3.2 NATIONAL ROAD BETWEEN ILIGAN CITY AND CAGAYAN DE ORO CITY

The transportation to and from the project area was mainly dependent on sea traffic. However, in line with the construction of Pan Philippine Highway, onland traffic has been gradually growing up. The road network along the coastal area facing the Mindanao sea has been maintained on a relatively high level, but the road connection to inland area are in poor condition. Small numbers of several trunk roads play important roles for feeding consumer goods and delivering crops harvested. The secondary roads run between the trunk roads are now under construction at many places.

The compteted sections of Pan Philippine Highway in Mindanao Island begins from Surigao del Norte via Agusuan del Norte, Agusan del Sur up to Davao Zamboanga. The 310 km long section between Butan and Cagayan de Oro and Iligan was completed in 1977 and has alleviated traffic condition in the coastal area.

3.3 THE PROJECT PORT SITES

3.3.1 Selection of Promising Port Sites

The main purpose of this study is to select the proper port site where the required port facilities are to be constructed for handling both EAC factory-related commodities and regional goods. At present EAC factory uses the public pier in Iligan port for loading/unloading the products/ materials. The distance between EAC factory and the public pier is approximately 23 km. The products and materials shall be transported through this distance by truck. This inland transportation cost is considerably high.

The finger piers (No.1, No.2) in Iligan port are now tightly used for loading/unloading general cargoes and other bulk materials, so that EAC factory uses only No.3 pier. The most up-to-date port statistics in 1979 shows the berth operability of the piers as follows.

Table 16 BERTH OPERABILITY OF ILIGAN PORT (1979)

	No.1, No.2 pier	No.3 pier
Berth occupancy	51.7%	27.9%
Average service time per vessel	21.3 hs.	54.2 hs.
Average waiting time per vessel	0.5 hs.	7.4 hs.
Idle time /service time	51%	60%

The No.3 pier, though having low berth occupancy, requires vessels to wait longer than expected. It is understood that this situation is based on the shallowness in half of the berthing area. If this shortcoming is overcome by dredging and one more new berth is added, this waiting time will be shortened. According to the queuing calculation if a new berth were added, the average waiting time would be shortend to 2.5 hours per vessel from 7.4 hours per vessel, and berth occupancy would also be reduced to 14% from 28%. Judging from the above results, if berth extension plan is implemented on schedule, no significant problem will occur for ber operability in Iligan port in future.

Meanwhile, in the vicinity of Iligan port there are 9 private piers which serve handling factory goods. The EAC factory has ever used Floro cement pier, but as the cargo volumes of Floro cement has been increasing, it is anticipated that in future this kind of spot hiring will not be available. Furthermore, other private piers are also congested leaving no chance of EAC factory's using them. Next to the private pier of the Mindanao Portland Cement Corporation, there is an 45 m long old public pier that has been left unmaintenanced after the foundation piles was destroyed by ship collision.

This public pier is located in the well sheltered Kiwalan Cove, so that this one may have good possibility of being used for EAC private pier. However this pier has been deleted for the following reasons.

(1) All the demolished piles shall be removed, requiring additional costs.
(2) On account of the restricted back-up onland area, no space can be allocated for open sheds and warehouses.
(3) This pier is so closely located to the neighboring private pier that sufficient berth length cannot be spaced.

Meanwhile, at Punta Silum, 1.8 km west of EAC factory, there is a demolished pier that remains un repaired after damaged by storm. By our site reconnaissance this site has been revealed as one of the most promising berth site.

As the last alternative port site, the area just in front of EAC factory has been selected for the reason of the shortest access to the factory.

In consequence, as mentioned above two promising project port sites have been selected for further study.

a. Punta Silum port (near demolished pier)

b. Manticao port (in front of EAC factory)

3.3.2 Alternative Study

a) Natural condition

The Punta Silum port site, though open to northwest, is well sheltered against SW waves, because of the existence of a small point which is located 500 m south west of the demolished pier. The shoals extending offshore from this point make the waves refracted, resulting in the reduction of wave height.

However, in NE monsoon season, this shoals do not work, so that offshore waves come into the pier directly, resulting in low efficiency of cargo handling at berth, particularly in case of small boats berthed parallel to the shoreline. At Punta Silum the equivalent contour lines of 5 - 10 m water depth run about 20 - 50 m distant from the shoreline. Therefore, the required water depth for port facilities can be easily obtained within an economical reach from shore line. Furthermore the water depth deepens rapidly offshore of -10 m with slope of 1 : 1.5 ~ 1.4. This seabed condition facilitate to construct ocean-going vessel berths.

The shoreline in Manticao port runs in a nearby straight line. The gradient of seabed is considerably gentle with a slope of 1 : 50. The marine condition in Manticao port site is similar to that in Punta Silum. To accommodate a maximum of 7,000 DWT class vessels, the water depth of 8.50 m is required. This 8.50 m water depth runs 400 m apart from shore line, so that a 400 m long causeway shall be constructed to connect the pier and shore. The construction cost of this causeway is considered extremely high.

The distance between EAC factory and Iligan port is 23 km, and the distance between EAC factory and Manticao port is 1.8 km.

In view of back-up area for port development, both Punta Silum port and Manticao port have no problem, because the national highway runs about 100 - 150 m inland from shoreline and no obstacle can be found between them.

b) Regional development

There is no public pier along the entire stretch of 85 km coastal line between Cagayan de Oro port and Iligan port. All the consumer goods and agricultural products are now handled through either of the above two ports. Under these condition, the Manticao municipal in Misamis Oriental envisages to put up a new public pier that will serve as a subsidiary port to Iligan port and Cagayan de Oro port.

According to the information obtained from the provincial development staff, there is some future plan for establishing coconut processing plant, paper mill and cold storage for fish in the vicinity of the project area. Taking into account the above future plan, a new berth at

Manticao/Punta Silum would give a great impact to regional development.

c) Transportation cost comparison

Punta Silum port or Manticao port, would benefit not only EAC factory but also neighboring factories in the form of transportation cost saving of factory related goods. Of many factories using the Iligan port, the factory that will benefit from shortening of inland transport distance are limited to such factories as Ferro Chemical. Mindanao Steel Corp. and refractories Corp. of Philippines. The transportation cost saving has been tentatively calculated as belows. (Detailed calculation will be made in Chapter). The unit transportation cost per km·ton in the project area is 1.7 pesos/ton/km in case of truck. The distance between each destination is as listed below.

Table 17 DISTANCE BETWEEN PORT AND FACTORY

Factory	RCP	Mindanao-steel	EAC	Ferro chemical
Iligan Port	13	16.5	22.5	25.5
Punta Silum Port	7.5	4.5	2	5
Manticao Port	10	7	0.5	3.5

By use of unit transportation cost and transport distance, annual transportation costs have been calculated on both the domestic cargo and foreign cargo.

Table 18 ANNUAL TRANSPORTATION COST BY EACH PORT AND FACTORY

(unit: pesos)

		Alternative Port Sites			(a)-(b)	(a)-(c)
		(a) Iligan	(b) Punta Silum	(c) Manticao		
Domestic Cargo	RCP	362	209	278	153	84
	Mindanao Steel	157	43	66	114	91
	EAC	1,117	99	25	1,018	1,092
	Ferro chemi	-	-	-	-	-
	Total				1,285	1,267
Foreign Cargo	RCP	76	44	58	32	18
	Mindanao Steel	12	3	5	9	7
	EAC	945	84	21	861	924
	Ferro chemi	936	184	129	752	807
	Total				1,654	1,756

As shown on Table 18, in case of using Punta Silum port instead of Iligan port, the annual transportation cost saving on EAC domestic cargo and EAC foreign cargo are estimated at 1,018,000 pesos and 861,000 pesos respectively, totaling 1,879,000 pesos.

