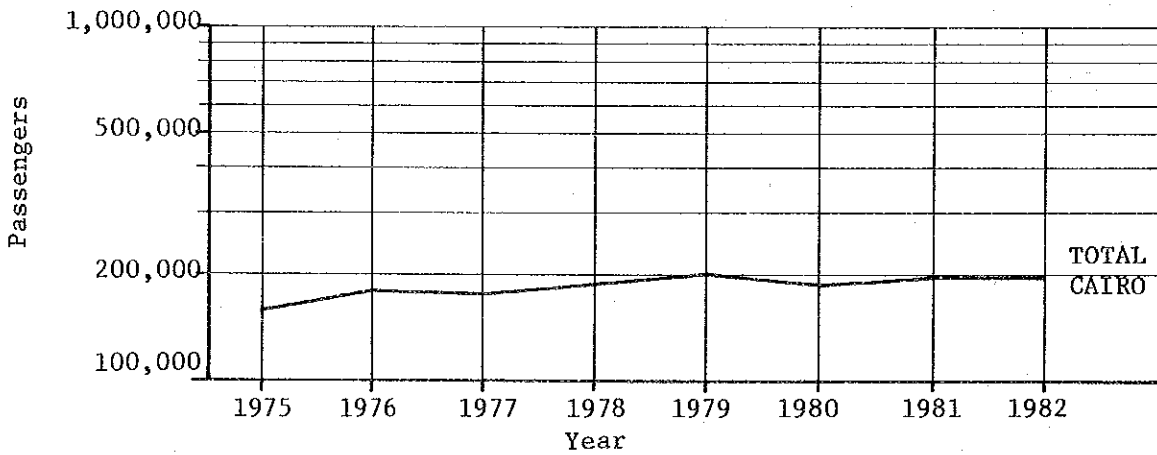


Fig. 3.5 Actual Record of International Transit Passenger Demand in Egypt

Table 3.4 Actual Record of Domestic Cargo Demand in Egypt (ton)

Airport \ Year	1975	1976	1977	1978	1979	1980	1981	1982	1983
Cairo	363	540	847	966	1,011	1,129	528	462	1,985
Aswan	237	387	307	539	544	624	1,175	1,202	1,059
Luxor	142	268	363	407	443	511	722	945	985
Abu Simbel	1	-	-	1	1	-	844	696	174
Alexandria	-	-	-	-	-	-	-	-	68
Hurghada	-	-	-	-	-	-	-	-	3
New Valley	-	-	-	13	-	-	233	152	1
Total	743	1,195	1,517	1,925	1,999	2,264	3,502	3,457	4,275

Source : Annual Statistical Report, ECAA
Annual Report, 1981, 1982, 1983 Egypt Air

Table 3.5 Actual Record of International Cargo Demand in Egypt (ton)

Airport \ Year	1975	1976	1977	1978	1979	1980	1981	1982	1983
Cairo	24,781	29,214	38,263	36,067	42,040	44,361	59,623	85,402	123,328

Source : Annual Statistical Report, ECAA

APPENDIX 3.2

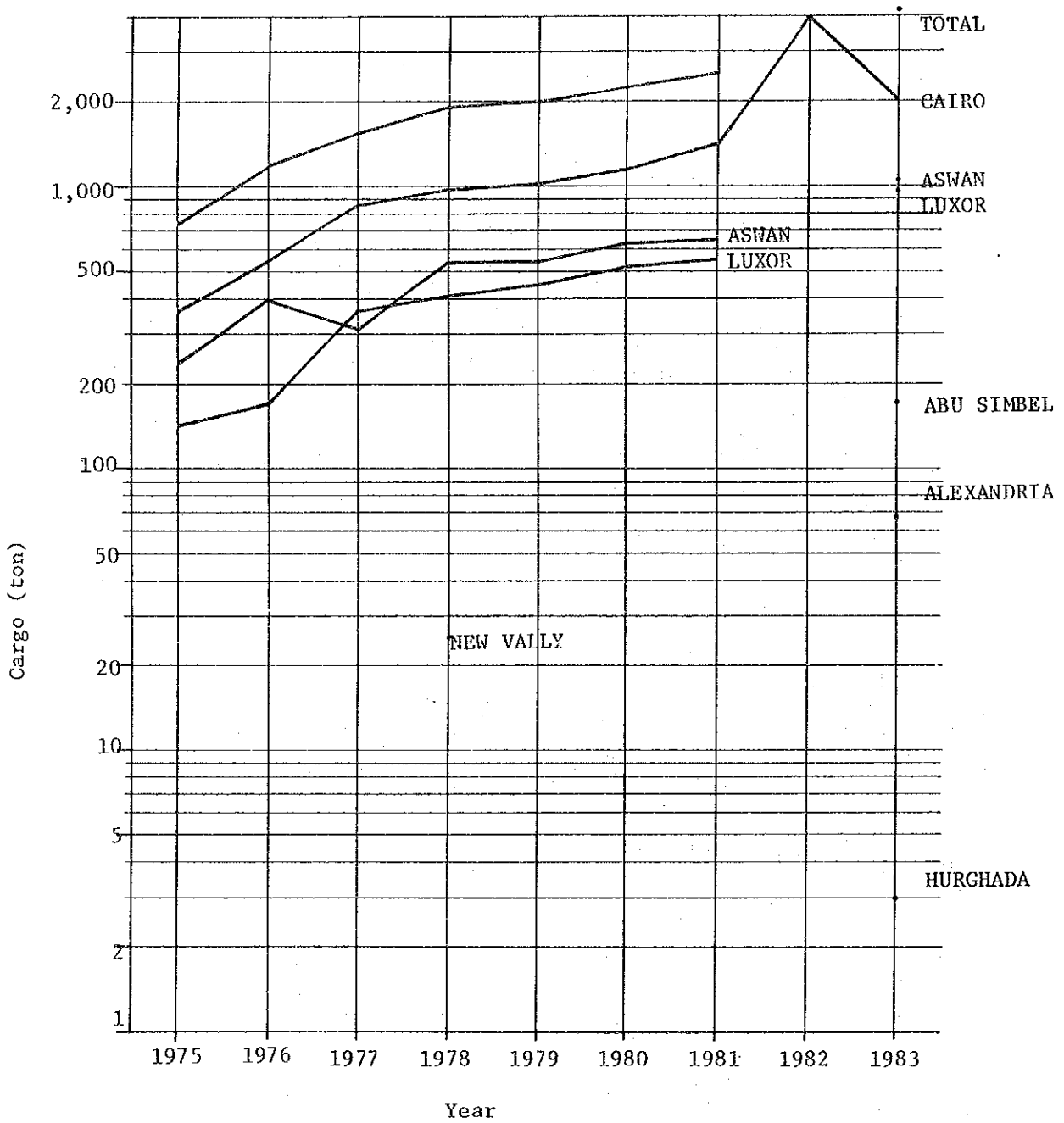


Fig. 3.6 Actual Record of Domestic Cargo Demand in Egypt

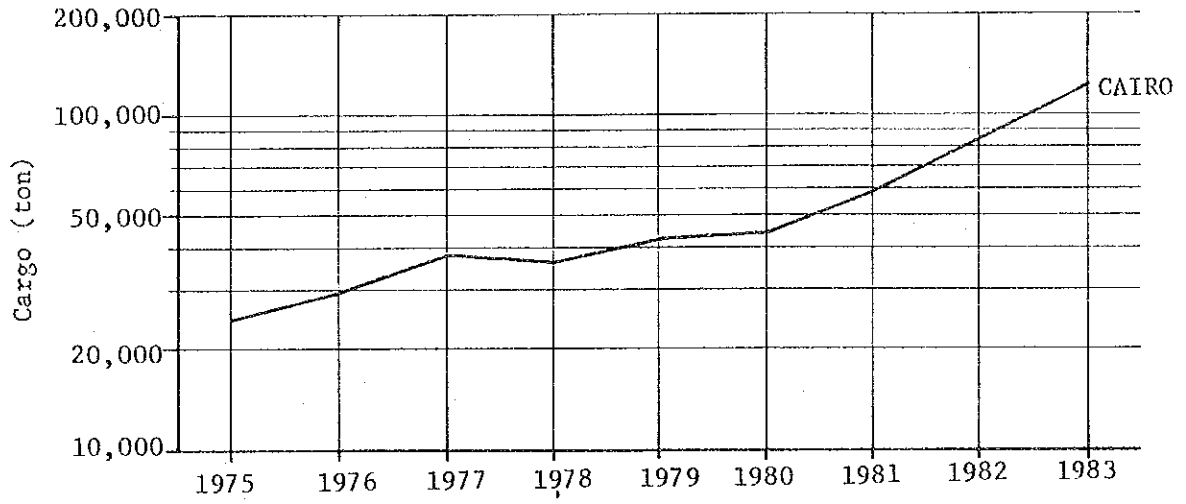


Fig. 3.7 Actual Record of International Cargo Demand in Egypt

APPENDIX 3.3

Appendix 3.3 Economic Indices and Domestic Air Transport

Per capita GDP, domestic passengers per 1,000 population and domestic cargo carried per 1,000 population which are used in Figs. 3.4.2 and 3.6.1, Main Report are summarized in Tables 3.6 and 3.7 for Egypt and various countries, respectively.

Table 3.6 Economic Indices and Domestic Air Transport in Egypt

	Population (Million)	GDP (1980 Billion US\$)	GDP/Capita (1980 US\$)	Domestic Passengers Carried		Domestic Cargo Carried	
				Number (x1,000)	Per 1,000 Population	Volume (1,000ton)	Per 1,000 Population
EGYPT							
1975	35.62	14.85	417	237.7	6.67	0.372	10.4
1976	36.77	16.37	446	301.0	8.19	0.546	14.8
1977	37.35	17.56	470	323.2	8.65	1.005	26.9
1978	38.28	19.34	506	434.1	11.3	0.982	25.7
1979	39.36	21.02	534	567.8	14.4	1.081	27.5
1980	40.55	24.01	591	758.0	18.7	1.457	35.9
1981	41.84	25.34	606	845.0	20.2	1.555	37.2
1982	43.01	24.49	570	807.1	18.7	1.769	41.1
1983	(43.91)	(26.50)	(603)	879.9	(20.0)	1.693	(38.6)

Source: Population, GDP : International Financial Statistics, IMF
Pax, Cargo volume : ICAO Bulletin

