Table 2-4 Package Type at Kupang Port

Unit : ton

Pakage Type	1984	1985	1986	1987	1988	1989	1990	1991	1992
General cargo	47,442	79,319	102,794	90,771	70,916	71,996	78,173	75,515	98,780
Unitized									
Rol									
Solid Bulk	6,815	12,700	29,945	10,000	39,412	25,376	45,152	60,482	76,787
Liquid Bulk					188				
Bag Cargo	62,890	57,943	64,594	77,580	79,857	78,858	96,818	99,473	121,834
Drum	12,393	9,800		4,452	4,371	11,635	9,323	7,350	13,995
Container							88	940	1,086
Total	129,537	159,762	197,333	182,803	194,644	187,865	229,344	243,760	309,582

Source : PERSERO of Kupang

Table 2-5 Cargo Movement at Kupang Port

Kupang			
Unloaded Last port	Share (%)	Loaded Next Port	Share (%)
E.JAWA	52	E. Jawa	50
S.Sulawesi	30	E. Timor	32
N.T.B.	9	N.T.T.	13
N.T.T.	4	Others	5
E. Timor	4		

Remarks: Pertamina cargo is excuded.
Source: Ship Call Records, Kupang 10/'92

Table 2-6 Disembarked and Embarked Passenger at Port of Kupang

Unit : Person

Year	Disembarked	Embarkes	Total
1984	11,469	13,726	25,195
1985	12,104	12,502	24,606
1986	15,229	16,191	31,420
1987	24,626	24,403	49,029
1988	28,780	26,871	55,651
1989	34,127	31,910	66,037
1990	29,256	26,339	55,595
1991	30,131	33,046	63,177
1992	28,205	25,048	53,253
A.G.R.	11.91	7.81	9.81

Source : PERSERO of Kupang
Remark : A.G.R. Annual Growth Rate (%) '84-'92

26. It can be estimated that the majority of cargoes, especially consumer goods, come from East Java (Surabaya) and South Sulawesi (Uj. Pandang). On the other hand, nearly half of the outgoing cargoes are destined for neighboring islands; cement accounts for a considerable portion of the outgoing cargoes.

Passenger traffic

27. Passenger traffic by embarkation and disembarkation at the port over the last nine years is shown in Table 2-6. The total passenger traffic increased steadily during 1984 - 1989. The average annual growth rate was more than 20% during the period.

28. Number of passenger in 1989 was 66,037, which was the largest ever recorded at the port of Kupang. Since that year, number of passengers has been decreasing. A total of 53, 253 passengers embarked or disembarked at the port of Kupang in 1992. Pelni passenger ship "KELIMUTU" calls the port four times a month.

29. More and more people have been attracted to ferry traffic centered at Bolok ferry terminal, which is situated 6 km south of the port. The Bolok ferry terminal is the base of ferry service for five routes in 1993.

30. Two cruising vessels also call the Kupang port. The vessels can accommodate a maximum of 42 passengers, and call the Kupang port once a week. The cruising vessels have 860 GRT with 41 m in length, and are based in Bali. Furthermore, a sailing ship comes from, and goes to Darwin, Australia during good navigation season of July - October.

E. Calling Vessels

31. Number of ship call by shipping type can be seen in Table 2-7. A total of 1,300 vessels including Pertamina special shipping called the port of Kupang in 1992. Gross Registered Tonnage of the calling vessels totaled 899,560 in 1992, which shows the annual growth rate of 9.83 % during 1984 - 1992.

32. Table 2-8 shows ship call, GRT, and cargo volume loaded/unloaded at the public wharves by shipping type in 1992. A total of 1,171 ship calls, 638,438 GRT was recorded at the public wharves in 1992. In terms of number of ship call, Rakyat was 705, by far the largest, followed by the Interinsular shipping, 347 ship calls in 1992.

33. In terms of GRT, on the contrary, the Interinsular shipping was 458,158, by far the largest, accounting for more than 70 per cent of the total.

34. In 1992, 61.00% of public cargoes destined to or departed from the port of Kupang were transported by Interinsular shipping. 32.84 % were transported by Rakyat shipping, 5.22 % by Ocean going, and 0.94 % by Perintis.

35. Average vessel size and cargo volume by shipping type in 1992 can be calculated as follows;

Shipping type	Av. GRT	Av. Cargo Volume
Ocean going	1,953	376
Interinsular	1,320	544
Rakyat	65	144
Perintis	666	38

36. Table 2-9 shows historical development of cargoes transported by each category of shipping type. Share of Rakyat shipping has been declining over the last several years. Cargo volume transported by the Rakyat shipping accounted for 43.3% in 1989, when this type of shipping enjoyed its largest role. Since then, shares of the Rakyat have been declining, 34.9% in 1990, 34.8% in 1991, and 32.8% in 1992.

Table 2-7 Ship Call by Kupang port

Year	Ocean Going		RLS		Local/Rakyat		Special		Perintis and Others		Total	
	CALL	GRT	CALL	GRT	CALL	GRT	CALL	GRT	CALL	GRT	CALL	GRT
1984	3	6,011	73	127,160	1,270	135,005	66	119,507	76	37,175	1,488	424,861
1985	6	17,447	62	113,750	1,175	135,165	33	85,926	94	37,545	1,370	389,833
1986	5	5,576	97	178,287	1,188	141,754	40	128,319	73	44,742	1,403	498,678
1987	10	12,632	88	223,609	867	104,068	31	109,461	28	13,894	1,024	463,664
1988	14	30,362	94	233,122	739	82,389	28	83,144	90	39,476	965	468,993
1989	11	22,560	292	333,033	698	28,791	34	90,064	122	63,311	1,157	537,759
1990	8	17,233	327	401,575	801	28,872	26	110,045	119	62,711	1,281	620,436
1991	17	45,691	339	403,769	747	36,341	42	100,256	148	131,200	1,293	717,257
1992	43	83,988	347	458,158	705	45,677	57	160,747	148	150,990	1,300	899,560
A.G.R.	39.49	39.04	21.51	17.38	-7.09	-12.67	-1.82	3.78	8.69	19.15	-1.67	9.83

Source : PERSERO of Kupang
Remarks : A.G.Rate Annual Growth Rate (%) '84-'92

Table 2-8 Share of Ship Type

	Kind of Line	Ship Call	GRT	Unloading	Loading	Total	Rate(%)
1	Ocean	43	83,988	15,065	1,086	16,151	5.22
2	Interinsular	347	458,158	141,864	46,988	188,852	61.00
3	Rakyat	705	45,677	61,092	40,584	101,676	32.84
4	Perintis	76	50,615	83	2,820	2,903	0.94
5	Total	1,171	638,438	218,104	91,478	309,582	100.00

Source : PERSERO of Kupang

Table 2-9 Cargo Volume by Ship Type at Kupang Port

Unit : ton

No.	Kind of Line	1984	1985	1986	1987	1988	1989	1990	1991	1992
1	Ocean	2,133	6,950	4,803	8,836	9,929	16,043	9,601	7,998	16,151
2	Interinsular	48,752	36,184	67,336	44,377	64,564	84,934	135,996	154,948	188,852
3	Lokal	54,433	65,542	66,487	57,487	39,828	0	0	0	0
4	Special	55,610	46,517	52,686	58,497	54,503	67,103	46,341	108,159	120,625
5	Perintis	615	1,586	614	778	4,760	5,855	3,666	5,225	2,903
6	Rakyat	23,503	48,870	58,094	71,980	75,573	81,601	80,081	89,728	101,676
	Total	185,046	205,649	250,018	241,955	249,157	255,536	275,685	366,058	430,207

Source : PERSERO of Kupang
Remark : These cargoes are included with petroleum (Pertamina) and coconut oil.

F. Facility Utilization

Berthing facilities

37. In general, the utilization level of the berthing facilities is evaluated by the following indicators.

a) Berth Occupancy Ratio (BOR)
b) Berth Throughput (BTP)

38. Above indicators are already calculated by PERSERO III. The historical development of indicator "BOR" is shown in Table 2-10. According to this Table, there were fluctuations regarding the average BOR of all berthing facilities at this port from 1985 to 1992.

Table 2-10 Berth Occupancy Ratio and Berth Throughput at Kupang

Year	BOR (%)	BTP (Tons/m)
1984	92	580
1985	73	713
1986	73	884
1987	58	822
1988	71	872
1989	78	777
1990	89	1,027
1991	62	921
1992	57	781

Source: PERSERO Kupang

39. The historical development of indicator "BTP" is shown in Table 2-10. According to this Table, there was an upward trend regarding the average BTP of all berthing facilities at this port.

Storage facilities

40. In Indonesia, the utilization level of the storage facilities is evaluated by the following indicators.

a) Shed Occupancy Ratio (SOR)
b) Shed Throughput (STP)
c) Open Storage Occupancy Ratio (OSOR)
d) Open Storage Throughput (OSTP)

41. Above indicators are also calculated by PERSERO III. The historical development of indicator "SOR", "STP", "OSOR" and "OSTP" is shown in Table 2-11. According to this Table, the following tendency is found.

a) There was a rapid upward trend regarding SOR and OSOR.

b) There was a steady upward trend regarding STP and OSTP.

Table 2-11 Utilization of Storage Facilities at Kupang

Year	SOR (%)	STP (Tons/m2)	OSOR (%)	OSTP (Tons/m2)
1984	12	16	n.a	n.a
1985	7	12	n.a	n.a
1986	9	15	9	2
1987	9	19	10	3
1988	12	19	12	2
1989	10	16	10	2
1990	15	23	15	2
1991	14	25	15	5
1992	10	24	15	5

Note: n.a means not available.
Source: PERSERO Kupang

G. Port Management and Operation

Organization

42. Public port facilities at Kupang port are managed by PERSERO branch office as class three commercial port. PERSERO office is responsible for maintenance and provisions of port facilities in good conditions, port services such as pilotage, towing, water supply, cargo handling as PBM, collection of port charge, preparation of port statistics and so on. ADPEL office, under KANWIL control, supervises the overall port operation as governmental coordinator.

43. Organization charts and number of personnel for PERSERO office and ADPEL office in Kupang port are as shown in Appendix 2-1 and 2-2.

Port service

44. In port of Kupang, following port service is provided by PERSERO and so on.

1) Berth allocation and overall coordination

45. Berth is allocated to ships by P2T meeting (integrated service center) chaired by Harbor Master based on "First come First serve" principle though priority is given to passenger ships and battle ships. This meeting is held three times per week for smoothly integrated ship and cargo handling service, and is attended by PERSERO office (service and pilotage section), cargo handling companies, forwarders, shipping lines, security, customs and so on.

2) Pilotage and towing service

46. Service vessels currently used at the port of Kupang are listed in the following table.

Table 2-12 List of Service Vessels

Name	Capacity	Quantity	Year of construction	Number of crews including captain
Pilot boat	310HP	1	1992	3
Tug boat (Out of order)	470HP	1	1985	3

Source: PERSERO Kupang port office

47. 24 hour service is available for pilotage and towing in the port of Kupang. However, tug boat is out of commission at present. At any rate the capacity of tug boat seems to be insufficient for towing large vessel.

3) Water supply service

48. Water has been supplied by pipe managed by PERSERO branch office. There are two tanks for water storage, capacity of which is 270 ton/day and 300 ton/day. Also, there are three water supply taps respectively in INTERISLAND berth and LOCAL berth. PERSERO buys original water from provincial government at unit price of Rp 75/ton and supplies for vessels at unit price of Rp 3,000 /ton. Water volume provided from 1986 to 1991 is as shown in Table 2-13.

Table 2-13 Supplied Water Volume (1987-1991)

	1986	1987	1988	1989	1990	1991
Supplied water volume(ton)	11,930	16,972	17,965	15,209	19,367	21,472

Source: PERSERO Kupang port office

4) Oil supply service

49. Oil has been supplied by pertamina. At present only INTERISLAND wharf is furnished with two oil supply taps (capacity: 25 ton/hours x 2 taps). PERSERO office has proposed to pertamina that LOCAL berth should be furnished with oil supply taps, too.

Port labor and cargo handling

1) Port labor supply system

50. There are eight cargo handling companies including service division of PERSERO office itself in the port of Kupang. The number of registered port labors working at Kupang port is 350, and they are allocated to cargo handling companies

on a daily basis by KOPERASI TKBM. Most of the port labor work 20 days per month on average. Wages for port labors is not on pace rate but fixed on a daily basis and daily wages range approximately from Rp 4,200 to Rp 5,400.

51. Cargo handling is operated approximately 350 days per year. Port labors usually work two shifts a day in the port of Kupang but the special cargo such as material for cement factory is unloaded all day long at three shift.

Ordinal shift	8:00 - 16:00	(12:00-13:00 break time)
	16:00 - 24:00	(18:00-19:00 break time)
Extra shift	24:00 - 8:00	(24:00-1:00 break time)

52. The gang organization for cargo handling is as follows:

(i) Stevedoring per gang

Head labor	1
Winch driver/pilot	3
Labor	8
Total	12 persons

(ii) Cargodoring per gang

	(without forklift)	(with forklift)
Head labor	2	1
Labor	22	11
Total	24 persons	12 persons

(iii)Delivery/Receiving per gang

Head labor	1
Labor	11
Total	12 persons

2) Cargo handling equipment

53. Table 2-14 outlines the equipment in the port of Kupang. At the INTERISLAND wharf, cargo handling is conducted for the oceangoing and interinsular vessels(more than 2000 DWT). The LOCAL wharf is for passenger vessels and interinsular vessels(less than 2000 DWT). Stevedoring is conducted by the derrick crane on the ships and mobile crane. Carriage of the cargoes to the transit sheds is performed by forklifts and trucks. In Kupang port a great deal of unloaded cargoes is carried from the wharf directly to the customers by means of trucks.

54. Equipment owned by PERSERO office includes two mobile cranes (having a suspending capacity of 15 tons and 25 tons) and six forklifts (2-5 tons). However, one of the mobile cranes with capacity 15 tons is out of commission at present.

Table 2-14 List of Cargo Handling Equipments in the Port of Kupang

Kind	Capacity	Number	Ownership	
			PERSERO	Private
Mobile Crane	15 Ton	1	1	-
	25 Ton	1	1	-
	Total	2	2	-
Forklift	2 Ton	5	3	2
	3-4 Ton	3	2	1
	5 Ton	1	1	
	Total	9	6	3

Source: PERSERO Kupang port office

3) Cargo handling productivity

55. The hourly cargo handling productivity per gang by cargo type is as follows.

Cargo type	Handling Productivity
General cargo	12 ton/g/h
Bagged cargo	18 ton/g/h
Liquid cargo in drum	15 ton/g/h

Customs procedure

56. In Indonesia, customs inspection of exports and interisland shipments was abolished. In the case of import consignments worth more than US$ 5,000, the authority to inspect was transferred from the Department of Customs to the contracted surveying firm which conducts inspections at the overseas origin of the cargo by INPRES 4/1985.

57. In the port of Kupang, 80 % of total imported cargo was consignments worth more than $ 5,000 which was free from customs inspections in 1991. As for the rest of imported cargo inspected by customs office, customs procedure takes one or two hours on average.

Port tariff and cargo handling tariff

58. There are three categories of port tariff classified by the rank of port in Indonesia. The first and second categories apply to the ports of Tg. Priok, Tg.Perak, Belawan and Makasar. The third category applies to all other Indonesian ports including Kupang. The charge system of Kupang port is generally divided into charges for ships, charges for cargoes and other charges such as water supply, entrance fee, land, building and equipment rent and so on, are determined by the director of PERSERO III. Current port tariff in Kupang port is shown as APPENDIX 2-3.

59. In Indonesia cargo handling charge is agreed upon by negotiation between association of cargo handling companies and that of users in each port. Current cargo handling tariff in the port of Kupang is shown as APPENDIX 2-4.

Financial statements of PERSERO III and port of Kupang

1) Financial statements of PERSERO III

60. The PERSERO III's balance sheets and profit and loss statements (1987-1991) are shown in Appendix 2-5. It can be generally said that when the calculated operating ratios are less than 70-75% and working ratios are less than 50-60%, the operation is efficient. Operating ratio and working ratio of PERSERO III has improved substantially. The value in 1991 (operating ratio: 59.4%, working ratio: 49.6%) shows the efficient financial conditions prevail at PERSERO III.

61. In addition, current ratio shows the conditions of liquidity, and it is desirable that it is more than 150%. The value of current ratio of PERSERO III has been at a very high level (above 300% in 1991) and it can furnish working capital easily to branch offices which run a deficit.

62. Profit and loss statements by service type of PERSERO III (1991) are shown in Appendix 2-5. About 23.7% of the revenue is generated from container terminal charge, 23.2% from main facilities charge (such as anchorage, mooring and quay charge), 9.3% from towing charge, 7.3% from warehouse and open yard charge, 5.6% from cargo handling charge.

2) Financial statements of port of Kupang

63. The balance sheets and profit and loss statements of PERSERO Kupang port office (1988-1991) are shown in Appendix 2-6. While operating ratio has slightly improved, values are still at a high level. Also, port of Kupang shows about Rp 200 million loss every year due to burden of depreciation cost. In addition, compared with profit and loss statements of PERSERO III and those of Kupang port, the latter has only a slight share in the former, namely 0.5% in revenue and 1.2% in expense. From this view point one may say that the change in financial statements of Kupang port has little influence on the overall financial statements of PERSERO III.

64. Profit and loss statement by service type of Kupang office(1991) are shown in Appendix 2-6. About 50% of the revenue is generated from main facility charges, 18.4% from water supply charges, 11.5% from equipment charge, 10.2% from pilotage charges and so on. It is noteworthy that towing services show a deficit in Kupang port. This is because the PERSERO office cannot collect towing service charge stipulated in port tariff due to the fact that the capacity of tug boat is only 470 HP which does not fulfill the requirements for tugging services by the Ministerial Decree 76 of 1990 which states that capacity of tug boat must be above 600 HP at least.

H. Review of the Existing Plans

General

65. The port development at Kupang port has been based on the master plan which was formulated by the foreign consultant named TTA. CONSULTANTS and Indonesian consultant named P.T. INCONEB in October 1985. The title of this master plan report was "MASTERPLAN AND FEASIBILITY STUDY FOR THE PACKAGE-E PORTS TENAU".

66. This master plan has three main objectives. One of the main objectives is as follows; Preparation of master plan to ensure the satisfactory long-term development of this port for the period up to the year 2000.

67. When this master plan was formulated, this port had main quay (length: 84 m + 139 m) only. Therefore, the port development at this port placed emphasis on the quay berthing local vessels at that time.

Outline of master plan

68. The results of demand forecast of total port throughput in 2000 are shown in Table 2-15. According to this Table, this port will have to handle 419,000 tons cargoes at the public wharves. On the other hand, container cargoes were not given consideration, even though container cargoes had begun to be handled at other ports in Eastern Indonesia.

Table 2-15 Total Port Throughput in 2000

Unit: 1,000 Tons

(In + Out)	2000
Main Quay traffic:	
- Non-transhipment cargo	294.1
- Additional transhipment cargo	82.0
Sub-Total Main Quay	376.1
- Perahu traffic	42.9
Total (excl.Oil)	419.0
Oil products	296.2
Total	715.2

Source: Master plan report in 1985

69. The additional required port facilities in 2000 are shown in Table 2-16. According to this master plan, this port will require new local quay (length: 180 m) up to 2000. The local quay has already been partially developed, the present quay length is 100 m. Therefore, this port will need an additional extension of 80 m at the local quay before 2000. And the transit storage facilities which are mentioned in Table 2-16 have not yet been developed.

Table 2-16 Additional Port Requirements

	2000
Berthing facilities:	
- Main Quay extension (m)	-
- Local Quay (m)	180
- Perahu Quay extension (m)	-
Transit storage facilities:	
- Transit shed (m2)	4,800
- Open storage (m2)	1,800

Source: Master plan report in 1985

Chapter 3 NATURAL AND ENVIRONMENTAL CONDITIONS

A. Meteorological Conditions

Climate

1. Though Indonesia generally belongs to the tropical climate zone classified into tropical forest or tropical monsoon climates, Nusa Tenggara belongs to the semi-dry step climate zone extending from the northwest region of Australia. The climate there is divided into the rainy season from December to March and the dry season with few precipitation from May to October.

Temperature and humidity

2. Air temperature is slightly high in the rainy season and rather low in the dry season. Monthly mean temperature ranges from 25.6°C to 28.8°C with no substantial change throughout the year as shown in Table 3-1. Mean maximum temperature varies from 31°C to 33°C, and mean minimum temperature from 21°C to 24°C. The temparature fluctuation in a day is 7°C to 11°C. Relative humidity is rather high in the morning, around 85%, in the rainy season, and low humidity of less than 50% is occasionally recorded in the afternoon in the dry season. The mean relative humidity is within the range from 63% to 83%.

Precipitation

3. Annual mean precipitation is low, 1,443 mm, and the fluctuation in annual total precipitation is remarkable. Eighty five percent (85%) of annual mean precipitation falls in the rainy season from December to March. Monthly mean precipitation ranges from 2 mm in September to 388 mm in January.

Wind

4. WNW wind prevails in the rainy season from November to April and ESE wind in the dry season from May to October. In the rainy season, wind velocity increases over 10 m/s with the superposition of sea breeze and monsoon in the afternoon as shown in Table 3-2 and Figure 3-1.

Cloud cover

5. Cloud cover is 4 in the rainy season, but no more than 1 in the dry season. This indicates the areal coverage of clouds is 10% in the whole sky, and therefore the weather is very clear.

Table 3-1 Meteorogical Data in Kupang (10°10'S., 123°34'E.)

