12.3 Cargo Handling System

12.3.1 Cargo Handling Capacity

According to the Demand Forecast conducted for the target year 2000 in Chapter 10, the cargo volume to be handled in Cai Lan Port will amount to as much as 2.7 million tons and it will reach 14.3 million tons in 2010. To introduce the proper cargo handling system, it is necessary to estimate cargo handling capacity by berths and commodities.

(1) Estimated cargo handling efficiency by commodities

Cargo handling efficiency per hour per gang is calculated and estimated by the following basic preconditions;

For break bulk cargo......@ "x" KT x 20 cycles x 0.9

@ "x"	: Assumed cargo weight of one sling.
20 cycles	: Cycles of cargo slinging per hour.
0.9	: Coefficient of stoppage of cargo work.

For bulk cargo............@ "y" KT x "z" cycles x 0.9

@ "y"	: Using a certain capacity bucket x bulk density, but for cement, grain and scrap used special equipment.
"z"	: Cycles of cargo slinging (grab bucket).

The result is shown in Table 12-3-1

In comparison with Hai Phong Port (figures are also shown in Table 12-3-1), the calculated result is higher than past average of efficiency in that port. In actual cargo operation except cargo in bulk or bagged cargo, it is seldom that one commodity is handled on a break bulk carrier vessel and it is very often that loading and unloading operation are conducted simultaneously.

From this point of view, it should be noted that the estimated efficiency may be rather high.

At any rate, it is indispensable for the port to provide high level and high quality port services to clients, such as shippers, consignees and shipping companies because they are demand just-in-time service for cargo delivery, receipt and ship's schedule.

Table 12-3-1 Estimated Cargo Handling Efficiency by Commodities

Cargo	Style	No.	Precondition & Formula	Productivity kt/h/gang
General Cargo	C/S, CTN	1	Past Average in Hai Phong Port (by shore crane)	11
			(by ship's gear)	8
		2	One sling (@1.5 KT) x 20 cycles/h x 0.9	27
	C/S, CTN	x		@ 25
	Drum	x	One Sling (@2 KT) x 20 cycles/h x 0.9	@ 36
	Unitized	x	(@ 1.5 x 2) x 20 cycles/h x 0.9	@ 50
Container	Ship Gear	X	One unit x 12 cycles/h x 0.9	@ 10 U/T
	Shore Cr.	X	One unit x 20 cycles/h x 0.9	@ 18 U/T
	Gantry C.	X	One unit x 25 cycles/h x 0.9	@ 22 U/T
Bagged Cargo	Bag in Loose	1	Past Average in Hai Phong Port (by shore crane)	21
			(by ship's gear)	16
		2	One sling *(@1.5 KT) x 20 cycles/h x 0.9	27
		x	Bag Loader 1800-3000 bags/h x 50 kgs x 0.9	81~135 @ 90
		x	One sling x 20 cycles/h x 0.9	@ 25
Steel Product	Bdl, Skid Bare	1	Past Average in Hai Phong Port (by shore crane)	45
			(by ship's gear)	26
		2	One sling **4.0 KT x 20 cycles/h x 0.9	72
		x	Average of above	@ 50
Scrap	Loose	x	Polyp Type Grab (2 KT) x 20 cycles x 0.9	@ 36
Apatite/Phosphate	Bulk	1	Past Average in Hai Phong Port (by shore crane)	52
		x	4.7 m^3 x 1.5 x 30 cycles/h x 0.9 (Grab Capacity (Bulk sensity)	@ 190
Cement	Bulk	x	3.5 m^3 x 1.5 x 30 cycles/h x 0.9	@ 142
		x	Bucket Elevator Type	@ 400
Wheat/Maize/Rice	Bulk	1	3.5 m^3 x (0.70-0.75) x 30 cycles/h x 0.9	66~71
		x	250 t/h (Pneumatic tire-mounted unloader)	@ 250
		x	Travelling Type Unloader	@ 400
Coal	Bulk	1	3.5 m^3 x (0.75) x 30 cycles/h x 0.9	71
		x	4.0 kt (Wagon Bucket) x 20 cycles/h x 0.9	@ 72
Iron Ore/Others	Bulk	x	3.5 m^3 x (2.0 x 2.6) x 30 cycles/h x 0.9	189~246/@215
Rice	Bulk	x	3.5 m^3 x 0.8 x 20 cycles/h x 0.9	@ 50
Fertilizer	Bulk	x	3.5 m^3 x (0.75~0.96) x 30 cycles/h x 0.9	71~91/ @ 80

Remark: "X" marked productivity are used for computing various cargo handling capacity in this section.

(2) Estimation of cargo volume and capacity of berths

Based on efficiency levels in Table 12-3-1, the captioned estimation is computed by following two methods (precondition & formula);

1) The first method is used to determine the cargo handling capacity based on productivity;

(a) : Assigned cargo volume to each berth.
(b) : Ratio of each commodity at each berth.
(c) : Cargo handling efficiency per hour per gang.
(d) : Amount of handling volume per gang per year by the following formula;
(b) x (c) x working hrs/day x 365 x 0.65 x 0.9 x 0.9 = (d)
365 : Days in a year.
0.65 : Coefficient of berth occupancy.
0.9 : Coefficient of stoppage due to rain, wind, etc.
0.9 : Coefficient of loss hours for berthing/unberthing, etc.
(e) : Planned number of gangs.
(f) : Maximum productivity by commodity.
(g) : (a) / (f)

As a result of this calculation, the volume of certain commodity exceeds the handling capacity. By this method, maximum commodity-wise cargo volume for the berth through the year is computed in the ratio of each commodity cargo volume to assigned berth total volume. This means that maximum handling volume per year by commodity is fixed without consideration of cargo efficiency. Working hours for each commodity are shared in the above ratio, so capacity is exceeded when high cargo volumes are combined with low efficiency.

2) The second method is used to verify the capacity shortage (productivity kt/h/gang);

The allowance of high productivity cargo in the ratio can be diverted to handle over-capacity cargo with low efficiency and this is checked by the second method. Maximum working hours per year per berth is computed (4,151 hours) and these are shared according to the ratio of necessary hours to handle assigned cargo volume by commodity. And the maximum productivity of each commodity based on working hours can be obtained.

(A) : Necessary net hours to handle the assigned cargo by commodity.
(a) / (c) / (e)

(B) : Ratio of (A) by commodity to total assigned cargo volume.

(C) : Maximum working hours per year per berth.
24 hours x 0.9 x 365 x 0.65 x 0.9 x 0.9 = 4,151 hours
4,151 x (B) = (C)

(D) : (c) x (e) x (C) = (D)

(E) : (a) / (D) = (E)

The results of calculation (both methods) are shown in Table 12-3-2 for the target year 2000.

Table 12-3-2 Cargo Volume and Capacity of Berths in the Target Year 2000

Berth No.	Cargo Commodity	Cargo Status	Assigned Cargo Volume UNIT: 1,000 KT (a)	Ratio of Commodity (b)	Cargo Handling Efficiency KT/hr/gang (c)	Amount of Handling KT/gang/year Unit: 1,000 (d)	Planned Number of Gangs (e)	Total Capacity of Product. Unit: 1,000 KT (f)	Handling ratio by Efficiency (g)	Reviewed Over-Capacity Cargo: Necessary Hours for Assigned Cargo (A)	Ratio (B)	Max. Working Hours / Year Unit: Hour (C)	Max. Produ. / Year Unit: 1,000 KT (D)	Handling Ratio by Commodity (E)
No.1	Rice in Bag	Dom. In	80	40%	25	41,098	3	123	65%	1,067	40%	1,644	123	65%
	General Cargo	Dom. In/Out	122	60%	25	62,675	3	188	65%	1,627	60%	2,507	188	65%
	Total		202		50	103,773		311	65%	2,693	65%	4,151	311	65%
No.2	Rice in Bag	Dom. In/Out	78	39%	25	40,071	3	120	65%	1,040	44%	1,829	137	57%
	Fertilizer in Bag	Dom. Out	74	37%	25	38,016	3	114	65%	987	42%	1,735	130	57%
	Steel Product	Dom. Out	50	25%	50	51,373	3	154	32%	333	14%	586	88	57%
	Total		202			129,460		388	52%	2,360	57%	4,151	355	57%
No.3	Steel	Dom. Out	300	100%	50	207,546	3	623	48%	2,000	100%	4,151	623	48%
	Total		300			207,546		623	48%	2,000	48%	4,151	623	48%
No.4	Scrap in Loose	Import	287	88%	36	131,154	3	393	73%	2,657	88%	3,671	396	72%
	Asphalt in Drum	Import	30	9%	36	13,709	3	41	73%	278	9%	384	41	72%
	Coal in Bulk	Import	10	3%	72	9,140	2	18	55%	69	2%	96	14	72%
	Total		327			154,003		453	72%	3,005	72%	4,151	452	72%
No.5	Container	Export	94	16%	180	122,358	2	245	38%	261	9%	373	134	70%
	Container	Import	225	39%	180	292,879	2	586	38%	625	22%	894	322	70%
	MTY CTNR regarded as cargo WT		131	23%	180	170,521	2	341	38%	364	13%	520	187	70%
	General in B. Bulk	Export	37	6%	25	6,689	3	20	184%	493	17%	705	53	70%
	General in B. Bulk	Import	87	15%	25	15,729	3	47	184%	1,160	40%	1,658	124	70%
	Total		574			608,176		1,239	46%	2,903	70%	4,151	821	70%
No.6	Cement in Bag	Export	120	28%	25	28,826	3	86	139%	1,600	39%	1,615	121	99%
	Cement in Bulk	Export	120	28%	190	219,077	2	438	27%	316	8%	319	121	99%
	Fertilizer in Bag	Import	103	24%	25	24,742	3	74	139%	1,373	33%	1,386	104	99%
	Chemical in Drum	Import	89	21%	36	30,786	3	92	96%	824	20%	832	90	99%
	Total		432			303,431		691	62%	4,113	99%	4,151	436	99%
No.7	Rice in Bag	Export	200	26%	25	26,954	3	81	247%	2,667	67%	2,791	209	96%
	Maize in Bulk	Export	300	39%	250	404,311	2	809	37%	600	15%	628	314	96%
	Grained Wheat, Bag	Export	30	4%	25	4,043	3	12	247%	400	10%	419	31	96%
	Wheat in Bulk	Import	240	31%	400	517,518	2	1,035	23%	300	8%	314	251	96%
	Total		770			952,826		1,937	40%	3,967	96%	4,151	806	96%
Cargo total			2,676			2,288,694		5,301	50%	20,677	72%	28,536	3,616	74%
MTY CTNR regarded as Cargo WT			131			170,521		341	38%	364	70%	520	187	70%
Grand Total			2,807			2,459,215		5,642	50%	21,041	72%	29,056	3,803	72%

(3) Estimation of cargo volume and number of calling vessels

In the report of the Urgent Rehabilitation Plan of Hai Phong Port, average ship size and handling volume was introduced (Table 12-3-5).

Table 12-3-3 Average ship Size and Handling Cargo Volume in 1992 at Hai Phong Port

Type of Cargo	IMPORT				EXPORT				TOTAL			
	Number of Ship	Ship's D.W.T. (a) KT	Cargo Volume (b) KT	Unload Ratio (b)/(a)	Number of Ship	Ship's D.W.T. (a) KT	Cargo Volume (b) KT	Load Ratio (b)/(a)	Number of Ship	Ship's D.W.T. (a) KT	Cargo Volume (b) KT	Load Ratio (b)/(a)
General Carg	33	5,250	2,990	0.57	4	4,635	2,162	0.47	37	5,184	2,900	0.56
Bulk Cargo	76	4,833	1,078	0.22	22	4,614	1,705	0.37	98	4,784	1,219	0.25
Bagged Cargo	74	9,139	6,117	0.67	15	5,035	3,286	0.65	89	8,447	5,640	0.67
Sub. Total	183	6,649	3,460	0.52	41	4,770	2,328	0.49	224	6,305	3,253	0.52
Container	38	4,414	722	0.16	36	4,553	459	0.10	74	4,482	594	0.13
Grand Total	221	6,265	2,990	0.48	77	4,669	1,454	0.31	298	5,853	2,593	0.44

This data is perhaps not very accurate because it includes only 221 of 947 calling vessels. But some prevailing tendencies are indicated by this data. Average vessel size and cargo volume (import/export) except container vessels are calculated as 6,305 DWT and 3,253 tons of cargo volume respectively, and average load ratio (cargo volume/ DWT) is 52 % . Average load ratio of bagged cargo vessel is 67 % and this figure is very high.

Even if above data should be used for the estimation, it is very difficult to estimate cargo volume by size and commodity for Cai Lan Port because deeper draft vessel will be able to enter Cai Lan Port than Hai Phong Port. In a general way, if Cai Lan Port will be used by liner vessels for regular service, number of vessels calling this port may increase, but volume of handling cargo per vessel may decrease. On the contrary, if tramp vessel will use this port, number of calling vessels may decrease, but volume per vessel may increase.

Captioned estimation is computed by following two methods. The first one is that handling cargo volume per vessel is set in three ways : 3,000, 5,000 and 7,000 tons. The second one is that cargo volume per vessel is fixed in consideration of vessel size and capacity in present trade service.

1) The first method;

To obtain productivity per day per vessel;

@ Efficiency/hr/gang x 24 hrs x 0.9 x Planned No.of gangs = E

(a) (b) (c) (d)

(a)(b)(c) (d): Same as fore-mentioned.

E: Productivity per day per vessel.

To obtain number of vessels;

Planned cargo volume/ Assumed cargo volume per vessel

(In 3 ways per 3,000, 5,000, 7,000)

To obtain days of stay;

Three alternatives (@ 3,000, @5,000, @ 7,000) / E x 1.2

1.2 : Loss hours for berthing/unberthing, entry procedure, etc.

The results of calculation are shown in Table 12-3-4 for the target year 2000.

By using Table 12-3-6, number of vessel entering and leaving can be estimated.

Cargo volume 3,000....... 936 vessels x 2 / 365 days = 5.13

5,000....... 561 vessels x 2 / 365 days = 3.07

7,000....... 401 vessels x 2 / 365 days = 2.20

Also, net working days are obtained;

For domestic : 327 days

For foreign trade : 643 days

Table 12-3-4 Cargo Volume and Number of Calling Ships in the Target Year 2000

Berth No.	Cargo Commodity	Cargo Status	Assigned Cargo Volume UNIT: 1,000 KT	Cargo Handling Efficiency KT/hr/gang	Planned Number of Gangs	Product /Day /Ship Unit: 1,000 KT	Average of Handling Cargo Volume per Ship @ 3,000 Number of Ships per Year	@ 3,000 Net Work. Days per Ship	@ 5,000 Number of Ships per Year	@ 5,000 Net Work. Days per Ship	@ 7,000 Number of Ships per Year	@ 7,000 Net Work. Days per Ship	Total Net Working Days at Berth
No. 1	Rice in Bag	Dom. In	80	25	3	1.62	26.67	1.85	16.00	3.09	11.43	4.32	49.38
	General Cargo	Dom. In/Out	122	25	3	1.62	40.67	1.85	24.40	3.09	17.43	4.32	75.31
	Total		202				67.33		40.40		28.86		124.69
No. 2	Rice in Bag	Dom. In/Out	78	25	3	1.62	26.00	1.85	15.60	3.09	11.14	4.32	48.15
	Fertilizer in Bag	Dom. Out	74	25	3	1.62	24.67	1.85	14.80	3.09	10.57	4.32	45.68
	Steel Product	Dom. Out	50	50	3	3.24	16.67	0.93	10.00	1.54	7.14	2.16	15.43
	Total		202				67.33		40.40		28.86		109.26
No. 3	Steel	Dom. Out	300	50	3	3.24	100.00	0.93	60.00	1.54	42.86	2.16	92.59
	Total		300				100.00		60.00		42.86		92.59
Sub Total for Domestic			704				234.67		140.80		100.57		326.54
No. 4	Scrap in Loose	Import	287	36	3	2.33	95.67	1.29	57.40	2.14	41.00	3.00	123.03
	Asphalt in Drum	Import	30	36	3	2.33	10.00	1.29	6.00	2.14	4.29	3.00	12.86
	Coal in Bulk	Import	10	72	2	3.11	3.33	0.96	2.00	1.61	1.43	2.25	3.22
	Total		327				109.00		65.40		46.71		139.10
No. 5	Container	Export	94	180	2	7.78	31.33	0.39	18.80	0.64	13.43	0.90	12.09
	Container	Import	225	180	2	7.78	75.00	0.39	45.00	0.64	32.14	0.90	28.94
	MTY CTNR regarded as cargo WT		131	180	2	7.78	43.67	0.39	26.20	0.64	18.71	0.90	16.85
	General in B. Bulk	Export	37	25	3	1.62	12.33	1.85	7.40	3.09	5.29	4.32	22.84
	General in B. Bulk	Import	87	25	3	1.62	29.00	1.85	17.40	3.09	12.43	4.32	53.70
	Total		574				191.33		114.80		82.00		134.41
No. 6	Cement in Bag	Export	120	25	3	1.62	40.00	1.85	24.00	3.09	17.14	4.32	74.07
	Cement in Bulk	Export	120	190	2	8.21	40.00	0.37	24.00	0.61	17.14	0.86	14.62
	Fertilizer in Bag	Import	103	25	3	1.62	34.33	1.85	20.60	3.09	14.71	4.32	63.58
	Chemical in Drum	Import	89	36	3	2.33	29.67	1.29	17.80	2.14	12.71	3.00	38.15
	Total		432				144.00		86.40		61.71		190.43
No. 7	Rice in Bag	Export	200	25	3	1.62	66.67	1.85	40.00	3.09	28.57	4.32	123.46
	Maize in Bulk	Export	300	250	2	10.80	100.00	0.28	60.00	0.46	42.86	0.65	27.78
	Grained Wheat, Bag	Export	30	25	3	1.62	10.00	1.85	6.00	3.09	4.29	4.32	18.52
	Wheat in Bag	Import	240	400	3	25.92	80.00	0.12	48.00	0.19	34.29	0.27	9.26
	Total		770				256.67		154.00		110.00		179.01
Sub Total for Foreign Trade			2,103				701.00		420.60		300.43		642.95
Grand Total			2,807				935.67		561.40		401.00		969.50
Cargo total			2,676				892.00		535.20		382.29		952.65
MTY CTNR regarded as Cargo WT			131				43.67		26.20		18.71		16.85
Grand Total			2,807				935.67		561.40		401.00		969.50

2) The second method;

Representative size of the various ship types currently in service is introduced in following tables;

Table 12-3-5	: Dimensions of representative ships calling Hai Phong in recent years.
Table 12-3-6	: Representative size of coastal ships in Japan.
Table 12-3-7	: Representative size of ocean going conventional ships.
Table 12-3-8	: Representative size of container ships in foreign trade
Table 12-3-9	: Representative size of full container ship size in present Intra-Asia feeder service.
Table 12-3-10	: Representative size of bulk carriers with ship gears in current world trade.

Table 12-3-5 Dimensions of Representative Ships Calling Hai Phong in Recent Years

Type of Ships	Flag		Dimension L.O.A. m	Draft(s) m	D.W.T.	Container Capacity or Bale Capacity
Full Container	Vietnam	1	92	6.6		260 TEU
		2	102	7.4		320 TEU
		3	114	8.5		450 TEU
		4	120	8.8		520 TEU
		5	140	9.2		650 TEU
Semi-Container	Denmark	1	115.5	5.36	5,230	414 TEU
Ro-Ro	Vietnam	1	122.3		12,800	354 TEU
General Cargo	Vietnam	1	125.3	8.5	11,832	14,580 m³
		2	151.4	9.0	10,785	15,180 m³
		3	118.6	7.7	9,639	10,329 m³
		4	118.0	7.4	8,610	9,869 m³
	C I S	5	136.8	7.5	7,700	6,667 m³
		6	135.2	6.5	7,390	6,280 m³

Table 12-3-6 Representative Size of Coastal Ships in Japan

Type	Dimension L.O.A. m	Beam m	Draft(s) m	Tonnage Gross	Net	D.W.T. MT	CTNR Capacity TEU
Coastal Feeder Container Ship	84.85	15.0	4.80	2,300			150
	118.10	18.0	6.37	4,094	2,585	6,216	320
Coastal General Cargo ship	112.2	18.43	7.62	3,647	2,602	7,561	
	51.0	8.0	4.90	631		1,000	
	79.5	12.53	5.10	998	646	2,747	
	69.7	11.50	4.27	499	301	1,573	
	76.0	12.0	F:3.6 A:4.6	490		1,650	
	49.0	9.20	F:1.5 A:2.8	190		680	
Box Type Barge	LxWxD: 40.0 x 13.5 x 3.0 m Hatch Size: 32.0 x 12.5 x 5.0 Grain Capacity:2,000 m³						

Table 12-3-7 Representative Size of Ocean Going Conventional Ships

Type of Vessel	Dimension			Tonnage			Capacity		No. of Hatch	CTNR Capa-city (TEU)	Crane Capacity KT
	L.O.A m	Beam m	Draft (S) m	Gross	Net	D.W.T. MT	Bale m³	Grain m³			
Twin Decker	167.8	22.80	10.20	13,267	7,819	20,518	24,265	26,519	4	527	10,15,25,40
Twin Decker	166.0	27.00	9.82	21,024	8,669	23,618	31,649	34,094	4	756	16,26,51,91
Twin Decker	166.4	27.60	9.42	16,896	9,417	28,320	34,214	36,869	5	1,012	25,35,50
Heavy Carrier	162.5	24.40	10.53	14,479	7,232	22,107	26,250	27,634	4	558	10,15,25,40 Heavy D.350
Heavy Carrier	162.5	25.2	10.48			24,383	28,606		3	402	13,16,25,31 Heavy (350)
Twin Decker	163.2	21.20	9.88	11,584	7,828	17,620	24,288		5	482	18,22,30,58
Single Decker	185.1	27.5	10.93	20,499	17,197	30,976	35,941		5	1,100	16,60
Twin Decker	181.8	26.0	11.62	18,220	10,666	29,331	37,758		4	1,100	25

Table 12-3-8 Representative Size of Container Ships on Foreign Trade

Class	No.	Actual Capacity TEU	Dimension			Tonnage		
			L.O.A. m	Breadth m	DRAFT (S) m	GROSS	NET	D.W.T. MT
1,000 TEU	1	958	157.05	25.0	9.19	12,688	8,052	12,850
	2	1,036	198.03	28.6	10.615	22,525	8,341	22,536
2,000 TEU	3	2,000	217.98	32.2	11.519	35,739	11,884	34,194
	4	1,902	217.24	32.2	11.528	36,375	14,509	31,901
3,000 TEU	5	2,990	247.85	32.22	11.517	41,442	15,149	39,157
	6	2,906	251.50	32.20	11.525	43,327	13,357	39,015
Over 3,500 TEU	7	3,618	288.31	32.20	13.025	50,606	21,988	59,567
	8	3,618	288.30	32.20	13.025	50,501	21,795	59,567
	9	4,456	279.0	32.20	13.65			57,800
Planned	10	5,500		39.60				

Table 12-3-9 Representative Container Ships Size on Present Intra-Asia Feeder Service

No.	L.O.A. m	Breadth m	Depth m	Draft Summer m	Tonnage Gross	Tonnage Net	Tonnage D.W.T.	CNTR Capacity TEU On Deck	CNTR Capacity TEU Hold	CNTR Capacity TEU Total
1	144.90	23.50	11.50	8.65	10,400	5,600	12,850	304	619	923
2	145.33	22.06	11.10	8.45	9,162	5,614	13,140	336	314	650
3	157.05	25.00	14.02	9.191	12,688	8,053	15,270	538	420	958
4	156.70	22.86	11.20	8.64	11,998	5,701	14,140	364	794	1,158
5	158.90	21.5	11.10	8.249	9,446	7,299	14,823	352	340	692
6	140.50	21.00	10.60	7.80	8,556	4,753	12,573	298	362	660

Table 12-3-10 Representative Size of Bulk Carriers with Ship Gears on the Current World Trade

Items \ No.	1	2	3	4	5	6	7
D.W.T.	42,838 MT	34,970 MT	28,452 MT	21,989 MT	17,806 MT	9,120 MT	7,035 MT
Gross Tonnage	24,942	20,766	16,722	13,019	11,228	6,788	5,484
Net Tonnage	14,148	12,848	10,435	8,641	6,805	2,982	2,135
L.O.A.	189.50 m	177.46 m	169.03 m	155.20 m	146.089 m	114.65 m	97.95 m
Beam	30.00 m	29.50 m	27.20 m	22.86 m	22.868 m	18.20 m	18.20 m
Draft (Summer)	10.994 m	10.521 m	9.745 m	9.96 m	9.318 m	7.67 m	7.495 m
Cargo Gear	Cranes 25 T x 4	Cranes 25 T x 4	Cranes 30.5T x 4	Cranes 25 T x 4	Derrick 25 T x 4 80 T x 1	Cranes 25 T x 2 Derrick 15 T x 2	Crane 52 T x 1 Derrick 20 T x 2
Hatch/Hold	5/5	5/5	5/5	4/4	4/4	2/2	2/2
Bale Capacity	53,163.90 m^3	41,282 m^3	35,788.99 m^3	26,685 m^3	20,391.82 m^3	14,629.69 m^3	11,640.53 m^3
Grain Capacity	54,069.50 m^3	42,561 m^3	37,549.55 m^3	27,793 m^3	21,206.42 m^3	15,760.25 m^3	12,850.09 m^3

Above tables are very suggestive in terms of the kind of ship and the size of ships expected to call Cai Lan Port in future. Cargo volume carried by the various kinds of ships is assumed based on suitability and loadability as follows.

