dollars, which represents 33 % of all charges and 8,538 US dollars for handy size.

Table 2-4-1-2 Port & Channel Charges for Rosario Port ('87)

TERMS	Particular	Panamax	Handy
	Vessel DWT	64,446	29,492
	N.R.T.	25,497	10,657
	Breadth	31.86	24.46
	Depth	18.34	13.80
	L.O.A	224.01	194.70
	Fiscal Unit	164	83
	Port Calculated	3 Days	3 Days
	Condition		
Entrance/Light Dues	US$ 0.073 × NRT	1,861	778
Permanency Dues	US$ 0.138 × NRT × Day	10,556	4,412
Pilotage(Reca./Zona Comun)	Based on Km × Fiscal Unit	1,855	1,082
Pilotage(Z.Comun/Rosario R.)	Do	4,528	2,692
Pilotage(P.Rosario Entrance)	Based on Offi.Tariff per F.U.	918	495
Pilotage(P.Rosario Depar.)	Do	918	495
Pilotage(Rosario R./Z.Comun)	Based on Km. × F.U.	4,528	2,692
Pilotage(Z.Comun/Reca.)	Do	1,855	1,082
Mooring/Unmooring	Launch Service as per Tariff	708	708
Watchmen Service	Based on Fixed Wages	377	377
Compulsory Clerk	Based on Fixed Wages	352	352
Toll Dues E.Mitra Channel	US$ 0.38 per NRT.	8,924	3,730
Custom House Guards	as per Official Tariff	200	200
Facilities for Overall Voy.	Bonus to Pilots	2,500	2,500
Minor Expenses		1,500	1,500
Agency Fee as per Tariff		3,045	2,625
	Total (US$)	44,625	25,720

Note: Fiscal Unit = LOA × Breadth × Depth Dividing the Result by 800

b) Bahia Blanca Port

Table 2-4-1-3 shows all port charges concerned with ocean vessel at Bahia Blanca port. Towage charge for panamax size vessel amounts to US 29,168 dollars, and US 17,080 dollars for handy size, representing 50 percent of all charges.

Table 2-4-1-3 Port & Channel Charges for Bahia Blanca ('87)

Term	Particular	Panamax	Handy
	Vessel DWT	64,446	29,492
	N.R.T.	25,497	10,657
	Breadth	31.86	24.46
	Depth	18.34	13.80
	L.O.A	224.01	194.70
	Fiscal Unit	164	83
	Port Calculated	3 Days	3 Days
	Condition		
Entrance/Light Dues	US$ 0.121 × NRT	3,085	1,290
Permanency Dues	US$ 0.164 × NRT × Day	12,545	5,243
Ria Pilotage(Entrance)	Based on Km×Fiscal Unit	1,381	740
Ria Pilotage(Departure)	Do	1,381	740
Port Pilotage(Entrance)	Based on Official Tariff	1,130	600
Port Pilotage(Departure)	Do	1,130	600
Towage Service(Entrance)	(Plus 40% Overtime)	14,584	8,540
Towage Service(Departure)	Do	14,584	8,540
Mooring/Unmooring	as per Official Tariff	800	800
Watchmen Service	Based on Fixed Wages- 4×Day	280	280
Compulsory Clerk	Based on Fixed Wages- 2×Day	360	360
Custom House Guards	as per Official Tariff	100	100
Facilities For Overall Voy.	BonusS to Pilots	3,000	3,000
Minor Expenses		1,500	1,500
Agency Fee as Per Tariff		3,045	2,625
	Total (US$)	58,905	34,958

Note: Fiscal Unit = LOA×Breadth×Depth Dividing the Result by 800

2) Uruguayan Ports

a) Montevideo Port

Port charge of Montevideo port is shown in table 2-4-1-4. Pilotage needs to be taken only two times to and from Montevideo port. Accordingly, pilotage charge of Montevideo port is 50 percent less than Up-river ports. From this point of view, Montevideo port is more favorable for grain terminal construction.

b) Nueva Palmira Port

Port charge of Nueva Palmira port is shown in table 2-4-1-5. Port and channel charges at Nueva Palmira port are even less than Montevideo port.

Table 2-4-1-4 Port & Channel Charges for Montevideo ('92)

Term	Particular	Panamax	Handy
	Vessel DWT	64,446	29,492
	N.R.T.	25,497	10,657
	Breadth	31.86	24.46
	Depth	18.34	13.80
	L.O.A	224.01	194.70
	Fiscal Unit	164	83
	Port Calculated	1 Day	1 Day
	Condition		
Port Pilotage(Entrance)	Based on Official Tariff	1,510	960
Port Pilotage(Departure)	Do	1,510	960
Towage Service(Entrance)	Do	3,620	2,600
Towage Service(Departure)	Do	3,620	2,600
Mooring Service	per Official Tariff/ Day	225	195
Unmooring Service	Based on Official Tariff	600	400
Watchmen Service	per Official Tariff/ Day	205	205
Agency Fee	Based on Official Tariff	3,000	2,600
Entrance Light Dues	Do	1,020	427
Others Fee	Do	500	500
	Total (US$)	15,810	11,447

Table 2-4-1-5 Port & Channel Charges for Nueva Palmira ('92)

Term	Particular	Panamax	Handy
	Vessel DWT	64,446	29,492
	N.R.T.	25,497	10,657
	Breadth	31.86	24.46
	Depth	18.34	13.80
	L.O.A	224.01	194.70
	Fiscal Unit	164	83
	Port Calculated	1 Day	1 Day
	Condition		
Channel Pilotage(Entrance)	Based on Official Tariff	4,400	3,150
Channel Pilotage(Departure)	Do	4,400	3,150
Towage Service(Entrance)	Do	0	0
Towage Service(Departure)	Do	0	0
Mooring Service	per Official Tariff/ Day	225	195
Unmooring Service	Based on Official Tariff	350	350
Watchmen Service	per Official Tariff/ Day	180	180
Agency Fee	Based on Official Tariff	3,000	2,600
Entrance Light Dues	Do	1,020	427
Others Fee	Do	400	400
	Total (US$)	13,975	10,452

(3) Fuel Expenses

a) Fuel Price

Market price of fuel in 1992 is shown in table 2-4-1-6. The fuel price is different in each country, for example, 104 US dollars/ton in Japan and US 93 dollars/ton in Brazil. In this report, we adopt US 110 dollars/ton for fuel oil and US 220 dollars for marine diesel oil.

Table 2-4-1-6 Market Price ('92)

	Japan US$/ton	Brazil US$/ton
Fuel Oil	104	93
M.Diesel Oil	227	240

b) Consumption Volume

Table 2-4-1-7 shows consumption volume of fuel oil and marine diesel oil by size of vessel. This consumption volume is taken in general as the average level.

Table 2-4-1-7 Fuel Consumption Volume

	Fuel Consumption (ton/day)				
	55,000 (DWT)	37,000 (DWT)	25,000 (DWT)	20,000 (DWT)	15,000 (DWT)
Navigation					
Fuel Oil	35	27	20	20	15
M.Diesel Oil	2	2	2	2	1
Mooring in Port					
Fuel Oil	Nil	Nil	Nil	Nil	Nil
M.Diesel Oil	2	2	1.5	1	1

2-4-2 Comparison of Transportation Route

It is necessary to examine transportation cost of the Argentine route and the Uruguayan route which will be estimated by making use of cost factor of section 2-4-1.

(1) Argentine Route

Three cases are considered concerning the transportation routes of grain from the basin of La Plata river and table 2-4-2-1 shows transportation cost per ton each.

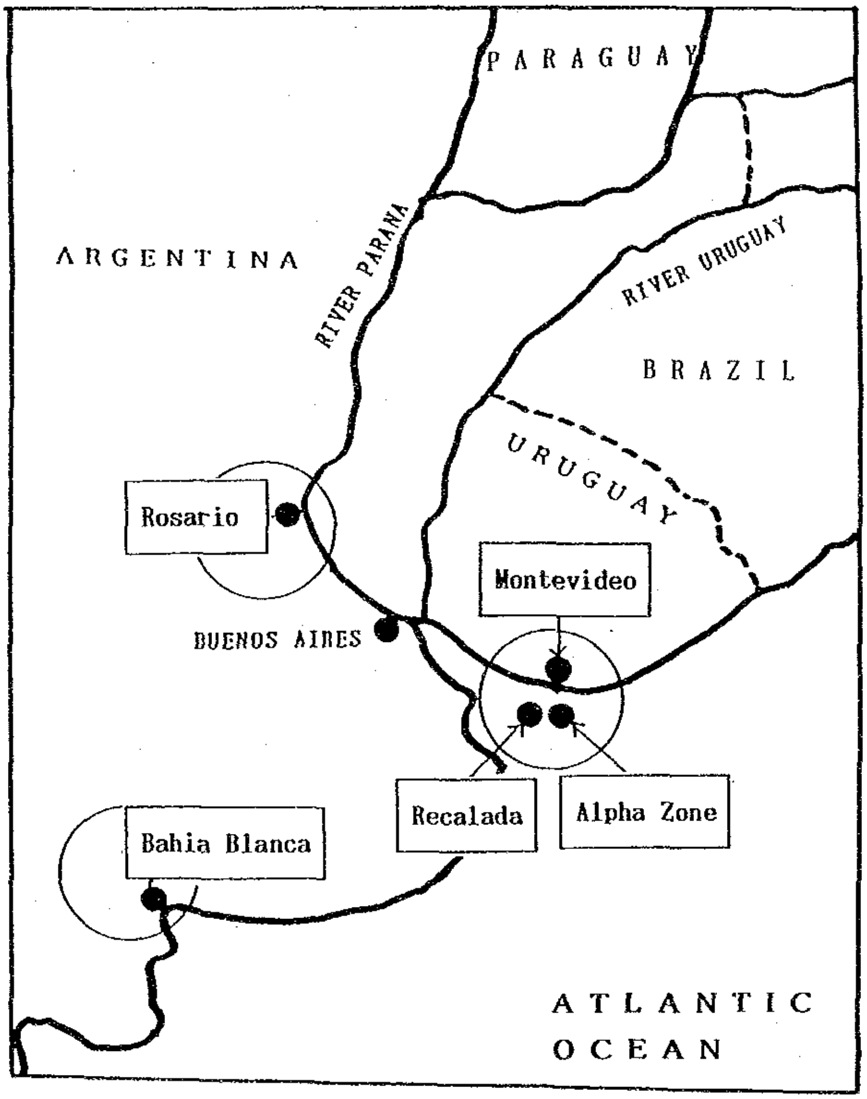


Figure 2-4-2-1 Ports Location in the Mouth of La Plata River

Table 2-4-2-1 Transportation Cost of Argentine Route

Case A-1 Panamax (52,000 tons) Recalada - Up-River (Half Load) - Alpha Zone (Fulll Load) - Recalada
Case A-2 Panamax (52,000 tons) Recalada - Up-River (Half Load) - Bahia Blanca (Full Load) - Recalada
Case A-3 Handy (35,000 tons) Recalada - Up-River (Half Load) - Bahia Blanca (Full Load) - Recalada

	Ship Cost	Port & Channel Charges	Fuel Expenses	Loading Charge	Total Transport.Cost (US $)	Trans.Cost Per Ton (US $)
Case A-1 52,000 T	Navigation Distance 1,200Km Navigation 3 days Loading (Up-River) 6 : : (Alpha Zone) 5 : Delay 21 : Total 35 days 35 days × 11,000=385,000 US$	Up-River 55,181 US$ Alphe Zone 3,710 US$	Navigation 3 days Fuel Oil 35t/day × 3=105t M.D. Oil 2t/day × 3= 6t Mooring 32 days Fuel Oil 0T M.D. Oil 2t/day × 32= 64t 105t × 110 US$ = 11,150 70t × 220 US$ = 15,400	Up-River Port Contract = Up-River port F.O.B. Alpha Zone 10 US$ × 26,000 T=260,000 US$ Including Freight between Up-River and Alpha Zone		
Sub.Total	385,000 US$	58,891 US$	26,550 US$	260,000 US$	730,441	14.05
Case A-2 52,000 T	Navigation Distance 2,800Km Navigation 6 days Loading (Up-River) 6 : : (B. Blanca) 4 : Total 16 days 16 days × 11,000=176,000 US$	Up-River 55,181 US$ Bahia Blanca 63,086 US$	Navigation 6 days Fuel Oil 35t/day × 6=210t M.D. Oil 2t/day × 6= 12t Mooring 10 days Fuel Oil 0t M.D. Oil 2t/day × 10=20t 210t × 110 US$ = 23,100 32t × 220 US$ = 7,040	Up-River Port Contract = Up-River Port F.O.B. Bahia Blanca Port Contract= Bahia Blance Port F.O.B.		
Sub.Total	176,000 US$	118,267 US$	30,140 US$		324,407	6.24
Case A-3 35,000 T	Navigation Distance 2,800Km Navigation 6 days Loading (Up-River) 6 : : (B. Blanca) 2 : Total 14 days 14 days × 9,000 =126,000 US$	Up-River 30,132 US$ Bahia Blanca 33,211 US$	Navigation 6 days Fuel Oil 27t/day × 6=162t M.D. Oil 2t/day × 6= 12t Mooring 8 days Fuel Oil 0t M.D. Oil 2t/day × 8= 16t 162t × 110 US$ = 17,820 28t × 220 US$ = 6,160	Bahia Blanca Port Contract= Bahia Blanca Port F.O.B.		
Sub.Total	126,000 US$	63,343 US$	23,980 US$		213,323	6.09

1) Case A-1

This case adopts transportation route first starting from Recalada, next loading at Up-River port, finally loading at Alpha Zone and coming back to Recalada. Objective vessel is panamax size loaded with 52,000 tons. This route presently employs the topping-off system being operated at Alpha Zone. Navigation condition on this route is as follows:

a) Navigation

Distance of navigation to and from Recalada is 1,200 km and total days of navigation is three.

b) Loading Operation

It took six days at Up-River port and five days at Alpha Zone based on data in 1984 of a private company.

c) Port & Channel Charges

Please refer to chapter in 2-4-1

d) Fuel Expenses

Navigation period is estimated at three days and 32 days for mooring.

e) Alpha Zone

Top-off operation cost of handling from top-off barge to ocean-going vessel is US 10 dollars per ton. Also this cost includes freight from Up-River ports to Alpha Zone

Transportation cost of this system is US 14.05 dollars per ton.

2) Case A-2

This case adopts the transportation route first starting at Recalada, next loading at Up-River port, topping-off at Bahia Blanca and finally returning to Recalada. Objective vessel is the same as case A-1. It is difficult to obtain the recent operation data of this route. For above reason, the delay period is excluded from the cost estimation.

a) Navigation

Total navigation distance is 2,800 km, comprising 1,200 km of to and from Recalada via Up-River port and 1,600 km to and from Recalada via Bahia Blanca. It is estimated that six navigation days will be required. In this case, it is considered that topping-off cargoes are produced in neighbouring area of Bahia Blanca port. Montevideo port is considered more profitable, since the cost of carrying grain cargoes to Bahia Blanca by truck and railway is much higher than carrying cargoes to Montevideo port by river transportation from the area of Up-River.

b) Loading Operation

Loading period is the same as in case A-1 at Up-River port. At port of Bahia Blanca, it is estimated that top-off cargoes of about 26,000 tons are handled for four days.

Transportation cost of this system is US 6.24 dollars per ton.

3) Case A-3

Navigation route is the same as in case A-2. But the objective vessel is handy size loaded with 35,000 tons. This case is prepared for comparing the transportation cost of panamax size vessel case A-2 with that of handy size.

Transportation cost in this case is US 6.09 dollars per ton.

(2) Uruguayan Route

Three cases are considered as shown in table 2-4-2-2.

1) Case U-1

This case adopts transportation route first starting from Recalada, next loading completely at Montevideo port and coming back to Recalada. Objective vessel is panamax size with the capacity of 55,000 tons. Days of navigation is negligible, because distance of navigation is only about 50 km one way. The period for loading cargoes of 55,000 tons to panamax vessel at Montevideo port is assumed at two days, although loading day is influenced by the capacity of loading equipment. Loading charge per ton at Montevideo port is assumed to be US 1.5 dollars in this chapter. This system needs a shuttle vessel service between Montevideo port and Up-River port.

Transportation cost excluding shuttle service is only US 2.21 dollars per ton.

2) Case U-2

This case adopts transportation route first starting from Recalada, next loading at Up-River ports, last loading fully at Montevideo port and coming back to Recalada. This system is assumed only for top-off operation, whose function is the same as Alpha Zone. Top-off cargoes, of course, must be carried to Montevideo port by shuttle vessel.

a) Navigation

Three days are required for vessels to navigate the distance of 1,200 km, the same distance as in Case A-1.

b) Loading Operation

Six days are required for loading at Up-River port and one day at Montevideo port. Also, loading charge at Montevideo port is estimated at US 1.5 dollars per ton.

Table 2-4-2-2 Transportation Cost of Uruguayan Route

Case U-1 Panamax (55,000 tons) Recalada - Montevideo (Full Load) - Recalada
Case U-2 " Recalada - Up-River (Half Load) - Montevideo (Full Load) - Recalada
Case U-3 " Recalada - Nueva Palmira (Half Load) - Montevideo (Full Load) - Recalada

	Ship Cost	Port & Channel Charges	Fuel Expenses	Loading Charge	Total Transport.Cost (US $)	Trans. Cost Per ton (US $)
Case U-1 55,000 T	Navigation Distance 100Km Navigation 0 day Loading (Monte.) 2 : Total 2 days 2 days × 11,000= 22,000 US$	Montevideo 16,240 US$	Navigation 0 day Fuel Oil 40t/Day × 0= 0t M.D. Oil 2t/day × 0= 0t Mooring 2 days Fuel Oil 0t M.D. Oil 2t/day × 2= 4t 0t × 110 US$ = 0 4t × 220 US$ = 880	Montevideo Port Loading Charge = 1.5 US$ 1.5 US$ × 55,000T= 82,500 US$		
Sub.Total	22,000 US$	16,240 US$	880 US$	82,500 US$	121,620	2.21
Case U-2 55,000 T	Navigation Distance 1,200Km Navigation 3 days Loading (Up-River) 6 : (Monte.) 1 : Total 10 days 10 days × 11,000=110,000 US$	Up-River 55,181 US$ Montevide 15,810 US$	Navigation 3 days Fuel Oil 35t/day × 3=105t M.D. Oil 2t/day × 3= 6t Mooring 7 days Fuel Oil 0t M.D. Oil 2t/day × 7= 14t 105t × 110 US$ = 11,550 20t × 220 US$ = 4,400	Up-River Port Contract= Up-River Port F.O.B. Montevideo Port Loading Charge = 1.5 US$ 1.5 US$ × 30,000T= 45,000 US$		
Sub.Total	110,000 US$	70,991 US$	15,950 US$	45,000 US$	241,941	4.40
Case U-3 55,000 T	Navigation Distance 508Km Navigation 2 days Loading (N.almira) 4 : (Monte.) 1 : Total 7 days 7 days × 11,000= 77,000 US$	Nueva Palmira 15,190 US$ Montevideo 15,810 US$	Navigation 2 days Fuel Oil 35t/day × 2= 70t M.D. Oil 2t/day × 2= 4t Mooring 5 days Fuel Oil 0t M.D. Oil 2t/day × 5= 10t 70t × 110 US$ = 7,700 14T × 220 US$ = 3,080	Nueva Palmira Port Contract= Nueva Palmira Port F.O.B. Montevideo Port Loading Charge = 1.5 US$ 1.5 US$ × 30,000T= 45,000 US$		
Sub.Total	77,000 US$	31,000 US$	10,780 US$	45,000 US$	163,780	2.98

c) Fuel Expenses

Three days are required for navigation and seven days for mooring.

Accordingly, transportation cost of this system is US 4.40 dollars per ton.

3) Case U-3

This case adopts transportation route first starting from Recalada, next loading about 25,000 tons to panamax size vessel at Nueva Palmira, loading fully (55,000 tons) at Montevideo port and finally returning to Recalada.

a) Navigation

Total navigation distance is 508 km. Therefore, it takes two days for navigation.

b) Loading Operation

It is estimated that four days are required for the loading operation at Nueva Palmira and one day at Montevideo port. In this case, loading charge at Montevideo port is estimated at US 1.50 dollars per ton.

Accordingly, transportation cost of this system is US 2.98 dollars per ton.

(3) Shuttle Vessel Service

All mentioned cases U-1, U-2 and U-3 require shuttle vessel service. But an efficient transportation system is not easily implemented. To reduce delay time as much as possible, a shuttle vessel schedule must be discussed and coordinated before it is finalized. Objective vessel size, about 15,000 DWT, is shown in Table 2-4-2-3. There is an additional service charge for unloading and storage at Montevideo port. The charges are estimated at US 3.0 dollars per ton.

In this chapter, navigation number of shuttle vessel for a year is decided and the transportation cost per ton is estimated to compare with the operation cost of Alpha Zone.

Table 2-4-2-3 Particulars of Standard Vessel (15,000 DWT)

Vessel Name	GRT (tons)	NRT (tons)	DWT (tons)	L.O.A. (m)	Breadth (m)	Draft (m)
Byakudan Maru	10,367	6,408	15,556	150	21.8	9.02
Shinkai Maru	10,336	6,397	15,540	150	21.8	9.02
Oregon Rainbow	9,694	6,649	15,961	142	21.8	9.10

1) Navigation Period

The navigation distance is 196 km from Montevideo port to Buenos Aires and is 447 km from Buenos Aires to San Martin, the main port among the Up-river ports. The total navigation distance is 643 km. The navigation speed of shuttle vessel is estimated at 10 knots per hour, based on river restrictions.

643 km ÷ 1.852 km = 347.2 mile
347.2 mile ÷ 10 knot = 34.7 hours
34.7 hours ÷ 24 hours = 1.44 days

Accordingly, the number of navigation days for a one-way trip is estimated at 1.5 days.

2) Loading Period at Up-river Ports

According to the operation data of a private company in 1984, loading volume was 4,292 tons on average per day. Based on this data, 3.5 days are required for shuttle vessel to load 15,000 tons. However, this system is estimated at 3 days because loading volume of shuttle vessel is 11,000 tons less than panamax size vessel. Namely, the reduction of loading volume means that there is little possibility for shuttle vessel to cause day of delay.

$$25{,}754 \text{ tons} \div 6 \text{ days} = 4{,}292 \text{ tons / day}$$
$$15{,}000 \text{ tons} \div 4{,}292 \text{ tons} = 3\ (3.49) \text{ days}$$

3) Unloading Period at Montevideo Port

The unloading capacity of new grain terminal at Montevideo port is estimated at 1,400 tons per hour. Accordingly, unloading period of shuttle vessel is one day because operation is conducted in new grain terminal 24 hours per day.

$$15{,}000 \text{ tons} \div 1{,}400 \text{ tons} = 10.7 \text{ hours}$$

4) Navigation Period for One Cycle of feeder shuttle vessel

Taking account of the above conditions, navigation period is shown in table 2-4-2-4. This navigation period includes one day per one cycle as a spare day in case of inclement weather.

Table 2-4-2-4 Navigation Period of Shuttle Vessel

Condition	Period (day)
Navigation (Montevideo - Up-River Port)	1.5
Loading (Up-River Port)	3.0
Navigation (Up-River - Montevideo)	1.5
Unloading (Montevideo)	1
Spare Day	1
Total	8.0

5) Annual Transportation Volume of Shuttle Vessel

Number of working days is estimated at 300 days per year. Accordingly, navigation number of planned shuttle vessel is estimated at 37.5 times per year. One shuttle vessel service can carry grain cargoes of 562,500 tons per year.

$$300 \text{ days} \div 8.0 \text{ days} = 37.5 \text{ navigations}$$
$$37.5 \text{ navigations} \times 15{,}000 \text{ tons} = 562{,}500 \text{ tons}$$

6) Required Capacity of Shuttle Vessel by Cargo Volume

Number of feeder shuttle vessel according to a specific volume is shown in table 2-4-2-5.

2,000,000 tons ÷ 562,500 tons = 3.55 Shuttle Vessels
2,500,000 tons ÷ 562,500 tons = 4.44 Shuttle Vessels
3,000,000 tons ÷ 562,500 tons = 5.33 Shuttle Vessels

Table 2-4-2-5 Number of Shuttle Vessels to Each Volume

Cargo Volume (tons)	2,000,000	2,500,000	3,000,000
Total Shuttle Vessel	4	5	6

7) Transportation Cost by Shuttle Vessel

Estimated transportation cost of shuttle vessel adopts cost factor described in this section 2-4-1.

(Ship Cost)

365 days x 5,000 US $ / day = 1,825,000 US $ ---------(A)

(Port & Channel Charge)

Up-river Port
37.5 Navigationsx 16,731 US $ = 627,412.5 US $ ----(a)
Montevideo Port
37.5 Navigationsx 11,447 US $ = 429,262.5 US $ ----(b)
Total Cost = (a) + (b)
627,412.5 US $ + 429,262.5 US $ = 1,056,675 US $ ---------(B)

(Fuel Expenses)

Navigation

Fuel Oil: 37.5 Nav.x3 Daysx15 Tons/Dayx110 US$ =185,625 US $ -(a)

M.D. Oil: 37.5 Nav.x3 Daysx 1 Ton /Dayx220 US$ = 24,750 US $ -(b)

Mooring in Port

Fuel Oil: Nil

M.D. Oil: 37.5 Nav.x5 Daysx 1 ton /Dayx220 US $ = 41,250 US $ -(c)

Total Cost = (a) + (b) + (c)

185,625 US $ + 24,750 US $ + 41,250 US $ = 251,625 US $ --------(C)

(Unloading & Storage Charges)

Montevideo Port

562,500 Tons x 3 US $ = 1,687,500 US $ ---------(D)

(Total Transportation Cost)

Table 2-4-2-6 shows total transportation cost.

Total Cost per Year = (A) + (B) + (C) + (D)

Table 2-4-2-6 Transportation Cost of Shuttle Vessel

Unit:US $

(A) Ship Cost	(B) Port/Channel	(C) Fuel	(D) Terminal	Total Cost
1,825,000	1,056,675	251,625	1,687,500	4,820,800

(Transportation Cost per Ton)

Total Transportation Cost/Year ÷ Total Transportation Volume/Year

4,820,800 US $ ÷ 562,500 Tons = 8.57 US $ Cost/Ton

8.57 US $

Concerning the freight of shuttle vessel from Nueva Palmira to Montevideo is assumed as the same as Up-river feeder service.

2-4-3 Transportation Cost from Montevideo Port to Each Regional Port

Table 2-4-3-1 shows the transportation cost of panamax size and handy size vessel from Montevideo port. From (c) of this table, there is only a small difference in the period of navigation for both vessels due to similar navigation speed. However, considering the transportation cost to Buenaventura, panamax size vessel is cheaper than handy size by US 0.6 dollars/ton. Also the freight charge between Montevideo and Yokohama port of Japan in Asia region is lower using the panamax size vessel by US 1.8 dollars.

From this point of view, handy size vessel (35,000 DWT) is at a disadvantage in terms of grain transportation in the world. Also, main import countries of grain, for example, Republic of China and Benelux are far away from the basin of the La Plata river. Accordingly, grain transportation from the basin of the La Plata river will be handled almost exclusively by panamax size vessel from the viewpoint of reducing of transportation cost.

Table 2-4-3-1 Comparison between Panamax Size and Handy Size Vessel (from Montevideo)

	(a) Distance. (mile)	Route	Ship Type	(b) Speed /Knot (hour)	(c) (a) ÷ (b) Period of Nav. (day)	(d) Ship Cost / Day (US $)	(e) (c) × (d) Sub.Total Ship Cost (US $)	(f) Fuel Cost	(g) (e) + (f) Total Trans.Cost	(h) Volume/ Loading (tons)	(i) (g) ÷ (h) Trans.Cost (US $/ton)
Latin America Buena ventura	5,706	Panama	Panamax Handy	13 12.5	19 19	11,000 8,000	209,000 152,000	81,510 64,790	290,510 216,790	55,000 37,000	5.3 5.9
Europa Antwerp	6,313	Atlantic	Panamax Handy	13 12.5	21 21	11,000 8,000	231,000 168,000	90,090 71,610	321,090 239,610	55,000 37,000	5.8 6.5
Middle Near East Istanbul	7,107	Gibraltar	Panamax Handy	13 12.5	23 24	11,000 8,000	253,000 192,000	98,670 81,840	351,670 273,840	55,000 37,000	6.4 7.4
Asia Yokohama	12,041	Cape G.Hope	Panamax Handy	13 12.5	39 41	11,000 8,000	429,000 328,000	153,310 139,810	556,310 467,810	55,000 37,000	10.6 12.6

2-4-4 Comparison of Each Case

Table 2-4-4-1 compares the route of Argentina with that of Uruguay.

Table 2-4-4-1 Comparison of Argentine Route and Uruguayan Route

	Loading /Volume (DWT)	(1) Ship Cost /La Plata (US$/ton)	(2) Shuttle C. /La Plata (US$/ton)	Sub.Total (US$/ton)	(3) Trans.Cost / Antwerp (US$/ton)	(1)+(2)+(3) Total Cost (US$/ton)
Argentina						
Case A-1	52,000	9.05	5.00	14.05	5.80	19.85
Case A-2	52,000	6.24	No use	6.24	5.80	12.04
Case A-3	35,000	6.09	No use	6.09	7.04	13.13
Uruguay						
Case U-1	55,000	2.21	8.57	10.78	5.80	16.58
Case U-2	55,000	4.40	8.57	12.97	5.80	18.77
Case U-3	55,000	2.98	8.57	11.55	5.80	17.35

(1) Comparison between Argentina A-1 and Uruguay U-1

In this case, a comparison of shuttle vessel service and top-off barge service is carried out.

Comparing (1) of Case A-1 with Case U-1, ship cost of Case U-1 is lower by US 6.84 dollars per ton.

Shuttle cost (2) is calculated as the cost of top-off vessel in Case A-1 and that of shuttle vessel. Comparing (2) of Case A-1 with (2) of Case U-1, shuttle cost of Case U-1 is higher by 3.57 dollars per ton. This higher cost at Montevideo port is caused by the storage charge at the New Grain Terminal. Also, comparing Sub. Total of case A-1 with that of case U-1, the transportation cost of case U-1 is lower by US 3.27 dollars per ton.

Predominant point of Case U-1 is that the cost is lower by
US 3.27 dollars per Ton

Regarding the transportation cost to Antwerp port (3), Montevideo port of Case U-1 is the same as Alpha zone of Case A-1 because of the same vessel size.

The difference in the total cost between Case A-1 and Case U-1 is US 3.27 dollars per ton, in favor of Case U-1.