Height above Mean Water Level:1.45m

Data covering 10 to30 years from 1931 to 1960

Month	Mean Air Pressure at Mean Sea Water Level	Temparature					Mean Humidity			Mean Cloud Cover (One-Tenth Ratio)		Precipitation		Wind Derection 0800									Mean Wind Velo-city	No.of Windy days	No.of Foggy Days	No.of Thundery Days
		Daily Mean Max	Daily Mean Min	Monthly Mean Max	Monthly Mean Min	Monthly Mean	07:00	13:00	Monthly	07:00	13:00	Mean	No.of days with rain fall of more than 2.5mm	N	NE	E	SE	S	SW	W	NW	Calm				
	mb	℃	℃	℃	℃	℃	%	%	%	-	-	mm	-	%	%	%	%	%	%	%	%	%	m/s			
Jan	1009	31	24	33	22	26.6	86	71	82	4	4	388	18	17	3	1	1	2	7	15	11	43	3.6	0	0	10
Feb	1009	31	24	33	22	26.4	85	71	83	4	4	367	15	4	2	1	2	1	2	26	8	54	3.1	0	0	8
Mar	1010	31	23	33	22	26.9	85	68	81	4	4	222	13	6	3	7	0	1	3	6	6	68	3.1	0	0	6
Apr	1010	32	22	33	20	27.6	80	57	74	1	3	64	5	2	8	40	19	5	3	1	2	20	3.1	0	0	2
May	1010	32	22	34	19	27.6	71	52	68	1	1	28	3	1	4	50	25	4	1	2	1	12	3.6	1	0	1
Jun	1011	31	22	33	18	26.4	69	47	66	1	1	10	1	1	7	48	19	1	0	1	1	22	3.6	1	0	0
Jul	1012	31	21	33	18	26.0	67	46	65	1	1	5	1	4	9	56	13	2	1	1	0	14	3.6	1	0	0
Aug	1012	32	21	34	18	25.6	62	44	63	1	1	3	*	1	12	57	13	1	2	1	1	12	3.6	2	0	1
Sep	1011	33	22	36	18	26.7	62	46	63	1	1	2	*	4	19	42	16	2	1	1	5	10	3.1	1	0	1
Oct	1011	33	22	36	20	27.8	62	50	66	1	3	18	1	12	22	15	8	6	2	2	5	28	3.6	0	0	5
Nov	1010	33	23	36	22	28.8	68	57	73	1	3	90	7	16	9	9	9	1	1	3	4	54	3.1	0	0	11
Dec	1009	32	24	34	22	27.4	80	66	80	3	4	246	15	10	13	9	4	2	1	5	6	50	3.6	0	0	18
Average	1010	32	23	x 37	xx 17	27.0	73	56	72	3	3	-	-	7	9	28	10	2	2	5	4	32	3.6	-	-	-
Total	-	-	-	-	-	-	-	-	-	-	-	1443	80	-	-	-	-	-	-	-	-	-	-	6	*	63
Extreme	-	-	-	x 38	xx 16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
No.of Years Recorded	30													15									15	30		

x Average of annual maximum temperature xx Average of annual minimum temperature + Maximum temparature recorded ++ Minimum temparature recorded *Rare

Table 3-2 Occurance of Wind

Jan. to Dec.92(year)

Direction / Velocity(kt)	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	Total	(%)		
-4.99	9	16	20	46	64	45	97	86	19	4	30	36	16	5	16	10	519	(5.9)		
5.00-9.99	24	9	94	415	867	179	262	137	58	9	94	228	328	138	228	98	3168	(36.2)	Total	8779
10.00-14.99	8	1	38	391	582	51	72	36	20	·	32	70	345	173	184	29	2032	(23.2)	Observed	8772
15.00-19.99	1	·	5	159	226	20	12	8	2	1	1	5	64	42	28	·	574	(6.6)	No record	7
20.00-	·	·	·	28	23	1	2	·	·	·	·	1	·	·	·	1	56	(0.6)	Calm	2423
Total	42	26	157	1039	1762	296	445	267	99	14	157	340	753	358	456	138	6349			
(%)	0.5	0.3	1.8	11.8	20.1	3.4	5.1	3.0	1.1	0.2	1.8	3.9	8.6	4.1	5.2	1.6	72.4			

May. to Oct.92(ESE monsoon)

Direction / Velocity(kt)	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	Total	(%)		
-4.99	7	10	12	32	36	30	32	62	8	1	5	6	9	3	7	4	264	(6.0)		
5.00-9.99	15	4	69	282	658	145	175	86	11	2	6	21	100	42	113	47	1778	(40.4)	Total	4412
10.00-14.99	7	·	26	312	528	46	57	30	8	·	1	13	124	65	78	18	1314	(29.8)	Observed	4405
15.00-19.99	·	·	5	146	216	19	10	6	·	·	·	1	12	16	16	·	448	(10.2)	No record	7
20.00-	·	·	·	28	23	1	1	·	·	·	·	·	·	·	·	·	53	(1.2)	Calm	552
Total	29	14	112	800	1461	241	275	184	27	3	12	41	245	126	214	69	3853			
(%)	0.7	0.3	2.5	18.2	33.2	5.5	6.2	4.2	0.6	0.1	0.3	0.9	5.6	2.9	4.9	1.6	87.5			

Jan. to April and Nov. to Dec.92(WNW monsoon)

Direction / Velocity(kt)	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	Total	(%)		
-4.99	2	6	8	14	28	15	65	24	11	3	25	30	7	2	9	6	255	(5.8)		
5.00-9.99	9	5	25	133	209	34	87	51	47	7	88	207	228	96	115	51	1393	(31.9)	Total	4367
10.00-14.99	1	1	12	79	54	5	15	6	12	·	31	57	221	108	106	11	719	(16.5)	Observed	4367
15.00-19.99	1	·	·	13	10	1	2	2	2	1	1	4	52	26	12	·	127	(2.9)	No record	0
20.00-	·	·	·	·	·	·	1	·	·	·	·	1	·	·	·	1	3	(0.1)	Calm	1871
Total	13	12	45	239	301	55	170	83	72	11	145	299	508	232	242	69	2496			
(%)	0.3	0.3	1.0	5.5	6.9	1.3	3.9	1.9	1.7	0.3	3.3	6.9	11.6	5.3	5.5	1.6	57.2			

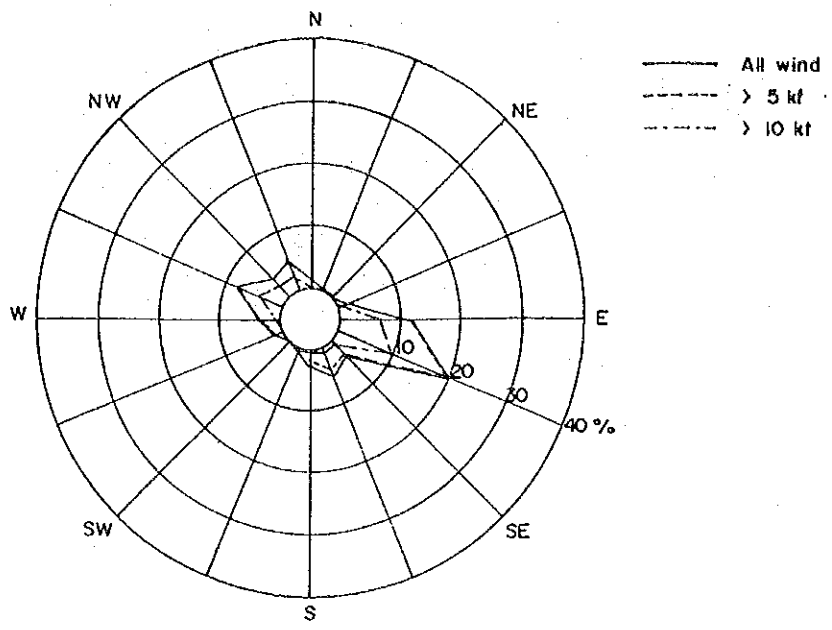

Figure 3-1 Wind Rose (1992)

B. Topographical Conditions

6. A mountain range with average elevation of 1,800 to 2,100 m runs on Timor Island, and the highest is Mt. Fatamailau with elevation of 2,920 m. Kupang port (4°00' S and 119°30' E) is situated on the northern coast with no flatland but coral and volcanic hills near the western edge of the island and wide fringing reefs are developed. In the old Kupang port facing the north-west direction, extend fringing reefs with maximum width of about 500 m and small ships cast their anchors at the edge of the reefs. The port is hardly usable during the NW wave season from December to April. Though located behind Semau Island in the west, Tenau port or the new Kupang port is affected at times by SW waves as shown in Figure 3-2.

C. Bathymetric Conditions

7. The coastal profile is steep along the northern coast of Kupang port. Coral reef, some 200 m wide, spreads near the Pertamina Pier on the south coast (Figure 3-2). The seabed is little covered with coral fragments and lava sand.

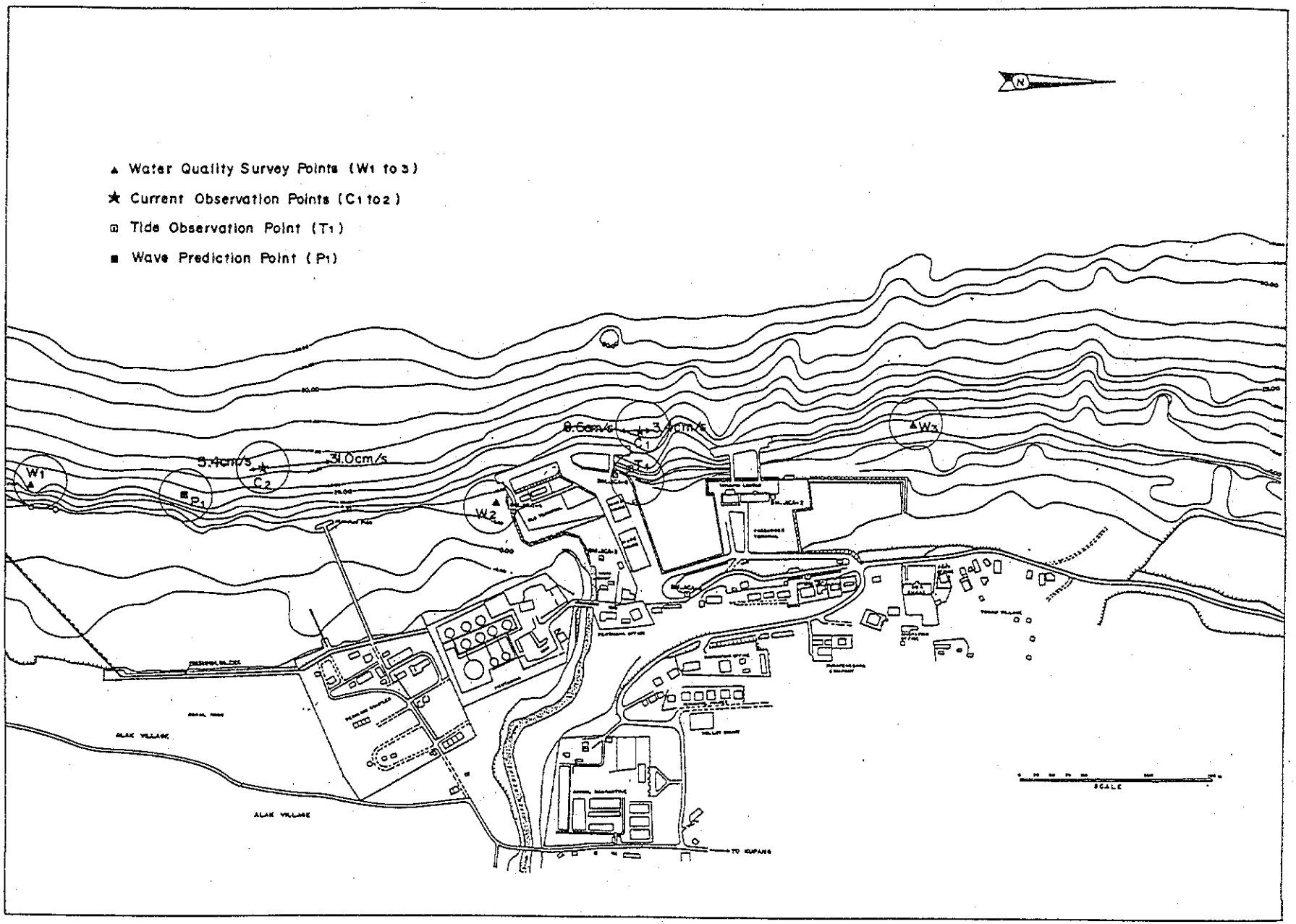

Figure 3-2 Kupang Port

D. Hydrographic/Oceanographic Conditions

Tide

8. Harmonic analysis of tide in Kupang port reveals that the diurnal tide is prevailing with mixed tide as shown in Table 3-3. According to the tide observed during the period from August 6 to September 7, 1993, the HWL and LWL are fixed at +1.70 m and ±0 m, respectively.

Table 3-3 Tidal Constituents in Kupang

Item	M_2	S_2	N_2	K_1	O_1	M_4	MS_4	K_2	P_1	Z_0
A (cm)	52	24	4	3	9	8	1	7	11	110
g°	299	261	299	299	255	345	246	26	298	--

Position : 04°00'S, 119°30' E
GMT : + 08.00
Survey : From August 6 to September 7, 1993

Current

9. Current condition at Kupang port is as follows.

(a) Maximum observed currents are 25 cm/s at C-1 and 40 cm/s at C-2. During spring tide, flood currents reach 3.4 cm/s (357°, C1) and 31.0 cm/s (353°, C2), though ebb currents reach 8.7 cm/s (177°, C1) and 5.4 cm/s (173°, C2) as shown in Table 3-4 and Figures 3-2 and 3-3.

(b) Currents oscillate in N-S direction. Prevalent currents move southwards at C1 and northwards at C2.

(c) Currents consist of semi and quadri-diurnal currents and short period turbulent currents.

(d) Northward flood and southward ebb currents flow fastest two hours before high and low tides, respectively.

Table 3-4 Tidal Current Ellipse

Position layer(m)	Date moon age	Axis	M1			M2			M3			Constant	
			ϕ °	V cm/s	H h	ϕ °	V cm/s	H h	ϕ °	V cm/s	H h	ϕ °	V cm/s
C1 -5.0	Aug 93 5 to 6 17.0	L	338	0.7	21.9	357	6.3	9.1	0	3.5	6.0	179	2.6
		S	68	0.2	15.9	87	1.1	6.1	90	0.5	4.5		
		S/L		0.33			0.17			0.14			
C2 -5.0	Aug 93 6 to 7 18.2	L	356	4.3	2.9	353	18.8	8.3	351	6.2	0.0	354	12.8
		S	86	0.0	20.9	83	0.2	5.3	81	0.3	4.5		
		S/L		0.00			0.01			0.05			

Wave

10. Waves are predicted at P1 based on the wind data in 1992 observed in Kupang, for they have never been observed in Kupang port (Figure 3-2). Waves travel from WNW and NW as shown in Figure 3-4. Maximum significant wave is predicted as 0.93 m and 3.9 s.

Littoral drift

11. As sand and coral fragments are deposited on the seabed to some extent in and around Kupang port, it is foreseeable that the littoral drift occur due to the wind wave and swell generated in the northwest monsoon season. However, it is expected that the influence of littoral drift on the port activities will relatively reduced when the port facilities are expanded.

E. Geological Conditions

12. Quaternary volcanic rocks are widely spread over Timor Island, and Neogene sedimentary rocks and coral reefs are also spread as shown in Figure 3-5.

F. Seismic Activity

13. Great folded mountains extending from the Himalayas in the direction of south to Sumatra, Java and Nusa Tenggara have volcanic chains where volcanic and seismic activities are notable. The folded mountains run through Flores Island, which was attacked and heavily damaged by earthquake and tsunami in December 1992, and Damar Islands, and then turn to the direction of west. Timor Island on the other anticlinal axis extending parallel the said folded mountains, and this anticlinal axis runs from Sumba Island as its southwest edge to Maluku as its northwest edge, through Timor Island and Aru Islands where the axis turns to the direction of northwest as shown in Figure 3-5.

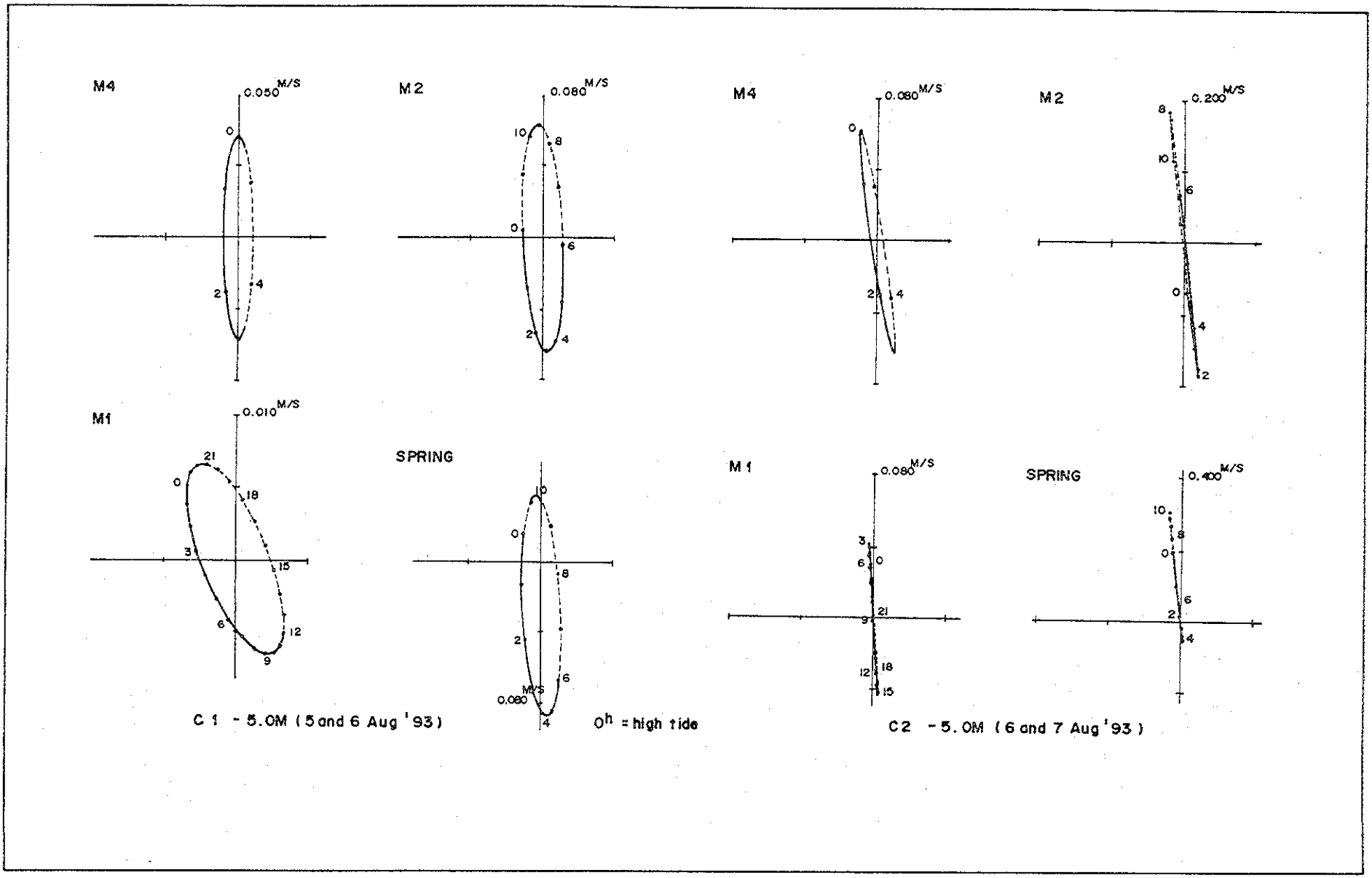

Figure 3-3 Tidal Current Ellipse

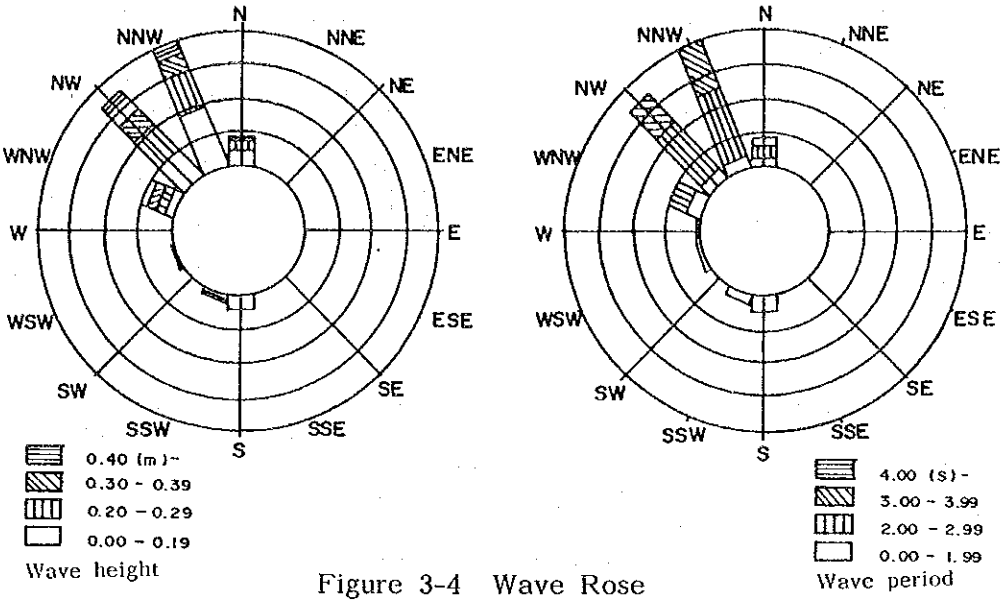

Figure 3-4 Wave Rose

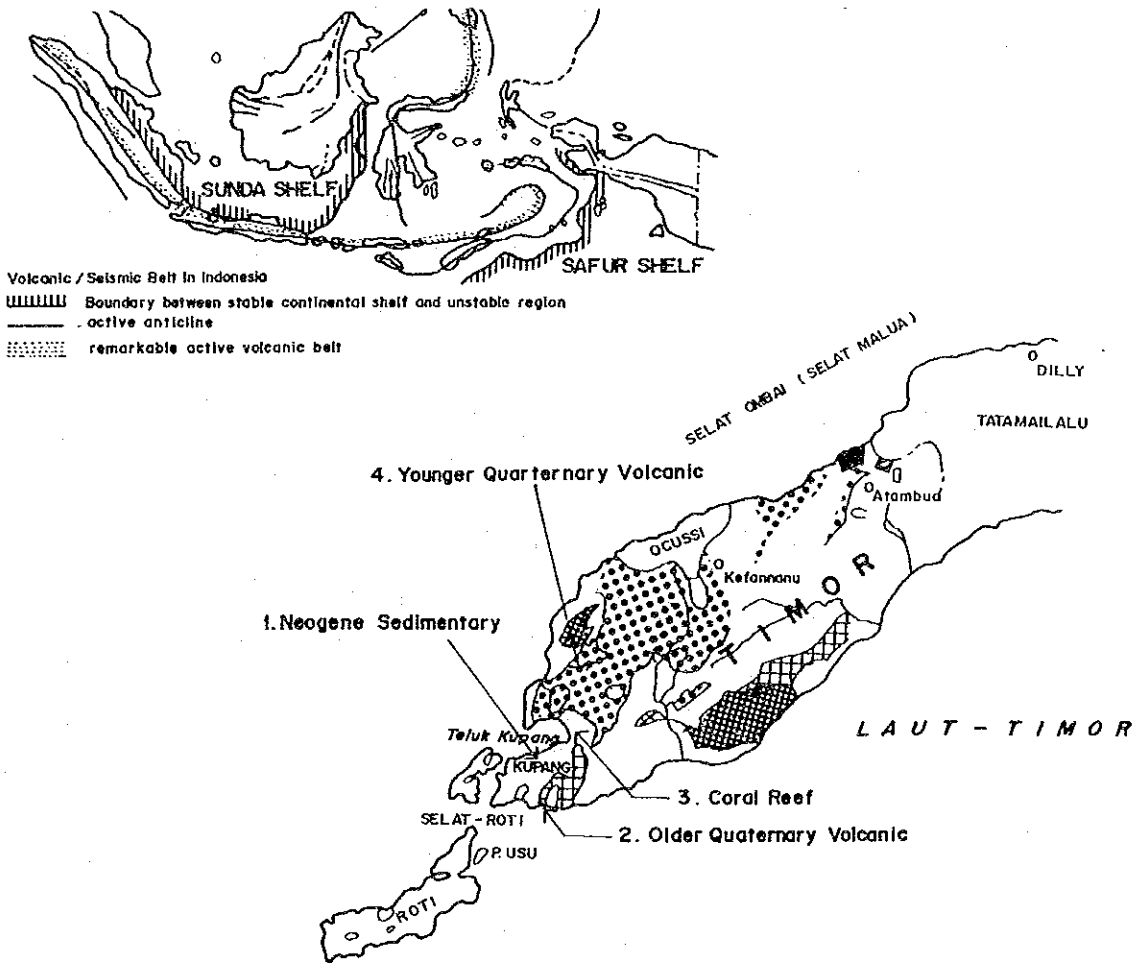

Figure 3-5 Geological Map

G. Soil Conditions

14. Previous soil surveys in the port area of Kupang were conducted in 1985 for extension of oil terminal in the direction of south and for construction of a new local pier. The boring surveys carried out for the present study aimed at verifying the seabed soil composition at the terminal point of the lines A-A and C-C which are drawn from the previous boring point in the direction of north and south, respectively. The location of these offshore boring executed and the seabed soil composition verified are shown in Figure 3-6.

15. Seabed surface layer at the points on imaginary lines parallel with the shoreline around the oil terminal is composed of medium hard sand mixed with gravel and coral fragments. Thickness of this surface layer of sand varies from 2 m to 15 m, depending on the water depth; the thickness is inversely proportional to the water depth. A hard layer of limestone with N value of more than 50 underlies the surface layer, elevation of which is within the range of -22 to -28 m.

16. Soil composition of the seabed north of the new local pier is generally similar to that of the seabed around the oil terminal, but a hard layer exist at the shallower elevation of -16 m.

H. Environment Conditions

17. Water quality surveys carried out in Kupang port in August to September 1993 as a link of the environmental surveys. Sea water was sampled at W1 to 3 at the depth of 0.5 m below the sea surface and at the depth equivalent to a half of the water depth at high tide and low tide during the period of spring tide as shown in Figure 3-2. The surveys covered physical and chemical 8 items; water temperature, salinity, pH, dissolved oxygen, transparency, COD, SS and turbidity as shown in Table 3-5.