Note : () Estimated Value

APPENDIX 3.3

Table 3.7 Economic Indices and Domestic Air Transport of Foreign Countries

Item Country	Population (Million)	GDP Billion US\$	GDP/Capita (1980) US\$	Domestic Passengers Carried		Domestic Cargo Carried	
				Number (x1,000)	Per 1,000 Population	Volume (Million ton)	Per 1,000 Population (kg)
ARGENTINA							
1976	-	-	-	2,655	-	13.25	-
1978	27.35	48.10	1,759	3,018	110	11.82	432
1980	28.24	51.83	1,835	2,849	101	16.36	579
1982	29.16	46.23	1,585	2,613	89.6	11.44	392
AUSTRALIA							
1976	13.92	130.4	9,365	9,762	701	53.99	3,878
1978	14.36	133.7	9,312	12,122	844	61.63	4,292
1980	14.69	141.1	9,604	13,649	929	62.82	4,276
1982	15.17	147.7	9,733	-	-	-	-
BRAZIL							
1976	107.5	186.2	1,731	6,078	56.5	70.98	660
1978	112.9	227.5	2,015	9,563	84.7	73.60	652
1980	118.6	248.6	2,096	11,407	96.2	97.31	820
1982	126.8	-	-	11,868	93.6	114.2	901
CANADA							
1976	20.03	232.4	10,090	12,701	551	48.00	2,084
1978	23.49	245.5	10,449	13,853	590	53.17	2,264
1980	23.96	255.8	10,677	16,924	706	54.71	2,283
1982	24.63	252.7	10,259	14,337	582	67.26	2,731
COLUMBIA							
1976	24.33	23.83	979	3,180	131	25.04	1,029
1978	25.64	30.50	1,190	3,849	150	21.02	820
1980	27.09	33.40	1,233	3,975	147	15.59	576
1982	-	-	-	5,947	-	19.51	-
GREECE							
1976	9.17	37.77	4,118	2,382	260	6.528	712
1978	9.36	38.05	4,065	3,332	356	8.311	888
1980	9.64	40.15	4,165	3,235	336	8.375	869
1982	9.79	39.97	4,082	3,912	400	9.430	963
INDIA							
1976	613.3	141.1	230	3,537	5.77	11.88	19.4
1978	638.4	160.1	250	4,752	7.44	19.80	31.0
1980	663.6	162.1	244	4,935	7.44	23.26	35.0
1982	717.8	176.0	245	6,344	8.84	34.35	47.9
INDONESIA							
1976	138.2	52.93	383	2,580	18.7	13.27	96.0
1978	143.2	62.08	434	3,702	25.9	17.02	119
1980	148.0	72.48	490	4,137	28.0	20.77	140
1982	153.0	79.99	523	-	-	15.50	101
JAPAN							
1976	112.8	926.6	8,217	28,246	250	92.53	821
1978	114.9	943.4	8,210	37,101	323	126.6	1,102
1980	116.7	1,040	8,906	40,424	346	152.0	1,302
1982	118.5	1,118	9,434	40,483	342	197.6	1,668

Table 3.7 (Cont.)

Item Country	Population (Million)	GDP 1980 (Billion US\$)	GDP/Capita (1980) (US\$)	Domestic Passengers Carried		Domestic Cargo Carried	
				Number (x1,000)	Per 1,000 Population	Volume (Million ton)	Per 1,000 Population (kg)
MALAYSIA							
1976	12.30	17.30	1,407	1,698	138	8.107	659
1978	12.91	20.21	1,566	1,779	138	8.241	638
1980	13.87	23.81	1,717	2,694	194	11.18	806
1982	14.53	26.94	1,854	3,191	220	12.27	845
PAKISTAN							
1976	72.4	19.06	263	1,161	16.0	6.892	95.2
1978	77.5	21.03	272	1,178	15.2	7.307	94.3
1980	82.1	23.89	291	1,501	18.3	7.535	91.7
1982	87.1	26.82	308	1,714	19.7	8.660	99.4
PHILIPPINES							
1976	43.8	28.06	641	2,377	54.3	25.59	585
1978	45.5	33.42	734	3,117	68.5	15.74	346
1980	48.4	35.42	732	4,880	101	13.34	276
1982	50.7	36.19	713	-	-	10.23	202
SAUDI ARABIA							
1976	7.58	80.95	10,680	2,228	294	3.574	472
1978	8.26	98.73	11,952	4,550	551	5.491	665
1980	8.96	116.0	12,944	6,894	769	9.158	1,022
1982	9.68	127.0	13,119	7,357	760	17.53	1,811
SOUTH AFRICA							
1976	26.13	62.83	2,405	2,396	91.6	15.43	591
1978	27.30	70.33	2,576	2,399	87.9	16.30	597
1980	28.61	78.93	2,759	3,182	111	19.01	664
1982	30.04	81.82	2,723	3,143	105	20.52	683
USA							
1976	61.51	2,316	10,623	206,267	946	1,194	5,477
1978	61.31	2,567	11,532	212,686	956	1,062	4,772
1980	61.56	2,632	11,558	237,811	1,044	953.7	4,197
1982	61.64	2,650	11,421	235,401	1,014	801.7	3,455

APPENDIX 3.4

Appendix 3.4 Economic Indices of Egypt and Related Regions

Foreign countries which are connected by air transport from/to Egypt are divided into three regions, i.e., Middle East region, Europe/USA region and other region. Economic indices are projected for the traffic demand forecast. A conservative projection is adopted for the economic growth taking into account the objectives of the feasibility study.

Projection of GDP, population and per capita GDP are tabulated in Table 3.8 with the actual record.

Table 3.8 Actual Record and Projection of Economic Index of Egypt and Foreign Countries

Year	EGYPT						MIDDLE EAST						EUROPE/USA						OTHERS						
	GDP (1980)		Population		GDP/Capita (1980)		GDP (1980)		Population		GDP/Capita (1980)		GDP (1980)		Population		GDP/Capita (1980)		GDP (1980)		Population		GDP/Capita (1980)		
	Million US\$	%	Million	%	US\$	%	US\$	%	Million	%	US\$	%	US\$	%	Million	%	US\$	%	US\$	%	Million	%	US\$	%	
1975	14,847	-	35,616	-	417	-	98.8	-	10.98	-	9,000	-	4,184	-	472.31	-	8,860	-	829	-	200.84	-	4,130	-	
1976	16,367	10.2	36,773	3.2	446	7.2	108.6	9.9	11.35	3.4	9,570	6.3	4,404	5.3	474.23	0.4	9,290	4.9	882	6.5	204.73	1.9	4,310	4.4	
1977	17,564	7.3	37,350	1.6	470	5.1	121.5	11.9	11.77	3.7	10,320	7.8	4,596	4.4	476.38	0.5	9,650	3.9	918	4.0	209.33	2.2	4,390	1.9	
1978	19,341	10.1	38,283	2.5	506	7.6	129.4	6.5	12.24	4.0	10,570	2.4	4,792	4.3	479.37	0.6	10,000	3.6	979	6.6	213.29	1.9	4,590	4.6	
1979	21,020	8.7	39,363	2.8	534	5.6	138.6	7.1	12.74	4.1	10,880	2.9	4,935	3.0	482.61	0.7	10,020	0.2	1,029	5.2	217.17	1.8	4,740	3.3	
1980	24,006	14.2	40,548	3.0	591	10.7	146.9	8.7	13.25	4.0	11,090	1.9	4,943	0.2	486.16	0.7	10,170	1.5	1,080	4.9	222.08	2.3	4,860	2.5	
1981	25,337	5.1	41,844	3.2	606	2.4	153.5	5.9	14.00	5.7	11,110	0.2	5,007	1.3	488.94	0.6	10,240	0.7	1,125	4.2	226.15	1.8	4,970	2.3	
1982	24,490	43.3	43,006	2.8	570	45.9	146.2	46.0	14.37	2.6	10,170	48.5	4,967	40.8	490.56	0.3	10,130	41.1	1,162	3.3	230.53	1.9	5,040	1.4	
1975-1982		7.4		2.7		4.6		5.8		3.9		1.8		2.5		0.5		1.9		4.9		2.0		2.9	
1985	31,165	8.5	45.8	2.1	680	6.1	161	6.3	16.0	3.7	10,100	40.3	5,500	3.5	497	0.5	11,100	3.0	1,300	3.7	244	1.9	5,310	1.8	
1990	42,000	6.1	50.8	2.1	826	4.0	210	5.4	18.9	3.4	11,100	1.9	6,240	2.5	509	0.5	12,300	2.1	1,510	3.1	269	2.0	5,610	1.1	
1995	54,600	5.4	56.3	2.1	969	3.2	272	5.4	22.3	3.4	12,200	1.9	7,070	2.5	520	0.5	13,600	2.1	1,760	3.1	298	2.1	5,910	1.0	
2000	71,000	5.4	62.5	2.1	1,140	3.2	354	5.4	26.4	3.4	13,400	1.9	8,020	2.5	532	0.5	15,100	2.1	2,050	3.1	331	2.1	6,190	0.9	
2005	92,300	5.4	69.4	2.1	1,330	3.2	460	5.4	31.1	3.4	14,800	1.9	9,090	2.5	544	0.5	16,700	2.1	2,390	3.1	370	2.2	6,460	0.9	
2010	120,000	5.4	77.0	2.1	1,560	3.2	598	5.4	36.8	3.4	16,200	1.9	10,300	2.5	557	0.5	18,500	2.1	2,790	3.1	412	2.2	6,760	0.9	
1982-1010		5.8		2.1		3.7		5.2		3.4		1.7		2.6		0.5		2.2		3.2		2.1		1.1	

Remarks

1) Country Groups are represented by the following countries.

Middle East : Saudi Arabia, Kuwait, Jordan

Europe/USA : France, Germany, Greece, Italy, United Kingdom, Switzerland, Netherlands, U.S.A.

Others : Tunisia, Kenya, Pakistan, Japan

Source (Except Egypt)

1) 1975-1982

GDP : International Financial Statistics, IMF

Population : Ditto

2) 1985-2000

GDP : Global 2000 Report to the President, Technical Report Vol. II, the Council on Environmental Quality and Development of State, USA

Population : World Development Report, 1983, World Bank

3) 2000-2010 : Same growth rates are adopted for 1985-2000 period

APPENDIX TO CHAPTER 4

Appendix 4.1 Runway Length Requirements

1. A300-B4 / 50C2 Engine / Take-off

(1) Conditions

OAT : 30.6°C
 Airport elevation : 0 ft
 Runway slope : 0 percent

Flight route : Alexandria (ALY) → Heathrow London (LHR) → Orly Paris (ORY) (Alternate)

Distance : 1870NM (ALY to LHR) and 240NM (LHR to ORY)
 Flight level : FL280/310/-40kt (head wind)

(2) Take-off weight

DOW : 91,800 KG
 Fuel carried : 39,000 "
 Maximum payload : 32,200 "
 Take-off weight : 163,000 "
 Maximum structural take-off weight : 165,000 "

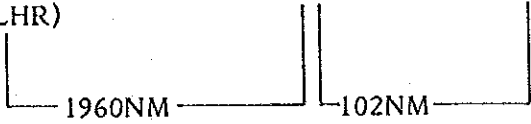
(3) Required runway

Field length : Slats 16°/Flaps 8° 3,000 m
 Slats 16°/Flaps 0° - m

APPENDIX 4.1

2. A300-B4 / 50C2 Engine / Landing

(1) Conditions

OAT	:	30.6°C
Airport elevation	:	0 ft
Runway slope	:	0 percent
Flight route	:	Heathrow $\xrightarrow{\hspace{2cm}}$ Alexandria $\xrightarrow{\hspace{1cm}}$ Cairo London (LHR) (ALY) (CAI) (Alternate)
Distance	:	
Flight level/ wind	:	FL290/330/+20kt (tail wind)

(2) Landing weight

DOW	:	<u>91,800 KG</u>
Fuel left	:	<u>9,000 "</u>
Maximum payload	:	<u>32,200 "</u>
Landing weight	:	<u>130,200 "</u>
Maximum structural landing weight	:	<u>134,000 "</u>