The cost saving by other than EAC factory is calculated at 267,000 pesos on domestic cargo and 793,000 pesos on foreign cargo, totaling 1,060,000 pesos.

This simple calculation shows the superiority of the Punta Silum plan.

3.3.3 The Proposed Port Sites

The two port sites have been studied in terms of natural condition, regional development and transportation cost. In all respects, it is found that a new port plan like Punta Silum port or Manticao port is worthy of further detailed studying. Therefore Punta Silum port and Manticao port have been studied on the same level in the following chapter.

CHAPTER IV

DESIGN CRITERIA ON PROJECT PORT

CHAPTER IV

DESIGN CRITERIA ON PROJECT PORT

4.1 NATURAL CONDITION

4.1.1 Tide

The tidal elevations in Iligan port are as follows:

H.H.W.	+1.71 m	
M.H.W.	+1.00 m	
M.L.W.	+0.15 m	
M.L.L.W.	±0.00 m	(Datum line)
L.L.W.	-0.51 m	

Usually, the tidal elevations shall be determined through the analysis of one year data actually measured on site. The project site (Punta Silum or Manticao) is only 20 - 23 km away from the Iligan port, and the shape of the shoreline is not so complicated that no significant problem is to occur, even if the tidal elevations in Iligan port is used for the designing of the project port. Therefore, in designing project port facilities, the tidal elevations of Iligan port have been used.

4.1.2 Tidal Currents

Through the tidal measurement conducted in our investigation, the existence of the longshore ocean currents have been revealed. This ocean currents constantly run from east to west.

In the area in front of EAC factory, the dominant tidal currents was in the direction of SW and a maximum speed was about 0.7 knots during the investigation period. Meanwhile, in the area of Punta Silum, the dominant direction was to the south, and a maximum current speed was 0.44 knots.

It is understood that this difference in the current speed between two port sites is attributed to the diffence in the water depths. In the Punta Silum area, the seabed lines with a steep slope of 1 to 1.5 or 1 to 4, while in the Manticao area, the seabed is considerably gentle 1 : 50.

4.1.3 Winds

Looking at the wind data of Cagayan de Oro weather station, the prevailing winds in the project area are from N, S and NW. The south winds, land breeze, are occasionally accompanied by heavy showers. The frequency of wind velocity by the direction is tabled below.

Table 19 MAX WINDS IN 1975 - 1977

	Knot 0 - 3	Knot 4 - 10	Knot 11 - 16	Knot 17 - 27
N		34.4	6.9	0.8
NE	0.2	3.4	1.8	
E		1.0	1.2	0.2
SE		0.4	0.2	
S	0.1	1.2	0.7	0.1
SW		2.9	2.4	0.3
W		2.8	1.1	0.1
NW		29.9	7.1	0.7
CALM				0.1
Total	0.3	76.0	21.4	2.3

Table 20 AVERAGE WIND SPEED IN 1975 - 1977

(Unit %)

	Knot 0 - 3	Knot 4 - 10
N	19.7	1.3
NE	1.7	
E	0.6	0.1
SE	-	
S	22.8	1.8
SW	16.7	1.7
W	3.1	
NW	12.6	0.6
CALM	16.0	1.5
Total	93.2	7.0

The typhoons in Philippines are usually generated in the eastern Mindanao, passing through the project area in prematured condition, so that no fatal damages are brought about to the project port sites. The courses of the typhoons between 1971 and 1974 that influenced the project area were illustrated in Fig. 4. The maximum wind speeds observed during this period was 22 - 27 knots. The probability of the maximum winds have been studied by use of the wind data from Cagayan de Oro weather station. The maximum wind occuring once in 100 years is estimated at 24 knots.

Table 21 PROBABILITY OF MAXIMUM WIND SPEED OCCURENCE

	Wind Speed (knot)
5 years	16
10 years	18
20 years	20
50 years	22
75 years	23
100 years	24

4.1.4 Waves

Since the project area is located in the mild climate zone and outside the typhoon-hitten area as well, the wave condition is comparatively gentle. The maximum wave height is, according to the local information, said to be under 2.4 m. In order to examine the reliability of this figure, the wave analysis has been carried out by use of the wind data observed at the Cagayan de Oro weather station. (In this calculation, the onshore wind speeds have been converted into the offshore ones.) Waves developed by S.M.B. method are tabulated below.

Direction	Onland Wind Speed	Offshore Wind Speed (m/sec)	Wave Height (m)	Wave Period (sec)	Fetch (km)
N	11.8	14.2	2.6	6.2	126
NW	10.3	12.3	2.2	5.8	144
W	11.3	13.6	1.7	4.8	48
SW	9.3	11.1	1.4	4.5	54

Except for the above wave information, there is no noteworthy data, so that in the designing of the project port, the maximum wave height of 2.6 m has been adopted.

4.1.5 Soil

The surface layer of the seabed is muddy soil dotted with coral limestone. In our investigation four holes of offshore test boring have been put down in such locations as shown in Fig. 15 . Three of them was conducted in the vicinity of the existing demolished pier at Punta Silum, and the remaining one in front of EAC factory.

Soil condition between BH-1 and BH-3

The alluvium consists of the alternate layes of silt, clay and sand. The upper layer is sandy silt with N value of 2 to 9. The second layer, about 8 m thick, is dark greenish grey silty sand with N value of 12 to 21. The third layer is dark greenish-grey and well compacted sandy silt with N value of 22 to 28. The lower layer (the forth), located under 17 to 18 m below LWL, is dark greenish-grey alternate layer of silty sand and clay with N value of 34 to 64.

Soil condition between BH-1 and BH-2

In this area, limestone can be found in comparatively shallow depth. It is assumed that this limestone layer is extending out continuously from the coral-limestone which can be found in the shoreline.

The medium to dense sandy soil overlies this limestone. Its N value is 12 to 58. Near the BH-1, the thickness of the limestone is very thin, and underlying sandy soil shows alternate layers mixed with sandy silt and sand.

In order to clarify this alternate layers, more numbers of test boring shall be carried out in costruction stage.

Fig.15 BORING SITE LOCATION MAP

4.1.6 Seismic Disturbance

Fig.16 shows the frequency of the earthquake which occurred during the past 57 years between 1862 and 1918. According to this record, the project area had an average of 6 earthquakes a year which could be sensible to human-being.

Annual average of felt shocks in the period 1862-1918 as determined by the Philippines Weather Bureau.

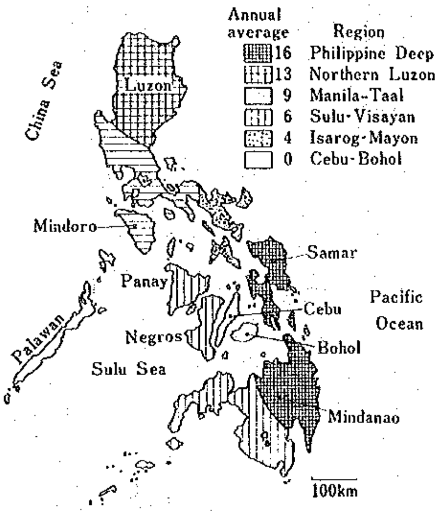

Fig.16 EARTHQUAKE RECORDS

The hypocenter and magnitude of the earthquake between 1915 and 1976 are shown in Fig.17. The earthquake with a magnitude of 6.0 - 6.9 once occured 56 km away from the project site, and a magnitude of 7.0 - 7.9 about 112 km away.