(2) Comparison between panamax size vessel (52,000 DWT) of Case A-2 and handy size vessel (35,000 DWT) of Case A-3.

At basin of the La Plata river, ship cost of panamax size vessel is only US 0.15 dollars higher. But transportation cost by panamax size vessel from Montevideo port or Recalada to Antwerp port in Belgium is lower by US 1.09 dollars per ton than that of handy size vessel.

Transportation cost to Antwerp PORT (3) shows that panamax size vessel is lower by US 1.09 dollars.

(3) Comparison between Case U-3 and Case U-1.

In the case of U-3, a panamax size vessel is first loaded at Nueva Palmira port and then is fully loaded at Montevideo port. Transportation cost of Case U-1 is lower by US 0.77 dollars, compared with Case U-3.

2-4-5 Conclusion

According to this comparison of transportation cost, transportation cost of the new system is cheaper than that of topping-off system at Alpha Zone. Therefore, it is considered that there are great possibilities for this new system to be introduced to the Montevideo port. However, there are many problems to be solved before introducing the new system. The biggest problem lies in the fact that most handling cargoes are transshipped from Argentina and Paraguay. Uruguayan grain cargoes cannot be expected because production is small. The handling cargoes in Montevideo port are affected by the agricultural policy of neighbouring countries. Accordingly, the construction of new grain terminal in Montevideo port must be carefully considered through the points of not only the transportation cost but also other factors.

3 MAIN FACILITIES PLAN

3-1 General

As already examined, one of the most important problems to be solved is the low cargo handling efficiency. To attain this objective, several counter-measures were already examined in the course of the Masterplan study.

New projects proposed in the Masterplan are the expansion of container terminal, development of fishing terminal and grain terminal, remodeling of existing wharves and so on. Concerning expansion of container terminal, some study was carried out, while a part of remodeling of existing wharves is under way.

The study team selected two facilities as main port facilities, i.e., grain terminal and fishing terminal for the short term development plan.

3-2 Grain Terminal

3-2-1 View Point of Planning of the Grain Terminal

The Port of Montevideo is located at the mouth of the La Plata River. Accordingly, all cargoes to be exported or to be imported from/to up-river ports pass the front of the Port. And yet, it is necessary for these cargoes to be transshipped because the depth of these ports is not enough for accommodating ocean-going vessels in many cases. It is easier to maintain a sufficient depth at the Port of Montevideo than at other ports in La Plata River Basin. Consequently, the Port of Montevideo has not only a locational advantage but also physical superiority in terms of depth.

Nowadays, many ports in the world play roles as transshipment bases of cargo in the world trade network. Among other things, container cargo is the most predominant one. The next will be bulk cargo.

Grain terminal in the Port of Montevideo would provide the transshipment base for grain cargoes produced in La Plata River Basin. Although it has several advantages, it should be attractive for international shipping corporations which provide shipping services from/to La Plata River Basin. What is the attractiveness? That would be the high quality of service at a low cost. It is considered that high quality of service with low cost depends on high efficiency, i.e., high cargo handling capacity of equipment, deep draft of basin and channel, calm and safe water area and so on.

3-2-2 Objective Vessel Size and Berth Dimension

(1) Objective Vessel Size

As described in the previous chapter, new transportation system is composed of export from the Port and shuttle service between the Port and up-river ports. Export is conducted by main vessel and shuttle service is conducted by shuttle vessel.

1) Main Vessel

Figure 3-2-2-1 shows ship size distribution of grain carrier by exporting area. According to this figure, in case of South American Countries, the category of 40,000 to 60,000 DWT accounts for the majority with 40% of the total. At the same time, the category of 60,000 to 80,000 DWT also represents a high share (38%).

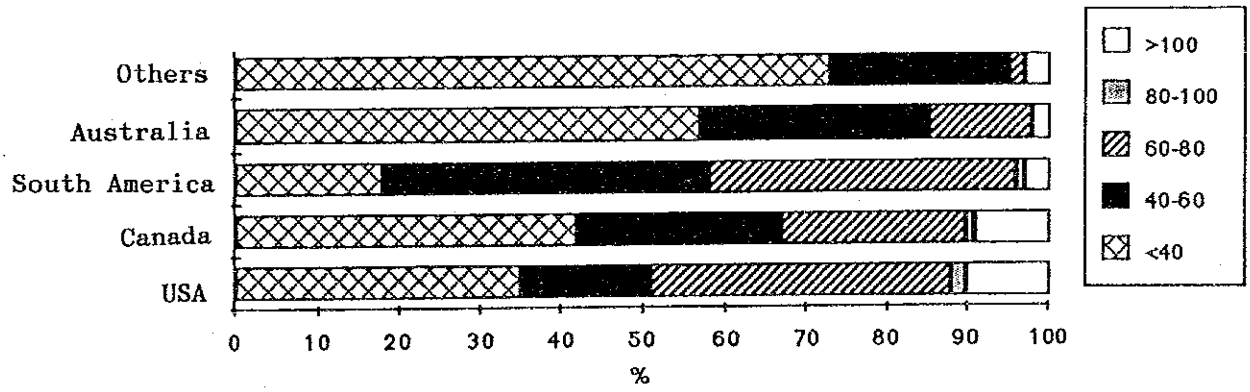


Figure 3-2-2-1 Distribution of Grain Bulk Carrier Size by Exporting Region (1987)

Table 3-2-2-1 shows dimension data of vessels which were topped off at the Alpha zone in 1984. Several vessels whose dimension data are unknown are excluded from this table. The biggest vessel size was about 72,000 DWT, while the minimum vessel size was about 31,000 DWT. The category of 60,000 to 70,000 holds the majority share. The full load draft of many vessels is more than 12 m and the number of vessels whose draft is less than 12 m is only five. The depth of Alpha zone is around 12 m. Accordingly, it is assumed that they were not topped off to the full capacity. And also it is assumed that tidal difference is used to some extent.

Table 3-2-2-1 Dimensions of vessels topped off at the Alpha Zone

Name	DWT	Length	Draft	Breadth	Bilt	Frequency
FLISVOS	35308	194.6	10.7	27.2	1971	1
PACIFIC PROSPERITY	64976	228	12.8	32.3	1982	2
SATURN	62212	224	12.6	32.7	1980	3
PANTHER	61188	227.7	12.2		1982	2
CHRISMIR	62185	224	11.3		1980	2
ORIENT ENTERPRISE	66917	224	13.7	32.3	1968	2
MAKEDONIA	68024	224	13.7	32.3	1973	2
ROLLON	67826	224	13.6		1973	2
ANITA VENTURE	61776	223	13		1982	2
EVLIMEN 1	61613	224.5	12.4	32.2	1979	2
NEPTUNE C	68401	235.5	13.7	31.9	1967	1
MASSIMILIANO F	54562	223.5	12.7	30.6	1973	1
PRECIOUS	65420	224.4	12.6	32.3	1981	1
HELLES PONT MERCHANT	64730	230.2	13	32.3	1978	1
HELLESPONT MARINER	64657	230.2	13	32.3	1978	1
APNIA	72073	230	14.4	32.3	1975	1
MIRANDA	31130	194.7	10.4	24.5	1964	1
PLOTO	63260	235	12.7	31.9	1968	1
BULGARIA	52700	215.4	12.3	31.9	1978	1
ANGELIC GRACE	68847	228.8	13.3	32.3	1971	1
ZUREIKA BORGES	38677	200.9	10.4	27.3	1980	1
WORLD NOBILITY	45821	190	12.3	29	1967	1
ANTARTICO	47917	211.7	11.9	28.6	1965	1
KANG SU HAI	64444	224	13.3	31.8	1975	1
NICHOLAS G PAPALIOS	53351	206.8	13.3	29.1	1975	1
DAMODAR G T J PARK	53586	229.1	12.6	28.6	1975	1

Concerning bulk carrier, relations between overall length and DWT, full load draft and DWT, breadth and DWT are shown in Figure 3-2-2-2, 3-2-2-3, 3-2-2-4.

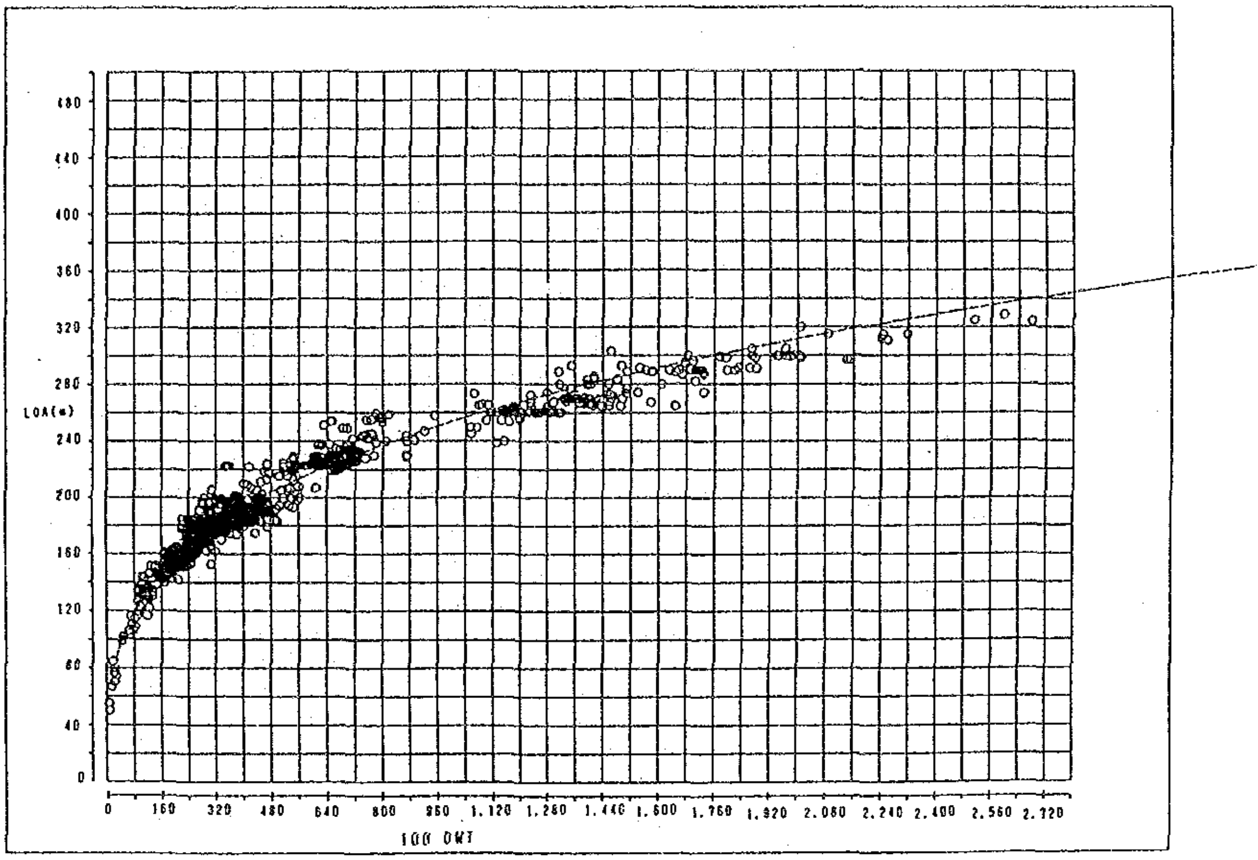


Figure 3-2-2-2 Relations between Overall Length and DWT

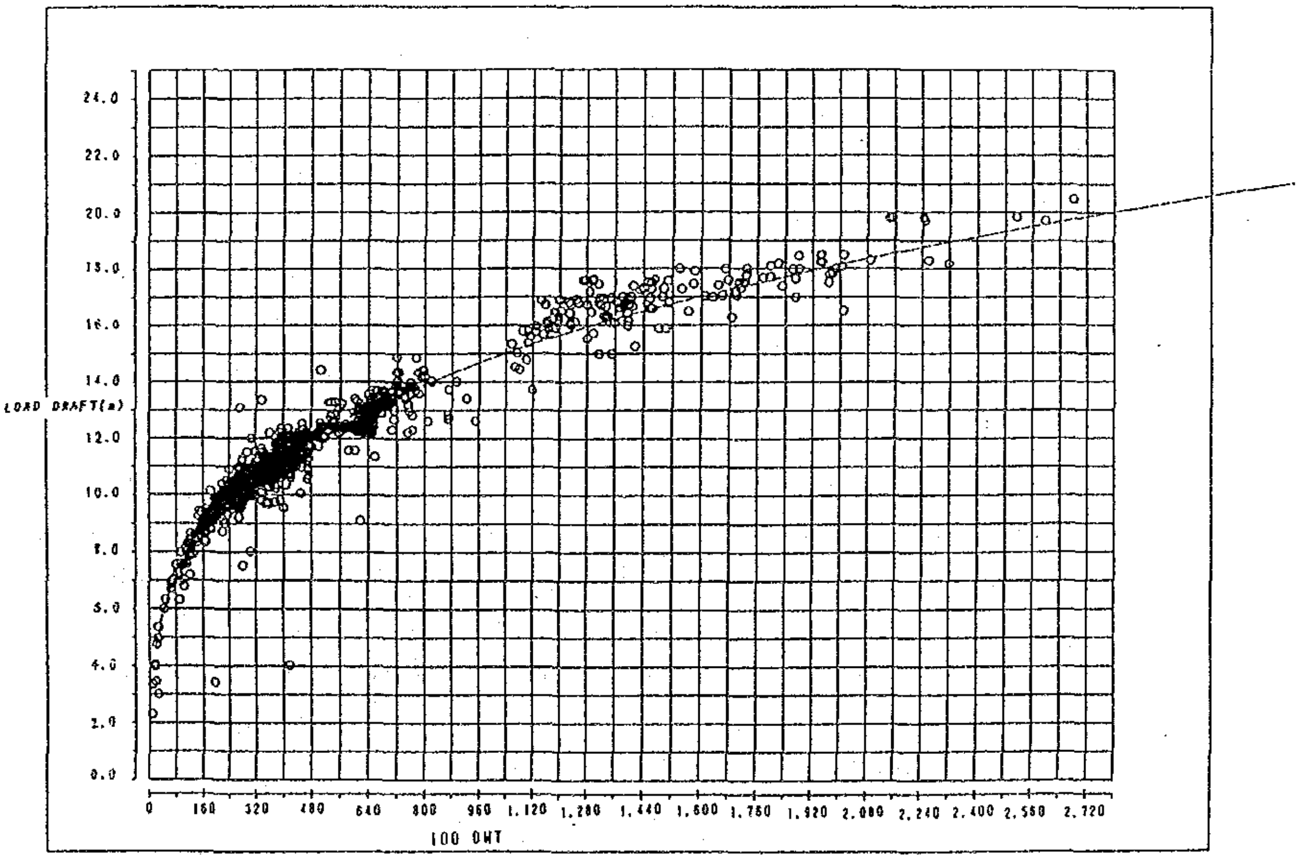


Figure 3-2-2-3 Relations between Full Load Draft and DWT

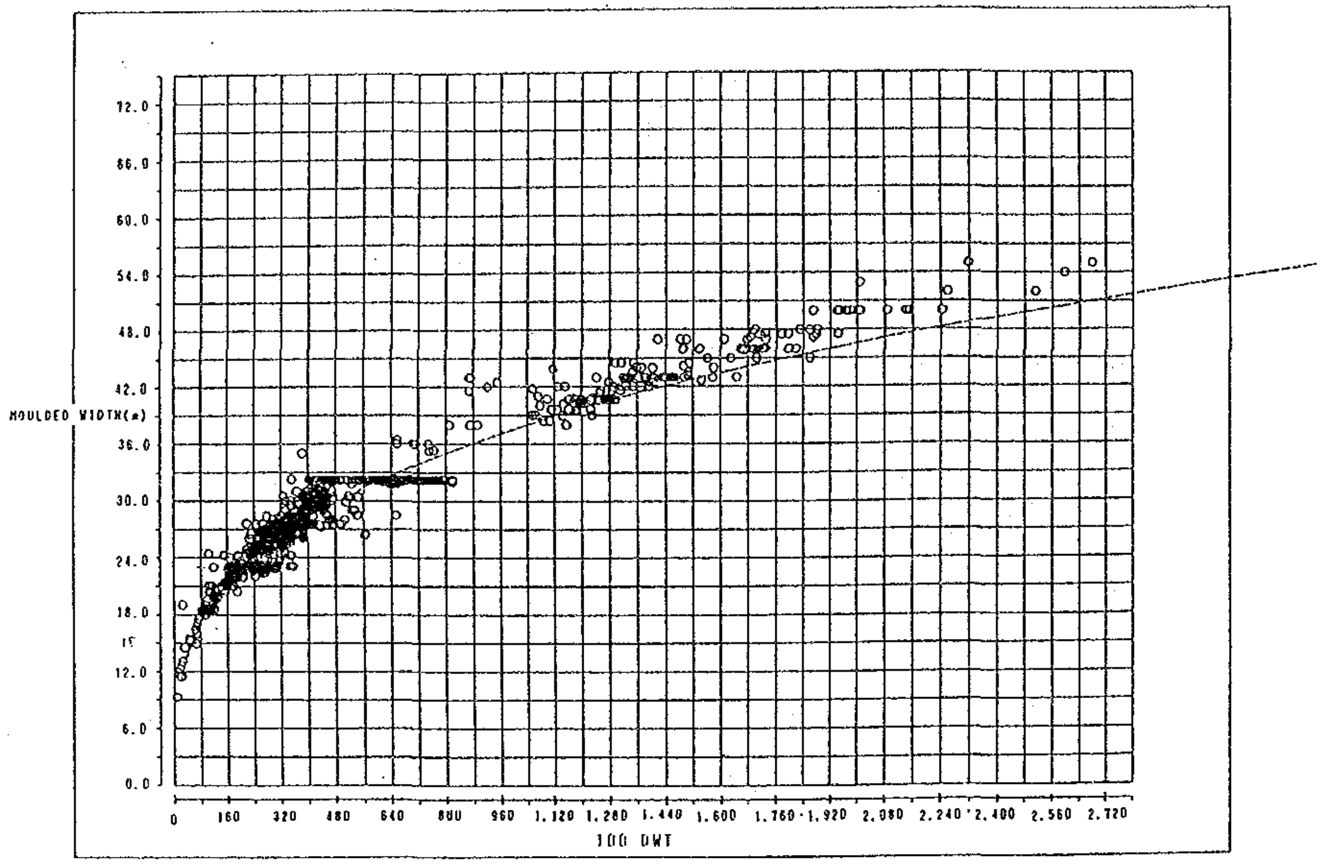


Figure 3-2-2-4 Relations between Breadth and DWT

From these surrounding conditions described above, the objective vessel size of main vessel is assumed as follows:

Objective Vessel Size: 65,000 DWT

Length = 230m, Full Load Draft = 13m

Ordinary Load Draft = 11.5m

2) Shuttle Vessel

Shuttle vessel size is determined from the physical limit of channel between the Montevideo port and the up-river ports. As described in Chapter 4 of Part I, the depth of Mitre Channel is 9 m and a margin of 0.30 m has to be left below the keel for navigation.

From these conditions, following is adopted for the maximum size of the shuttle vessel:

Objective Vessel Size: 15,000 DWT

Length = 145m, Full Load Draft = 8.7m

(2) Berth Dimension

1) Main vessel

Berth depth is determined by adding an under keel clearance to the draft of objective vessel. Generally, 10 percent of the draft is added as the clearance. According to the Master Plan, 0.90 m is proposed as the clearance, including the tidal difference of 0.40 m.

Besides these technical matters, following conditions should be considered to determine the depth of berth:

(a) The depth of Alpha zone is about 12m.

(b) There are some ocean ports which are accommodating ocean-going grain vessels in the neighboring countries. Depth of berth in ports such as Paranagua and Bahia Branca is approximately 12 m.

Considering this situation, the depth of the new grain terminal has to be at least 12 m to compete with other ports located near by.

Dredging cost of the approach channel and basin is enormous; however, as dredging will be required for other facilities in the near future, there is a possibility that the costs will be shared. Here, cost allocation can be assumed, considering the following matter.

(c) The depth of container terminal is planned at -11 m. However, there is a strong tendency to increase the size of container vessel. According to new building orders of container vessel, forty vessels with capacities of more than 2000 TEUs were ordered by main shipping lines in 1990, and it can be said that the trend toward large vessels is continuing.

Table 3-2-2-2 New Building Orders of Container Vessel by Size

TEU CLASS	1988			1989			1990		
	VSL %	DWT	TEU %	VSL %	DWT	TEU %	VSL %	DWT	TEU %
UNDER 1000	21 34	234,136	12,321 13	29 22	463,560	14,528 6	40 32	386,856	21,655 11
1000 -1999	20 33	315,810	21,498 22	56 42	1,081,820	73,319 32	43 35	824,741	55,350 28
2000 -2999	10 16	385,000	27,140 28	30 23	1,224,760	78,300 34	23 19	904,747	55,438 28
3000 -3999	7 12	322,587	24,550 25	11 8	547,860	37,100 16	16 13	835,910	59,568 31
4000 & OVER	3 5	181,917	12,000 12	6 5	330,000	26,425 12	1 1	51,800	4,300 2
TOTAL	61 100	1,439,450	97,509 100	132 100	3,648,000	229,672 100	123 100	3,004,054	196,311 100

Source: World Container Fleet (NYK(NIppon Yusen Kabushikigaisha))

Some vessels which recently calls at the neighboring ports have deep draft as follows:

Route: North America and South America, American Transport Lines
Sea Fox: 34,318GRT, 1,914TEU, 18.5Knot
(L, B, Dr =198.8m, 32.2m, 10.9m)
Sea Wolf: 34,318GRT, 1,914 TEU, 17.7Knot
(L, B, Dr =198.8m, 32.2m, 10.9m)
Sea Lion: 34,318GRT, 1,914TEU, 17.7Knot
(L, B, Dr =198.8m, 32.2m, 10.9m)

Route: Europe, Mediterranean and South America
HAMBURG-SUDAMERIKANISCHE DAMPFSCHIFFAHRTS-
GESELLSCHAFT EGGERT & AMSINCK
Cap Polonio: 29,739GRT, 1,960TEU, 18.5Knot
(L, B, Dr =200,2m, 32.2m, 12.0m)
Cap Trafalgar: 29,739GRT, 1,960TEU, 18.5Knot
(L, B, Dr =200.2m, 32.3m, 12.0m)

From these trends, it is considered that the depth of container berth will increase to at least 12m in near future.

(d) The number of large vessels entering the port for grain handling is assumed to be less than 60. Therefore, it is possible to consider that vessels entering/departing the port will be carried out using tide. (The mean tidal level is about 0.9m above C.D.L in Montevideo)

On the other hand, berth length is determined by adding the breadth to the length of the objective vessel.

Accordingly, dimensions of berth, and that of basin are assumed as follows:

Depth of berth = -13m
Length of berth = 270m
Depth of basin = -12m

2) Shuttle Vessel

In accordance with the objective vessel size, dimensions of shuttle vessel berth are assumed as follows:

Depth of berth = -9.5m
Length of berth = 170m

3-2-3 Required Number of Berth

In case of a grain bulk terminal, generally speaking, fundamental ideas to be considered are as follows:

(a) From the view point of port interest, one high-capacity grain bulk cargo terminal is preferable to two or more terminals with moderate yearly capacity.
(b) Expansion in installing additional ship loader and higher-capacity conveyors and increasing the stockpile area at a later stage would prove more economical than the construction of a second terminal for grain.
(c) According to handling volume data of existing grain terminals in USA shown in Table 3-2-3-1, many terminals handle a fairy large amount of cargo volume using only one berth.

The maximum grain cargo volume to be handled at the Port in 1998 will be around 2,800,000 tons. Accordingly, it is considered that one berth can handle this amount of cargo by handling equipment with sufficient capacity. An proper capacity of handling equipment is calculated in the next section.

Table 3-2-3-1 Present Conditions of Grain Elevators in New Orleans, USA

Elevator	Storage Capacity (MT)	Loading Capacity	Number of Berth	Handling Volume ('000 ton)	Turnover Rate
Zennou Grain Elevator	105,000	3,000	1	11,300	108
Cargill Grain Elevator	187,000	1,750	1	1,560	8
Peavey Grain Elevator	50,000	1,500	1	3,300	66
Cargill Grain Elevator	141,000	2,000	2	10,140	72
Reserve Grain Elevator	107,000	1,750	1	3,830	36
ST Charles Grain Elevator	150,000	1,750	1	5,130	34
BUNGE Grain Elevator	175,000	2,500	1	3,110	18
ADM Growmark Grain Elevator	131,000	1,500	1	8,200	63
Continental Grain Elevator	106,000	3,000	2	9,700	92
Mississippi River Grain Elevator	150,000	2,000	1	2,190	15

3-2-4 Handling and Storage Facility

As already described in the former chapter, grain transported from up-river ports is transshipped, in principal, through unloader, silo and loader. Grain produced within Uruguay is brought into the port by truck and loaded to vessel after storing in silo.

(1) Handling Facility

1) Method of Calculation

Handling facilities to be planned are loader, unloader and relevant equipment. Grain terminal is a new facility in the Port of Montevideo and there are no data related to handling efficiency, ship arrival and so on.

Therefore, these data are supplemented with data usually used in these operations. Required capacity of handling equipment is calculated based on premises described below:

a) Minimum estimated volume, 2,000,000 tons, is assumed as the target cargo volume.
b) Arrival distribution is assumed to be Poisson distribution.
c) Berthing time distribution is assumed to be Erlung distribution
d) Number of unit of handling equipment is, in principal, two.

Optimum handling capacity will be normally determined so as to make the total cost of transportation minimal. Transportation cost comprises many components. When the capacity of handling equipment changes, ship cost in the port, handling cost itself and procurement cost of handling equipment would change in the transportation cost. Accordingly, when total of these costs described above reaches the minimum level, it is possible to consider that optimum capacity of handling equipment is attained.

Formulas used for this calculation are as follows:

$C = C_1 + C_2$

where: C : Total Cost

C_1 : Ship Cost per Unit Cargo Volume

C_2 : Handling Equipment Cost per Unit Cargo Volume

$C_1 = (Cs \times Tm)/Ws$

Where: Cs : Ship Cost

Tm : Average Staying Days in the Port

Ws : Average Loading(Unloading) Volume per Vessel

$Tm = Th + Tw$

Where: Th : Average Berthing Days

Tw : Average Waiting Days

$Th = Ws/(Qn \times N \times h \times r) \times 365/d$

where: Qn : Capacity of Loader(Unloader)

N : Number of Unit of Loader(Unloader)

h : Working Hours per Day

r : Handling Efficiency

d : Workable days per year

$Tw = \rho/(\mu(1-\rho)) \times 0.6$

where: ρ : Berth Occupancy Rate(λ/μ)

μ : Average Berthing Number of Vessel per Day

λ : Average Arrival Number of Vessel per Day

2) Result of Calculation

The results of the calculation are as follows:

Cargo Volume (ton)	Optimum Capacity (ton x unit)	
	Unloader	Loader
2,000,000	900 x 2	1,200 x 2

Comparing these data with those in table 3-2-3-1, the figures above are larger. It is considered that ship cost incurred by waiting for the berth attributes to this result. Generally speaking, it is possible to assume that ship arrival scheduling would be made for specified berth where only one kind of cargo is handled. Therefore, it is assumed that some lower capacities would be more realistic. Through this consideration, capacities are determined as follows:

Cargo Volume	Optimum Capacity	
	Unloader	Loader
2,000,000	700 x 2	900 x 2

(3) Storage Facilities

Required storage capacity of silo is calculated using the following formula:

$$V = (N \times C)/(R \times \alpha)$$

Where V : Required Storage Capacity
N : Annual Handling Volume of Cargo
C : Peak Ratio(1.3)
R : Turnover Rate
α : Utilization Rate(0.7)

According to the data of transshipment grain terminal shown in table 3-2-3-1, turnover rate varies from 8 to 108 and the average is 50.1 in nominal. In case of transshipment, the turnover rate is comparatively high. However, at the same time, turnover rate is determined based on the level of operational technique. Therefore, turnover rate of silo in Montevideo Port is assumed at 40, since such a high level of productivity may not be possible at this time.

Objective main vessel size is 65,000 DWT and loading volume is 55,000 tons. Accordingly, the capacity of silo should be more than 55,000. Considering utilization rate of 0.7, the minimum capacity required will be 80,000 tons.

Based on these premises, required storage capacity is calculated as follows:

Cargo Volume(ton)	Required Capacity(ton)
2,000,000	93,000

3-2-5 Channel and Basin

(1) Channel

Layout, width and depth of channel should be determined for objective vessels to pass safely.

According to the Masterplan study, layout is determined considering the volume of sedimentation. In case of river port, sedimentation is sometimes one of the most important points. As already described, the method used for estimating the sedimentation volume in the Masterplan study is deemed generally appropriate, and therefore layout plan taken in the Masterplan study is assumed to be appropriate.

One-way channel is planned as recommended in the Masterplan study. Channel width should be decided by the size of ship to be catered for and sea conditions. Length and breadth of the maximum objective vessel for grain transportation are 230 m and 32.2 m, respectively. The maximum current velocity is 40 cm/sec and it does not affect navigational condition. According to UNCTAD standard, the minimum value for the width of a one way channel is 5 times the beam width of the biggest vessel in the absence of a cross current. Based on this standard, the width of the channel is calculated at 160m (5 x 32.2m = 160 m). In Japan, guidelines state that a one-way channel should have a width of more than 0.5 L (L = Length Overall). From these considerations, 160 m is determined as the width of channel.

According to the Masterplan study, 1 m is considered as the keel clearance. Since the draft of the maximum vessel is 11.5 m, the depth of channel will be 12.5 m. On the other hand, PIANC suggest 10 % of the maximum draft as the gross under-keel clearance on the condition that the planning area is less exposed to swell. If this suggestion is applied, the depth will be 12.7 m.

Since frequency of the maximum vessel's passage of channel would be low, it is possible to use the tide. In Montevideo Port, Mean Water Level is situated at 91 cm above the tidal datum and average tidal difference is 45 cm. Considering these conditions, 12m is determined as the depth of channel.