Table 3-5 Water Quality Surveys in Kupang Port

Data of Spring Tide : September 3, 1993
Time of High Tide : 05:30 - 06:40
Time of Low Tide : 11:35 - 12:35

Time	Point W-	Water Depth (m)	Sampling Depth (m)	Trans-parency (m)	Tempera-ture (℃)	pH	DO (mg/ℓ)	Salinity (‰)	COD (mg/ℓ) $K_2Cr_2O_7$	Turbidity (NTU)	SS (mg/ℓ)
Low Tide											
05:30	1	40.0	20.0	17.0	25.0	8.47	5.4	3.53	24.0	6.5	14
05:45			0.5		25.3	8.44	7.1	3.48	19.2	6.0	20
06:00	2	20.0	10.0	16.0	25.1	8.30	4.5	3.44	16.2	6.5	16
06:10			0.5		25.2	8.28	6.0	3.50	35.1	6.5	22
06:25	3	30.0	15.0	18.0	25.8	8.26	6.2	3.48	29.6	6.0	17
06:40			0.5		26.0	8.24	5.6	3.52	36.8	5.5	19
High Tide											
11:35	1	42	21.0	19.0	26.5	8.35	6.2	3.60	29.7	5.5	14
11:45			0.5		26.4	8.30	7.1	3.53	24.3	5.0	13
12:00	2	22	11.0	16.0	27.1	8.26	5.4	3.55	43.9	6.0	16
12:15			0.5		27.3	8.31	7.2	3.51	18.7	6.0	12
12:25	3	32	16.0	17.0	27.0	8.29	5.8	3.43	20.4	5.5	18
12:35			0.5		26.8	8.25	5.6	3.47	19.1	5.0	15

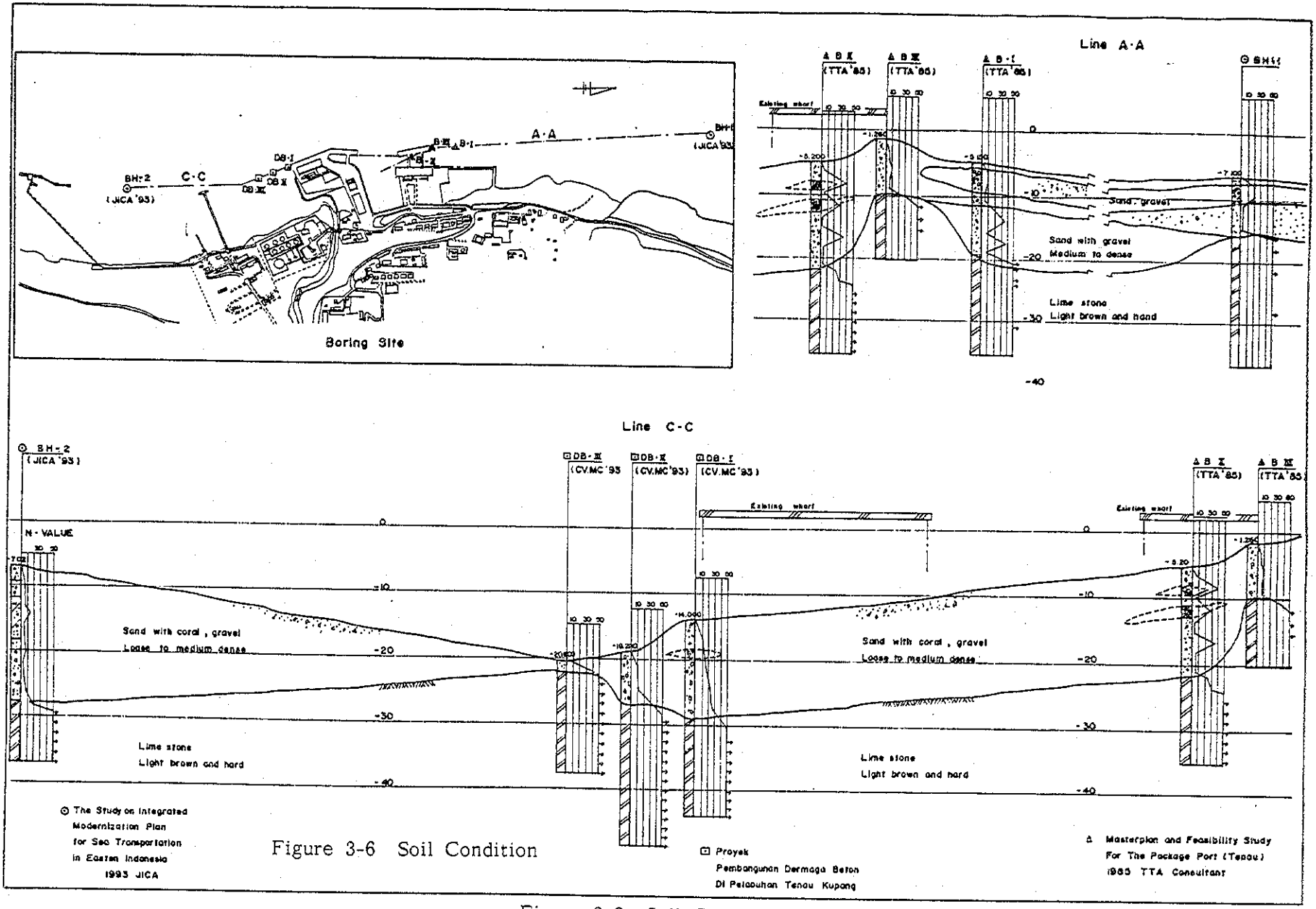

Figure 3-6 Soil Condition

Chapter 4 DEVELOPMENT POTENTIAL OF THE PORT HINTERLAND

A. General

1. East Nusa Tenggara Province is one of the most economically depressed provinces in the Indonesia. Per capita income of East Nusa Tenggara Province is Rp.384,166 in 1991, which is 38% level of the national average.

2. The economic structure of East Nusa Tenggara is still dominated by the traditional agriculture sector, which accounts for 51.5 % of the total GRDP of the province in 1991. Industrial sector has not been developed as expected, and its contribution is still only 1.99 % of the total GRDP.

3. Surplus of agricultural products (food and plantation crops) which can be locally processed or transported to other islands in the form of raw materials is very limited because of both small amount of quantity and widespread locations of the production.

4. Only 2.6% of the whole land of East Nusa Tenggara Province are suitable for wet land agriculture besides 31.1% are suitable for dry land agriculture. Rest of the entire land are critical land and stony area, which are unsuitable for continuous agricultural activities.

5. The government of East Nusa Tenggara Province has set the following objectives of economic development in the province although significant achievements have not been observed;

1. Poverty reduction
2. Change of economic structure
3. Output increase

B. Timor Gap

6. Referring to the conditions described above, local government of East Nusa Tenggara Province sees that one of the good possibilities for East Nusa Tenggara Province, a possible chance to keep up with national economic development and to change the local economic structure, is to use the momentum of Timor Gap Exploration stage, which has been in the exploration drilling stage.

7. Indonesia and Australia signed the Timor Gap Zone of Co-operation Treaty in December 1989, and the inaugural meeting of the Treaty Ministrial Council was held in Bali in February 1991, after 12 years of negotiations between the two countries. Under the Treaty, Area A shown in Figure 4-1 is the Zone of Co-operation under joint control, Area C under Indonesian control, and Area B under Australian control.

8. The Joint Authority was established by the two nations under the Treaty in order to manage the project, and award of production sharing contracts has been made by the Authority. Technical Directorate of the Authority has been established in Darwin, Northern Territory, and is responsible for the day-to-day management of petroleum operations in Area A.

9. Of the 11 contracts in Area A, four were signed between the Authority and consortium companies on 9 January 1992 in Jakarta, six others were signed on 17 December 1991, while one contract is in process of signing.

10. The contracts specify that the seismic works start at the beginning of 1992, while the exploration drilling at the end of 1992. Material supply, air transportation and other logistic supports for the offshore drilling in Area A will be provided through Kupang and/or Darwin as its basis for logistic and supply.

11. Operating contractors have to decide their preference of material and service from Indonesia or Australia, or provided by subcontractors operating in Indonesia or Australia, based on competitive rules and conditions which regulate the both sides in common.

12. According to Pertamina Bulletin, the total work commitments proposed by the successful applicants comprised over 52,100 km of seismic survey and interpretation, a total of 45 wells to be drilled, with more than 20 exploration wells drilled in the first three years, amounting to a total exploration budget in excess of US$362.32 million.

13. By the end of 1992 the Marathon joint ventures sank their first exploration well into Area 91-11. Marathon was committed to drilling one more well this year, as well as six others over the next two years in Area 91-11 and two in 91-19 in 1993 and 1994.

14. As shown Figure 4-2, exploration drilling has been carried out in Timor Sea besides in Timor Gap, and some of the wells have commercially succeeded in producing oil. The Timor Sea is producing more than 100,000 barrels of oil a day.

15. It is reported that the Marathon consortium's exploration rig has drilled three holes targeting sizable structures at depths between 3,000 m and 3,500 m so far, two of which showed signs of petroleum, but neither in large enough quantities to warrant testing.

16. Marathon is joined by Woodside, BHP, Petroz, and Phillips Petroleum in exploration within the Timor Gap in 1993. It is said that over the next few years, 20 international companies will explore the Timor Gap and the surrounding Timor Sea.

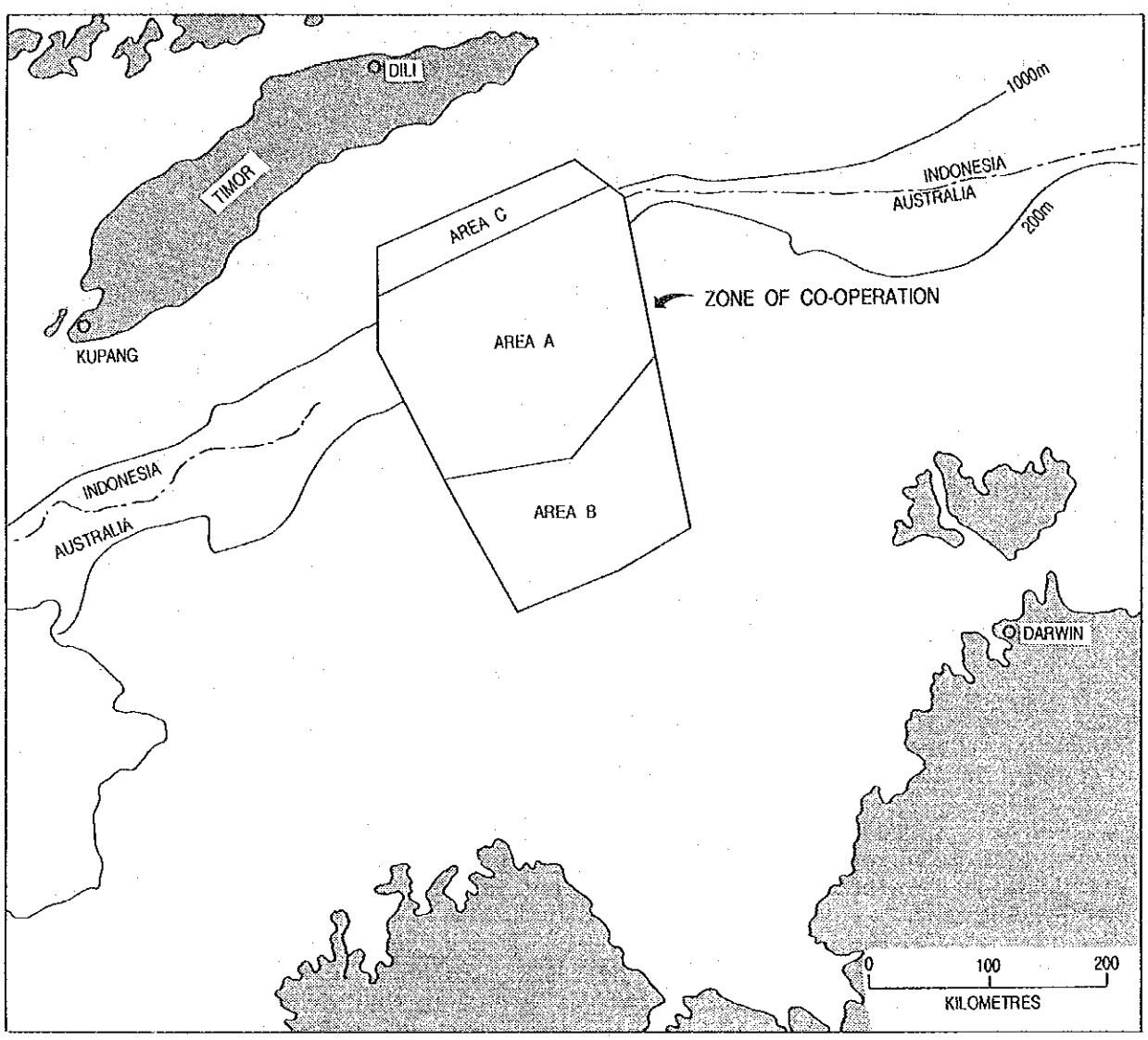

Figure 4-1 Timor Gap

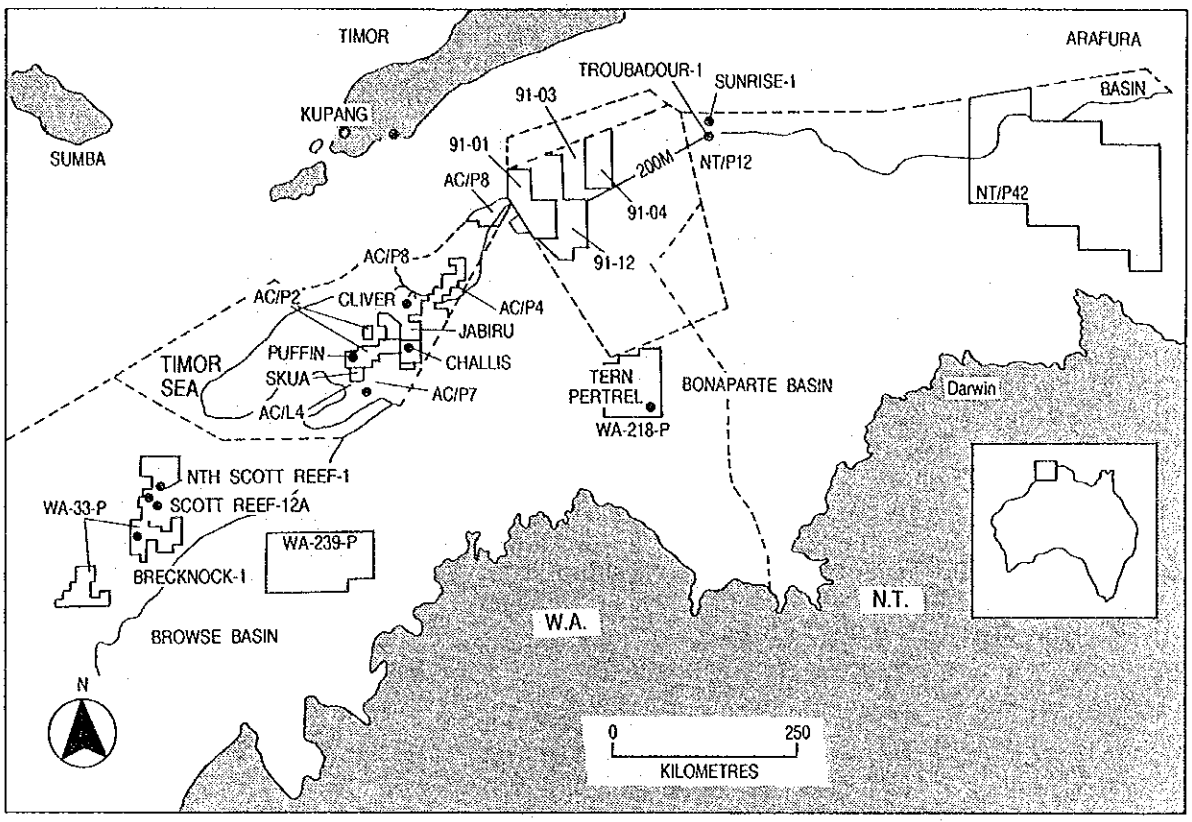

Figure 4-2 Oil Exploration Permit Location Map

C. Cement Industry

PT. Semen Kupang

17. A public cement factory PT. Semen Kupang was established and started production at the beginning of 1984 with the installed production capacity of 120,000 ton/year. The factory is located on the hill about one km away from the port of Kupang.

18. Coal and other raw materials such as gypsum are transported from Sumatra and other islands, and unloaded at the port of Kupang. Pt. Semen Kupang holds the mining license for lime stone and clay at Alak Village with 25 hectares.

19. Demand for cement in Timor and neighboring islands has been increasing constantly year by year, and has exceeded the installed production capacity. Therefore, PT. Semen Kupang is importing clinker from other cement factory in Indonesia to meet the ever increasing demand.

20. Product of PT. Semen Kupang is shipped to West Nusa Tenggara, East Timor, Southeast of Maluku as well as East Nusa Tenggara. Product of PT. Semen Kupang in 1992 was distributed as follows;

P.Timor	63,990 ton
P.Flores	40,610 ton
P.Sumba	13,670 ton
N.T.B.	520 ton
Tim-Tim	22,060 ton
TOTAL	140,879 ton

21. Pt. Semen Kupang has been proposing that its production capacity be increased up to 620,000 ton/year from the existing capacity of 120,000 ton/year. According to Ministry of Industry, the central government has not made any final decision on this matter so far.

OSIN (PT. Osmo Semen Indonesia) Project

22. Memorandum of understanding is exchanged between Czecho (formerly Czechoslovakia) government and East Nusa Tenggara provincial government to establish a new cement factory with production capacity of 1,500,000 ton/year. 200 ha of land with waterfront which is about 4 km away from the port of Kupang has been planned.

23. The new factory has been named OSIN. Investment of Rp. 350,000 million is expected although this project is still under negotiation with Czecho government.

24. According to Bappeda of East Nusa Tenggara province, feasibility study of this project is under going. It is expected that this study will be finalized by the end of 1993.

25. The company has asked the government to construct a new port in front of the planned location of OSIN project. The government, however, did not commit to this request.

26. The company proposes that production will begin in 1996/97. The OSIN project is conceived as targeting international market, anticipating to avoid possible conflict with other domestic cement factories.

D. Regional Development Policy in East Nusa Tenggara Province

27. Considering the geographic location and socioeconomic conditions of East Nusa Tenggara, which is significantly strategic in its relation to the future economic growth of Asia, Pacific, Australia and New Zealand, and in relation to the oil and gas prospect of the Timor Gap, the local government has set up a regional development policy to push Kupang Town to be a center of services or the gateway in South Indonesia.

28. The local government has proposed a future land use plan along the entire Kupang Bay as shown in Figure 4-3, although this plan has not officially authorized. This plan aims at establishing the Kupang Bay area as an international trade center in the long run, and logistic supply bases for the Timor Gap project in the short run.

29. The local government views that during the early stage of the exploration, capital-intensive and/or hi-tech oriented investment will be based at Darwin, Australia, and that additional investment, however, for exploration supporting facilities which require simple technologies and labor force, will be based at Kupang, Indonesia.

30. To realize the above mentioned policy, the local government has set up the following work programme, and some of them including road development work are in the implementation stage.

(a) Preparation of a space layout master plan
(b) Acquisition of the land along Kupang Bay
(c) Establishing of Bay Authority
(d) Construction of infrastructures
    Reliable access roads
        Improvement 4 km, 12 m wide
        New road 2.5 km
    Tap water supply
    Telecommunication
    Power, installed capacity 32 MW, sold capa. 12 MW,

Port of Darwin

31. On the other hand, the Northern Territory Government is pushing Darwin as the supply base for the whole exploration industry now concentrating its attention on northwest Australia. In the past seven years, Darwin has grown as a support base for the Timor Sea exploration activities, and is now set to tap into offshore oil and gas boom by promoting itself as a regional oil supply and trading base for active exploration in the adjacent seas.

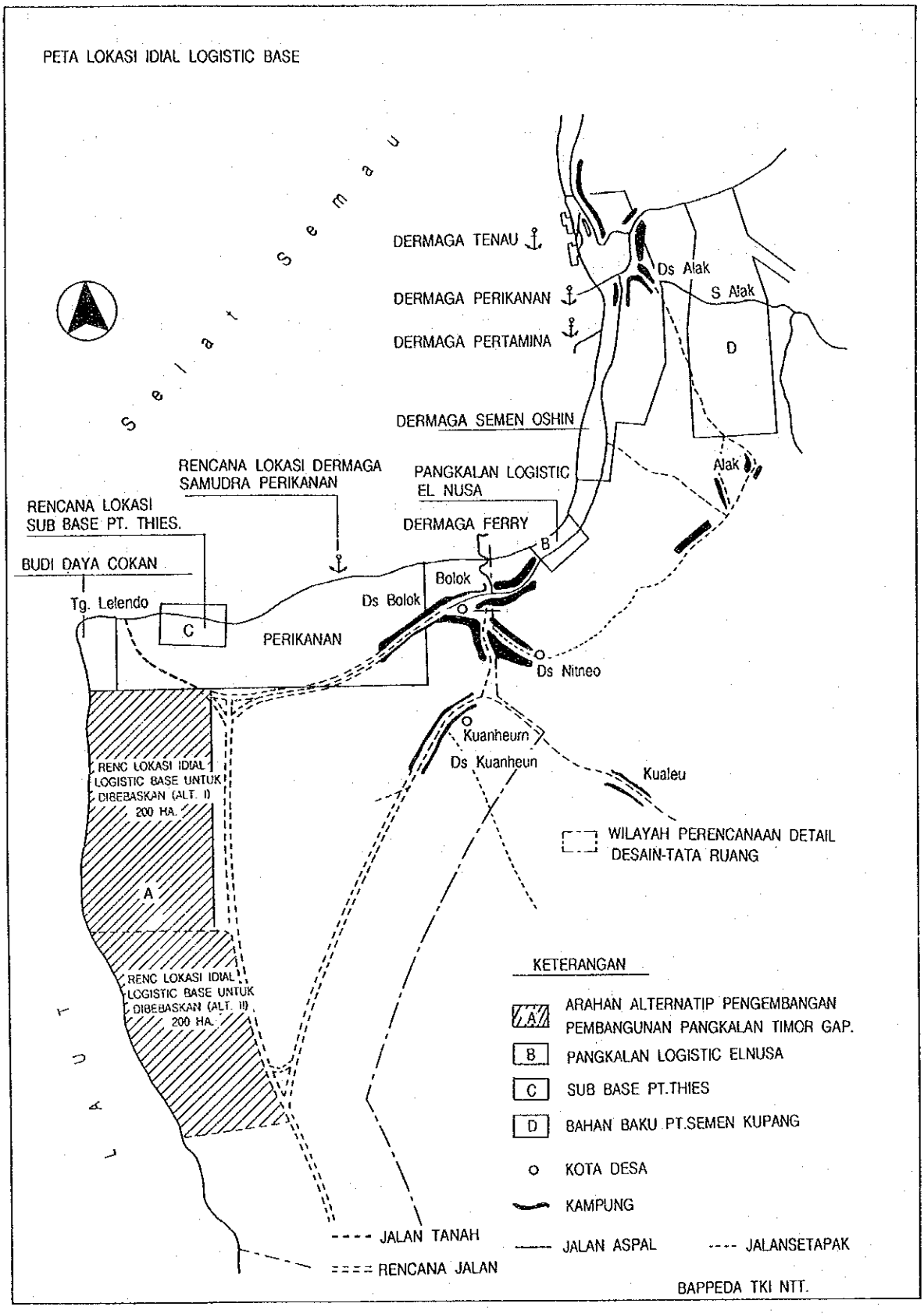

Figure 4-3 Proposed Land Use Plan

33. Darwin already has an international port with regular, direct shipping services to Singapore and Indonesia. In recognition of the Darwin's geographical advantage, i.e., closer to the major equatorial shipping services, and to fully realize its potential, the Northern Territory Government has committed itself to the construction of a significant new port development which will be operational in 1995. The site for the new port of Darwin is shown in Figure 4-4.

34. The development of the new port of Darwin will take place in three stages. The first stage, already well underway, includes an Environmental Impact Study, onshore and offshore survey work, hydraulic modeling and sediment transport studies and the design of the project.

35. Second stage involves the construction of some 400 m of berthing frontage, establishment of bulk handling, live cattle and container handling equipment. These elements of the port will become operational in 1995.

36. The design of the new facility allows for final expansion to some 1,100 m of berth space for major vessels to handle about 500,000 containers per annum, which presents 30 per cent of the total container volume currently crossing Australian wharves. The minor bulk port will be capable of handling an estimated two million tones of material per annum.