(3) Required runway

Field length	:	Slats 25°/Flaps 25°	<u>1,470 m (Dry)</u>
			<u>2,100 m (Wet)</u>
	:	Slats 16°/Flaps 15°	<u>1,940 m (Dry)</u>
			<u>2,720 m (Wet)</u>

ACTUAL LANDING DISTANCESSLATS 25°/FLAPS 25°

$$\text{FAR Field Length} = \frac{\text{Actual landing distance}}{0.6}$$

WEIGHT (tons)		160	150	140	130	120	110	100
V _{REF} (kt)		150	145	140	135	130	124	119
LANDING DISTANCE (m)	DRY RUNWAY	1090	1010	940	880	820	770	720
	WET RUNWAY	1510	1420	1340	1260	1180	1100	1020
	ICY RUNWAY	—	3590	3400	3210	3020	2820	2620

Dry = 1,470m

Wet = 2,100m

SLATS 16°/FLAPS 15°

WEIGHT (tons)		160	150	140	130	120	110	100
VAPP (V _{REF} + 5) (KT)		155	150	145	140	135	129	124
LANDING DISTANCE (m)	DRY RUNWAY	1530	1400	1270	1160	1060	970	910
	WET RUNWAY	2130	1930	1780	1630	1500	1370	1260
	ICY RUNWAY	—	—	—	—	3950	3670	3410

Dry = 1,940 m

Wet = 2,720 m

CORRECTIONS ON LANDING DISTANCES

- . WIND : per 5kt tailwind add 10 %
per 5kt headwind subtract 2 %
- . AIRPORT ELEVATION : per 1000 ft above sea level add 5 %
- . EFFECT OF TEMPERATURE : per 10°C above ISA, landing distances are increased by 3.5 %
- . EFFECT OF REVERSE THRUST : landing distances are decreased by :
 - 4 % on dry runway
 - 10 % on wet runway
 - 45 % on icy runway

APPENDIX 4.1

3. B747-300 / JT9D-7R4G2 Engine / Take-off

(1) Conditions

OAT	:	30.6°C
Airport elevation	:	0 ft
Runway slope	:	0 percent
Flight route	:	Alexandria (ALY) → Heathrow London (LHR) → Orly Paris (ORY) (Alternate)
Distance	:	1870NM (ALY to LHR) / 240NM (LHR to ORY)
Flight level	:	FL280/310/-40kt (head wind)

(2) Take-off weight

DOW	:	<u>176,750 KG</u>
Fuel carried	:	<u>75,330 "</u>
Maximum payload	:	<u>65,930 "</u>
Take-off weight	:	<u>318,010 "</u>
Maximum structural take-off weight	:	<u>371,950 "</u>

(3) Required runway

Field length	:	Flaps 10°	<u>2,430 m</u>
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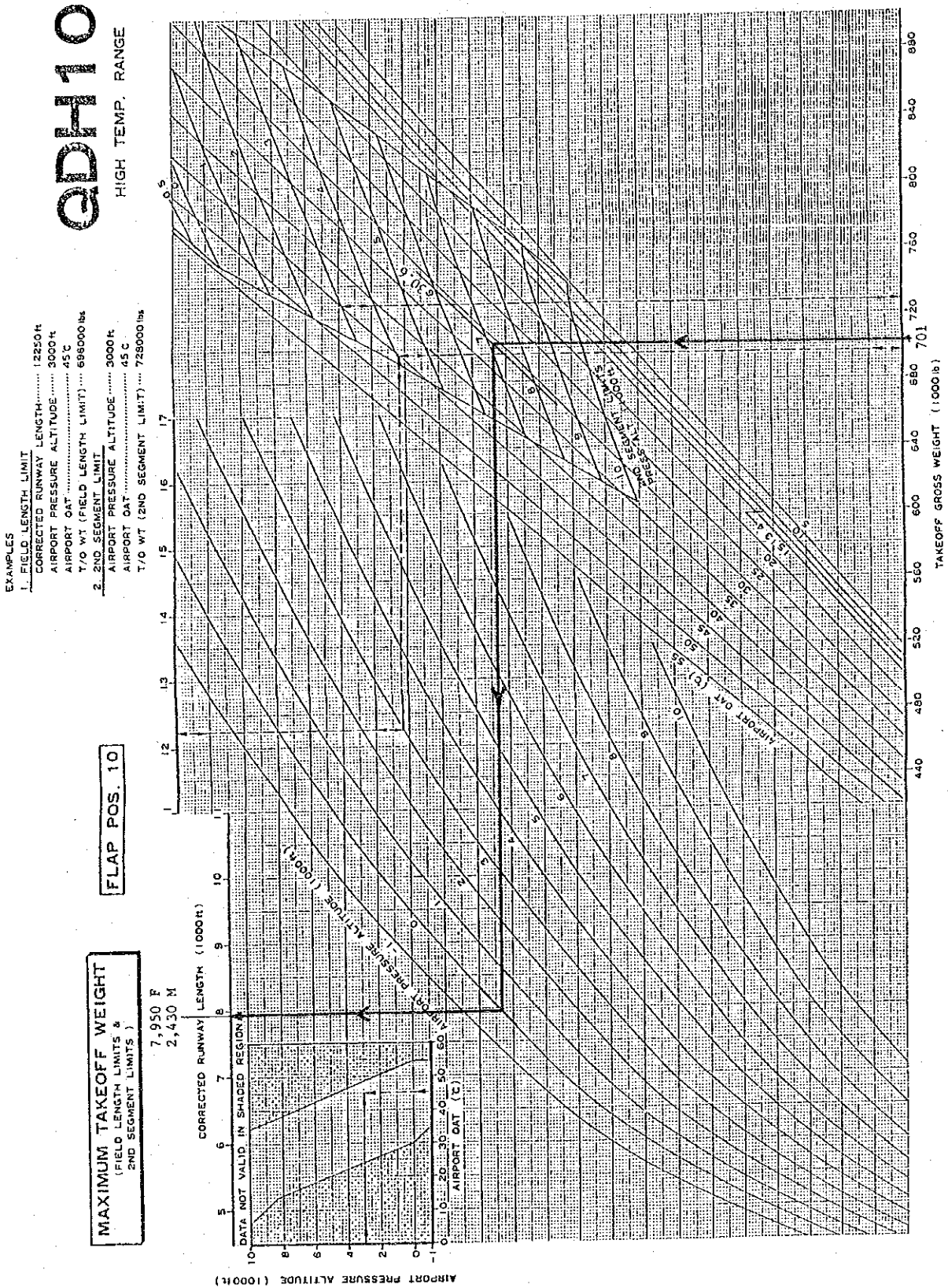


Fig. 4.1 Runway Length Requirement (B747-300)

APPENDIX 4.1

4. B747-300 / JT9D-7R4G2 Engine / Landing

(1) Conditions

OAT	:	30.6°C
Airport elevation	:	0 ft
Runway slope	:	0 percent
Flight route	:	<pre> (Alternate) v Heathrow -----> Alexandria -----> Cairo London (ALY) (CAI) (LHR) ----- 1960NM ----- ----- 102NM ----- </pre>
Distance	:	
Flight level/ wind	:	FL290/330/+20kt (tail wind)

(2) Landing weight

DOW	:	<u>176,750 KG</u>
Fuel left	:	<u>15,100 "</u>
Maximum payload	:	<u>65,930 "</u>
Landing weight	:	<u>257,780 "</u>
Maximum structural landing weight	:	<u>260,370 "</u>

(3) Required runway

Field length	:	Flaps 25°	<u>2,030 m (Dry)</u>
			<u>2,320 m (Wet)</u>

70

* FOR MANUAL SPOILERS,
INCREASE FIELD LENGTH BY 600 FT.

25

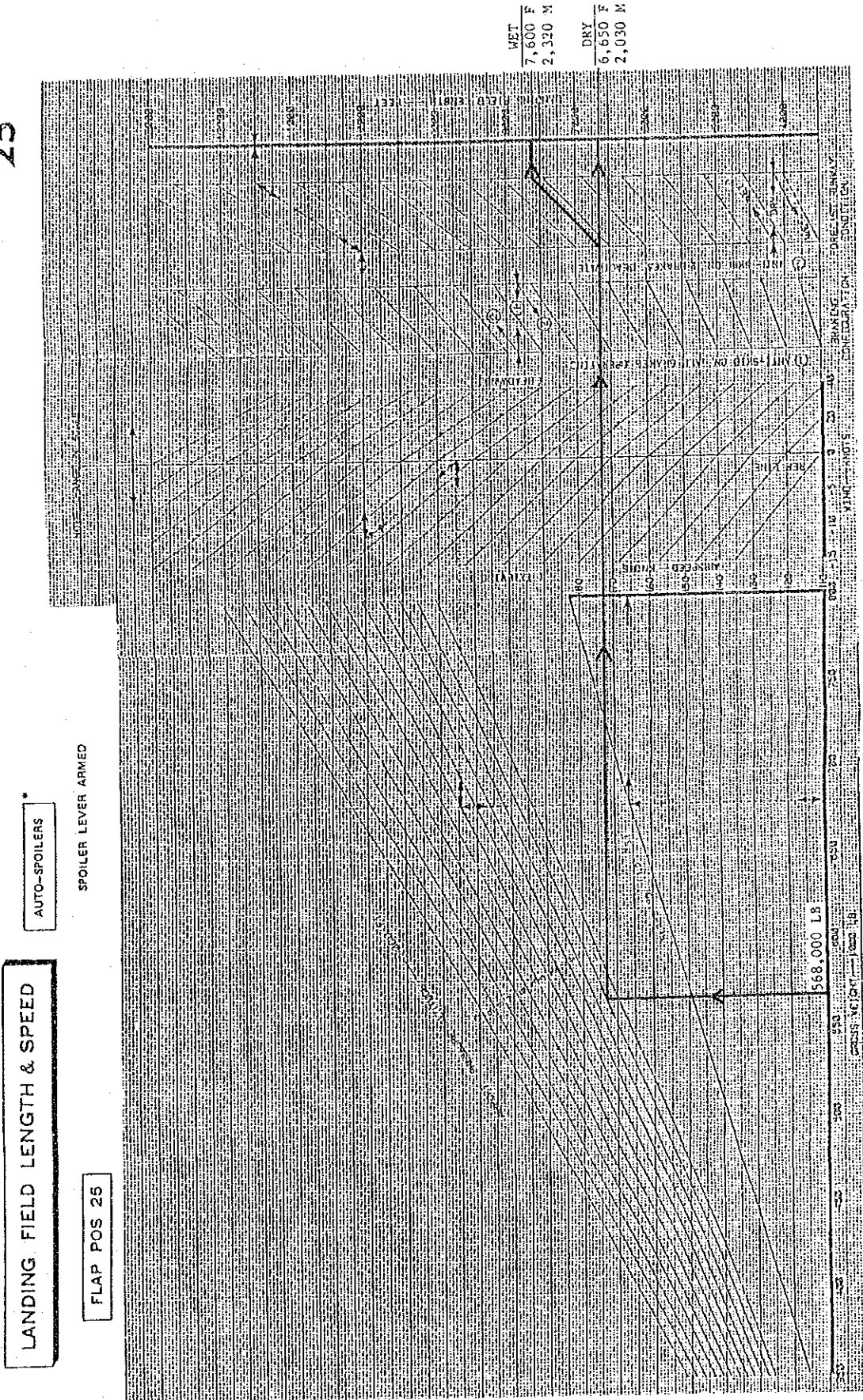


Fig. 4.2 Runway Length Requirement (B747-300)