For domestic transportation;

There are various kinds of ships running for domestic transportation because of the types of service and area, cargo commodity and volume, etc.

As for the berth occupancy, for instance, cargo handling productivity of three small size vessels alongside two berths is equal to productivity of one large vessel alongside one berth.

(example in case of two berths;
one small ship with 2 gangs x 3 ships = 6 gangs,
one large ship with 3 gangs x 2 ships = 6 gangs).

Therefore D.W.T. 7,500 ship is adopted for calculation in cargo volume per vessel per berth for domestic transportation. But cargo volume in weight is assumed 90 % of D.W.T. (the remaining 10 % D.W.T. is other weight like ballast water, fuel oil, constant weight of the ship, etc). Usually this sort of ship calls several ports for loading and unloading on regular service, thus cargo volume per ship of 2,250 kilo tons is adopted to calculate the number of ships calling three port.(7,500 x 0.9 / 3 ports = 2,250)

For general in break bulk and palletized and some bagged cargoes;

Nowadays so-called conventional ships are constructed for multi-purpose cargo transportation, not only break bulk cargo but also containers, dry bulk cargo and plant cargo. In general, capacity of cargo is limited by two aspects, one is by cargo weight and the other another is by space. It can be said that transportable cargo volume by this type of ship is mostly limited by space because cargo in one cubic meter is less than one kilo ton or weight ton is less than measurement ton.

From the Table 12-3-10, average D.W.T. and bale capacity of seven ships are about 25,000 tons and about 30,000 cubic meters respectively. If 35 % of broken space occurs in stowing cargo, 19,500 cubic meters cargo in measurement can be loaded onto 30,000 cubic meters bale capacity ship. If the cargo weight per one measurement ton is 0.5 kilo ton, total cargo weight on this vessel is about 10,000 kilo tons in spite of 25,000 D.W.T.

In general, this type of ship calls several ports on regular service, and if there ports are four calling ports and handling volume is the same at every port, 2,500 kilo tons of cargo volume is expected when calling Cai Lan Port and this figure is adopted for calculation. Furthermore, though several different type of cargoes are likely to be loaded onto this ship type, in this calculation it is assumed that only one commodity is handled.

For container ships;

Judging from Table 12-3-8 and 12-3-9, larger-sized full container ships has been put into foreign trade and this tendency may continue in future. But the trend of 1,000 TEU capacity container ship observed in Intra-Asia service, may not change much in the near future since the mother vessel between hub ports must minimize calling ports by taking the shortest and economical way.

In Table 12-3-11 example of number of handling units in Intra-Asia feeder service trade obtained from one of the major shipping companies in Japan is introduced for estimation of handling container units in Cai Lan Port for the target years. The average handling volume is forecast at 500TEUS of 19 ports is adopted in the target year 2000, while in future it is likely to increase to 680 TEUS.

For bulk carriers;

Cai Lan Port is designed for 40,000 D.W.T. ship. This ship's loadable maximum cargo weight is about 80 % to 90 % in D.W.T., the reason for which has been already mentioned the passage in Domestic Transportation.

Thus the maximum cargo volume per ship for unique commodity transportation is expected to range between 20,000 kilo and 35,000 kilo tons to 20,000 kilo tons considering the nature of cargoes.

The results of calculation based on above preconditions are shown in Table 12-3-16 for the target year 2000, in Tables 12-3-17 and 12-3-18 for the year 2010.

Table 12-3-11 Example of Number of Handling Unit on Intra-Asia Feeder Service Trade (Weekly Service) (1994.1~1994.6)

Calling Port	Case-1 Handling Number			Case-2 Handling Number			Case-3 Handling Number	Case-4	Average per Call	Handling Volume More than 450 TEU
	Load TEU	Unload TEU	Total TEU	Load TEU	Unload TEU	Total TEU	Load/ Unload	Load/ Unload		
Japan-1 (TK)	100	320	420	100	40	140	621	621	451	451
Japan-2 (SZ)				60	80	140	214		177	
Japan-3 (YH)				350	110	460		247	354	
Japan-4 (NG)	120	105	225				465	465	385	
Japan-5 (KB)	350	30	380	110	200	310	754	754	550	550
Vietnum(HCM)	50	40	90						90	
Thailand-1(BK)	400	410	810	550	600	1,150			980	980
Thailand-2(LCB)	50	160	210	130	20	150			180	
Singapore-1							595	595	595	595
Singapore-2							792	792	792	792
Taiwan-1 (KL)								483	483	483
Taiwan-2 (KL)							499		499	499
Taiwan-3 (KAO)				0	250	250		213	232	
Phil-1 (MNL)							365		365	
Phil-2 (MNL)								408	408	
Hong Kong-1								806	806	806
Hong Kong-2							721		721	721
Malaysia (PKL)							437		437	
Indonesia							987	987	987	987
	1,070	1,065	2,135	1,300	1,300	2,600	6,450	6,371	9,490	6,864
Calling Ports	6	6	6	7	7	7	11	11	19	10
Average by Ports	178	178	356	186	186	371	586	579	499	686

Table 12-3-12 Cargo Volume and Number of Calling Ships in the Target Year 2000

Berth No.	Cargo Commodity	Cargo Status	Assigned Cargo Volume UNIT: 1,000 KT	Ratio	Cargo Handling Efficiency KT/hr/gang	Planned Number of Gangs	Product /Day /Ship Unit: 1,000 KT	Assumed Cargo Volume per Vessel	Number of Ships per Year	Net Work. Days per Ship	Total Net Working Days at Berth
No.1	General Cargo	Dom. In/Out	122	100%	25	3	1.62	2,500	48.80	1.54	75.31
No.3	Steel	Dom. Out	300	86%	50	3	3.24				
No.2	Steel Product	Dom. Out	50	14%	50	3	3.24				
	Sub Total		350	100%				2,500	140.00	0.77	108.02
No.2	Fertilizer in Bag	Dom. Out	74	100%	25	3	1.62	2,500	29.60	5.40	159.88
No.2	Rice in Bag	Dom. In/Out	78	49%	25	3	1.62				
No.1	Rice in Bag	Dom. In	80	51%	25	3	1.62				
	Sub Total		158	100%				2,500	63.20	1.54	97.53
No.5	General in B. Bulk	Export	37	10%	25	3	1.62				
No.7	Grained Wheat,Bag	Export	30	8%	250	2	10.80				0.00
No.6	Fertilizer in Bag	Import	103	27%	25	3	1.62				
No.5	General in B. Bulk	Import	87	23%	25	3	1.62				
No.6	Chemical in Drum	Import	89	24%	36	3	2.33				
No.4	Asphalt in Drum	Import	30	8%	36	3	2.33				
	Sub Total		376	100%				2,500	150.40	1.46	219.07
No.7	Rice in Bag	Export	200	100%	25	3	1.62	8,500	23.53	5.25	123.46
No.6	Cement in Bag	Export	120	100%	25	3	1.62	15,000	8.00	9.26	74.07
No.5	Container	Export	94	21%	180	2	7.78				
No.5	Container	Import	225	50%	180	2	7.78				
No.5	MTY CTNR regarded as Cargo WT		131	29%	180	2	7.78				
	Sub Total		450	100%				5,000	90.00	0.64	57.87
No.4	Scrap in Loose	Import	287	100%	36	3	2.33	20,000	14.35	8.57	123.03
No.4	Coal in Bulk	Import	10	100%	72	2	3.11	10,000	1.00	3.22	3.22
No.6	Cement in Bulk	Export	120	100%	190	2	8.21	20,000	6.00	2.44	14.62
No.7	Maize in Bulk	Export	300	100%	250	2	10.80	35,000	8.57	3.24	27.78
No.7	Wheat in Bulk	Import	240	100%	400	2	17.28	35,000	6.86	2.03	13.89
Cargo Weight Total			2,676						590.31		1,097.74
MTY CTNR regarded as Cargo Weight			131						0.00		0.00
Grand Total			2,807						590.31		1,097.74

12.3.2 Expected Cargo Handling System in Cai Lan Port

(1) The outline of cargo flow and handling ratio in Hai Phong Port

Figure 12-3-1 shows the outline of present cargo flow and handling ratio by routes in Main Port of Hai Phong. Judging from figures in the report of Urgent Rehabilitation Plan for Hai Phong Port, the ratio of direct-load and direct-delivery is rather high and this might have caused the cargo handling productivity to decrease, and may be a reason for the traffic congestion in and around the port.

(2) General Cargo, steel and unitized cargo

A fork lift can play a great part in handling such cargoes using pallets and can make an important contribution to the handling productivity, safety of cargo operation, prevention of road dock congestion and high efficiency of truck rotation. Figure 12-3-2, a conceptional flow, shows how to use fork lifts efficiently in the loading operation. The opposite direction of this flow can be adopted for the unloading operation.

(3) Container Cargo

The type of container handling system;

The type of container handling system adopted in the terminal depends on conditions such as site situation, safety, the volume of containers to be handled and the amount of funds available to the terminal. There are four major handling systems. However there are many terminals that combine two or more different system to handle the containers efficiently and use the container yard fully and effectively.

A comparison of three systems is shown in Table 12-3-13 and conceptional flows are shown in Figures 12-3-3, 12-3-4 and 12-3-5 respectively.

1) Straddle carrier system

This system mainly employs a cargo-handling device called a straddle carrier for marshalling containers. As the machine enables three or four tiers stacking of containers, this system has the advantage of efficient utilization of the container yard. It is a very flexible and simple system and quick dispatch of containers is possible. However, it requires a thick durable pavement in the container yard. This system requires a high maintenance cost and skilled personnel.

2) Transfer crane system (Transtainer)

This system makes use of a cargo handling machine called a transtainer for marshalling containers. The machine can stack containers in four or five tiers in the yard. Thus, this system results in the most efficient use of the container yard. It requires the most heavy pavement, because this pavement is limited to some fixed truck lanes for the transtainer. This system needs highly skilled maintenance personnel.

3) Chassis system

This system has been developed by Sea-Land Service, Inc. In this system, containers are placed on chassises and lined up in the container yard. Tractors are linked to these containers directly for transportation. Other special cargo handling equipment is not required and containers are lined up with no relation to each other. In other words, it is a very flexible, safe and simple system. Therefore, this system enables quick delivery at any time. The possibility of damage is lessened. However, this system requires a large container yard and many chassises.

4) Forklift (Reach stacker) system

In this system, a large forklift is used to handle containers. The investment in equipment is relatively small. This system is used in comparatively small container yards.

5) Container handling system in the target year 2000 in Cai Lan Port

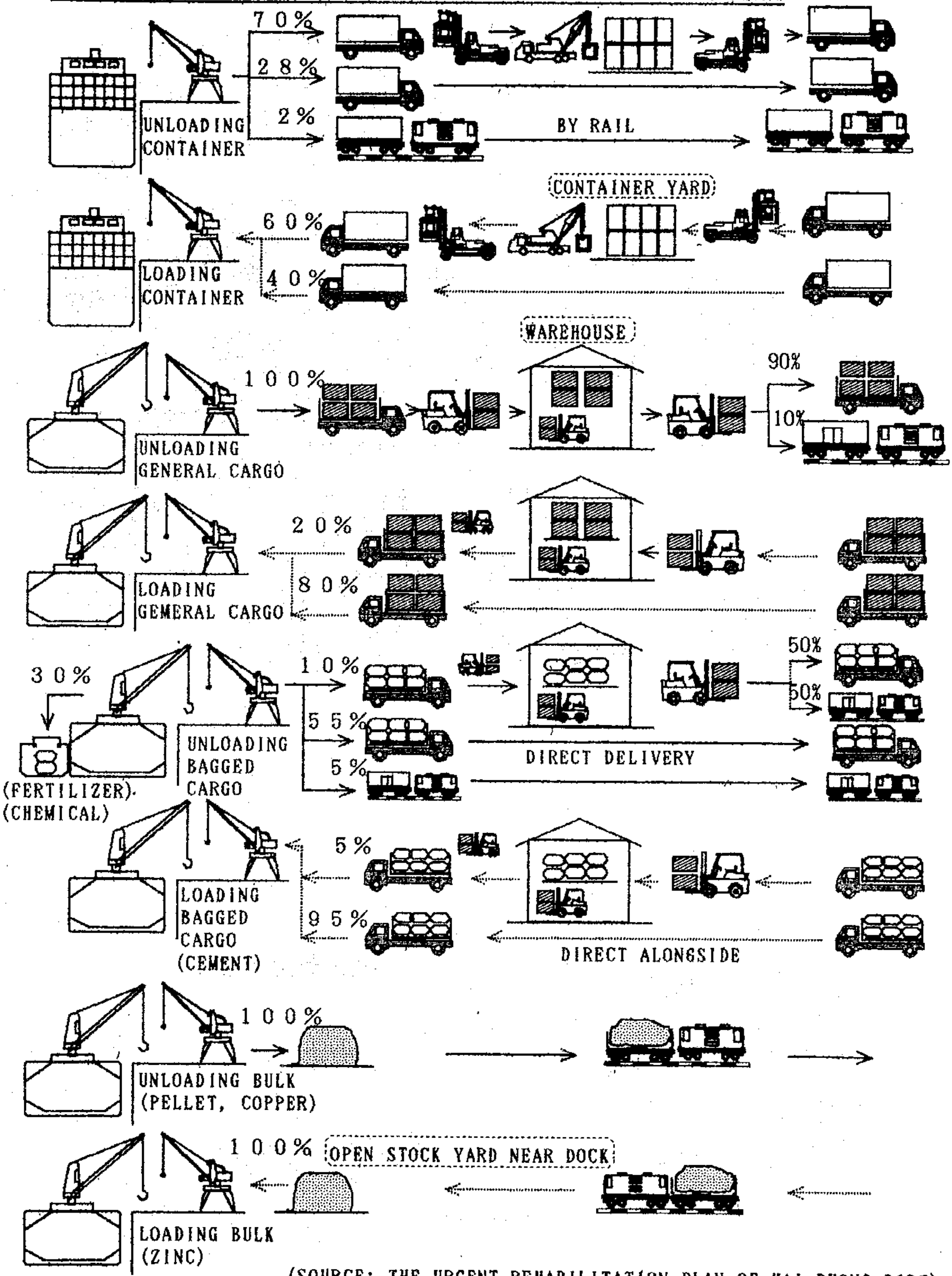
In Allotment of Cargo Handling Volume to each berth in Chapter 11-5-4, berth No.5 is allotted for handling containers and general cargoes as a multi-purpose berth. On the other hand, container cargo volume in year 2000 is estimated at 319 thousand tons which is equivalent to 32,000 TEU (about 10 tons of cargo per container). In addition to above number of laden containers, considerable number of empty containers (13,100 units) may dwell a long time in the port area due to the imbalance of import and export. Countermeasures to avoid this situation should be considered.

Judging from points of initial investment and cargo volume, for the year 2000, the forklift system is recommendable. After the year 2000, this berth will be able to be used as a multi-purpose berth for handling small size container vessels, plant vessels, general cargo vessels when exclusive container terminals are constructed in the future.

Furthermore, equipment in this system can be easily used in assisting neighboring berths where containers and other cargoes are handled simultaneously.

Moreover, around the year 2000, it is considered that there would be a high volume of L.C.L. (less than container load) cargo through C.F.S. (container freight station) since the work for development and/or improvement of land transportation may have progressed and land transportation system would not be suitable to carry sea containers by road and rail, so that C.F.S. should make full use of its function to handle these cargoes. In Figure 12-3-6 the conceptional layout of the transtainer system and the forklift system is introduced.

CARGO FLOW AND HANDLING RATIO BY ROUTES IN MAIN PORT OF HAI PHONG



(SOURCE: THE URGENT REHABILITATION PLAN OF HAI PHONG PORT)

Figure 12-3-1

Conceptional Flow of Handling Cargo by Forklifts & Pallets
(In Case of Loading)

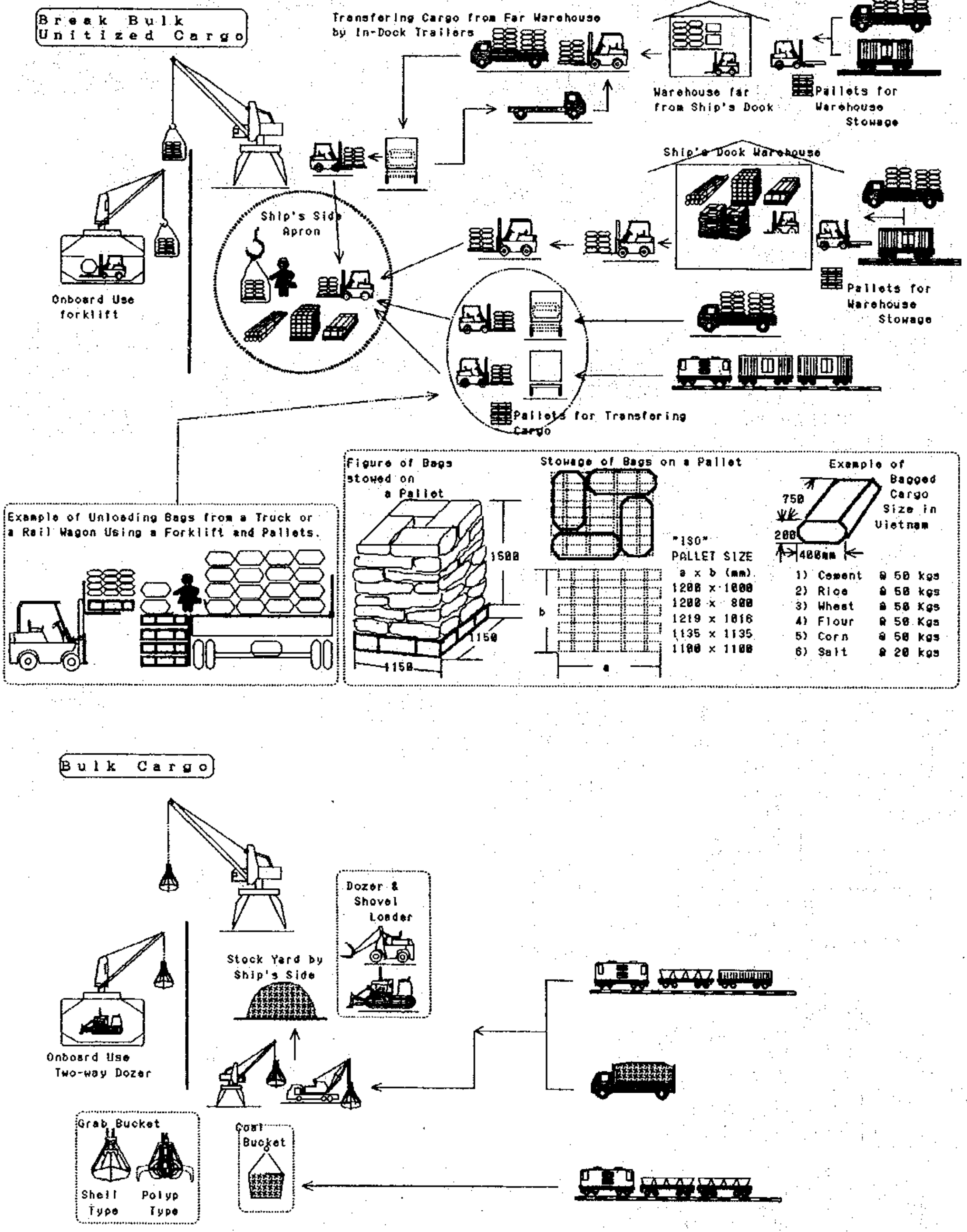


Figure 12-3-2

Table 12-3-13 Comparison of Container Handling System at Terminal

No.	Items \ Handling System	Straddle Carrier		Tire-mounted Transfer Crane		Chassis	
1.	Equipment for handling CTNR between Gantry and Yard	Straddle Carrier only		Chassis or Straddle Carrier		Chassis only	
2.	Mobility of equipment	◎		△		◎	
3.	Initial cost	○		△		△	
4.	Storage capacity	○	3 tiers	◎	More than 3 t.	△	One tier only
5.	Safety (Operation)	△	Many carriers Poor visibil.	○	Outside trailer for in/out	◎	
6.	Flexibility for CTNR in/out	◎		△		◎	
7.	Flexibility of CY position	○		○		◎	
8.	Number of labor	◎		◎		○	
9.	Strength of pavement	△	High	○	Partial	◎	
10.	Safety to CTNR/Damage to CTNR	△		◎		◎	
11.	Occurance of equipment trouble	△		◎		◎	
12.	Fear of damage by gale	△		○		◎	
13.	Noise, calmness	△		◎		○	
14.	Safety in yard area	△		◎		○	
15.	Degree of fatigue of a driver	△		◎		○	
16.	Follow-up ability to efficiency of cranes	◎	Increase	△		◎	
17.	Occurance of rehandling CTNR	○		△		◎	
	Total Judgement						