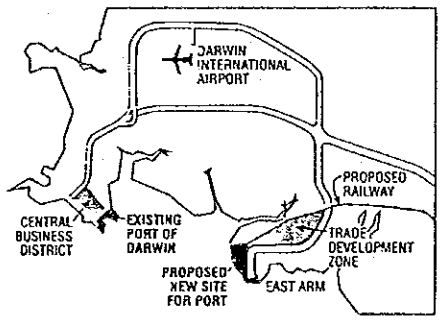

Figure 4-4 Site for the New Port of Darwin

Comparison

37. Comparison of the two possible logistic supply bases is illustrated below.

Facilities	Kupang	Darwin
1. Distance to oil rig	175 mile	350 mile
2. Helicopter flight time	2 hrs	4 hrs
3. Shipping time	15 hrs	32 hrs
4. Open storage facility	Insufficient	Available
5. Wharf facility	Insufficient	Available
6. Water facility	Sufficient	Sufficient
7. Electric Facility	Sufficient	Sufficient
8. Heavy cargo equipment	Less	Sufficient
9. Tariff/port dues	Cheap	Expensive
10. Manpower	Cheap	Expensive
11. Catering	Cheap	Expensive
12. Hotel	Cheap/simple	Expensive

E. Other Projects and Development Potential

1) Fishery complex development project

38. According to the local government, existing mooring jetty for fishing boats, which is adjacently located to the south of the port of Kupang, will be moved further to the south. An area of 200 hectares of land near Bolok ferry terminal has been prepared for the relocation of the fishery jetty, village and school, and other fishery related facilities.

2) Salt industry project

39. 5,000 ha of land have been permitted to develop salt industry along Bay of Kupang, and about 4,000 ha of land have been developed so far. Rp.2 billion have been invested to this project. Production of the following goods is expected;

Grm. Industry	650,000 ton
Grm. Magnesium	10,000 ton
Grr. Meja Ydm	100,000 ton
Artania	20 ton
Soda Abu	200,000 ton

40. According to Investment Co-ordinating board, investment from China is expected for the salt project. Physical development is not yet started. Land clearing works will begin in 1994. It is generally said that two years are required for construction stage. During the first phase of the operation, production of 250,000 ton/year is expected.

3) Industrial zone

41. Southern area of Kupang Port will be developed as industrial zone, which will include 400 ha of land for the Timor Gap project related industries. Road in the south of the port of Kupang is currently only 6 m wide, and will be improved to 18 m wide. Construction of new road in the proposed industrial zone has been started.

4) Power

42. Electricity has enough capacity for industrial development because less than 50 percent is currently utilized.

5) Water supply

43. Water supply is sufficient for new industrial activities because there is a spring. According to Kanwill of Ministry of Industry, there is a underground water reserve which lays 40 to 80 m below the ground level. Therefore, water supply will be sufficient for industrial development. Further, price of water is cheaper in Kupang than in Surabaya. What is needed is only pumps.

Chapter 5 TRAFFIC DEMAND FORECAST

General

1. Forecast of traffic through the port for the year of 2000 will be described in this Chapter. The traffic being forecasted in the present report is cargo volume only.

A. Socioeconomic Frame for the Target Year

Hinterland

2. The hinterland of the port of Kupang is determined from the data on the origin and destination of cargo passing through the port and from the inland transportation situation described in Chapter 2, Section B.

3. When considering the island transport network, we may consider the following hinterlands for the port of Kupang.

Hinterland : West Timor, East Timor, Flores, Sumba and a number smaller islands in East Nusa Tenggara.

Population

4. According to the census taken in 1990, the population of Indonesia is about 179 million, and that of East Nusa Tenggara Province is 3,269,000. This represents 1.8% of the total Indonesian population.

5. The future population was estimated through a cooperative venture between the Demographic Institute of University of Indonesia and the National Development Planning Board in Table 5-1.

Table 5-1 Projecte Population

Unit : thousand

Year	1990	1995	2000	Annual Growth Rate (%)
Indonesia	179,379	198,950	215,863	1.87
E.N.T.	3,269	3,287	3,306	0.11

Source : Population Projection of Indonesian Province 1990-2020
The Demographic Institue of University of Indonesia
and the National Development Planning Board

6. Based on projections of the above cooperative venture, Indonesian Population will grow at an average growth rate of 1.87 percent. On the other hand, the projected growth rate of population of East Nusa Tenggara Province is 0.11 percent. This annual growth rate is lower than those in the other provinces. As a result, the total population of East Nusa Tenggara Province in 2000 is estimated to be about 3,306,000.

Economy

7. The economic growth rate is assumed at 7 % per annum in East Nusa Tenggara in this study so that the economic discrepancy between the national average and that of the province shall be decreased in future.

8. Table 5-2 shows actual annual growth rate of GRDP in East Nusa Tenggara by sector. In 1988/1990 GRDP growth rate is 6.2 percent, and several sectors such as Mining & Quarrying, Construction, Trade, Transportation & Communication and Bank exceed the average rate. It is assumed that GRDP growth rate by sector will not change significantly through 2000.

Table 5-2 Economic Growth Target and Actual Rate by Sector

Unit : (% / year)

No	Sector	Pelita IV	'83-'88	Pelita V	'89-'90
1	Agriculture	7.0	2.4	3.3	4.8
2	Mining & Quarrying	6.9	6.2	6.0	9.8
3	Industry	8.5	0.6	12.0	5.2
4	Electricity & Water	6.4	16.6	6.5	3.8
5	Construction	8.9	8.0	9.1	8.0
6	Trade, Hotel & Restaurant	8.3	5.2	7.5	7.3
7	Transportaion & Communication	10.8	10.9	7.5	15.2
8	Bank & Financial Institutions	6.5	7.9	7.6	16.0
9	House Hiring		1.5	4.5	2.7
10	Goverment		6.2	5.0	4.7
11	Services	5.3	4.1	7.0	2.5
	Total	7.0	4.2	5.0	6.2

Sourse : Bappeda

Remark : PELITA IV and V is projected data.
'83-'88,'89-'90 is actual growth rate.

B. Methodology for Demand Forecast

9. Generally speaking, there are two methods to forecast the commercial cargo volume handled at the port. One is a macro forecast which is a method to estimate the cargo volume as a group including many commodities, regardless of the volume of each commodity. The other is a micro forecast, which is a method to estimate the cargo volume of each commodity individually.

10. Macro forecast follows the past trends without considering a special development plan. As discussed in Chapter 4, the port of Kupang is characterized as an industrial port, and cement production is expected to increase significantly. An industrial estate development project is also ongoing. Future cargo volume of a development port like Kupang cannot follow the past trends. Herein, the cargo volumes handled at Kupang Port for the target year will be forecast as those obtained by the micro forecast method.

11. After categorizing the major commodity groups into the following groups, the volume of each commodity is forecast individually and the total cargo volume is then calculated by the summation of these volumes (Rice, asphalt, cement and cement material).

C. Forecast of Cargo Volume

12. Considering the present cargo volume, long term trend and package type by commodity, the cargo handled at the port of Kupang is classified into the following 8 categories for the micro forecast.

(1) Rice
(2) Foodstuffs excluding rice
(3) Fertilizer
(4) Wood
(5) Asphalt
(6) Cement and material
(7) General cargo
(8) Material for development plan

13. Volume of each commodity group is forecast according to its particular characteristics. The resultant commodity growth rates in the cargo forecasts are shown in Table 5-3. The following outlines the methods employed for the forecasting of each commodity group.

Table 5-3 The Commodity Growth Rate

Unit : %

	Commodity	Annual Growth Rate
1	Rice	7.2
2	Foodstuffs	5.4
3	Fertilizer	8.0
4	Wood	9.2
5	Aspalt	9.2
6	Cement	15.0
7	Genaral cargo	7.5
8	Material for Dev.	-

(1) Rice
Demand increase reflects population growth, per capita consumption growth and increased area harvested.

(2) Foodstuffs excluding rice
Demand forecast assumes the continuation of past trends.

(3) Fertilizer
Demand increase is commensurate with consumption growth of Indonesia.

(4) Wood
Demand increase is commensurate with annual growth rate of construction sector GRDP of East Nusa Tenggara.

(5) Asphalt
Demand increase is commensurate with annual growth rate of a construction sector GRDP of East Nusa Tenggara.

(6) Cement and material
Demand will be forecast by correlation with GRDP.

(7) General cargo
Reflects annual growth rate of GRDP of East Nusa Tenggara.

(8) Material for development plan
Increased inputs for a new development of an Industry area and Timor Gap project.

14. Table 5-4 shows a summary of the forecast cargo. A total of 741,000 tons of cargo is expected to be loaded or unloaded at the port of Kupang in 2000.

Table 5-4 Result of Micro Forecast at Kupang Port

Unit : 1,000 ton

	Commodity	G. Cargo	Solid Bul	Bag cargo	Drum	Total
1	Rice	0	0	67	0	67
2	Foodstuffs	0	0	10	0	10
3	Fertilizer	0	0	6	0	6
4	Wood	0	17	0	0	17
5	Aspalt	0	0	0	22	22
6	Cement & Material	0	116	284	0	401
7	Genaral cargo	161	0	0	0	161
8	Material for Dev.	58	0	0	0	58
	Total	219	133	367	22	741

D. Volume of Container Cargoes

15. The volume of container cargo is forecast by multiplying containerizable cargo volume by the containerization rate. Containerizable cargo is estimated by an assessment of the physical characteristics of the major cargo categories and their suitability for containerization from the port statistic data.

16. The main categories of the containerizable goods include most foodstuffs, manufactured goods, refined sugar, chemical product and so on. Other cargoes such as cement, stone, cereal, liquid bulk, timber and metal product have been pronounced unsuitable for containerization.

17. The containerization rate is the percentage of the volume of containerized cargo to the containerizable cargo. The containerization rate at the port of Kupang in target year is assumed to be 10 percent.

18. Volume of container cargo forecast is shown in Table 5-5. The volume of container cargo in target year can be obtained from the general cargo by the package type.

Table 5-5 Percentage of Containerization at Kupang Port

	1989	1990	1991	1992	2000
Container Cargo (ton)		86	940	1,006	21,908
Containerizable Cargo (ton)	71,996	78,173	75,515	96,780	210,081
Percentage of Containerization	0%	0%	1%	1%	10%

Chapter 6 PORT FACILITY DEVELOPMENT PLAN

A. Basic Consideration for the Port Development

Necessity of the revision of the port development plan

1. As discussed in Section H, Chapter 2, port facility improvement works at the port of Kupang have been based on the development plan studied in July 1985. This existing development plan basically well forecast future economic and maritime activities in the region, and formulated a reasonable facility development plan for the port.

2. After the formulation of this development plan, however, drastic changes in national maritime policy were observed. As well, some of the premises set in the existing master plan study have been altered. Changes of planning conditions include;

a) The existing development plan was formulated under the framework of the gateway policy and ILS concept, noting in the study report that "implementation of the ILS-concept will have greater consequences for Tenau than for any of the other package-E ports because of the significant increase of transhipments." In reality, the Indonesian government issued PAKNOV 21/88 to deregulate shipping activities in 1988 as discussed in Chapter 5, Part I, Volume I. Consequently, volume of the transshipment cargo at the port of Kupang has been moderate.

b) The existing master plan study examined the possibility of containerization and concluded that as the volumes and regional distribution of cargo suitable for containerization were so small for Eastern Indonesia that before the end of the century no significant volumes of containerized cargo were expected. As a result, no container facilities were proposed in the existing master plan. In reality, the port of Kupang started container operation in 1990, and full container vessels come from Darwin, Australia, although volume of container cargo is still minimal.

c) New projects have been proposed, and serious efforts have been made to realize them. The projects which are likely to significantly influence regional development of Nusa Tenggara province include Timor Gap project and expansion or establishment of cement factory as were described in Chapter 6. The potential for regional development has been identified and discussed only recently.

3. Description above fully explains the necessity of revising the existing development plan of the port of Kupang. It should also be noted that significance of the Eastern Indonesia issue nowadays has drastically changed from that in 1985.

Development policy of the port of Kupang

1) Government should initiate actions through improving port facilities at Kupang port to promote regional development in NTT

4. East Nusa Tenggara province has neither fertile land for agriculture and forestry, nor natural resources for industries. It has scarce rainfall and a long dry season. The province is located far away from national markets, which are centered at Java island.

5. Considering this province's situation, local government adopted the policy to use the momentum of Timor Gap Exploration stage, which is expected in near future to start operation. The local government expects that private organizations which are interested in this project will invest in this region if infrastructures are provided by the public sector.

6. The local government started construction works of road improvement and development for a total length of 6.5 km in the area of the proposed industrial estates near Bolok ferry terminal. This local government's action has been based on the belief that government should invest first in order to attract private investors.

7. JICA study team supports this local government's idea, and recommends the central government and other port-related public institutions take necessary steps to strengthen port functions and to improve port facilities at the port of Kupang for the sake of regional economic development. Kupang airport has been expanding its landing capacity to accommodate larger aircraft, giving more opportunities for East Nusa Tenggara people to open markets and to expand trade with international communities. Why not Kupang port ?

2) Kupang port should be developed to support locally-based industry

8. In order to change the economic structure in East Nusa Tenggara province, it is necessary to promote industrialization. Cement manufacturing has been the prominent industry in the secondary sector in this province. As explained in Chapter 16, there are two cement manufacturing projects, which look like independent projects, but actually are closely interrelated with each other.

9. PT. Semen Kupang has been proposing expansion of its production capacity by 500,000 ton/year from the present rated capacity of 120,000 ton/year. On the other hand, Osmo cement would like to construct a new cement factory with production capacity of 1,500,000 tons/year at the location a few km away from the Pt. Semen Kupang.

10. The central government has not made a final decision on this matter. In this present study, JICA study team assumes that production capacity of cement in Kupang area will be increased either through the expansion of the existing factory or establishing a new factory, to meet the ever-increasing demand for cement in East Nusa Tenggara, East Timor, and West Nusa Tenggara, and that existing public port will be utilized for unloading raw materials, and for loading cement.

3) Kupang port should be developed as a leading container port in the region

11. Containerization will progress with the increase of both cargo volume and per capita income. Although the economic structure in East Nusa Tenggara has been dominated by the primary sector, relative importance of the secondary and the tertiary sector will be year by year increased. New policy setting to promote agro-industry in the province as well as nationwide will enhance the increase of volume of cargoes which are suitable for container transportation. Thus, the port of Kupang, which has been playing a dominant role in the southern part of Eastern Indonesia, is required to establish container handling capability in an efficient way.

12. The port of Kupang has been handling containers from 1990. Perkins Shipping Line opened a container shipping service which calls Kupang port. Now, export cargoes can be shipped from the port of Kupang directly to Singapore, Hong Kong and anyplace in the world. Although container handling has remained in the initial stage at Kupang port, it is expected that volume of container cargo will increase sharply with the development of suitable container facilities, and thus help facilitate interregional trade and to promote regional development.

4) Kupang port should be developed to support oil exploration projects in Timor Gap and Timor Sea

13. As explained in Chapter 4, Kupang is regarded as one of the possible support bases for Timor Gap projects. The other candidate is Darwin, Australia. Kupang's strength is its shorter distance to drilling wells, cheaper labor and goods/service, and weather while its weakness is its insufficient basic port infrastructure.

14. Another oil exploration project is on going. According to Kupang branch office of PERSERO III, AMOSES oil company is preparing for inland exploration drilling near Soe, East Nusa Tenggara. The exploration drilling is scheduled to start in October 1993, and the port of Kupang will be used as the transshipment port of goods necessary for drilling such as steel pipes.

15. If the port of Kupang, which is located closer than any other major ports in Indonesia to oil exploration wells in Timor Gap and Timor Sea, cannot provide necessary support to these projects due to lack of basic facilities and space, then the projects will be hampered. Insufficient basic port infrastructure at the port of Kupang may lead to economic loss to the nation and to the region. It is advisable that the port of Kupang should be developed to support oil exploration projects nearby.

Other planning elements and conditions

16. People's and local shipping has been playing a significant role for means of sea transportation, and account for more than 30 % of the total seaborne traffic at the port of Kupang. Vessels of this type of shipping have been using Local Wharf for loading/unloading together with passenger ships. Local Wharf, however, has a limited Wharf length, and cannot provide sufficient space for People's shipping vessels. JICA study team observed some of the sailing boats were unloading timbers into the sea because berthing space was not available for the boats. Therefore, piers for sailing boats and local vessels should be built.

17. PELNI passenger ship "Kelimutu" regularly calls the port of Kupang, and moors along the Local Wharf, which has a quay length of 100 m. In 1994 a new passenger ship is scheduled to call the port of Bitung instead of "Kelimutu". Total length of the new passenger ship is said to be 140 m. It is necessary for the port to expand the Local Wharf in order to accommodate the passenger ship safely.

B. Present Capacity of the Port

Optimum berth occupancy

18. Capacity estimation of the existing berthing facilities is a necessary step for the determination of magnitude of additional berthing facilities to accommodate the anticipated traffic in 2000.

19. The capacity of the berthing facilities is defined as cargo volume when the berthing facilities are optimally utilized. The optimal berth occupancy is the berth occupancy for which annual costs and benefits of berth extension are equal to each other. The optimal berth occupancy depends on the cost of new quays (including back-up facilities), the waiting cost of vessels in port and the number of interchangeable berths. To provide a preliminary indication of quay extension requirements, provisional optimal berth occupancies have been obtained from the ISTS study:

Number of berths	1	2	3	4
Optimal berth occupancy	55%	59%	61%	63%

20. According to UNCTAD monograph, the figures given below are suggested in principle to be regarded as desirable occupancy rates for multipurpose terminals:

Number of berths	Berth occupancy rate
1	30 %
2	50 %
3	65 %

21. As indicated above, the optimum berth occupancy increases with the increase of number of interchangeable berths. The berthing facilities at the port of Kupang are basically divided into two categories: Interisland Wharf and Local Wharf. The Interisland Wharf consists of two or three berths, and the Local Wharf consists of more than three berths for sailing boats. Considering the number of the existing berths at the port, the optimum berth occupancy at each Wharf can be estimated as follows:

60 % for the Interisland Wharf
65 % for the Local Wharf

Capacity of the existing berthing facility

1) Calculation based on ship productivity

22. Existing berth capacity is the volume of cargo which can be handled at the berth at the rate of the optimum berth occupancy, and is expressed in the form of tons per linear meter per year.

23. One method to estimate the existing berth capacity is based on ship productivity, and can be expressed by the following empirical formula:

$$C = N \times 24 \times U \times BPI / L$$

in which,

C = optimum berth throughput (ton/m/year)
N = number of working days per year
U = optimum berth occupancy
BPI = cargo loaded/discharged per ship-hour at berth (ton/hr)
L = linear quay length occupied by a berthing vessel (m)

24. According to the branch office of PERSERO III, cargo handling is operated approximately 350 days per year excluding special national holidays and nasty weather days.

25. Analysis of ship call record and cargo handling documents of the port of Kupang for April 1993 reveals that ship productivity (BPI) of break-bulk cargo was 5.9 ton/ship-hour for Interisland Wharf, and 1.23 ton/ship-hour for Local Wharf provided that 50% of ship time at berth is spent for actual cargo handling. Main findings can be summarized as follows;

(a) Interisland Wharf

Number of Vessels	26	vessels
Ave. Ship Length	47.35	m
Ave. DWT	615.50	DWT/ship
Ave. Cargo Volume	378.01	ton/ship
Ave. Waiting Time	0.48	hr/ship
Ave. Berthing Time	64.19	hr/ship
Ave. Ship Productivity	5.89	ton/ship-hour

(b) Local Wharf

Number of Vessels	47	vessels
Ave. GRT	50.26	GRT/ship
Ave. Cargo Volume	75.90	ton/ship
Ave. Waiting Time	2.11	hr/ship
Ave. Berthing Time	123.90	hr/ship
Ave. Ship Productivity	0.61	ton/ship-hour

26. Linear quay length (L) occupied by a ship can be estimated based on the average ship length and allowance as 60 m for Interisland Wharf and 20 m for Local Wharf.

27. Existing berth capacity based on the operation record of the port can be estimated as 500 ton/m for Interisland Wharf (break-bulk cargo) and 336 ton/m for Local Wharf.

2) Calculation based on gang-productivity

28. Another method to estimate the existing berth capacity is based on gang productivity, and can be expressed in the following empirical formula:

$$C = N \times H \times U \times GPI \times n / L$$

in which,

C = optimum berth throughput (ton/m/year)
N = number of working days per year
H = number of working hour a day
U = optimum berth occupancy
GPI = cargo loaded/discharged per gang-hour (ton/hr)
n = number of gangs
L = linear quay length occupied by a berthing vessel (m)

29. As explained in Section G, Chapter 2, port labors usually work two shifts a day in the port of Kupang except for special cargoes such as coal. Considering break time, actual working time for break-bulk cargo is estimated at 14 hours a day, and 21 hours for coal.

30. According to the branch office of PERSERO III, the hourly cargo handling productivity per gang by cargo type at the port of Kupang is 12 ton/g/h for general cargo, and 18 ton/g/h for bagged cargo as shown in Section G, Chapter 2. It is assumed that 1.1 gangs on average are engaged in cargo handling operations for average 500 - 1,000 DWT vessels.

31. For dry bulk cargo, 25 ton/g/h for gang productivity and 2.0 for number of gangs for 2,000 DWT to 3,000 DWT vessels are assumed based on observations regarding current operations at the port. For cement loading, same vessel size and gang number are assumed as those of dry bulk cargo.

32. The capacity of the existing berth can be calculated as follows;

(i) 2 shifts

C = 647 ton/m	General cargo on Interisland Wharf
C = 970 ton/m	Bagged cargo on Interisland Wharf

(ii) 3 shifts

C = 1,512 ton/m	Cement on Interisland Wharf
C = 2,100 ton/m	Dry bulk cargo on Interisland Wharf

33. The Local Wharf has been utilized for both passenger ships and sailing boats. For these vessels, berthing time is spent not only for cargo handling operation, but also for waiting for passengers and cargoes, and sometime resting. Therefore, the capacity of the existing berth cannot be calculated based on the gang productivities.

3) Summary of capacity of existing berth

34. There is a big discrepancy between the two calculations, that based on the ship productivity and that based on the gang productivity. In order to estimate the capacity of the existing berth, capacity calculation based on the gang-productivity is more appropriate than that based on the ship productivity because the latter does not necessarily guarantee that the present cargo operation is at the maximum.

35. Regarding the capacity of the Interisland Wharf, where cargoes of different package types are handled, average berth capacity under the present package composition can be calculated as follows.

Packing type	Capacity	Composition
General cargo	647 ton/m	35%
Bagged cargo	970 ton/m	20%
Bagged Cement	1,512 ton/m	20%
Dry Bulk (Coal)	2,100 ton/m	25%
Average	1,248 ton/m	

36. From the discussions above, the capacity of the existing berth can be estimated as follows

1,248 ton/m x 223 m =	278,304 ton/year	for Interisland Wharf
336 ton/m x 100 m =	33,600 ton/year	for Local Wharf
Total	311,904 ton/year	

37. The port of Kupang handled 308,496 tons of cargo in 1992, which is almost identical to the capacity of the existing berthing facilities. Berth occupancy ratio of 61 % in 1992 was also optimum. In fact, actual traffic at Kupang has reached the optimum level, and utilization of south-side revetments in the mooring basin for coal unloading activities, which is not regarded as berthing facility in the calculation above, considerably contributed to avoiding excess port congestion. As a considerable portion of the mooring basin, however, becomes dried up at low tides, the revetments cannot be regarded as a permanent berthing facility.

Capacity of existing storage facility

38. Capacity estimation of existing storage facilities is a necessary step for the determination of magnitude of additional storage facilities to accommodate the anticipated traffic in 2000.

39. The capacity of the storage facilities is defined as cargo volume when the storage facilities are optimally utilized. The optimal utilization means that the storage facilities are used based on the standard conditions, i.e., "safe cargo handling system", "standard working time" and "effective usage of the storage facilities".

40. Port of Kupang has the following public storage facilities at present.

1) Transit sheds
2) Open storage areas
3) Container yard

1) Transit sheds

41. In general, the capacity of a transit shed is calculated by the formula shown in Appendix 6-1.

42. In this study, the factors were based on the present practices in this port. According to the information of Kupang branch office of PERSERO III, existing transit shed floor area is 2,500 m^2, the average dwelling time is 4 days and the operating days are 350 days per year. Based on the standard data, the peak ratio is 1.3, the effective storage area ratio is 0.6 and the volume of cargoes per unit area is 1.5 tons/m^2.