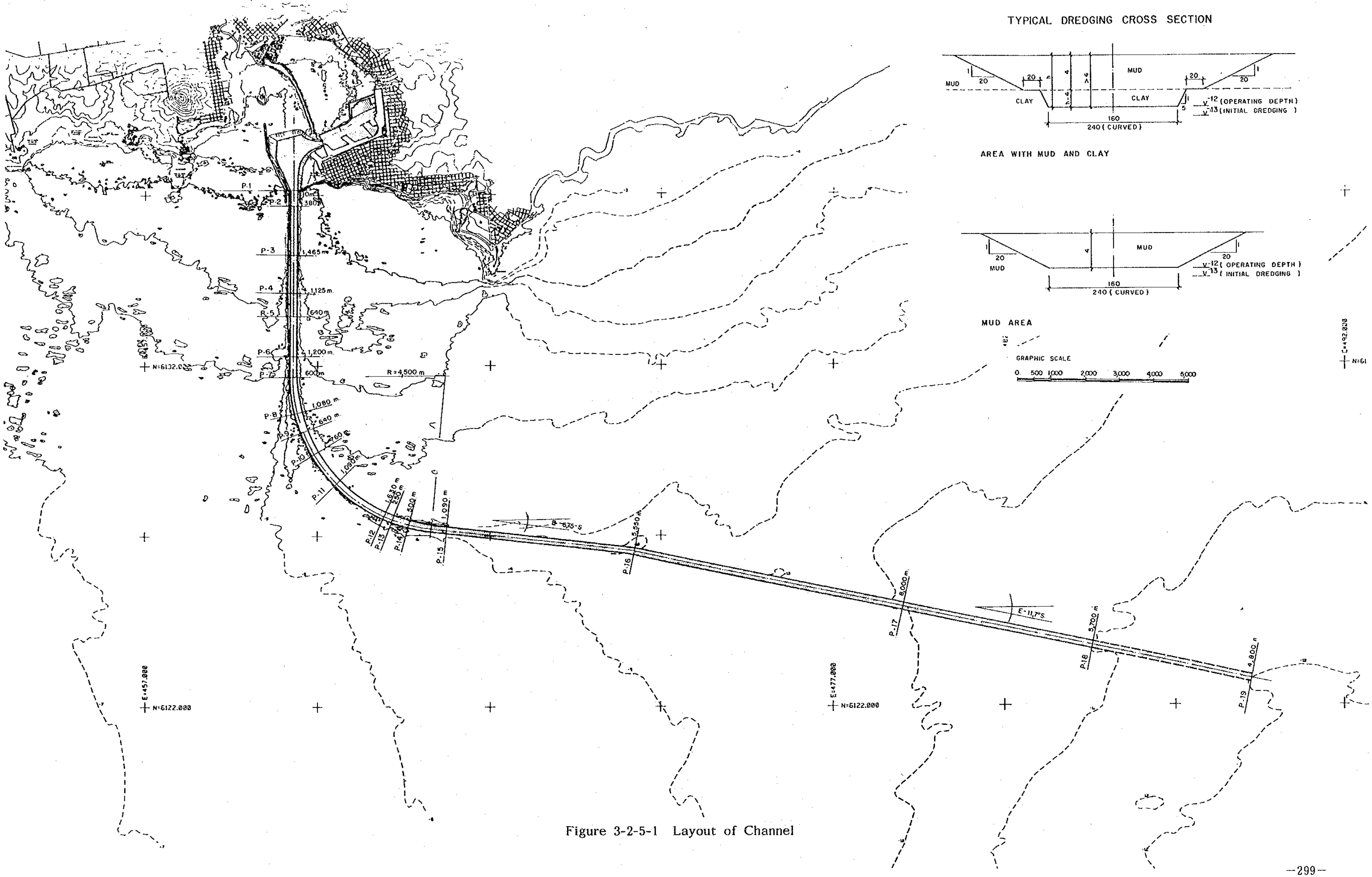


Figure 3-2-5-1 Layout of Channel

(2) Basin

Under the condition that turning of vessel is carried out with the assistance of tug boat, circle area with diameter of 2L (L = Length overall of the objective vessel) should be secured. The depth of basin in front of the grain berth for main vessel is planned at -13 m with a width of 50 m (1.5 B, B = breadth).

3-2-6 Selection of the site

(1) Candidate sites of grain terminal

There are four candidate sites for grain terminal as follows:

(a) Site 1--East side of Wharf A
This wharf is used for handling general cargo. Size of apron is very narrow and transit sheds are not utilized much. In the Masterplan study, it is recommended to construct a silo at the place where transit sheds are demolished.

(b) Site 2--East side of west breakwater
It is possible to provide a deep and wide area for accommodating large vessel in this alternative site.

(c) Site 3--North side of Cintura breakwater
This area is not used now. It is possible to provide a deep and wide area for accommodating large vessels there.

(d) Site 4--North side of Sarandi breakwater
There is an unused wide water area on the north side of Sarandi breakwater. Although there is an idea to construct a naval base here in the Masterplan, this idea still remains in the conceptual stage.

Location of the four alternatives is shown in Figure 3-2-6-1 and a very rough layout plan of each alternative is shown in Fig 3-2-6-2 to Fig.3-2-6-5. The layout and length of breakwater are determined considering similar ideas examined in the course of the Masterplan study.

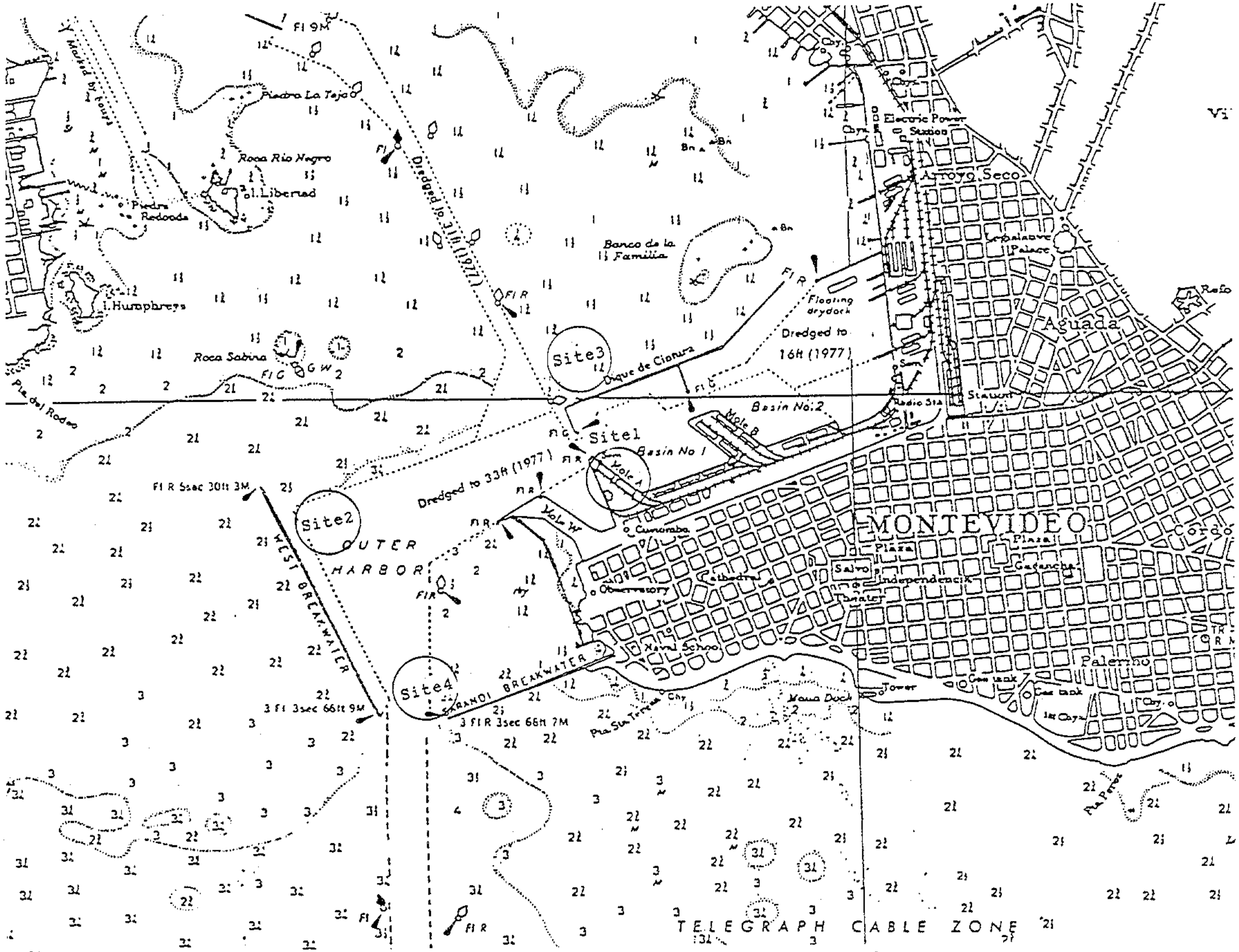


Figure 3-2-6-1 Candidate Sites of Grain Terminal

Figure 3-2-6-2 Layout Plan in Site 1

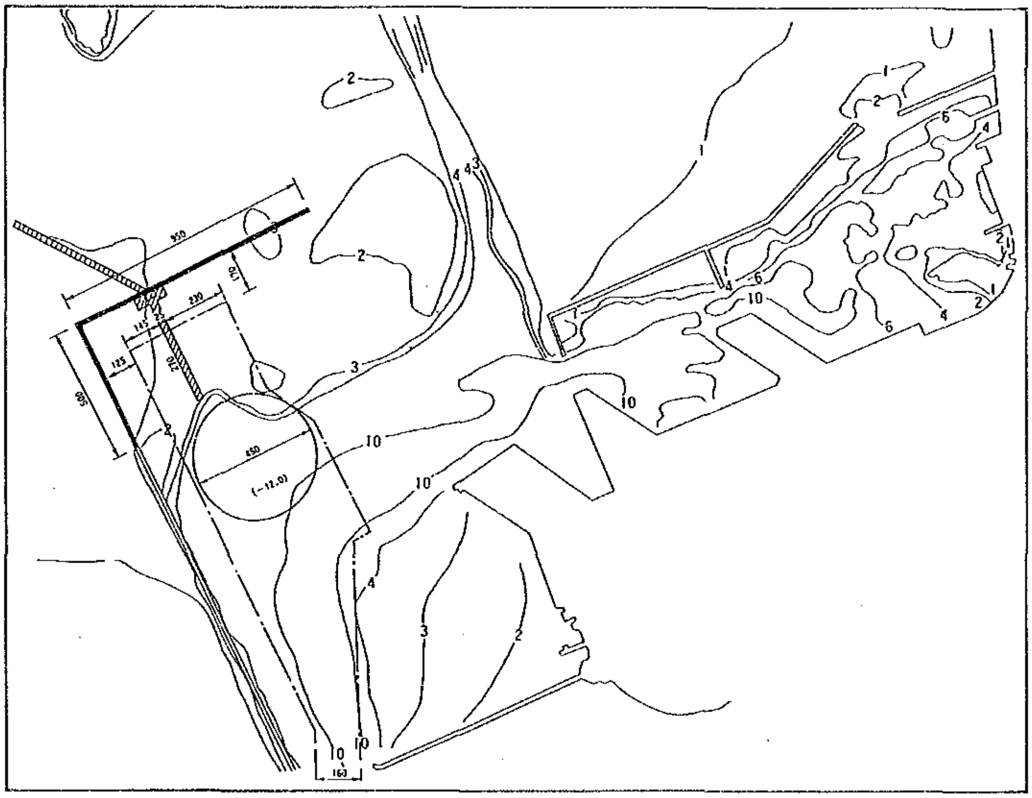


Figure 3-2-6-3 Layout Plan in Site 2

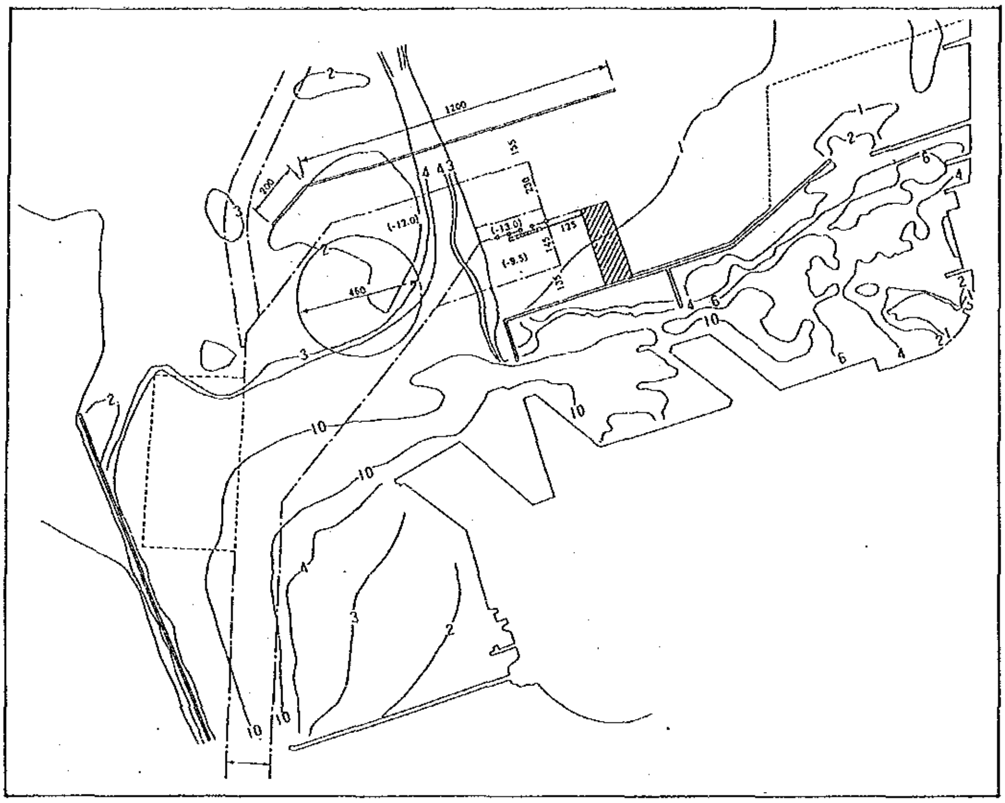


Figure 3-2-6-4 Layout Plan in Site 3

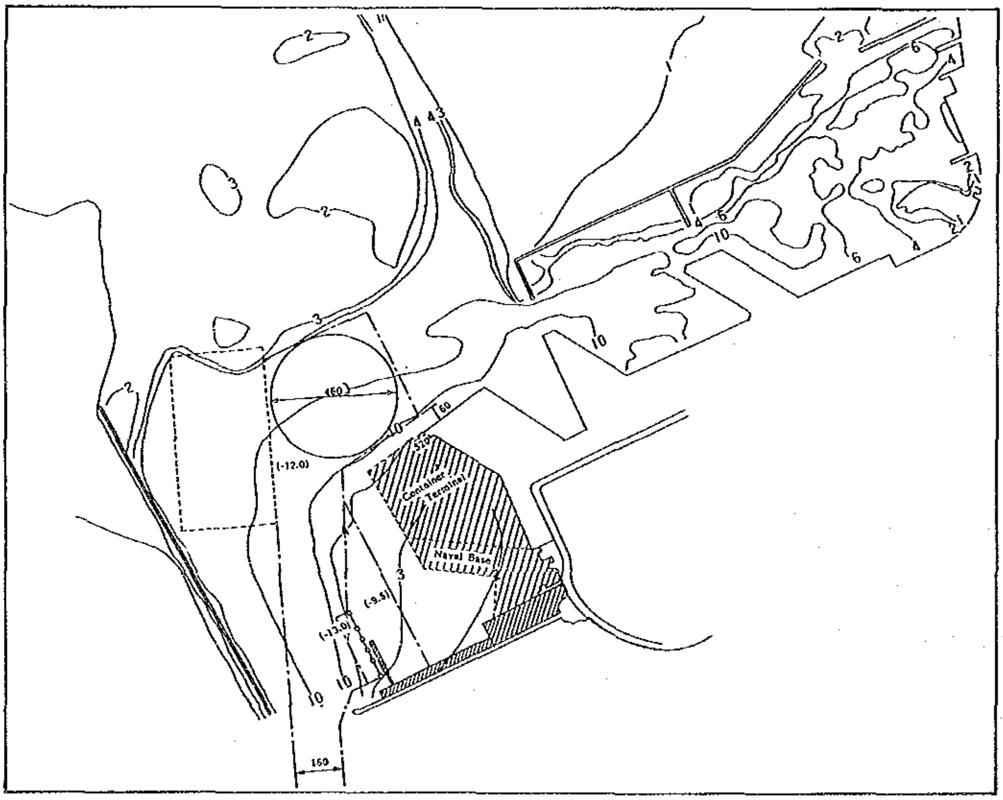


Figure 3-2-6-5 Layout Plan in Site 4

(2) Rough Cost Estimation for Four Alternatives

For the comparison of construction cost for four alternatives described in foregoing section, rough cost estimation is presented in this section based on the following conditions:

1) Estimation Limits and Conditions

* Not included are such common costs for four alternatives as initial dredging costs of approach channel and foreport and construction costs of grain handling equipment and the related facilities.

* Indirect construction costs such as mobilization, physical contingency, overhead and so on are not included.

* Taxes locally imposed on materials and labors except customs duties are included.

* Maintenance dredging costs are estimated referring to annual shoaling heights of sediment evaluated in Chapter 6 of Part I.

2) Exchange Rate

Exchange rates among U.S.$, Uruguayan Peso and Japanese Yen are as follows:

1 U.S.$ = 2,667 N.$ = 130 Yen

Construction costs are estimated using the price at the end of February, 1992.

3) Estimation Procedure

* The prices of main materials used for the cost estimation are listed as follows:

Concrete	Stone	Aggregate	Steel
(US$/$m^3$)	(US$/$m^3$)	(US$/$m^3$)	(US$/ton)
170	29	36.5	915

* Prices in Japan, Argentina and Brazil are used for estimating the costs of imported materials and goods.

* If the prices are unavailable, they are estimated by comparing the prices of other goods in Japan, Uruguay and the other neighboring countries.

* The additional tax rate on the materials is estimated as 22 %.

Estimation Result for Four Alternatives are presented in Table 3-2-6-1 to 4.

Table 3-2-6-1 Construction and maintenance Dredging Cost of Site 1

Unit: in US$

No.	Description of Works	Unit	Q'ty	Unit Price	Total Amount (X 1,000)	Remarks
A	Initial Construction Cost	LS	1		7,044	
1	Dredging	m^3	542,000	1.59	862	-13/-9.5m
2	Removal of 2 Sheds	LS	1		656	
3	Pavement	LS	1		159	
4	Mooring Facilities	LS	1		4,167	
5	Belt Conveyer	LS	1		1,200	
B	Maintenance Dredging Cost	LS	1		437	Shoaling Thickness
6	Port Mouth	m^3	39,441	1.59	62	0.99 m/yx0.3
7	Central Area	m^3	142,783	1.59	227	1.41 m/yx0.3
8	Transfer Station	m^3	93,050	1.59	148	0.50 m/y

Table 3-2-6-2 Construction and maintenance Dredging Cost of Site 2

Unit: in US$

No.	Description of Works	Unit	Q'ty	Unit Price	Total Amount (X 1,000)	Remarks
A	Initial Construction Cost	LS	1		47,103	
1	Dredging	m^3	2,332,300	1.59	3,708	-13/-9.5m
2	Breakwater	m	1,450	11,372.42	16,490	
3	Filling	LS	1		1,196	
4	Revetment	LS	1		1,180	
5	Pavement	LS			198	
6	Mooring Facilities	LS			9,046	
7	Connecting Bridge	m	1,200	6,037.52	7,245	
8	Belt Conveyer	LS	1		8,040	
B	Maintenance Dredging Cost	LS	1		372	Shoaling Thickness
9	Port Mouth	m^3	61,992	1.59	99	0.80 m/yx0.3
10	Central Area	m^3	32,081	1.59	51	0.29 m/yx0.3
11	Transfer Station	m^3	140,000	1.59	222	0.70 m/y

Table 3-2-6-3 Construction and maintenance Dredging Cost of Site 3

Unit: in US$

No.	Description of Works	Unit	Q'ty	Unit Price	Total Amount (X 1,000)	Remarks
A	Initial Construction Cost	LS	1		47,804	
1	Dredging	m^3	6,694,000	1.59	10,643	-13/-9.5m
2	Breakwater	m	1,400	11,372.42	15,921	
3	Filling	LS	1		6,655	
4	Revetment	LS	1		3,566	
5	Pavement	LS			773	
6	Mooring Facilities	LS			9,046	
7	Belt Conveyer	LS	1		1,200	
B	Maintenance Dredging Cost	LS	1		643	Shoaling Thickness
9	Port Mouth	m^3	31,872	1.59	51	0.80 m/yx0.3
10	Central Area	m^3	14,181	1.59	22	0.29 m/yx0.3
11	Transfer Station	m^3	358,855	1.59	570	0.70 m/y

Table 3-2-6-4 Construction and maintenance Dredging Cost of Site 4

Unit: in US$

No.	Description of Works	Unit	Q'ty	Unit Price	Total Amount (X 1,000)	Remarks
A	Initial Construction Cost	LS	1		21,224	
1	Dredging	m^3	935,980	1.59	1,488	-13/-9.5m
2	Filling	LS	1		4,426	
3	Revetment	LS	1		1,855	
4	Pavement	LS			345	
5	Mooring Facilities	LS			9,430	
6	Belt Conveyer	LS	1		3,680	
B	Maintenance Dredging Cost	LS	1		399	Shoaling Thickness
9	Port Mouth	m^3	39,441	1.59	63	0.99 m/yx0.3
10	Central Area	m^3	103,719	1.59	165	1.41 m/yx0.3
11	Transfer Station	m^3	107,730	1.59	171	0.70 m/y

(3) Comparison of Four Alternatives

An evaluation of four sites by item is shown in Table 3-2-6-5.

Table 3-2-6-5 Evaluation of Alternative Site

	Site 1	Site 2	Site 3	Site 4
Cost	○	×	×	○
Construction	○	×	×	○
Maintenance	△	○	○	△
Development potential	×	○	○	○
Basin	×	○	○	○
Calmness	○	○	○	○
Construction difficulty	○	○	○	○
Environmental aspect	×	○	○	○
Coordination with other plan	○	○	△	△

Note: ○ △ × show the grade of preference in this order.

1) Preliminary Selection

Following conditions are basic matters for selection of the site:

* Transshipment base should be constructed at the place directly connected to the land.

* Transshipment base should be constructed at as low a cost as possible for securing competitiveness. Therefore, a site which requires high construction costs for works such as long breakwater and wide basin area should be rejected.

From these two criteria, two candidate sites, Site 2 and 3 would be abandoned:

Site 2 is located off shore and it would cost a lot to construct connection means from that location to land.

Also site 3 is currently located off shore. In spite of the fact that there is a plan to connect the Cintura breakwater to land, the plan has been suspended pending the conclusion of water pollution survey which has yet to be conducted. There is one more difficult matter for this site; the need for a long breakwater as a countermeasure against sedimentation.

2) Qualitative Comparison of Two Alternatives

Characteristics of two sites (Site1, Site4) are as follows:

a) Site 1

* Since this site is used for handling general cargoes, remodeling of this berth for the use of handling grain cargo might cause shortage of handling capacity for general cargo.

* It would be the cheapest site for constructing the grain terminal because most of existing main terminal facilities could be available.

* Basin 1 does not have sufficient space for turning of large vessels more than approximately 50,000 DWT.

* It is very difficult to shut out dust arising from loading of grain. Since this site is very near the city area, it is to some extent impossible to avoid influence of dust on some areas.

* The passenger terminal is located close to this site.

* It is difficult to secure future expansion space in this site.

b) Site 4

* Since it is located at the mouth of the Port, dredging volume is small and influence of dust on city area is relatively small.

* It is possible to secure future expand space.

* It is necessary to coordinate with the naval base plan.

* In some areas, rocks beneath the seabed may present a problem for future dredging.

The disadvantage of Site 1 that it has little space for future expansion is a fatal defect as the transshipment base for grain from up river ports. Also, it is a major disadvantage that remodeling of Site 1 might cause shortage of handling capacity of general cargo.

From the view point of initial construction cost, Site 1 is the most preferable. However, maintenance dredging cost of Site 1 is higher than Site 4. On the long term basis, it is not possible to ignore the maintenance dredging cost difference.

3) Comprehensive Evaluation

Based on these comparisons, it is judged that site 4 is the most preferable for the construction of the grain terminal. Layout of facilities are shown in Figure 3-2-5-6 to 3-2-5-7.

From the view point that it is difficult to forecast accurately the structural change of transportation system and development of the Port of Montevideo, the ANP requested further study on site 3 where the space for the transportation system by both sea and land is easily reserved. Consideration of grain terminal located at site 3 is conducted. (See A-9)

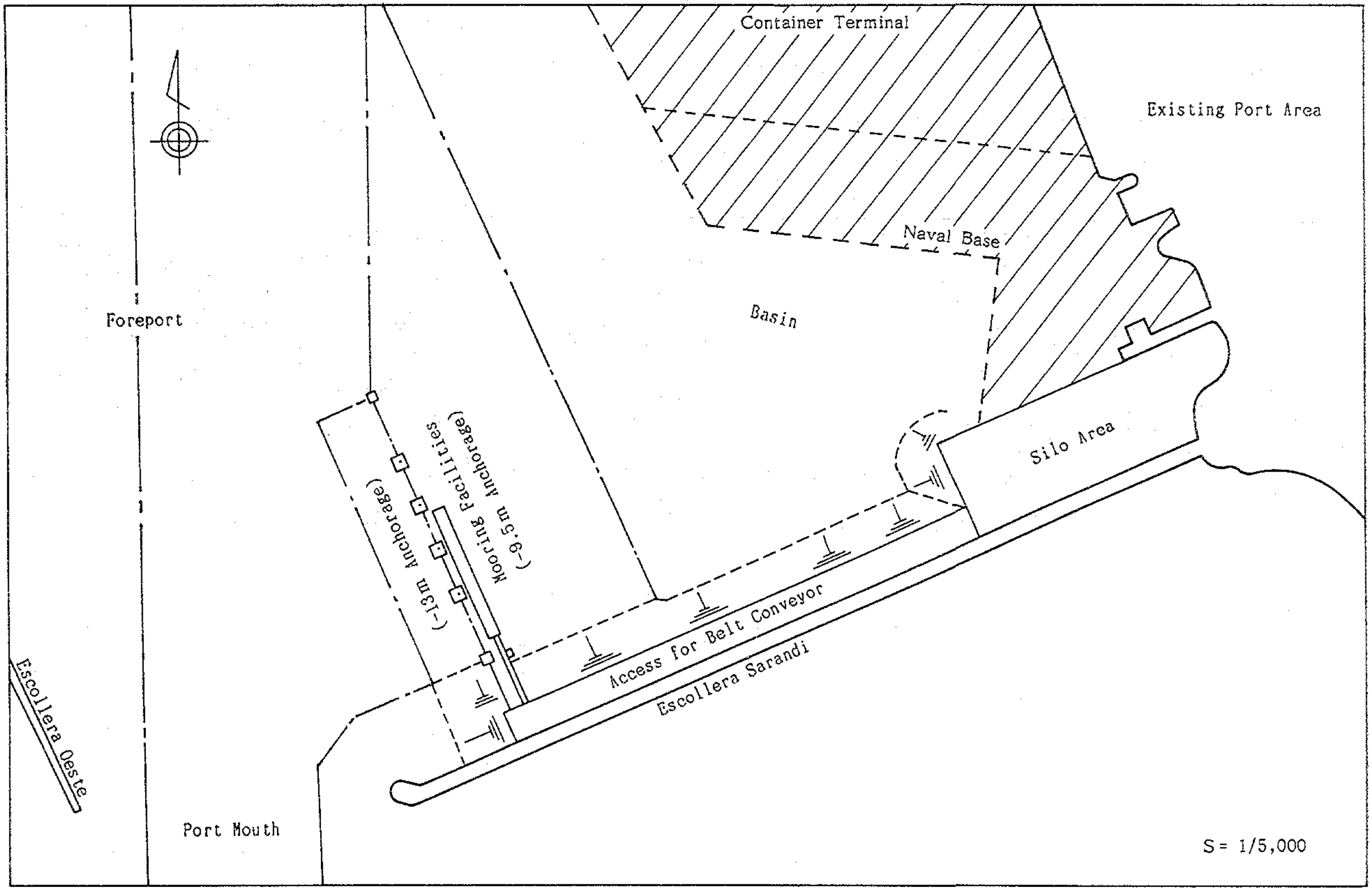


Figure 3-2-6-6 Layout of Grain Terminal

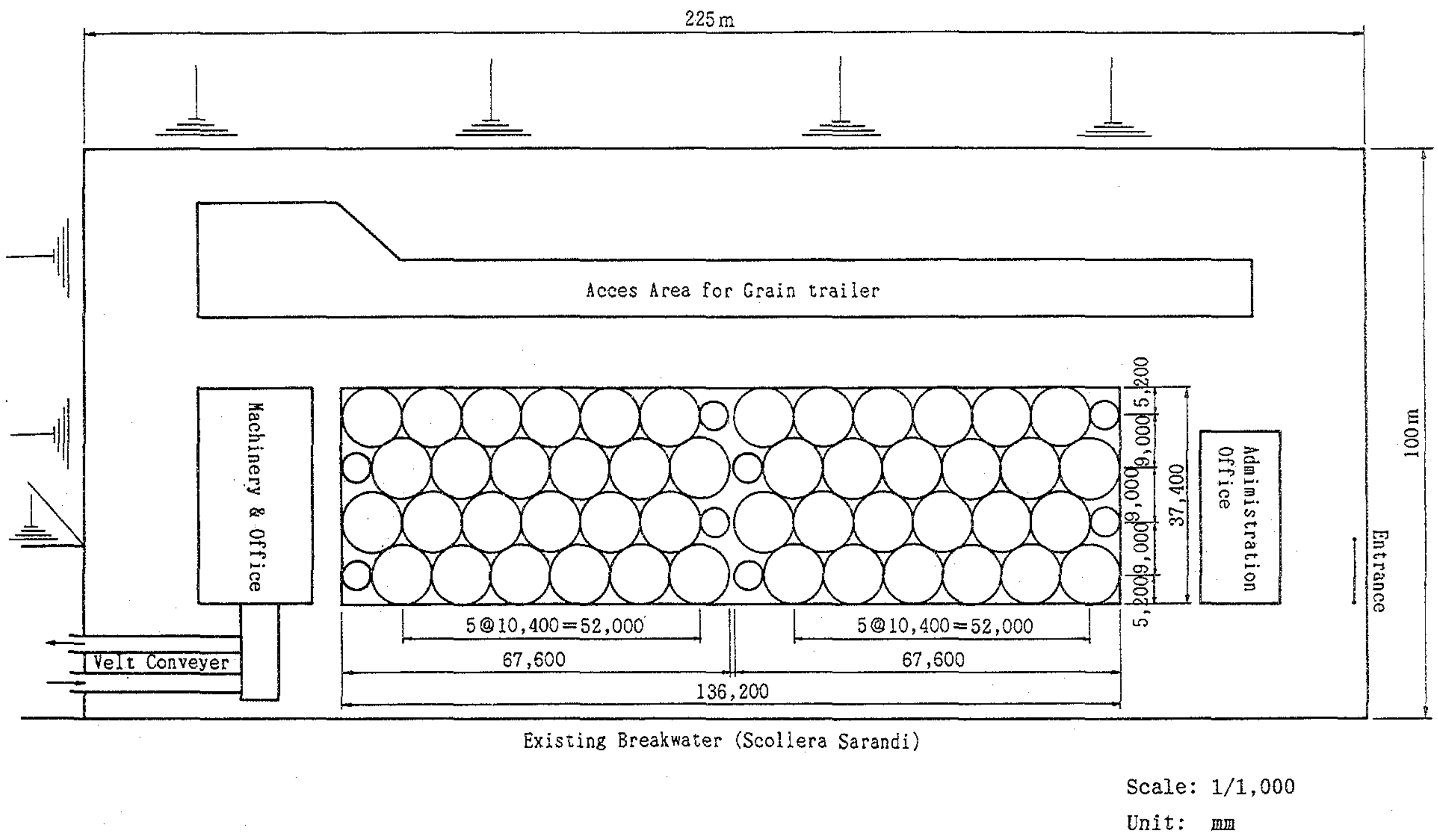


Figure 3-2-6-7 Layout of Grain Silo

3-2-7 Estimate of the Number of Workable Days of Ship Operation

The site No.4 has been selected as the best site for a grain terminal, so that the number of workable days of ship operation has been estimated for his site as follows:

(1) At first, the occurrence percentage Pk of each significant wave height Hk is shown in Table 3-2-7-1 which was obtained dividing each occurrence number by the total observation number 1,116 on the basis of Table 2-3-2-4 in Part I.