Evalutation Key: ◎; Excellent, ○; Good, △; Some problem

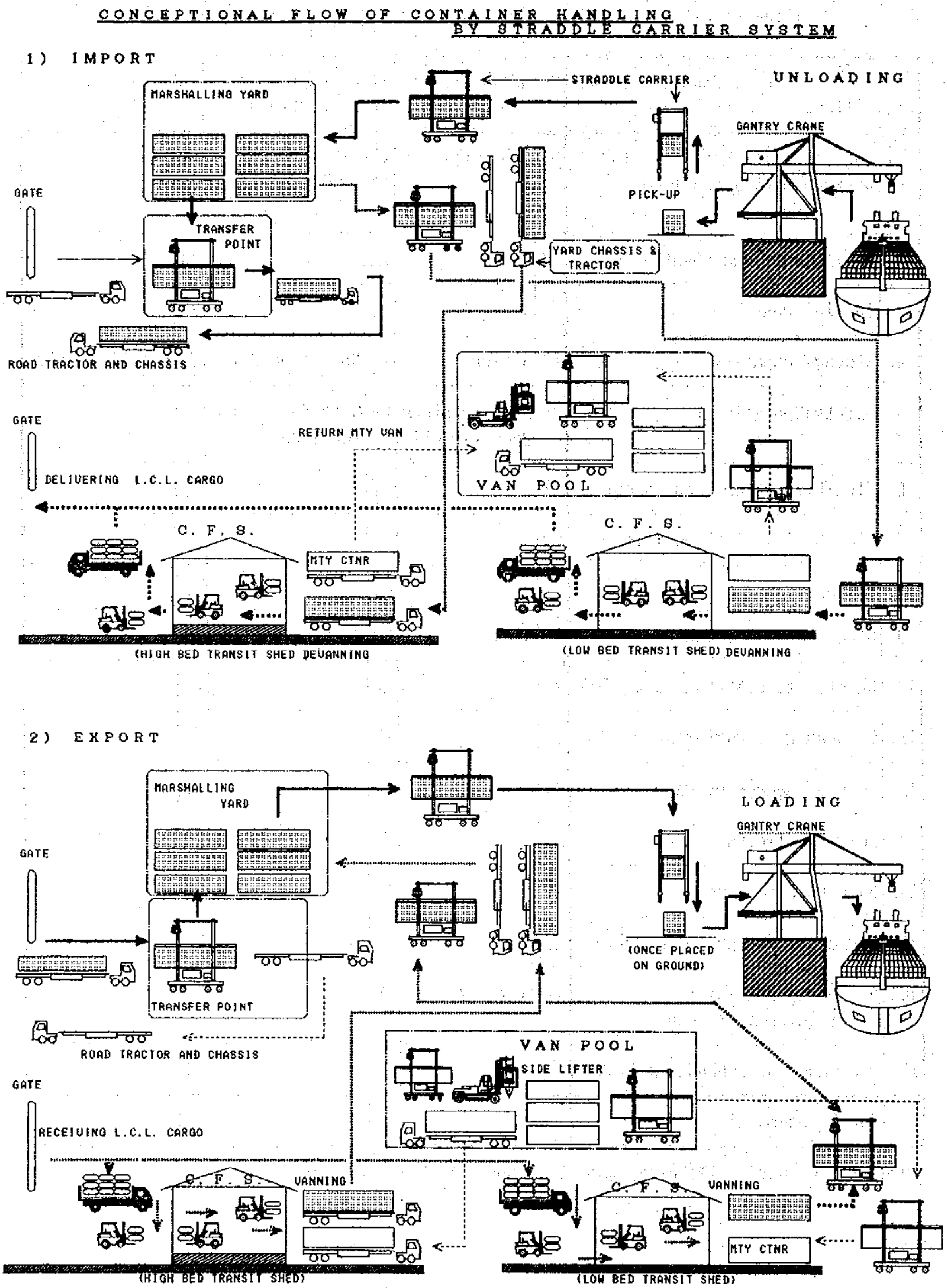
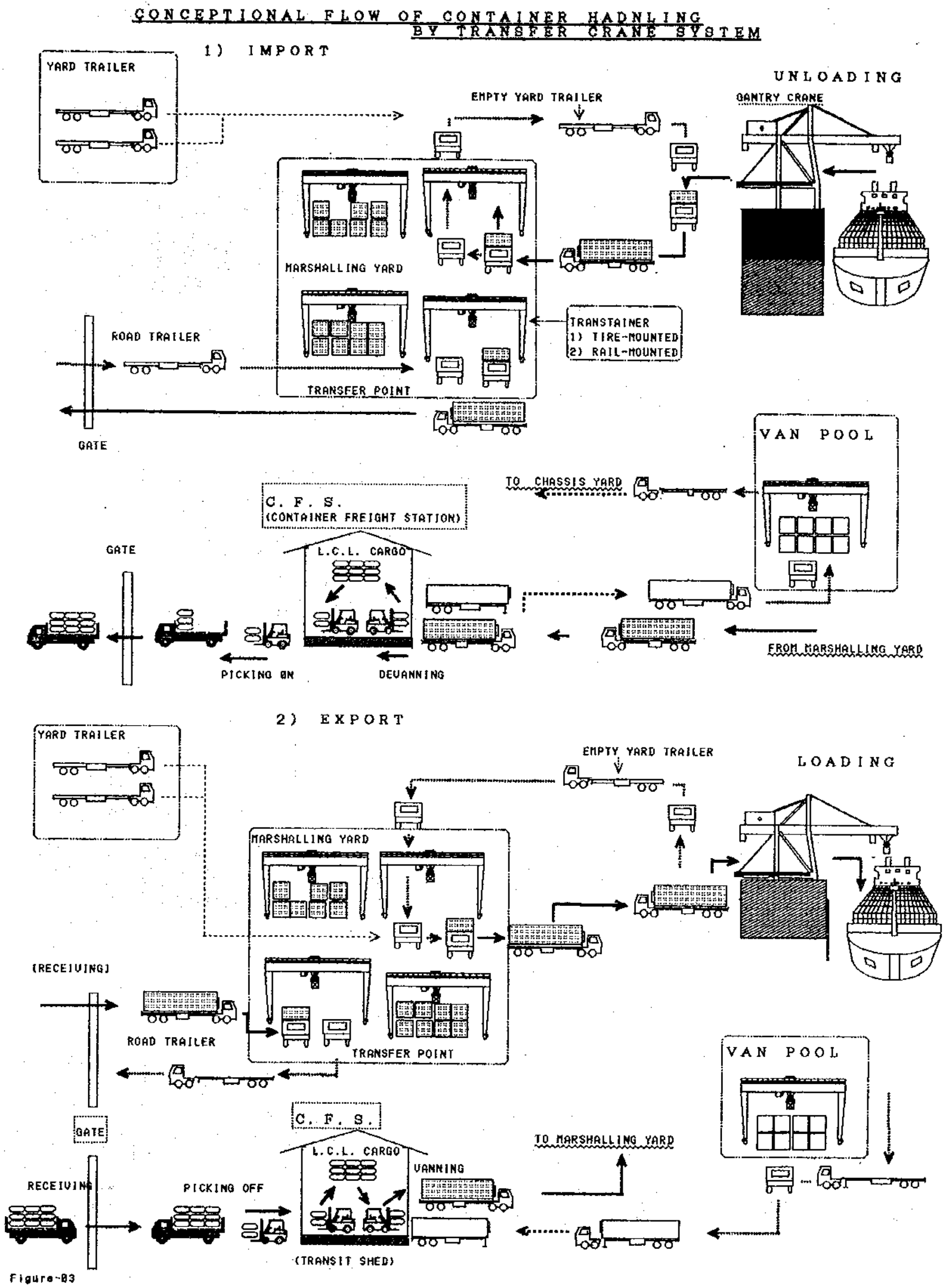

CONCEPTIONAL FLOW OF CONTAINER HANDLING
BY STRADDLE CARRIER SYSTEM
1) IMPORT
MARSHALLING YARD
STRADDLE CARRIER
UNLOADING
GANTRY CRANE
PICK-UP
GATE
TRANSFER POINT
YARD CHASSIS & TRACTOR
ROAD TRACTOR AND CHASSIS
GATE
RETURN MTY VAN
DELIVERING L.C.L. CARGO
VAN POOL
C. F. S.
MTY CTNR
C. F. S.
(HIGH BED TRANSIT SHED DEVANNING
(LOW BED TRANSIT SHED) DEVANNING
2) EXPORT
MARSHALLING YARD
LOADING
GANTRY CRANE
GATE
(ONCE PLACED ON GROUND)
TRANSFER POINT
ROAD TRACTOR AND CHASSIS
VAN POOL
SIDE LIFTER
GATE
RECEIVING L.C.L. CARGO
C. F. S.
VANNING
VANNING
MTY CTNR
(HIGH BED TRANSIT SHED)
(LOW BED TRANSIT SHED)

Figure 12-3-3



CONCEPTIONAL FLOW OF CONTAINER HADNLING BY TRANSFER CRANE SYSTEM
1) IMPORT
YARD TRAILER
UNLOADING
EMPTY YARD TRAILER
GANTRY CRANE
MARSHALLING YARD
ROAD TRAILER
TRANSTAINER
1) TIRE-MOUNTED
2) RAIL-MOUNTED
TRANSFER POINT
GATE
VAN POOL
TO CHASSIS YARD
C. F. S.
(CONTAINER FREIGHT STATION)
GATE
L.C.L. CARGO
PICKING ON
DEVANNING
FROM MARSHALLING YARD
2) EXPORT
YARD TRAILER
EMPTY YARD TRAILER
LOADING
MARSHALLING YARD
(RECEIVING)
ROAD TRAILER
TRANSFER POINT
VAN POOL
GATE
C. F. S.
TO MARSHALLING YARD
L.C.L. CARGO
VANNING
RECEIVING
PICKING OFF
(TRANSIT SHED)
Figure-83

Figure 12-3-4

CONCEPTIONAL FLOW OF CONTAINER HANDLING BY CHASSIS SYSTEM

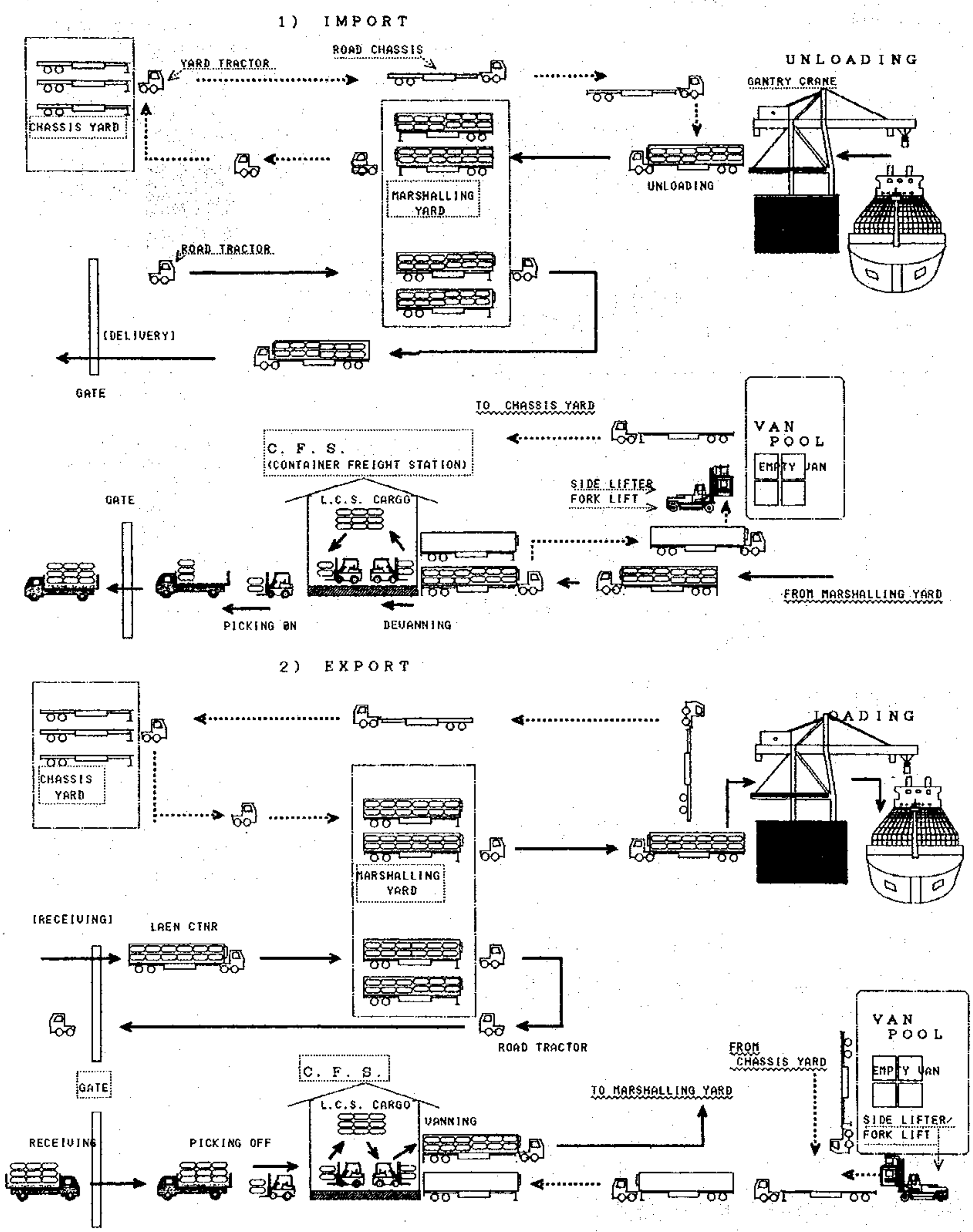


Figure 12-3-5

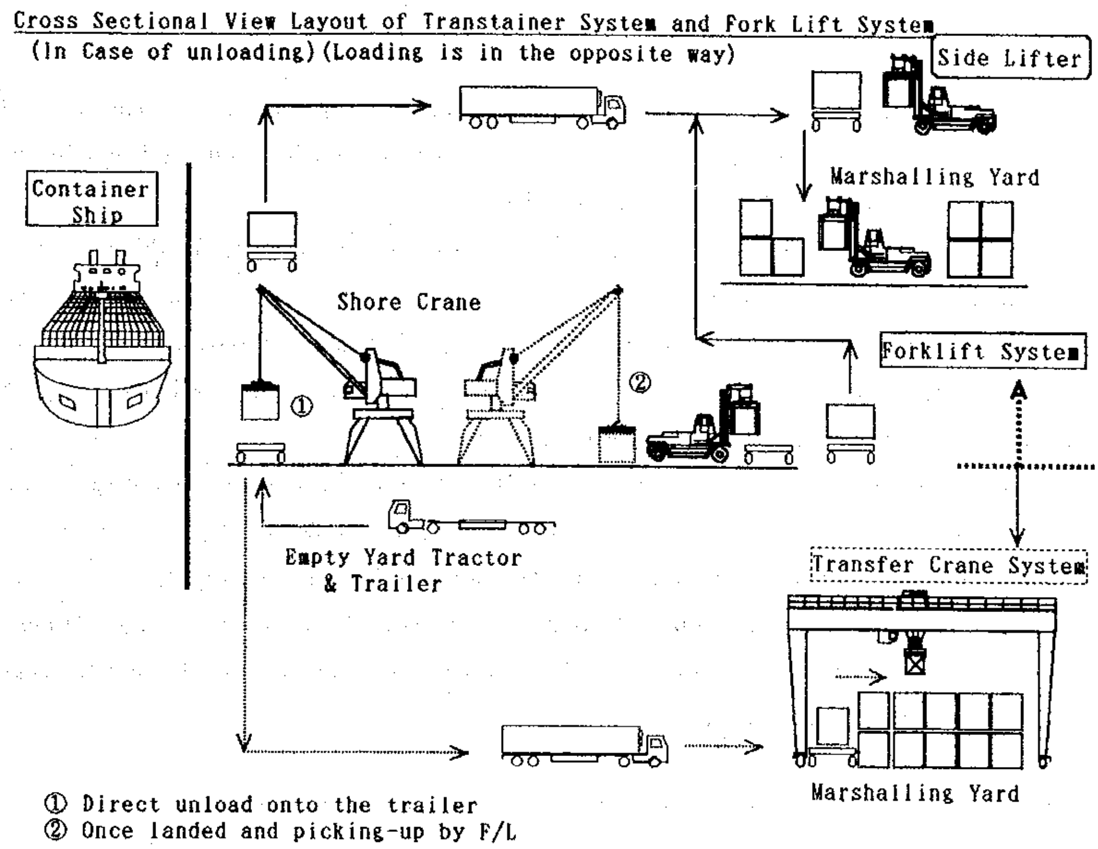

Cross Sectional View Layout of Transtainer System and Fork Lift System
(In Case of unloading)(Loading is in the opposite way)
Side Lifter
Marshalling Yard
Container Ship
Shore Crane
①
②
Forklift System
Empty Yard Tractor & Trailer
Transfer Crane System
Marshalling Yard
① Direct unload onto the trailer
② Once landed and picking-up by F/L

Figure 12-3-6

(4) Bulk cargo

Berth No.7 is planned to handle grain cargoes in bags and in bulk for the year 2000. If the berth is installed with proper facilities to handle each commodity, volume listed in the demand forecast in Chapter 10 would be no problem.

As for the exclusive grain berth, there are two basic possible cargoes handling systems, batch system and continuous system. As for unloading, batch system adopts cranes and continuous system includes pneumatic unloaded as well as other mechanical continuous unloaders. There are also two systems for transportation after unloading, one is trucks (batch system) and the other is conveyor (continuous system).

A pneumatic unloaded can be operated even during rain which is an advantage of this system, especially when handling powdered cement. Mechanical unloaded has recently gained popularity. There are several mechanical unloaders such as bucket elevator type continuous unloaded, belt conveyor type continuous unloaded, chain conveyor type continuous unloaded and screw conveyor type continuous unloaded. The following is a comparison of the pneumatic unloaded and the mechanical unloaded.

a. Mechanical unloaded has better efficiency and stability than pneumatic.

b. Mechanical unloaded has difficulty in unloading cargoes at the final stage. A combination of small bulldozer and pneumatic unloaded may be required to gather remaining scattered cargo.

c. Mechanical unloaded requires 5-20 % higher initial investment, but operation cost is 20-30 % less compared with pneumatic unloaded (cost in Japan).

d. Pneumatic unloaded makes 10-20 dB more noise than mechanical unloaded. There is no significant difference in producing dust and spill.

e. The mechanical unloaded can adapt its function to more types of cargoes than the pneumatic unloaded. Crushing during the operation is less by mechanical unloaded.

f. Weight of mechanical unloaded is around 300 tons, 10-20 % heavier than pneumatic unloaded.

As fore-mentioned, there are significant differences between the pneumatic unloaded and mechanical unloaded. When the type of unloaded is decided in future for bulk berth, a detailed study on total cost including initial investment as well as operation cost should be conducted.

By reason of initial investment and cargo volume for the year 2000 in Cai Lan Port, it is advisable to install crane system with appropriate buckets combining portable type convey system or trucking system.

There are two typical cranes; gantry type crane and level luffing crane. Level luffing crane is suitable for rather small vessel of 60 thousand D.W.T. or less, while gantry type crane has an advantage in handling larger vessels. As for the unloading capacity, level luffing crane is more economical than gantry type crane and handling capacity is up to 900 tons per hour.

The crane system is appropriate for a terminal at which more than two cargo items are handled, including break bulk cargo because it can be applied by just changing the attachment to a wide selection of cargo.

Some conceptional flows of representative bulk cargoes listed in the demand forecast are shown in the following Figures.

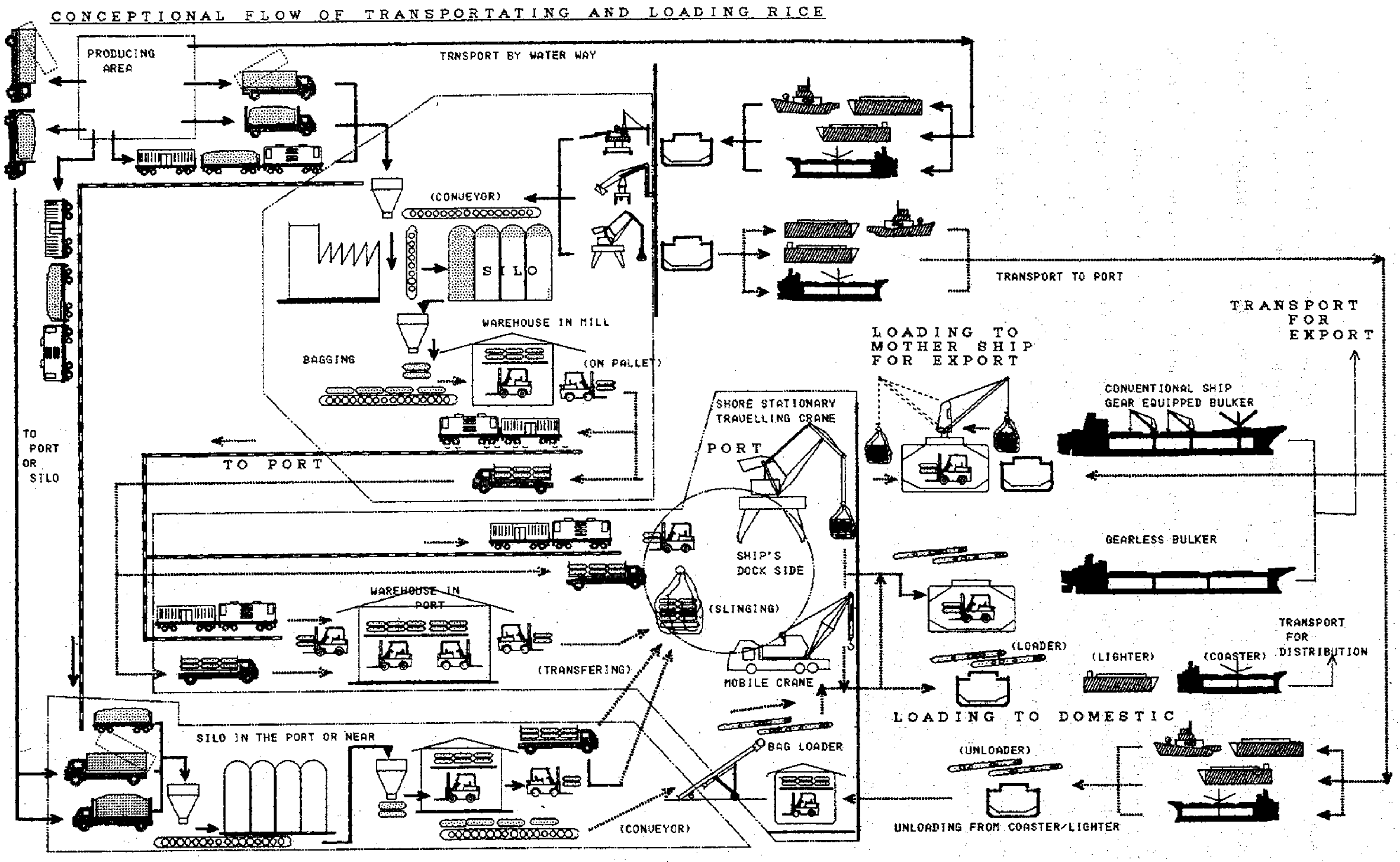

CONCEPTIONAL FLOW OF TRANSPORTATING AND LOADING RICE
PRODUCING AREA
TRNSPORT BY WATER WAY
TO PORT OR SILO
(CONVEYOR)
SILO
WAREHOUSE IN MILL
BAGGING
(ON PALLET)
TO PORT
TRANSPORT TO PORT
TRANSPORT FOR EXPORT
LOADING TO MOTHER SHIP FOR EXPORT
CONVENTIONAL SHIP GEAR EQUIPPED BULKER
SHORE STATIONARY TRAVELLING CRANE
PORT
SHIP'S DOCK SIDE
(SLINGING)
GEARLESS BULKER
WAREHOUSE IN PORT
(TRANSFERING)
MOBILE CRANE
(LOADER)
(LIGHTER)
(COASTER)
TRANSPORT FOR DISTRIBUTION
LOADING TO DOMESTIC
SILO IN THE PORT OR NEAR
BAG LOADER
(UNLOADER)
(CONVEYOR)
UNLOADING FROM COASTER/LIGHTER