43. Existing capacity of the transit sheds at this port can be estimated as about 151,000 tons.

44. According to the head office of PERSERO III, the shed throughput (STP) is 24 tons/m^2 in 1992. Therefore, the volume of cargoes through the transit sheds in 1992 can be estimated as 60,000 tons.

45. According to the above results, it seems that the present transit shed can handle about two and half times the volume of the present level.

2) Open storage

46. The capacity of open storage area is also calculated by the same formula. According to the information of Kupang branch office of PERSERO III, existing open storage areas are 18,735 m^2, the average dwelling time is 5 days and the operating days are 350 days per year. Based on the standard data, the peak ratio is 1.3, the effective storage area ratio is 0.6 and the volume of cargoes per unit area is 1.5 tons/m^2.

47. Existing capacity of the open storage areas at this port can be estimated as about 908,000 tons.

48. According to the information of Kupang branch office of PERSERO III, the open storage throughput (OSTP) is 5 tons/m^2 in 1992. Therefore, the volume of cargoes which passed through the open storage areas in 1992 can be estimated as about 94,000 tons.

49. According to the above results, it seems that the present open storage areas can handle about ten times the volume of the present level.

3) Container yard

50. In general, the capacity of a container yard is calculated by the formula shown in Appendix 6-2.

51. According to the information of Kupang branch office of PERSERO III, existing container yard area is 1,265 m^2, the average dwelling time is 7 days, the average stacking height is 2 stacks and the operating days are 350 days per year. Based on the standard data, the storage area per TEUs is 60 m^2/TEU, the peak ratio is 1.3, the working area factor is 0.5 and the effective storage area ratio by handling system is 0.75.

52. Existing capacity of the container yard at this port can be estimated as about 600 TEUs.

53. According to the statistical data of Kupang branch office of PERSERO III, the container handling volume at this port in 1992 is about 240 TEUs. Therefore, it seems that the present container yard at this port can handle more than two times the volume of the present level.

C. Required Scale of the Port Facilities

Cargo volume forecast

54. As shown in Table 5-4, a total of 741,000 tons of cargo is forecast at the port of Kupang in 2000. Breaking down by packing type, general cargoes accounted for 219,000 tons, solid bulk 133,000 tons, bag cargo 367,000 tons, and drum 22,000 tons.

Berthing facilities

1) Cement Berth

(a) Berth dimensions

55. Two hundred and eightyfour thousand tons of bagged cargo will be cement for loading, and 116,000 tons of solid bulk cargo of unloading are raw materials or fuel for cement production such as coal. These cement related cargoes will reach a total of 401,000 tons a year.

56. In order to accommodate the cement related traffic, a new specialized berth will be required although part of cement will be loaded at conventional berths.

57. All of the solid bulk cargo which is related to cement production should be handled at the new Cement Berth in view of both efficient port operation and preservation of port environment.

58. The largest vessels which call the port of Kupang are coal carriers. According to analysis of shipcall records for July and August 1992, vessels with 5,972 DWT came from South Sulawesi province and returned to the same province. Based on these data, the new Cement Berth should be built to accommodate 5,000 DWT class vessels, which require water depth alongside of 7.5 m.

(b) Cargo handling and BOR

59. According to the branch office of PERSERO III, port labors at the Kupang port can unload 600 tons to 800 tons of solid bulk cargo a day. Therefore, it will take 166 days a year on average to unload the coal and other raw materials for cement production.

60. It is assumed that 80 percent of the total volume of cement loaded will pass through the new Cement Berth. The rest of the bagged cement have small lot sizes, and will be loaded through conventional berths.

61. According to Semen TONASA, bagged cement is loaded at a special port near the factory at a handling rate of 1,700 tons/day to 2,850 ton/day using a bag loader. Assuming the same handling efficiency, it will take 100 days a year on average to load 227,000 tons of bagged cement.

62. Accordingly, the new Cement Berth will be occupied by cement related ships for 266 days a year. The BOR of the berth is estimated at about 73 percent, which is in the neighborhood of the optimum BOR.

63. Besides a cement bag loader, a conveyor system may be installed at the expense of users at the port of Kupang to unload and transport coal to factories. Truck transportation of coal may easily cause environmental disputes when volume of coal increases.

2) Heavy Cargo Berth

64. It is forecast that a total of 22,000 tons of container cargo will be handled at the port of Kupang in 2000. Container traffic, both for international and interisland, will continuously grow with the increase of incoming and outgoing cargo volume. In 2000, container handling capability will be regarded as one of the prerequisites for the major ports even in Eastern Indonesia.

65. A berth for heavy cargoes including containers should be built to help regional development and industrial development. This new berth will handle cargoes which are related to the industrial estate development project and oil exploration project, totaling 58,000 tons.

66. Analysis of the shipcall record of the port of Kupang for July and August 1992 shows that the largest container vessel coming from Darwin is 2,890 DWT.

67. On the other hand, it is also expected that the port of Kupang will serve as a supply base for oil exploration projects. Supply boats transport steel pipes and casings for oil exploration between exploration sites and a supply base. Size of supply boats in general ranges from 1,500 DWT to 3,000 DWT.

68. According to information provided by oil companies, it is unlikely that a private oil exploration company will build a port and use it as its own supply base before oil is actually found because cost for the port construction is too high to justify the investment. It is likely, however, for an oil company to construct a port for its own activities after oil is found because cargo movement is quite different before and after oil is found.

69. One of the necessary requirements as a supply base for oil exploration is to have sufficient area of open yard to stock materials and equipment. On average, one hectar per oil well is sufficient. In addition, a warehouse is needed to stock materials and protect them from bad weather. The supply base is usually treated as some sort of bonded area.

70. Judging from information above, required quay length of the new Heavy Cargo Berth will be a minimum 130 m, and water depth alongside will be 7.5 m, thus making it possible to accommodate 5,000 DWT class cargo vessels, although 10,000 DWT class vessels loaded with heavy cargo are likely call the port of Kupang after the industrial state is fully operational.

71. Total volume of these cargoes is 74,000 tons in 2000. The resultant BTP will be 570 tons/m.

3) Local Wharf

72. The existing Local Wharf accommodates PELNI passenger ship, which is 99.80 m in length. According to the branch office of PERSERO III, a new PELNI passenger ship with 144.8 m in length will call the port of Bitung.

73. It is necessary for the port to expand the Local Wharf in order to accommodate the passenger ship safely. The required quay length for the new passenger ships is 170 m.

74. Perintis ships made calls to Kupang 76 times in 1992. They stayed at the port for an average 55 hours per shipcall. This type of ship has been engaged in not only cargo transportation but also passenger transportation. In addition, government ships for national defense made calls to Kupang about 70 times in 1992.

75. In all, berth occupancy of the Local Wharf by passenger ships, Perintis ships, and government ships will be in the neighborhood of 30 percent after extension by 70 m.

76. Therefore, the Local Wharf can be used for other types of ships when the Wharf is empty. It is reasonable to estimate that 30 to 35 percent of the total time can be used for cargo handling. The optimum capacity of cargo handling of this Wharf is estimated at 43,000 tons a year.

4) Rakyat Wharf

77. Local Wharf is 100 m in length, and has been used for both passenger ships and local/Rakyat ships. Rakyat shipping has been playing an important role and 101,676 tons of cargoes were loaded or unloaded by the Rakyat ships at the port of Kupang in 1992.

78. Rakyat ships made a total of 705 shipcalls to Kupang in 1992. An analysis of shipcall record for April 1993 reveals that a Rakyat ship stays at the port of Kupang for an average 5.25 days. Therefore, average 10.5 Rakyat ships are simultaneously staying at the port of Kupang. No sufficient space is available for so many Rakyat ships at the moment.

79. Role of the Rakyat shipping will remain important in the foreseeable future. It is recommendable that the government build a new jetty for Rakyat ships. Building a new jetty will also contribute to releasing excess congestion, and will help improve cargo handling efficiency at the Local Wharf.

80. In order to accommodate ten Rakyat ships simultaneously, 100 linear meter quay length is required at minimum. As the Rakyat ships can be berthed at both sides of the jetty, the length of the jetty should be 50 m at minimum.

81. As discussed in Section B, Chapter 6, optimum berth capacity per linear meter of the Local Wharf where most of the Rakyat ships have been accommodated is estimated at 336 tons/m. There is room, however, for improvement of cargo handling efficiency and operation. It is expected that cargo handling efficiency will be increased by 50 percent in 2000, then the 50 m long jetty can handle 50,000 tons of cargo.

5) Interisland Wharf

82. Rest of the cargoes can be handled at Interisland Wharf of 223 m in length. Commodities to be handled at this Wharf include general cargoes, rice, asphalt, and cattle. It is forecast that a total 230,000 tons of cargoes will be loaded/unloaded at this Wharf, and that the Berth Throughput will be about 1,000 ton/m.

6) Summary and on-going projects

83. Berth utilization in 2000 can be summarized as follows;

	Length (m)	Cargo ('000 ton)	BTP (ton/m)
Interisland Wharf	223	230 +cattle	1,100
Local Wharf	170	43 + pass.+ Gov.	ships
Rakyat Wharf	50	50	500
Cement Berth	130	344	2,646
Heavy Cargo Berth	130	74	570

84. Development of Raykat Wharf and extension of Local Wharf can be considered as on-going projects because engineering studies, which are necessary steps for the implementation of the projects, have been undertaken.

Storage facility

85. Port of Kupang in 2000 will require the following public storage facilities.

1) Transit shed
2) Open storage
3) Container yard

1) Transit shed

86. In general, the required area of a transit shed is calculated by the formula shown in Appendix 6-3.

87. In this study, the factors were based on the future practices in 2000 at this port. But it is assumed that the future practices in 2000 at this port are at the same level as the present practices. Incidentally, according to the demand forecast of port traffic at this port, the cargo volume of cement will increase rapidly. Therefore, the preferred transit shed for cement is planned at the new development area.

(a) Transit shed for cement

88. The cement handling volume in 2000 is 284,000 tons in total. It is assumed that the existing wharves will handle 20% of the cement and 80% of the cement will be handled at the new Cement Berth. Furthermore, the new transit shed will be operated in case of rainy days (100 days), so annual cargo handling volume of cement through new transit shed is 65,000 tons. The dwelling time is 5 days and the operating days are rainy days only, or 100 days per year. On the other hand, the peak ratio is 1.1, effective storage area ratio is 0.6 and the volume of cargoes per unit area is 3.5 tons/m^2.

89. This port will require an area of about 1,700 m^2 for the new transit shed for cement at the new development area in 2000.

(b) Transit shed for general cargoes, etc.

90. Annual cargo handling volume except cement through transit shed is 91,000 tons in 2000. Here, it is assumed that 20% of the cargo except cement will transit the sheds. The dwelling time is 4 days and operating days are 350 days per year. On the other hand, the peak ratio is 1.3, the effective storage area ratio is 0.6 and the volume of cargoes per unit area is 1.5 tons/m^2.

91. The required area of the transit shed for general cargoes, etc. in the year 2000 can be estimated as about 1,500 m^2.

92. The present area of the transit sheds in 1992 is 2,500 m^2. Therefore, it seems that an additional transit shed is not necessary in 2000.

2) Open storage

(a) Existing Port area

93. The required area of open storage is also calculated by the same formula. Annual cargo handling volume through open storage is 160,000 tons. Here, it is assumed that 35% of the cargo will transit the open storage. The dwelling time is 5 days and the operating days are 350 days per year. On the other hand, the peak ratio is 1.3, the effective storage area ratio is 0.6 and the volume of cargoes per unit area is 1.5 tons/m^2.

94. The required area of the open storage for port traffic in the year 2000 can be estimated as about 3,300 m^2.

95. The present area of the open storage in 1992 is 18,735 m^2. Therefore, it seems that an additional open storage is not necessary in 2000.

(b) New reclamation area

96. The required area of open storage for material for development plan is calculated by above formula,too. Annual cargo handling volume through open storage is 43,000 tons. Here, it is assumed that 90% of the cargo will transit the open storage. The dwelling time is 5 days and the operating days are 350 days per year. On the other hand, the peak ratio is 1.3, the effective storage area ratio is 0.6 and the volume of cargoes per unit area is 2.5 tons/m^2.

97. This port will require about 600 m^2 of open storage for material for development plan at the new reclamation area in 2000.

3) Container yard

98. In general, the area of a container yard is determined by the number of ground slots and the layout of ground slots which depends on a container handling method. The required number of ground slots is calculated by the formula shown in Appendix 6-4.

99. In this study, the factors were based on the future practices in 2000 at this port. But it is assumed that the future practices in 2000 at this port are at the same level as the present practices.

100. Container handling volume in 2000 is 3,800 TEUs. As regards the container handling system, it is assumed that the handling system is the same as at present. The dwelling time is 7 days and the operating days are 350 days per year. The peak ratio is 1.3 and the average stacking height is 2 stacks. On the other hand, the dwelling time of empty containers is 10 days and the operating days are 350 days. The peak ratio is 1.3 and the average stacking height is 2.5 stacks.

101. The required number of ground slots at the container yard in the year 2000 can be estimated as follows;

Stuffed container : Ns = 29
Empty container : Ns = 24

102. To arrange above ground slots, this port will require about 3,200 m^2 of container yard in 2000.

103. Port of Kupang has 1,265 m^2 of container yard (paved concrete blocks) at present. But it is planed that the container cargoes will be handled at the new Heavy Cargo Berth in 2000, so a new container yard will be required behind the Heavy Cargo Berth. Required area is about 3,200 m^2.

Timor Gap Support Base

104. It is thought that Timor Gap Support Base will require wide areas which can stock long casing pipes, a lot of bentonite, etc.. According to the information about the existing support base, the required areas must have more than 100 m depth. Also a wide frontage is required.

105. At the new reclamation area, it is possible to occupy about 1.4 ha of area for Timor Gap Support Base.

D. Access Roads

General

106. It is thought that present road conditions around the project site which is proposed as the new Cement Berth and the Heavy Cargo Berth are poor. The southern area from this port has a high potential regarding new development. But the existing road between this port and that area also poor, because the area around this port is hilly place, so it is difficult for trucks carrying heavy cargoes to pass above road. Therefore, a new access road will be required when the above port facilities start operation.

107. The route of this access road is from Interisland Wharf to the existing road which is connected with the southern area of this province. This access road is located behind the new port area because most vehicles which use this road will be generated by the port activities in this area.

108. The total length of the access road is 1,150 m in case of above route.

Determination of traffic volume

109. In general, a design traffic volume can be calculated by the formula shown in Appendix 6-5.

110. In this case, the target cargoes will be generated by operating the new container terminal and the new Cement Berth. So annual handled cargo volume is 178,000 tons/year. On the other hand, the share by vehicles is 1.0, the monthly variation is 1.5, the daily variation is 1.1, the truck real loadage is 10 tons, the real load rate is 0.5, the related vehicle rate is 0.5 and the hourly variation is 1.1. Here, above factors are based on the future land traffic activities in 2000.

111. The required design traffic volume can be estimated at 25 vehicles/hour in 2000. So daily new port area generated traffic volume is about 600 vehicles.

Road plan

112. Taking the speciality of vehicles using inner port roads and the convenience of parking into consideration, two lanes are proposed. Figure 6-1 shows the standard section of the road.

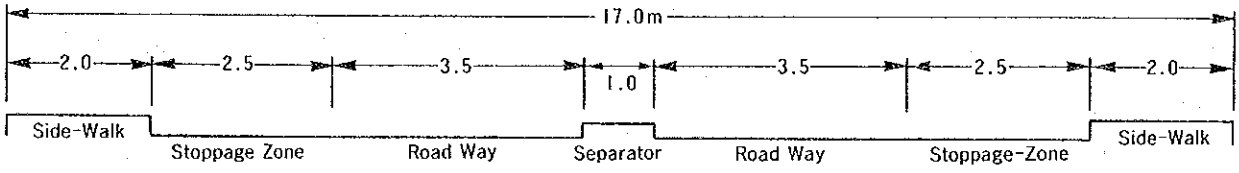

Figure 6-1 Standard Section of Access Road

E. Site Selection for the Port Development

113. Taking into consideration the location of the urban center, the existing and proposed land use, and both natural and environmental conditions, construction site of the required port facilities up to the year 2000 should be evaluated and selected among the possible sites in the vicinity of the present Port of Kupang.

114. It will be convenient for port operation and management if the location of the new port facilities is adjacent to the existing one. From the above view point, the following two possible sites shall be evaluated: adjacently north of the existing Tenau port (Tenau North), and adjacently south of the existing Tenau port (Tenau South).

115. The existing Kupang port was built in 1964 to replace the activities of the old port which was located at the estuary near downtown Kupang. Since the existing port is situated about five miles south of the downtown area, Kupang North has a locational advantage in being able to reduce cost and time of land transportation for the cargoes destined for downtown Kupang.

116. Disadvantage of this site is oceanographic conditions. The existing port is generally well protected by Semau Island from the waves coming from the west. The effect of Semau Island as a shelter, however, decreases as the port moves to the north. Kupang North is less advantageous than Kupang South from the view point of wave condition.

117. The greatest disadvantage of this site lies in the environmental condition around this district. Coastal zone just starting from the existing revetments for reclamation toward the north has been designated by the provincial government as a natural conservation area since wild animals such as monkeys are living there. Any economic activities which may disturb natural habitats are prohibited in this area. Therefore, this site is not suited as a location for port development.

118. Tenau South is an ideal site for port development from the view point of natural conditions. Water basin is better shielded by Semau Island than the existing port site where high waves come only about five days a year.

119. Water area near coastline is shallow and good for reclamation. Coral reef, some 200 m wide, spreads near the south of the existing port site. Layers of loose silty sand mixed with the coral form the bed materials from the surface to the elevation of -25 m. At the edge of the reefs, seabed becomes steep suddenly, and sufficient water depth to accommodate large vessels can be easily obtained.

120. Tenau South also has a locational advantage as a port development site. As shown in Figure 4-3, proposed locations of the regional development projects are found on the coastline south of the existing port. It is hoped that the majority of the port cargoes will be generated from and destined to the southern district of the Semau Bay.

121. Natural conditions at Tenau South favor port development, and more importantly, Tenau South has sufficient space for future development even after 2000. Tenau South can be recommended as the site for the required port facilities.

Photo 6-1 Coastal Zone at Tenau

F. Preparation of Alternative Layout Plans

Required facilities

122. As mentioned above, Kupang port will require the following port facilities in 2000.

(1) Cement Berth : 130 m (-7.5 m)
(2) Heavy Cargo Berth : 130 m (-7.5 m)
(3) Transit shed : 1,700 m^2
(4) Container yard : 3,200 m^2
(5) Open storage : 600 m^2
(6) Timor Gap Support Base: 1 unit
(7) Access road : Length 1,150 m, Width 17 m

Alternative layout plans

123. Layout plan of the Cement Berth and the Heavy Cargo Berth is based on the future port activities at this port. Thus, the cargoes which will be handled at the Cement Berth are cargoes which are related to cement production, on the other hand, the cargoes which will be handled at the Heavy Cargo Berth are those which are related to their living standard of this province. Therefore, it seems that the latter cargoes will have a higher potential after 2000. So, the Heavy Cargo Berth should be located at the area which has a future expansion area.

124. In this case, the waterway is planned to pass through between the existing yard of the Interisland Wharf and the planned yard of the Cement Berth, and the width of the waterway is decided to be 30 m so that velocity of water at flood time does not exceeded 0.5 m/sec at the berth.

125. In order to ensure the most adequate layout among various ideas in this regard, the following two alternatives were proposed:

Alternative 1 : This alternative is based on an idea to construct above facilities easily. Furthermore, the future expansion after 2000 is considered. The layout plan is shown in Figure 6-2.

Alternative 2 : This alternative is based on an idea to operate above facilities easily. Also, the future expansion after 2000 is considered. The layout plan is shown in Figure 6-3.

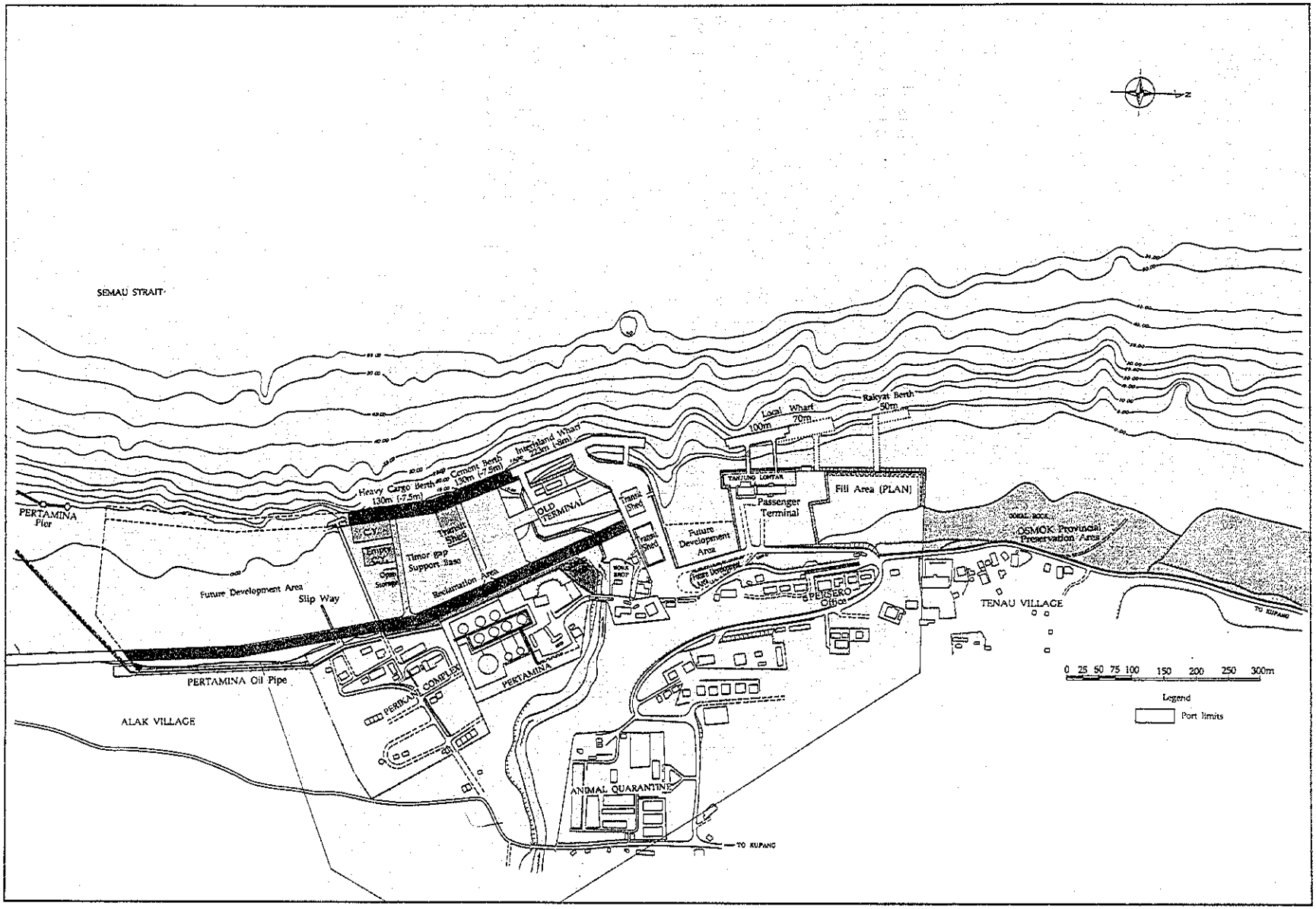

Figure 6-2 Kupang Port Development (Alternative 1)