Table 3-2-7-1 Occurrence rate of significant waves

Hk (meter)	Pk (%)	Hk (meter)	Pk (%)
0.0	0.0	1.1	5.6
0.1	0.0	1.2	3.3
0.2	0.4	1.3	2.4
0.3	3.9	1.4	1.4
0.4	11.8	1.5	0.7
0.5	13.9	1.6	0.7
0.6	15.1	1.7	0.4
0.7	12.2	1.8	0.4
0.8	12.0	1.9	0.4
0.9	9.1	2.0	0.4
1.0	6.0		
		Total	100.0

(2) Since the direction of the above waves was not measured, the occurrence percentage Fk for each direction of winds of more than 5 m/sec is shown in Table 3-2-7-2 which was obtained from Table 2-2-5-1 in Part I.

Wave direction was assumed to coincide with wind direction as well as in the "Master Development plan". This is, the above occurrence percentage Fd has been used in place of the occurrence percentage for the wave direction.

Table 3-2-7-2 Occurrence rate of winds more than 5 m/sec for each direction

Direction	SE	SSE	S	SSW	SW	WSW	Total
Occurrence Rate Fd (%)	5.09	3.28	5.38	3.15	2.63	2.51	28.05

(3) The diffraction coefficients of points A,B,C and D in Figure 3-2-7-1 were calculated for the significant wave period of 5 second on the basis of the theory of irregular waves. The condition of calculation is as follows:

- Frequency spectrum: Bretschneider-Mitsuyasu type [1)]
- Directional spreading function: Mitsuyasu type [2)]
- Division number of frequency: 5
- Division number of wave direction: 36
- Coefficient of wave reflection on the breakwater: 0.3

That is, the energy of irregular wave of 5 seconds in period was divided into 180 (= 5 X 36) of sinusoidal single waves, being calculated the diffraction coefficient of each single wave. Then these 180 of diffraction coefficients were composed to get the diffraction coefficient of irregular waves. [3)]

The above mentioned frequency spectrum, directional spreading function and some examples of diffraction diagram are explained in A-3 of Appendix.

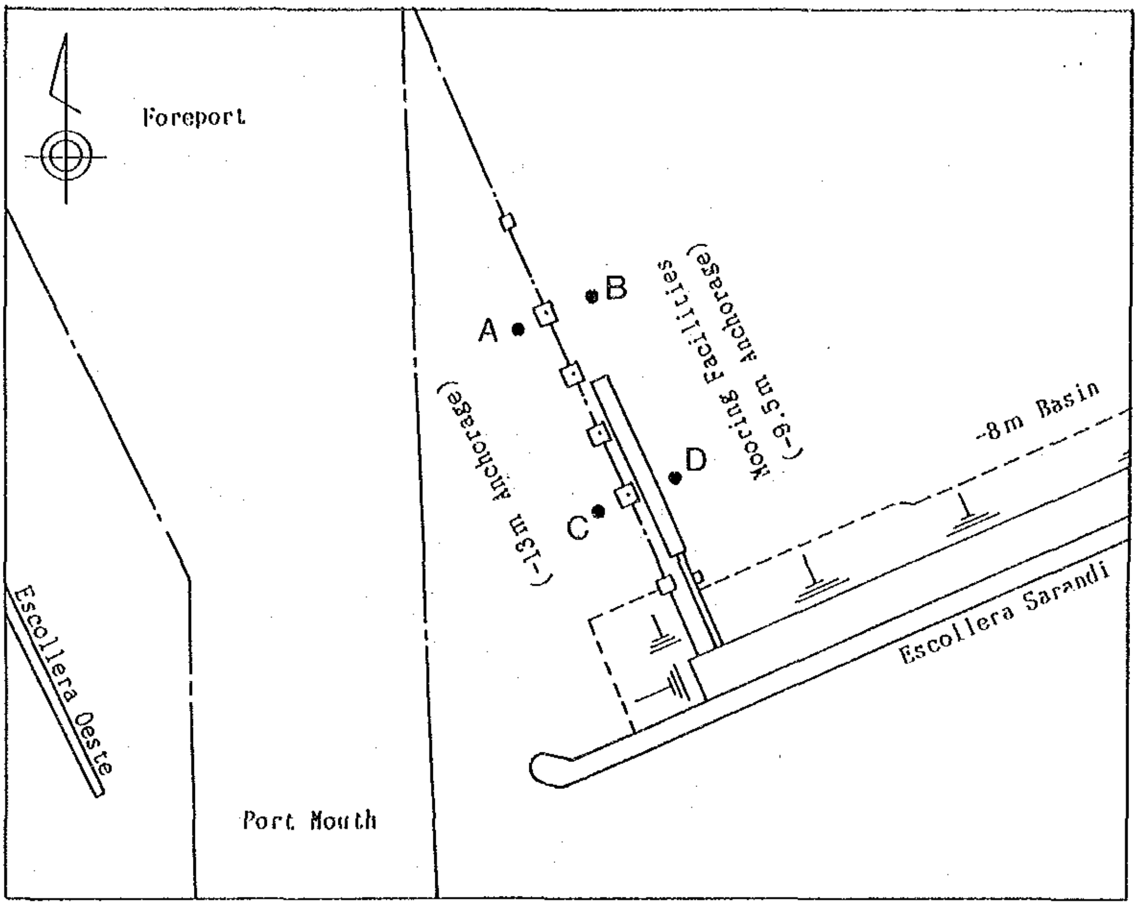


Figure 3-2-7-1 Location of calculation points of diffraction coefficient

Table 3-2-7-3 shows the diffraction coefficient Dd of the loading side and unloading side, where the former is the average of the coefficient of A and B and the latter is that of C and D in Figure 3-2-7-1.

Table 3-2-7-3 Diffraction coefficient Dd of waves in the Grain Terminal

Direction	ESE	SE	SSE	S	SSW	SW	WSW
Dd at Loading Side	0.15	0.21	0.60	0.72	0.81	0.73	0.61
Dd at Unloading Side	0.08	0.10	0.45	0.58	0.69	0.70	0.60

(4) The wave of wave height Hk and wave direction d at the port mouth becomes Hk X Dd in height at the grain terminal and its occurrence rate is Pk X Fd.

Accordingly, if Hk/Dd is classified at intervals of 0.1 m and each occurrence rate is summed, Table 3-2-6-4 is obtained.

Table 3-2-7-4 Occurrence Rate Ri of waves at the Grain Terminal

H(m)	Occurrence Rate Ri		H(m)	Occurrence Rate Ri	
	Loading Side	Unloading Side		Loading Side	Unloading Side
0.1	7.4	7.6	1.1	0.2	0.1
0.2	4.2	2.5	1.2	0.1	0
0.3	2.7	4.3	1.3	0.1	0
0.4	4.4	3.1	1.4	0.1	0
0.5	2.7	2.7	1.5	0	0
0.6	2.6	2.1	1.6	0	0
0.7	1.5	0.9	1.7	0	0
0.8	0.8	0.7	1.8	0	0
0.9	0.7	0.3	1.9	0	0
1.0	0.3	0.2	2.0	0	0

From the above calculation, the occurrence rate Ru of waves of more than one meter in height at the loading side is as follows:

$$Ru = \sum_{i=1.1}^{2.0} Ri = 0.5\ \%$$

Also the occurrence rate Re of waves of more than 0.5 m at the unloading side is as follows:

$$Ru = \sum_{i=0.6}^{2.0} Ri = 4.3\ \%$$

The above rate has been increased by 1% for extra safety against strong local winds in every direction etc. Therefore, the rate of workable days of ship operation is approximately estimated as follow:

- 98.5 % for the loading side

- 94.7 % for the unloading side

Then the number of annual workable days is estimated as follows:

365 X 0.985 = 359 days   for the loading side

365 X 0.947 = 345 days   for the unloading side

3-3 Fishing Terminal

3-3-1 Foreign Fishing Terminal

(1) Fundamental Development Policy of Foreign Fishing Facility

1) Reasons for Foreign Fishing Vessels' Visit at the Port

Several reasons are given below for foreign fishing vessels' visiting at the Port:

a) It is prohibited for foreign fishing vessels to load cargoes for fishing in the ports of Argentina, while it is possible in the ports of Uruguay.

b) It is easier to conduct export/import and immigration procedure in Uruguay than in Argentina.

2) Necessity of Construction of Mooring Facilities for Foreign Fishing Vessels

It is understood that foreign fishing vessels are not treated well, at present. They have very low priority for berthing and many of them have to change berthing place several times per one entrance. If this situation continues, many will eventually choose another port.

At the same time, it is understood that mooring of other vessels such as container vessel and conventional vessel are bstructed somewhat by foreign fishing vessels mooring at the general berth.

On the other hand, many foreign vessels bring direct profit to Uruguay, namely:

a) They generate increase in port income through entrance charge, handling charge, facility usage charge and so on.

b) They create jobs in that they require many services such as food supply, refueling, water supply, ship repairing and so on in Uruguay.

c) Payment for these is in foreign currency.

Based on the above, construction of mooring facility for foreign fishing vessels is an urgent matter.

3) Fundamental Ideas of the Mooring Facilities

Fundamental idea in the construction of the mooring facilities are as follows:

a) From the view point of maintaining the tariff at a lower level in order not to discourage foreign fishing vessels' intention to use the port, construction cost for mooring facilities should be reduced as far as possible.

b) Therefore, it is appropriate to assume that the majority of transshipment activity, which is possible to be carried out without using mooring facilities, is carried out in water area, mainly foreport area.

c) On the other hand, mooring facilities for fishing preparation such as loading of food or water, and resting activity including crew exchange and repairing should be constructed.

d) Normal mooring method at this facility is stern mooring, i.e., perpendicular to the facility.

e) It is not usual for larger vessels (more than 1,000 GRT) to conduct stern mooring. These vessels are assumed to continue the same mooring as before.

f) Since there would be some occasions when alongside mooring is inevitable for loading/unloading, a facility for that purpose is also planned.

(2) Mooring Facility plan

1) Premises

For planning mooring facilities for foreign fishing vessels, following are main conditions:

a) The number of foreign fishing vessels entering the Port in 1998 is 500.

b) Monthly fluctuation of fishing vessels entering and vessel size distribution are based on the data of 1991.

c) The upper limit of vessel size for mooring facility to be planned is assumed at 1,000 GRT. (Foreign fishing vessels of less than or equal to 1,000 GRT are called "Objective vessels" and the number of it is 374.)

d) Based on the existing data in 1991 and the result of interviews with agents of fishing vessels in Montevideo, 20% of objective vessels entering the Port in June and July are assumed to stay until the beginning of the next fishing season (January).

e) Other objective vessels are assumed to stay following the staying pattern of January to March in 1991.

2) Objective Vessel Size

The dimensions of the objective vessel are assumed by size as follows:

Table 3-3-1-1 Dimensions of Objective Vessel and Berth

GRT (t)	Length (m)	Breadth (m)	Berth Length (m)	Berth Depth (m)	Basin Length (m)
100 ~ 300	40	8	10	5.0	85
301 ~ 400	50	8.5	11	5.5	105
401 ~ 500	55	9.5	12	6.0	120
501~1,000	70	10.5	13	7.0	150

Note:

1. Berth Length = Breadth + Allowance (3m or 0.15xBreadth)
2. Basin Length = 2.1 L

3) Required Number of Berth

Distribution described below is data of vessels which entered the Port from July to September in 1991. Vessel size distribution in 1998 is assumed to follow this distribution.

Table 3-3-1-2 Vessel Size Distribution

Vessel Size	No.
101 ~ 300	7
301 ~ 400	30
401 ~ 500	16
501~1000	24
1001~	26

The pattern of behavior of foreign fishing vessels is divided into two types as follows:

* 1st category: Vessels in this category enter the Port in June or July, when the fishing season of squid ends, and stay until around the end of December when the next fishing season begins.

* 2nd category: Vessels in this category enter the Port at all times

throughout the year and stay at the Port for short periods for transsshipment of fish catching, preparation of next fishing activity, crew exchange and so on.

a) Estimation of Number of Berth for 1st Category Vessels

Based on ship arrival data from January to March in 1991, there are no vessels which stay at the Port until the beginning of the next squid fishing season (the end of December). On the other hand, according to ship arrival data from July to September, around 20 % of objective vessels of calling ships stay until the beginning of the next fishing season. And yet, according to interviews with shipping agents, staying vessels are mainly squid catch vessels which enter the port some time in June or July. Therefore, 20% of objective vessels which enter the Port in June and July is assumed to stay until the end of December.

Based on the monthly fluctuation in 1991 the number of foreign fishing vessel arrival is calculated as follows:

Table 3-3-1-3 Estimated Number of Vessel Arrival

Month	1	2	3	4	5	6	7	8	9	10	11	12
Number	47	23	46	46	56	92	90	26	20	20	21	14

Based on the vessel size distribution and vessel arrival data described above, number of long staying vessel is calculated as 14 in June, and 14 in July, for a total of 28. Number by vessel size is shown in table 3-3-1-4.

Table 3-3-1-4 Number by Vessel Size

GRT	Number
101 ~ 300	2
301 ~ 400	12
401 ~ 500	6
501 ~ 1000	8
Total	28

Since the staying period of these vessels is very long (from 5 to 6 months), it is necessary to prepare berths for all these vessels. Accordingly, necessary berth number is calculated as 28.

b) Estimation of Berth Number for 2nd Category Vessel

Majority of foreign fishing vessels belong to the 2nd category. Estimation is carried out by applying queuing theory.

The optimum berth number is determined as the economically optimum number. It is generally accepted that the economically optimum condition is realized when total cost of waiting ship cost which depends on number of berth and service cost including construction cost of berth is at its minimum level. For this purpose, queuing theory is often used for calculation of waiting ship cost.

To apply this theory, it is necessary to determine ship arrival distribution and staying period distribution. Since two kinds of staying patterns are included in the data of arrival vessels from July to September, data of January to March is used. Figure 3-3-1-1 and Figure 3-3-1-2 show the two distributions.

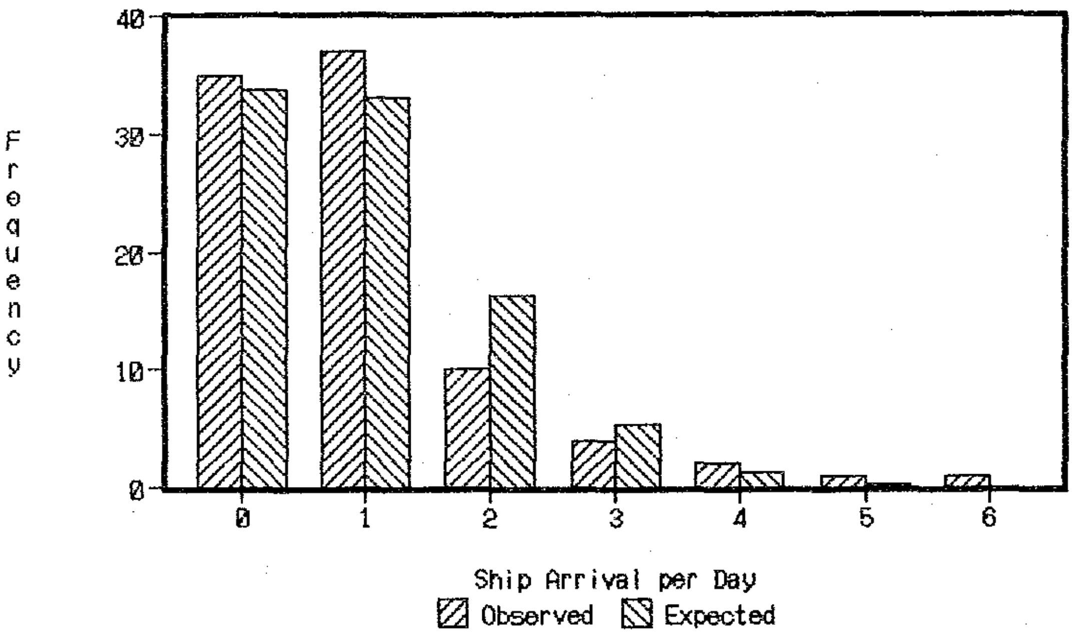


Figure 3-3-1-1 Vessel Arrival Distribution (January to March, 1991)

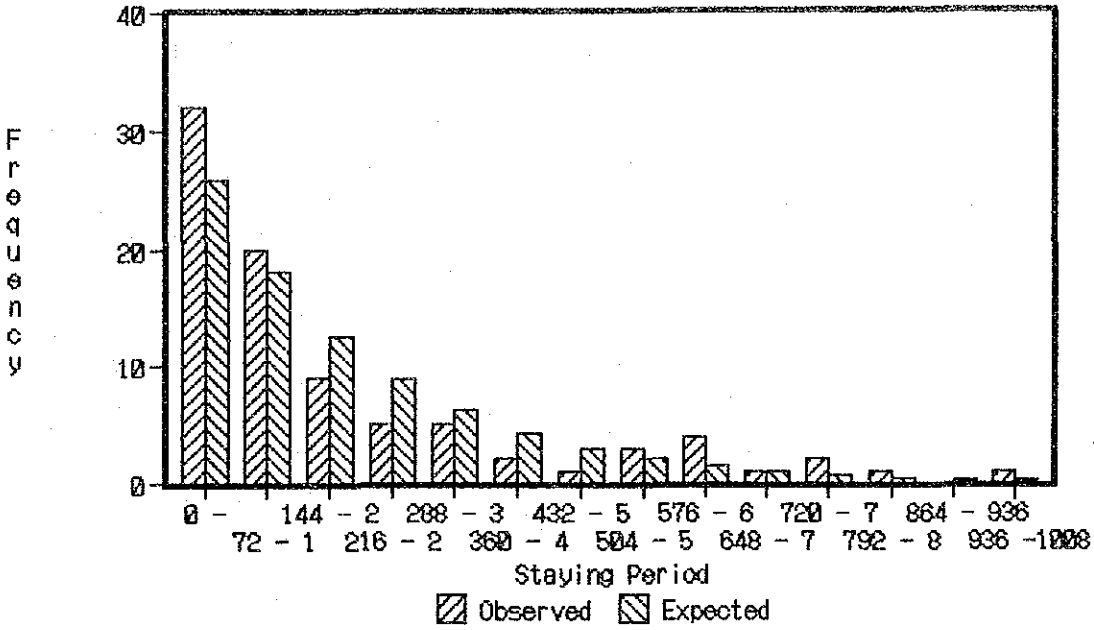


Figure 3-3-1-2 Staying Period Distribution (January to March,1991)

From these figures, the following can be assumed:
Arrival distribution: Poisson distribution
Staying period distribution: Erlung distribution(k=1)

It is very difficult to calculate correctly costs of ship and service as there is a lack of information. Here, the ratio of ship cost to service cost is assumed to be 100:1 based on a very rough estimation.

Under these conditions described above, optimum number of berth is calculated as follows:

GRT	Number
101 ~ 300	2
301 ~ 400	5
401 ~ 500	3
501 ~ 1000	4
Total	14

c) Summary

Through the calculations described above, the following berths are planned:

Table 3-3-1-5 Required Number

GRT	Long Staying Vessel Number	Short Staying Vessel Number	Total Number	Berth Length
101 ~ 300	2	2	4	40
301 ~ 400	12	5	17	187
401 ~ 500	6	3	9	108
501 ~ 1000	8	4	12	156
Total	28	14	42	491

d) Other Dimension of Berth

Width of pier is determined as 12m by considering passage of truck, space of mobile crane and allowance.

4) Mooring of Foreign Fishing Vessels more than 1,000 GRT

Behavior of foreign fishing vessels in the port is already described in chapter 3 of part I. They conduct transshipment of fish catch, loading of daily necessities, exchanging of crew, ship repairing and so on, berthing in basin and at berth. Generally speaking, it is no problem for foreign fishing vessels to use the general wharf if it is not busy.

Vessels more than 1,000 GRT are not squid catch vessels and the vessel arrival patterns do not have a seasonal fluctuation like squid catch vessels. Therefore, generally speaking, it can be assumed that they will not affect the usage of berth by general cargo vessels so much as squid catch fishing vessels.

According to the result of capacity evaluation of general cargo berths, there is some room to accommodate other vessels. Namely, if the productivity of cargo handling improves 30 % more than the present level, the capacity of general cargo berths would be 772,000 tons. As estimated general cargo volume in 1998 will be 611,000 tons, berth occupancy rate of nine berths is calculated at 55.5%. If 70 % is the maximum berth occupancy rate as described before, 14.6 % is extra capacity.

Therefore, if foreign fishing vessels uses general cargo berth by making use of this extra space, 65 vessels can moor under condition that average mooring period is 6 days. Of 500 vessels which would enter the port in 1998, there are 126 vessels that have a size larger than 1,000 GRT. Since they often moor double or triple at the same berth, it is judged that there is enough room for them to moor at the general berths.

5) Other Facilities

Water pipe and cable for lightning are installed.

6) Construction Site

There are two ideas for the construction site, i.e., out of the present port area and within the present port. It is impossible to select the former alternative because of enormous cost for new facilities such as dredging of basin. Therefore, the latter alternative is selected.

There is some space between Basin II and fishing port. Although this space is not quite sufficient, it is possible to secure additional space for accommodating foreign fishing vessels.

7) Layout Plan

Layout plan is shown in Figure 3-3-1-3. Considering turning area both of general cargo vessel in Basin II and of fishing vessel in domestic fishing port basin, the location of foreign fishing vessels' pier is determined. Direction of the pier is planned parallel to Wharf B.

Concerning planning depth of basin, the facts that most of the vessels to be moored are in the situation of less than half load and that mean water level is 90 cm above the tidal datum should be considered. Therefore, the draft of vessel is assumed at the level of 1 m less than full load draft. Meanwhile, since the depth of basin is to be maintained at 10 m in Basin II and 5 m in Cabotaje Basin, these existing depths should be taken into account.

Accordingly, the basin is planned as shown in Figure 3-3-1-3.

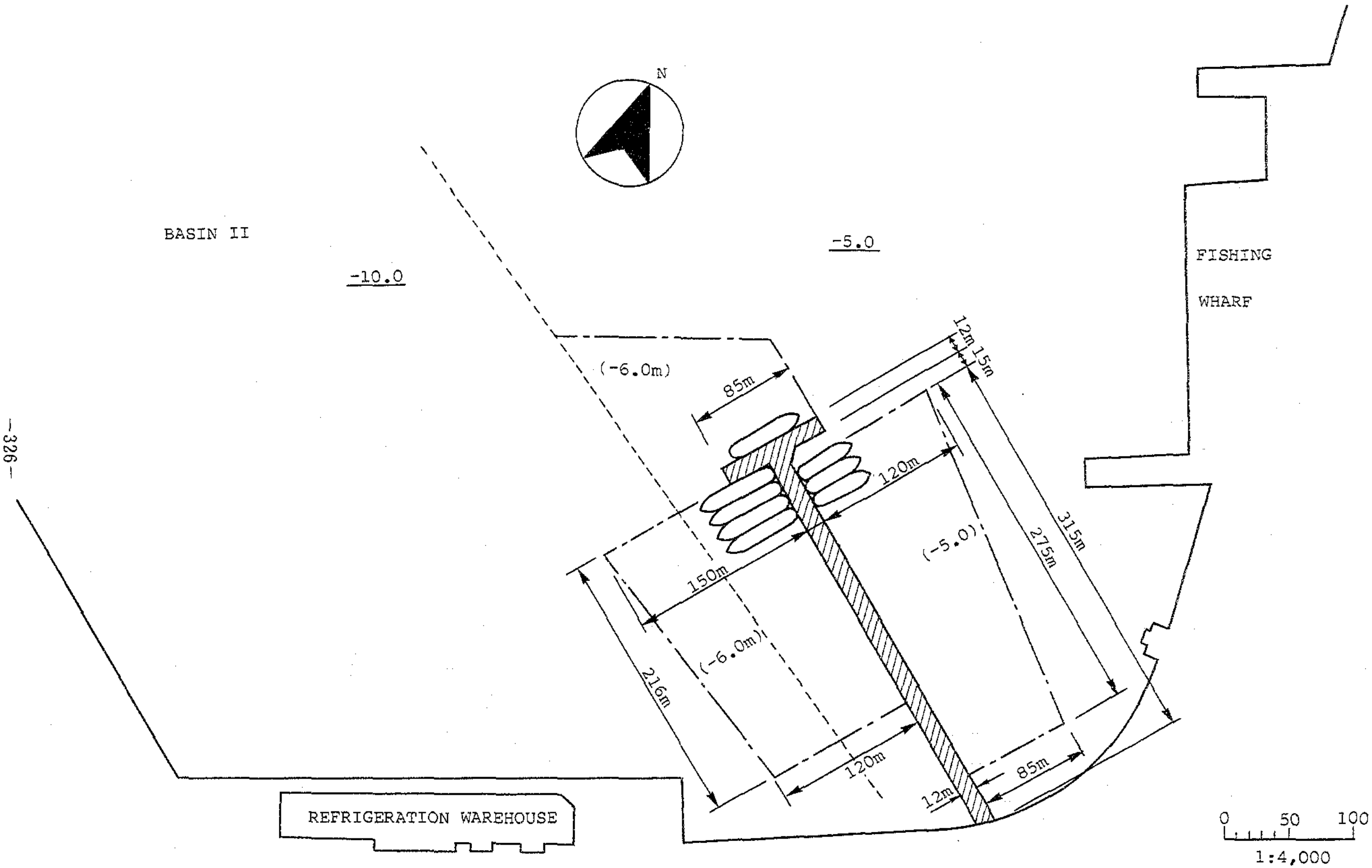


Figure 3-3-1-3 Foreign Fishing Terminal

3-3-2 Domestic Fishing Terminal

The location of the fishing port is not preferable because it is situated in the commercial port area whose function is basically different from that of a fishing port. In spite of the fact that the fishing port does not have any relation to import-export function, the area of fishing port is completely separated from out-of-port area. And since fishing vessels also use the same port entrance, this will probably cause some interruption of other vessels' entrance.

There are no estimation that the volume of fish catch will increase rapidly or that vessel size will increase in the short term. Therefore, now, it is not appropriate to develop new facilities in the outer area of existing port area, because it involves a large amount of investment. However, if improvement *of fishing industry is fairly promising or commercial port function of the port* should be strengthened strongly, fishing port function should be developed in outer area of the existing port.

At present it is appropriate to judge that the situation will not change in the short term period. Therefore, improvement of existing facilities is assumed to be the most preferable course.

(1) Premises

Premises for planning domestic fishing port are assumed as follows:

a) Vessel number will be 60

b) Distribution of vessel draft and vessel length are assumed to be the same as those in 1990.

Table 3-3-2-1 Distribution of Draft

Vessel Draft	No.	Share
~ 3	831	60.8%
3.01 ~ 4	301	22.0
4.01 ~ 5	209	15.3
5.01 ~ 6	0	0.0
6.01 ~ 7	18	1.3
7.01 ~ 8	8	0.6
Total	1367	

Table 3-3-2-2 Distribution of Length

Length	No.	Share
~ 20	299	21.9%
21 ~ 40	937	68.5
41 ~ 60	131	9.6
Total	1367	

c) Dimensions of Vessel and Berth by Depth of Berth

Depth of berth is calculated by adding allowance to full load draft. Allowance is assumed to be about 0.5 m. The maximum depth of existing berth is 5m. According to ship arrival data from July to September in 1991, all vessels except one vessel used the fishing port berth. Although full load draft of some vessels is more than 4.5 m, it is possible to assume that all the domestic fishing vessels will use domestic fishing port. Then, domestic fishing berth is planned for all the domestic fishing vessels. Accordingly, it is necessary to secure sufficient berth length for larger vessels even if the depth is limited at 5m.

Based on table 3-3-2-1, 3-3-2-2, each dimension by the depth of berth is assumed as follows:

Table 3-3-2-3 Berth Dimensions

Berth Depth	Vessel Draft	Vessel Length	Vessel Breadth	Berth(1) Length	Berth(2) Length
3	0～2.5	17.5	4.5	20	6
4	～3.5	22.5	6.5	26	8
5	3.5～	32.5	8.0	38	10
		47.0	9.0	54	11

Note: (1) Length for Alongside Berthing
(2) Length for Stern Berthing

(2) Required Length of Berth

Required length of berth is calculated as follows:

1) Estimation of Standard Utilization of the Fishing port

The method on standard utilization is used for planning of fishing terminal. At first it is necessary to calculate the standard utilization of the fishing facility. Generally, the standard utilization means landing volume of standard day, number of vessels using the port on standard day and so on. The standard day is decided as follows:

a) Selection of two months whose landing volume is the maximum among continuous two months of recent three years

b) Selection of top ten days in landing volume among days of continuous two months selected before

c) Taking average of these ten days

Since there are no data on daily landing volume of fish catch, daily arrival of vessel is used for facility planning. Fishing vessels enter the port basically for landing fish catch after completion of fishing and it is possible to assume that this data is proportionate to daily landing volume.