Meanwhile, according to the National Building Code, the design seismic coefficient can be calculated in the following formula.

$$K_h = K \cdot C \cdot Z$$

K_h : Horizontal seismic coefficient

K : Earthquake factor (0.1)

C : Coefficient according to importance of structure (1.0)

Z : Area and ground factor (1.2)

$$K_h = 0.1 \times 1.0 \times 1.2 = 0.12$$

The German Consultant has ever used $K_h = 0.10$ for designing the Iligan port, Considering above situations, $K_h = 0.12$ has been adopted for designing the project port.

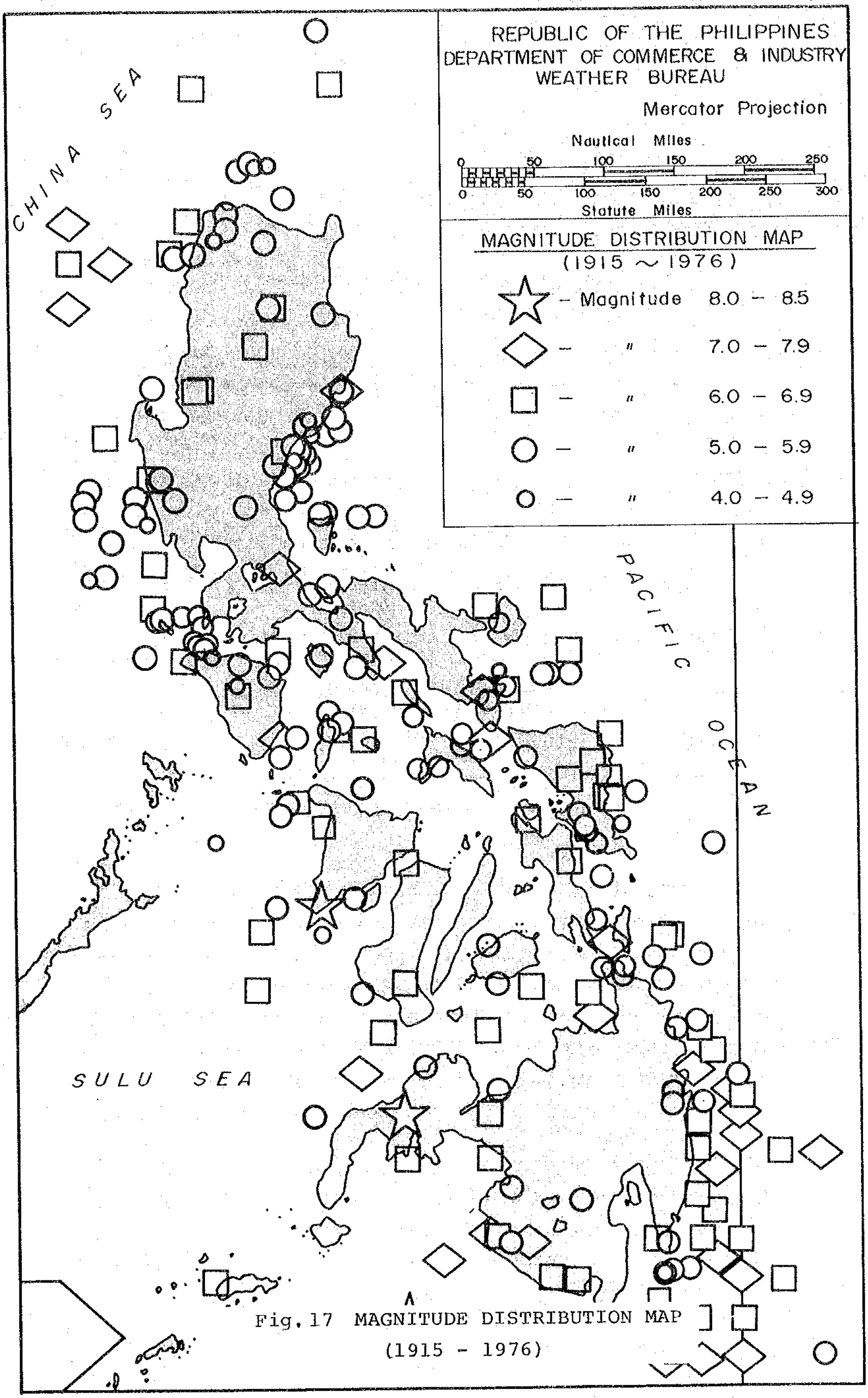

Fig. 17 MAGNITUDE DISTRIBUTION MAP
(1915 - 1976)

4.2 DESIGN CRITERIA FOR EAC PRIVATE PORT

4.2.1 General

The following materials are necessary to produce ferro-silicon at a rate of 12,000 ton/year.

Table 22 MATERIALS USED FOR EAC FACTORY

Material	Origin	Annual Transportation Volume	Volume Converted	No. of Voyage
Silica	Luzon Is.	20,000 T (1.3)	20,000 T	30 times
Coal	Negros Is.	5,000 T (0.7)	7,150 M^3	8 times
Chalcoal	Parawan Is.	3,000 T (0.5)	6,000 M^3	6 - 7 times
Hammer Scale	Japan	4,000 T (2.0)	4,000 T	6 times
Cokes	Japan	8,000 T (0.7)	11,400 M^3	
Paste	Japan	700 T (1.0)	700 T	2 times

*Figure in parentheis is apparent specific gravity.

Among above materials, hammer scale is imported from Japan 8 times a year by ocean-going liners or trampers. On completion of the project port, the ocean-going vessels carrying hammer scale and paste will call at the project port 6 times a year. The product (ferro-silicon) will be carried once a month by 5,000 PWT class liners with one lot of 1,000 ton.

4.2.2 Vessels

The vessels now being used by EAC factory are classified as below.

a) 500 DWT-1000 DWT class coastal barges which carry silica, coal and chalcoal.

b) 3000 DWT-7000 DWT class ocean-going cargo vessels which carry hammer scale, cokes and paste from Japan.

c) 3000 DWT-7000 DWT ocean-going cargo vessels which carry ferro-silicon.

The 500 DWT-1000 DWT class coastal barges are allocated exclusively for carrying the raw materials. The barge sizes and their calling frequencies are summarised below on the basis of the port statistics in Iligan Port.

Table 23 CALLING OCCURENCY AND AVERAGE SHIP LENGTH IN ILIGAN PORT

	Calling (%) Occurency	Average (m) Ship Length	Max (m) Draft
600 DWT	76	37	2.5
800 DWT	17	42	2.8
1,000 DWT	7	45	3.0

As easily understood from the above table, the dominant barge size is 600 DWT class. The above barge size distribution can be applied to the planning of the piers of the project port, because no change of calling frequency can be expected even in case of using the project port instead of the Iligan Port.

Most of the ocean-going cargo vessels for EAC factory are trampers which are being allocated in the region of Southeast Asia or Philippines. The Iligan port or the project port are located in the course of their voyages.