Figure 12-3-7

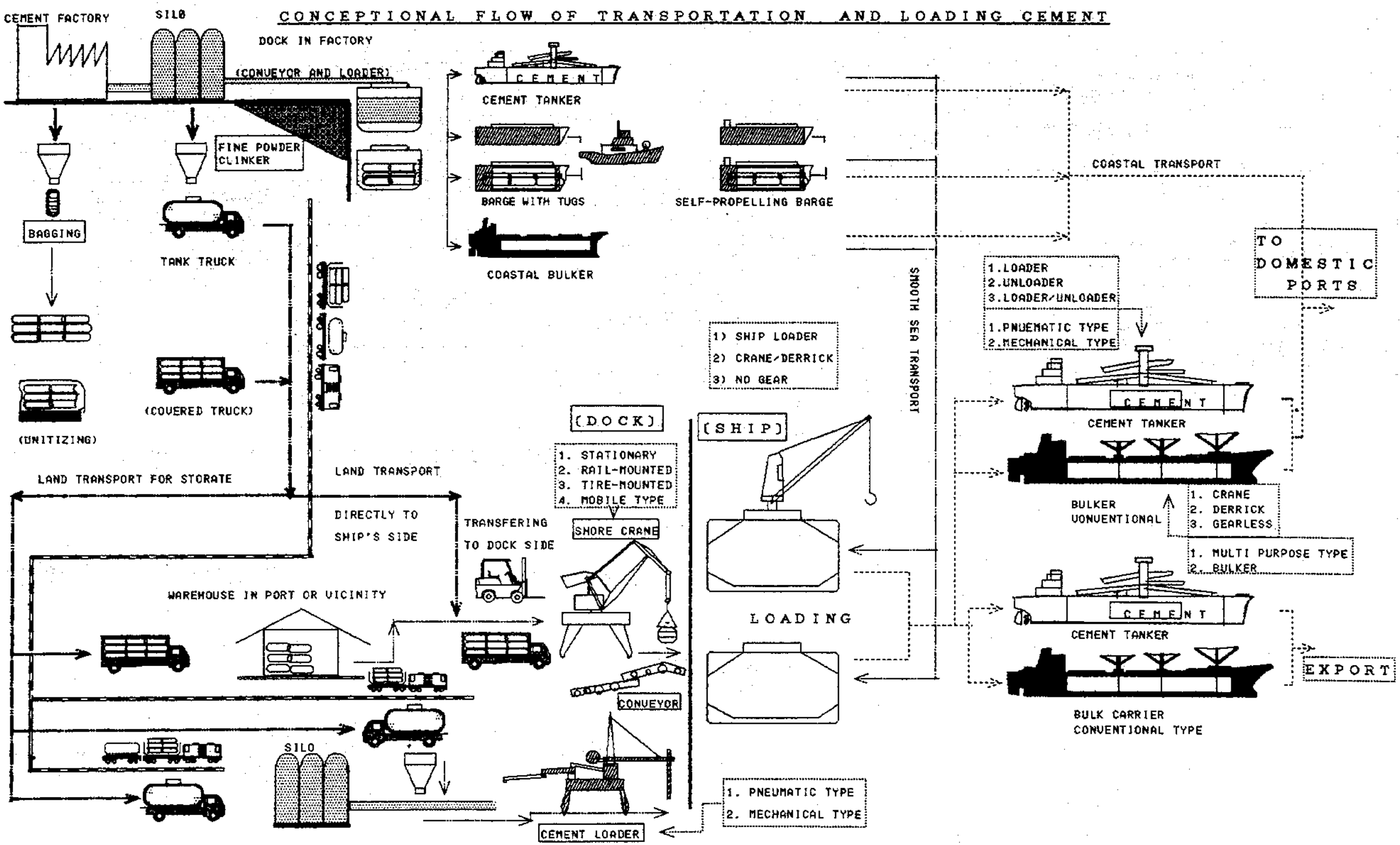

CONCEPTIONAL FLOW OF TRANSPORTATION AND LOADING CEMENT
CEMENT FACTORY
SILO
DOCK IN FACTORY
(CONVEYOR AND LOADER)
FINE POWDER
CLINKER
BAGGING
TANK TRUCK
(COVERED TRUCK)
(UNITIZING)
CEMENT
CEMENT TANKER
BARGE WITH TUGS
SELF-PROPELLING BARGE
COASTAL BULKER
COASTAL TRANSPORT
SMOOTH SEA TRANSPORT
TO DOMESTIC PORTS
1.LOADER
2.UNLOADER
3.LOADER/UNLOADER
1.PNUEMATIC TYPE
2.MECHANICAL TYPE
1) SHIP LOADER
2) CRANE/DERRICK
3) NO GEAR
LAND TRANSPORT FOR STORATE
LAND TRANSPORT
DIRECTLY TO SHIP'S SIDE
TRANSFERING TO DOCK SIDE
(DOCK)
1. STATIONARY
2. RAIL-MOUNTED
3. TIRE-MOUNTED
4. MOBILE TYPE
SHORE CRANE
(SHIP)
LOADING
CEMENT TANKER
BULKER
VONVENTIONAL
1. CRANE
2. DERRICK
3. GEARLESS
1. MULTI PURPOSE TYPE
2. BULKER
CEMENT TANKER
EXPORT
BULK CARRIER
CONVENTIONAL TYPE
WAREHOUSE IN PORT OR VICINITY
CONVEYOR
SILO
CEMENT LOADER
1. PNEUMATIC TYPE
2. MECHANICAL TYPE

Figure 12-3-8

CONCEPTIONAL FLOW OF UNLOADING AND TRANSPORTING GRAIN

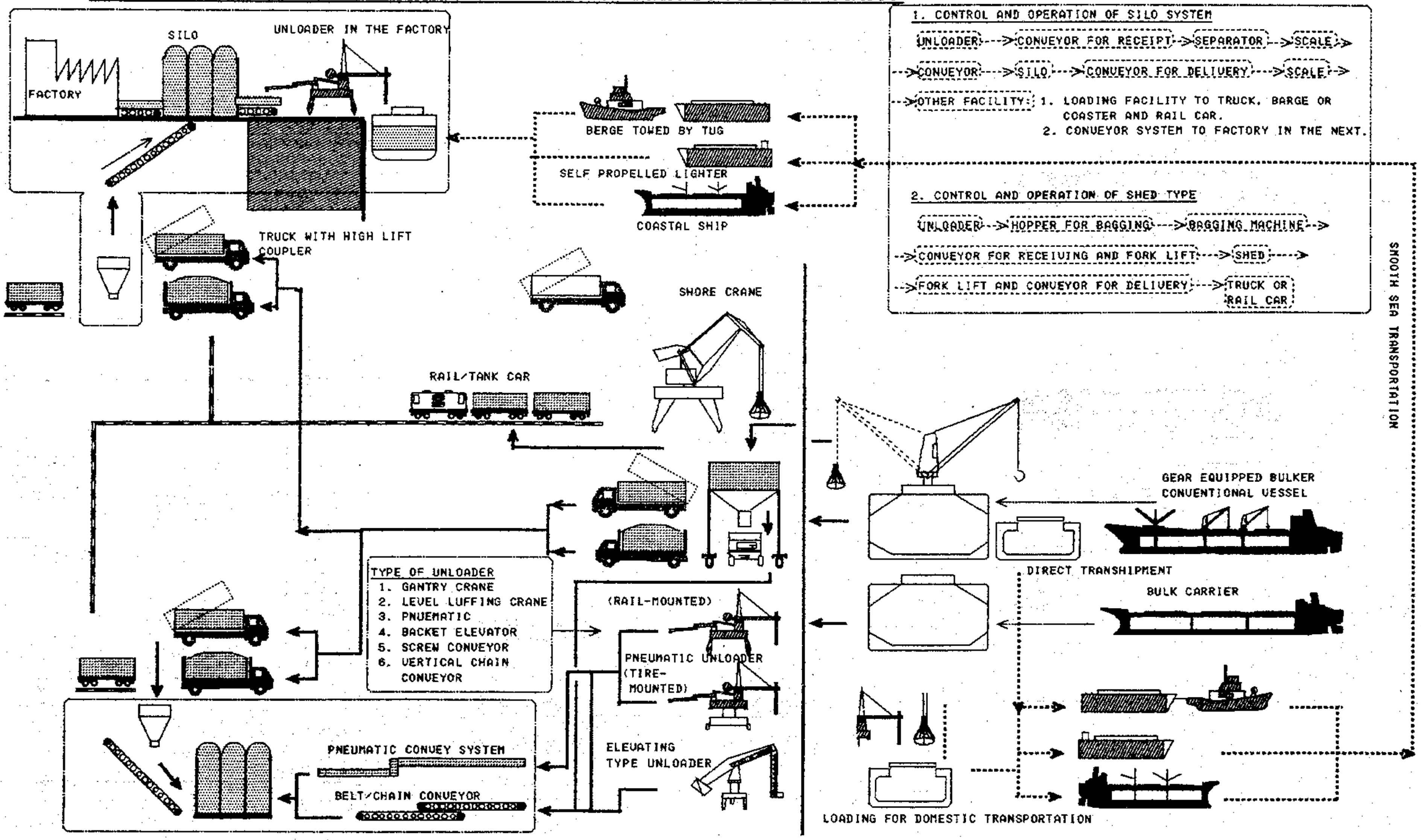


Figure 12-3-9

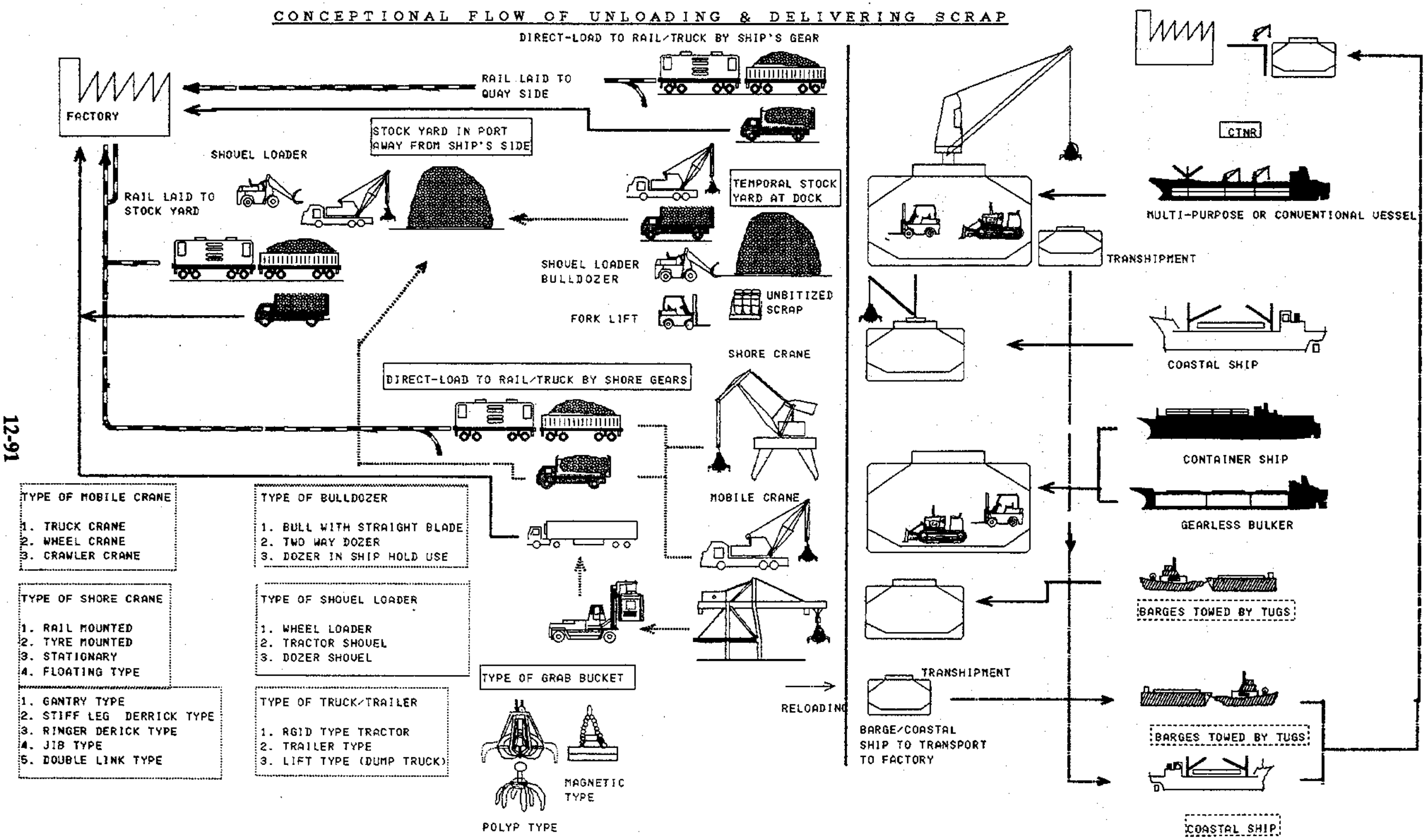


Figure 12-3-10

12.3.3 Cargo Equipment

Necessary cargo equipment for the year 2000 is listed in Table 12-3-14. Needless to say, the key point to perform safe operations and to raise the cargo handling efficiency is to deploy the most useful type of equipment and employ it efficiently.

Furthermore, appropriate slinging materials should be used for each specific cargo. Examples of equipment are introduced in following tables and figures;

Table 12-3-15 (Example of loading commodity-wise efficiency),
Table 12-3-16 (Example of unloading commodity-wise efficiency by equipment)
Table 12-3-17 (Example of type and capacity of grab buckets)
Table 12-3-18 (Example of efficiency of scrap handled by lifting magnet)
Table 12-3-19 (Example of Mobile Type Shore Crane)
Figure 12-3-11 (Type of buckets and cargo slings)

Table 12-3-14 Necessary Equipment for the Target Year 2000

Berth No.	Cargo	Planned Main Gear	Onboard	Dockside	Warehouse	Yard	Others
No.1	Bag G.C.	Ship's Gear	*Forklift (3KT) 2 UT	*Forklift (3KT) 1 UT (5KT) 1	*Forklift (3KT) 1 UT (5KT) 1 UT		*Trailer for transfering cargo from far T. Shed 15 UT * Tractor for above 5 UT
NO.2	Bag Steel	Ship's Gear	*Forklift (3KT) 1 UT (5KT) 1 UT	*Forklift (3KT) 1 UT (5KT) 1 UT	*Forklift (3KT) 1 UT		
No.3	Steel	Ship's Gear	*Forklift (3KT) 1 UT (5KT) 1 UT	*Forklift (3KT) 1 UT (5KT) 1 UT	*Forklift (3KT) 1 UT		
No.4	Asphalt, Drm Coal, Bulk Scrap, Loose	Ship's Gear	*Forklift (3KT) 1 UT *2-W Dozer 1 UT	*Forklift (3KT) 2 UT	*Forklift (3KT) 1 UT	*Shovel Loader 2 UT *Grab Bucket (For each) 2 UT	
No.5	Container G.C.	Shore Crane (Rail Mount) (Capacity 40 KT) 2 UT	*Forklift (3KT) 1 UT (5KT) 1 UT	*Forklift (3KT) 1 UT (5KT) 1 UT (15KT) 1 UT *Top Lifter (30.5KT) 2 UT	*Forklift (3KT) 1 UT (5KT) 1 UT	*Reach Stacker (30.5KT) 3 UT *Side Lifter (4.5KT) (5 Trs) 1 UT *Yard Tractor 10 UT *Yard Trailer 10 UT	(C.F.S.) *Reach Stack. (30.5KT) 1 UT *Yard Tractor 1 UT *Trailer 6 UT *Forklift (3KT) 3 UT (2KT) 2 UT
No.6	Bag/Drum Cement, BLK	Ship's Gear	*Fork Lift (3 KT) 2 UT	*Fork Lift (3 KT) 2 UT	*Fork Lift (3KT) 1 UT		
No.7	Bulk	Level Luffing Type Crane (40KT) 2 UT Ship's gear	*2-way Dozer 1 UT	*Grain Truck (22 m³) 6 UT *Hopper 2 UT		*Hopper 2 UT *Grab Bucket 2 UT (Each Cargo) *Shovel Loader 2 UT *Conveyor 2 Set	
Shore Crane		*Mobile Type Crane 4 UT (For Gearless Ships)					

Total	* Fork Lift @ 2 KT: 2 UT @ 3 KT: 25 UT @ 5 KT: 9 UT @ 15 KT: 1 UT * Top Lifter @ 30.5 KT: 2 UT * Reach Stacker 4 UT	* Side Lifter (4.5 KT) : 1 UT * Yard Tractor (CTR & CFS) @ : 11 UT * Yard Trailer (CTR & CFS) @ 20'/40' : 16 UT	* Tractor (Cargo Transfer) @ : 5 UT * Trailer (Cargo Transfer) @ 28 KT : 15 UT * 2-way Dozer @ : 2 UT * Conveyor System : 2 Sets	* Shovel Loader @ (3 m³) : 4 UT * Movable Hopper @ (30 m³) : 4 UT * Grab Bucket @ Grain (8 m³) : 2 UT @ Cement (5 m³) : 2 UT @ Scrap (3 m³) : 2 UT * Grain Truck : 6 UT (22 M³)

Table 12-3-15 Example of Loading Commodity-wise Efficiency by Equipment

1) For Cement and Cement Clinker

	Type of Ship Loader	Loading Efficiency t/h	Remark	Objective Vessels 1,000 DWT
1	Ship Loader (Bucket Elevator)	1,000	Opened hatch	22
2	Ship Loader (Bucket Elevator)	1,000	Opened hatch	20
3	Ship Loader (Bucket Elevator)	400	Opened hatch	30

2) For Bagged Cargo

	Type of Loader	Loading Efficiency Bags/h	Weight per Bag kgs	Objective Vessels 1,000 DWT
1	Ship Loader (Rail-mounted)	1,800～3,000	100～20	20～lighter
2	Ship Loader (Rail-mounted)	3,000	50～40	10～0.5

Table 12-3-16 Example of Unloading Commodity-wise Efficiency by Equipment

1) For Grain

	Type of Unloader	Unloading Efficiency t/h	Lifting Weight t	Capacity of Grab Bucket m^3	Objective Vessels DWT
1	Bridge Type Unloader	500	20	14.3	50
2	Level Luffing Type Unloader	450	12	8.1	50
3	Pneumatic Unloader (Travelling)	400			20～50
4	Pneumatic Unloader (Floating)	450			50
5	Pnewmatic Unloader (Travelling)	200			20
6	Pnewmatic Unloader (Fixed)	150			1
7	Pnewmatic Unloader (Tire-Mounted)	250			30
8	Pneumatic Unloader (Mobile)	200			30
9	Pneumatic Unloader (Portable)	20-130	(Tire)		-
10	Pneumatic Unloader (Tire-mounted)	250			30

2) For Scrap

	Type of Unloader	Unloading Efficiency t/h	Lifting Weight t	Capacity of Grab Bucket m^3	Objective Vessels 1,000 DWT
1	Level Luffing Type Unloader	-	20.4	4.0	30
2	Level Luffing Type Unloader	80	15.0	3.0	30
3	Level Luffing Type Unloader	-	20.0	5.0/6.0	30
4	Level Luffing Type Unloader	100	15.3	3.0	30

3) Coal

	Type of Unloader	Unloading Efficiency t/h	Lifting Weight t	Capacity of Grab Bucket m^3	Objective Vessels 1,000 DWT
1	Bridge Type Unloader	350	10.0	6.3	40
2	Bridge Type Unloader	1,000	34.0	21.3	30

4) For Cement Clinker

	Type of Unloader	Unloading Efficiency t/h	Lifting Weight 1,000 T	Capacity of Grab Bucket m^3	Objective Vessels 1,000 DWT
1	Bridge Type Unloader	250	6.3	2.5	0.8
2	Level Luffing Type Unloader	450	11.8	4.7	35
3	Pnewmatic Unloader (Travelling)	250			40
4	Level Luffing Type Unloader	500	7.5	5.0	50

Table 12-3-17 Example of Type and Capacity of Grab Bucket for Unloaders

Type of Grab Bucket	Cargo Handling Equipment	Applicable Cargo	Capacity of Grab m^3	Grabbing Weight KT	Grab Weight KT
Shell Type Double Wired Bucket	Ship Unloader	Multiple	6.0	9.0	6.0
	Ship's Gear	Ore	2.0	4.0	4.5
	Bridge Type Unloader	Grain	13.0	10.4	8.6
	2,500/h tons Unloader	Iron Ore	18.9	43.0	45.0
Polyp Type Double Wired Bucket	Ship's Crane	Ore	2.4	3.6	5.0
	1,500/h tons Unloader	Scrap	5.0	6.0	15.0
	Mobile Crane	Scrap	0.8	1.0	2.4
Shell Type Single Wired Bucket	Various Type of crane	Ore	3.5	8.4	8.5
		Grain	7.0	5.6	
	Shore Crane	Grain	8.0	6.4	4.8
	Various Type of Crane	Cement	3.5	4.2	3.7
	- do -	Cement	5.0	6.0	5.5
	- do -	Cement Clinker	7.0	9.4	8.5
Polyp Type Single Wired Bucket	Various Type of Crane	Ore & Other Rock	1.6	2.4	2.2
	- do -	Ore Rock	0.8	1.0	1.8
Shell Type Electric Hydraulic Grab	Ship Unloader	Ore	20.0	32.0	26.0
	Bridge Type Unloader	Ore	5.0	11.0	13.0
	Various Type of Crane	Scrap	1.6	2.0	4.3

Table 12-3-18 Example of Efficiency of Handling Scrap by Lifting Magnet

Lifting Magnet		Slab	Crack Ball	Pig Iron	1st Class Scrap	2nd Class Scrap
Diameter/mm	Weight /kg					
510	300	3,000	1,500	100~ 350	70~ 100	-
690	580	6,000	1,500	150~ 350	100~ 200	-
894	720	10,000	4,500	350~ 500	200~ 300	60~ 100
1,112	1,350	15,000	6,000	500~ 900	300~ 500	100~ 200
1,300	1,850	20,000	8,000	900~1,400	500~ 800	200~ 300
1,510	2,650	27,000	10,000	1,300~1,900	800~1,100	300~ 400
1,820	4,300	38,000	14,000	1,800~2,700	1,100~1,600	400~ 600
2,110	6,300	52,000	19,000	2,500~3,500	1,500~2,000	600~ 900
2,420	9,300	67,000	23,000	3,500~5,000	2,000~3,000	900~1,300

Table 12-3-19 Example of Mobile Type Shore Crane

No.	Type of Crane	Slewing Radius (m)	Safety Working Load (t)	Objective Vessel
1	Tower Type Truck Crane	13.5 21.0	15.0 8.0	Up to 50,000 DWT
		13.5	15.0	Up to 5,000 DWT
2	Electric Jib Crane	10.0 23.0	30.0 10.0	Up to 30,000 DWT
		14.0 20.0	35.0 22.0	Up to 50,000 DWT
		15.0 24.0	25.0 15.5	Up to 30,000 DWT
3	Truck Crane	See Chart "A"		
4	Crawler Crane	See Chart "B"		
5	Mobile Type Jib Crane			Up to 15,000 DWT

Chart "A"

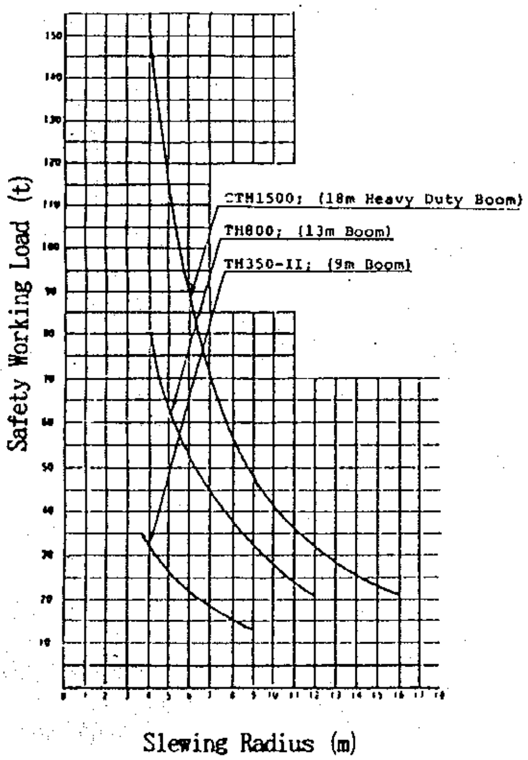
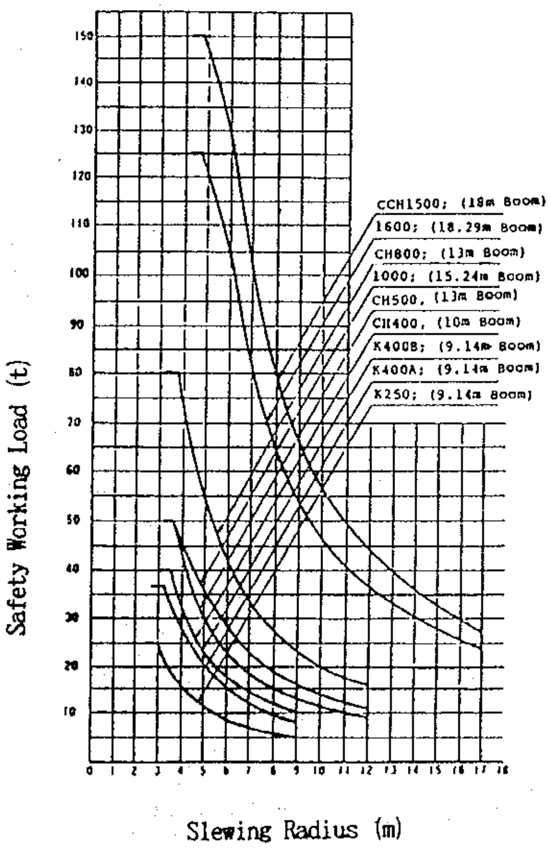


Chart "B"



Type of Buckets and Cargo Slings

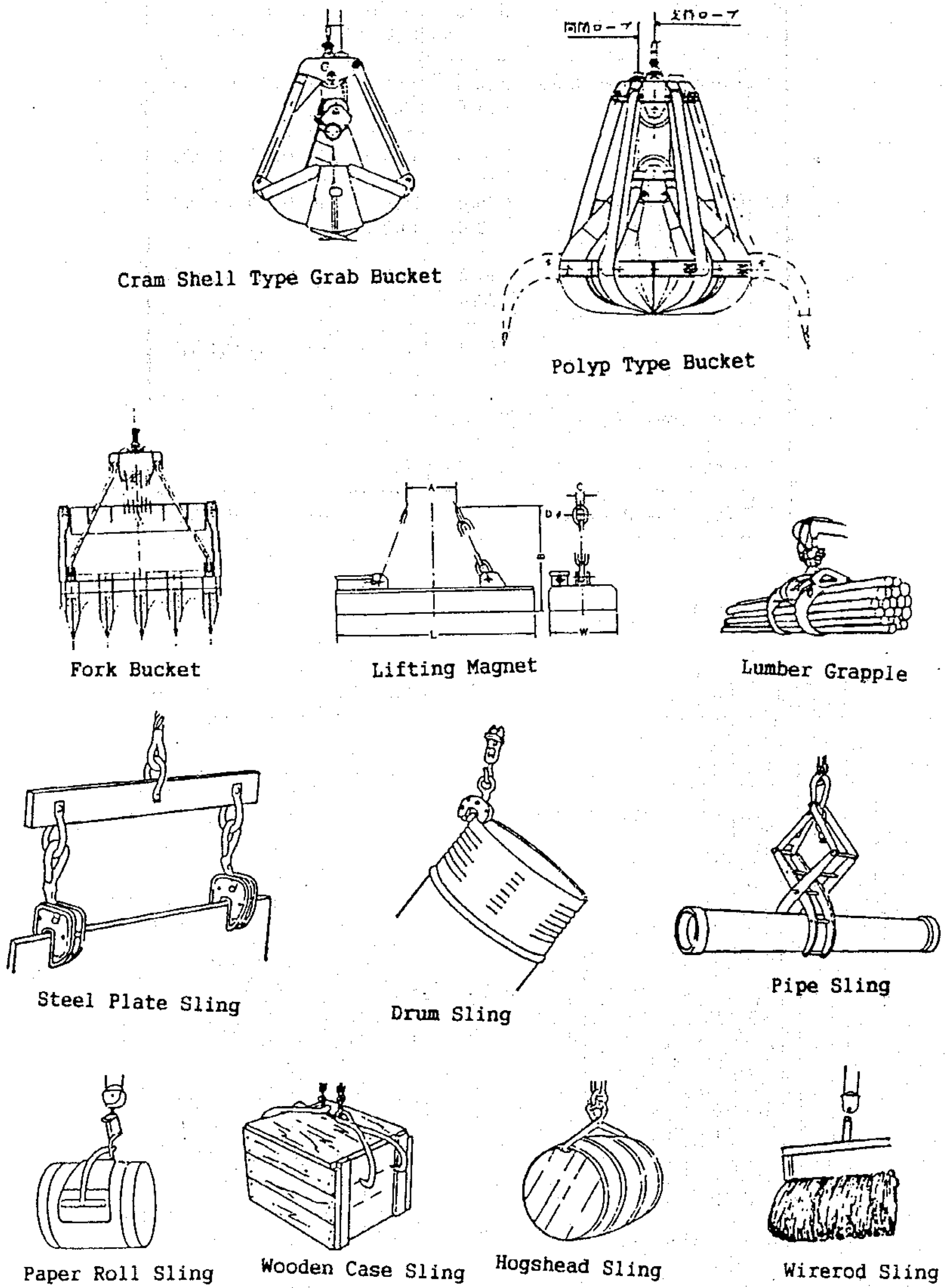


Figure 12-3-11

In addition to above equipment, pallets are very important for forklift operations and stowage in the transit shed and open yard.