As July is the month in which maximum number of domestic fishing vessels enter the port, data of this month is used. Table 3-5-1-3 in Part I shows the movement of all domestic fishing vessels entering the port in July and August in 1991. According to this table, it is possible to calculate some standard data for port planning.

Table 3-3-2-4 Standard Vessel Number Using Fishing Port

No.	Date	Number of Arrival Vessel	Number of Departing Vessel	Number of Staying Vessel
1	Aug.30	26	0	20
2	Aug.7	17	2	15
3	Jul.29	15	1	24
4	Jul.18	14	4	21
5	Aug.1	11	1	33
6	Aug.18	11	2	26
7	Jul.17	10	6	15
8	Jul.25	10	8	15
9	Jul.30	10	6	33
10	Aug.8	10	11	21
Average		14	5	22

2) Calculation of Required Length of Berth

Required length of berth is calculated for each purpose such as landing, preparation and resting

a) Landing Berth

Required length is calculated by the following formula:

Required Length = (N x L)/r

where N: Number of Vessel Using Landing Berth

L: Length of Berth
r: Turnover Rate(Available time/Landing time per vessel)

Fishing berth is used all throughout the year and all the day. Landing time per vessel is assumed based on the actual data in 1990. Namely, landing volume per vessel is calculated at 66.53 tons using data of annual landing volume and number of entering vessel. Accordingly landing time per vessel is assumed to be 3.33 hours using the efficiency ratio of 20t/h.

Therefore, number of berth and berth length are calculated as follows:

Berth Depth	Objective No. of Vessel	Berth Number	Length of Berth
3	2	1	20
4	8	2	52
5	3	1	38
5	1	1	54
Total		5	164

b) Preparation Berth

Required number of berth is calculated by following formula:

Required Length = (N'x L)/r'

where N': Number of vessels of Preparation Berth

r' : Turnover Rate(Available time/preparation time per vessel)

According to the result of interviews with shipping agents and fishermen, time for loading of fishing necessities including oil is around two hours. Therefore, number of berth and berth length are calculated as follows:

Berth Depth	Objective No. of Vessel	Berth Number	Length of Berth
3	1	1	20
4	3	1	26
5	1	1	38
Total		3	84

c) Resting Berth

Required Number of berth is calculated by following formula:

Required Length = n x B

where n : number of berthing vessel per day

B : required berth length per vessel (Breadth + Allowance)

Based on the number of resting vessels, number of berth and berth length are calculated as follows:

Berth Depth	Objective No. of Vessel	Berth Number	Length of Berth
3	5	5	30
4	11	11	88
5	6	6	60
total		22	178

d) Summary

Based on the calculations described above, the following facilities are necessary for domestic fishing vessels. Fortunately, the present berth length of fishing wharf is longer than required berthing facilities.

Berth Depth	Landing	Preparation	Resting	Total
3	20	20	30	70
4	52	26	88	166
5	38	38	60	136
5	54			54
Total	164	84	178	426

(3) Other Facilities

An increase in the registered number of vessels is not assumed for the planning of the domestic fishing terminal. Therefore, if present condition of usage continues in future, it is not necessary to construct new facilities. As for logistic facilities for fishing activities, an ice plant is not installed in the Port. However, necessary volume of ice is provided from ice plants located in Montevideo.

Open space of fishing port is sufficiently wide to accommodate all activities related to the fishing port. If any facilities are required to be installed, this open space would be used.

(4) Berthing Plan

According to the result of calculation of required berth length, allocation of fishing vessel to each berth by size is planned as in figure 3-3-2-4.

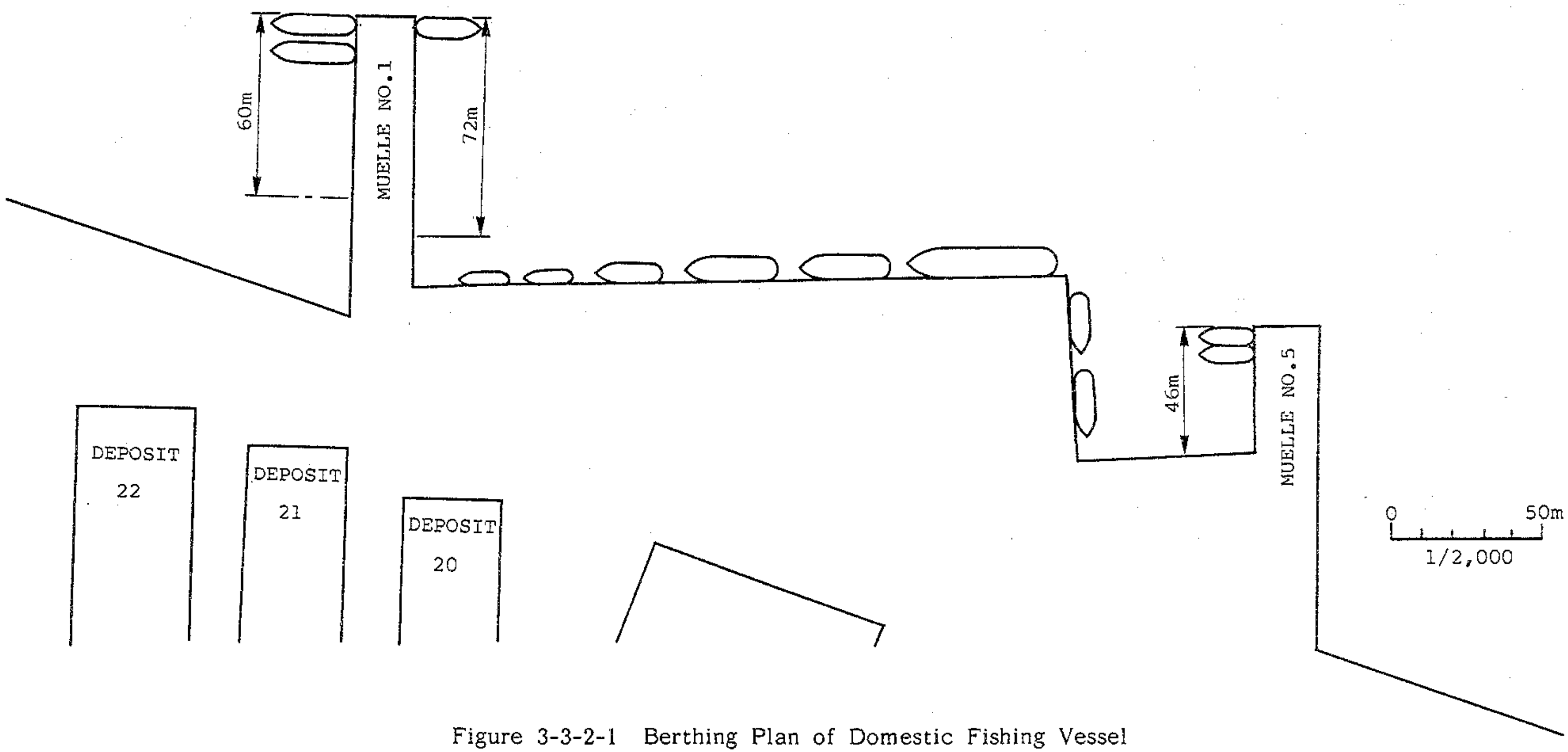


Figure 3-3-2-1 Berthing Plan of Domestic Fishing Vessel

3-4 Brief Consideration of General Cargo Berth and Solid Bulk Cargo Berth

General cargo and solid bulk cargo will be handled at the berth of deposit 1 to 11. Very rough evaluation of handling capacity of these berths was already carried out in 7-4 of part I.

Cargo volumes to be handled in 1998 are 611,000 tons of general cargo and 301,000 tons of solid bulk cargo. Accordingly, the capacity of berths of No.1 to No.11 except No.6 and No.7 would be sufficient for handling general cargo, while berths of No.6 and No.7 can handle the estimated volume of solid bulk cargo. Berth allocation plan of cargo is shown below.

Table 3-4-1 Berth Allocation of Cargo

Berth	Cargo Volume (ton)	Berth Occupancy (%)	Remarks
Wharf A East	138,000	56.3	General Cargo
Wharf (Basin I)	225,000	61.2	General Cargo
Wharf B West	301,000	38.1	Solid Bulk Cargo
Wharf B East	150,000	61.2	General Cargo
Refrigeration Wharf	98,000	40.0	General Cargo (Frozen)
Total	912,000		

3-5 Consideration of Environmental Aspect

3-5-1 Environmental Protection System in Uruguay

(1) Establishment of Ministry of Environmental Affairs

Ministry of environmental affairs (Direccion Nacional de Medio Ambital, DNMA) was established in 1991. Until then, each ministry was in charge of coordinating environmental affairs related to the works of the ministry.

(2) Laws and Regulations Related to Environmental Affairs

There are no laws and regulations related to environmental affairs except water pollution at the national level. Concerning water quality control, Decreto 253 was enacted in 1979 and revised in 1989. Besides this law, there are some regulations in each local department.

3-5-2 General Description of Present Environmental Condition

(1) General

The survey by public sector on the condition of environmental factors such as water, air, vibration, noise, smell, animal and plant has not been carried out except for water. On the other hand, there are several data of environmental factors which have been gathered by some private sectors.

(2) Water Pollution

A survey on water quality in the bay area has been conducted only twice(1988, 1985) by the public sector since 1979 when the Decreto was made. According to the DNMA, the current condition of water pollution in the Montevideo Bay was not good. Drainage flows into the Bay without any treatment.

There are eleven mouths of drainage in the port area. Of them, polluted water flows into port area from 7 mouths.

The municipal government is now conducting a simulation study on the water pollution in the Bay. This simulation is done for formulating the master plan of water discharge system in the Bay. The study will be completed in the latter half of 1993. The content of the project consists of laying pipes for gathering polluted water and constructing a treatment facility for primary treatment at Humphreys island in front of the hill called Cerro.

Although there are no criteria of water pollution control for specified water area, it is possible to apply general criteria to this bay. It is expected that class 3 in which BOD should be less than 10 ppm will be the target of the Bay.

(3) Air Pollution

There is a power station near the port. SOx has been measured by the power station itself. Now that DNMA has been established, this kind of survey will be conducted by DNMA itself.

(4) Animals, Plants

There are no reports on present condition of animals and plants to be protected in the bay area. However, it is assumed that no special animals and plants to be protected dwell here.

(5) Cultural Assets

The old city center area which contains several cultural roperties is located just behind the port.

There is the Hill of Montevideo (Cerro de Montevideo) on the opposite side of the bay. An old fort has been maintained as the museum for weapons of war at the top of this hill. Views from the top are splendid. This is one of the important spots for the formation of a good landscape in the bay area.

(6) Garbage Disposal

There is one garbage disposal yard outside the city, located to the northeast. Its capacity is sufficient to handle garbage disposal for more than ten years.

3-5-3 Selection of Environmental Factors Affected by the Port Planning

Generally speaking, a port facility itself does not greatly influence the environment. In many cases, environmental impacts are caused by cultivation of industrial activities which are often vitalized by the port development project.

This project involves only the development of a grain terminal and fishing terminal. As facilities to be constructed are relatively small, onstruction of these facilities will not bring a big impact on the environmental conditions.

However, it is a fact that construction activities always involve some type of environmental influence. Further, handling of grain, especially loading, always result in the dispersion of small grain partiicle.

Following is a very brief consideration of environmental factors affected by the project:

* Air Pollution

As already explained, dispersal of small grain particles is assumed to be the most important factor to be considered as an impact of this project. Air pollution other than that is caused by increase of traffic volume. Generally speaking, this is a very important problem in the port planning. However, air pollution newly imposed by this project is assumed to be very small because it does not bring a big increase of land transportation traffic.

* Water pollution

Although present condition of water quality is generally bad in the Port, it is not anticipated that new facilities will bring any bad effect on the water quality within the Port. As already described, study on countermeasures against deterioration of water quality in the Port is now under way. A first step in the improvement of water quality in the Port would be to implement countermeasures determined based on the result of the study.

* Oceanography, topography

Construction work will have some impact on topography and in particular oceanography will be affected by port construction work. Construction work in this project is carried out within the port area and the scale of it is very small. Therefore, its impact would be negligible.

* Odour

An odour will be caused by flying of small grain particles during loading of grain.

3-5-4 Environmental Impact and Countermeasures against it

The following are brief comments regarding environmental impact and countermeasures against such impact:

(1) Flying of small grain particles

Generally speaking, it is very difficult to measure the volume of flying particles caused by the handling of grain at the port. At present, there is no proper method to estimate the impact of flying grain particles on the enviromental conditions. (See A-3-2)

Countermeasures against dust caused by handling of grain are assumed as follows:

* Flying of dust from conveyer is prevented by installation of cover at the conveyer section.
* The tip of ship loader should be kept as low as possible while loading, not to increase the distance between the tip of shiploader and the top of cargo heap using system of TELESCOPIC. (See Figure 3-5-1)
* The duct should be installed at the part of skirt of TELESCOPIC to collect dust.

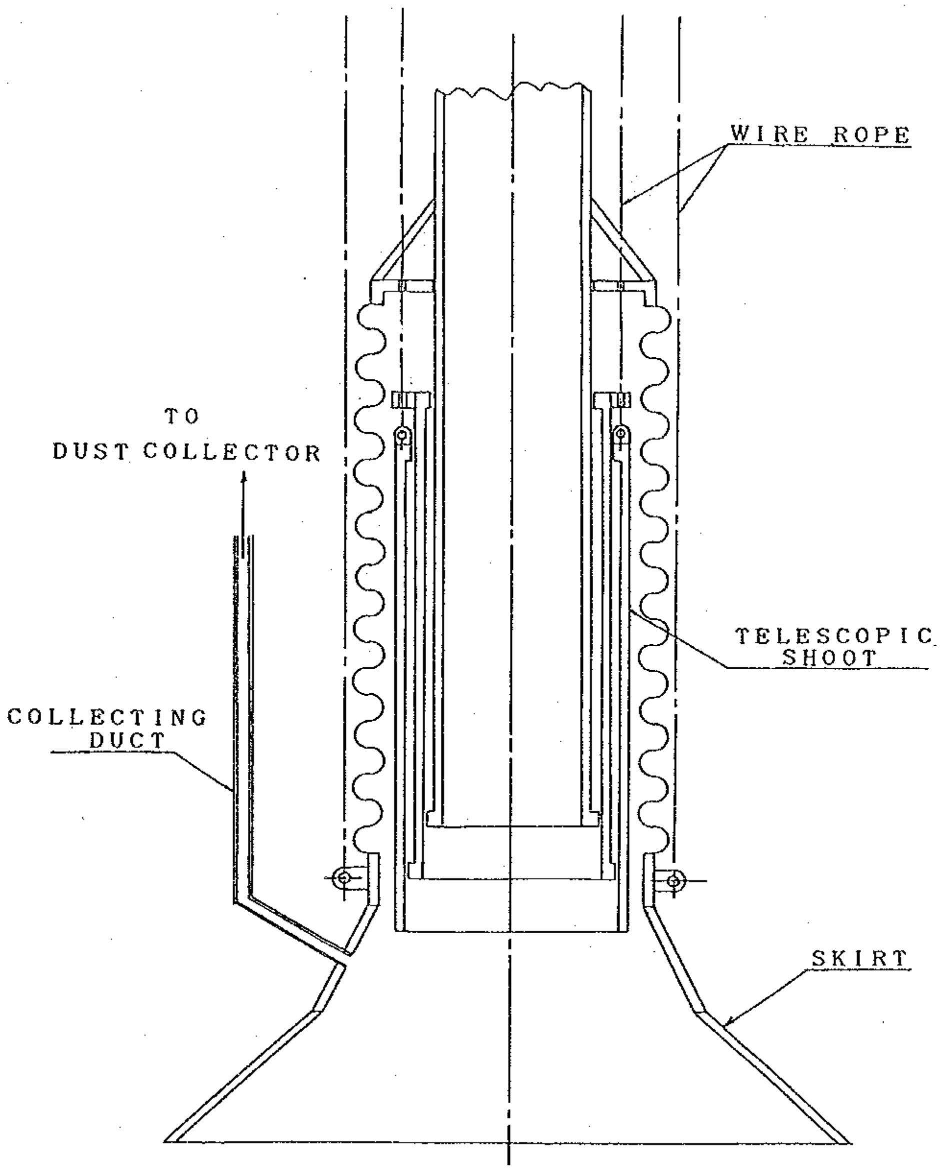
(2) Others

1) Traffic congestion

Port activities will result in more traffic burdens on the present road system. There are some parts of the road system even at present around Montevideo Port where smooth traffic conditions do not exist. However, the improvement of road conditions just behind the Port is now under way.

2) Landscape design

Hill of Montevideo will play a very important role in providing a picturesque landscape as already described.



DUST COLLECTING SYSTEM
FOR SHIPLOADER

Figure 3-5-1 Dust Collecting System for Shiploader

4 PRELIMINARY DESIGN

4-1 Basic Premises

According to the foregoing sections, the facilities of the grain terminal and the fishery terminal are designed based on the following basic premises:

1) The grain terminal is designed for the candidate site 4 which has been selected as the most suitable site in Section 3-2 of Part II.
2) The fishery terminal is designed for the site which is shown in Section 3-3 of Part II.
3) The utilization of present working crafts and facilities in Montevideo are considered as much as possible in designing.

4-2 Mooring Facilities of Grain Terminal

4-2-1 Design Conditions

The structures are designed under the following conditions:

(1) Basic Conditions

1) Berth depth

Berth depth is -13 meters at the loading side and -9.5 meters at the unloading side.

2) Maximum design vessel

For the mooring facilities for loading: 65,000 DWT

(Length 230 m, Breadth 32.5 m, Ordinary draft 11.5 m and Full load draft 13 m)

For the mooring facilities for unloading: 15,000 DWT

(Length 145 m, Breadth 21 m and Full load draft 8.7 m)

3) Crest height

+ 4.0 meters for the mooring facilities for loading

+ 3.5 meters for the mooring facilities for unloading

4) Berth length

270 meters for the mooring facilities for loading

170 meters for the mooring facilities for unloading

5) Seismic forces are not considered.

6) Surcharge

A 200 tons of a ship loader for each breasting dolphin

A 800 tons of an unloader for the unloading pier

(2) Natural Conditions

From Section 2 of Part I, the followings are applied:

1) Tidal level

M.H.W.L: + 1.135 meters

M.W.L: + 0.910 meters

M.L.W.L: + 0.685 meters

2) Soil conditions

As the soil conditions, the profile B3 in Figure 2-4-2-1 of Part I is applied to the entire area of mooring facilities of grain terminal, although it is sure that this area is not uniform in soil condition. The profile B3 is shown in Figure 4-2-1-1 also. As shown here, the hard rock layer underlying deeper part than -17.7 meters is efficient as a bearing stratum.

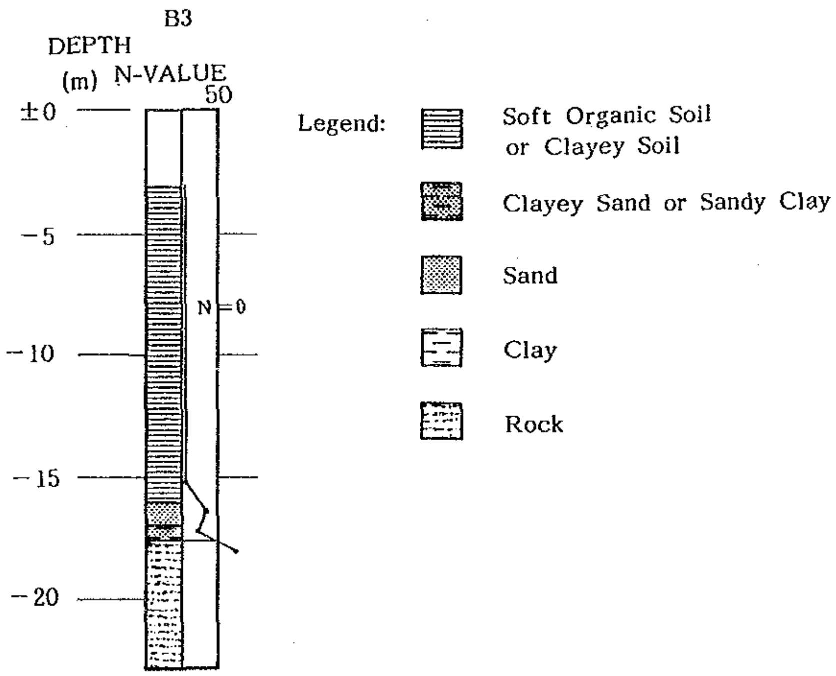


Figure 4-2-1-1 Soil Profile of B3

(3) Other Conditions

1) Berthing velocity of vessels: 0.10 m/sec

2) Strength of construction materials

Concrete for reinforced concrete pile and deck concrete:

Standard design strength: $\sigma c = 240\ kg/cm^2$

Elastic Modulus:

for stress calculation: $Ec = 1.4 \times 10^5\ kg/cm^2$

for calculation of elastic deformation:

$Ec = 2.5 \times 10^5\ kg/cm^2$

Allowable bending compression stress:

$\sigma ca = 60\ kg/cm^2$

Steel bar for reinforced concrete:

Allowable tensile stress: $\sigma ta = 2{,}000\ kg/cm^2$

Elastic modulus: $Es = 2.1 \times 10^6\ kg/cm^2$

4-2-2 Design

The plan view of mooring facilities is shown in Figure 4-2-2-1. The mooring facilities for loading consist of four breasting dolphins with three gangways connected to them and two mooring dolphins. The mooring facility for unloading consists of an unloading pier, an approach jetty and two mooring bitts, one of which is on the breasting dolphin for loading and the other is on the mooring dolphin connected to the approach jetty.

In designing the structures, the following items are considered:

1) A structural type of open deck with reinforced concrete piles is economically and technically advantageous in comparison with possible acceptable alternative of concrete caisson.

2) The structures are stable against such various conditions as berthing impact, surcharge of heavy equipment and wind load.

3) The structures are stable when the berth depth increases up to one more meter deep due to the maintenance dredging there.

4) The maximum tractive force acting at a mooring dolphin or bitt is taken as a 200 tons for a 65,000 DWT of vessels and a 100 tons for a 15,000 DWT of vessels.

The structures designed according to the theory of elasticity under the above conditions and consideration are shown in Figure 4-2-2-2 to 4-2-2-6.

All structures are of reinforced concrete pile type, except the mooring dolphin for a 65,000 DWT of vessel which is of reinforced concrete caisson type. A mooring dolphin for a 15,000 DWT of vessel at the side of approach jetty is of the same structure as the breasting dolphin for a 65,000 DWT of vessel.

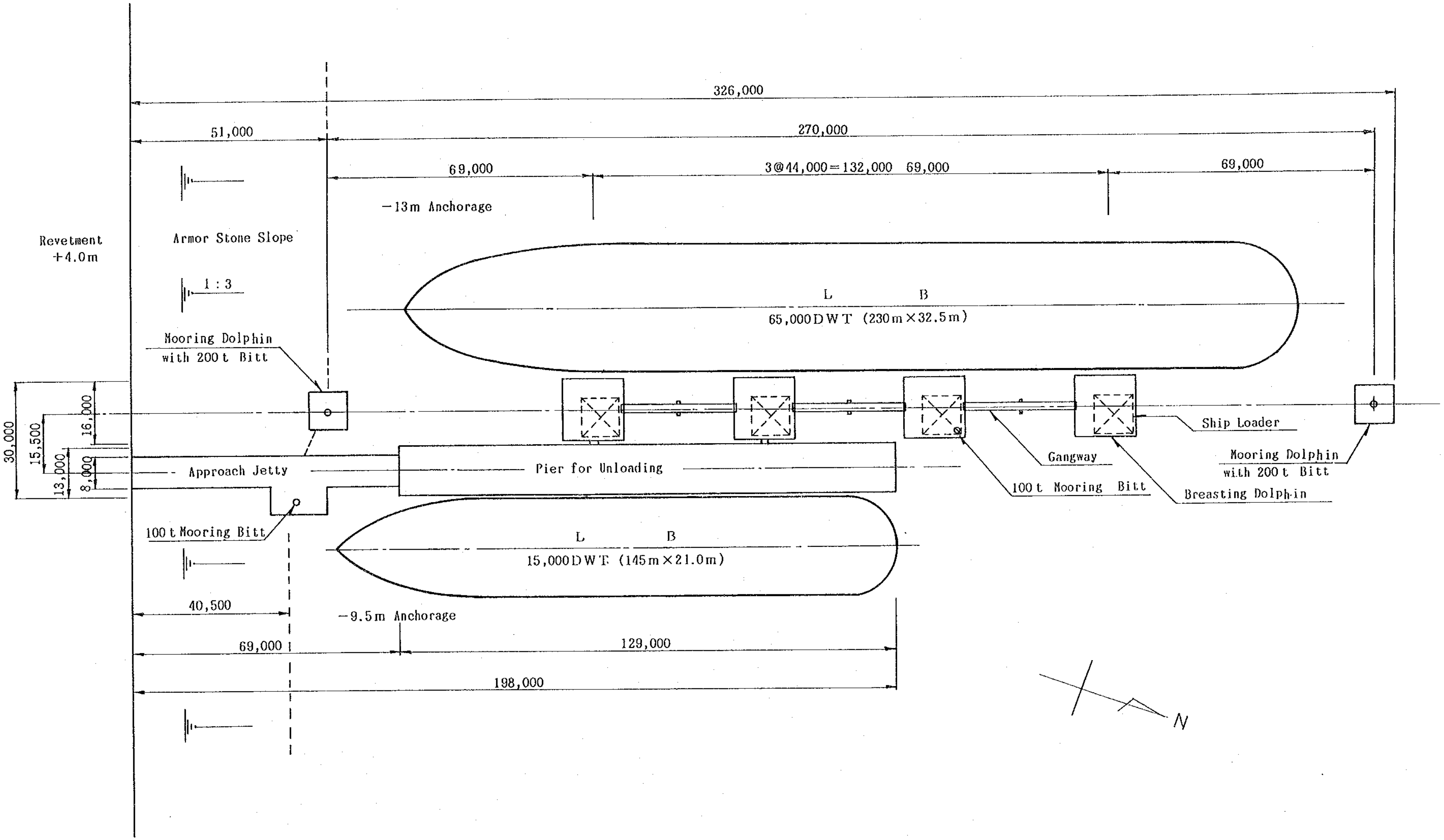


Figure 4-2-2-1 Plan View of Mooring Facilities at Grain Terminal

Scale: 1/1,000

Unit: mm

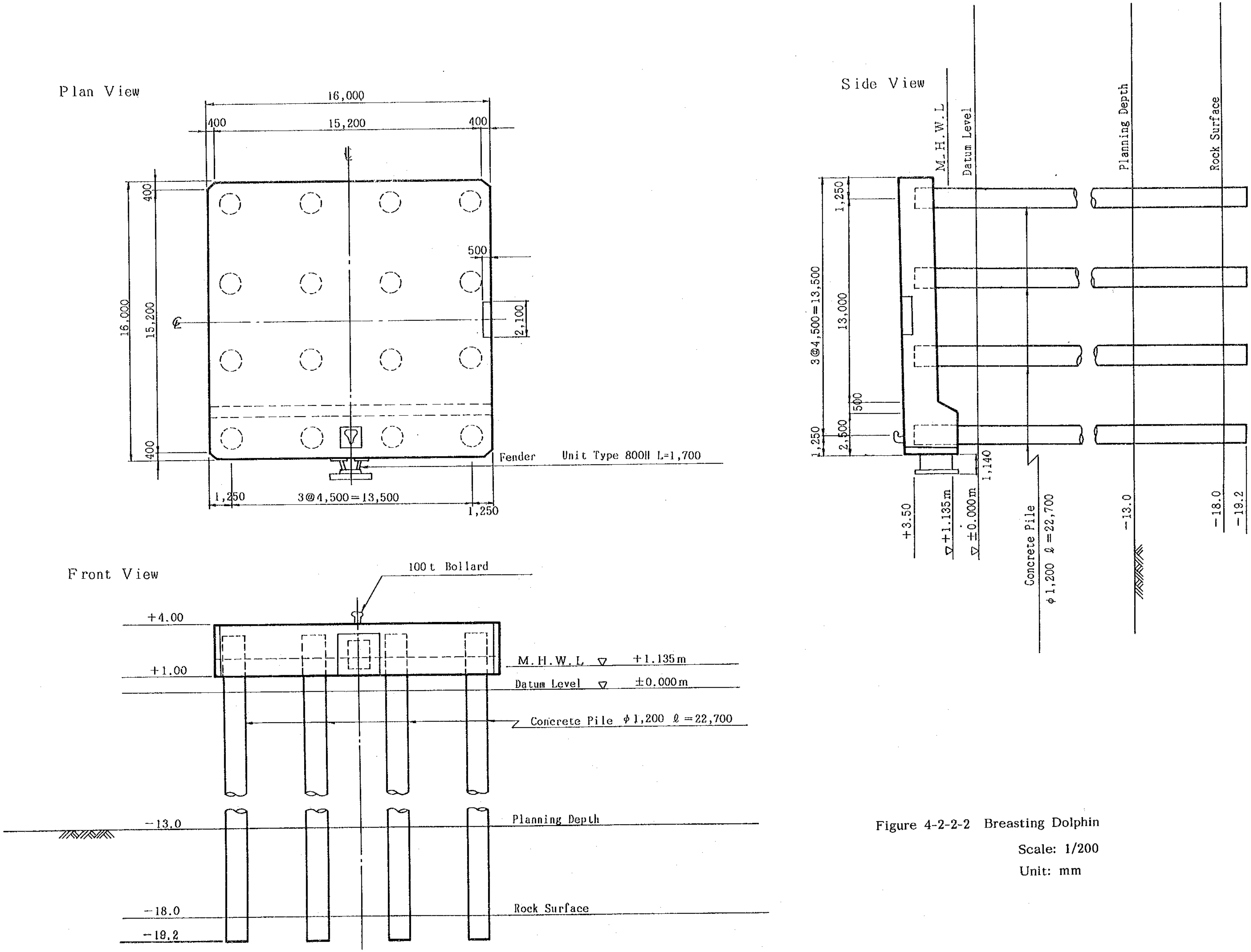
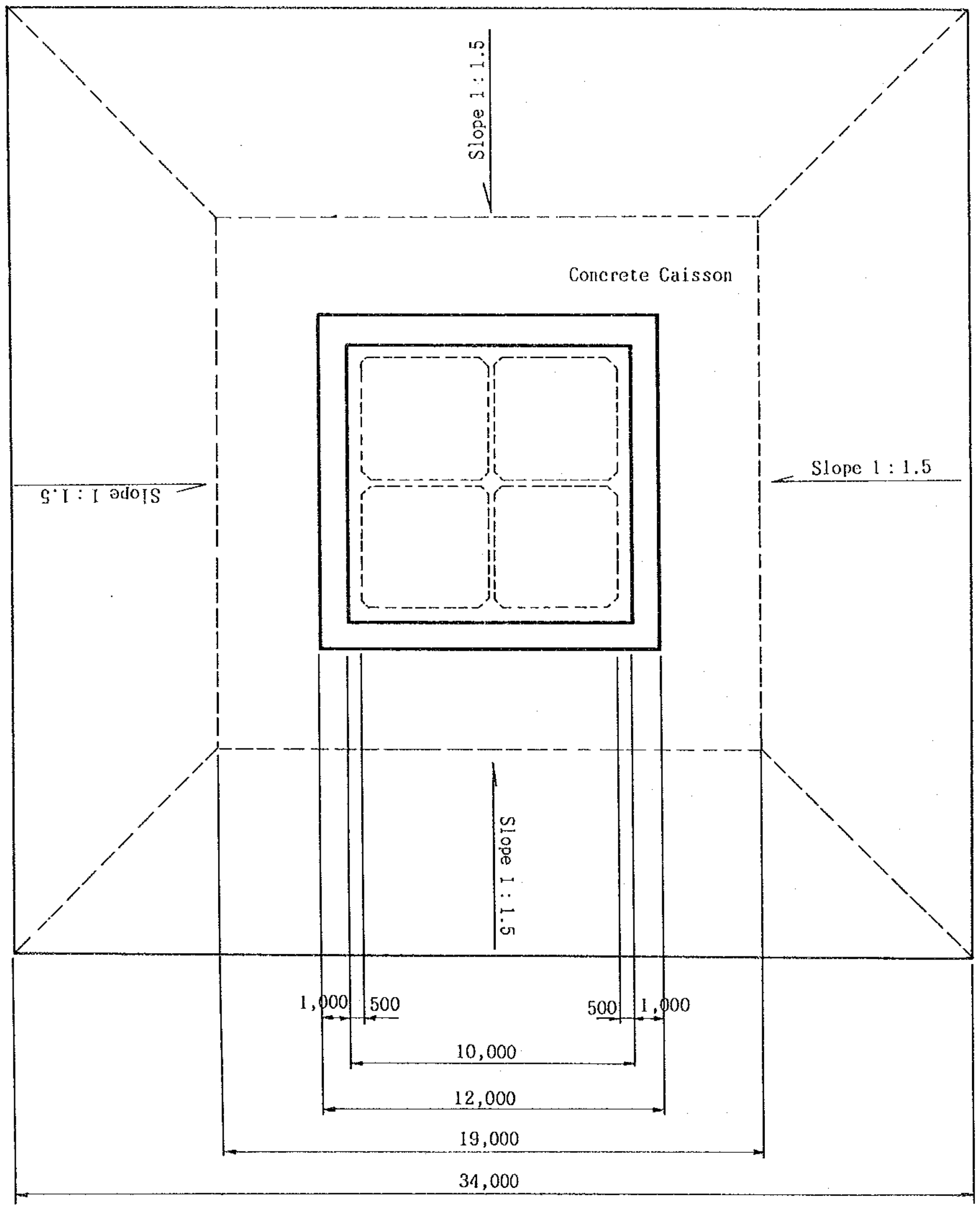