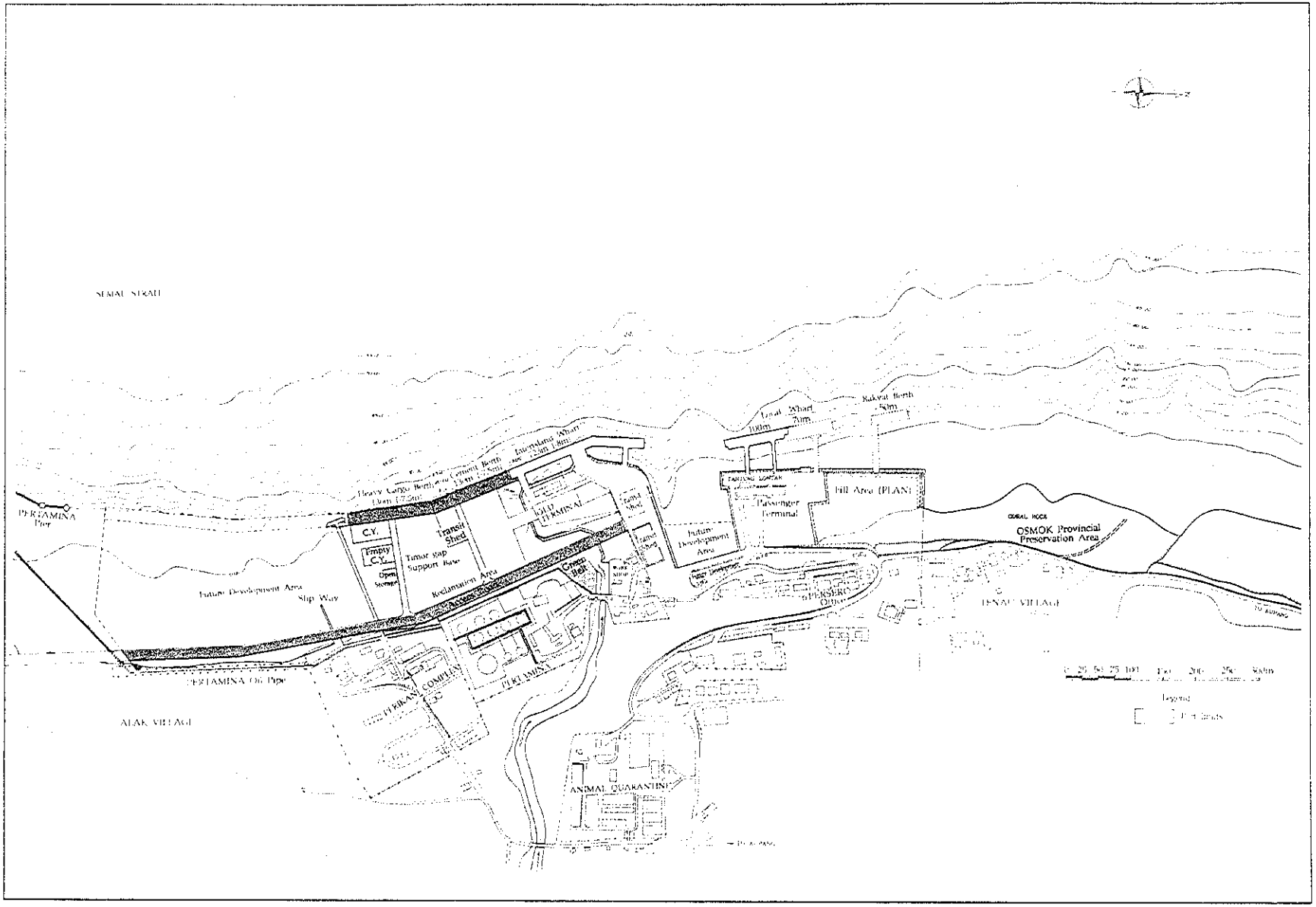

Figure 6-2 Kupang Port Development (Alternative 1)

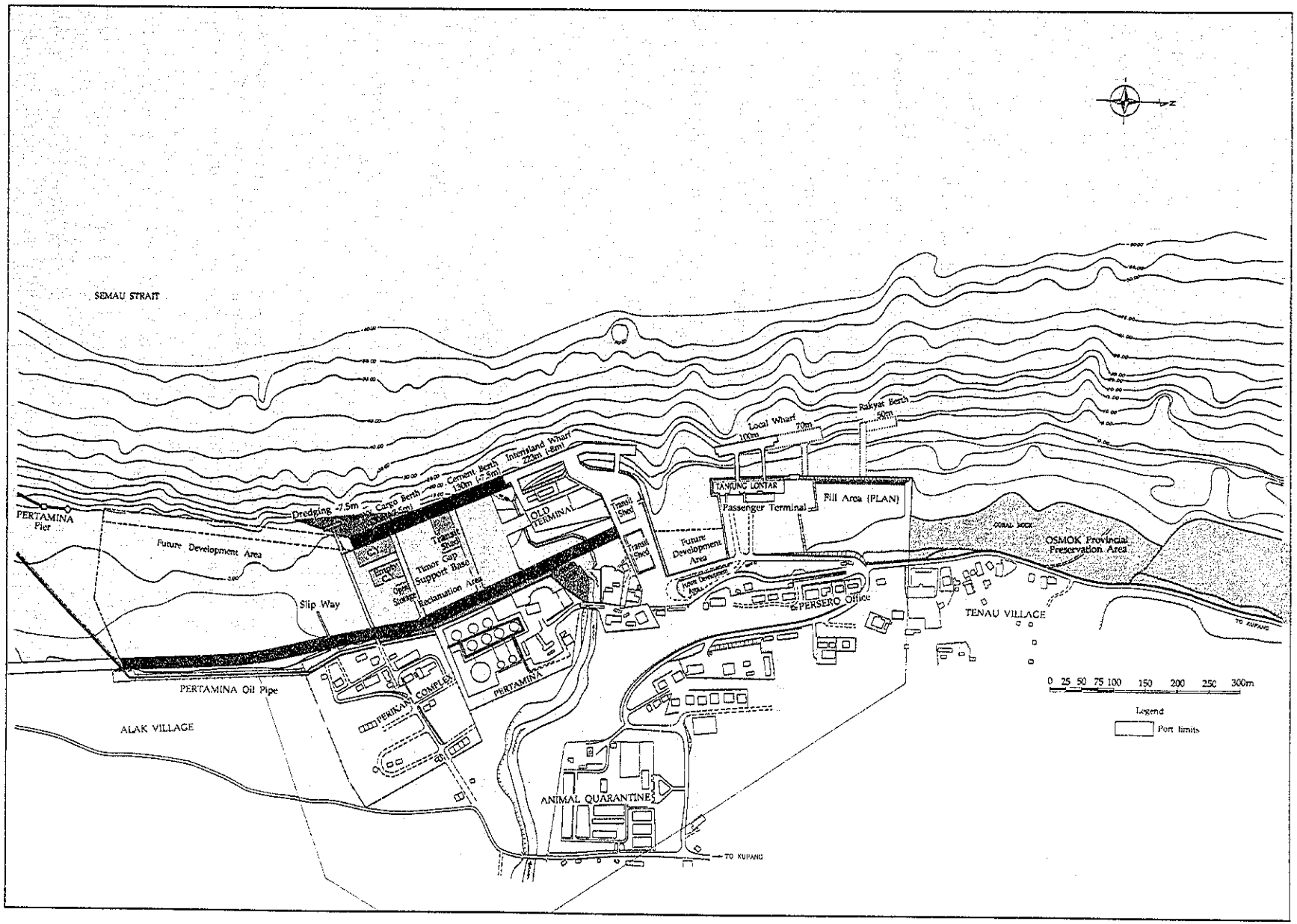

Figure 6-3 Kupang Port Development (Alternative 2)

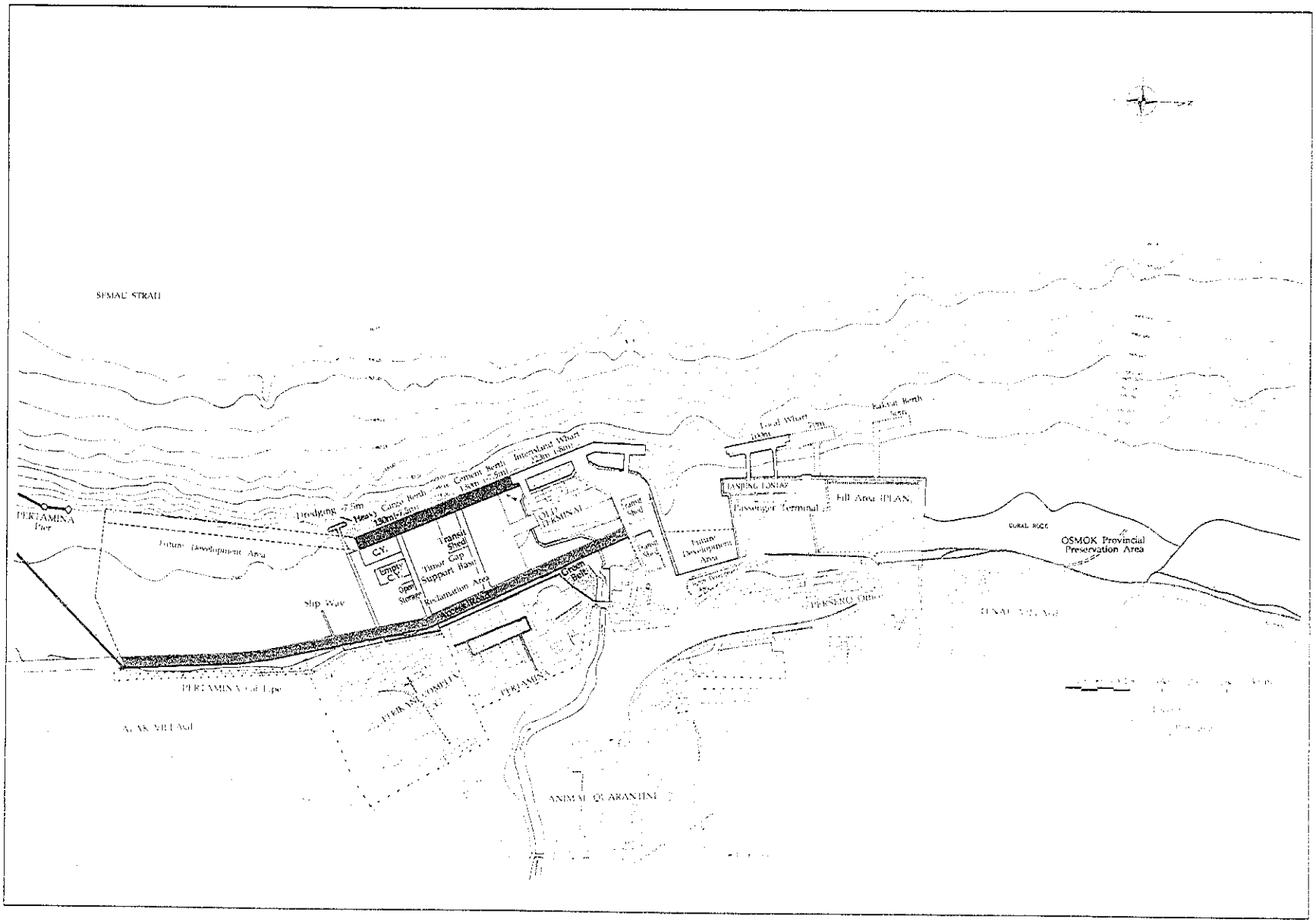

Figure 6-3 Kupang Port Development (Alternative 2)

G. Evaluation of Alternative Layout Plans

General

126. Each alternative has its inherent advantages and disadvantages. Therefore, it is very important to evaluate the alternative layout plans to select the optimum plan.

Alternative 1

127. Alternative 1 has the following inherent advantages;

(1) To maintain the water depth, it is not necessary to dredge the sea bottom which consists of dead coral. Above dredging contains many problems and requires much time and money according to past examples.

(2) Because there is no dredging, the impact to the water quality is small.

(3) By this reclamation, a large port land area will be required.

(4) It seems that the future expansion cost of this port also will be low because there is no dredging.

128. Alternative 1 has the following inherent disadvantage;

(1) The Cement Berth and the Heavy Cargo Berth bend, so it is difficult to use as a continuous berth.

(2) The lay of the reclamation area is distorted, so there is some dead space in this area.

Alternative 2

129. Alternative 2 has the following inherent advantages;

(1) The Cement Berth and the Heavy Cargo Berth can be used as a continuous berth.

(2) The lay of the reclamation area is quadrilateral, so there is little dead space in this area.

130. Alternative 2 has the following inherent disadvantages;

(1) To maintain the water depth, it is necessary to dredge the sea bottom which consists of dead coral. Above dredging contains many problems and requires much time and money according to past examples.

(2) The impact to the water quality is not small because of the above dredging.

(3) By this reclamation, the required area is smaller than Alternative 1.

(4) It seems that the future expansion cost of this port will be more expensive than Alternative 1 because of the dredging.

Conclusion

131. From the above observation, it is concluded that Alternative 1 is the more adequate layout plan for future development of this port.

H. Consideration of Degree of Calmness

Criterion of calmness

132. Generally, a mooring basin or anchorage for ships must be sufficiently calm to permit mooring or anchoring at least 95% of the year in front of the Wharf.

133. A limiting condition that allows ships to anchor or take up berth is chiefly determined by elements of wave height, which are to be established in accordance with the manners of use; and it is set at less than 0.3 m for small vessels of 1,000 G/T class, less than 0.5 m for medium sized ones between 1,000 G/T and 5,000 G/T class, and less than 0.7 m to 1.5 m for larger ones.

Degree of sheltering (Degree of calmness)

134. With Semau Island on the opposite shore as shown in Figure 6-4, Port of Kupang (Tenau) is not affected seriously by wind and waves since their influences are limited from NW to N and waves from other directions are not considered serious, judging from their fetches.

135. Table 6-1 shows the results of wave hindcasting at the said port based on the wind data collected during 1992.

136. Supposing the currently proposed berth is to be used for medium sized vessels, the limiting wave height is set at 0.5 m, occurrence frequency in excess of it is 2.2 per cent (2.2%), that is, 97.8 percent (98%) is a usable rate.

137. As a result, 95 percent (95%), the target during a year is attained; however, this degree of calmness will be decreased a little because the subject port may be subject to swells.

Table 6-1 Occurrence of Wave

Wind data ; Jan.1992 to Dec.1992
Observed ; 8784

Direction / Wave height(m)		S	SSW	SW	WSW	W	WNW	NW	NNW	N	Total
0.00～	No.										
0.09	%										
0.10～	No.	163	42	7	15	18	149	528	818	177	1,917
0.19	%	1.9	0.5	0.1	0.2	0.2	1.7	6.0	9.3	2.0	21.8
0.20～	No.	19	43	3	23	22	128	448	538	119	1,343
0.29	%	0.2	0.5	0	0.3	0.3	1.5	5.1	6.1	1.4	15.3
0.30～	No.		11	4	7	2	127	263	243	43	700
0.39	%		0.1	0.1	0.1	0	1.5	3.0	2.8	0.5	8.0
0.40～	No.			1	1	2	55	166	116	16	357
0.49	%			0	0	0	0.6	1.9	1.3	0.2	4.1
0.50～	No.						24	103	58	7	192
0.59	%						0.3	1.2	0.7	0.1	2.2
0.60～	No.						16	37	23	1	77
0.69	%						0.2	0.4	0.3	0	0.9
0.70～	No.						2	24	6	1	33
0.79	%						0	0.3	0.1	0	0.4
0.80～	No.						1	9	1		11
0.89	%						0	0.1	0		0.1
0.90～	No.							1			1
0.99	%							0			0
Total	No.	182	96	15	46	44	502	1,579	1,803	364	4,631
	%	2.1	1.1	0.2	0.5	0.5	5.7	18.0	20.5	4.1	52.7

Calm 4153
Nonrecord 0

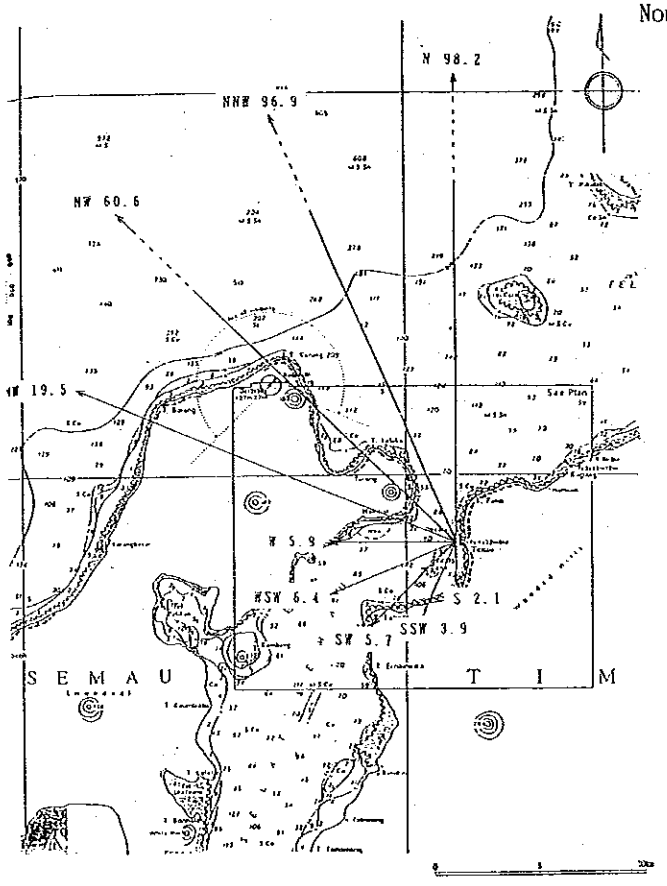

Figure 6-4 Wave Predicted Site and Fetch

I. Cargo Handling Equipment and Working Vessels

138. The Heavy Cargo Berth at the port of Kupang is expected to handle about 22,000 tons of containers in the year 2000. In addition, a total of 74,000 tons of general cargo will pass through this berth at the target year. It can be considered that some of them will be heavy cargoes, which may be related to industrial development projects.

139. There is no excess capability for heavy cargo or container handling at the port. Therefore, it is necessary for the port to acquire equipment to handle the said amount of containers and heavy cargoes in an efficient manner.

140. The new Cement Berth will accommodate coal carriers and cement carriers, and it is forecast that a total of 344,000 tons of cement or its related materials will pass through this berth. A specialized cement bag loader may be installed at this berth in order to achieve the expected loading efficiency. Furthermore, a belt conveyer may be installed to avoid traffic congestion by trucks. Since these kinds of equipment will be exclusively utilized by cement companies, procurement cost of this equipment is excluded from the project cost in this present study.

141. In the planning of container handling equipment, it is important to consider the whole cycle of container handling and storing at the container terminal.

142. The first decision that must be made concerns the capabilities and efficiencies of the equipment for loading and unloading cargo. It should be noted that container transportation at the port of Kupang in 2000 will still remain in the initial stage of development although rapid and steady traffic growth can be expected.

143. Containers to/from the port of Kupang will be transported by vessels with ship gears. Considering the planned number of TEUs at the port, it cannot be economically justified to install a container gantry crane for loading/unloading containers between a ship and the quay. It is generally said that the critical level for a single berth container terminal with a gantry crane is about 60,000 containers a year.

144. Observed container handling efficiency using a ship gear was sometimes in the neighborhood of 5 to 6 boxes per hour, which is considerably below the expected efficiency. Therefore, it is necessary to prepare a mobile crane at the quay side in the terminal. The mobile crane can be used to load and unload containers on ships and also to handle heavy loads in the terminal cargo handling areas.

145. The jib should be hinged sufficiently high to clear containers stacked on deck and to handle containers of all rows without any need to change on board. Container handling efficiency of a mobile crane is comparable to or a little less than that of a gantry crane.

146. The second decision concerns the selection of equipment for cargo handling areas. The work can be divided into three phases:

(a) Horizontal carriage of cargo
(b) Storage and stacking
(c) Delivery to and reception from shore transport

147. There are many kinds of equipment which can be used to move cargo horizontally such as trailers, front lift truck, side loader truck, carrier truck, reach stacker crane, mobile portal crane, straddle carrier, rubber tired and rail mounted gantries. Except the trailer and rubber tired or rail mounted gantry, all of the above machines can undertake stacking also.

148. In the case of machines combining moving and lifting, attention should be paid to their characteristics and efficient use; combination of trailer plus front lift truck is the most used initially, trailer plus reach stacker crane is gaining ground, and trailer plus straddle carrier is the most sophisticated and expensive.

149. Considering the volume of container traffic at the target year and versatility of equipment, following machines can be proposed to handle containers and heavy duty cargo at the Heavy Cargo Berth.

1. Heavy duty mobile crane (50t)	1 unit
2. Forklift trucks (24t)	1
3. Forklift trucks for vanning/devanning(2t)	1

150. In addition, procurement of the following floating craft is recommended to secure safety and efficiency of the port operation:

(a) Tug	(2 x 400 HP)	1 unit

J. Direction of Further Development

151. One of the advantages of the port of Kupang is that the port has sufficient development space even after the proposed berths are saturated. The port can utilize the water area between the proposed Heavy Cargo Berth and existing Pertamina jetty for ship maneuvering and cargo handling/stocking by reclamation.

152. Characteristics of this site are basically the same as those of the proposed development site in this study. The water basin is well protected from high waves by Semau Island and is calmer than the existing port site (Tenau). Reclamation cost will not be high because of shallowness of the seabed. Sufficient water depth to accommodate larger vessels can be obtained without heavy burden off the coral edge.

153. The Port of Kupang has good potential for future development of port facilities. In other words, this water area between the existing port facilities and the Pertamina jetty is crucial for the economic development of NTT, and sprawl of both land use and water area use should not be allowed. This coastal area should be preserved until time for port development is matured.

154. South of the existing Tenau port has been designated as a nature reserve area and physical development of this area is strictly limited. Consideration should be given, however, regarding how to move containers between Tenau port and downtown Kupang. The existing road is so narrow, winding, and steep that transportation of containers is troublesome. In future, handling and transportation of 40-foot containers may be an issue for the port of Bitung. Careful reexamination about possible adverse environmental effects and economic benefits will be required in the future stage.

Chapter 7 DESIGN OF THE MAJOR PORT STRUCTURE

A. Basic Design Principles

Points to be considered in design

1. In the master plan for development of the port of Kupang (Tenau), a heavy/general cargo wharf is proposed to be constructed as the major port structure to handle mainly inward cargo including plant, equipment and materials for accelerating the industrialization in the region. The port structure should be of a rigid type which can bear the surcharge and other cargos unloaded onto the structure, as well as the vehicle loads of mobile cranes and trailers carrying these heavy cargos.

2. Kupang area is within the Seismic Zone II with earthquake factor of 0.09g and a heavy earthquake struck this area in December 1992. Seabed in the port area is covered with a surface layer of loose sand with thickness of 15 m. Accordingly, the proposed port structure should be of an earthquake-resistant type and so designed as to prevent the foundation settlement.

3. Seabed with gentle slope extends to the point 150 m offshore from the shoreline where the water depth is 5 m, and from this point the seabed is steepened at a slope of 1:2.5. The heavy cargo berth and cement berth are planned to have a depth alongside of 10 m and to accommodate the cargo ships of 5,000 DWT class. In designing the wharf, the said natural seabed configuration should be considered to ensure the economic construction works.

Points to be considered in selection of construction method

4. Dangerous cargos are handled at oil product unloading pier of Pertamina located south of the old terminal of Kupang Port. During the construction of the proposed port structure, execution of offshore works around this oil pier will be limited during the dangerous cargo handling operations. Accordingly, this factor should be considered in working out the construction schedule of the port structure.

5. Locally produced materials should be used in the construction works to the maximum extent, and the construction method that is widely adopted and ensures possible the early completion of the works should be selected. Selection of such a construction method as will require special technique or special constructional plant should be avoided in any case.

6. To minimize the offshore works which may delay the construction works, precast members manufactured on land should be used to the maximum extent possible.

7. Due attention should be paid to the environmental aspect and proper countermeasures should be taken to avoid sea water pollution by effluence of filling materials from the reclaimed area and waste oil from the floating equipment used during the construction works.

B. Port Facilities to be Designed

Cement Berth

8. Facilities comprising Cement Berth will be as follows:

Cement Berth:	Main pier
Yard:	Transit shed Revetment Roadways of terminal Access road

9. Cement Berth is planned to be constructed adjacent to the existing pier as shown in Figure 7-1 and used for forwarding bagged cement and discharging powdered cement.

10. The berth will allow 5,000 DWT class cargo ships to directly berth. The length of Cement Berth will be 130m and depth alongside -7.5m with the 20m wide apron on which such cargo-handling vehicles as trucks and forklifts will pass.

11. A transit shed will be constructed in the yard to serve as a transit point for bagged cement.

12. The river running along the side of the old terminal will be renovated into an open channel of 30m, in width, which is a necessary width to keep the velocity of flow less than 0.5 kt. at the berth lest the flow should affect moored ships and facilitate proper maintenance of the channel at the same time.