APPENDIX 4.1

5. DC10-30 / CF6-50A Engine / Take-off

(1) Conditions

OAT : 30.6°C
 Airport elevation : 0 ft
 Runway slope : 0 percent

Flight route : Alexandria (ALY) → Heathrow London (LHR) → Orly Paris (ORY) (Alternate)

```

    graph LR
      ALY["Alexandria (ALY)"] -- 1870NM --> LHR["Heathrow London (LHR)"]
      LHR -- 240NM --> ORY["Orly Paris (ORY) (Alternate)"]
    
```

Distance : 1870NM (Alexandria to Heathrow) and 240NM (Heathrow to Orly)

Flight level : FL280/310/-40kt (head wind)

(2) Take-off weight

DOW : 124,000 KG
 Fuel carried : 49,750 "
 Maximum payload : 43,000 "
 Take-off weight : 216,750 "
 Maximum structural take-off weight : 251,740 "

(3) Required runway

Field length : Flaps 12° 2,420 m

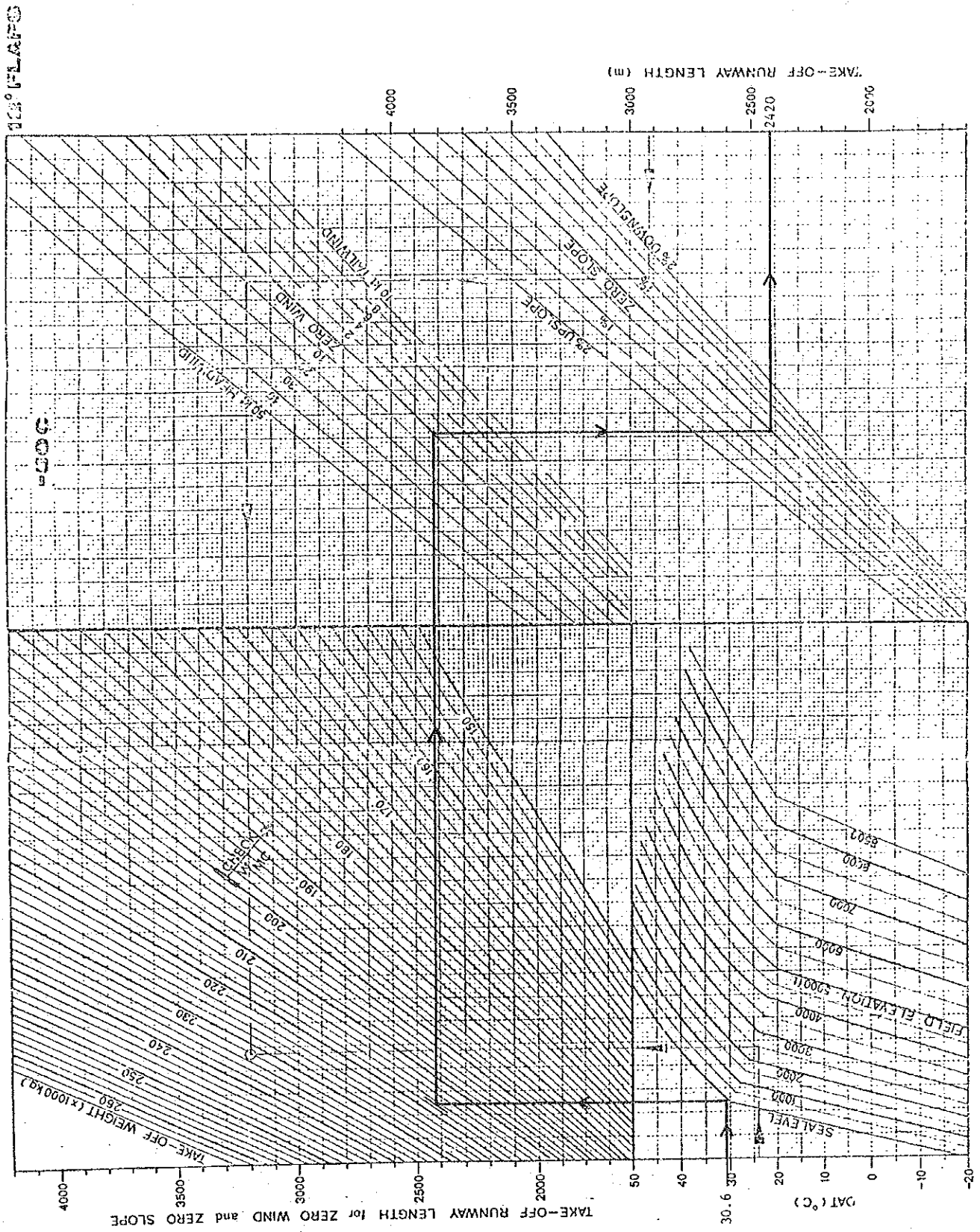


Chart based on:
 • No Engine bleed
 CORRECTIONS:
 • Engine Anti-Ice:
 • SUBTRACT: 1500 M

Fig. 4.3 Runway Length Requirement (DC 10-30)

APPENDIX 4.1

6. DC10-30 / CF6-50A Engine / Landing

(1) Conditions

OAT : 30.6°C
 Airport elevation : 0 ft
 Runway slope : 0 percent

Flight route : Heathrow → Alexandria → Cairo
 London (LHR) (ALY) (CAI) (Alternate)

Distance : 1960NM
 Flight level/wind : FL290/330/+20kt (tail wind)
 : 102NM

(2) Landing weight

DOW : 124,000 KG
 Fuel left : 8,000 "
 Maximum payload : 43,000 "
 Landing weight : 175,000 "
 Maximum structural landing weight : 183,000 "

(3) Required runway

Field length : Flaps 35° 1,890 m (Dry)
2,160 m (Wet)

Chart is valid for Automatic or Manual (with pilot's operation)

APPENDIX 4.1

The Max. Landing Weight for DISPATCH is the lower of:

- (i) Max. Structural LW
- (ii) Landing RW length limited weight*)

*) (ii) is determined for:

- . longest runway with zero wind
- . most suitable runway with forecast wind

- using WET scale for DESTINATION (or DRY scale if forecast indicates dry, SCD)
- using DRY scale for ALTERNATE

2,160 M (Wet)
1,890 M (Dry)

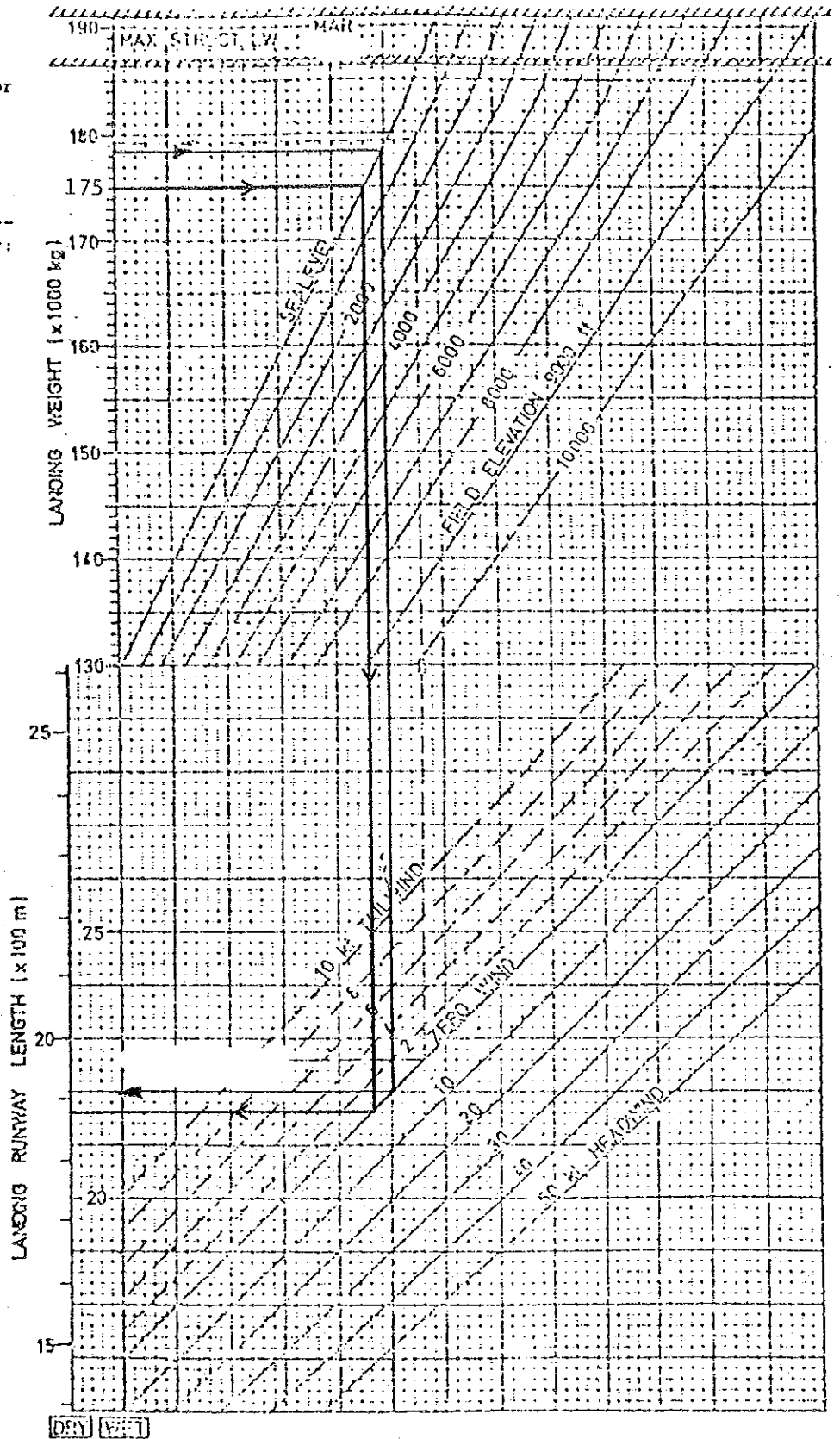


Fig. 4.4 Runway Length Requirement (DC 10-30)

APPENDIX TO CHAPTER 14

Appendix 14.1 Estimation of Standard Conversion Factor

1. Standard Conversion Factor (SCF)

When various kinds of local input (costs) and output (benefits) at financial (market) price are converted into those at economic (international/border) price, it is most precise to use the conversion factors which correspond to the various kinds of input and output. However, it is very difficult to collect the fundamental data for estimation of the conversion factors. In this case, SCF is used assuming that it represents a set of the conversion factors.