The recent size distribution of ocean-going vessels which called at the Iligan port was as follows:

over 5,000 DWT .... 3 times
4,000 DWT-5,000 DWT .... 4 times
under 4,000 DWT............. 3 times

Considering the low frequency of calling of the ship over 5,000 DWT, it is understood that providing a plus 5,000 DWT class pier in the initial stage of the project port is not so economical. Therefore, in the initial stage the vessel size has been determined at a maximum of 5,000 DWT for ocean-going vessel and 600-1000 DWT barges for coastal vessels.

4.2.3 Number of Ship Calling

The annual amount of materials and product in EAC factory are described in 4.2.1 and the sizes of vessel to carry these commodities has been determined in 4.3.2. Using the above basic conditions, the numbers of shop calling on each ship size and commodity can be calculated as shown on Table 24. A total number of ship calling are 45-time/year by barges and 20 times/year by ocean-going vessels.

Table 24 ANNUAL NUMBERS OF CALLING BY SHIP SIZE

Commodity	Annual Cargo	Barge			Ocean-going Vessel
		600 DWT 76%	800 DWT 17%	1,000 DWT 7%	5,000 DWT 100%
Silica	20,000 t	23.0 nos	5.1 nos	2.1 nos	-
Coal	7,150 m^3	6.0	1.3	0.6	-
Chalcoal	6,000 m^3	5.0	1.1	0.5	-
Hammer Scale	4,000 t 11,400 m^3	-	-	-	6 nos

Commodity	Annual Cargo	Barge			Ocean-going Vessel
		600 DWT 76%	800 DWT 17%	1,000 DWT 7%	5,000 DWT 100%
Paste	700 t	-	-	-	2 nos
Ferro silicon	12,000 m^3	-	-	-	12
		34.0	7.5	3.2	20
		44.7 ≑ 45			
		65			

4.2.4 Number of Berths Required

There are two approach in determining the number of berths to cater for the required ship calling; one way is to give restriction on berth occupancy and another is to give restriction on average waiting time per ship. The former method is applied in case of the private pier where the time schedule of each ship is considerably fixed or in case of fishing port where the port service time of each boat is so short, resulting in quick turn around. The latter method is applied for public port where many kinds of vessels call at the pier at randum.

The project port, which has the character of public pier for handling general cargoes in addition to EAC goods, shall be studied in the latter method.

By use of the queuing theory, the average waiting time per ship have been estimated at 1.0 hours and 1.3 hours for barges and ocean-going vessels respectively. The berth occupancy have also been developed as 9% and 8% for barge berth and ocean-going vessels berth.

4.3 DESIGN CRITERIA FOR PUBLIC PORT

4.3.1 Public Port Requirement

The local commodities which are expected to be handled through the project port are agricultural goods, timber and fish, among of which the first two are so small in quantity. Speaking of ship size, it is anticipated that 40 - 100 DWT-class coastal vessels usually used for Iligan, Cagayan de Oro, Bohol, Cebu and Dumaguete will be dominant. These vessels will be easily berthed along the pier, making use of the vacant berth of the project port, so that no special design criteria on this kind of vessel has been established.

Meanwhile, most of the fishing boat working in the project area are small boats so called "BANCA", which are canoes with small-powered engines. These small boats are left on shore while off duty. Besides these small boats, there are 20 ton-class larger fishing boats which usually anchor about 100 m offshore. The captured fish are transshipped from these larger boats to small canoes, and carried upto shore. This transshipment will be deleted, if the project port can be used. To meet this requirement, at the ends of the pier, the space for fishing boats are considered.

4.3.2 Other Factories' Requirement

a) General

Besides the traffic of local cargo and agricultural products, there are some traffics of materials and products necessary for the factories in the vicinity of EAC. These factory-related commodities will have the chance of being handled through the project port. The commodities and their volumes to be handled are listed below.

Table 25 MATERIALS & PRODUCTS OF EAC-SURROUNDING-FACTORY

Name of Factory and Its Commodity	Barge	Ocean-going Vessel
1) Ferro Chemical		
Cokes	-	7,200 t
Ferrochrome	-	14,400 t
2) Mindanao Steel Corp		
Steel Plate	* 6,000 t	-
3) R.C.P.		
Chrome Ore	7,000 t	-
Refractory	10,000 t	-
Magnesia Clinker	-	12,000 t

* Of total volume of 18,000 ton, 6,000 ton is transported by sea.

b) Vessels

The Ferro Chemical Corp. produces ferro-chrome. The vessel size and frequency of the calling for Ferro Chemical Corp. is almost the same as those for EAC factory. Most of the materials, other than cokes are available inside the Mindanao island. Cokes and ferro-chrome are carried by 5,000 DWT class vessels 4 times a year and 12 times a year respectively.

The Mindanao Steel Corp. procures most of the materials from NSC factory. Other material like zinc, ammonium chloride, lead and sulphun total 1,235 ton/year in volume. The product like steel plate are brought out both by land and by sea. According to the Hatch Report, a total of 6,000 t products are shipped at Iligan port in an average lot of 40 ton, 150 times a year or 3 times a week.

The vessel size distribution to and from the Iligan port are listed below. The distribution has been reused for planning berth utility of the M.S.C. in the project port.

The R.C.P. transports chrome ore by barge and magnesia clinker by 5,000 DWT class bulk carrier 4 times a year each. Refractories is shipped 2 times a month.

The vessel sizes for other than EAC factory has been determined as follows:

Barge	600 - 1000 DWT class
Coastal freighter...	300 - 500 DWT class
Ocean-going vessel..	5000 DWT and under

c) Number of Ship calling

The number of ship calling on each ship size and commodity has been calculated in the same manner as conducted in EAC factory.

Table 26 ANNUAL NUMBER OF CALLING BY SHIP SIZE FOR EAC-SURROUNDING FACTORY (BARGE)

Name of Factory and its Commodity	Annual Cargo	Ship Charac-teristics	Ship Size Distribution		Annual No. of Ship Calling
Mindanao Steel Corp. Steel plate	6,000 t	General Cargo	300 DWT class	(17%)	25.5 nos
			500 DWT class	(38%)	57
			700 DWT class	(21%)	31.5
			900 DWT class	(17%)	25.5
R.C.P. Chrome Ore	7,000 t	Barge	600 DWT class	(76%)	8.0
			800 DWT class	(17%)	1.8
			1000 DWT class	(7%)	0.7
Refractories	10,000 t	General Cargo	300 DWT class	(17%)	4.1
			500 DWT class	(38%)	9.1
			700 DWT class	(21%)	5.0
			900 DWT class	(17%)	4.1
			Total		172.3 nos

Table 27 ANNUAL NUMBER OF CALLING BY SHIP SIZE FOR EAC-SURROUNDING FACTORY (OCEANGOING VESSEL)

Name of Factory and its Commodity	Annual Cargo	Ship Charac-teristics	Ship Size Distribution	Annual No. of Ship Calling
Ferro Chemical				
Cokes	7,200 t	Bulk Canier	5000 DWT class	4 nos
Ferro chrome	14,400 t	General Cargo Carrier	5000 DWT class	12
Mindanao Steel Corp.				
Steel plate	6,000 t	General Cargo Carrier (domestic)	plus 1000 DWT class (8%)	12
R.C.P.				
Refractories	10,000 t	General Cargo Carrier (domestic)	plus 1000 DWT class (8%)	1.9
Magnesia Silica	12,000 t	Bulk Carrier	5000 DWT class	4
			Total	33.9

4.3.3 Number of berths Required

When EAC-related commodities plus surrounding three factories' commodities are handled through one barge berth and one ocean-going vessel berth, average waiting time per vessel is 1.7 hours or 2.9 hours and the berth occupancy is 23% or 16% respectively. In comparison with 51.7% in pier No.1 & No.2 and 27.9% in pier No.3 of Iligan port, the figures calculated for the project port is said to have good allowance.