Figure 4-2-2-2 Breasting Dolphin

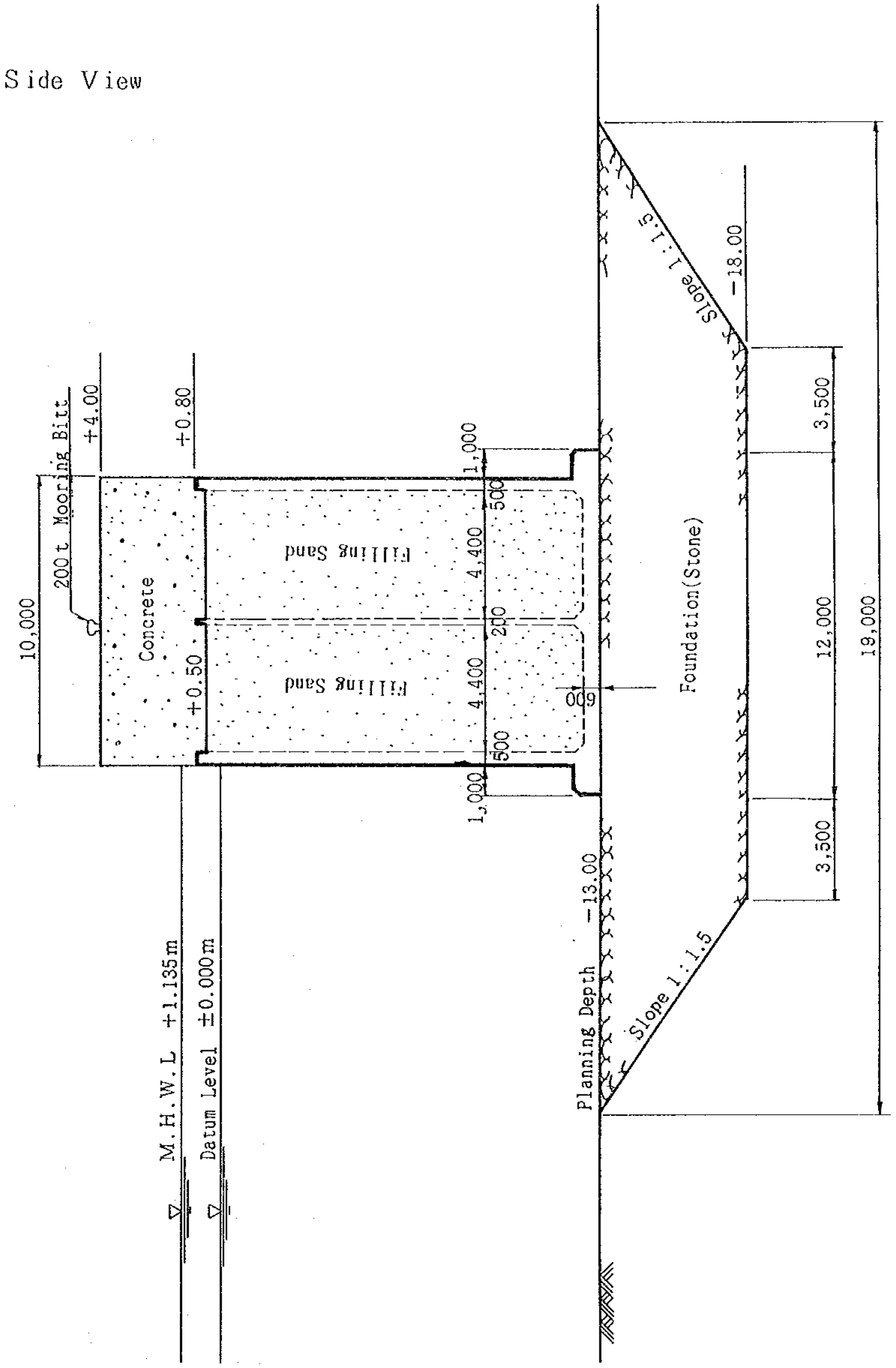
Scale: 1/200

Unit: mm

Plan View



Side View



Scale: 1/200
Unit: mm

Figure 4-2-2-3 Mooring Dolphin

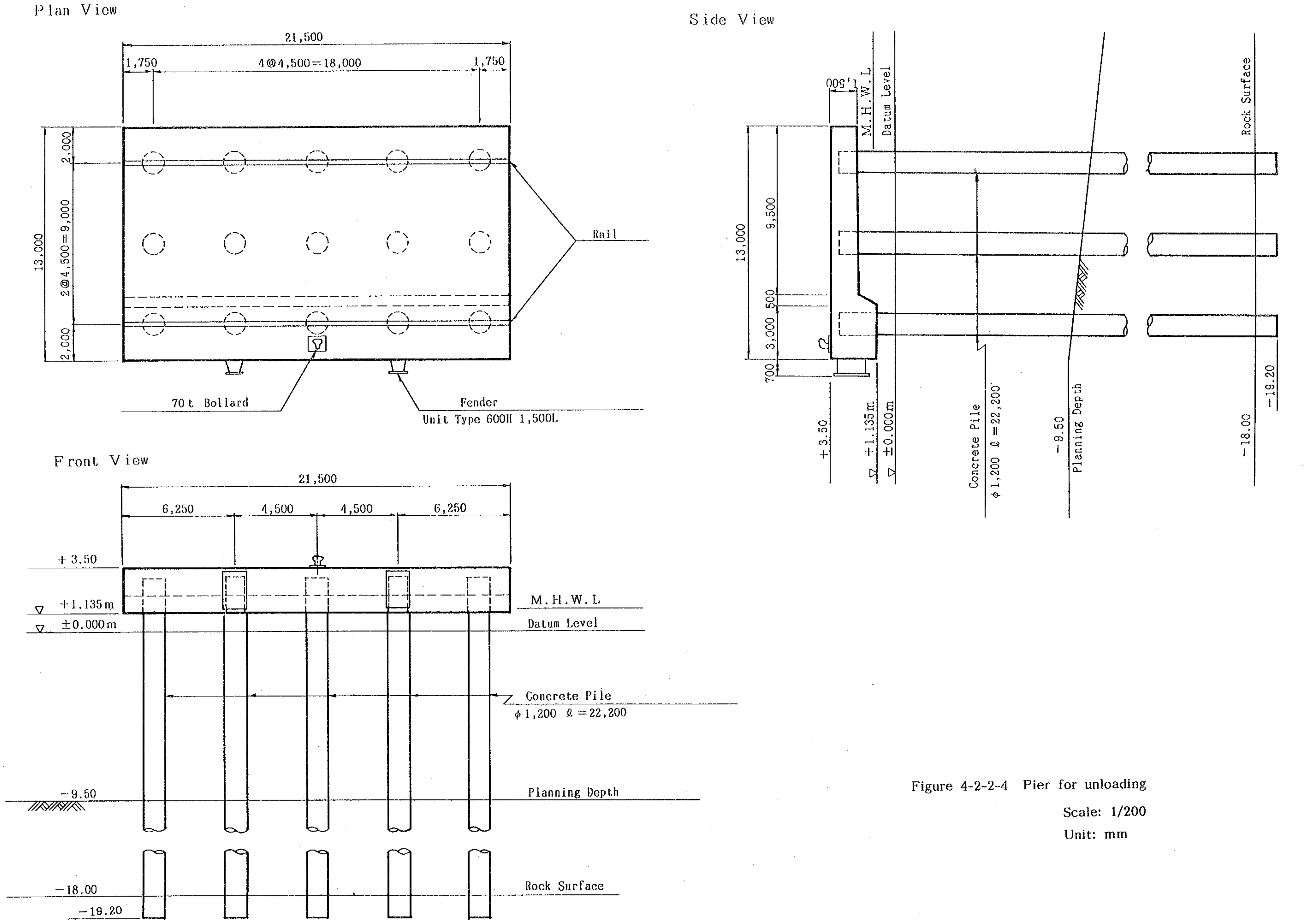
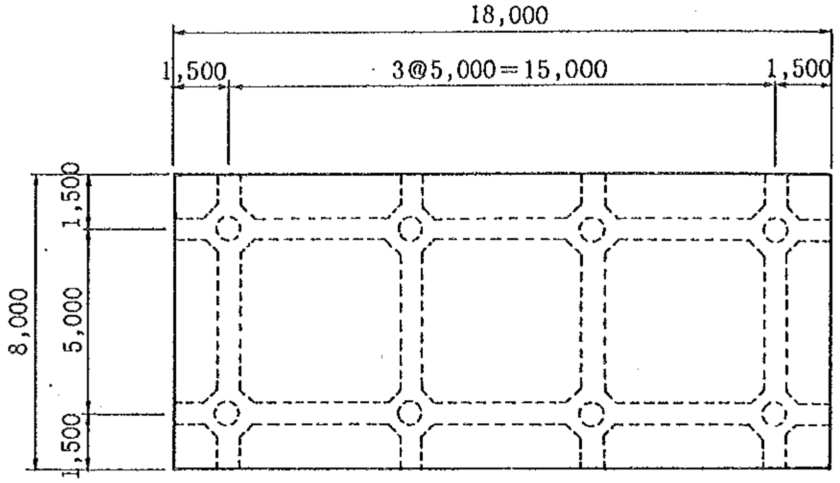


Figure 4-2-2-4 Pier for unloading

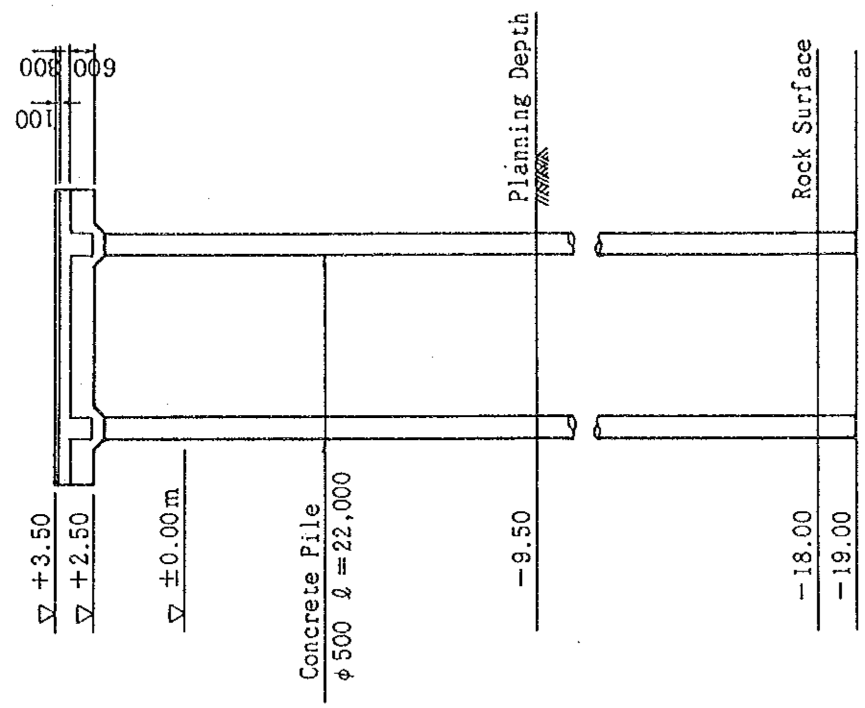
Scale: 1/200

Unit: mm

Plan View



Side View



Front View

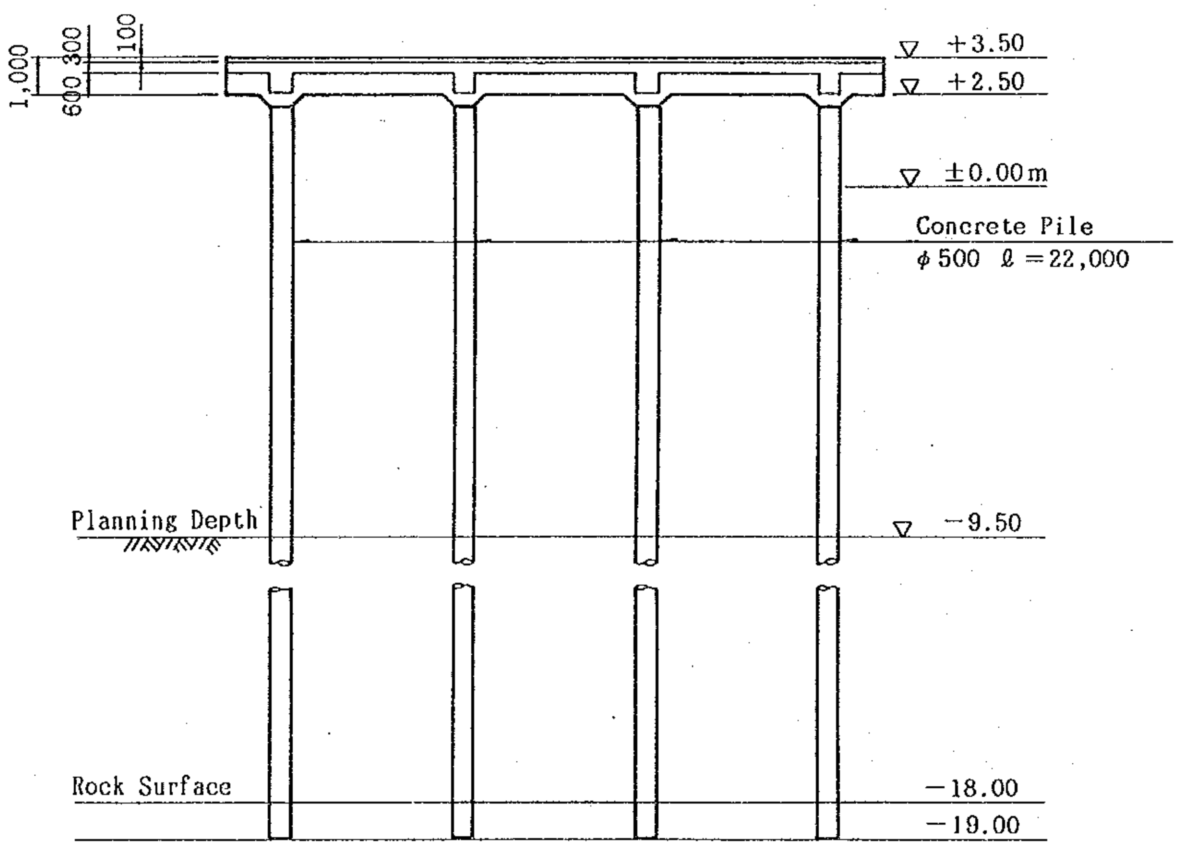
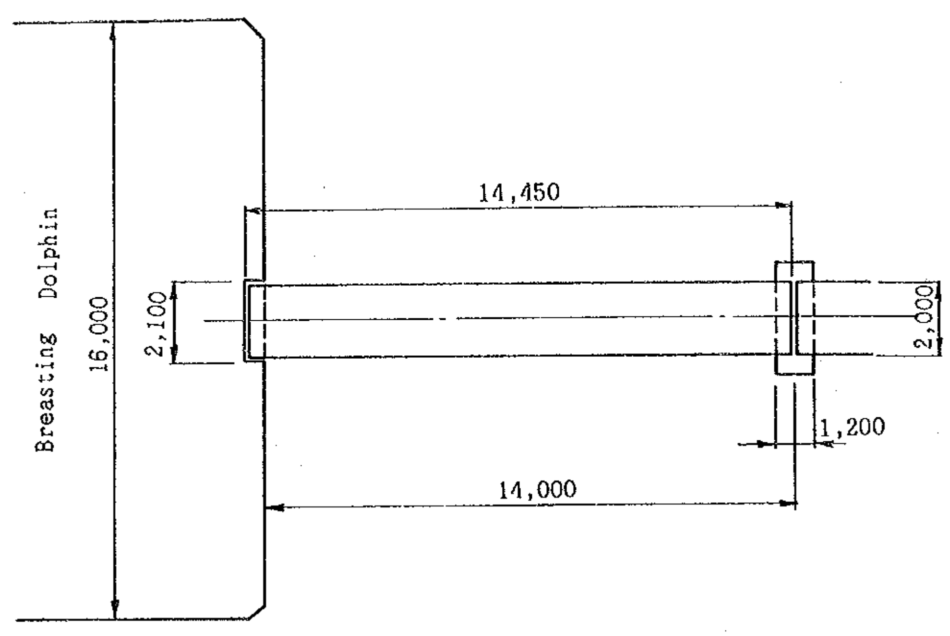


Figure 4-2-2-5 Approach Jetty

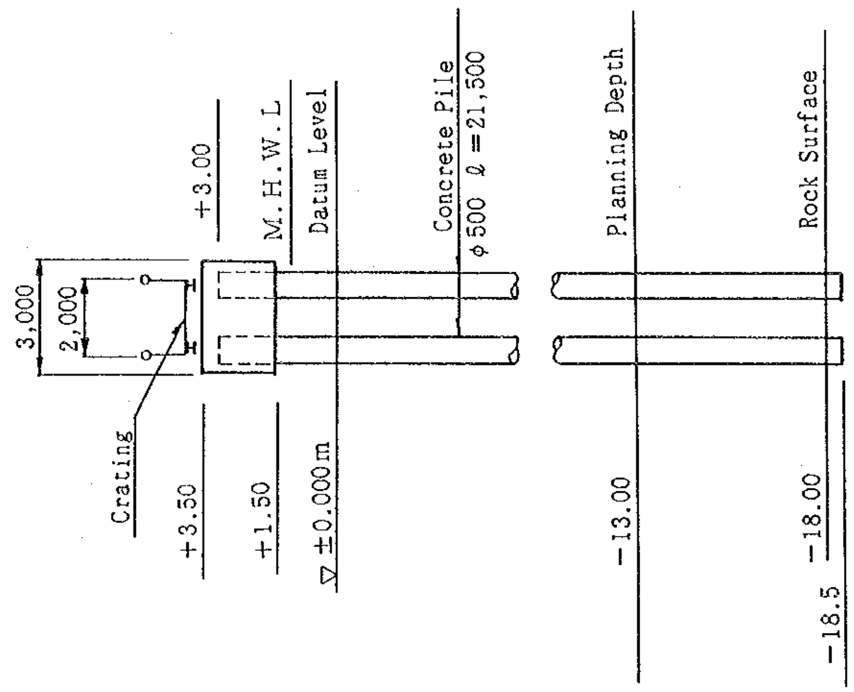
Scale: 1/200

Unit: mm

Plan View



Side View



Front View

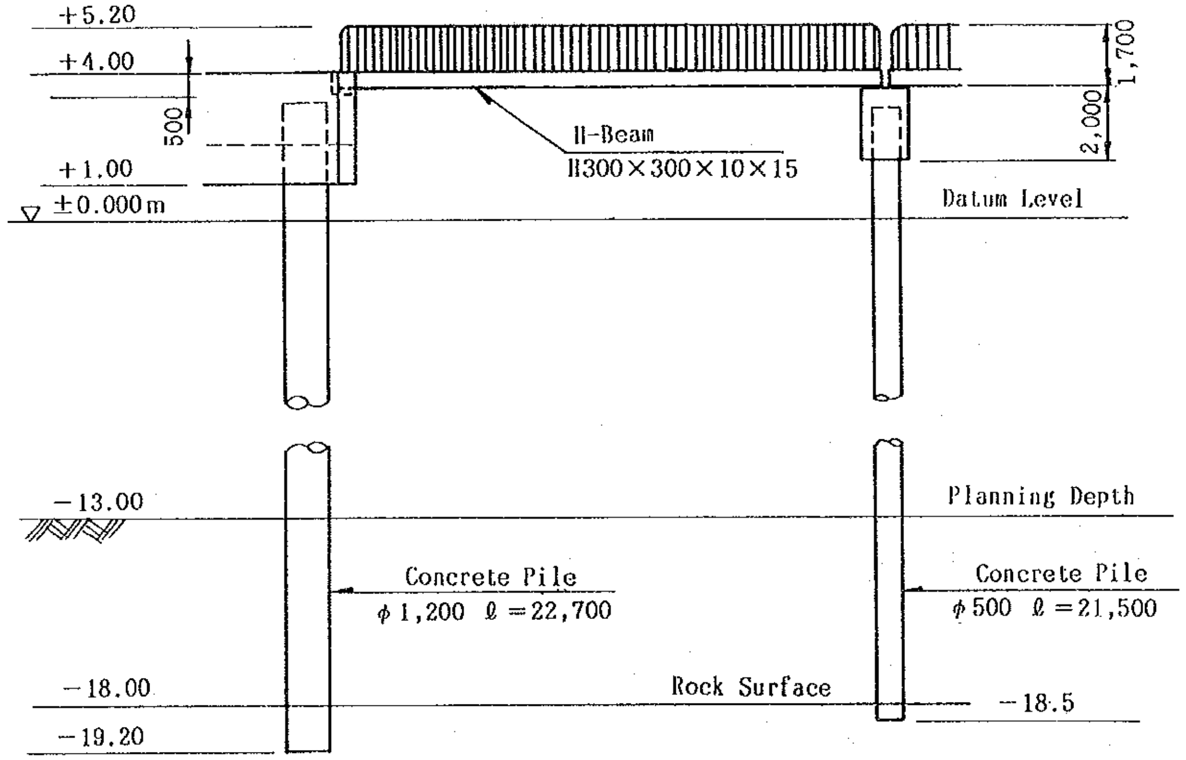


Figure 4-2-2-6 Gangway

Scale: 1/200

Unit: mm

4-3 Mooring Facilities at Fishery Terminal

4-3-1 Design Conditions

The structures are designed under the following conditions:

(1) Basic Conditions

1) Berth depth: - 6.0 meters

2) Maximum design vessel

1,000 GT (Length 70 m, Breadth 10.5 m and Draft in half-load 5.0 m)

3) Crest height: + 4.0 meters

4) Berth length: See Figure 3-3-1-3 of foregoing section

5) Seismic forces are not considered.

6) Surcharge: 1.0 ton/m^2

(2) Natural Conditions

From Section 2 of Part I, the followings are applied:

1) Tidal level: The same as Grain Terminal of Section 4-2-1

2) Soil conditions

As the soil conditions, the profile B1 in Figure 2-4-2 of Part I is applied to all the length of mooring pier, although it is sure that this area is not uniform in soil condition. The profile B1 is shown in Figure 4-3-1-1 also. As shown here, any rock layer is not found up to - 34.2 meters, but there is fine silty sand or fine clayey sand in deeper layer than - 11 meters, which is of 10 to 38 in N-value and is efficient as a bearing or a friction stratum.

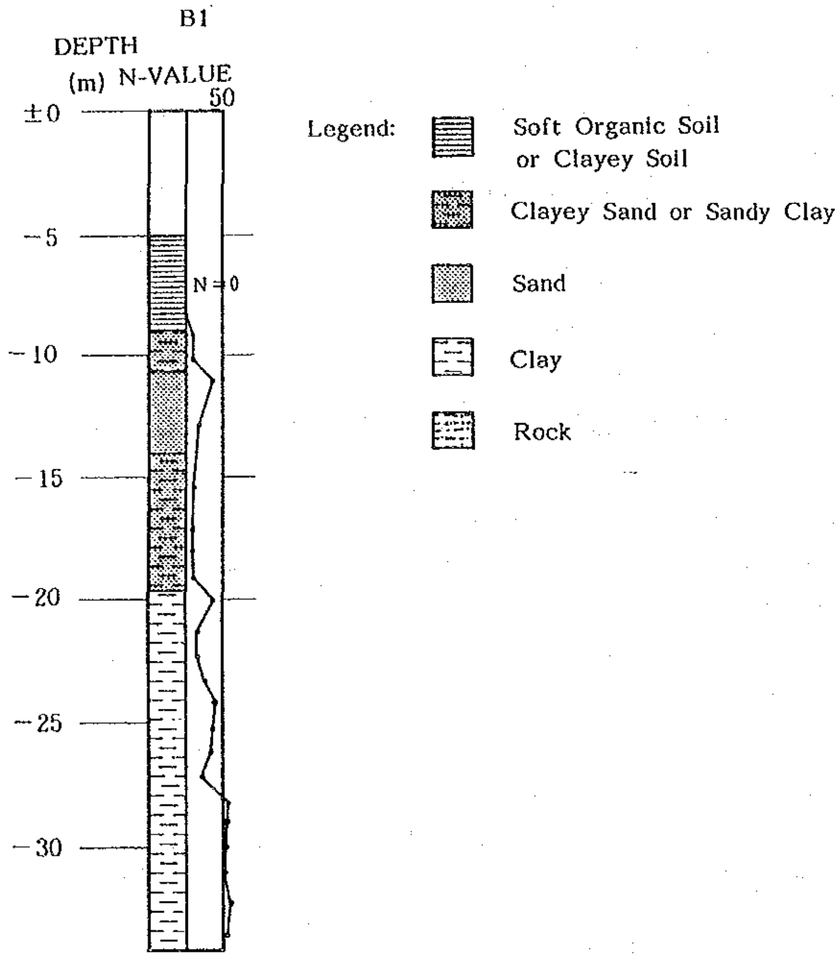


Figure 4-3-1-1 Soil Profile of B1

(3) Other Conditions

1) Berthing velocity of vessels: 0.15 m/sec
2) Strength of construction materials:
   The same as Grain Terminal of Section 4-2-1

4-3-2 Design

The plan view of mooring pier has been shown in Figure 3-3-1-3. The mooring method at the pier is planned to be ordinarily stern mooring and sometimes alongside mooring.

In the design of structures, are considered the following items:

1) A structural type of open deck with reinforced concrete piles is economically and technically advantageous.
2) The structures are stable against such various conditions as berthing impact and 1 ton/m^2 of surcharge.
3) Considering the chance that full-load of ships might moor in the future, a 6.5 m of draft is taken in designing the pier structure.
4) In calculating the stabily, soft surface soil layer above - 9.0 m is disregarded because it is of soft soil with N-value of zero. Therefore, the berth depth will be able to be made one or two more meters deeper in the future without any more reinforcement to the structure.
5) The maximum tractive force acting at a mooring pier or to a bitt is taken as a 35 tons.

The structure designed under the above conditions and considerations is shown in Figure 4-3-2-1.