2. Definition of SCF

The general formula of SCF is as follows:

$$SCF = (I + E) / (I + E + ID - ED + ES)$$

Where;

I : Total imports

E : Total exports

ID : Total import duties

ED : Total export taxes

ES : Total export subsidies

3. Fundamental data for estimation of the SCF of Egypt

(unit: million £ E)

	Export	Import	Import Duties
1977	668.4	1,884.3	979.0
1978	679.4	2,632.2	920.0
1979	1,287.8	2,686.2	905.5
1980	2,132.2	3,402.0	1,329.0 ¹
1981	2,262.9	6,187.4	1,458.5 ²

Note ¹: 1980/81

Note ²: 1981/82, provisional

Source: Economic Bulletin, National Bank of Egypt

APPENDIX 14.1

4. Estimation of the SCF

a) Time series of the SCF

1977 0.723

1978 0.783

1979 0.814

1980 0.806

1981 0.835

b) The SCF adopted in this analysis

The value of the SCF is set at 0.9 in this analysis, taking an increasing tendency in the time series into account.

5. Other conversion factors adopted in this analysis

- (1) As described in the section 1 of Appendix 14.1, when various kinds of local input (costs) and output (benefits) of a project at financial (market) price are converted into those at economic (international/border) price, it is most precise to use the conversion factors which correspond to the kinds of input and output. It is because that volume and kind of goods and services are different by the kind of input and output, and that, as a result of this, a degree of influence of price policy in the country concerned upon the value of input and output is also different each other. The introduction of conversion factors aims to deduct the influence from the value.
- (2) Therefore, it is necessary to collect detailed information on the goods and service, which compose of the input or the output, and the price policy and the related matters in order to estimate suitable conversion factors.
- (3) Lacking the detailed information and data in case of this analysis, SCF (Standard Conversion Factor) is mainly used to convert the kinds of the cost items, and conversion factors estimated upon "Egypt National Transport Study", for the conversion of the kinds of the benefit, with a few exceptions.

Assuming that import duties and other taxes would not be imposed on the goods and services imported for this project because this project is a national project, the value estimated at CIF base is adopted as the value at economic price without conversion.

- (4) The conversion factors and the reasons which are adopted are as shown in Table 14.1.

Table 14.1 Cost and Benefit Item - Conversion Factor

Cost and Benefit Item	Conversion Factor Adopted	Reason of the Adoption
Construction Cost (local)	SCF (=0.9)	Wage, clay and stone product and fuel consist mainly of the cost. However, the composition of the service and goods is not clear, and even if clear, it is difficult to estimate the corresponding conversion factor.
Operation and Maintenance Cost		
• Personnel Cost	SCF	CFC (Conversion Factor for Consumer) should be adopted because the wage would be used for purchase of consumers' goods. However, it is difficult to estimate the CFC.
• Material and Utilities Cost	1.3 *	Supposing fuel cost consists of the main part of this cost.
• Maintenance and Repair Cost	SCF	Supposing wage and clay and stone product consist of the main part of this cost, acknowledge that replacement cost of the equipment is also included.
Construction O/M Costs saved Cairo Airport	SCF	Same reason as that of construction cost (local) above.
O/M Cost saved at Nozha Airport	SCF	Ditto
Benefit due to Accommodation of Overflowing Egyptian Int'l Pax		
• Travelling Cost on surface transportation		See, Appendix 14.2
• Travelling Time value saved on surface transportation	SCF	Same reason as that of personnel cost above, because the travelling time value is estimated based upon the wage rate. See, Appendix 14.2.
• Saving of Air Fares	None	Supposing the air fares would be paid in foreign currency. See, Appendix 14.2.

Table 14.1 (Cont.)

Cost and Benefit Item	Conversion Factor Adopted	Reason of the Adoption
Benefit due to Accommodation of Overflowing Domestic Pax		
• for Etyptian Pax	1.3 *	Reason described in "Egypt National Transport Study". See, Appendix 14.2
• for Foreign Pax	None	Supposing the payment would be made in foreign currency. See, Appendix 14.2
Benefit due to Accommodation of overflowing Int'l Cargo	1.15	Reason described in "Egypt National Transport Study". See, Appendix 14.2
Benefit due to Reduction of Passenger processing time at the Airport	SCF	Same reason as that of Travelling time value saved on surface Transportation described above.
Benefit to Airline by Permitting Introduction of Larger Aircraft	None	This benefit is estimated based upon data of foreign carriers.
Additional Access Cost in Case of the New Airport (Disbenefit)		
• Time value of Egyptian Pax	SCF	Same reason as that of Travelling time value saved on surface transportation described above
• Vehicle Cost		Reason described in "Egypt National Transport Study"

Note*: Estimated based upon the data in "Egypt National Transport Study"

APPENDIX 14.2

Appendix 14.2 Estimation of Transportation Cost and Fare at Economic price

1. Surface Transportation Cost of Passengers between Cairo and Alexandria
2. Economic Time Value to be saved on Surface Transportation
3. Additional Airfare between Cairo and Alexandria in Case of International Flight
4. Benefit due to Accommodation of Overflowing Domestic Passengers
5. Surface Transportation Charge for Cargo between Cairo and Alexandria
6. Additional Cargo Airfare between Cairo and Alexandria in case of International Flight

1. Surface Transportation Cost of Passengers between Cairo and Alexandria

(1) Estimation method

a) Economic cost per passenger km in 1979

Bus	0.86	P.T./passenger km
Train DMU* I class	3.27	ditto
II class	2.80	ditto

Note *: Diesel Multiple Unit

Source: Egypt National Transport Study

b) Average economic cost, weighting a) above with the following passengers modal share.

Public bus/public car	52.6%
Train	47.4%

Source: Egypt National Transport Study

c) Inflating b) above to estimate b) in 1984, using an average annual increasing rate of price in transportation and communication section (16.5%)

d) Multiplying c) above by the road distance between Cairo and Alexandria (210 km).

(2) The surface transportation cost at economic price in 1984

8.5 £E/passenger.

APPENDIX 14.2

2. Economic Time Value to be saved on Surface Transport

- a) Travelling time between Alexandria and Cairo is supposed to be four hours, and between Alexandria downtown and the new airport around 40 minutes.
- b) Economic time value per passenger per hour is estimated to be 0.5 £E based on the financial time value and the SCF.
- c) From a) and b) above, the economic time value to be saved on the surface transport is calculated.

3. Additional Airfare between Cairo and Alexandria in Case of International Flight

(1) Estimation method

- a) From ABC World Guide Airways, the following facts are obtained.
 - i) Up to 1,700 - 1,800 Maximum Permitted Mileage (MPM) from Cairo Airport, Fare Construction Unit (FCU) increases sharply in accordance with MPM.
 - ii) Exceeding 1,700 - 1,800 MPM the FCU does not increase so steeply as in i) above.
- b) In MPM between Cairo and Alexandria is 113 miles. It is assumed that this distance results in decrease or increase of FCUs for the routes up to 1,700 - 1,800 MPMs, and does not affect the airfare of the longer routes.
- c) Two international air routes are projected from/to Alexandria, a north route via the Mediterranean and a south route via Luxor and Cairo.

In the European/USA market, the major eight cities, i.e., Paris, Frankfurt, Athens, Rome, Amsterdam, Zurich, London and New York, are selected. It is assumed that the north route is used for the flights from/to Alexandria, and that only the MPMs to Athens and Rome are decreased based on the assumption b) above.

In the Middle East market, Bahrain, Sanaa, Amman, Kuwait, Doha, Riyadh, Jeddah, Abu Dhabi, Dubai and Baghdad are selected. It is assumed that the north route is used for the flight from/to Amman and Baghdad based on the present air route and the MPMs to the two cities are decreased by 113 miles. As to the remaining eight cities, the south route is used and the MPMs are increased.

- d) Conversion of the incremental MPMs to airfare using the conversion factor in ABC World Airways Guide.

APPENDIX 14.2

e) Calculating constituent ratios of air passengers from/to each city to the total air passengers, in 1983.

f) From d) and e) above, average additional airfare per international passenger.

(2) Additional airfare between Cairo and Alexandria in case of international flight in 1984

to/from European/USA	8.3 £E/passenger
to/from Middle East countries	3.3 £E/passenger
to/from other countries	4.8 £E/passenger

Note: The airfare from/to the other countries is estimated to be an arithmetic average of those from/to the Middle East and European/USA.

The additional airfares which will be paid to foreign airlines in "WOP" case as compared with "with project" case are saved and measured as a benefit.

i) Additional Airfare from/to Europe/USA Region

Routes	Airfare from/to Cairo (FCU)	Airfare from/to Alexandria (FCU)	Additional Airfare (FCU)	Additional Airfare (£E)	Route Share 1983 (%)	Average Additional Airfare (£E)
Paris	571.7	571.7	0	0	15.4	0
Frankfurt	571.7	571.7	0	0	10.1	0
Athens	245.8	216	30	19.7	23.8	4.7
Rome	471.9	437	35	23.0	15.6	3.6
Amsterdam	571.7	571.7	0	0	4.7	0
Zurich	530.8	530.8	0	0	6.2	0
London	625.7	625.7	0	0	16.3	0
New York	990.0	990.0	0	0	7.9	0
Total					100.0	8.3

ii) Additional Airfare from/to Middle East Region

Routes	Airfare from/to Cairo (FCU)	Airfare from/to Alexandria (FCU)	Additional Airfare (FCU)	Additional Airfare (£E)	Route Share 1983 (%)	Average Additional Airfare (£E)
Bahrain	315.9	335.9	-20.0	-13.1	1.6	-0.2
Sanaa	401.3	426.3	-25.0	-16.4	2.7	-0.4
Amman	171.8	131.8	40.0	26.3	23.6	6.2
Kuwait	261.9	288.9	-27.0	-17.7	17.1	-3.0
Doha	315.9	335.9	-20.0	-13.1	2.8	-0.4
Riyadh	311.4	327.4	-16.0	-10.5	10.5	-1.1
Jeddah	230.9	223.9	7.0	4.6	26.6	1.2
Abu Dabi	373.7	396.7	-23.0	-15.1	3.7	-0.6
Dubai	373.7	396.7	-23.0	-15.1	2.4	-0.3
Baghdad	262.2	230.2	32.0	21.0	9.1	1.9
Total					100.0	3.3

4. Benefit due to Accommodation of Overflowing Domestic Passengers

(1) Estimation Method

a) The benefit per domestic passenger (both of foreign and Egyptian passengers) is defined as residual of an average domestic airfare and an average surface transport charge.

b) The domestic airfare and surface transport charge are estimated as follows.

Unit: £E

Air Routes	Air Fare		Surface Transport Charge
	Egyptian	Foreigner	
Alexandria - Cairo	15	23	6.5
Alexandria-Upper Egypt	56 ^{1/}	83 ^{1/}	46.6 ^{2/}
Alexandria-Others	34 ^{3/}	44 ^{3/}	18.0 ^{4/}

Note ^{1/} Adding the airfare between Cairo and Upper Egypt to that of between Cairo and Alexandria

^{2/} Adding the berth charge between Cairo and Luxor/Aswan to that of the first class charge between Alexandria and Cairo

^{3/} The average airfare between Cairo and Alexandria/Upper Egypt/Hurghada.

^{4/} The average railway charge of highest class between Cairo and Alexandria/Luxor/Aswan/Matruh

c) Weighting b) above with the following share of domestic passengers by domestic air route.