4.4 DESIGN CRITERIA FOR THE PROJECT PORT

4.4.1 General

As stated before, the project port is composed of a barge berth and an ocean-going vessel berth. A maximum vessel to be accommodated in the barge berth is 1,000 DWT class and in the ocean-going vessel 5,000 DWT class.

4.4.2 Vessel Characteristics

The characteristics of the maximum vessel is tabulated below.

Table 28 VESSELS ADOPTED FOR DESIGNING PROJECT PORT

	Design Ship Size	Ship Length	Ship Width	Max. Draft
Ocean-going Vessel	5000 DWT	103 m	15 m	(7.5 m) 6.8 m
Barge	1000 DWT	45 m	12 m	3.0 m

(Structually, an ocean-going vessel berth has been designed to accommodate up to 7,000 DWT vessels.)

4.4.3 Water Depth

In the project port area, the lowest low water is 50 cm below the sea datum line, so that the water depth at the berth and approach channel shall be designed adding 50 cm to the normal water depth required. The normal water depth for each berth has been determined by considering 10% allowance to the maximum draft to be expected. Therefore the actual water depth at the berth have been calculated as follows.

Water depth = a maximum draft x 110% + 50 cm

Table 29 WATER DEPTH FOR DESIGNING

	Vessel Size Adopted	Water Depth
Ocean-going Vessel Berth	5,000 - 7,000 DWT	-8.5 m
Berge Berth	1,000 DWT	-4 m

4.4.4 Handling Equipment

The commodities to be handled on the project berth are not only factory-related goods but also general cargoes like consumer goods. Since most of the factory-related goods are bulk material, it is desirable some special handling equipment such as belt convey is provided in view of handling efficiency. However, these stationary equipment would sometimes block the movements of other cargoes which will be handled in different handling pattern. Furthermore the stationary equipment is to make some dead space.

The major handling pattern in the platform are classified as below:

i) Ship - crane - forklift - truck
ii) Ship - cramshell - (payloader) - truck
iii) Ship - cramshell - hopper - truck

The machines and plant to conduct the above operation are as follows:

Truck	:	loading capacity	15 ton
Forklift	:	hoisting capacity	5 ton
Cramshell	:	bucket capacity	2 m^3
Payloader	:	bucket capacity	1.8 m^3
Hopper	:	bucket capacity	15 m^3

4.4.5 Platform

The width of the platform has been determined at 12 m to cater for every operation mentioned in 4.4.4. The surcharge on the platform can be determined considering specific gravity of material and height of the pile. Among the bulk material, magnesia silica has the heaviest specific gravity of 3.1, followed by 2.0 of hammer scale and chrome ore. On the assumption that magnesia silica or hammer scale is stacked 1.5 m high, the surcharge can be calculated at 4.65 t/m² or 3.0 t/m². In designing the platform, the surcharge of 3.0 t/m² has been adopted under the condition that magnesia silica shall not be stocked on the platform, but directly be loaded onto trucks.

4.4.6 Stockyard

The materials and cargoes discharged from the ship are partly stocked on the platform and partly conveyed directly to the plant. The remaining portion will be stocked in the stockyard located adjacent to the platform. The area of the stockyard has been determined to space a full load of 3,600 DWT that is equal to a maximum bulk carrier carrying cokes. If cokes are stocked 3 m high and 30% of dead space are considered, a total area of the stockyard can be estimated as follows.

$$3,600 \text{ ton} \div 0.7 \text{ t/m}^3 = 5,100 \text{ m}^3$$

$$\frac{(5,100 \div 3)}{0.7} = 2,400 \text{ m}^2$$

4.4.7 Warehouse

The commodities which shall be stocked in the warehouse are ferro-silicon, ferro-chrome, paste, steel plate and general cargoes. Hammer scale and magnesia are also desirable to be stocked in the warehouse, but temporary stocking can be allowed. The capacity of warehouse has been determined to accommodate a half of the maximum lot to be shipped. A maximum lot is 1,200 ton in case of shipping ferro-chrome, so that the capacity of 600 ton has been adopted. The area of warehouse has been calculated in the following procedure.

pile height	: 2 m
specific gravity	: 1.0
efficiency	: 60%

Area of warehouse

$$= \frac{600}{2 \times 1.0 \times 0.6} = 500\ m^2$$

CHAPTER V

THE PLAN OF THE PROJECT PORT

THE PLAN OF THE PROJECT PORT

5.1 GENERAL

In the project port sites of Punta Silum and Manticao, four alternatives have been taken up: one for Manticao port and three for Punta Silum port. On each alternative plan, stage development has been considered. The phase I will mainly take care of the barge up to 1,500 DWT at a maximum, while the phase II will take care of ocean-going vessels up to 5,000 DWT.

5.2 ALTERNATIVE I

In the phase I, the barge berth is aligned in line with the existing demolished pier at Punta Silum. The barge berth can accommodate up to 1,000 DWT class. In the phase II, the ocean-going vessel berth is expanded 75 m westward from the barge berth.

Phase I

In order to cover the berth length for 1,000 DWT class barges, the offshore side of the pier is located in the water depth of 18 m where structually concrete pile can be hardly applied.

The fishing boats berthed in the tip of the pier will be able to unload fish. This operation may be, however, sometimes hindered by the waves coming abeam that occurs especially in the afternoon. In order to escape these waves, the boats will have to anchor offshore.

Phase II

The ocean-going vessel berth is located at the angle of 110° to the barge berth. This ocean-going vessel berth shall be provided with rubber fender system instead of appitong crustea piles, because the prohibitive water depth of over 18 m cannot be overcome by wood piles. The west side of the barge berth will be used for small-drafted boats like fishing boats.