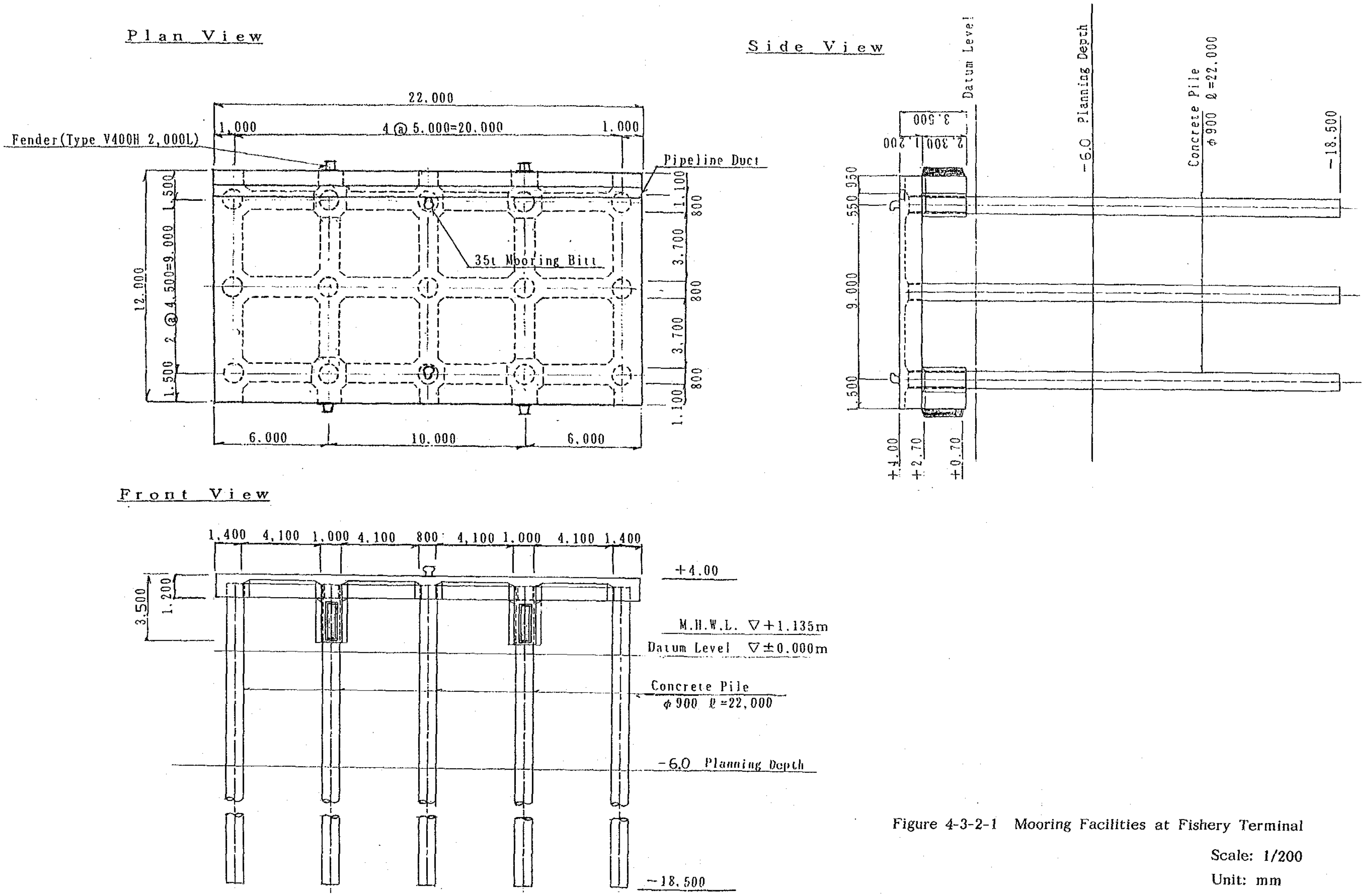


Figure 4-3-2-1 Mooring Facilities at Fishery Terminal

Scale: 1/200

Unit: mm

4-4 Handling and Storage Facilities

4-4-1 Design Conditions

(1) Basic Conditions of Grain and Grain Facilities

1) Annual grain handling volume is 2,000,000 tons in the target year 1998.
2) Grains to be handled are wheat, soybeans, maize, pellets, etc.
3) Capacities of facilities determined by the optimum capacity calculated in the sub-section 3-2-4 of part II are as follows:
   - Storage capacity of silo: 93,000 tons
   - Unloader: 700 ton/hr X 2 sets
   - Shiploader: 900 ton/hr X 4 sets
4) Type of grain handling
   - Intake from shuttle vessels (15,000 DWT) and trucks in a style of bulk cargo are considered, but train transportations and bagged grains are not considered to be handled.
   - Carrying to large sized vessels (65,000 DWT) and trucks in a style of bulk cargo are considered, but bagged grains are not considered to be handled.
   - Direct loading from trucks to large sized vessels are not considered.

(2) Other Conditions

1) Main dimensions of loading dolphin and unloading pier are as mentioned in the section 4-2.
2) Main dimensions of loading vessel of 65,000 DWT are as follows:
   - Length: 230 m
   - Breadth: 32.5 m
   - Moulded depth 18.9 m
   - Ordinary draft: 11.5 m
   - Light draft: 4.2 m
   - Width of hatch: 14.8 m
   - Height of hatch: 1.8 m above the deck
3) Main dimensions of unloading vessel of 15,000 DWT are as follows:
   - Length: 145 m
   - Breadth: 21 m
   - Moulded depth: 12.2 m

- Moulded depth: 12.2 m
- Ordinary draft: 8.7 m
- Light draft: 2.8 m
- Width of hatch: 9.8 m
- Height of hatch: 1.4 m above the deck

4) Work conditions
   - Annual available days for operations:
     - Unloader: 250 days/year
     - Shiploader: 250 days/year
   - Daily available hours for operations:
     - Unloader: 20 hours/day
     - Shiploader: 20 hours/day

5) Electricity
   - Receiving voltage: 30,000 V, 50 Hz
   - Power source voltage:
     - High tension: 6,000 V, 3-phase 3-line, 50 Hz
     - Low tension: 380 V, 3-phase 3-line, 50 Hz
     - for control: 220 V, single-phase 2-line, 50 Hz
     - for lights: 220 V, single-phase 2-line, 50 Hz

6) Natural conditions
   - Wind velocity:
     - Working time: 16.7 m/sec (60 km/hr)
     - Non-working time: 33.3 m/sec (120 km/hr)
   - Annual average temperature: 16.9 ^{o}C
   - Annual average relative humidity: 74.0 %
   - Annual average rainfall: 1,163 mm

The other natural conditions are as mentioned in the foregoing section 4-2 of part II.

4-4-2 General Description of Facilities

(1) Component of Facilities

Grain handling and storage facilities comprise the following main facilities:

1) Unloading Facilities
2) Loading Facilities
3) Silo Facilities
4) Conveyor Facilities

Each facility comprises following components as listed in Table 4-4-2-1.

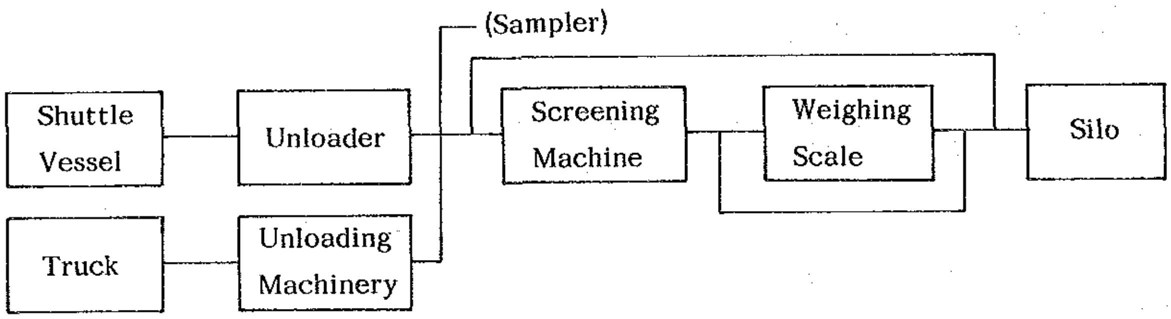
Table 4-4-2-1 List of Facilities

Facility	Component	General Description
Unloading Facilities	Unloader	700 ton/hr X 2 sets, Mechanical Type
Loading Facilities	Shiploader	900 ton/hr X 4 sets, Non-slewing boom type, with Dust Collector
Silo Facilities	Silo	Main Bin: 1860 ton X 4 X 12 = 89,280 ton Auxiliary Bin: 465 ton X 8 = 3,720 ton Total Volume: 93,000 ton
	Machinery	Conveyor, Bucket Elevator, Screening Machine, Weighing Scale, Sampler, Fumigator, Temperature Controller, Dust Collector
	Building	Machinery Office: 2,600 m^2 Administration Office: 900 m^2
	Electrical Facilities	Power Receiving/Distributing Facilities, Power Controller, Inventory Controller
	Silo Foundation	Concrete Slab and Wooden Pile
	Others	Receiving and Carrying Facilities from /to Truck
Conveyor Facilities	Wharf Conveyor for Unloading	700 ton/hr X 200 m X 2 lines
	Receiving Conveyor	700 ton/hr X 400 m X 2 lines
	Carrying Conveyor	900 ton/hr X 400 m X 2 lines
	Wharf Conveyor for Loading	900 ton/hr X 100 m X 1 line 900 ton/hr X 180 m X 1 line

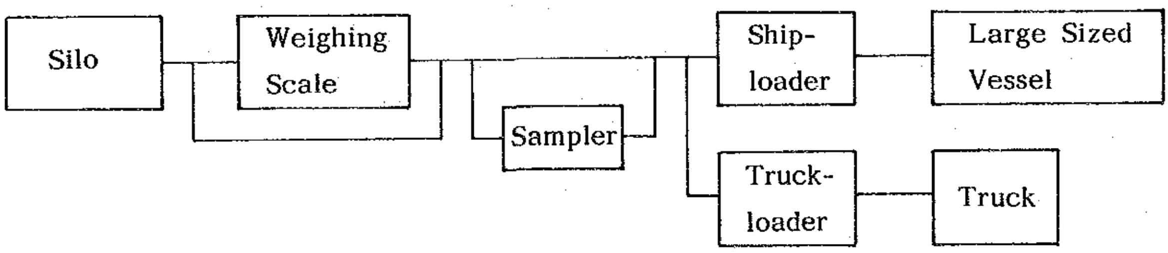
(2) System of Grain Handling Works

Grain Handling works are classified into 3 systems, each flow of which is as shown in the diagrams of Figure 4-4-2-1. Direct loading from shuttle vessels or trucks to large sized vessels is not considered. The detailed entire system is as shown in Figure 4-4-2-2.

1) Flow of Unloading



2) Flow of Loading



3) Rotation

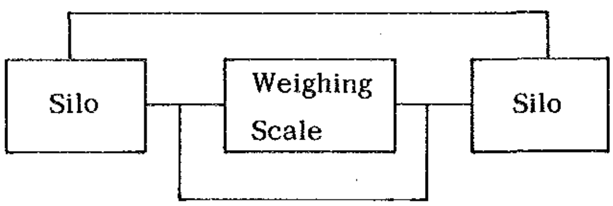


Figure 4-4-2-1 Diagram of Flow of Grain Handling Works

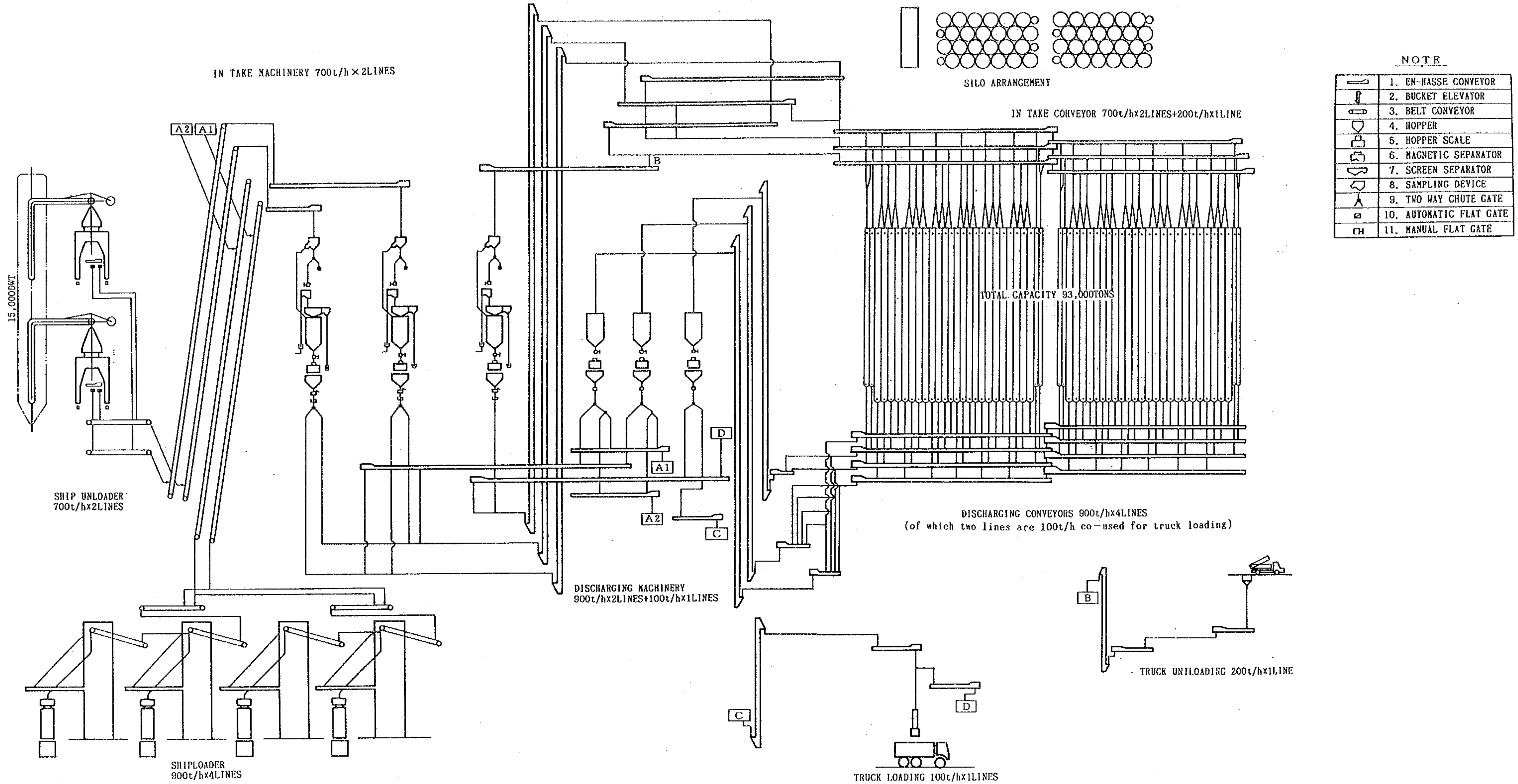


Figure 4-4-2-2 System of Grain Handling Works

4-4-3 Design of Equipment/Machinery

Equipment/machineries listed below will be installed in this grain terminal, of which main equipment/machineries are explained in respect to the design ground or concept.

- Unloading Facilities
  - Unloader
  - Wharf Conveyor for Unloading
  - Receiving Conveyor
  - Unloading Machinery from Truck
- Machinery in Silo
  - Bucket Elevator
  - Chain Conveyor
  - Screening Machine
  - Weighing Scale
  - Sampler
  - Fumigator
  - Temperature Controller
  - Dust Collector
- Loading Facilities
  - Carrying Conveyor
  - Wharf Conveyor for Loading
  - Shiploader
  - Truckloader

(1) Unloader

Unloaders are divided into various classification with different names from scientific and practical points of view, but generally the following classification is adopted.

Table 4-4-3-1 Classification of Unloader

- Intermittent type — Grab Bucket Type
  - Bridge Crane Type
    - Man-trolley Type
    - Rope-trolley Type
    - Grab-trolley Type
  - Level Luffing Crane Type
- Continuous type
  - Pneumatic Type
  - Mechanical Type
    - Bucket-elevator Type
    - Bucket-wheel Type
    - Screw-conveyor Type
    - Belt-conveyor Type
    - Chain-conveyor Type

Unloaders that have widely diffused are grab bucket type and pneumatic type, but from its excellence of cargo handling efficiency, stability of handling capacity and the other merits itemized below, the continuous mechanical type has been recently coming into wide use and is adopted in this design. The outline is as shown in Figure 4-4-3-1.

Merits of continuous mechanical type of unloader, comparing with the other types, are as follows:

1) Loading capacity is stable and has less alteration due to the conditions of cargo loaded.
2) Cargo dropping at unloading is less.
3) Operation cost (electricity) is less.
4) Operation in the rain is possible.
5) Less quantity of dust generates.
6) Repair is easy.

Continuous mechanical type has some demerit that initial investment is a little higher and total dead weight is heavier, but synthetically judging, this type has an advantage over the other types.

Unloading capacity is 700 tons/hr X 2 sets as determined in the foregoing section.

(2) Conveyor

Conveyors to be installed in this terminal are designed as follows:

1) Wharf conveyor for unloading

Will be installed on the unloading pier along the rail for unloader and will convey grains from the unloader to the receiving conveyor.

Capacity	: 700 ton/hr X 2 lines
Length	: Approx. 200 meters
Width of Belt	: 1200 mm
Speed of Belt	: 150 m/min

2) Receiving conveyor

Will be installed on the access road and connected to the wharf conveyor for unloading and will convey grains to the silo area.

Capacity	: 700 ton/hr X 2 lines
Length	: Approx. 400 meters
Width of Belt	: 1200 mm
Speed of Belt	: 150 m/min

3) Carrying conveyor

Will be installed on the access road in parallel with the receiving conveyor and will convey grains from the silo to the wharf conveyor for loading.

Capacity	: 900 ton/hr X 2 lines
Length	: Approx. 400 meters
Width of Belt	: 1400 mm
Speed of Belt	: 150 m/min

4) Wharf conveyor for loading

Will be installed on the loading dolphins in overhead type connecting each shiploader and will convey grains from the carrying conveyor to the shiploader.

Capacity	: 900 ton/hr X 2 lines
Length	: Approx. 100/180 meters
Width of Belt	: 1400 mm
Speed of Belt	: 150 m/min

(3) Shiploader

Performance of shiploader is decided by industrial and economical conditions such as capacity, type of goods, ship in use, handling equipment and condition of location, but shiploaders now in use are generally divided into following two classes:

1) A travel-slewing type of shiploader is the most popular one with the function of moving the loader the and tripper to an appointed place by traveling and of making cargoes pile in one or several holds of a ship by slewing a boom. Trimming is easily operated by using the function of traveling and slewing. By adding accessory devices, it can, be used for almost every kind of ship types, and further by slewing a boom, it can as a whole, be housed within the quay border in order not to cause any trouble for mooring and detaching of ships. It is possible to moor ships on either side of the berth for loading, so that it is very advantageous from a view point of the berth occupation rate. But, the shiploader itself and relating facilities such as wharf conveyor and wharf foundation are expensive.

2) A non-travel-slewing type of shiploader is the one that traveling devices are removed from the above-mentioned travel-slewing type of shiploader, and *slewing boom is mantled on fixed trestle. It does not require any trippers,* and cargoes from fixed type conveyor are directly distributed to shiploader. It is usually used for small sized ships, but large sized ships are also covered by using several shiploaders which receive cargoes from the conveyor through the dumper. By adding a boom derricking motion, namely boom slewing and shuttling devices, it easily covers the holds of from small sized ships to large sized ships, and further it can as a whole, be housed within the quay border in order not to cause any trouble for mooring and detaching of ships. Thhe shiploader itself and relating costs are comparatively cheap.

The other types of shiploader such as boom-derricking type and slewing shuttle type etc. are also now in use. These types are ones arranged by adding or removing some functions and are structurally simplified.

Considering the above-mentioned functions and costs, the non-travel-slewing shuttle type of shiploader, that meets the general layout plan of terminal and the condition of location, is adopted in this design. The outline is as shown in Figure 4-4-3-1.

Although the capacity of wharf conveyors is 900 ton/hr X 2 lines as determined in the foregoing section, 4 sets of shiploaders are required in order to accommodate the normal loading to a 65,000 DWT of long sized ship, but two sets of them are operated at the same time.

(4) Dust Collecting System

In order to prevent dust from generating and exploding, dust collectors will be equipped within the silo and shiploading facilities where there is possibility that dust will generate. Collected dust including grains will be returned to the blower and grains left there will be re-loaded.

The dust prevention measure equipped on the shiploader is designed in cluding following devices:

1) Covers set over the conveyor so that dust of grains will not be flowed away by wind.

2) Telescopic equipped at the exit-mouth of vertical loading unit so that clearance between loaded grain and the exit-mouth can be minimized and dust can be prevented from flowing away.

3) Pneumatic dust collector equipped at the skirt of the tip of telescopic through which dust can be vacuumed.

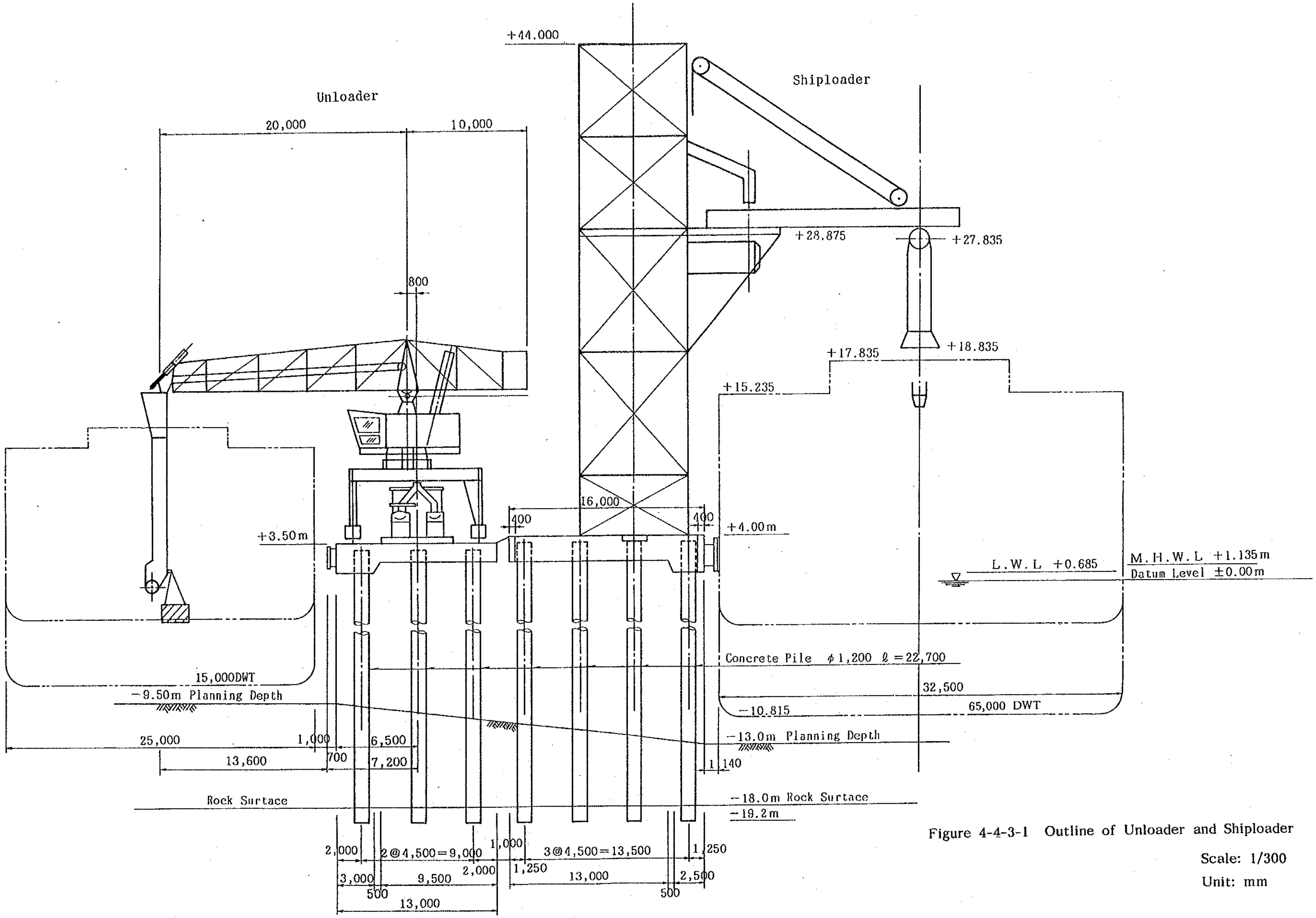


Figure 4-4-3-1 Outline of Unloader and Shiploader

Scale: 1/300

Unit: mm

4-4-4 Design of Silo Facilities

(1) Silo

1) Capacity

Storage capacity is 93,000 tons as determined in the foregoing section.

2) Structure

There are two types of silo structure such as vertical and horizontal type, and the former type is adopted in this design, considering the layout plan and conditions of location. Steel plate, corrugate steel and reinforced concrete are usually used as a main material of vertical type of silo, but corrugate steel structure has difficult points in controlling temperature and durability though it is economical. Some comparisons between steel plate and reinforced concrete structure are shown in Table 4-4-4-1. Seeing the table, both type structures are found to have each merit/demerit, but inclusively looking over them, steel plate structure is advantageous because construction costs including foundation are economical due to its light weight and it has more merits in the other points as shown in the table below. Therefore, the steel plate structure is adopted in this design.

Table 4-4-4-1 Comparison of Silo Characteristics by Structure

	Reinforced Concrete Structure	Steel Plate Structure
(1) Light Weight	×	◎
(2) Airtightness	△	◎
(3) Durability	○	△
(4) Watertightness	△	○
(5) Insulation	○	○
(6) Fireproof	◎	△
(7) Wear Resistance	△	○
(8) Construction Difficulty	○	○
(9) Cost	○	◎

Note: ◎, ○, △ and × show the grade of preference in this order.

3) Arrangement

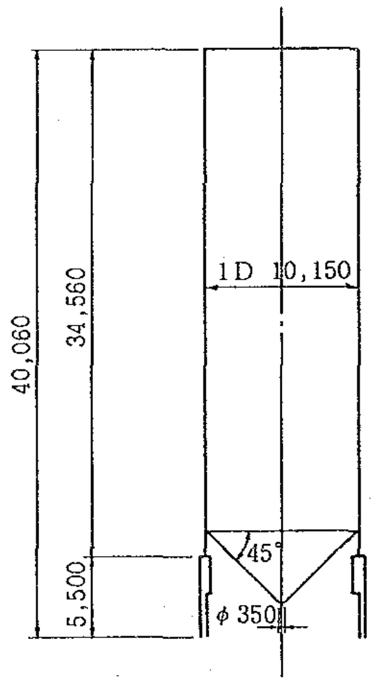
As shown in Figure 3-2-6-7, silo bins will be alternately arranged so that the necessary quantity and costs of in/out grain conveyors can be minimized. Silo bins will be constructed from next to the machinery office toward land side as shown in the Figure 3-2-6-7, considering it becomes possible that silo bins will be extended from next to machinery office toward sea side in the future.

4) Volume and quantity of silo bin

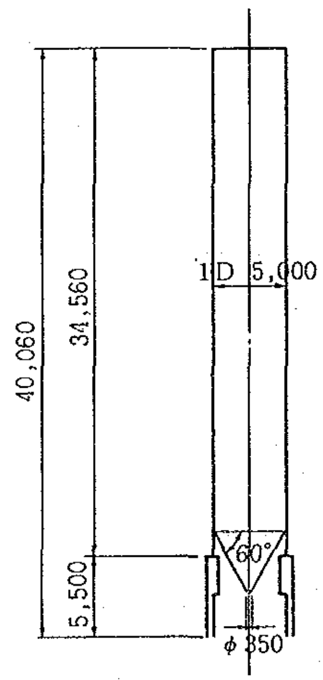
Silo comprise main bins and auxiliary bins, and main bins mainly play a role of a large amount of storage, while auxiliary bins are for an unusual and small amount of storage and will be constructed at the open space of alternate arrangement. Dimensions are as follows:

	Diameter	Height	Volume	Quantity
Main Bin:	10.15 m	40.40 m	1,860 t	48 pieces
Auxiliary Bin:	5.00 m	40.40 m	465 t	8 pieces

Outline of silo bins are as shown in Figure 4-4-4-1.



Main Bin



Auxiliary Silo

Figure 4-4-4-1 Outline of Silo Bins

Scale: 1/500

Unit: mm

4-5 Comments

The following items should be carefully considered in the future detailed design and construction stage.

(1) Clarifying Soil Conditions through the Entire Area

The soil condition in inner port of Montevideo is of a full of variety and is not uniform from place to place, as described in Section 2-4 of Part I. In spite of it, the above designs have been done under the assumption that the soil profile is uniform through all the berth length for each mooring facility. Accordingly, it is very important and indispensable to conduct further more detailed boring survey, and then the embedded length of piles should be adjusted so that each pile reaches the reliable bearing strata.

(2) Connection between Both Ends of Pile and Bedrock or Coping Concrete

As the connection between both ends of pile and bedrock or coping concrete has been designed as a rigid connection for maintaining the stability of dolphin or pier against the berthing energy of vessels and the other external forces, this work shall be carefully performed.

5 CONSTRUCTION AND COST ESTIMATION

5-1 Construction Quantities

(1) Facilities

The construction quantities of facilities of the grain terminal and fishery terminal are presented in Table 5-1-1-(1) and (2), respectively.

Table 5-1-1-(1) Grain Terminal Facilities and Construction Quantities

Facility		Unit	Quantity	Remarks
1. Dredging	(1) Transfer Station	m^3	935,980	-13m/-9.5m Depth
	(2) Foreport	m^3	567,000	-12m Depth
	(3) Approach Channel	m^3	11,833,000	-12m Depth, 160m Width
2. Reclamation	(1) Silo Area	m^3	318,600	22,500 m^2
	(2) Access Road	m^3	288,000	14,400 m^2
3. Slope Protection	(1) Access Road	m	510	Armor Stone Slope
4. Mooring Facilities	(1) Breasting Dolphin	unit	4	Concrete Pile
	(2) Mooring Dolphin A	unit	2	Concrete Caisson
	(3) Unloading Pier	m	129	Concrete Pile
	(4) Approach Jetty	m	53	Concrete Pile
	(5) Mooring Dolphin B	unit	1	Concrete Pile
5. Pavement	(1) Silo Area	m^2	3,738	Asphalt Pavement
	(2) Access Road	m^2	2,760	Asphalt Pavement
6. Grain Handling Facilities	(1) Unloader	unit	2	700 ton/hr
	(2) Ship Loader	unit	4	900 ton/hr
7. Grain Storage Facilities	(1) Silo	unit	1	93,000 ton
	(2) Wharf Conveyor for Unloading	line	2	700 ton/hr X 200m
	(3) Receiving Conveyor	line	2	700 ton/hr X 400m
	(4) Delivery Conveyor	line	2	900 ton/hr X 400m
	(5) Wharf Conveyor for Loading	line	2	900 ton/hr X 100m

Table 5-1-1-(2) Fishery Terminal Facilities and Construction Quantities

Facility		Unit	Quantity	Remarks
1. Mooring Facilities	(1) Pier	m	415	Concrete Pile

(2) Materials

The main materials needed for the construction are listed in Table 5-1-2-(1) and (2). Water, fuel and electricity are not included in this table. As shown in the table, a great amount of materials are needed for the construction. Therefore, the supply method of the materials should be examined in more detail before construction.