Necessary number of pallets is estimated as follows;

1) Estimated ground area of a shed: 5,000 m2
2) Use rate of area : 60 %
3) Unit area per pallet: 1.0 m x 1.2 m x 1.1 = 1.32
   1.1 ...Coefficient for cargo overhanging
4) Average tiers of stowing: 2.5 Tiers
5) Required number of pallets: 3,000 m2 / 1.32 x 2.5 = 5,682 Units (Max. number)
6) Average units per 1 m2 of ground area; 5,682 / 5,000 = 1.14 pallets
7) Required for cargo handling: 2,500 KT / @1.5 kT x 10% = 170 /ship
   2,500 KT : Cargo volume per ship
   1.5 KT : Estimated weight per pallet
   10 % : Coefficient for actual use

If area of a shed is given, it is possible to estimate required number of pallets by using the figure in item 6).

12.3.4 Examination of Cargo Handling System for the Target Year 2000

On the basis of the cargo flow in Chapter 12.2.6(5), estimation of route-wise cargo volume of each berth is computed and shown in Table 12-3-20 for the year 2000.

(1) Cargo handling system

1) Berth No.1 to No.3 for domestic transportation

The main cargo handling gear is ship's gear. But mobile cranes with high lifting capacity should be prepared for a gearless ship such as a coastal large barge and an old type ship equipped with poor capacity derrick. Especially in further, it is thought that movement of domestic transhipment containers will increase in proportion to the brisk foreign trade.

According to the above estimation, it is expected that the majority of cargoes will be handled via transit sheds. Forklifts should be prepared sufficiently and used efficiently in any fields to raise up cargo productivity as fore-mentioned in Figure 12-3-6.

2) Berth No.4 for foreign trade

The basic gear is the same as domestic berths.
Cargoes in bulk suitable for open yard are once placed in yard in the vicinity of ship alongside dock by using proper grab buckets and other handling equipment already introduced in Figures and Tables.

3) Berth No. 5

At this berth, two rail-mounted shore cranes of multi-purpose type are planned to be installed for handling containers and various kinds of cargoes.

For the container operation in case of unloading;
At dock side, top lifters are used for picking up containers that are placed on the apron by the crane and loading onto yard trailers. Then a yard tractor connects the yard trailer and proceeds to the designated container yard slot in direction of anti-clockwise fixed running route.

At container yard, a reach stacker handle containers and stow them in designated positions. All types of container (regardless of laden or empty or C.F.S. container) are once placed in the container yard. Containers which go to C.F.S. are also transported by yard trailers.

For loading containers, the above procedure can be reversed.

In the C.F.S. shed, one bay consisting of 2 container docks is placed on one side, while another bay of the same size is on the other side : and one side is used for receiving cargo and the other is used for delivering cargo. In case of import cargo, container cargoes that are assorted by destination-wise are devanned by a forklift and usually placed on the floor in front of the container opening. Devanned cargoes in break bulk are loaded onto road trucks for delivery.

For exporting cargoes, the above procedure is reversed.

4) Berth No.6

The concept is the same as with berth No.4 except a grab bucket is deployed for cement.

5) Berth No.7

Bagged cargoes are handled by the same system as fore-mentioned break bulk cargoes in the year 2000 by reason of initial investment and cargo volume by shore cranes.

For exporting maize in bulk via the transit shed, it may be necessary to install two sets of portable type of conveyor and loader system connected with hoppers in the transit shed. Grain in bulk in the shed is dumped into hoppers by shovel loaders. Shore cranes are very useful to set up such portable equipment.

For importing wheat in bulk, hoppers and grain trucks can be used for unloading and transporting to the transit shed.

For handling above two kinds of grain to/from barges, it would be an economical way to use appropriate grab buckets with joint use of 2-way dozers for trimming and gathering scattered cargoes.

But after the year 2000, this berth should be installed with specific equipment to handle exclusive grain cargoes because increase of grain cargoes in bulk are expected to

(2) Required number of workers

1) Table 12-3-21;

Required number of workers per gang by commodity by job scope is estimated considering grade of handling difficulty.

2) Table 12-3-22:

Number of workers per gang (per crane) by container handling systems.

3) Table 12-3-23

Number of workers for one dock in C.F.S.

4) Table 12-3-24

Number of workers for other jobs in a container terminal.

Table 12-3-20 Estimation of Route-wise Cargo Volume at Berths in the Target Year 2000

Berth No.	Cargo Commodity	Cargo Status	Assigned Cargo Volume UNIT: 1,000 KT (a)	In the Port Port Facilities (A) To/From Tran. Shed Unit: 1,000 %	KT	To/From Open Yard Unit: 1,000 %	KT	To/From Outside of the Port Route from/to Facilities in Port (B) = (A) x % By Truck Unit: 1,000 %	KT	By Rail Unit: 1,000 %	KY	By Barge Unit: 1,000 %	KT	Direct Load/Delivery By Road Unit: 1,000 %	KT	By Rail Unit: 1,000 %	KT	By Barge Unit: 1,000 %	KT
No.1	Rice in Bag	D.In	80	0.8	64.0			1.0	64.0					0.2	16.0				
	General Cargo	D.I/O	122	0.9	109.8			1.0	109.8					0.1	12.2				
	Total		202		173.8				173.8		0.0		0.0		28.2		0.0		0.0
No.2	Rice in Bag	D.I/O	78	0.8	62.4			1.0	62.4					0.2	15.6				
	Fertilizer, Bag	D.Out	74	0.8	59.2			1.0	59.2					0.2	14.8				
	Steel Product	D.Out	50	0.5	25.0	0.3	15.0	1.0	40.0					0.2	10.0				
	Total		202		146.6		15.0		161.6		0.0		0.0		40.4		0.0		0.0
No.3	Steel	D.Out	300	0.5	150.0	0.3	90.0	1.0	240.0					0.2	60.0				
	Total		300		150.0		90.0		240.0		0.0		0.0		60.0		0.0		0.0
No.4	Scrap in Loose	Imp.	287			1.0	287.0	1.0	287.0										
	Asphalt in Drum	Imp.	30			0.9	27.0	1.0	27.0					0.1	3.0				
	Coal in Bulk	Imp.	10			1.0	10.0	1.0	10.0										
	Total		327		0.0		324.0		324.0		0.0		0.0		3.0		0.0		0.0
No.5	Container	Exp.	94	0.3	28.2	0.7	65.8	1.0	94.0										
	Container	Imp.	225	0.2	45.0	0.8	180.0	1.0	225.0										
	MTY CTR for CFS					1.0	73.2	1.0	73.2										
	MTY CTR regarded as cargo WT	Exp.	131			1.0	57.8	1.0	57.8										
	General in B.B	Exp.	37	0.9	33.3			1.0	33.3					0.1	3.7				
	General in B.B	Imp.	87	0.9	78.3			1.0	78.3					0.1	8.7				
	Total		574		184.8		376.8		561.6		0.0		0.0		12.4		0.0		0.0
No.6	Cement in Bag	Exp.	120	0.4	48.0			1.0	48.0					0.1	12.0			0.5	60.0
	Clinker, Bulk	Exp.	120															1.0	120.0
	Fertilizer, Bag	Imp.	103	0.7	72.1			1.0	72.1									0.3	30.9
	Chemical, Drum	Imp.	89	0.4	35.6	0.5	44.5	1.0	80.1					0.1	8.9				
	Total		432		155.7		44.5		200.2		0.0		0.0		20.9		0.0		210.9
No.7	Rice in Bag	Exp.	200	0.7	140.0			1.0	140.0					0.2	40.0			0.1	20.0
	Maize in Bulk	Exp.	300	0.9	270.0			1.0	270.0									0.1	30.0
	Grained Wh't, Bag	Exp.	30	0.5	15.0			1.0	15.0					0.5	15.0				
	Wheat, Bulk	Imp.	240	0.5	120.0			1.0	120.0					0.5	120.0				
	Total		770		545.0				545.0						175.0				50.0
Cargo total			2,676		1,356		793		2,148		0		0		340		0		261
MTY CTNR regarded as Cargo			131		0		131		58		0		0		0		0		0
Grand Total			2,807		1,356		923		2,206		0		0		340		0		261

Table 12-3-21 Considerable Number of Workers per Gang by Cargo Commodity

Field	Role	Handling Commodity			
		Unitized Cargo	General cargo	Bagged Cargo	Bulk Cargo
ON BOARD	Supervisor	0.5	0.5	0.5	0.5
	Planner				
	Gang Boss	0.5	0.5	0.5	0.5
	Deck Man	1.0	1.0	1.0	1.0
	Crane Driver	1.0	1.0	1.0	1.0
	Machine Driver	1.0	1.0	1.0	1.0
	Hold Man	6.0	10.0	14.0	2.0
	Sling Man	2.0	2.0	2.0	1.0
	Sub Total	12.0	16.0	20.0	7.0
LONGSHOR-RING	Gang Boss	0.5	0.5	0.5	0.5
	Longshore Man	2.0	6.0	8.0	1.0
	Machine Driver	2.0	2.0	2.0	1.0
	Crne Driver	(1)	(1)	(1)	(1)
	Sub Total	4.5	8.5	10.5	2.5
WAREHOUSING	Shed Boss	0.5	0.5	0.5	0.5
	Worker	2.0	4.0	6.0	
	Machine Driver	1.0	1.0	1.0	2.0
	Sub Total	3.5	5.5	7.5	2.5
TALLYING	Tally Man	1.0	1.0	1.0	1.0
TOTAL		21.0	31.0	39.0	13.0

Table 12-3-22 Considerable Number of Workers per Gang by Container Handling System

FIELD	JOB	Container Handling System			
		Straddle Carier	Transfer Crane	Chassis	Fork/ Stacker
CONTROL TOWER	Planner	0.5	0.5	0.5	0.5
	Supervisor	0.5	0.5	0.5	0.5
ON BOARD	Lasher	6.0	6.0	6.0	6.0
	Signal Man	1.0	1.0	1.0	1.0
ON DOCK	Crane Driver	1.0	1.0	1.0	1.0
	* A signal man and a crane driver to be changed by turns				
	Cranker	2.0	2.0	5.0	2.0
	Tractor Driver (2 S/carrier)		3.0	6.0	3.0
	St. Carrier Driver (2 S/C)	4.0			
	Top Lifter Driver (T/Crane)				2.0
CTNR YARD	Transtaianer Driver		1.0		
	Signal man at Ctr Yard		1.0	1.0	1.0
	Top Lifter Driver				1.0
TALLY	Tally Man	1.0	1.0	1.0	1.0
SUB TOTAL		16.0	17.0	22.0	19.0

Table 12-3-23 Considerable Number of Workers for One Dock in C.F.S.

C.F.S.	Dock Worker	2.0	2.0	2.0	2.0
	Fork Driver	1.0	1.0	1.0	1.0
	Tally Man	1.0	1.0	1.0	1.0
	Measuring Staff	1.0	1.0	1.0	1.0
	Tractor Driver	0.2	0.2	0.2	0.2
SUB TOTAL		5.2	5.2	5.2	5.2

Table 12-3-24 Considerable Number of Workers for Other Jobs in a Container Terminal

AT GATE (IN CASE OF 4 GATES)	Clerk	1.0
	Ctr Checker	2.0
AT MAINTENACE SHOP	Electrician	2.0
	Welder	2.0
	Carpenter	2.0
AT GUARD SHACK	Guard man	4.0
SUB TOTAL		13.0

Chapter 13 PRELIMINARY DESIGN FOR THE SHORT TERM PORT DEVELOPMENT PLAN

13.1 General

In the short-term plan for the Port of Cailan by 2000, the layout and dimensions such as planned water depth, berth length of the port facilities are concluded in section 11.2, chapter 12, and the main facilities considered.

The soil condition in the new port expansion area is relatively good, the depth of the bedrock layer is not deep as shown in Figure 13-1-1, only a few meters below the planned water depth of the basin with from -9.0 m to -13.0 m and for 10,000 DWT ship size of general cargo to maximum 40,000 DWT of dry bulk cargo.

The soft soil consisting of sandy silt in a state of running plasticity will be replaced with quarry run or rubble stones for the quaywall stability. Consequently, a gravity type structure will be adopted due to subsoil conditions belonging to Pattern I as shown in Table 13-1-1.

13.2 Procedure of Design

The quaywall design is carried out in stepwise manner as shown below:

Step-1: To determine the design conditions and criteria:

- Datum level
- Ship's size
- Crown height and planned water depth of the quaywall
- Surcharge on the apron
- Seismic force
- Allowable stress of the materials
- Safety factor
- Soil conditions

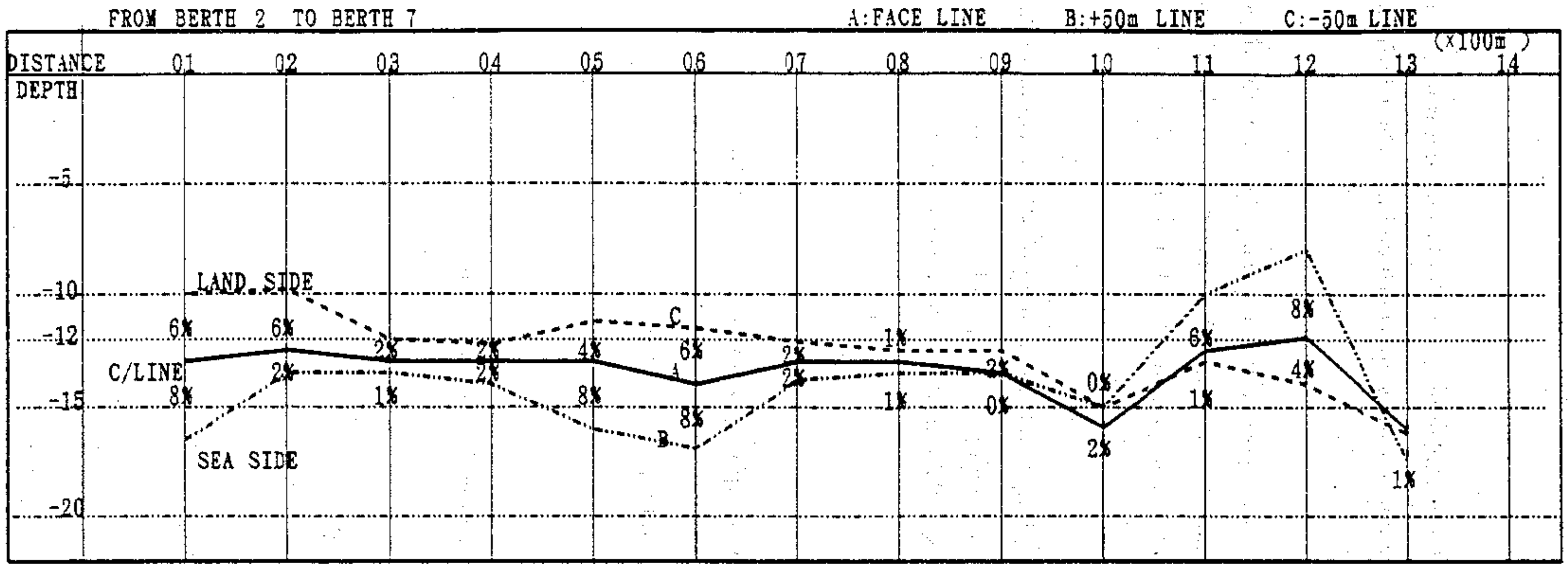


Figure 13–1–1 Depth of Bedrock Layer

Table 13-1-1 Pattern I: Selection of Quaywall Type (Thin Soft Soil on Shallow Bedrock)

Subsoil Condition	Type of quaywall	Construction Materials	Local availability	Remarks
SEA BED	1) Wall of Concrete Block Type	Mass concrete stones, quarry run	Yes	Reasonably good subsoil is needed Some types susceptible to settlements
CLAY, SILT OR SAND	2) Wall of Cellular Concrete Block Type	Reinforced concrete, stones quarry run, mass concrete	Yes	- Ditto -
GRAVEL OR	3) Wall of Caisson Type	- Ditto -	Yes	Reasonably good subsoil is needed Calm sea while placing required
WEATHERED ROCK	4) Wall of L-shaped Concrete Type	- Ditto -	Yes	- Ditto -
HARD ROCKS	5) Steel Plate Cellular Cofferdam	Circular steel plate, sand	Limited	Sensitive to horizontal loads until cell has filled

Table 13-1-2 Pattern II: Selection of Quaywall Type (Mixed layer of Clay and Sand., etc)

Subsoil Condition	Type of quaywall	Construction Materials	Local availability	Remarks
SEA BED CLAY SILT OR SAND SAND HARD ROCKS	1) Open type pier with vertical piles	Steel, reinforced concrete, tie cable, sand	Limited	Structure itself absorb settlements, which may however not be acceptable for quay apron, often the least cost solution
	2) Open type pier with coupled batter piles	- Ditto -	Limited	
	3) Steel pile quaywall with a relieving platform	Steel, reinforced concrete, prestressed concrete	Limited	
	4) Sheet pile type quaywall (vertical pile anchorage)	- Ditto -	Limited	
	5) - Ditto - (concrete wall anchorage)	- Ditto -	Limited	

Some items should be determined based on the usage of the quaywall and some other on the local conditions in Vietnam.

Step-2: To select several structural types of new quaywall, comprising Concrete Block type, Concrete Caisson Type, Concrete Cellular Block Type, Steel Sheet Pile Cellular Cofferdam Type., etc indicated in Table 13-1-1 Pattern I as a gravity type quaywall.

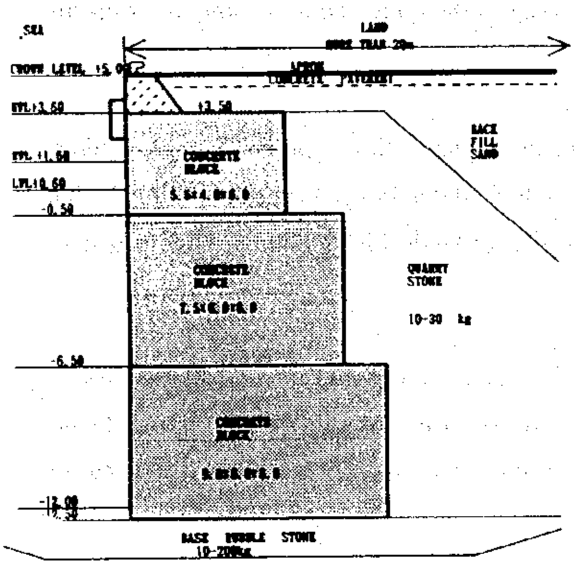
The section of quaywall type in step 2 should be carried out considering various factors such as the natural conditions regarding depth of foundation layer, construction period, availability of materials, and types normally used in Vietnam.

Step-3: To set up the major dimensions and structural requirement for respective quaywall type, an example of a sequence of Design of Gravity Type Quaywall is shown in Figure 13-2-1.

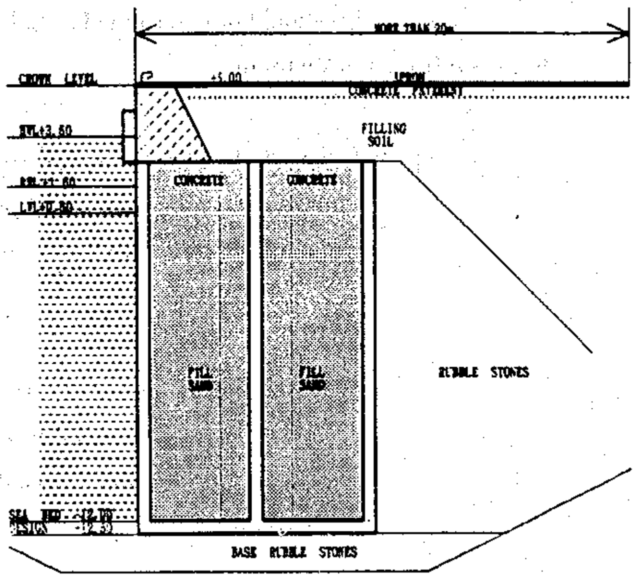
Step-4: To conduct the structural analysis to determine whether structural dimensions satisfy the allowable stress/safety factor or not.

Concerning Step-3 and Step-4, the methodology of calculation in Vietnam is almost the same as that in Japan excluding seismic force at earthquake, so these step should be carried out based on "Technical Standards for Port and Harbour Facilities in Japan".

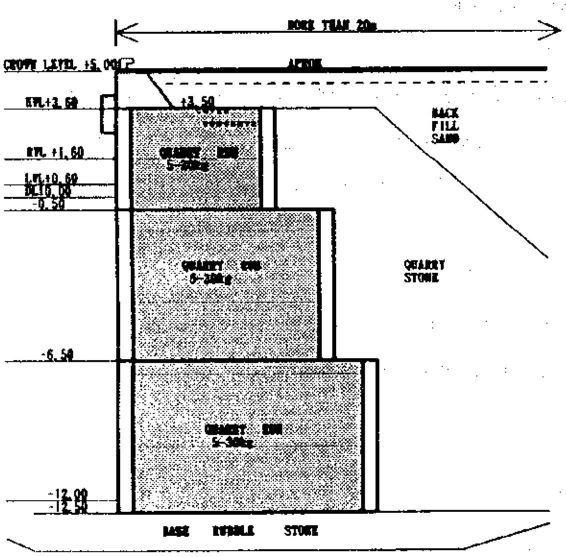
Step-5: To compare the merits and demerits of each type, and choose the best one from the type indicated in Table 13-1-1. Examples of a typical cross section of a gravity quaywall are shown in Figure 13-1-2.