13. A bridge with a 20m span will be constructed to allow the access road to cross the open channel. In addition, a connecting bridge will also be constructed to directly connect the cement berth to the old terminal.

Heavy Cargo Berth

14. Facilities comprising the heavy cargo berth will be as shown in Figure 7-1:

Heavy Cargo Berth:	Main pier
Container yard:	Stacking yard Open storage Roadways of the yard Revetment Access road Support base

15. At Heavy Cargo Berth, containerized cargo will also be handled in addition to handling of such heavy cargoes as an oil drilling rig. The berth will allow 5,000 DWT class cargo ships to directly berth. The length of the berth will be 130m and depth alongside -7.5m with the 20m wide apron.

16. A container stacking yard and an open storage yard where heavy cargoes will be temporarily stored will be constructed in the yard.

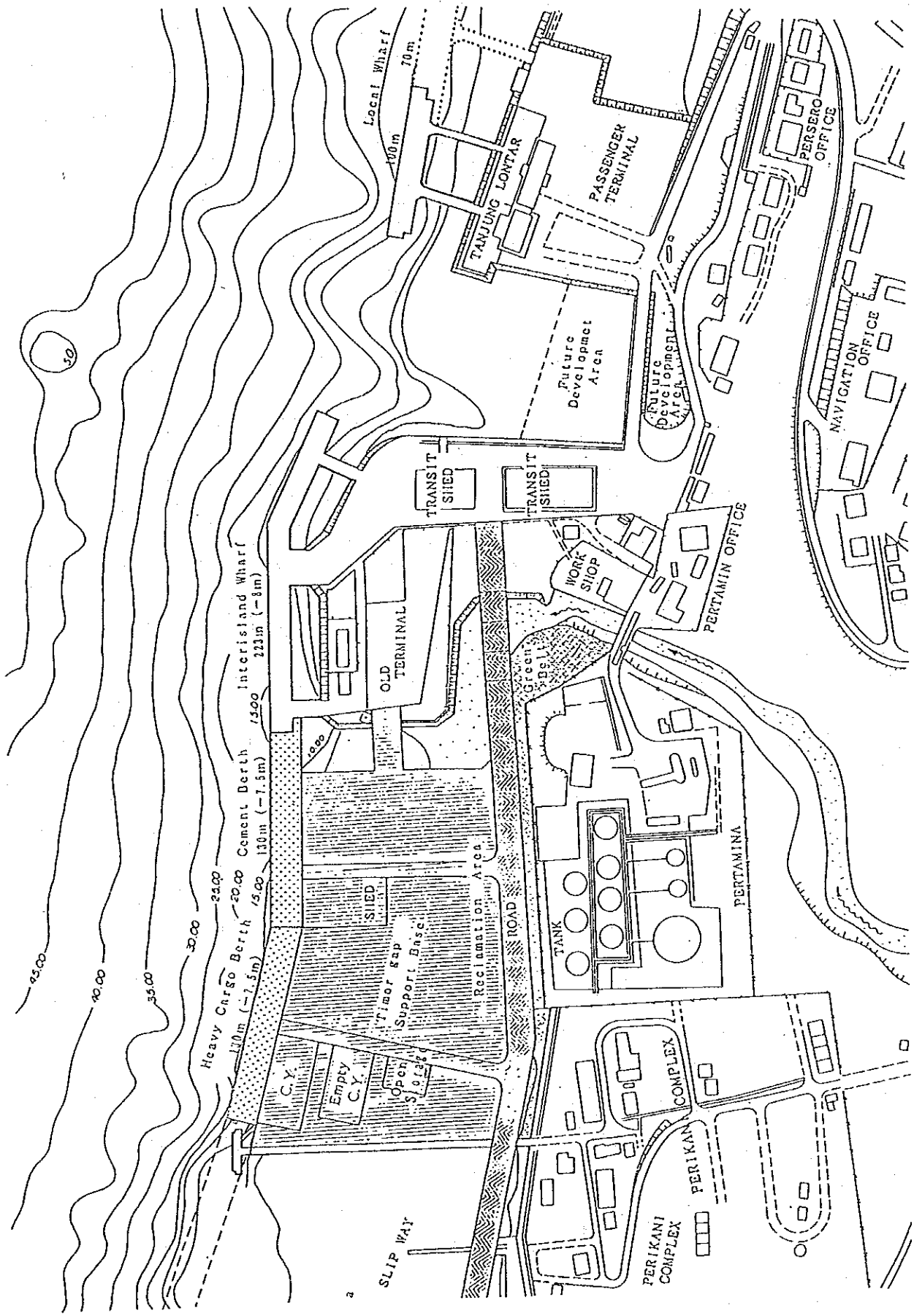

Figure 7-1 Arrangement of Port Facilities

17. A part of the reclaimed site will be utilized as the Timor Gas Support Base.

18. The peripheral revetment will be constructed only as the retaining revetment in the rear of the pier. As for the southern side of the pier, the existing masonry walkway to the Fishery Jetty will be utilized as it is to function as the revetment.

19. An access road having two lanes, each 6m wide, will be constructed by partly reclaiming land from the sea along the seashore.

C. Selection of Structural Types

Cement Berth

20. In Kupang port area, a shallow coral reef extends to a distance of 150m offshore from the shoreline where the water depth suddenly increased from 5m to 10m. Since the berth face line lies on this line of sudden depth change, the type of berth structure is necessarily limited.

21. In addition, just under the surface layer of coral fragments, a loose sand bed lies. Hence, it is uneconomical to try to improve these unfavorable geological features.

22. From the above study, it seems that the pier type with pile foundations does match the actual conditions. Nonetheless, it is still necessary to take certain measures to secure the load bearing capacity. This is because a limestone bed which is the load bearing layer occurs at a limited depth.

23. A PC girder bridge will be constructed to allow the access road to cross the river. The length of the bridge is taken as 20m to facilitate smooth passage of floating bulky debris.

Heavy Cargo Berth

24. Heavy Cargo Berth adjacent to Cement Berth shares the same foundation ground with Cement Berth. The same structural type as Cement Berth, i.e. the pier type with pile foundations, will also be selected for this berth.

D. Design Conditions

Tide level and water depth

25. The tidal levels at Kupang port are as follows:

High water level: +1.70m

Low water level: ±0.00m

26. The water depth alongside Cement and Heavy Cargo berths are taken as shown below:

	Original seabed (m)	Required depth (m)	Design depth (m)
Cement Berth	-8.0 to -15	-7.5	Original sea bed
Heavy Cargo Berth	-8.0 to -18	-7.5	-Ditto-

Berth elevation

27. The berth elevation is taken as +3.50m in accordance with the Design Criteria, which is obtained by adding an estimated additional height of 1.8m to the tidal range of 1.7m at Kupang port. This berth elevation is the same as the existing berths.

Soil condition

28. The seabed geological conditions of both berths are the same.

-8.0 ~ -18.0 Original seabed
Sand with gravel and coral (Loose)

-27.0
N=10
Limestone (Hard)
N>50

Ship dimension

29. The berth should be able to accommodate 5,000 DWT class ship:

Length (OA):	108.0m
Breadth (mld):	17.0m
Depth:	8.5m
Draft (mld):	6.5m
Displacement:	7,900 ton

Design load

30. The seismic coefficient is taken as follows in accordance with the Design Criteria of DGSC.

Regional seismic coefficient: 0.09
(Kupang port: Zone II, soft soil)

Coefficient of importance: 1.5

Thus

Design seismic coefficient k = 0.09 x 1.5 = 0.15

31. Uniform load which will be imposed on the surface of the pier is taken as 3.0 t/m^2 in accordance with the Section, Heavy Cargo Berth, of the Design Criteria. For earthquakes, it is increased by 50% to 1.5 t/m^2.

32. Live load is taken as follows based on the planned cargo-handling equipment:

(1) Cement Berth

Truck load		max. 10t per wheel

(2) Heavy Cargo Berth

Mobil crane	50t Hoist	max. 50t per outrigger
Heavy unit load		max. 50t

33. Load to be imposed on the container yard is taken as follows:

Loaded container: three-high stacking Wc = 4.0 t/m^2

34. Berthing velocity of ship

For the berthing velocity of 5,000 DWT class ship, V = 15 cm/sec is taken.

Design criteria and conditions

35. The following are the design criteria and conditions to be considered in designing the major port structure:

(a) Standard Design Criteria for Ports in Indonesia published by the Directorate General of Sea Communications, Ministry of Communications;

(b) Peraturan Beton Bertulang Indonesia 1971 (Indonesian Regulations Concerning Reinforced Concrete 1971) published by the Directorate General of Works Development, Ministry of Public Works and Electric Power;

(c) Peraturan Perencanaan Bangunan Baja Indonesia 1984 (Indonesian Regulations Concerning Steel Structure Planning 1984) published by the Institute of Construction Problems Investigation;

(d) Peraturan Muatan Indonesia 1970 (Indonesian Regulations Concerning Loading 1970) published by the Directorate General of Works Development, Ministry of Public Works and Electric Power;

(e) Peraturan Perencanaan Geometrik Jalan Raya (Indonesian Regulations Concerning Geometric Planning of Highways) published by the Directorate General of Highways, Ministry of Public Works;

(f) Technical Standards for Port and Harbour Facilities in Japan 1988 published by Bureau of Ports and Harbour, Ministry of Transport.

E. Preliminary Design of the Port Facilities

Cement Berth

36. Figure 7-2 shows the standard cross section of the main pier of Cement Berth. Since the water under the face line of the pier is deep and moreover a hard limestone bed occurs at a limited depth, the limestone bed should be drilled prior to pile driving, if necessary depending on the actual situations.

37. A drilling hole should be opened slightly smaller than the pile diameter so that the load bearing capacity can be obtained by driving piles through it. In this case, the driving frequency will increase with possible damage to PC piles, if used. For that reason, steel pipe piles will be used for this berth.

38. Since the surface of the pier will be used for the passage of heavy trucks loaded with bagged cement, a rigid structure should be adopted for the pier. Reinforced concrete will be used for the coping concrete which is to be laid in situ. It will be surfaced with concrete pavement at a slope of 1%.

39. The retaining revetment in the rear of the pier will be constructed by transporting by sea L type blocks prefabricated on the land and installing them at the site. The slope face will be protected by armor stones.

40. As shown in Figure 7-3, the masonry revetment will be used for the reclamation revetment of the yard. Figure 7-4 shows the pavement of the yard.

41. Figure 7-4 shows the access road having two lanes, each 6m wide, with a median strip and sidewalks. The overall width will be 17m.

42. Figure 7-5 shows the bridge constructed to allow the access road to cross the river. The bridge will be provided with PC beams and will have mass concrete piers to protect them from damage which may be done by floating bulky debris.

Heavy Cargo Berth

43. A 50t mobile crane will be installed on the main pier and moreover heavy cargoes and containerized cargo will be placed on it. Hence, the main pier should be designed in such a way that it can adequately withstand these loads. Dimensions are the same as the cement berth. Figure 7-6 shows the standard cross section of Heavy Cargo Berth.

44. The container yard pavement should be such that it can withstand three-high stacking of stuffed containers and unit loads of 50 tons.

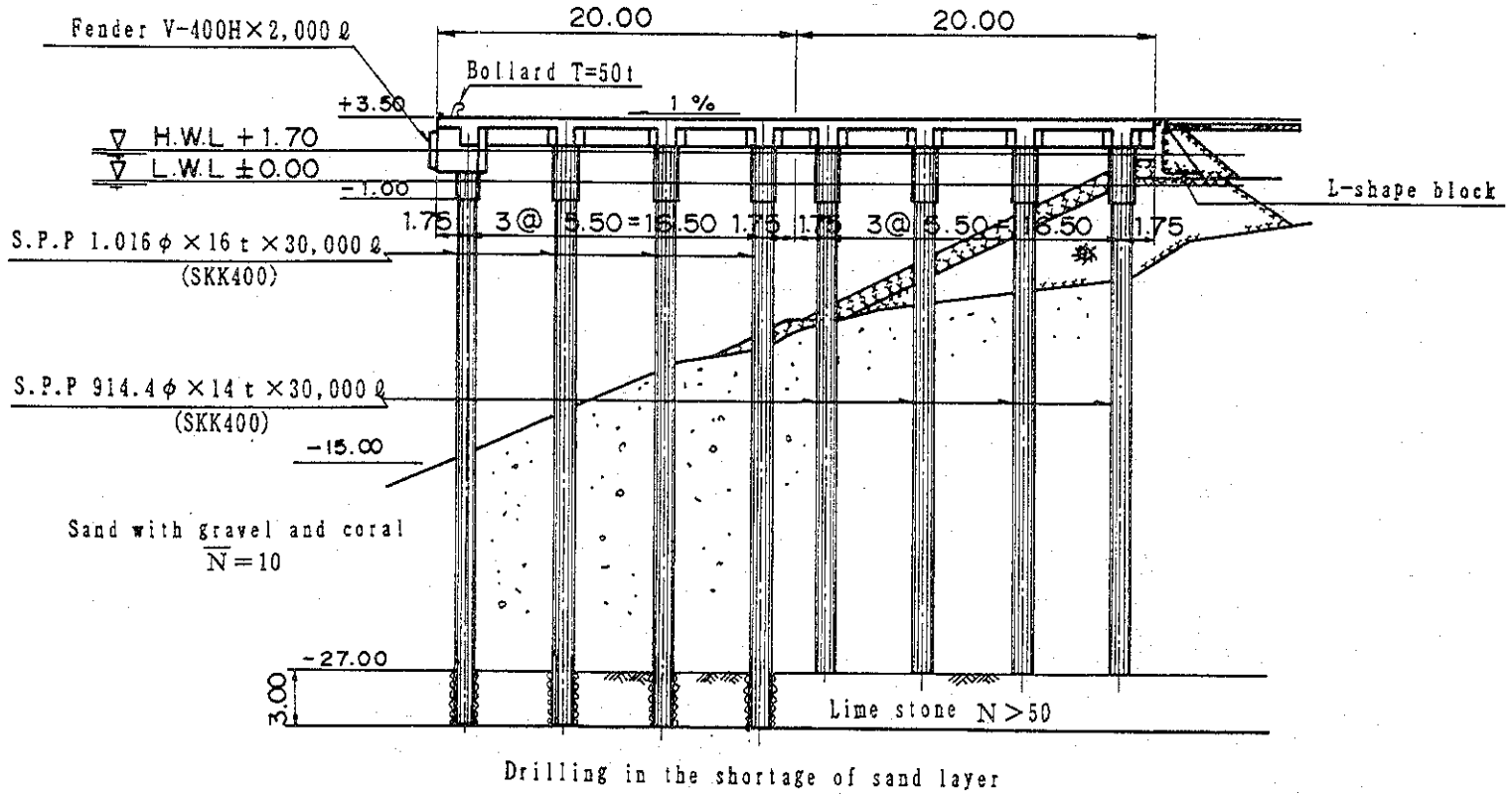

Figure 7-2 Standard Cross Section of Cement Berth

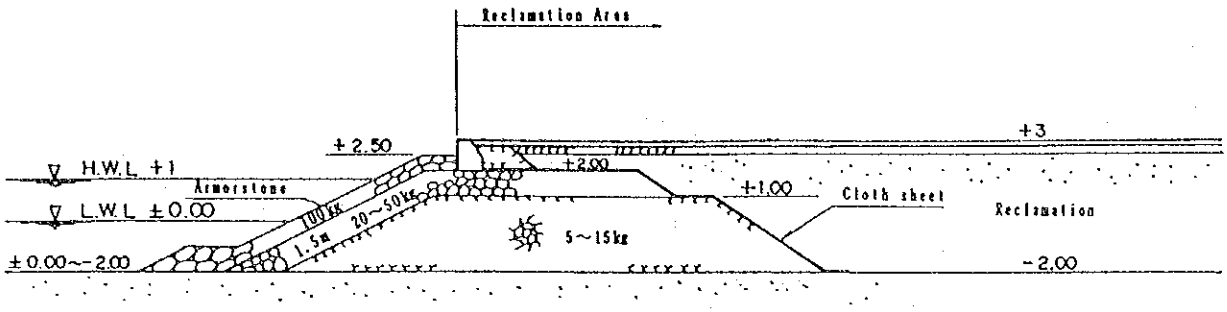

Figure 7-3 Section of Revetment for Reclamation

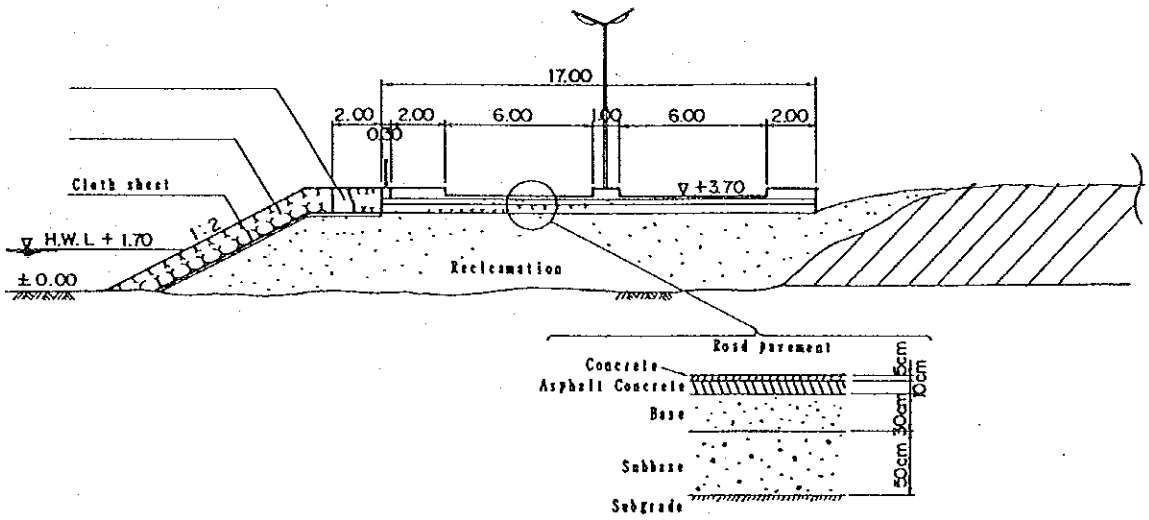

Figure 7-4 Section of Access road

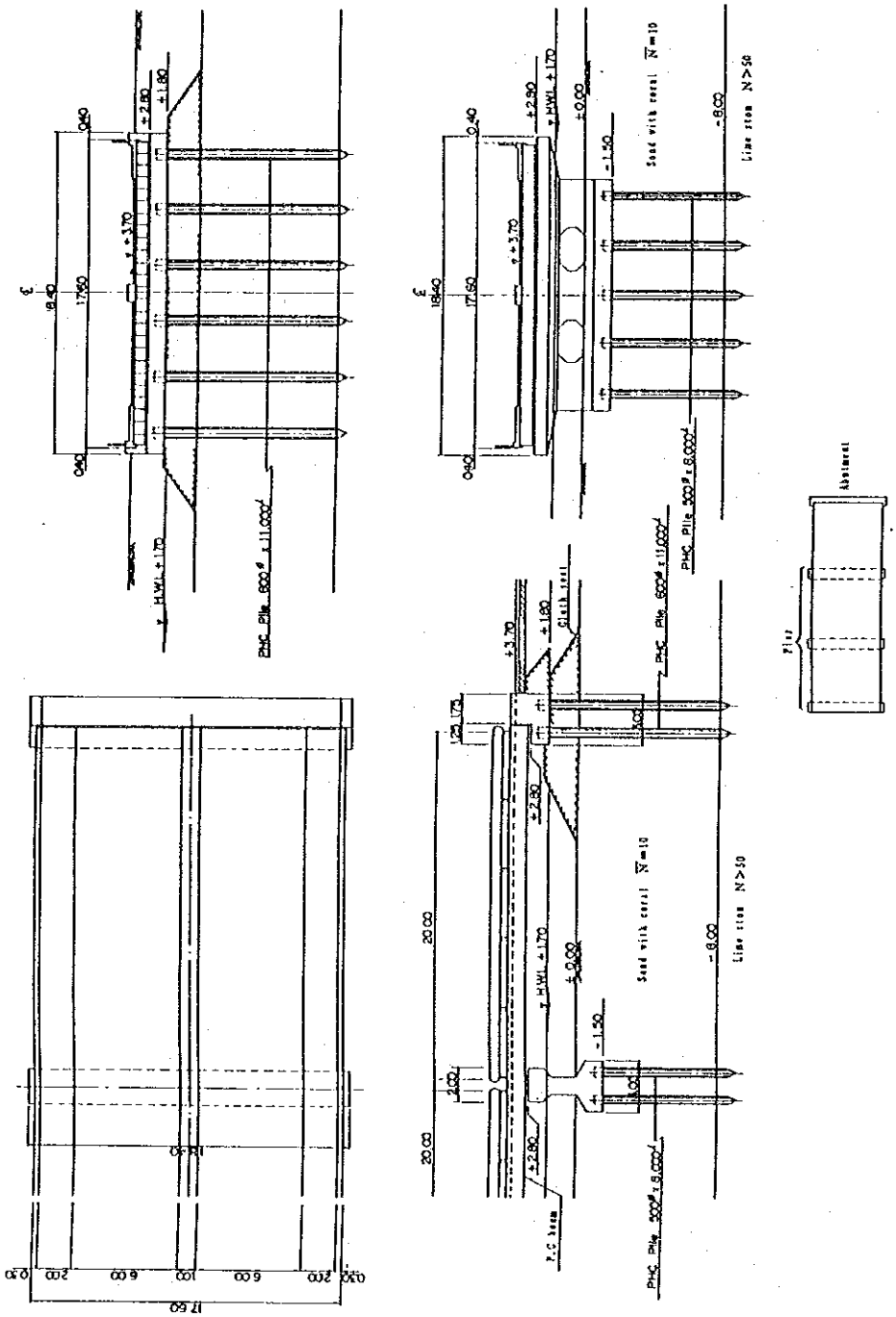

Figure 7-5 Bridge in Access Road

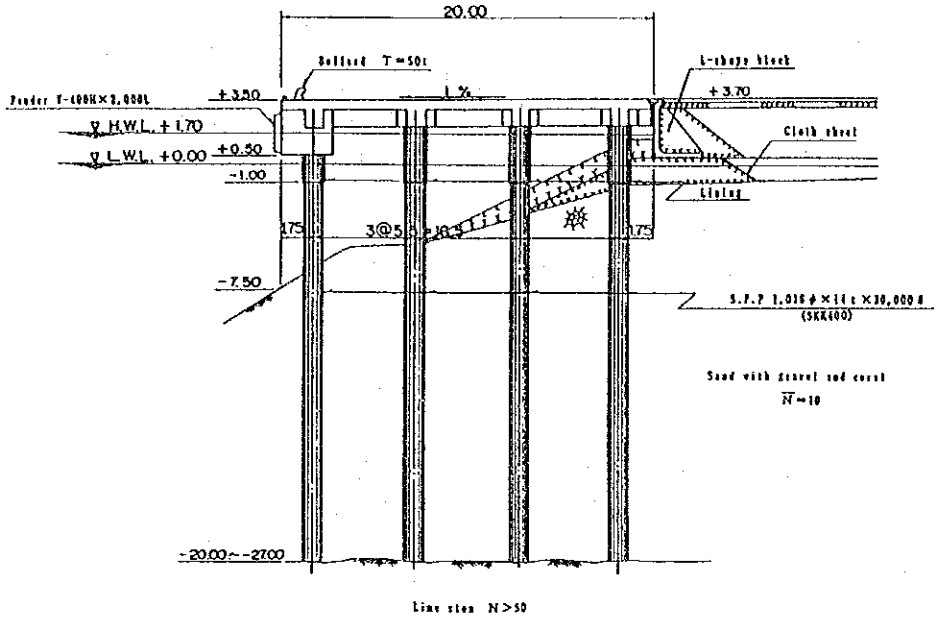

Figure 7-6 Standard Cross Section of Heavy Cargo Berth

Chapter 8 COST ESTIMATE AND CONSTRUCTION SCHEDULE

A. Basic Conditions for Cost Estimation

1. Basic prices of materials, labor, work crafts, equipment, etc. to be used for estimation of the construction cost are those obtained by the JICA survey team in December, 1992 and adjusted to reflect subsequent price hikes.