Alexandria - Cairo	70%
Alexandria - Upper Egypt	25%
Alexandria - Other	5%

(2) Benefit due to accommodation of overflowing domestic passengers

at financial price:	Egyptians	9	£E/passenger
	Foreigners	22	ditto

at economic price:	Egyptians	11.7	ditto
	Foreigners	22	ditto

The benefit for foreigners at economic price remains the same as that of financial price because the payment is made in foreign currency, while the benefit for Egyptians is calculated by multiplying the benefit at financial price by 1.3 (the ratio of cost at economic price to that at financial price, Egypt National Transport Study).

5. Surface Transport Charge for Cargo between Cairo and Alexandria

- a) It is assumed that road transportation is used to carry international air cargo between Cairo and Alexandria in "WOP" case, based on the following data.

Cargo Modal Share in 1979

Railway	6.4%
Road	93.6%

Source: Egypt National Transport Study

- b) It is assumed that the charge is equal to the cost due to lack of data on the charge. The charge at economic price is estimated at 16.5 Egyptian Pounds/ton.

- c) The surface transport cost in b) above is estimated using the following data:

- i) Economic cost for carrying cargo by truck combination in 1979

3.66 P.T./ton km

- ii) Average annual increasing rate of price at transportation and communication sector: 16.5%

- iii) Road distance between Cairo and Alexandria: 210 km

6. Additional Cargo Airfare between Cairo and Alexandria in case of International Flight

(1) Estimation method

a) According to ICAO statistics, an average revenue from the charged air cargo per ton km of the scheduled flight carriers in the world in 1982 is 34.6 US cents.

b) The cargo airfare is estimated on a) above, using the following data:

i) Exchange rate of US dollar to Egyptian Pound : 0.82 £ E = 1 US dollar

(ii) Conversion factor of 1.15 from the cargo airfare to that at economic price (Egypt National Transport Study).

iii) The average annual increasing rate of the cost from 1982 to 1983: 8.2% (ICAO statistics)

iv) The flight distance between Cairo and Alexandria is: 113 miles in MPM

c) The economic cargo airfare to/from Europe/USA Region is calculated according to the procedure b) above, in case of the fare to/from Middle East Region, the constituent ratios of air passenger by the north and south route (north: 67.3%, south: 32.7%, 1983) are taken into account, and as to the fare to/from other countries, an arithmetic average of the rates to/from Europe/USA and Middle East countries.

(2) Economic cargo airfare between Cairo and Alexandria in case of international flight

to/from Europe/USA	59.4	£E/ton at 1984 economic price
to/from Middle East countries	20.6	ditto
to/from Other countries	40.0	ditto

Appendix 14.3 Benefits in Economic Price up to Year 2010

(1)	Benefit due to Accommodation of Overflowing Egyptian International Passengers	Table 14.1
(2)	Benefit due to Accommodation of Overflowing Domestic Passengers	Table 14.2
(3)	Benefit due to Accommodation of overflowing International Cargo	Table 14.3
(4)	Benefit due to Reduction of Passenger Processing Time at the Airport	Table 14.4
(5)	Benefit to Airline by Permitting Introduction of Larger Aircraft	Table 14.5
(6)	Additional Access Cost in case of the New Airport (Disbenefit)	Table 14.6

Table 14.1 Benefit due to Accommodation of Overflowing Egyptian International Passengers

Year	Air passenger (1000)					Benefit (1000 £E, 1984 economic price)						
	Overflowing Egyptian Int'l Pax	Carried by Foreign Carrier			Surface Transport Cost	Time Saving	Air Fare Paid to Foreign Carrier			Total		
		Middle East	Europe /USA	Others			Total	Middle East	Europe /USA		Others	Sub Total
1992	340	70	110	50	230	2,620	580	230	910	290	1,430	4,630
1995	680	210	180	70	460	5,240	1,160	690	1,490	410	2,590	8,990
2000	930	310	230	80	620	7,160	1,580	1,020	1,910	460	3,390	12,130
2005	1,200	420	280	100	800	9,240	2,040	1,390	2,320	580	4,290	15,570
2010	1,510	540	350	120	1,010	11,630	2,570	1,780	2,910	700	5,390	19,590

Note 1. Overflowing Egyptian Int'l paxs. are estimated based on the Overflowing Int'l paxs., taking into account the situation of "WOP" and the future trend of Egyptian Int'l paxs. (See, Chapter 3)

2. 67% of Overflowing Egyptian Int'l paxs. are carried by foreign carriers, distributed to three international markets using the distribution ratios of the Overflowing Int'l paxs. by market.

3. Economic surface transport cost per pax : 7.7 £E, Economic time saving value per Pax : 1.7 £E

Airfare per Pax between Cairo and Alexandria in international flight to/from Middle East : 3.3 £E
 Europe/USA : 8.3 £E
 Others : 5.8 £E

Table 14.2 Benefit due to Accommodation of Overflowing Domestic Passengers

Year	Overflowing Domestic Passengers (1,000)			Benefit (1,000£E, 1984 economic price)		
	Egyptian	Foreigner	Total	Egyptian	Foreigner	Total
1992	5	5	10	60	110	170
1995	35	35	70	410	770	1,180
2000	85	85	170	990	1,870	2,860
2005	155	155	310	1,810	3,410	5,220
2010	240	240	480	2,810	5,280	8,090

Note 1. Assumption that Egyptian domestic passengers are 50% of the total domestic passengers

2. Economic benefit per passenger

Egyptian : 11.7 £E, 1984 economic price

Foreigner : 22.0 £E, ditto

Table 14.3 Benefit due to Accommodation of Overflowing International Cargo

Year	Cargo (tons)				Benefit (1,000 fE, 1984 economic price)						
	Overflowing Egyptian Int'l Cargo	Carried by Foreign Carrier			Surface Transport Cost	Cargo Airfare Paid to Foreign Carrier			Sub Total	Total	
		Middle East	Europe /USA	Others		Total	Middle East	Europe /USA			Others
1992	9,850	2,130	3,200	1,370	6,700	160	40	190	50	280	440
1995	15,450	4,770	4,150	1,590	10,510	250	100	250	60	410	660
2000	21,600	7,290	5,390	2,010	14,690	360	150	320	80	550	910
2005	29,700	10,500	7,130	2,570	20,200	490	220	420	100	740	1,230
2010	40,150	14,600	9,340	3,360	27,300	660	300	550	130	980	1,640

Note 1. Half of Overflowing Int'l Cargo is evaluated as Overflowing Egyptian Int'l Cargo.

2. Assumption that 67% of the Overflowing Egyptian Int'l Cargo is carried by foreign carriers, distributed to three international markets using the some distribution ratios as used to distribute the Overflowing Egyptian Int'l paxs.

3. Economic surface transport cost per ton : 16.5 fE

Cargo airfare per ton between Cairo and Alexandria in international flights to/from
 Middle East : 20.6 fE
 Europe/USA : 59.4 fE
 Others : 40.0 fE

Table 14.4 Benefit due to Reduction of Passenger Processing Time at the Airport

(Unit: 1,000L·E, 1984 economic price)

Year	"WOP" Egyptian Dom Pax (1,000)	Benefit
1992	62	30
1995	62	30
2000	62	30
2005	62	30
2010	62	30

Note 1. "WOP" Egyptian Dom Pax for the benefit

$$= \text{"WOP" Dom Pax} \times 50\% \times 1/2$$

(Departure only)

2. Economic Egyptian time value : 0.5 £E/hr

Table 14.5 Benefit to Airline by Permitting Introduction of Larger Aircraft

Unit: 1,000 £E, 1984 economic price

Year	International Operation			Domestic Operation			Total Benefit
	"WOP" Int'l paxs. using Egypt Air (1,000)	Net Reduction of Operation Cost (£E/Pax)	Benefit from Int'l Operation	"WOP" Dom paxs. using Egypt Air (1,000)	Net Reduction of Operation Cost (£E/Pax)	Benefit from Dom Operation	
1992	132	0.0	0	250	0.0	0	0
1995	132	0.28	40	250	0.20	50	90
2000	132	0.75	100	250	0.40	100	200
2005	132	1.18	160	250	0.46	120	280
2010	132	1.55	200	250	0.62	160	360

- Note 1. WOP Int'l paxs. using Egypt Air are estimated by multiplying WOP Int'l paxs. by 33% (share of Egypt Air, 1983)
2. Net Reduction of the Operation Cost in "with project" case is calculated by subtracting the operation cost in "with project" case from that in "WOP".

**Table 14.6 Additional Access Cost in Case of
the New Airport (Disbenefit)**

Unit: 1,000 EE, 1984 economic price

Year	Disbenefit
1992	370
1995	370
2000	370
2005	370
2010	370

Note : "WOP" Egyptian international passengers: 310,000

Appendix 14.4 Cash Flow of Sensitivity Analysis Cases

(1) Case 1: Construction Cost Up by 10% Table 14.7

(2) Case 2: Traffic Demand Down by 10% Table 14.8

(3) Case 3: Construction Cost Up by 10% and Traffic Demand Down by 10%
(Simultaneously) Table 14.9