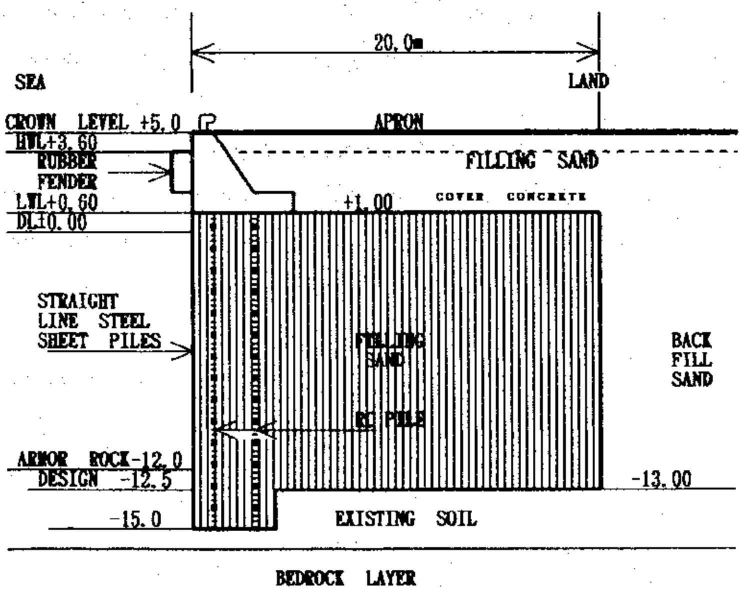
(1)Wall of Concrete Block Type



(3)Wall of Caisson Type



(2)Wall of Cellular Concrete Block Type



(4)Steel Sheet Pile Cellular Cofferdam Type

Figure 13–1–2 Example of Gravity Type Quaywall

The design of a gravity type quaywall preferably should follow the sequence below:

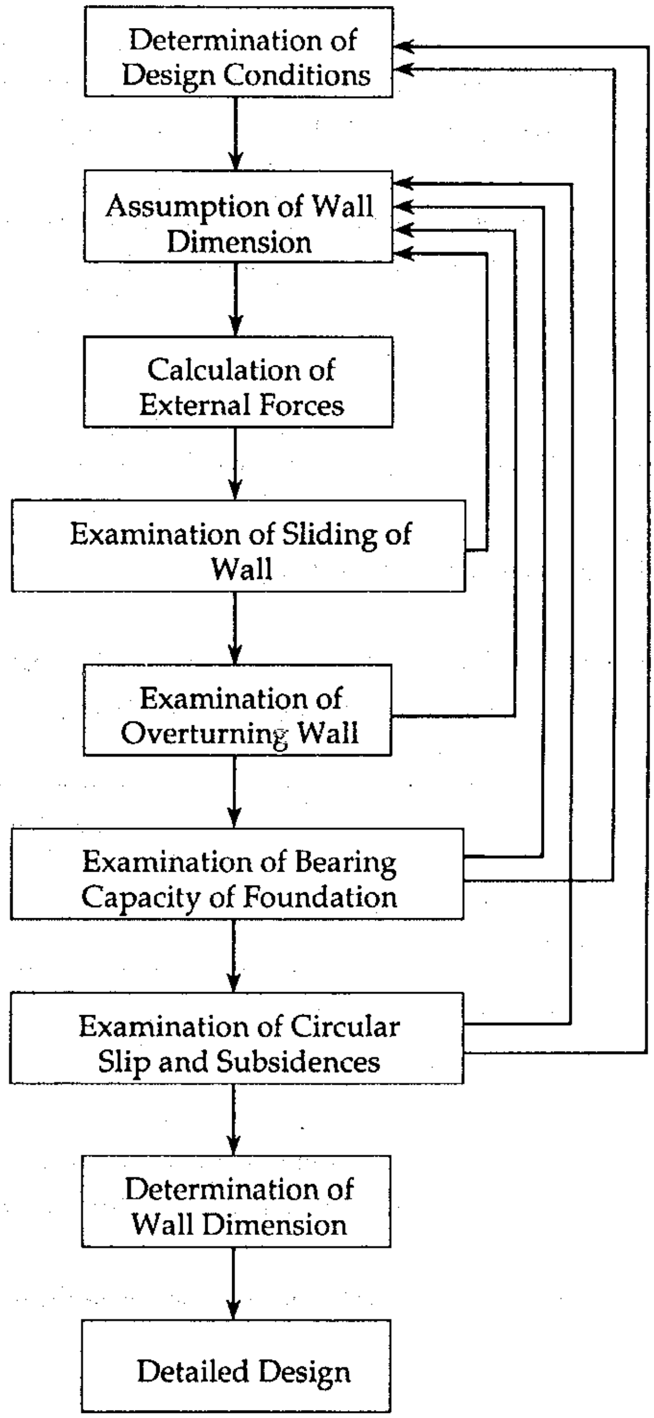


Figure 13-2-1 Design Sequence of Gravity Type

13.3 Design Conditions

13.3.1 Datum Level

The datum level for the design or construction works should be the same level as the Chart Datum, which is approximately equal to the lowest low sea level.

In the Port of Cailan, high water level is as +3.60 m, the mean sea level is usually +2.06 m and low water level is as +0.60 above the datum level by TEDI.

13.3.2 Ship's Size

The size of ships for general cargoes is shown in Table 13-3-1(1).

13.3.3 Crown Height/Water Depth of the Quaywall

The crown height of the quaywall should be determined by employing the following values as a height above H.W.L (in the case of tidal range less than 3.0 m)

Ship Size	Crown height above H.W.L
Quaywall for a small ship with a water depth less than 4.5 m	0.5 m - 1.5 m
Quaywall for a large ship with a water depth of 4.5 m or more	1.0 m - 2.0 m

The crown height of existing quaywall in the Port of Cailan is 1.4 m above H.W.L. and other crown height should be the same as that of wharf No.1 +5.0 m above D.L.

The water depth of the quaywall should be not less than the full load draft of the vessels plus some allowance.

In this case, the proper depth, that is the designed water depth, means the depth obtained by adding an allowance against propeller erosion of the bottom of berth so the design is based almost exclusively on experience or model test. Consequently, the design water depth of the quaywall is set as in Table 13-3-1 (1).

Table 13-3-1 (1) Design Conditions of Cailan Port Project

Aspect	Berth 1	Berth 2	Berth 3	Berth 4	Berth 5	Berth 6	Berth 7
1. DIMENSION OF QUAYWALL							
1) Planned depth (m)	-9.0	-9.0	-10.0	-11.0	-12.0	-12.0	-13.0
2) Design depth (m)	-9.5	-9.5	-10.5	-11.5	-12.5	-12.5	-13.5
3) Crown height (m)	+5.0	+5.0	+5.0	+5.0	+5.0	+5.0	+5.0
4) Berth length (m)	166.0	160.0	185.0	210.0	240.0	240.0	260.0
5) Apron width (m)	30.0	20.0	20.0	20.0	40.0	40.0	40.0
2. UTILIZATIONS							
1) Ship	General	Box, Bag	B-Bulk	B-Bulk	Box, etc. Container	D-Bulk	B-Bulk
a) Size of Ship (DWT)	10,000	10,000	15,000	20,000	30,000	30,000	40,000
b) Berthing velocity	10 cm/s	10 cm/s	10 cm/s	10 cm/s	10 cm/s	10 cm/s	10 cm/s
c) Tractive force on Bolland(tf)	70	70	70	100	100	100	150
d) Tractive force on Bitt (tf)	50	50	50	70	70	70	100
e) Surcharge (t/sm)							
- In ordinary condition	4.0	2.0 t/sm	2.0 t/sm	2.0 t/sm	2.0 t/sm	2.0 t/sm	2.0 t/sm
- During an earthquake	---	1.0 t/sm	1.0 t/sm	1.0 t/sm	1.0 t/sm	1.0 t/sm	1.0 t/sm
f) Live loads							
- Wheel load	---	T20	T20	T20	T20	T20	T20
- Tractor, Trailer load	---	T25	T25	T25	T25	T25	T25
- Cargo handling equi't	30 t	5 t	5 t	3 t	70 t	70 t	40 t

Table 13-3-1 (2) Design Conditions of Cailan Port Project

Aspect	Berth 1	Berth 2	Berth 3	Berth 4	Berth 5	Berth 6	Berth 7
2) Seismic coefficient	---	0.05	0.05	0.05	0.05	0.05	0.05
• Regional coefficient	---	0.05	0.05	0.05	0.05	0.05	0.05
• Factor for subsoil condition	---	1.0	1.0	1.0	1.0	1.0	1.0
• Coefficient of importance	---	1.2	1.2	1.2	1.2	1.2	1.2
3) Tide							
HWL +3.60	+3.60	+3.60	+3.60	+3.60	+3.60	+3.60	+3.60
LWL +0.60	+0.60	+0.60	+0.60	+0.60	+0.60	+0.60	+0.60
4) Residual water height	+1.60	+1.60	+1.60	+1.60	+1.60	+1.60	+1.60
5) Safety factor							
a) Sliding of wall							
Ordinary condition	1.2	1.2	1.2	1.2	1.2	1.2	1.2
During an earthquake	---	1.0	1.0	1.0	1.0	1.0	1.0
b) Overturning of wall							
Ordinary condition	1.2	1.2	1.2	1.2	1.2	1.2	1.2
During an earthquake	---	1.1	1.1	1.1	1.1	1.1	1.1
c) Bearing capacity of Foundation							
Ordinary condition	1.5	1.5	1.5	1.5	1.5	1.5	1.5
During an earthquake	---	1.0	1.0	1.0	1.0	1.0	1.0

Table 13-3-1 (3) Design Conditions of Cailan Port Project

Aspect	Berth 1	Berth 2	Berth 3	Berth 4	Berth 5	Berth 6	Berth 7
3. NATURAL CONDITION							
1) Soil conditions							
a) Existing subsoil							
• Sandy Silt (°)	25	25	25	25	25	25	25
• Colorful Clayed-Sand (°)	30	30	30	30	30	30	30
2) Backfill Material							
a) Rubble stone (°)	35	35	35	35	35	35	35
b) Sand (°)	30	30	30	30	30	30	30
3) Depth of existing sea bed (m)							
a) Alternative 1	-8.3 to -9.5	-1.6 to -9.0	-3.6 to -7.5	-2.5 to -8.5	-5.0 to -7.4	-7.3 to -7.9	-1.7 to -5.6
b) Alternative 2	-8.3 to -9.5	-5.3 to -9.6	-9.4 to -10.1	-9.4 to -9.5	-8.3 to -7.5	-3.8 to -8.0	-2.0 to 8.0
c) Alternative 3	-8.3 to -9.5	-1.6 to -9.0	-3.6 to -7.5	-2.5 to -8.5	-5.0 to -7.4	-5.0 to -6.5	-5.5 to -6.1

13.3.4 Surcharge on the Apron

Wharf No.1 with a berth of 166 meter length has been completed together with some back-up yard pavement. The live loads such as the cranes are in 30 t and the uniform loads on the apron are summarized in Table 13-3-1 (1) together with other planned quaywall.

In the case of an earthquake, the uniform live loads is reduced to half of the original loads in accordance with the Japanese Technical Standard.

The load of cargo handling equipment travelling on rail which is the total weight or the maximum wheel load taking the wheel interval and number of wheels into account is shown in Figure 13-3-1.

On the other hand, the wheel load should conform to the Specification indicated in Table 13-3-2 Load of Top Lifter for the Container Yard.

Container yard for the top lifter is required to be paved with concrete as shown in Figure 13-4-13, if the bearing capacity of the subsoil is assumed at 6% of CBR.

Table 13-3-2 Load of Top Lifter

Condition	Specification with Spreader (Double Tire)			
	No Load		Loaded	
	Front Wheel	Rear Wheel	Front Wheel	Rear Wheel
Whole weight of machine (kg)	69,500		101,600	
Weight in axle (kg)	44,000	26,000	93,540	8,100
Wheel load (kg)	10,960	12,830	23,390	4,030
Ground contact area (cm^2)	1,319	1,491	2,350	580
Contact pressure (kg/cm^2)	8.31	8.60	9.95	6.95

Values in the above table are assumed based on data of similar equipment.

13.3.5 Soil Conditions

According to soil boring investigation conducted by TEDI in Cailan Port area, the top soil consists of sandy silt at a consistency of running plasticity and bedrock appears below the sandy silt at -6.0 m to -12.0 m elevation, fluctuating across the area.

The physical and mechanical properties of the soil in the port area are summarized in Figure 13-3-2, Table 13-3-3 (1) and Table 13-3-3 (2).

On the other hand, soil characteristics for the Rough Design are assumed in Table 13-3-1 (3).

13.3.6 Seismic Force

The seismic force on a structure shall be calculated by the seismic coefficient method.

For the calculation, in use of the seismic coefficient specified in Design Seismic Coefficient, either of the seismic forces indicated below, shall be acted on the center of gravity of the structure.

a. Seismic force = Deadweight x Design seismic coefficient

b. Seismic force = (Deadweight + Surcharge) x Design seismic coefficient

The design seismic coefficient shall be determined in accordance with the following formula with consideration given to the classification of region where structure is located, that of the subsoil condition and the degree of importance of the structure.

Design seismic coefficient = Regional seismic coefficient x Factor for subsoil condition x Coefficient of importance

However, for the design seismic coefficient, only the horizontal coefficient is considered unless otherwise required specifically from the structure.

For the regional seismic coefficient of C ai Lan Port, the value is assumed at 0.05.

For the factor for subsoil condition, the value is assumed at 0.8 in consideration of the quaternary deposits such as alluvium and diluvium.

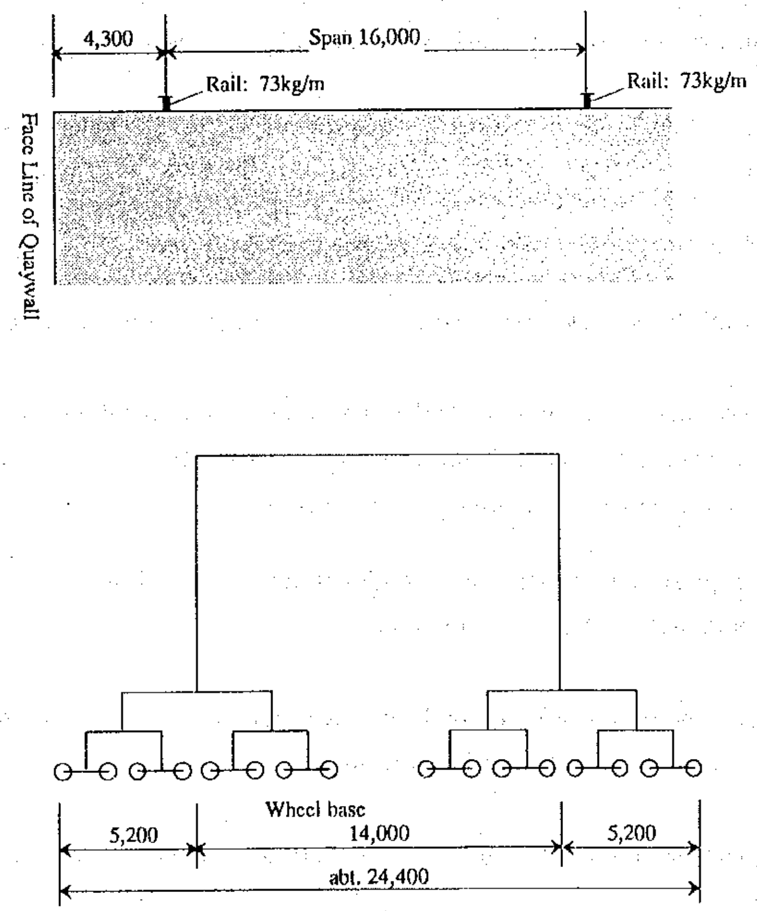
For the coefficient of importance, the value is assumed at 1.2 in consideration of the structures causing serious influences on the economic and social activities of the areas.

Accordingly, the seismic coefficient of 0.05 is adopted in accordance with the Japanese Technical Standard.

$$Kh = 0.05 \times 0.8 \times 1.2 = 0.048 \fallingdotseq 0.05$$

On the other hand, the calculation of seismic force of Vietnam is different from Japanese seismic coefficient method. The zoning map of seismic level in Vietnamese territory is shown in Figure 13-3-3, and so it is used to determine the coefficient on materials and subsoil conditions, etc. in provinces, cities, towns and residential areas for example.

Crane Load



Weight of Crane : Abt. 630 ton
Wheel No. (one side) : 16 wheels
Maximum Wheel Load : 25 t/wheel

Figure 13-3-1 Load of Crane for Container and General Cargo

Layer 1: Sandy silt in a state of running plasticity.

Layer 2: Colorful clayey sand in a state of hard plasticity.

Layer 3: Bedrock. Above the bedrock layer is the weathered rock layer.

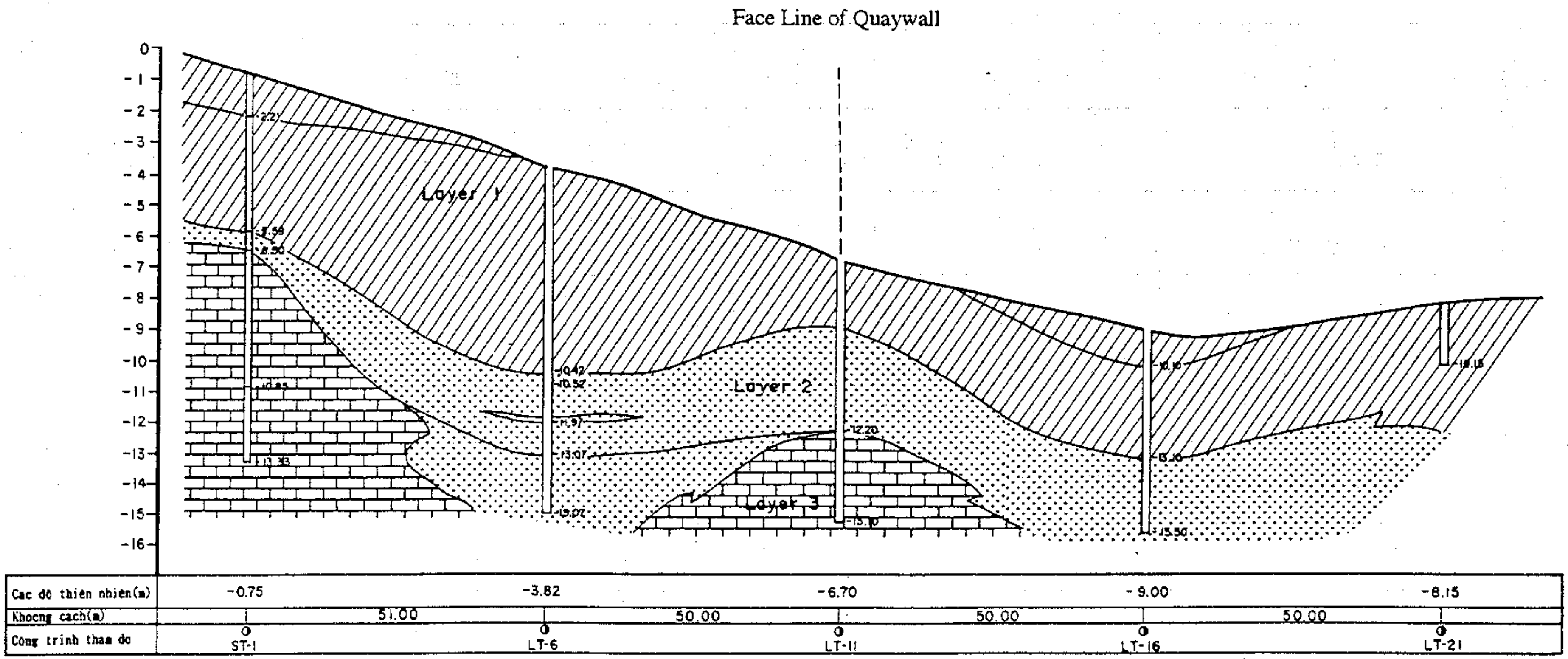


Figure 13-3-2 Geological Cross-section at Berth No.1 of Cailan Port

Table 13-3-3 (1) Soil Characteristics of Cailan Port

Soil Layer / Soil Characteristics		1b	1c	2	3	4	5	6	8	8a
		Silty clay sanday clay mixed with clam shells plastic and wet	Silty clay mixed with gravel shell and organic materials wet	Cllay plastic to wet	Clayey sand mixed with shell plastic soft to wet	Cllay plastic hand	Clay sand mixed with few gravel plastic hard to hard	Sand clay mixed with few gravel wet	Clay mixed with gravel half plastic	Clay sand mixed with gravel quartz half plastic
Grain distribution	mm									
> 2	%	3.02	1.12	-	0.30	0.12	3.19	7.21		17.16
2-0.05		22.68	27.2	25.50	68.27	25.76	47.38	74.19	36.25	51.34
0.05-0.005		47.23	34.34	42.50	15.73	31.62	20.23	8.60	17.75	16.50
< 0.005		27.07	37.34	32.00	15.70	42.50	26.60	10.00	46.00	15.00
Moisture Content	W %	39.96	55.20	50.93	25.80	26.23	19.61	23.65	24.62	16.44
Wet density	g/cm^3	1.76	1.66	1.68	1.97	1.99	2.06	2.12	1.99	
Dry density	g/cm^3	1.27	1.07	1.11	1.56	1.57	1.72	1.714	1.596	
Specific gravity	D	2.67	2.70	2.70	2.68	2.71	2.71	2.70	2.71	2.71
Saturation	G %	96.81	97.85	96.16	95.30	97.91	92.42	100	95.72	
Void raafio	n %	52.43	60.37	58.88	41.79	42.06	36.55	36.60	69.79	
		1.103	1.523	1.432	0.725	0.726	0.575	0.575	0.697	
Liquid Limit	wt %	30.46	43.11	47.84	24.62	36.03	26.13	21.91	44.58	25.88
Plastic Limit	wp %	16.19	21.81	21.86	14.34	18.56	13.89	15.18	22.35	14.80
Plastic Index	wn %	14.27	21.30	25.98	10.28	17.47	12.26	6.73	22.20	9.08
	B	0.96	1.56	1.00	1.11	0.43	0.46	1.25	0.10	0.18
Penetration Coefficient	Kcm/s	1.375x10	1.055x10	1.191x10		8.576x10	8.188x10			
		-	-	-						
Internal friction angle	φ	4.06	-		12.40	4.36	18.28	36.30	19.06	
Cohesion	Kg/cm^2	0.12	-		0.16	0.37	0.26	0.31	0.33	

Table 13-3-3 (2) Soil Characteristics of Cailan Port

Soil Layer / Soil Characteristics		1 Sand mixed with claim shells	1d	7a Fine to sand	7b Coarse	7c Gravel quartz
Grain distribution	mm					
> 2	%	0.62	41.30	12.24	39.64	66.33
2 - 1		0.62	5.46	4.03	6.86	8.03
1 - 0.5		4.50	24.12	12.38	7.4	10.03
0.5 - 0.25		17.66	12.46	40.92	13.68	6.67
0.25 - 0.1		42.70	13.37	15.27	5.75	3.62
0.1 - 0.005		20.10	3.29	16.16	26.93	5.32
0.05 - 0.01		4.90				
0.01 - 0.005		1.90				
< 0.005		7.00				
Specific gravity	DK cm/s					
Angle of stability (dry)	a° C		34.23	36.28	40.44	32.5
Angle of stability (wet)	a W*		29.17	25.02		31.36

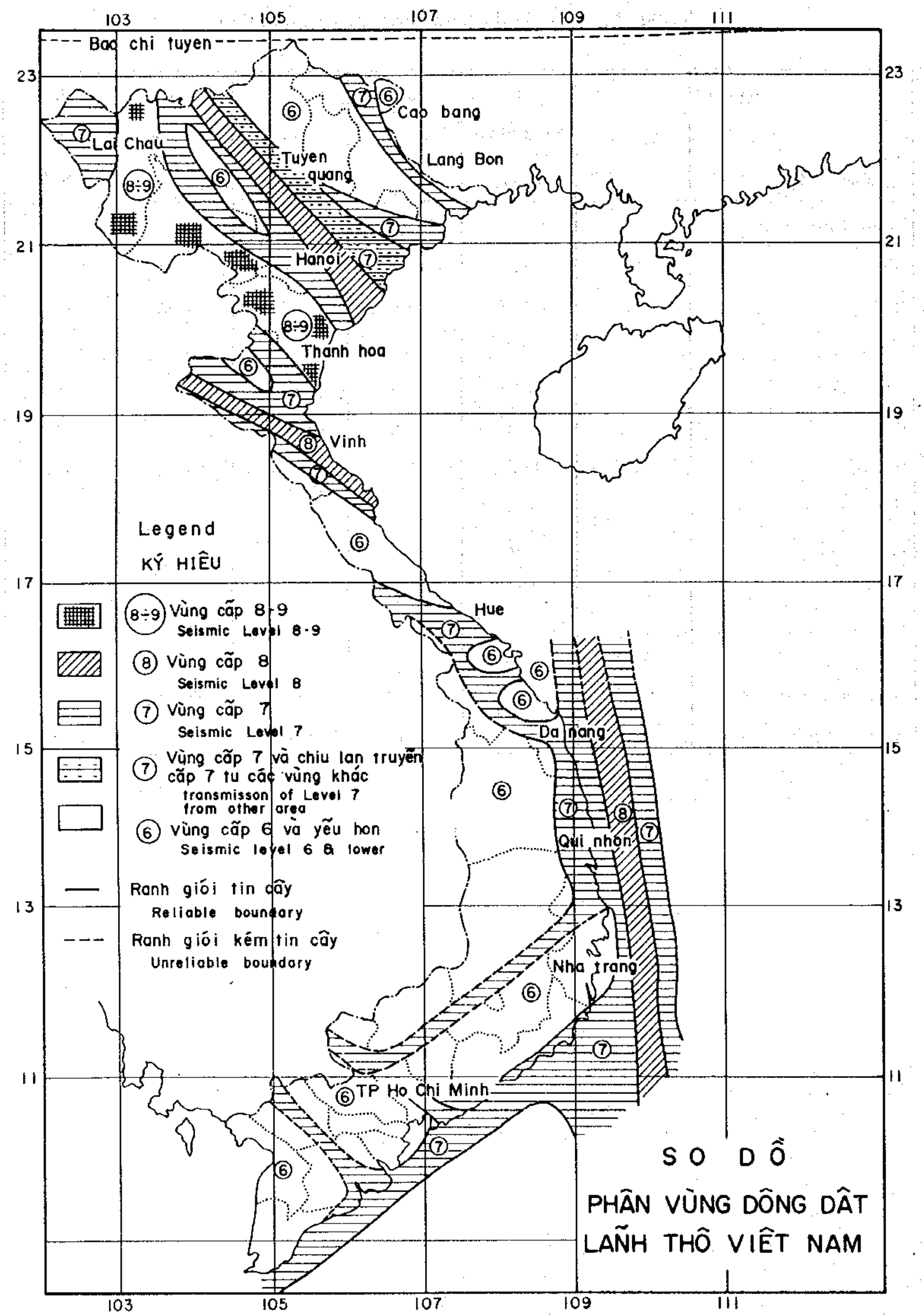


Figure 13-3-3 Zoning Map of Seismic Level

13.3.7 Allowable Stress

The allowable stress of steel and concrete is determined in accordance with the Japanese Industrial Standard (JIS). It is assumed that when the influence of an earthquakes is considered, the allowable stress can be increased by 50% over the normal value.