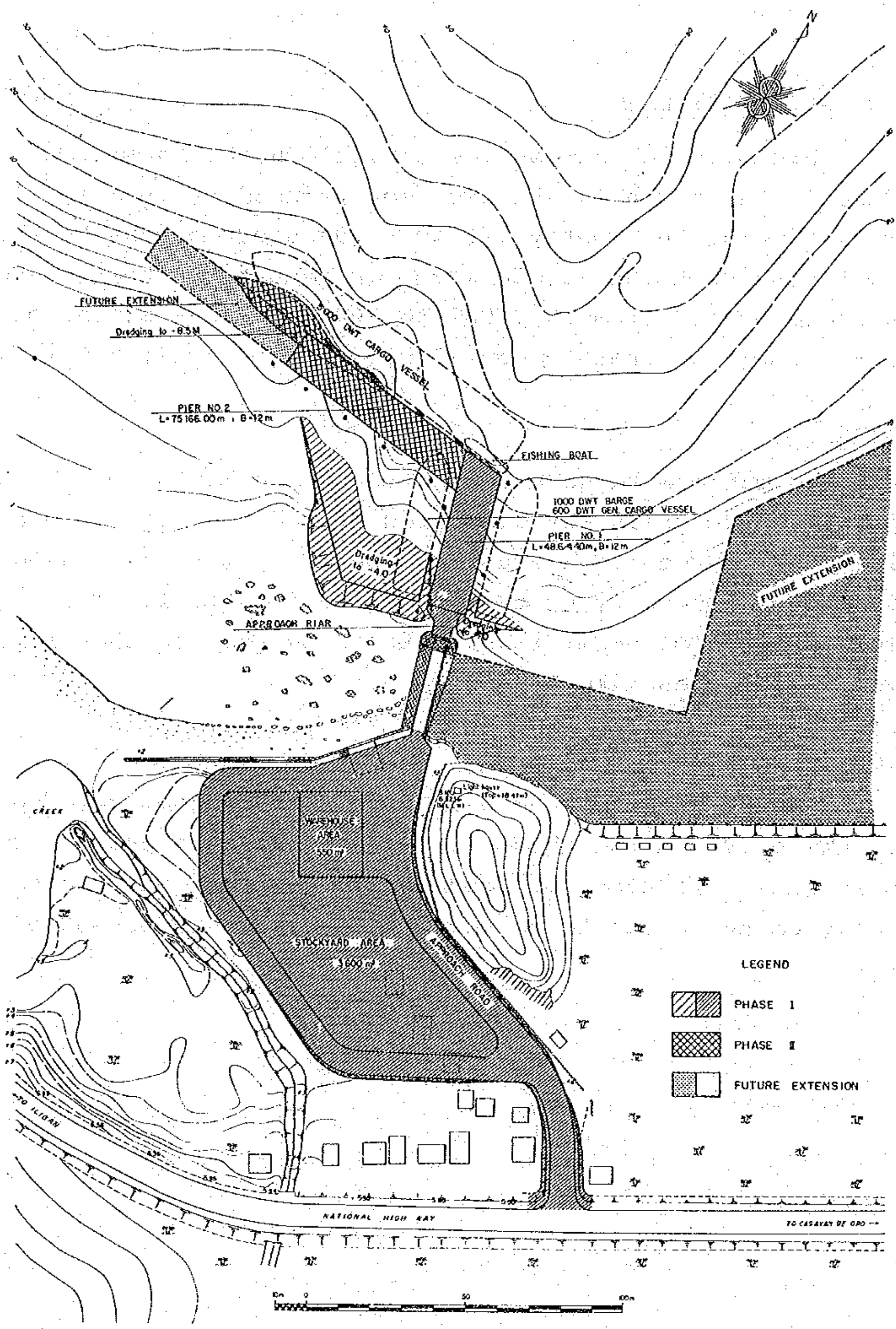

Fig.18 ALTERNATIVE I

5.3 ALTERNATIVE II

This plan has almost the same alignment as Alt. II. In phase I, the berth length has been reduced by 10 m resulting from deleting the costly offshoreside block of the berth. This shortening of berth length leads to reduce the barge size to be accommodated from 1000 DWT to 700 DWT. The extention of berth length in phase II is 75 m, same as in Alt. I.

Phase I

The maximum barge size has been reduced to 700 DWT class, so that structually the dimension of the concrete pile has also been reduced to a square shape by 45 m x 45 m instead of a square shape by 60 m x 60 m like in Alt. I. The rolling movement of small fishing boats berthed in the tip of pier will happen like Alt. I.

Phase II

The west side of the barge berth can accommodate up to 600 DWT class in the phase I. However, in the phase II due to extention of pier for accommodating ocean-going vessel, a maximum ship size to be accommodated is down to 400 DWT class.

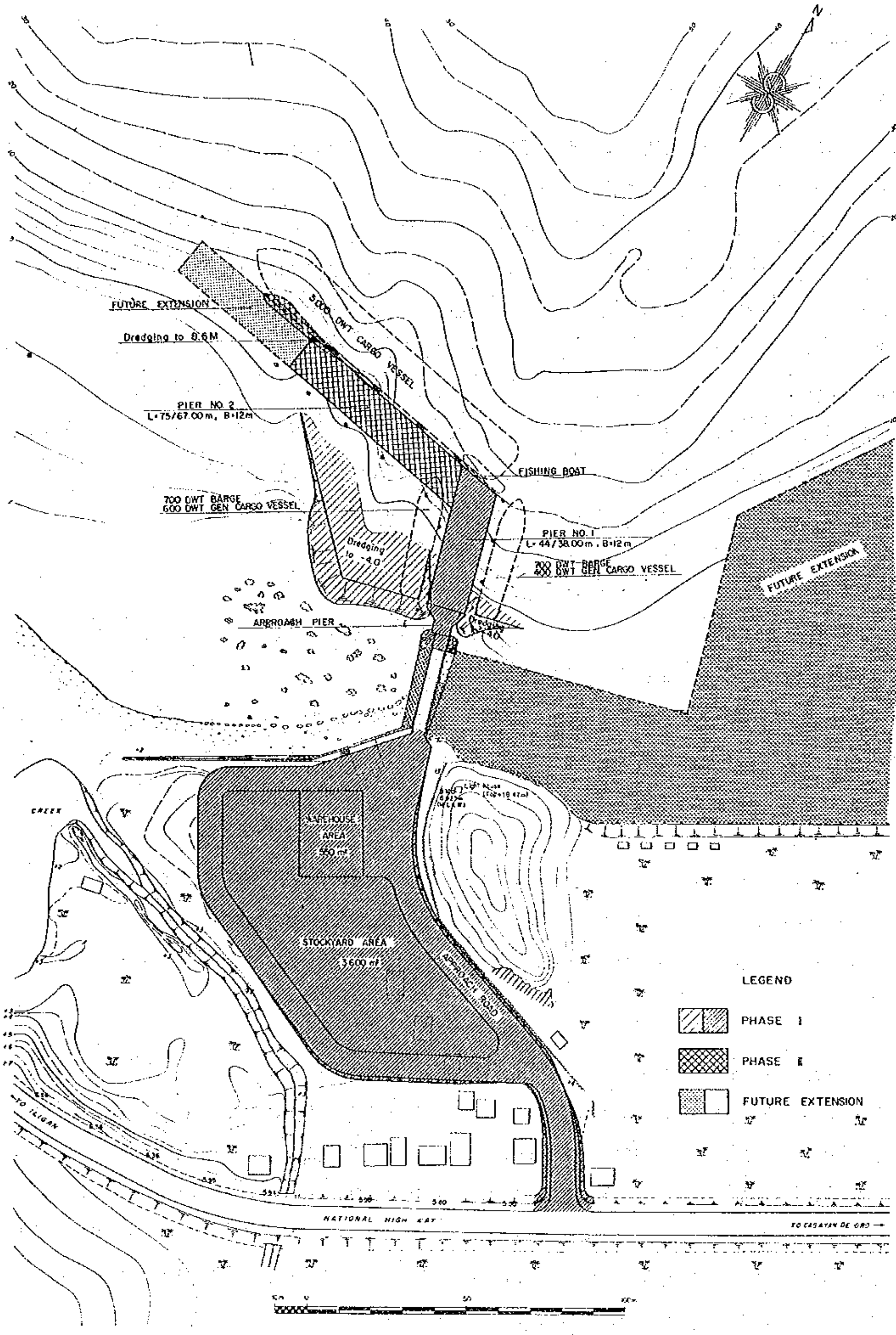

Fig. 19 ALTERNATIVE II

5.4 ALTERNATIVE III

The berth plan of Alt. III has been laid out independently of the existing old pier of Punta Silum. The barge berth is placed in parallel with the old pier, being 35 m westwards. This barge berth can accommodate up to 1,000 DWT class barge. The approach portion between this barge berth and the shore, though economically can be built by the causeway type, has been designed with piled foundation so as not to cause accretion or erosion in the nearby shore. In phase II, the ocean-going vessel berth for 5,000 DWT class is extended another 75 m with westward orientation.