Table 5-1-2-(1) Main Construction Materials (Grain Terminal)

Facility	Main Materials					
	Steel (t)	Concrete (m^3)	Stone (m^3)	Filling (m^3)	Asphalt (m^3)	Others
1. Dredging	---	---	---	---	---	
2. Reclamation	---	---	---	606,600	---	Fence (620 m)
3. Slope Protection	---	---	39,960	---	---	
4. Mooring Facilities	820	11,870	7,200	1,990	---	Rubber Fenderr (16 sets) Bitt & Bollard (12 sets) Beacon (2sets), Rail (220m)
5. Pavement	---	---	3,250	--- 650		
6. Grain Handling Facilities	1,060	---	---	---	---	
7. Grain Storage Facilities	9,185	---	---	---	---	
Total	11,065	11,870	50,410	608,590	650	

Table 5-1-2-(2) Main Construction Materials (Fishery Terminal)

Facility	Main Materials					
	Steel (t)	Concrete (m^3)	Stone (m^3)	Filling (m^3)	Asphalt (m^3)	Others
1. Mooring Facilities	660	7,854	---	---	---	Rubber Fender (75 sets) Bollard (75 sets) Light Beacom (1 set) Water Pipeline (415 m)
Total	660	7,854	0	0	0	

5-2 Construction Procedure

(1) Basic Concept

Dredging using a large sized dredger, and such construction works as piers and other port facilities have been executed at Montevideo Port. The newly proposed facilities described above will be able to be constructed using the same methods as before except for the grain handling facilities such as load/unloading equipment, belt conveyer and silo. This kind of grain handling facilities have been constructed twice before at the vicinity of Montevideo Port, Fray Bentos and Nueva Palmira by foreign construction companies, and this time also these facilities will be constructed by introduction of a foreign engineering. Equipment and laborers for the construction works will be locally procurable except for large sized construction crafts such as sand carrier with grab bucket, floating crane for cast-in-plase pile, etc.

(2) Construction of Each Facility

Construction procedures of the main facilities are as follows:

1) Dredging of the approach channel and foreport

A large sized dredger will be used as before. Trailing suction dredger owned by ANP will be efficient for the soft organic soil sedimented on the bottom surface of the approach channel. The dredged sand will be used for the reclamation work. Unsuitable dredged soil will be dumped in the present offshore dumping area 3 km away from along the approach channel.

2) Breasting Dolphin for a 65,000 DWT of grain vessels

The reinforced concrete pile (RC pile) structure is applied in preference of the previous experiences in Montevideo Port and other port nearby. Also, this type is more economical than a concrete caisson type as shown in Table 5-2-1 below.

Table 5-2-1 Comparison of Construction Cost between RC Pile Type and Caisson Type

(Unit: '000 US$)

RC Pile Type	Concrete Caisson Type
67,531 per meter	96,080 per meter

The construction method of the RC pile type of breasting dolphin is as follows: Figure 5-2-1 shows flow of construction works.

(a) Before drilling bedrock, soft surface soil is removed up to the bedrock and after drilling bedrock up to the required embedding depth, a steel casing for concrete pile is installed at the designed position by using a floating crane.

(b) Underwater concrete is cast to fill a gap between the casing and the hole drilled into the bedrock as a foot protection and then, after installing reinforcement bar into the steel casing, is poured there from the bottom upward.

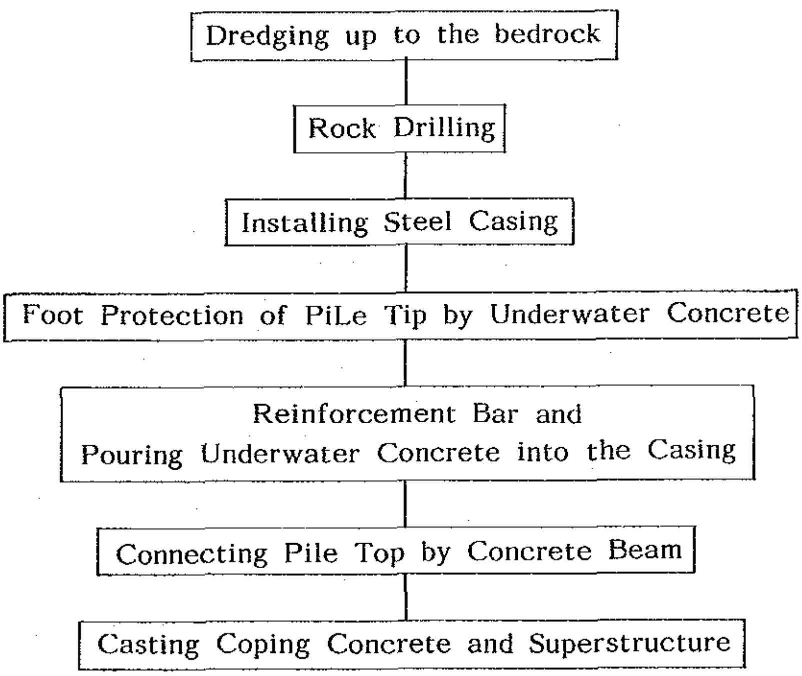


Figure 5-2-1 Flow of Construction Procedure of Breasting Dolphin

(c) Pile tops are connected each other by concretes beams and then deck concrete is cast in place. Instead of cast-in-place concrete, precast concrete slabs can be also applied.

3) Mooring dolphin for a 65,000 DWT of grain vessels

Concrete caisson type is applied because the preliminary design and cost estimate have proved that in the case of RC pile structures, the dolphin would be larger than a breasting dolphin due to a large tractive force of 200 tons and cost far more than a concrete caisson type.

The construction method of the concrete caisson type of mooring dolphin is as follows: Figure 5-2-2 shows flow of construction works.

(a) At first, soft surface soil is removed and replaced with rubble stone as a foundation for caisson.

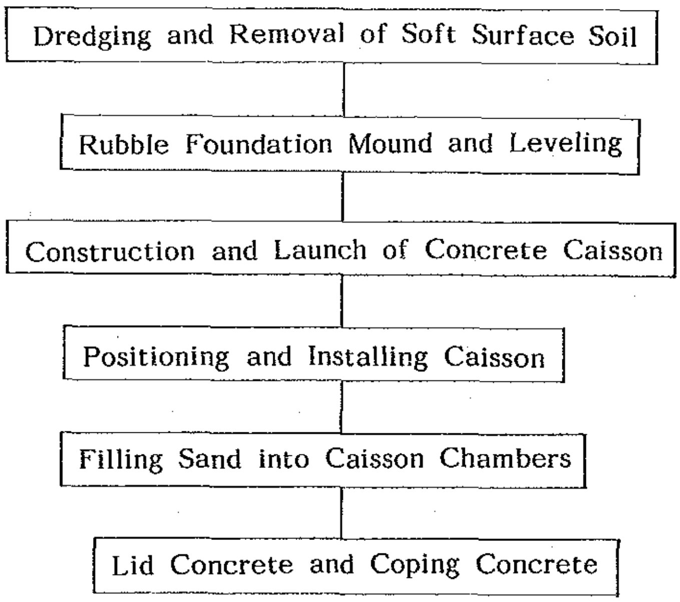


Figure 5-2-2 Flow of Construction Procedure of Mooring Dolphin

(b) After leveling the rubble foundation mound, the concrete caisson which has been constructed by using a floating dock or the other appropriate method, is set up at the designed position by using a floating crane and a tugboat and is settled down pouring sea water by pump.

(c) Concrete caisson settled at the designed position is stabilized by replacing sea water with filling sand into the caisson chambers.

(d) Lastly, lid concrete and coping concrete is cast in place.

4) Pier for a 15,000 DWT of grain vessels

The same reinforced concrete pile type as the breasting dolphin is aepplied to this pier also. Accordingly, the construction method and procedure is also as mentioned above.

5) Pier for fishing vessels

In this case also, the same structure type is applied. But, at the position of pile toe, there is no foot protection required because the piles are not only of bearing pile type as above but also of friction pile type. Therefore, when a steel casing is settled down, care shall be taken not so as to disturb the surrounding soil conditions. Accordingly, dredging only has to be done up to the designed berth depth and the other works except foot protection are as mentioned in the section of pier for grain vessels above.

6) Grain handling and storage facilities

Handling equipment such as shiploader, unloader, belt conveyor, etc and electrical facilities will be imported from Brazil and be locally assembled and installed on the trestles which will be produced in site by using imported and processed steel materials.

Silo will be constructed in site importing, processing and building those main material of steel plates.

Machinery and administration office will be constructed by using imported structural steels and utility facilities such as sanitation, air-conditioning, ventilating, fire hydrant etc.

5-3 Construction Schedule

The construction schedules of grain terminal and fishery terminal are presented in Table 5-3-1-(1) and(2), respectively. These schedule are made, on the assumption that the detailed design will have been completed by the end of 1993 before the commencement of the construction works. There fore, the schedules might be delayed due to the national conditions of Uruguay.

Table 5-3-1-(1) Construction Schedule of Grain Terminal

Facility		Unit	Quantity	Construction Year				
Item	Sub Item			1993	1994	1995	1996	1997
1. Dredging	(1) Transfer Station	m^3	935,980		—		—	—
	(2) Foreport	m^3	567,000				—	—
	(3) Approach Channel	m^3	11,833,000					—
2. Reclamation	(1) Silo Area	m^3	318,600			—	—	
	(2) Access Road	m^3	288,000			—		
3. Slope Protection	(1) Access Road	m	510				—	
4. Mooring Facilities	(1) Breasting Dolphin	unit	4		—	—		
	(2) Mooring Dolphin A	unit	2		—			
	(3) Unloading Pier	m	129		—	—		
	(4) Approach Jetty	m	53			—		
	(5) Mooring Dolphin B	unit	1			—		
5. Pavement	(1) Silo Area	m^2	3,738					—
	(2) Access Road	m^2	2,760					—
6. Grain Handling Facilities	(1) Unloader	unit	2				—	
	(2) Ship Loader	unit	4				—	—
7. Grain Storage Facilities	(1) Silo	unit	1				—	—
	(2) Conveyor Facilities	line	2				—	—

Table 5-3-1-(2) Construction Schedule of Fishery Terminal

Facility		Unit	Quantity	Construction Year				
Item	Sub Item			1993	1994	1995	1996	1997
1. Mooring Facilities	(1) Pier	m^3	935,980				—	—

5-4 Cost Estimation

This section presents the construction cost estimates of grain terminal and fishery terminal in the Short-Term Development Plan based on the following conditions:

5-4-1 Estimate Conditions

(1) Estimation Limit

Some limits for the estimation are as follows:

1) As for the grain terminal, the costs of Site 4 are estimated.
2) Dredging costs up to -11 meters in depth of water in the area of Foreport and Approach Channel are not included.
3) Taxes locally imposed on materials and labors except customs duties on import goods are also included.
4) Land rents, compensations and insurance costs are excluded from the estimation.

(2) Domestic and Foreign Portion

In general, the foreign portion includes the followings:

1) Articles and goods which have never been produced domestically
2) Articles and goods which are seldom produced domestically
3) Articles and goods which cannot be supplied locally because of low domestic production and high domestic consumption

Based on the above criteria, the foreign portion comprises:

1) Labor cost of the foreigners who work for foreign contractors, and the rental of construction equipment which belongs to foreign contractors
2) Equipment & machineries, electric facilities, steel materials, bitts, fenders, aids to navigation, etc

(3) Exchange Rate

Exchange rate among U.S.$, Uruguayan Peso and Japanese Yen are as follows:

1 U.S.$ = 2667 N.$ = 130 Yen

Construction Costs are estimated using the prices at the end of February, 1992.

(4) Physical Contingency

Estimated costs include physical contingencies. Contingency rates are as follows:

1) 0 % Imported grain handling equipment
2) 5 % Dredging cost and construction cost of breakwater, reclamation, slope protection and pavement
3) 10 % Construction costs of mooring facilities and electric facilities

5-4-2 Estimation Procedure

The estimation procedure is as follows:

(1) The prices of main materials used for cost estimation are listed below.

Concrete ($US\$/m^3$)	Stone ($US\$/m^3$)	Aggregate ($US\$/m^3$)	Steel (US$/ton)
170	29	36.5	915

(2) Prices of imported materials and goods are estimated by using the prices in Japan and Brazil.
(3) Local prices that are unclear are estimated by comparing the prices in Uruguay and Japan.
(4) Overhead is fixed as 20 % of the total direct construction cost and Engineering Services fee is 5 % of the total construction cost.
(5) The additional tax rate imposed on the materials and hired construction equipment is estimated as 22 % and tax rate on laborers is 16 %.

5-4-3 Estimation Result

The summary of estimated construction costs of the grain terminal and the fishery terminal is presented in Table 5-4-3-1-(1) and (2), respectively. And Table 5-4-3-2-(1) and (2) show the annual investment at the grain terminal and the fishery terminal, respectively.

Table 5-4-3-1-(1) Construction Cost of Grain Terminal

Facility		Unit	Quantity	Construction Cost ('000 US$)		
				Total	Foreign Portion	Local Portion
1. Dredging	(1) Transfer Station	m^3	935,980	1,738	0	1,738
	(2) Foreport	m^3	567,000	1,053	0	1,053
	(3) Approach Channel	m^3	11,833,000	16,068	0	16,086
	Sub-Total	LS	1	18,859	0	18,859
2. Reclamation	(1) Silo Area	m^3	318,600	2,238	1,690	548
	(2) Access Road		288,000	2,006	1,515	491
	Sub-Total	LS	1	4,244	3,205	1,039
3. Slope Protection	(1) Access Road	m	510	1,741	0	1,741
4. Mooring Facilities	(1) Breasting Dolphin	unit	4	3,328	1,645	1,682
	(2) Mooring Dolphin A	unit	2	924	67	858
	(3) Unloading Pier	m	129	4,730	3,354	1,376
	(4) Approach Jetty	m	53	323	111	212
	(5) Mooring Dolphin B	unit	1	832	411	421
	Sub-Total	LS	1	10,137	5,588	4,549
5. Pavement	(1) Silo Area	m^2	3,738	186	0	186
	(2) Access Road	m^2	2,760	138	0	138
	Sub-Total	LS	1	324	0	324
6. Grain Handling Facilities		unit	1	20,194	17,453	2,741
7. Grain Storage Facilities		unit	1	25,584	10,434	15,149
Total		LS	1	81,083	36,681	44,402
8. Engineering Services		LS	1	3,974	2,649	1,325
9. Physical Contingency		LS	1	2,272	719	1,553
10. Tax		LS	1	7,489	0	7,489
Grand Total		LS	1	94,818	40,049	54,769

Table 5-4-3-1-(2) Construction Cost of the Fishery Terminal

Facility	Unit	Quantity	Construction Cost ('000 US$)		
			Total	Foreign Portion	Local Portion
1. Mooring Facilities	m	415	5,589	2,141	3,447
2. Engineering Services	LS	1	279	107	172
3. Physical Contingency	LS	1	559	214	345
4. Tax	LS	1	1,137	425	712
Grand Total	LS	1	7,564	2,888	4,676

Table 5-4-3-2-(1) Annual Investment (Grain Terminal)

Unit: '000 US$

Facility		Unit	Quantity	1994			1995			1996			1997			Total		
				F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total
1. Dredging	(1) Transfer Station	m^3	935,980	0	869	869	0	0	0	0	521	521	0	348	348	0	1,738	1,738
	(2) Foreport	m^3	567,000	0	0	0	0	0	0	0	421	421	0	632	632	0	1,053	1,053
	(3) Approach Channel	m^3	11,833,000	0	0	0	0	0	0	0	0	0	0	16,068	16,068	0	16,086	16,068
	Sub-Total	LS	1	0	869	869	0	0	0	0	942	942	0	17,048	17,048	0	18,859	18,859
2. Reclamation	(1) Silo Area	m^3	318,600	0	0	0	507	164	671	1,183	384	1,567	0	0	0	1,690	548	2,238
	(2) Access Road		288,000	0	0	0	1,515	491	2,006	0	0	0	0	0	0	1,515	491	2,006
	Sub-Total	LS	1	0	0	0	2,022	656	2,677	1,183	384	1,567	0	0	0	3,205	1,039	4,244
3. Slope Protection	(1) Access Road	m	510	0	0	0	0	0	0	0	1,741	1,741	0	0	0	0	1,741	1,741
4. Mooring Facilities	(1) Breasting Dolphin	unit	4	1,481	1,514	2,995	165	168	333	0	0	0	0	0	0	1,645	1,682	3,328
	(2) Mooring Dolphin A	unit	2	67	858	924	0	0	0	0	0	0	0	0	0	67	858	924
	(3) Unloading Pier	m	129	2,347	963	3,311	1,006	413	1,419	0	0	0	0	0	0	3,354	1,376	4,730
	(4) Approach Jetty	m	53	0	0	0	111	212	323	0	0	0	0	0	0	111	212	323
	(5) Mooring Dolphin B	unit	1	0	0	0	411	421	832	0	0	0	0	0	0	411	421	832
	Sub-Total	LS	1	3,895	3,335	7,230	1,693	1,213	2,906	0	0	0	0	0	0	5,588	4,549	10,137
5. Pavement	(1) Silo Area	m^2	3,738	0	0	0	0	0	0	0	0	0	0	186	186	0	186	186
	(2) Access Road	m^2	2,760	0	0	0	0	0	0	0	0	0	0	138	138	0	138	138
	Sub-Total	LS	1	0	0	0	0	0	0	0	0	0	0	324	324	0	324	324
6. Grain Handling Facilities		unit	1	0	0	0	0	0	0	13,962	2,193	16,155	3,491	548	4,039	17,453	2,741	20,194
7. Grain Storage Facilities		unit	1	0	0	0	0	0	0	4,174	6,060	10,234	6,260	9,090	15,350	10,434	15,149	25,584
Total		LS	1	3,895	4,204	8,099	3,715	1,869	5,584	19,319	11,320	30,639	9,751	27,010	36,761	36,681	44,402	81,083
8. Engineering Services		LS	1	195	210	405	186	93	279	1,421	153	1,574	847	869	1,716	2,649	1,325	3,974
9. Physical Contingency		LS	1	390	377	767	270	154	424	60	153	213	0	869	869	719	1,553	2,272
10. Tax		LS	1	0	1,501	1,501	0	1,332	1,332	0	2,319	2,319	0	2,336	2,336	0	7,489	7,489
Grand Total		LS	1	4,480	6,292	10,772	4,171	3,448	7,619	20,800	13,945	34,745	10,598	31,084	41,682	40,049	54,769	94,818

Table 5-4-3-2-(2) Annual Investment (Fishery Terminal)

Unit: '000 US$

Facility	Unit	Quantity	1994			1995			1996			1997			Total		
			F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total
1. Mooring Facilities	m	415	0	0	0	0	0	0	1,178	1,896	3,074	964	1,551	2,515	2,141	3,447	5,589
2. Engineering Services	LS	1	0	0	0	0	0	0	59	94	153	48	78	126	107	172	279
3. Physical Contingency	LS	1	0	0	0	0	0	0	117	191	308	96	155	251	214	345	559
4. Tax	LS	1	0	0	0	0	0	0	234	391	625	191	321	512	425	712	1,137
Grand Total	LS	1	0	0	0	0	0	0	1,588	2,572	4,160	1,300	2,104	3,404	2,888	4,676	7,564

At for the annual maintenance dredging costs, they are presented in Table 5-4-3-3-1(1) and (2). Each annual maintenance dredging volume is estimated as follows reviewing and evaluating the report of "Master Development Plan".

As shown in Table 6-2-5-2 of Part I, in the case of 160 m wide approach channel, the shoaling volume for the case of -12.5 m in depth is 8,474 x 10^3 m^3, while that for the case of -11.5 m in depth is 6,260 x 10^3 m^3. The maintenance dredging volume is the difference between the above both volumes. The shoaling thickness of Port Mouth and Central Area are also the difference between the shoaling thickness for the above both depths and have been estimated as 30% of the shoaling thickness for the case of -11.5 m in depth of Area 1 and Area 2 in Table 6-3-4-1 of Part I, Respectively, *taking into account that the shoaling thickness* for the case of -11.5 m in depth in the table. In these estimation, included is an extra dredging of 5 m in depth for the depth allowance.

As for Transfer Station, applied is 4) in the notes of Table 6-3-4-2 of Part I. The shoaling thickness of Fishery Terminal is taken from Table 6-3-3-4 of Part I.

Table 5-4-3-3-(1) Annual Maintenance Dredging Cost (Grain Terminal)

Dredging Area	Area (m^2)	Shoaling Thickness (m/year)	Dredging Volume (m^3)	Cost ('000 US$)	Remarks
Approach Channel	---	----	2,214,000	2,457	-11 to -12m
Port Mouth	132,800	0.99*0.3	39,441	63	-11 to -12m
Central Area	245,200	1.41*0.3	103,719	165	-11 to -12m
Transfer Station	153,900	0.7	107,730	171	-12/-13m
Total				2,856	

Table 5-4-3-3-(2) Annual Maintenance Dredging Cost (Fishery Terminal)

Dredging Area	Area (m^2)	Shoaling Thickness (m/year)	Dredging Volume (m^3)	Cost (US$)	Remarks
- 5m Baisn	35,490	0.65	23,068	36,678	
- 6m Basin	46,205	0.83	38,350	60,976	
Total				97,654	

6 PORT MANAGEMENT AND OPERATIONS

6-1 Introduction

Not only proper port planning but also improvement and establishment of port management and the operation system is also required to carry out port projects. In this chapter, we have examined problems in the present system of management and operations, made recommendations on present management and operations, and drafted management and operation plans for new terminals in the Short-term Development Plan.

6-2 *Present Situation of Management and Operations*

To promote port use, it is essential to provide attractive port services to port users; specially berthing vessels and handling cargo with safety and speed, and establishing a rational tariff system which corresponds with provided services.

From the above points of view we have examined present management and operations as follows.

6-2-1 Cargo Handling Speed and Efficiency

(1) Shortening waiting hours for a berth, (2) Shortening berthing hours and (3) improving cargo handling efficiency, are essential in providing speedy port services. Waiting for a berth did not occur very often based on interviews of port related personnel in Montevideo Port, but cargo handling efficiency is not high because of the following reasons:

1) Stevedoring and on-shore cargo handling are carried out by separate organizations; at present, stevedoring is carried out by the ANSE and on-shore cargo handling is carried out by the ANP. Because there is lack of coordination between stevedoring and on-shore cargo handling, they can not achieve efficient cargo handling. For instance, sometimes cargo handling does not begin on time because labor has not been gathered by the starting time.

There is an incentive for laborers of the ANSE when they handle a minimum cargo handling volume per shift as shown in Table 6-2-1-1.

However, laborers of the ANP have no such incentive. Since cargo handling is like a chain, incentives do not work well if they are not distributed to equally. The result is that sometimes cargo handling ends when the minimum volume reached.

Furthermore, because of lack of coordination, a gang is sometimes assigned a task which their presence is superfluous; for example a crane operator, either a ship-side crane operator (when they use a ship-side crane) or a quay crane operator (when they use a quay crane) may be required, but occasionally it happens that both crane operators have received the assignment.

2) A substantial amount of cargo is handled through direct delivery from/to trucks without storage in warehouses. In this direct delivery case, a cargo handling plan is difficult to make and in case of delay of trucks cargo handling is sometimes suspended.

3) Cranes have become superannuated and their maintenance is insufficient. Especially, number 1 and 2 cranes of Wharf A and number 8 and 9 cranes of Wharf B are conspicuous; working ratios of these are very low (refer to Part I 3-4-3 Terminal Performance).

4) The width of aprons is too narrow to handle cargo.

Table 6-2-1-1 Minimum Handling Volume per Shift and Bonus on Yield

IN FORCE: As from 1st. November, 1991.

COMMODITY (*)		MINIMUM TONNAGE	COST PER ADDITIONAL TON.	
1.	GENERAL CARGO	70 Ton.	N$	10.683,oo
2.	HEAVY CARGO	126 Ton.	N$	5.713,oo
3.	HEAVY CARGO/BILLETS	270 Ton.	N$	2.674,oo
4.	WOOD + 1.000 kg.	115 Ton.	N$	6.511,oo
5.	WOOD - 1.000 kg.	85 Ton.	N$	8.807,oo
6.	LOGS in bundles	180 Ton.	N$	3.517,oo
7.	GRANITE - UNIT - 10 ton.	110 Ton.	N$	6.820,oo
8.	GRANITE - UNIT + 10 ton.	220 Ton.	N$	3.411,oo
9.	BURLAP in bales	70 Ton.	N$	10.683,oo
10.	BALES ALL KINDS a)	70 Ton.	N$	16.503,oo
11.	BALES ALL KINDS b)	85 Ton.	N$	13.605,oo
12.	BALES ALL KINDS c)	80 Ton.	N$	12.110,oo
13.	BALES ALL KINDS d)	90 Ton.	N$	10.768,oo
14.	BALES ALL KINDS e)	80 Ton.	N$	14.441,oo
15.	BALES ALL KINDS f)	90 Ton.	N$	12.846,oo
16.	BALES ALL KINDS g)	90 Ton.	N$	12.846,oo
17.	BALES ALL KINDS h)	70 Ton.	N$	17.390,oo
18.	BALES ALL KINDS i)	85 Ton.	N$	14.341,oo
19.	REELS - TRUCK OR WAGON	80 Ton.	N$	9.001.oo
20.	RELLS - TO SHORE	100 Ton.	N$	7.192,oo
21.	DRUMS + 350 UNITS	70 Ton.	N$	10.683,oo
22.	CELLULOSE	240 Ton.	N$	3.002,oo
23.	BAGS PALLETIZED TO DESTINATION	100 Ton.	N$	5.996,oo
24.	BAGS, PRESLUNG, BIG BAGS	100 Ton.	N$	9.064,oo
25.	LOOSE BAGS, 500 UNITS OF (*)			
	50 K. OR MORE 1.650 per	unit	N$	858,oo
	less than 50 k. p/unit	82.5 Ton.	N$	12.209,oo
26.	COTTON - OCEAN VESSEL FROM SHORE	70 Ton.	N$	10.276,oo
27.	COTTON - RIVER VESSEL "VESSEL TO VESSEL"	70 Ton.	N$	5.494,oo
28.	COTTON - RIVER VESSEL "VESSEL TO SHORE"	70 Ton.	N$	7.667,oo
29.	CONTAINERS WITH CARGO	per unit	N$	18.492,oo
30.	EMPTY CONTAINERS 15	per unit	N$	2.768,oo
31.	BUTTER a)	80 Ton.	N$	18.260,oo
32.	BUTTER b) in open hold	80 Ton.	N$	15.016,oo

NOTE: The above mentioned wages and amounts to be paid per additional tonnes correspond to straight time work on working days

Source: CNT

6-2-2 Tariff System

Since port charges are the main source of revenues of port management and operation, reasonable composition and level of tariff are important elements in the financial stability of a port management body.

The tariff system should accommodate a number of priorities and conditions.

Particularly, it should:

(1) Cover construction, maintenance and operating cost.

However, there are some cases where Government should subsidize construction cost when necessary because the port is considered important to public interest.

(2) Set appropriate charges that reflect the services provided.

(3) Provide an incentive structure to encourage more efficient port management and operation. In other words, the tariff system should be designed to make cargo and vessels flow more efficiently.

(4) Be competitive with neighboring ports.

(5) Be straightforward in its design and method of collecting charges.

With these criteria in mind, the following points on the present tariff system can be noted.

(1) Tariff system of wharfage charge is not reasonable.

Present wharfage charge of the ANP is based on length of vessel. However, taking into consideration that a wharfage charge is compensation for the use of a wharf, we should not merely take into account the length of vessel (occupied length of berth). Rather, we should pay more attention to size of vessel because it is necessary to increase berth depth to accommodate large vessels and the cost is great.

Table 6-2-2-1 shows comparison of wharfage charges at the ports of Montevideo, Buenos Aires, Singapore and Yokohama. The tariff of Montevideo Port is based on length of vessel, while that of the other three ports is based on size of vessel such as Gross Registered Tonnage (GRT) or Net Registered Tonnage (NRT). In the case of small vessels such as 500GRT class, there is not a big difference between Montevideo Port and the other ports, but in the case of large vessels such as Panamax type, the wharfage charge at the other ports is ten to twenty times higher than at Montevideo. This indicates that wharfage charge of Montevideo is usually low for large vessels and should be reconsidered.

Table 6-2-2-1 Comparison of Wharfage Charge

	Montevideo (Uruguay)	Buenos Aires (Argentina)	Singapore (Singapore)	Yokohama (Japan)
Tariff Rate	$1/m,day	$0.164/NRT, day	$0.15/GRT, day	$0.10/GRT, day
500GRT Vessel (LOA=55m)	$55/day ($1x55m)	$49/day (0.164x300NRT)	$75/day ($0.15x500GRT)	$50/day ($0.10x500GRT)
Panamax Type (LOA=225m)	$225/day ($1x225m)	$3608/day ($0.164x22000NRT)	$4800/day ($0.15x32000GRT)	$3200/day ($0.10x32000GRT)

(2) Tariff system levied on cargo is not reasonable.

Present charges levied on export and import cargo are classified into ten groups (export cargo) or four groups (import cargo) based on classification of NADE/NADI Code, and each group has a fixed rate. Taking into consideration that charges levied on cargo have a character of compensation of cargo handling, the tariff system should be based on difficulty or speed of cargo handling. Specifically, it should be designed based on type of cargo (container, palletized, bag, bulk cargo, etc.) basically, and characteristics of individual cargo (size, weight, value, etc.) when it is necessary. In this respect the present tariff system is not based on type of cargo directly and it is fairly complex.

(3) Regarding import cargo, the tariff system is based on value of cargo (CIF value), which is not suitable.

Both tariff levied on import cargo and export cargo are similar in that both are handled at a berth and pass through a port area. The present tariff system of the ANP is based on freight volume of cargo concerning export cargo, and value of cargo concerning import cargo. The value of cargo is not the sole guideline to decide a level of tariff, rather it is only one of guidelines. To adopt a tariff system based on value is not suitable because it has a similar effect like tax. Charges levied on cargo (both import and export cargo) should be designed based on freight volume and type of cargo.

(4) The tariff system of container is complicated compared with general cargo.

In the present system, container are levied with two kinds of charges; one is charges levied on cargo, which is the same as general cargo. The other is handling of container charge, which is based on a box (TEU). To levy charges on cargo based on each cargo in a container is complicated because contents of a container have to be precisely confirmed.