Table 13-3-3 Allowable Stress of Materials

Material	TCVN	JIS
1. STEEL		
- Structural steel	n.a	1400 kg/scm (SS 41)
- Steel sheet	n.a	1800 kg/scm (SY 30)
- Steel pile	n.a	1400 kg/scm (SKK 41)
- Reinforcement bar	n.a	1400 kg/scm (SR 24)
2. CONCRETE		
- Plain concrete	n.a	Compressive stress 55 kgf/scm
- Reinforced concrete	n.a	Bending compressive stress 70 - 140 kgf/scm

n.a: none available

TCVN : Vietnamese Standard
JIS : Japanese Industrial Standard

13.3.8 Safety Factor and Others

The safety factor of the structural design is empirically determined based on the investigations, tests, importance of the structure, and design formulas.

In this design, the values for the safety factor are chosen according to the Japanese Technical Standards as shown in Table 13-3-1 (2).

13.4 Design

Construction aspect of typical quaywalls are as follow;

13.4.1 Concrete Caisson Type

(1) Proposed site of temporary yard

i) The slipway provided at the Ha Long Ship Factory at present is used to built small steel ships. The basin depth (-2.5 m) is not sufficient to launch the caisson and thus dredging is required; -10.0 m depth below high tidal level should be secured.

ii) To construct a temporary slipway for the production of the caisson at the coastal zone of Bai Chai Bay, a large investment of more than 20 million dollars is required.

iii) Floating Dock System

The Floating Dock is available locally; the construction site has to located in -10.0 m depth and also, ready mixed concrete can be supplied easily.

(2) Material Procurement

i) Materials such as cement, sand and aggregate can be procured locally.

ii) Materials such as steel bar and metal forms, etc. must be procured from abroad

(3) Technical Aspect of Design and Construction System

i) Ballast is required due to higher height compared with width of structure in launching caisson.

ii) As local contractors have never constructed a caisson, it's technical transfer is required.

iii) Floating Dock System is suitable method considering site conditions, three floating docks are required for the construction of caissons over a two-year period.

(4) Topographic condition between proposed quay and temporary production yard

i) Water depth of more than -7.5 meter C.D is sufficient to launch caisson in Hon Gai as well as from approach channel to the site.

ii) Water depth is not sufficient in the other coastal zone except Hon Gai, dredging for launching and towing of caisson is required.

(5) Removal of Soft Foundation Soil and Leveling of Foundation Rubble

i) Excavation or dredging of soft soil of existing sea be is required. Once the bedrock layer is reached leveling work of foundation is required immediately.

13.4.2 Concrete Block Type

(1) Proposed site of temporary yard

i) A temporary pier and yard should be constructed in coastal area located in western direction of the existing pier No. 1 using excavated soil of high land to make the ground stable.

ii) An alternative is to construct a temporary yard in back site of the planned quaywalls for the following reasons;

The lowland located in the eastern area of Berth No. 4 is to be filled before the construction of quaywalls and also the stability of the soft ground will be improved to move heavy equipment such as mobile cranes.

On the other hand, the location of the temporary yard will disturb main cargo transportation flow of the port crossing approach road toward the existing pier No. 1.

(2) Material Procurement

i) Main materials using concrete block such as sand, gravel, quarry run, cement and timber are available locally.

(3) Technical aspect of Design and Construction System

i) Concrete blocks should be in limited to a maximum weight of 50 t considering trailer load as well as crane capacity.

ii) Floating crane barge with more than 50 t lifting capacity and pontoon with more than 700 t capacity must be procured from abroad.

(4) Removal of soft foundation soil and leveling rubble stone.

i) Same as in the case of Concrete Caisson Type

13.4.3 Concrete Cellular Block Type

(1) Proposed site of production yard

i) It is recommended to construct a temporary pier and yard in the coastal area located in the western direction of existing pier No. 1 using excavated soil of hiland to make the ground stable..

ii) Several operational problems such as disturbance of transportation flow of the port crossing approach road toward the existing pier No. 1 will occur, if the location of temporary yard is set in back site of the planned quaywalls.

(2) Material Procurement

Same as in the case of Concrete Blocks

(3) Technical aspects of design and construction system

There are technical problems such as quality control for cast in situ the under water concrete into cellular block.

It is required to install cellular blocks from sea side by floating crane, however the installation of cellular block from land side will be difficult due to poor ground stability for the mobile crane.

13.4.4 Steel Sheet Pile Cellular Cofferdam

(1) Proposed site of temporary yard

Coastal area located in western direction of the existing pier No. 1 should be used for temporary yard such as stock pile of steel materials and to construct a temporary pier and leveling ground.

(2) Material Procurement

i) Main materials such as flat-web steel sheet pile are obtained from abroad.

ii) Fill materials such as quarry run or sand are procured locally.

(3) Technical aspects of design and construction system

Cellular Cofferdam can be located on any subsoil which is able to carry their load, during the period of construction considerable settlements and horizontal deformations may be occur.

The flat-web steel sheet pile used for cellular bulkheads is characterized by heavy locks able to sustain the ring loads developed by the fill inside the cells and the steel in the splash and tidal zone is influenced slightly by corrosion.

During construction, it is necessary to place all the piles for a cell, lock-in-lock, before driving can commerce and until the cell has been partly or completely filled, it must be adequately braced against horizontal loads from waves or currents.

Cellular Cofferdam will be piled directly to sea bed with little replacement of sub soil, accordingly construction period will be rather reduced by this method.

13.4.5 Selection of Structure Type

The selection of structure type is evaluated as shown in Table 13-4-1.

Table 13-4-1 Selection of Structure Type

Type / Item	Caisson	Concrete Block	Cellular Block	Steel Sheet Pile Cellular Cofferdam
1. Subsoil conditions	Very good	Very good	Very good	Very good
2. Local material procurement	Good	Very good	Good	Poor
3. Technical aspect of design and construction system	Excellent	Good	Good	Good
4. Procurement of offshore equipment	Fair	Good	Fair	Poor
5. Proposed site of temporary production yard	Very good	Very good	Good	Good
6. Construction Period	Very good	Good	Very good	Excellent
7. Experience in local	Poor	Fair	Poor	Poor
8. Corrosion by sea water	Very good	Excellent	Very good	Poor
9. Ease or Difficulty of Maintenance	Very good	Very good	Very good	Fair
10. Construction Cost per Meter ($)	32 thous.	39 thous	38 thous	41 thous
Evaluation	Excellent	Good	Fair	Poor

13.4.6 Dimensions of Mooring Facilities and Revetments

Mooring facilities are facilities where ships berth for loading and unloading of cargo. The scale, arrangement, kind and structure of mooring facilities are shown in Figure 13-4-1 ~ Figure 13-4-8.

Typical sections of revetment are shown in Figure 13-4-9 ~ Figure 13-4-11.

13.4.7 Dimension of Container Freight Station (CFS)

The CFS storage area is determined considering items such as transit time (days), average stacking height of general cargo (meters) access factor and reserve capacity safety factor (percentage).

Dimensions of CFS for Berth No.5 are shown in Figure 13-4-12.

13.4.8 Pavement for Container Yard

The high front-wheel loads for top lifter as well as the grinding effect of their turning rear wheels, when the top lifter is empty and rear-wheels carry the full load of counter weight, are hard on pavements.

Accordingly, the pavement of CFS is determined considering maximum wheel loads using container yard. A typical cross section of concrete pavement is shown in Figure 13-4-13.

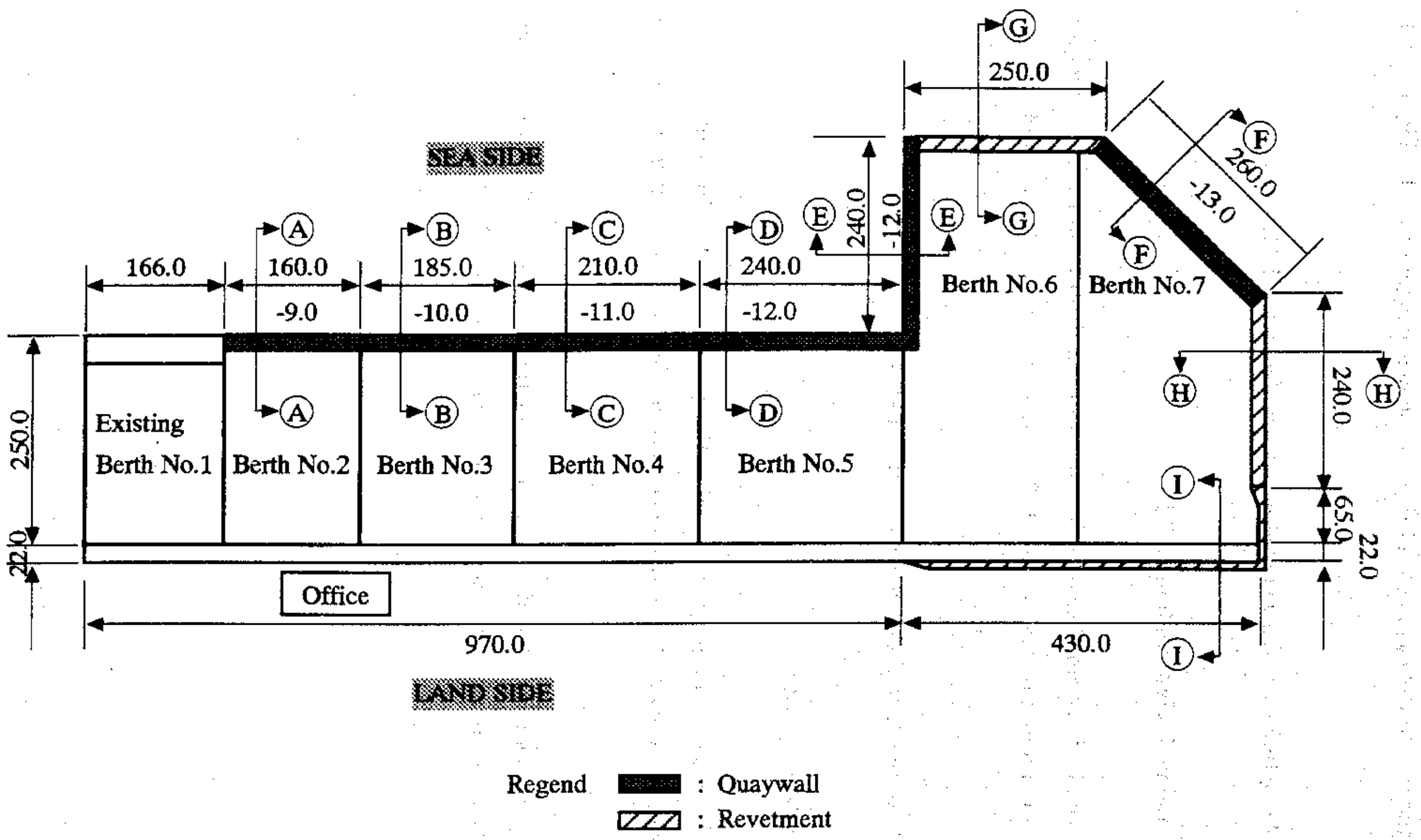


Figure 13-4-1 LAYOUT PLAN OF QUAYWALL & REVETMENT

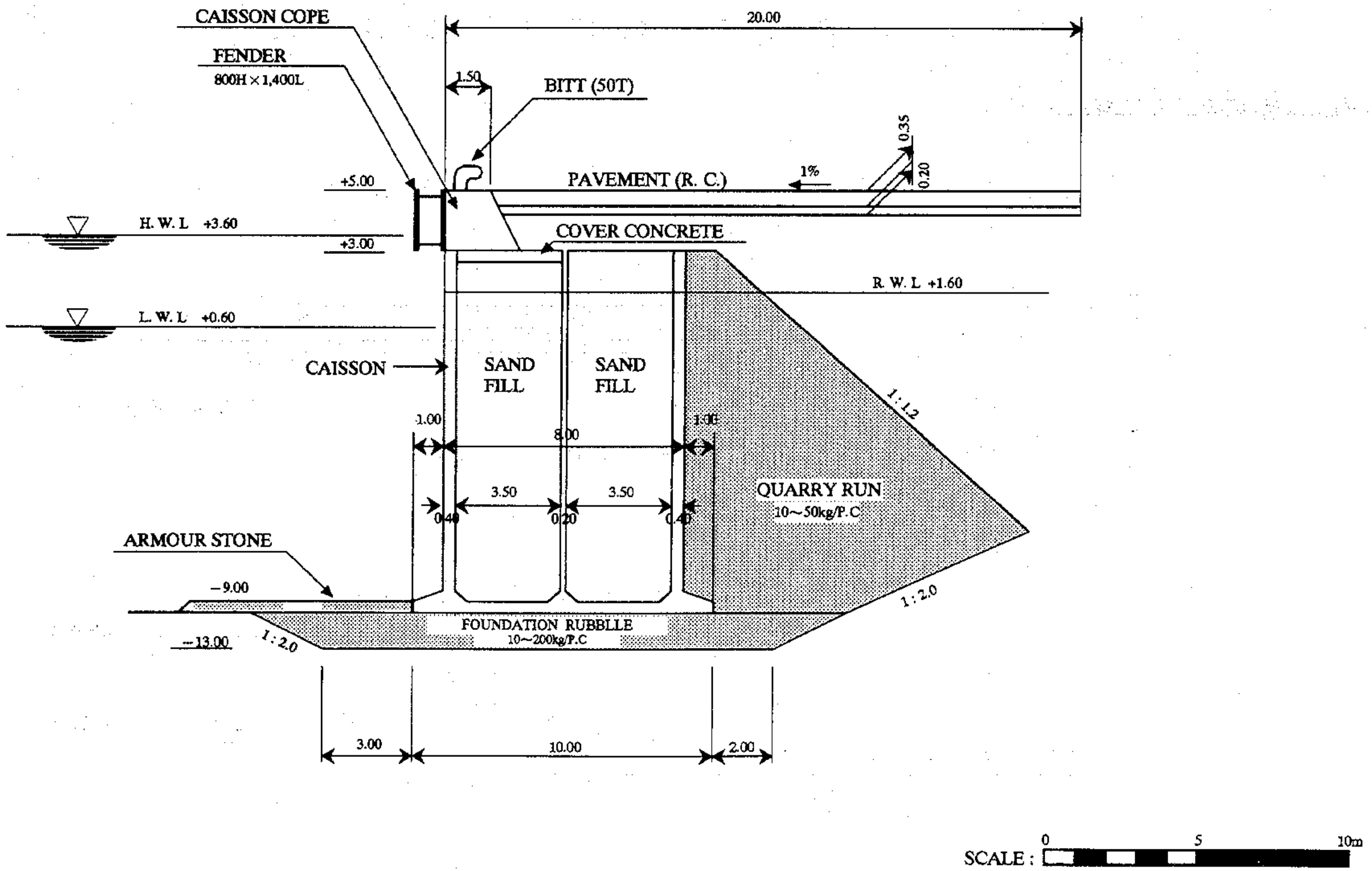


Figure 13-4-2 Quaywall of Berth-2, Ⓐ - Ⓐ

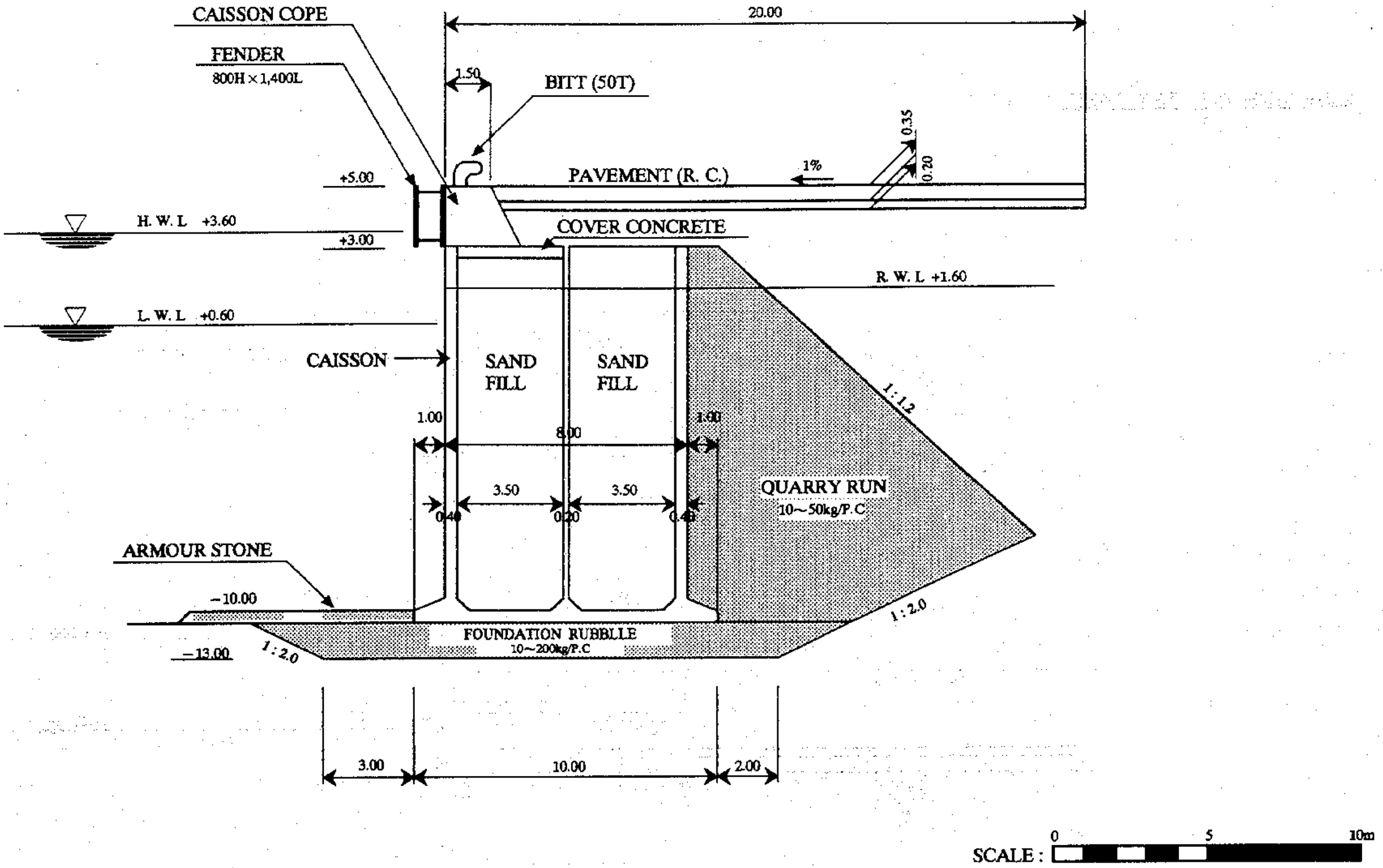


Figure 13-4-3 Quaywall of Berth-3, (B) - (B)