Phase I

The fishing boats can be berthed at any time in the approach portion with little rolling action by waves, so that offloading and refueling can be easily done. The landcut materials born in the course of leveling off the stockyard area can be easily used as landfill material for the area to be earmarked for warehouse. In other plan, the landcut material is cast to the dumping area. The revetment which is located between the approach portion and the existing old pier, can be used as net drying place or the slip for small boats.

The water depth of -4.50 m necessary for 1,500 DWT barge or 900 DWT freight cargo can be easily obtained by comparatively small amount of dredging. This barge berth, laid out parallel to the direction of the dominant waves, can give little rolling to the freight cargo. In other plans the freighters cannot be berthed in the barge berth due to the lack of the required water depth.

Phase II

The ocean-going vessel berth is located further westward as compared to other plans, so that ship manoeuvering near the berthing area is much easier in this plan.

Since the existing old pier has not been incorporated in this plan, that old pier has good possibility of being used as the fishing berth with minor rehabilitation if Manticao municipal wishes. Functionally, it is desiable that the fishing pier is put up separately from other cargo berths. If for a while the pier of the project port serves to promote fishing in this area, in near future, the rehabilitated old pier would work as the fishing pier fully equipped with fishing port facilities.

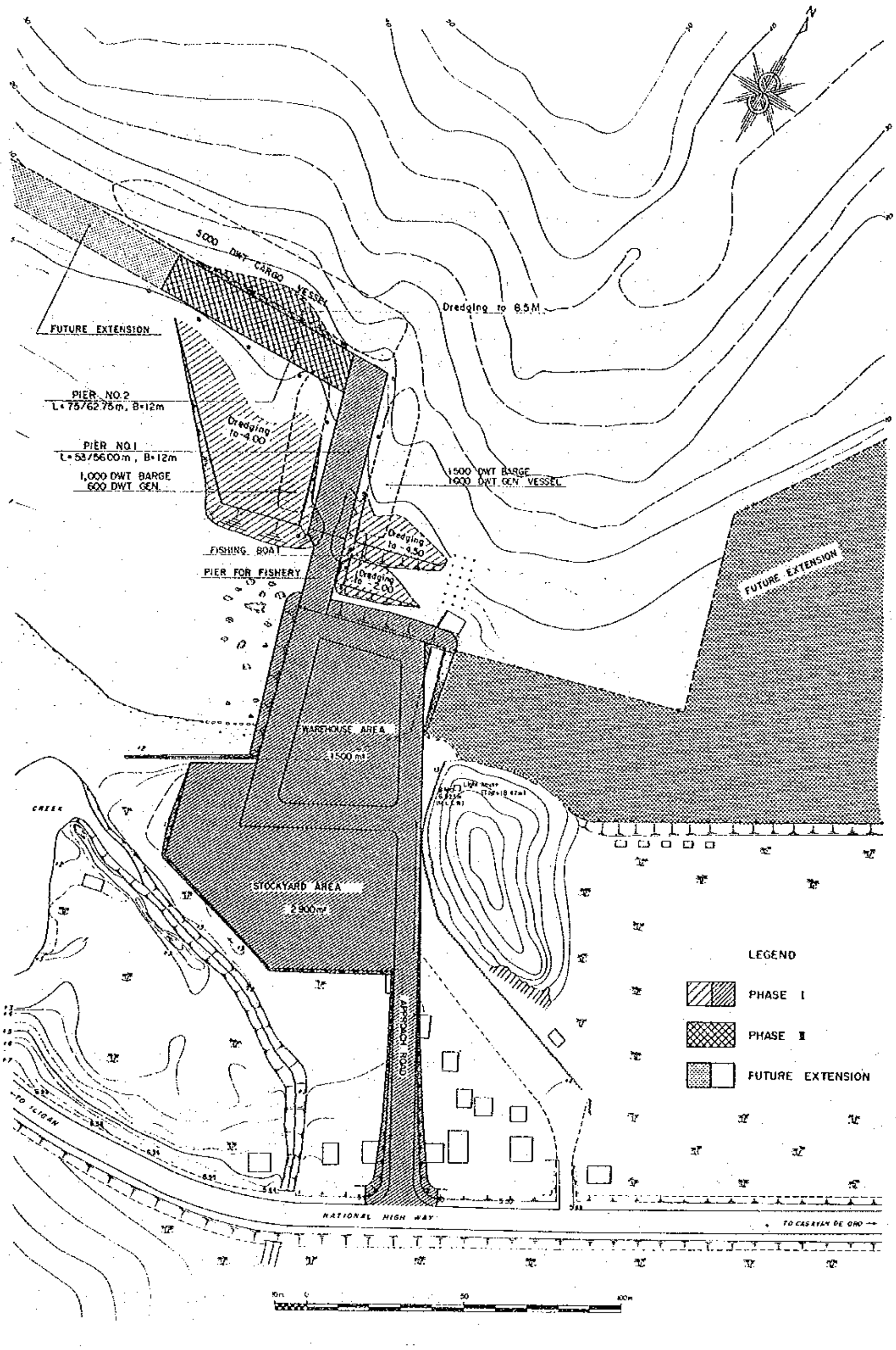

Fig. 20 ALTERNATIVE III

5.5 ALTERNATIVE IV

The 60 m long barge berth is located 200 m offshore of EAC factory to obtain navigable water depth. To locate the berth more nearshore dredging is not recommended, because the area to be dredged is in the siltation zone. The access to the shore from the barge berth is provided by causeway. The 75 m long ocean-going vessel berth is located 138 m offshore of the barge berth. Through the distance of 138 m, the trestle of piled foundation has been selected.

Phase I

The berge berth is oriented northward. This berth orientation does not cause rolling action to the ships berthed. The haul distance of materials and products to and from EAC factory is the shortest of all alternatives. During SW monsoon seasons, the fishing boats can be anchored safely at the east side of the causeway.

Phase II

The construction cost of long causeway and offshore berth is very expensive. The contour line of water depths run almost parallel to the shoreline, so that ship manoeuvering is easy.