(4) Case 4: Phase I Development Table 14.10

Table 14.7 Cash Flow of Sensitivity Analysis Case Construction Cost Up by 10%

Unit : 1 000E, 1984 economic price

YEAR	Cost						Benefit						NET BENEFIT
	CONST. COST	O & M COST	SAVE RT CAIRO	SAVE RT NOZHA	TOTAL COST	INT'L PAX	DOM. PAX	INT'L CARGO	TIME SAVE	AIRLINE BENEFIT	ADD. ACCESS	TOTAL BENEFIT	
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	1221.0	0.0	0.0	0.0	1221.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1221.0
1987	2475.0	0.0	0.0	0.0	2475.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2475.0
1988	4323.0	0.0	0.0	0.0	4323.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-4323.0
1989	12265.0	0.0	0.0	0.0	12265.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-12265.0
1990	27984.0	0.0	-3460.0	0.0	24524.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-24524.0
1991	23785.0	0.0	-3460.0	0.0	20325.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-20325.0
1992	0.0	2500.0	-210.0	-500.0	1890.0	4630.0	170.0	440.0	30.0	0.0	-370.0	4900.0	3010.0
1993	0.0	2500.0	-210.0	-500.0	1920.0	5870.0	510.0	530.0	30.0	30.0	-370.0	6600.0	4680.0
1994	484.0	2370.0	-220.0	-500.0	2434.0	7350.0	840.0	610.0	30.0	60.0	-370.0	8530.0	6056.0
1995	0.0	2500.0	-220.0	-500.0	1980.0	8990.0	1180.0	660.0	30.0	90.0	-370.0	10580.0	8610.0
1996	0.0	2700.0	-230.0	-500.0	2000.0	9480.0	1520.0	710.0	30.0	110.0	-370.0	11480.0	9480.0
1997	0.0	2700.0	-240.0	-500.0	2030.0	10150.0	1850.0	750.0	30.0	130.0	-370.0	12550.0	10520.0
1998	1900.0	2700.0	-250.0	-500.0	4010.0	10750.0	2190.0	800.0	30.0	150.0	-370.0	13560.0	9550.0
1999	9658.0	2810.0	-5330.0	-500.0	6118.0	11390.0	2530.0	840.0	30.0	180.0	-370.0	14600.0	8462.0
2000	19032.0	2840.0	-5330.0	-500.0	15372.0	12130.0	2860.0	910.0	30.0	200.0	-370.0	15760.0	1980.0
2001	3586.0	3200.0	-380.0	-500.0	2336.0	13440.0	3200.0	950.0	30.0	230.0	-370.0	16800.0	14510.0
2002	0.0	3250.0	-390.0	-500.0	5846.0	14200.0	3710.0	1020.0	30.0	250.0	-370.0	18060.0	12114.0
2003	0.0	3310.0	-400.0	-500.0	2410.0	14830.0	4210.0	1090.0	30.0	280.0	-370.0	19400.0	16990.0
2004	0.0	3350.0	-410.0	-500.0	2450.0	15350.0	4720.0	1160.0	30.0	300.0	-370.0	20620.0	18200.0
2005	484.0	3380.0	-410.0	-500.0	2954.0	15570.0	5220.0	1230.0	30.0	330.0	-370.0	21960.0	19006.0
2006	0.0	3410.0	-420.0	-500.0	2490.0	16340.0	5710.0	1310.0	30.0	360.0	-370.0	23310.0	20820.0
2007	1826.0	3420.0	-430.0	-500.0	4316.0	17130.0	6230.0	1390.0	30.0	390.0	-370.0	24720.0	20404.0
2008	0.0	3450.0	-440.0	-500.0	2510.0	17900.0	6910.0	1480.0	30.0	420.0	-370.0	26270.0	23760.0
2009	0.0	3490.0	-450.0	-500.0	2540.0	18650.0	7410.0	1560.0	30.0	450.0	-370.0	27630.0	25090.0
2010	0.0	3520.0	-460.0	-500.0	2560.0	19590.0	8090.0	1640.0	30.0	480.0	-370.0	29340.0	26780.0
2011	1023.0	3520.0	-460.0	-500.0	3583.0	19590.0	8090.0	1640.0	30.0	480.0	-370.0	29340.0	26780.0
2012	0.0	3520.0	-460.0	-500.0	2560.0	19590.0	8090.0	1640.0	30.0	480.0	-370.0	29340.0	26780.0
2013	3586.0	3520.0	-460.0	-500.0	6146.0	19590.0	8090.0	1640.0	30.0	480.0	-370.0	29340.0	26780.0
2014	0.0	3520.0	-460.0	-500.0	2560.0	19590.0	8090.0	1640.0	30.0	480.0	-370.0	29340.0	26780.0
2015	0.0	3520.0	-460.0	-500.0	2560.0	19590.0	8090.0	1640.0	30.0	480.0	-370.0	29340.0	26780.0
2016	-10382.0	3520.0	1360.0	-500.0	-6202.0	19590.0	8090.0	1640.0	30.0	480.0	-370.0	29340.0	35542.0

DISCOUNT RATE = 9. % B/C RATIO = 1.4372 NPV = 25169.60
 DISCOUNT RATE = 12. % B/C RATIO = 1.0987 NPV = 4510.35
 DISCOUNT RATE = 15. % B/C RATIO = 0.8359 NPV = -5351.95
 EIRR = 13.104 %

Table 14.8 Cash Flow of Sensitivity Analysis Case
Traffic Demand Down by 10%

Unit : 1,000EE, 1984 economic price

YEAR	Cost						Benefit						NET BENEFIT
	CONST. COST	O & M COST	SAVE AT CAIRO	SAVE AT NOZHA	TOTAL COST	INT'L FAX	DOM. PRX	INT'L CARGO	TIME SAVE	AIRLINE BENEFIT	MOD. ACCESS	TOTAL BENEFIT	
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	1110.0	0.0	0.0	0.0	1110.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1110.0
1987	2250.0	0.0	0.0	0.0	2250.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2250.0
1988	3930.0	0.0	0.0	0.0	3930.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3930.0
1989	11150.0	0.0	0.0	0.0	11150.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-11150.0
1990	25340.0	0.0	-3460.0	0.0	21980.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-21980.0
1991	21550.0	0.0	-3460.0	0.0	18090.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-18090.0
1992	0.0	2600.0	-210.0	-500.0	1890.0	4167.0	152.0	396.0	27.0	0.0	-333.0	4410.0	2520.0
1993	0.0	2630.0	-210.0	-500.0	1920.0	5283.0	459.0	477.0	27.0	37.0	-333.0	5940.0	4020.0
1994	440.0	2670.0	-220.0	-500.0	2390.0	6624.0	756.0	549.0	27.0	54.0	-333.0	7677.0	5287.0
1995	0.0	2690.0	-220.0	-500.0	1970.0	8091.0	1062.0	634.0	27.0	81.0	-333.0	9522.0	7592.0
1996	0.0	2730.0	-230.0	-500.0	2000.0	8532.0	1368.0	639.0	27.0	99.0	-333.0	10332.0	8330.0
1997	0.0	2760.0	-240.0	-500.0	2020.0	9135.0	1665.0	634.0	27.0	117.0	-333.0	11204.0	9275.0
1998	1800.0	2780.0	-250.0	-500.0	3030.0	9684.0	1971.0	730.0	27.0	135.0	-333.0	12204.0	9374.0
1999	8780.0	2810.0	-5830.0	-500.0	5260.0	10251.0	2377.0	756.0	27.0	162.0	-333.0	13140.0	7880.0
2000	1720.0	2840.0	-5830.0	-500.0	1330.0	10917.0	2574.0	819.0	27.0	189.0	-333.0	14184.0	357.0
2001	0.0	3220.0	-390.0	-500.0	3340.0	11538.0	2880.0	864.0	27.0	189.0	-333.0	15165.0	1225.0
2002	3260.0	3250.0	-390.0	-500.0	5620.0	12096.0	3339.0	918.0	27.0	207.0	-333.0	16254.0	1034.0
2003	0.0	3210.0	-400.0	-500.0	2410.0	12780.0	3789.0	981.0	27.0	216.0	-333.0	17460.0	1550.0
2004	0.0	3330.0	-410.0	-500.0	2420.0	13347.0	4248.0	1044.0	27.0	235.0	-333.0	18558.0	16138.0
2005	440.0	3380.0	-410.0	-500.0	2910.0	14013.0	4698.0	1107.0	27.0	252.0	-333.0	19764.0	1634.0
2006	0.0	3410.0	-420.0	-500.0	2490.0	14706.0	5139.0	1173.0	27.0	261.0	-333.0	20979.0	1809.0
2007	1660.0	3420.0	-430.0	-500.0	4150.0	15417.0	5607.0	1251.0	27.0	279.0	-333.0	22248.0	1809.0
2008	0.0	3450.0	-440.0	-500.0	2510.0	16110.0	6219.0	1332.0	27.0	298.0	-333.0	23643.0	21175.0
2009	0.0	3490.0	-450.0	-500.0	2540.0	16785.0	6669.0	1404.0	27.0	315.0	-333.0	24867.0	22337.0
2010	0.0	3520.0	-460.0	-500.0	2560.0	17631.0	7281.0	1476.0	27.0	324.0	-333.0	26406.0	23846.0
2011	930.0	3520.0	-460.0	-500.0	3490.0	17631.0	7281.0	1476.0	27.0	324.0	-333.0	26406.0	23846.0
2012	0.0	3520.0	-460.0	-500.0	2560.0	17631.0	7281.0	1476.0	27.0	324.0	-333.0	26406.0	23846.0
2013	3280.0	3520.0	-460.0	-500.0	5680.0	17631.0	7281.0	1476.0	27.0	324.0	-333.0	26406.0	23846.0
2014	0.0	3520.0	-460.0	-500.0	2560.0	17631.0	7281.0	1476.0	27.0	324.0	-333.0	26406.0	23846.0
2015	0.0	3520.0	-460.0	-500.0	2560.0	17631.0	7281.0	1476.0	27.0	324.0	-333.0	26406.0	23846.0
2016	-9630.0	3520.0	1360.0	-500.0	-5240.0	17631.0	7281.0	1476.0	27.0	324.0	-333.0	26406.0	31646.0

DISCOUNT RATE = 9. % B/C RATIO = 1.4109 NPU = 21685.60

DISCOUNT RATE = 12. % B/C RATIO = 1.0822 NPU = 3430.11

DISCOUNT RATE = 15. % B/C RATIO = 0.8450 NPU = -5248.67

EIRR = 12.934 %

Table 14.9 Cash Flow of Sensitivity Analysis Case
Construction Cost Up by 10% and Traffic Demand Down by 10% -
Unit : 1,000EE, 1984 economic price

YEAR	Cost						Benefit						TOTAL BENEFIT	NET BENEFIT
	CONST. COST	O & M COST	SAVE AT CAIRO	SAVE AT NOZHA	TOTAL COST	INT'L PAX	DOM. PAX	INT'L CARGO	TIME SAVE	AIRLINE BENEFIT	ADD. ACCESS	TOTAL BENEFIT		
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	1221.0	0.0	0.0	0.0	1221.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1221.0
1987	2475.0	0.0	0.0	0.0	2475.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2475.0
1988	4323.0	0.0	0.0	0.0	4323.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-4323.0
1989	12265.0	0.0	0.0	0.0	12265.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-12265.0
1990	27984.0	0.0	-3460.0	0.0	24524.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-24524.0
1991	23705.0	0.0	-3460.0	0.0	20245.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-20245.0
1992	0.0	2600.0	-210.0	-500.0	1890.0	4167.0	153.0	396.0	27.0	0.0	-333.0	4410.0	2520.0	
1993	0.0	2630.0	-210.0	-500.0	1920.0	5283.0	459.0	477.0	27.0	0.0	-333.0	5940.0	4020.0	
1994	484.0	2670.0	-220.0	-500.0	2434.0	6624.0	756.0	549.0	27.0	54.0	-333.0	7677.0	5243.0	
1995	0.0	2690.0	-220.0	-500.0	1970.0	8091.0	1062.0	594.0	27.0	81.0	-333.0	9522.0	7552.0	
1996	0.0	2730.0	-230.0	-500.0	2000.0	8532.0	1368.0	639.0	27.0	93.0	-333.0	10332.0	8332.0	
1997	0.0	2760.0	-240.0	-500.0	2020.0	9135.0	1665.0	684.0	27.0	117.0	-333.0	11295.0	9215.0	
1998	1980.0	2780.0	-250.0	-500.0	4010.0	9684.0	1971.0	720.0	27.0	135.0	-333.0	12204.0	8194.0	
1999	9652.0	2810.0	-500.0	-500.0	6130.0	10251.0	2277.0	756.0	27.0	162.0	-333.0	13140.0	7082.0	
2000	19052.0	2840.0	-500.0	-500.0	15562.0	10917.0	2574.0	819.0	27.0	180.0	-333.0	14184.0	-1338.0	
2001	0.0	3220.0	-300.0	-500.0	2340.0	11538.0	2820.0	864.0	27.0	189.0	-333.0	15165.0	12835.0	
2002	3586.0	0.0	-390.0	-500.0	5948.0	12096.0	3339.0	918.0	27.0	207.0	-333.0	16254.0	10508.0	
2003	0.0	3310.0	-400.0	-500.0	2410.0	12700.0	3789.0	981.0	27.0	216.0	-333.0	17460.0	15050.0	
2004	0.0	3330.0	-410.0	-500.0	2420.0	13347.0	4242.0	1044.0	27.0	235.0	-333.0	18558.0	16130.0	
2005	484.0	3380.0	-420.0	-500.0	2954.0	14013.0	4698.0	1107.0	27.0	252.0	-333.0	19764.0	16810.0	
2006	0.0	3410.0	-430.0	-500.0	2490.0	14706.0	5139.0	1179.0	27.0	261.0	-333.0	20979.0	18439.0	
2007	1826.0	3420.0	-430.0	-500.0	4316.0	15417.0	5607.0	1251.0	27.0	279.0	-333.0	22248.0	17532.0	
2008	0.0	3450.0	-440.0	-500.0	2510.0	16110.0	6219.0	1322.0	27.0	288.0	-333.0	23647.0	21133.0	
2009	0.0	3490.0	-450.0	-500.0	2560.0	16785.0	6669.0	1404.0	27.0	315.0	-333.0	24867.0	23277.0	
2010	0.0	3520.0	-460.0	-500.0	2560.0	17631.0	7281.0	1476.0	27.0	324.0	-333.0	26406.0	23846.0	
2011	1023.0	3520.0	-460.0	-500.0	3583.0	17631.0	7281.0	1476.0	27.0	324.0	-333.0	26406.0	23846.0	
2012	0.0	3520.0	-460.0	-500.0	2560.0	17631.0	7281.0	1476.0	27.0	324.0	-333.0	26406.0	23846.0	
2013	3586.0	0.0	-460.0	-500.0	6146.0	17631.0	7281.0	1476.0	27.0	324.0	-333.0	26406.0	23846.0	
2014	0.0	3520.0	-460.0	-500.0	2560.0	17631.0	7281.0	1476.0	27.0	324.0	-333.0	26406.0	23846.0	
2015	0.0	3520.0	-460.0	-500.0	2560.0	17631.0	7281.0	1476.0	27.0	324.0	-333.0	26406.0	23846.0	
2016	-1032.0	3520.0	1360.0	-500.0	-6202.0	17631.0	7281.0	1476.0	27.0	324.0	-333.0	26406.0	32698.0	