2. To adjust the basic prices, the price list published in Jakarta in July, 1993 and that published in the Province of NTT are used and moreover reference is made to the unit prices used for the construction cost estimates for the Semarang Port container terminal in the Province of Central Java. Accordingly, the basic unit prices are as of May, 1993.

3. The construction cost is divided into the local currency portion and the foreign currency portion. The applicable currency exchange rates are as follows:

US$1.00 = Rp2,083 = ¥105.47 (¥1 = Rp19.75)

4. For the physical contingency, ten percent (10%) for the local currency portion and five percent (5%) for the foreign currency portion are allowed in respect of the direct costs of the civil and building works as well as the total procurement costs of cargo-handling equipment and craft, costs of engineering service.

5. For the cost of engineering service (detail design and supervision), ten percent (10%) of the direct costs of the civil and building works is allowed and the cost is divided into thirty percent (30%) for the local currency portion and seventy percent (70%) for the foreign currency portion.

6. Value Added Tax (VAT) is indicated in the amount equivalent to ten percent (10%) of the sum of the direct cost of civil and building works, equipment procurement cost, craft cost, physical contingency and engineering service fee.

7. The rise in prices in future is not taken into consideration.

B. Result of the Cost Estimation

Basic price

8. The basic prices and hiring charges for construction equipment used for the cost estimation are shown in Appendix 8-1.

In the Appendix, (1) shows unit costs of labor charge, (2) the unit prices of major materials, and (3) construction equipment hiring charges per day.

9. Import items that represent the foreign currency portion are shown in (4) of the Table. The prices of these import items are the CIF Jakarta prices which are inclusive of roughly estimated import duties.

10. The method of cost estimation is based on the following standards:

- Cost Estimation Standard for Civil Works for Construction of Port Facilities compiled by the Bureau of Ports and Harbours, Ministry of Transport, Japanese Government.

- Analisa Upah dan Bahan (Labor Wage and Material Cost Analysis).

11. Table 8-1, 8-2 show the details of the cost estimation. From the Table the following is known:

Cement Berth: Rp 21,451 million

Heavy Cargo Berth: Rp 18,346 million

C. Preliminary Study of Construction Procedure

Cement Berth

12. The main pier of Cement Berth will be constructed next to the existing Interisland Wharf. The water at the connecting part with this existing wharf is deep (-18m) and a limestone bed occurs at a limited depth.

13. Depending upon the actual conditions, the limestone bed should be drilled prior to pile driving. The drilling works will constitute a critical path. On average, 2m of rock drilling is planned and thus the drilling capacity will be one hole per day and piling capacity 1.5 piles per day.

14. As for the revetment on the open channel side, the slope of the masonry revetment should be made steep in order to increase the cross section of the channel. In addition, this masonry revetment should be solidified with cement.

15. To construct the pier of the access road bridge crossing the channel, it is indispensable to carry out pile driving and dredging only during the dry season when the channel discharge is relatively low.

16. Reclamation is planned to be used for the materials from land. However, since the road is narrow at the planned construction site, it is necessary to contruct a temporary construction road in advance.

Heavy Cargo Berth

17. The structure of the main pier is the same as Cement Berth. However, in view of the rather deep limestone bed, it is desirable that the necessity of drilling should be fully evaluated in advance.

18. Since heavy cargos will be placed on the open storage, it should be paved with concrete after the loose foundation ground is well compacted.

19. The access road along the seashore should be constructed firmly after the site is well prepared so as to ensure unobstructed passage of heavy-duty vehicular traffic.

Table 8-1 Construction Cost of Cement Berth

unit ; million Rupia

Construction Item	Works	Quantity	unit	Total Cost	Total LC	Total FC	1st year Cost	1st year LC	1st year FC	2nd year Cost	2nd year LC	2nd year FC	3rd year Cost	3rd year LC	3rd year FC
I. Direct Cost				15,136.1	14,724.8	411.3				9,408.6	9,408.6		5,727.5	5,316.2	411.3
I-1. Mobilization and Preparation				675.0	675.0					675.0	675.0				
I-2. Reclamation	Revetment	240	m	971.9	971.9					971.9	971.9				
	Reclamation	64,000	m²	458.2	458.2					458.2	458.2				
I-3. Cement Berth	Main Pier	2,600	m²	6,838.4	6,838.4					6,838.4	6,838.4				
	Trestle Pier	510	m²	465.1	465.1					465.1	465.1				
	Yard	3,000	m²	303.1	303.1								303.1	303.1	
	Miscellaneous	1	L	1,832.5	1,421.2	411.3							1,832.5	1,421.2	411.3
	Road	450	m	3,591.9	3,591.9								3,591.9	3,591.9	
II. Craft		1	L	1,145.5	1,145.5								1,145.5	1,145.5	
III. Engineering and Supervision		1	L	1,513.6	454.0	1,059.6	756.8	227.0	529.8	378.4	113.5	264.9	378.4	113.5	264.9
IV. Physical Contingency		1	L	1,706.0	1,632.4	73.5	49.2	22.7	26.5	965.4	952.2	13.2	691.3	657.5	33.8
V. VAT		1	L	1,950.2	1,950.2		80.6	80.6		1,075.3	1,075.3		794.3	794.3	
Grand Total				21,451.4	19,906.9	1,544.4	886.6	330.3	556.3	11,827.7	11,549.6	278.1	8,737.0	8,027.0	710.0

Table 8-2 Construction Cost of Heavy Cargo Berth

unit : million Rupia

Construction Item	Works	Quantity	unit	Total Cost	Total LC	Total FC	1st year Cost	1st year LC	1st year FC	2nd year Cost	2nd year LC	2nd year FC	3rd year Cost	3rd year LC	3rd year FC
I. Direct Cost				10,848.1	10,436.8	411.3				6,744.6	6,744.6		4,103.5	3,692.2	411.3
I-1. Mobilization and Preparation		1	L	675.0	675.0					675.0	675.0				
I-2. Reclamation	Revetment	145	m	290.5	290.5					290.5	290.5				
	Reclamation	96,000	m³	687.4	687.4					687.4	687.4				
I-3. Heavy Cargo Berth	Main Pier	2,600	m²	5,091.7	5,091.7					5,091.7	5,091.7				
	Container Yard	5,000	m²	479.6	479.6								479.6	479.6	
	Miscellaneous	1	L	1,603.5	1,192.2	411.3							1,603.5	1,192.2	411.3
	Road	450	m	2,020.4	2,020.4								2,020.4	2,020.4	
II. Equipment gnd Craft		1	L	3,372.7	1,384.1	1,988.6							3,372.7	1,384.1	1,988.6
III. Engineering and Supervision		1	L	1,084.8	325.5	759.3	542.4	162.7	379.7	271.2	81.4	189.8	271.2	81.4	189.8
IV. Physical Contingency		1	L	1,372.7	1,214.7	158.0	35.3	16.3	19.0	692.1	682.6	9.5	645.3	515.8	129.5
V. VAT		1	L	1,667.9	1,667.9		57.8	57.8		770.8	770.8		839.3	839.3	
Grand Total				18,346.2	15,029.0	3,317.2	635.5	236.8	398.7	8,478.7	8,279.4	199.3	9,232.0	6,512.8	2,719.2

D. Construction schedule

20. The planned construction site is extremely calm during the dry season. However, during the rainy season, construction works may be greatly hampered by waves, swells, and winds.

21. As for the piling operations in particular, the key point is that they should be carried out at a stretch in the calm season.

According to the estimated construction schedule which is prepared on the assumption that the construction works are to be executed only during the favorable seasons, it takes two years respectively to complete both berths.

22. Figure 8-1 shows the construction schedule of Heavy Cargo Berth and Cement Berth. As is known from the Figure, the first year will be taken up by engineering such administrative procedures and thus construction works are to be executed in the second and third years. The progress of the works will be such that the pier will be constructed in the starting year of the construction works and the yard and roads in the following year.

23. The construction cost of Local Berth and Rakyat Berth which should be excluded in this new project is shown in Appendix 8-2.

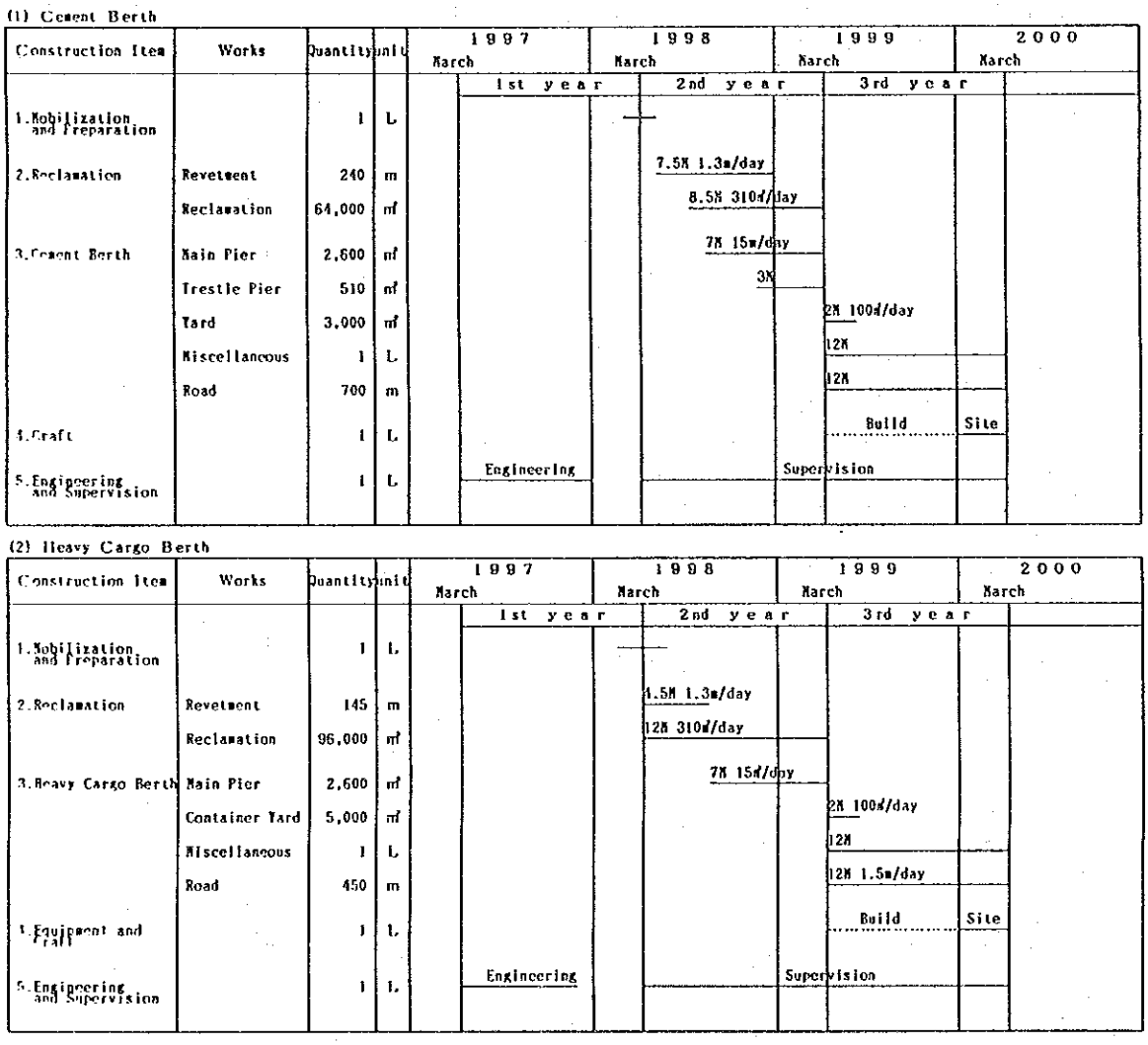

Figure 8-1 Construction Schedule

Chapter 9 ENVIRONMENTAL IMPACT ASSESSMENT

A. Basic Procedure of Environmental Impact Assessment

General

1. Environmental Impact Assessment (EIA) concerning the port development of Kupang is based on the following regulations in principle.

a) Government Regulation No.29, 1986 regarding the Analysis of Impact upon the Environment
b) Technical Guidance for Environmental Impact Analysis on Harbor Affairs (MOC, 1990)

2. Above regulations do not describe the detailed method of EIA regarding the feasibility study. Therefore, JICA study team adopts some of the international EIA technical guide-lines to this study.

3. In this study, JICA study team carried out the EIA according to the following stages.

a) Port construction stage
b) Port existence stage (Operations have not yet begun)
c) Port utilization stage

4. The assessment year of EIA in this study is 2000 (excluding Port construction stage) and the target area is as follows. The environmental impact source exist inside of the port area.

a) The land area is Kupang regency
b) The water area is waterfront of Kupang regency

Methodology of EIA

5. The EIA procedure in this study is shown in Figure 9-1. The summarized procedure of EIA is as follows.

a) Select the environmental impact elements by the port development and make the matrix of relation between the environmental impact elements and the environmental constituent factors.
b) Evaluate the present environmental condition using the existing data and results of field survey.
c) Establish the target of environmental preservation.
d) Estimate the change of the environmental constituent factors by the port development.
e) Investigate the countermeasures for environmental preservation.
f) Carry out the assessment by above conditions.

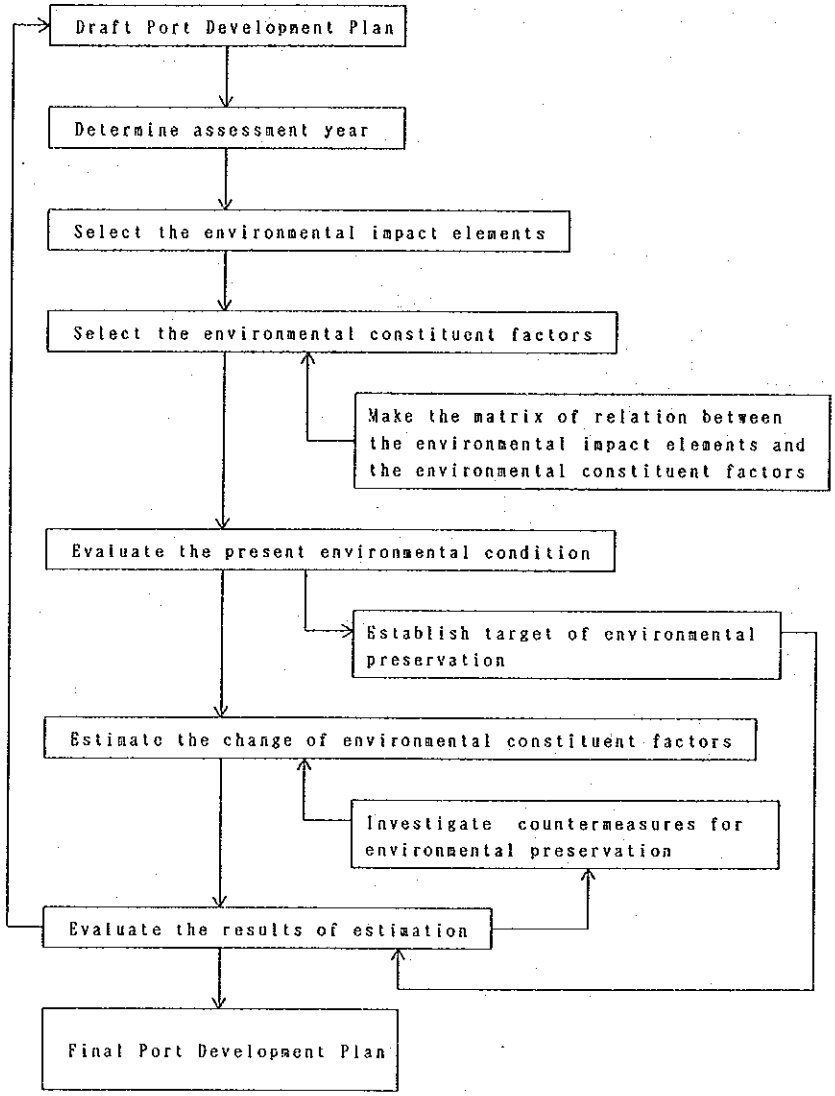

Figure 9-1 Flow-Chart of EIA

6. The relation between the environmental impact elements and the environmental constituent factors is shown in Table 9-1. According to this Table, the environmental impact assessment items were selected.

Table 9-1 Relationship between Environmental Impact Factors and Environmental Components

	Air Qty.	W/B cndns.	Nse/ Vibn.	Odor	Topo-graphy	Cstl Hyd	Fauna/ Flora	Scenic View	Wste	Scio-cltr.	Scio-econ.	Remarks
Construction works	o	o	o	o			o		o	o	o	
Existence of Port Facilities and Site		o			o	o	o	o		o	o	
Use of Water-area Facilities and Wharves	o	o			o		o		o		o	
Operation of Loading, Storage, Movable Facilities	o	o	o	o			o		o		o	
Operation of Facilities Handling Hazardous Wastes	o	o		o			o				o	
Operation of Waste Treatment and Disposal	o	o		o			o		o	o		
Traffic Functions	o		o				o			o	o	
Operation of Distribution and Storage Functions	o		o	o							o	

Note: Each environmental component has the following paticulars:

Air Qty = Air quality:	sulfur oxides, nitrogen oxides, carbon monoxide, hydrocarbon, dust, fluoride and other hazardous objects
W cndns = Water condition:	chemical oxygen demand(COD), nitrogen, phosphorus, dissolved oxygen, therma) discharge, grease, hazardous object, pH, suspended solid(SS)
B cndns = Bottom condition:	COD, ignition loss, sulfide, hazardous objects
Nse/Vibn = Noise/Vibration:	noise, vibration
Odor:	hydrogen sulfide, methyl mercaptan, methyl sulfide, ammonia, methyl disulfide, trimethylamine, acetaldehyde, styrene
Topography:	littoral drift, ground subsidence, groundwater hydrology
Cstl hyd = Coastal hydrology:	waves, currents
Fauna and Flora:	(aquatic) bacteria, plankton, weeds, attached organisms, benthic animals, coral, fishery resources, (terrestrial) birds on beaches, other animals and plants, mangroves
Scenic view:	scenic view
Wate = Waste:	municipal common wastes, industrial wastes
Scio-Cltr = Socio-culture:	resettlement of residents, local population distribution, cultual assets (historical, religious, academic), racial composition, communication
Scio-Econ = Socio-economy:	employment, fisheries, land use(agriculture, forestry, industry and mining), tertiary industry(including tourism, recreational facilities), local transport network, sanitation

7. Assessment method for this study was determined by the present environmental conditions around the port and the port development plan of this port. Based on the above conditions, "Impact Grasping Method" was applied as the assessment method in this study. This method tries to determine the magnitude of impacts of port development on the present environment in the hinterland in comparison with impacts from other causes. If the impact from the port development is determined to be small, then impacts of port development would not be subject to further examination.

8. In general, "Tidal current" and "Water quality" are the major environmental constituent factors likely to be affected by port development and reclamation. In this present study, therefore, computer simulation technique will be applied to investigate possible magnitude of environmental impact regarding these environmental constituent factors by the proposed port development project.

B. Impact Assessment of Construction Works

Presupposition of estimates

9. Based on the design of port structure, construction method and construction schedule which are described in Chapter 7 and 8, the impact assessment of construction works was carried out. The present socio-economic, natural and environmental conditions are based on Chapter 2 and 3.

10. There are little existing environmental monitoring data, in spite of the fact that the Indonesian government does have some regulations regarding the environment. Therefore, in this study, the target of environmental preservation was established as follows;

" The impact to environment will be permissibly small. "

Air quality

11. In general, the major pollutants generated by port construction works are dust and gases. The primary sources of dust are construction works and road traffic. Gas emissions are produced by work boats and construction machinery. Smoke, soot, fumes and vapors are also generated by work vessels.

12. Air pollution caused by construction works is a temporary impact during the construction period. In general, the scale of impact is smaller than that of industrial activities. The diffusion area of air pollutants caused by construction machinery is limited, because the altitude of the generation source regarding air pollution is low, so air pollutants are diffused and diluted by air current of the earth's surface. Therefore, it seems generally that the impact area stretches less than a hundred meters from the construction site.

13. In this case, the scale of construction works is not so large and the construction site is inside of the port area. Furthermore, the distance between the major construction site and residential areas is more than eight hundred meters. Based on the above conditions, it seems that the impact to the air quality will be limited, so air quality around Kupang port during the construction period will be the same as the present air quality.

Water quality

14. A major indicator of water pollution caused by construction works is Suspended Solid (SS). The primary sources of SS are dredging and reclamation work.

15. An increase of suspended solid caused by marine construction works depends on stirring bottom sediments and dumping soil. Thus the construction planning, the construction method and selection of construction machinery are very important for controlling an increase of suspended solid.

16. In this case, the scale of construction works is not so large. According to the soil condition at the seabed, bottom sedimemt consists of sand with coral and gravel. The current velocity around the construction site is not so fast. Therefore, the volume of suspended solid is limited. Furthermore, it is efficient for cutting the increase of suspended solid to start the reclamation work after the shore protection is completed. So slight increase of suspended solid during the construction period will be permitted. Thus it seems that the impact to water quality around Kupang port during the construction period will be permissibly small.

Noise and vibration

17. Noise and vibration are public nuisances associated with construction works. The primary sources of noise and vibration are operation of work boats and construction machinery.

18. Noise and vibration caused by construction works are intermittent impact during the construction period. In general, it is said that the power level of major work boats and construction machinery is about 100 dB(A). The noise level declines in proportion to the distance from the source. Based on a logarithmic scale, a decline of half the sound energy is measured as a decline of 3 dB(A) on the scale. In case of a point source of noise, the noise level in dB(A) declines by 6 dB(A) at every double distance from the source. On the other hand, the vibration level also declines in proportion to the distance from the source. Generally speaking, in case of a point source of vibration, the vibration level in dB declines by 3 to 6 dB at every double distance from the source. (refer to Appendix 9-1)

19. In this case, the distance between the major construction site (noise and vibration source) and residential areas is more than eight hundred meters. According to an example of noise reduction at certain distances, if the generated noise level is 100 dB(A), the noise level at a distance of 20 m is 66 dB(A) in case of point noise source. (refer to Appendix 9-2) Furthermore, hill,trees, fences, houses and similar obstacles are effective barriers against noise. Thus, it seems that the impact of noise around the Kupang port during the construction period will be small. Likewise, it seems that the impact of vibration also will be small.

Odor

20. In general, the substances causing stench are ammonia, methyl mercaptan, hydrogen sulfide, methyl sulfide, trimethyl amine, methyl bisulfide, acetaldehyde and styrene. The primary sources of them are dredging and dumped soil.

21. In this case, dredging and soil dumping will be carried out. But according to the soil condition data in the sea, above substances were not found. So it seems there will be no impact from odor.

Fauna and flora

1) Aquatic fauna and flora

22. The biological groups of aquatic fauna and flora are as follows;

a) Bacteria
b) Phytoplankton
c) Zooplankton
d) Seaweeds
e) Attached organisms
f) Coral
g) Benthic organisms
h) Fish and shellfish for fisheries

23. Dredging and soil dumping cause reduction of areas inhabited by aquatic life. Furthermore aquatic life is threatened by the increase of suspended solid.

24. In this case, the scale of dredging and reclamation is limited and the area of dredging and reclamation is inside of port area. Furthermore, there are no fishing grounds and marine preservation areas near the construction site. Substitute areas for aquatic life exist. (refer to Appendix 9-3)

25. Also, it is thought that impact to water quality during the construction period will be permissibly small. Therefore, it seems that impact to aquatic fauna and flora will be small.

2) Terrestrial fauna and flora

26. The biological groups of terrestrial fauna and flora are as follows;

a) Vegetation
b) Mammals
c) Birds
d) Reptiles
e) Amphibian
f) Insects
g) Others/Terrestrial shells, spiders

27. Operation of construction machinery hinders lives of terrestrial fauna and flora. Thus air pollution, noise and vibration make their living conditions worse.

28. In this case, the construction site is inside of the port area. So almost no terrestrial fauna and flora live in above area. Also, it is thought that impact to air quality and impact of noise and vibration during the construction period will be small. Therefore, it seems that impact to terrestrial fauna and flora will be small.

Wastes

29. With construction works, part of construction materials and surplus soil are generated. In general, the volume of wastes depends on the scale of construction works. So the construction plan and method are very important to decrease the volume of wastes.

30. In this case, the scale of construction works is not so large and construction plan and method will consider the environmental conditions around Kupand regency. Therefore, it seems that the impact of wastes will be small during the construction period.