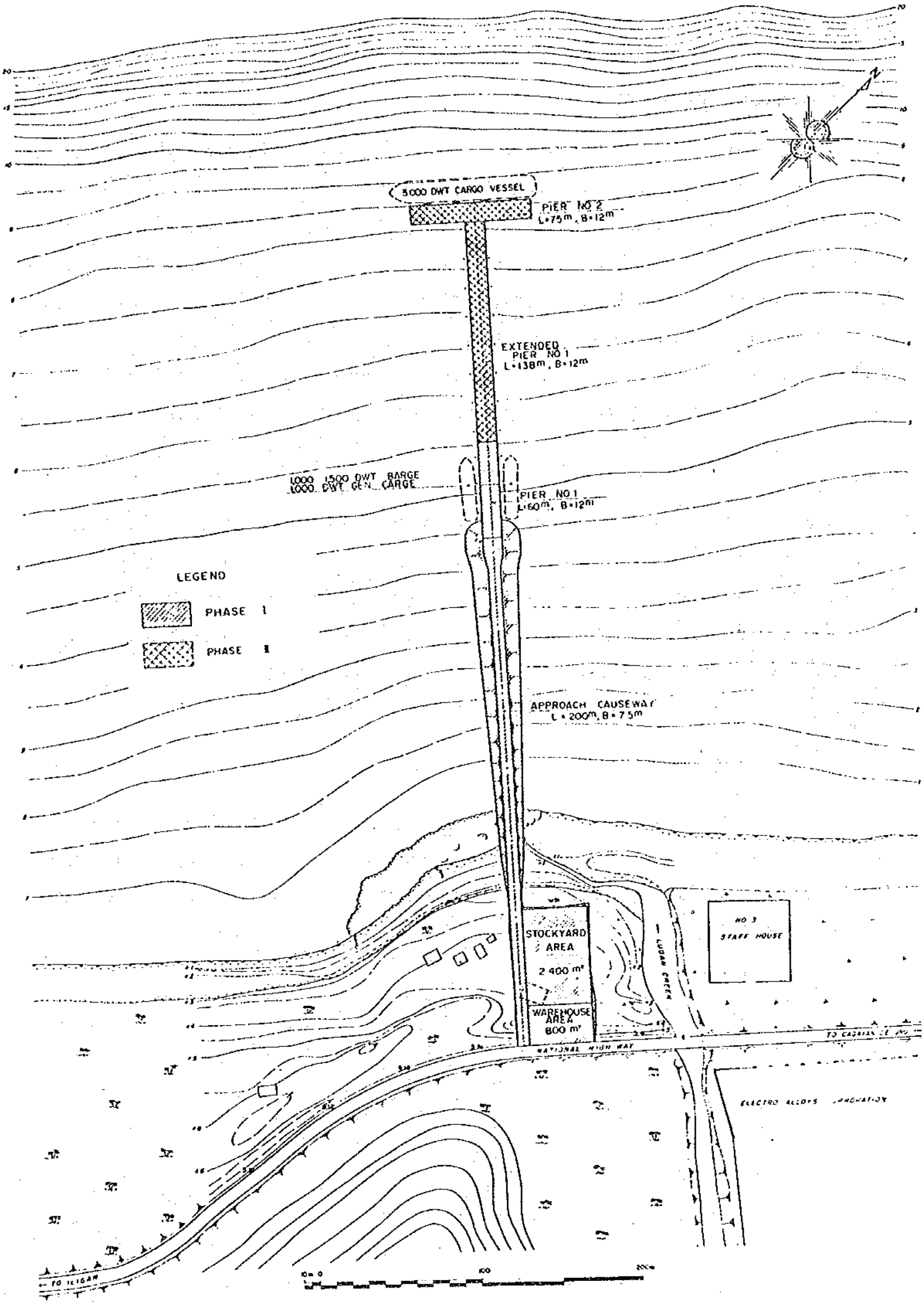

Fig. 21 ALTERNATIVE IV

5.6 COMPARISON OF ALTERNATIVE PLANS

5.6.1 Technical Consideration

In the previous chapters are described, the layouts and berth characteristics of four alternatives plans. Hereunder, the technical consideration is described.

Unlike Alt. I, II, III, the berth of Alt IV is located at 400 m offshore of the shoreline. In Alt. IV the berth connection from shore is provided by the costly access causeway. The construction cost of Alt. IV in phase I + II is 82,500,000 pesos, nearly double over the costs of other three alternatives. This long causeway furthermore, gives another short-coming that the littoral drift trapped by the causeway will cause beach accretion or erosion.

Therefore, Alt. IV has no advantage with the exception of the shortest haul distance between the berth and the factory.

Table 30 MAJOR DIMENSIONS OF ALTERNATIVES

	Act I		Act II		Act III		Act IV	
	Pier No.1	Pier No.2	Pier No.1	Pier No.2	Pier No.1	Pier No.2	Pier No.1	Pier No.2
Max Ship Size (Barge)	1,000 DWT	-	700 DWT	-	1,500 DWT	-	1,500 DWT	-
(ocean-going)	600 DWT	5,000 DWT	600 DWT (400 DWT)	5,000 DWT	1,000 DWT	5,000 DWT	1,000 DWT	5,000 DWT
Berth Length	44 m and 48.6 m (35.7 m)	75 m and 67 m	38 m and 44 m (30.6 m)	75 m and 67 m	53 m and 56 m (43.6 m)	75 m and 62.8 m	60 m x 2 (198mx2)	75 m

In general the Alt. I, II, III have little difference each other in berth length and the maximum ship size to be accommodated. Strictly speaking, the barge berth of Alt. II is slightly shorter than those of other plans, because the whole berth layout of Alt. II has been located much more shoreside. In consequence, the barge size to be accommodated is restricted to 700 DWT and under rather than 1,000 DWT class which are available in case of Alt. I and III. The Alt. II, despite of having disadvantage in vessel size, has the lowest construction cost.

The Alt. I and II shall have comparatively heavy members in slab and pile structure to cope with a deep water depth of 15 - 18 meter where the most offshoreside platform is constructed.

On the other hand, the berths of Alt. III, making full use of natural water depth, is located in the best position irrespective of the existing old pier, resulting in good berth orientation and little rolling action to vessels at berth. The area east of the causeway can also give good shelter for anchoring ships during SW monsoon season.

In addition to the above description advantageous to Alt. III, there are several merits of Alt. III.

1. The approach portion to the barge berth can be used exclusively for fishing boats because of having well-sheltered sea ground.
2. The east side of the barge berth can be easily dredged down to -4.50 m and barge berth itself has sufficient berth length, so that either 1,000 - 1,500 DWT class barge or 600 - 1,000 DWT cargo vessels can be berthed.
3. Since the existing old pier at Punta Silum is left untouched. It is possible that this pier will be used exclusively for fishing boats in Manticao area.

4. Since the warehouse is located adjacent to the pier, the handling at port can be operated efficiently.

As mentioned above, in technical view point the Alt. IV is the most inferior plan and Alt. III is the most superior plan.

5.6.2 Economic Consideration

There are many methods to evaluate the economic effect of the project. Here in this report, the net benefit (B-C) has been taken up for comparing alternative plans. As the benefit, the saving of transportation cost has been considered. The transportation cost is the cost necessary to haul EAC-related goods and other regional goods.

As the cost, construction cost of the project and operation & maintenance cost have been considered. The annual operation & maintenance cost has been estimated at 2% of the capital cost of the project.

Annual benefit and cost occuring in each pear in project life and construction period have been capitalized to the year 1980 with a discount rate of 8% and summed up to obtain total present value of benefit and cost.

The project life	:	20 years
Construction schedule	:	1 year for phase I
		1.5 - 2 years for phase I+II

Table 31 TOTAL PRESENT VALUE OF PROJECT COST AND BENEFIT DISCOUNTED AT THE RATE OF 8%.

Accumulated Present Value	Act I		Act II		Act III		Act IV	
	PhaseI	I+II	I	I+II	I	I+II	I	I+II
Project Benefit(B)	10.12	27.04	7.28	27.04	12.75	27.04	10.65	25.43
Project Cost (C)	7.96	16.75	6.97	14.62	7.84	14.78	12.89	31.12
(B) - (C)	2.16	10.29	0.31	12.42	4.91	12.26	Δ2.24	Δ5.69

As shown on the above table, in the phase I, Alt. III has the largest value of net benefit, while in the phase I + II, the Alt. II and III has the largest one. Strictly speaking, the Alt. II is slightly superior to the Alt. III, but this difference in the figure of net benefit is negligibly small. Therefore it can be said that in both phase I and phase I + II, the Alt. III is highly recommendable.

5.6.3 The Proposed Port Plan

The technical consideration and economical consideration support the Alt. III that has been designed at Punta Silum irrespective of the existing old pier. Consequently, in our study the Alt. III has been selected for final port plan, and further detailed technical and economic study of Alt. III will be made in the following chapter.