DISCOUNT RATE = 9. % B/C RATIO = 1.2935 NPV = 16035.90
DISCOUNT RATE = 12. % B/C RATIO = 0.9889 NPV = -506.25
DISCOUNT RATE = 15. % B/C RATIO = 0.7703 NPV = -8531.05
EIRR = 11.871 %

Table 14.10 Cash Flow of Sensitivity Analysis Case
Phase I Development --

Unit : 1,000EE, 1984 economic price

YEAR	Cost				Benefit								NET BENEFIT
	CONST. COST	O & M COST	SAVE AT CAIRO	SAVE AT NUZHA	TOTAL COST	INT'L PAX	DOM. PAX	INT'L CARGO	TIME SAVE	AIRLINE BENEFIT	ADD. ACCESS	TOTAL BENEFIT	
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	1110.0	0.0	0.0	0.0	1110.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1110.0
1987	2250.0	0.0	0.0	0.0	2250.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2250.0
1988	3930.0	0.0	0.0	0.0	3930.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3930.0
1989	11150.0	0.0	0.0	0.0	11150.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-11150.0
1990	25740.0	0.0	-3450.0	0.0	21900.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-21900.0
1991	21550.0	0.0	-3460.0	0.0	18000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-18000.0
1992	0.0	2600.0	-210.0	-500.0	1890.0	4630.0	170.0	440.0	30.0	0.0	-370.0	4900.0	3010.0
1993	0.0	2630.0	-210.0	-500.0	1920.0	5870.0	510.0	530.0	30.0	30.0	-370.0	6000.0	4680.0
1994	440.0	2670.0	-220.0	-500.0	2390.0	7360.0	840.0	610.0	30.0	60.0	-370.0	8530.0	6140.0
1995	0.0	2690.0	-220.0	-500.0	1970.0	8990.0	1180.0	660.0	30.0	90.0	-370.0	10580.0	8610.0
1996	0.0	2730.0	-230.0	-500.0	2000.0	9480.0	1520.0	710.0	30.0	110.0	-370.0	11480.0	9480.0
1997	0.0	2760.0	-240.0	-500.0	2020.0	10150.0	1850.0	800.0	30.0	130.0	-370.0	12350.0	10530.0
1998	0.0	2780.0	-250.0	-500.0	2030.0	10760.0	2190.0	880.0	30.0	150.0	-370.0	13560.0	11530.0
1999	460.0	2810.0	-260.0	-500.0	2510.0	11790.0	2530.0	840.0	30.0	180.0	-370.0	14490.0	12090.0
2000	1380.0	2840.0	-260.0	-500.0	3460.0	12130.0	2860.0	910.0	30.0	200.0	-370.0	15760.0	13680.0
2001	0.0	2840.0	-260.0	-500.0	2080.0	12130.0	2860.0	910.0	30.0	200.0	-370.0	15760.0	13680.0
2002	3260.0	2840.0	-260.0	-500.0	5340.0	12130.0	2860.0	910.0	30.0	200.0	-370.0	15760.0	13680.0
2003	0.0	2840.0	-260.0	-500.0	2080.0	12130.0	2860.0	910.0	30.0	200.0	-370.0	15760.0	13680.0
2004	0.0	2840.0	-260.0	-500.0	2080.0	12130.0	2860.0	910.0	30.0	200.0	-370.0	15760.0	13680.0
2005	440.0	2840.0	-260.0	-500.0	2080.0	12130.0	2860.0	910.0	30.0	200.0	-370.0	15760.0	13680.0
2006	0.0	2840.0	-260.0	-500.0	2080.0	12130.0	2860.0	910.0	30.0	200.0	-370.0	15760.0	13680.0
2007	1600.0	2840.0	-260.0	-500.0	3740.0	12130.0	2860.0	910.0	30.0	200.0	-370.0	15760.0	13680.0
2008	0.0	2840.0	-260.0	-500.0	2080.0	12130.0	2860.0	910.0	30.0	200.0	-370.0	15760.0	13680.0
2009	0.0	2840.0	-260.0	-500.0	2080.0	12130.0	2860.0	910.0	30.0	200.0	-370.0	15760.0	13680.0
2010	0.0	2840.0	-260.0	-500.0	2080.0	12130.0	2860.0	910.0	30.0	200.0	-370.0	15760.0	13680.0
2011	930.0	2840.0	-260.0	-500.0	3010.0	12130.0	2860.0	910.0	30.0	200.0	-370.0	15760.0	13680.0
2012	0.0	2840.0	-260.0	-500.0	2080.0	12130.0	2860.0	910.0	30.0	200.0	-370.0	15760.0	13680.0
2013	3260.0	2840.0	-260.0	-500.0	5340.0	12130.0	2860.0	910.0	30.0	200.0	-370.0	15760.0	13680.0
2014	0.0	2840.0	-260.0	-500.0	2080.0	12130.0	2860.0	910.0	30.0	200.0	-370.0	15760.0	13680.0
2015	0.0	2840.0	-260.0	-500.0	2080.0	12130.0	2860.0	910.0	30.0	200.0	-370.0	15760.0	13680.0
2016	-2750.0	2840.0	1360.0	-500.0	950.0	12130.0	2860.0	910.0	30.0	200.0	-370.0	15760.0	14610.0

DISCOUNT RATE = 9. % B/C RATIO = 1.3690 NPU = 17926.80
DISCOUNT RATE = 12. % B/C RATIO = 1.0767 NPU = 2986.60
DISCOUNT RATE = 15. % B/C RATIO = 0.8584 NPU = -4530.75
EIRR = 12.957 %

APPDNEIX 14.5

Appendix 14.5 Definition of the Internal Rate of Return

1. Efficiency or adequateness of a project is measured or evaluated through the comparison of an outflow (costs) with an inflow (benefits). The outflow consists of costs for the construction of the facilities and management of the project, while the inflow consists of benefits which are acquired by the operation of the facilities.

Benefit Cost Ratio (B/C Ratio), Net Present Value (NPV) and Internal Rate of Return (IRR) are used as indices for the economic assessment.

2. Timing of the outflow and inflow are different. The construction cost of the facilities are generated in the early stage of the project evaluation period, while the benefits are generated after the completion of the facilities.

All costs and benefits should be discounted and compared at a fixed time, i.e., the present value of costs and the present value of benefits.

3. Definition of the indices (B/C Ratio, NPV and IRR) is as follows:

B/C Ratio: Ratio of the present value of benefits to that of costs, i.e., B/C

$$\text{Present value of benefits} \quad B = \sum_{t=0}^T \frac{Y_t}{(1 + r_o)^t}$$

$$\text{Present value of costs} \quad C = \sum_{t=0}^T \frac{I_t + O_t}{(1 + r_o)^t}$$

Where;

Y_t: Benefits in year t

I_t: Capital expenditure in year t

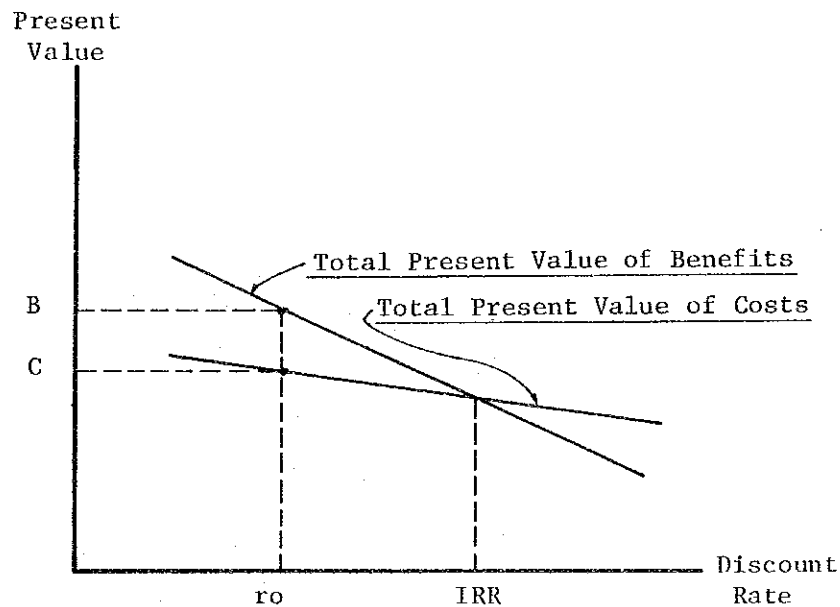
O_t: Operation and maintenance costs in year t

r_o: Opportunity cost of capital of the country concerned
(Maximum profit rate which would be expected when the fund is used to the other projects)

T : Project life

NPV: Difference between the present value of benefits and that of costs i.e., $B-C$. It shows the net contribution of the project to the national economy.

IRR: A discount rate to make a present value of the benefit equal to a present value of the cost. An iteration calculation method is used to calculate the discount rate, i.e., r on condition of $B=C$.



r_o : Opportunity cost of capital

B : Present value of benefits

C : Present value of costs

$$NPV = B - C$$

$$B/C \text{ Ratio} = B/C$$

4. Economic Assessment

- (1) When $NPV \geq 0$ or $B/C > 1$, the project is judged to be economically feasible.
- (2) When the IRR exceeds the opportunity cost of capital of the country concerned, the project is judged to be economically feasible.

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