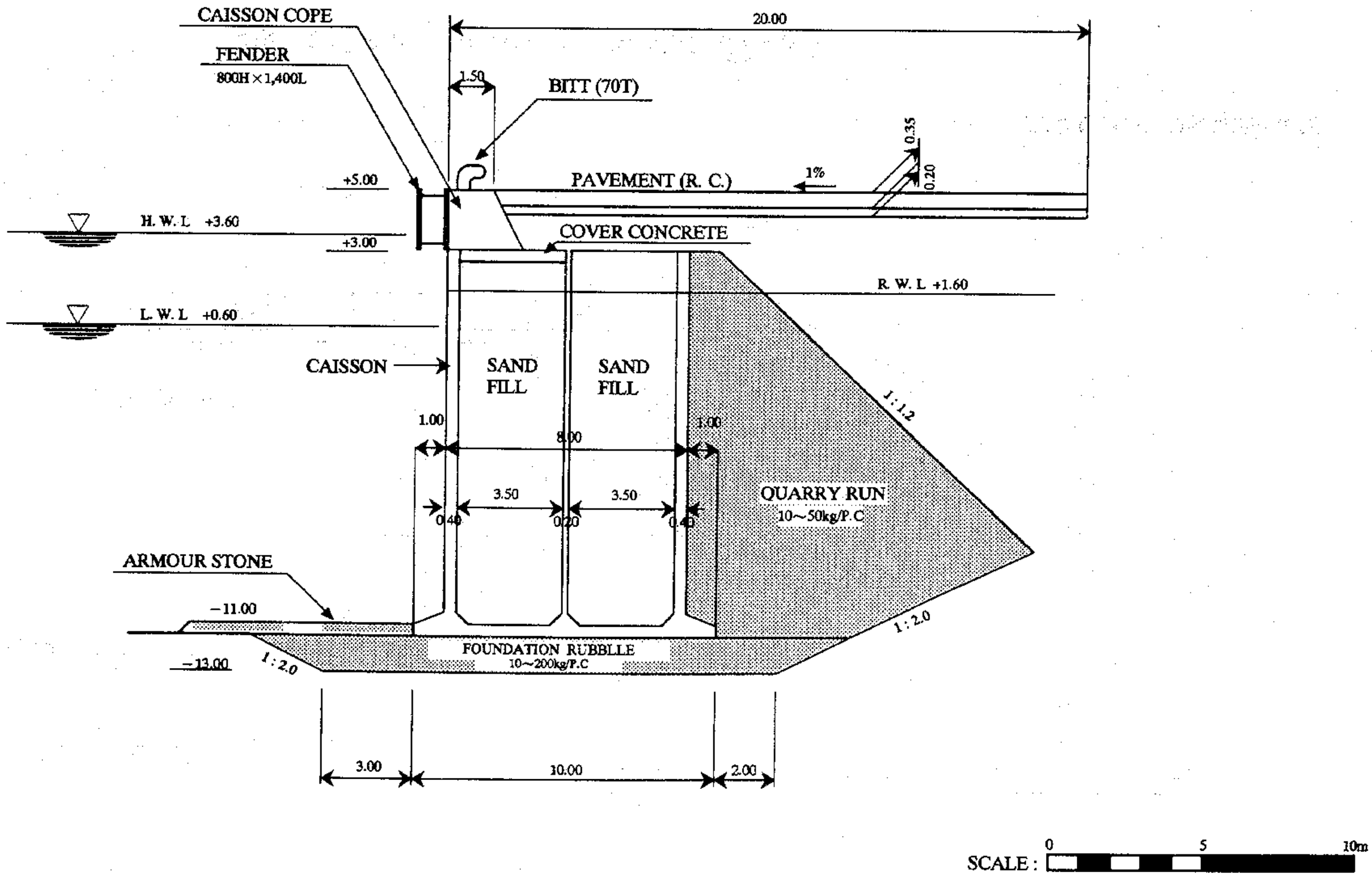


Figure 13-4-4 Quaywall of Berth-4, Ⓒ - Ⓒ

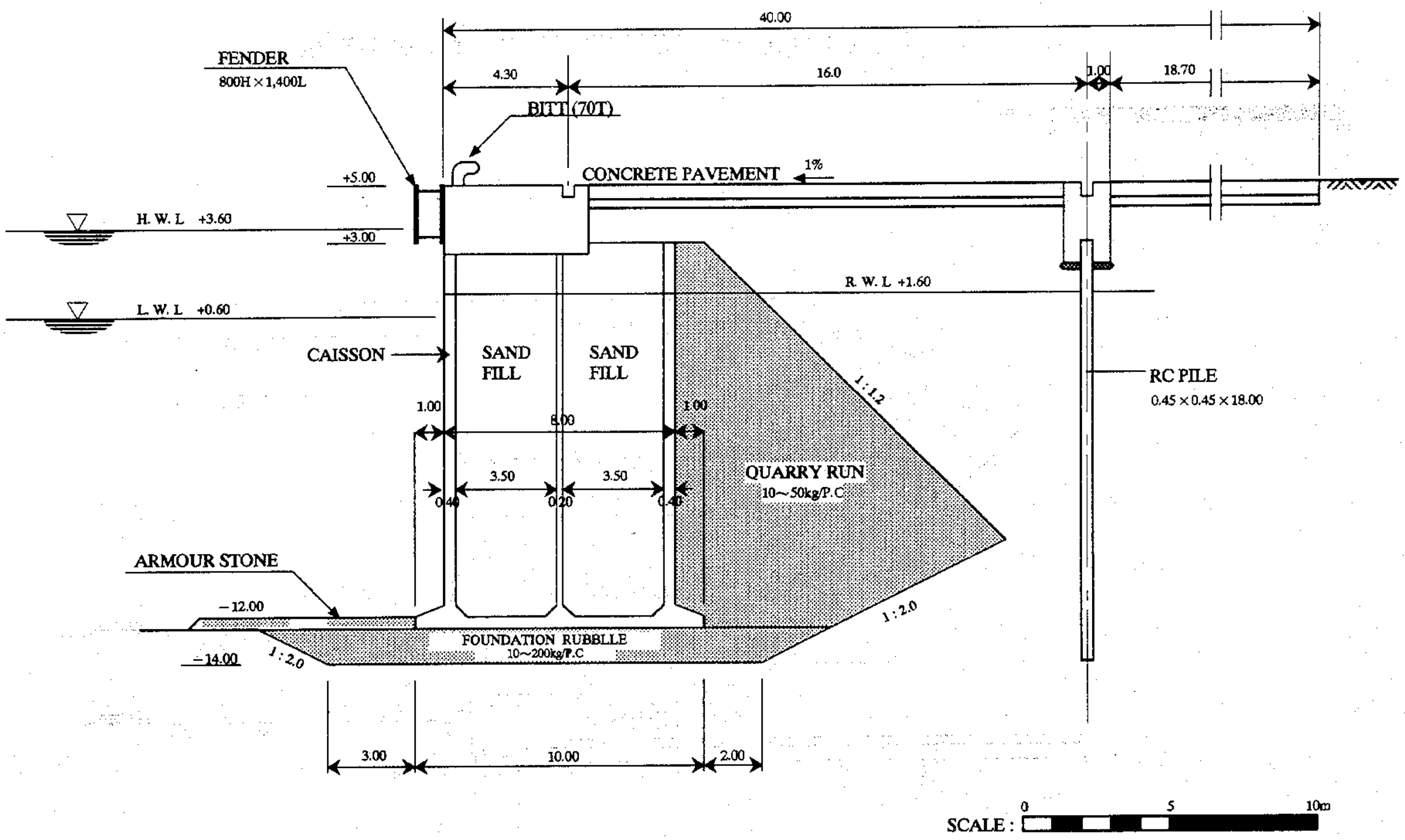


Figure 13-4-5 Quaywall of Berth-5, Ⓓ - Ⓓ

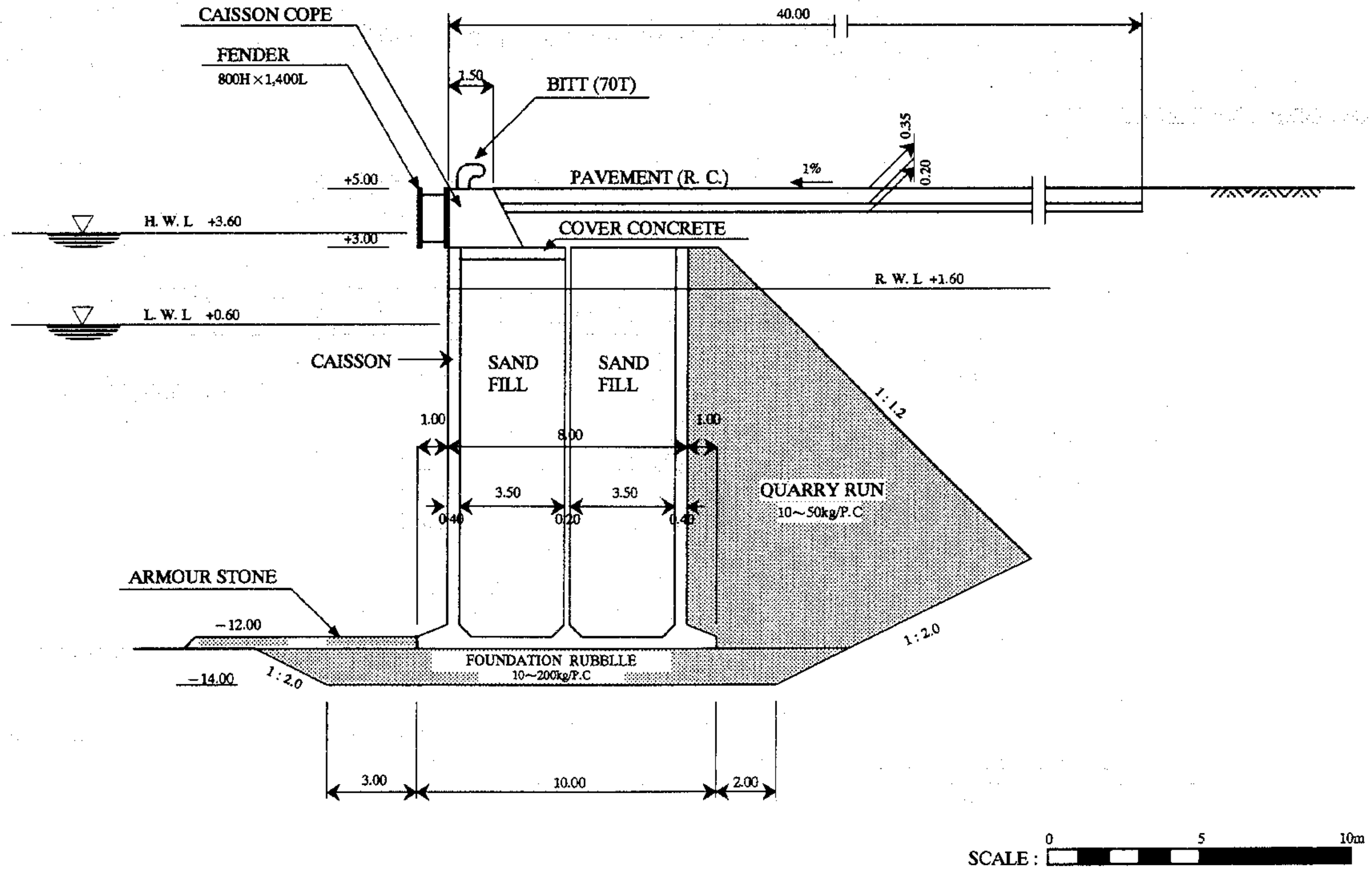


Figure 13-4-6 Quaywall of Berth-6, Ⓔ - Ⓔ

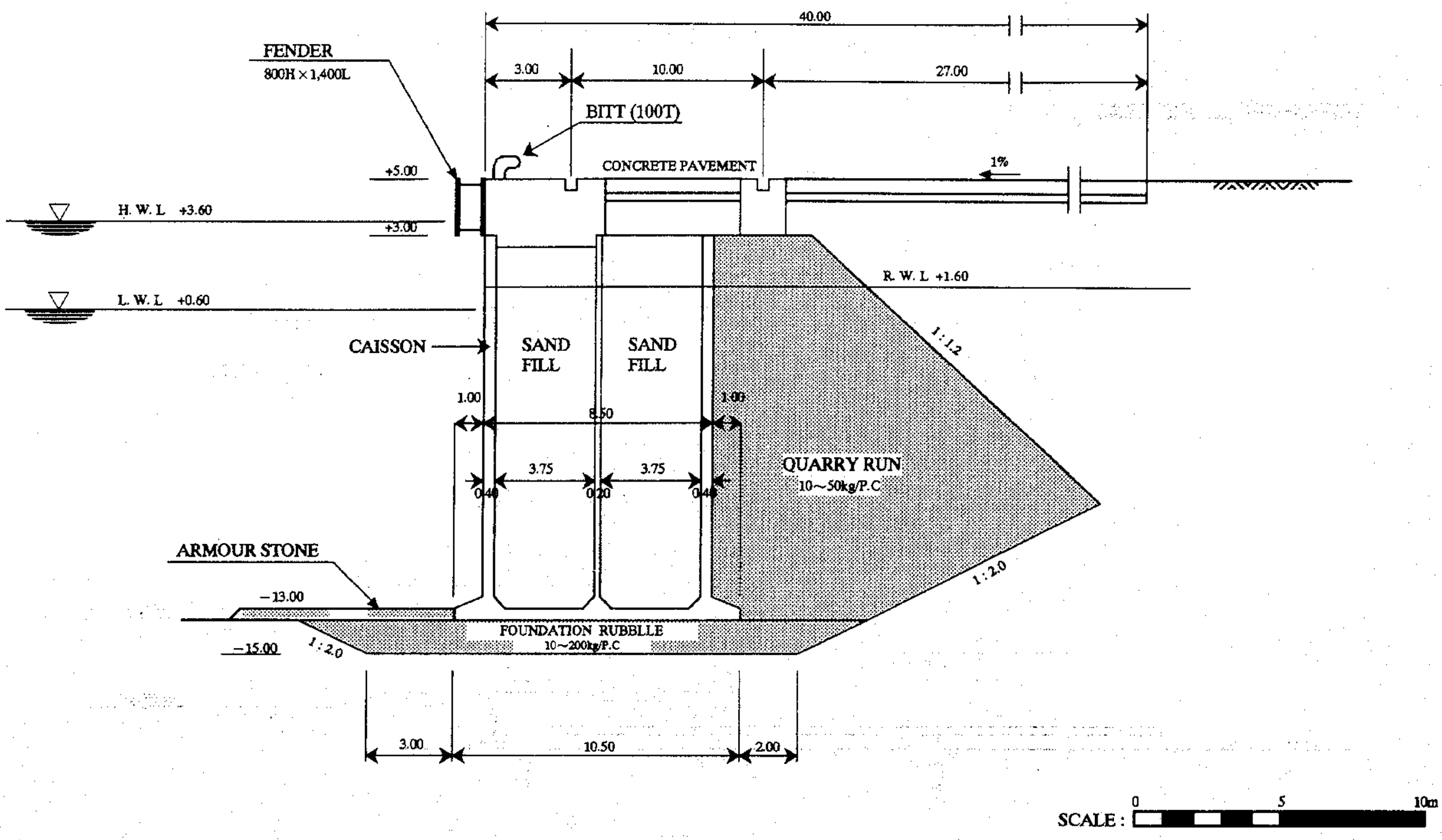


Figure 13-4-7 Quaywall of Berth-7, Ⓕ - Ⓕ

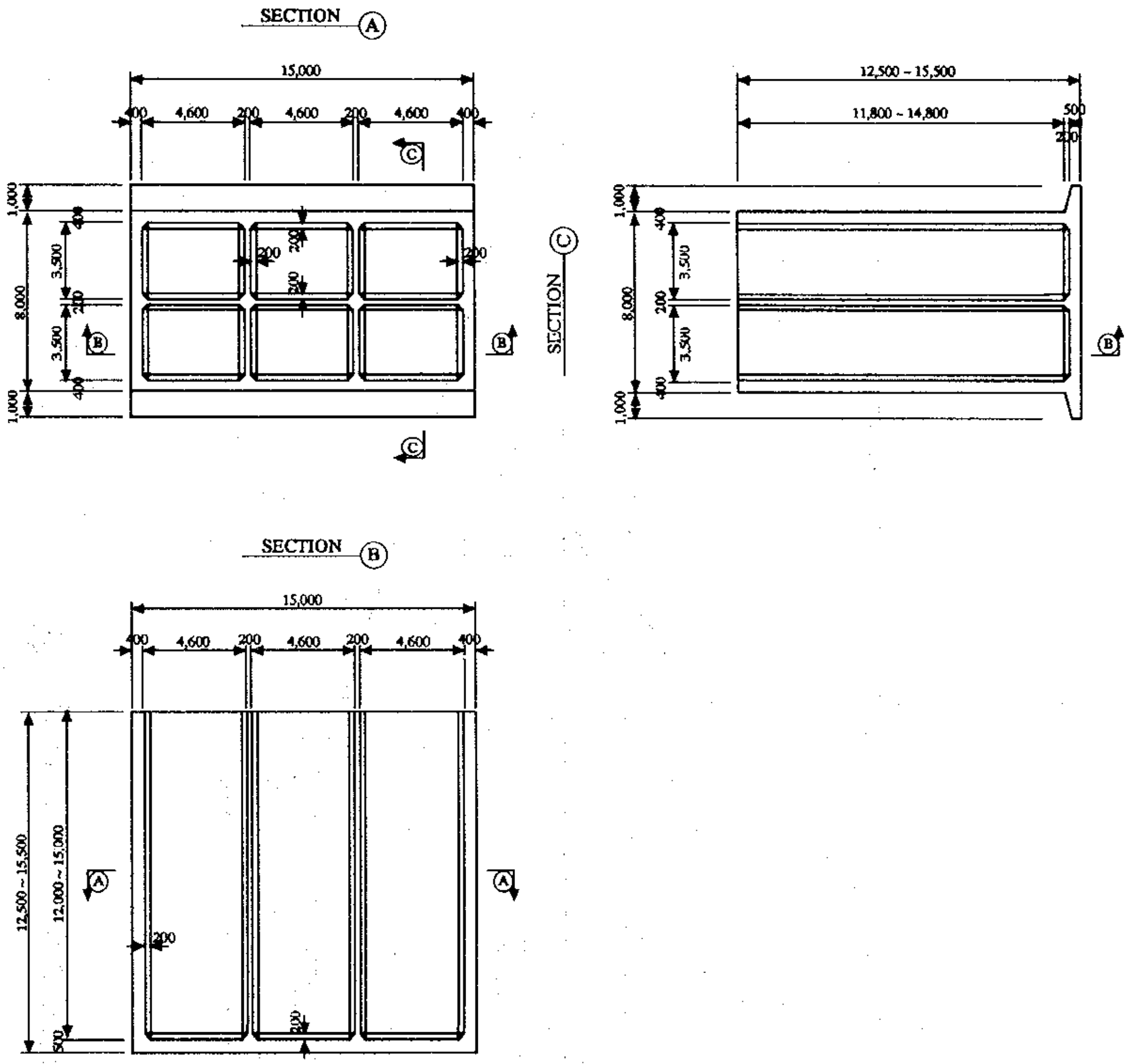


Figure 13-4-8 Concrete Caisson

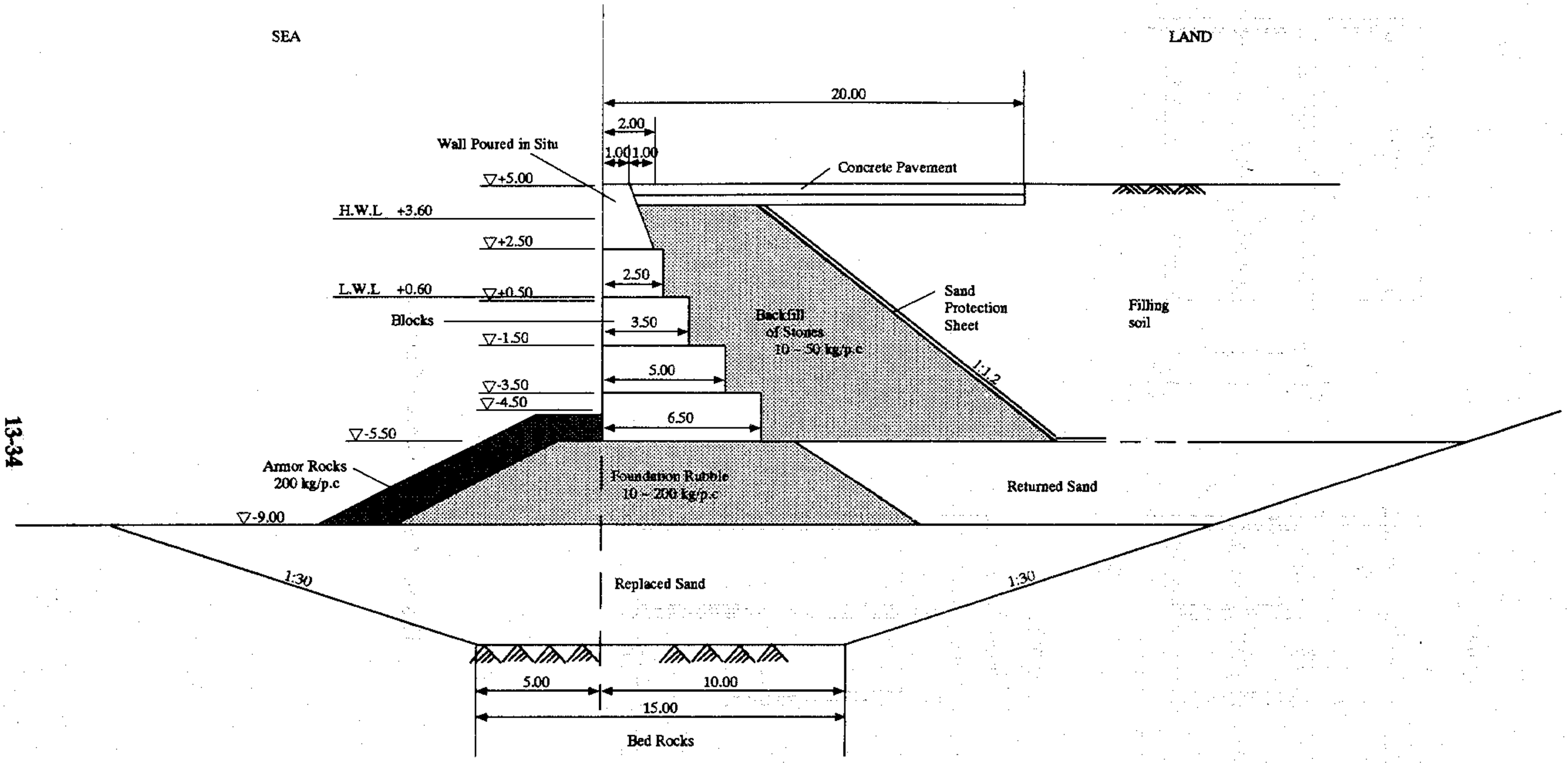


Figure 13-4-9 Revetment Ⓖ - Ⓖ

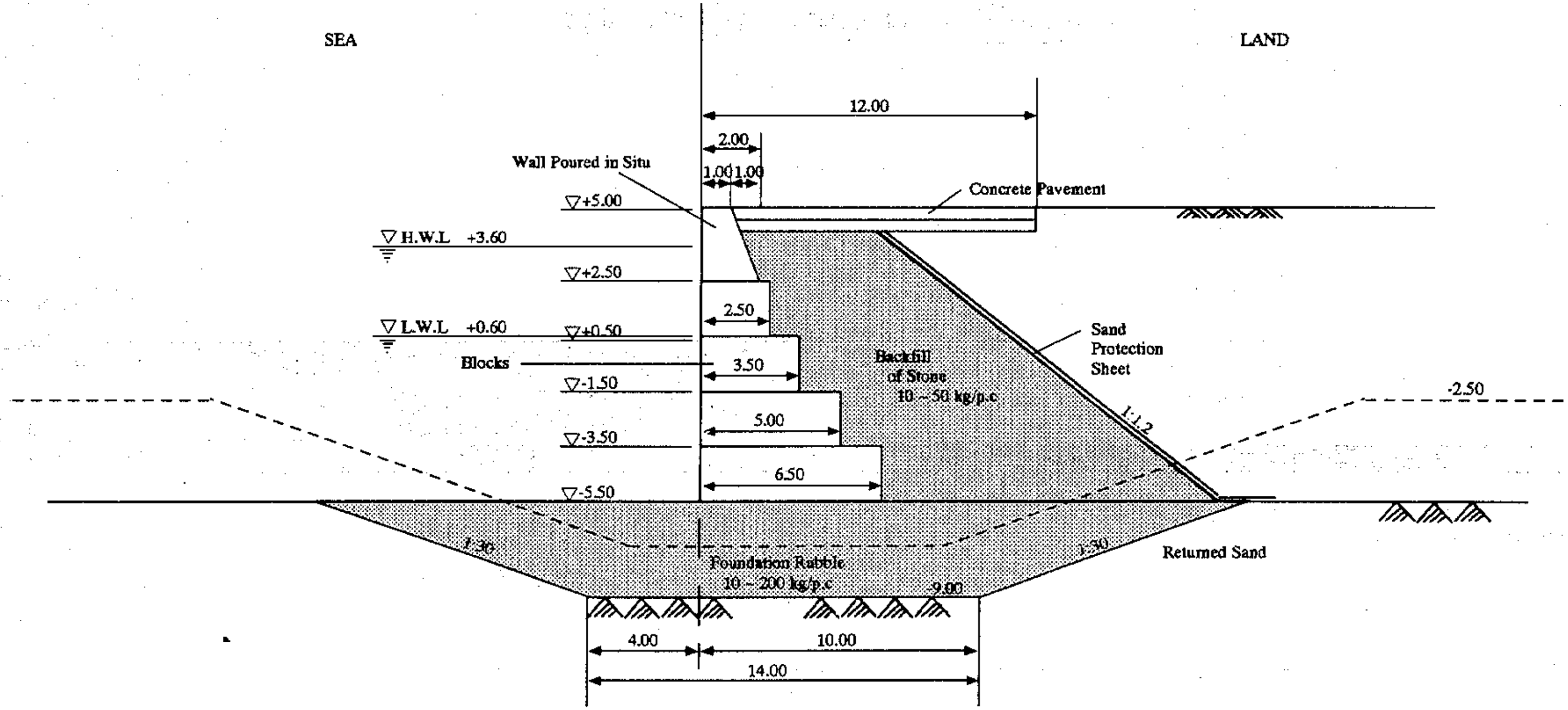


Figure 13-4-10 Revetment (H)-(H)

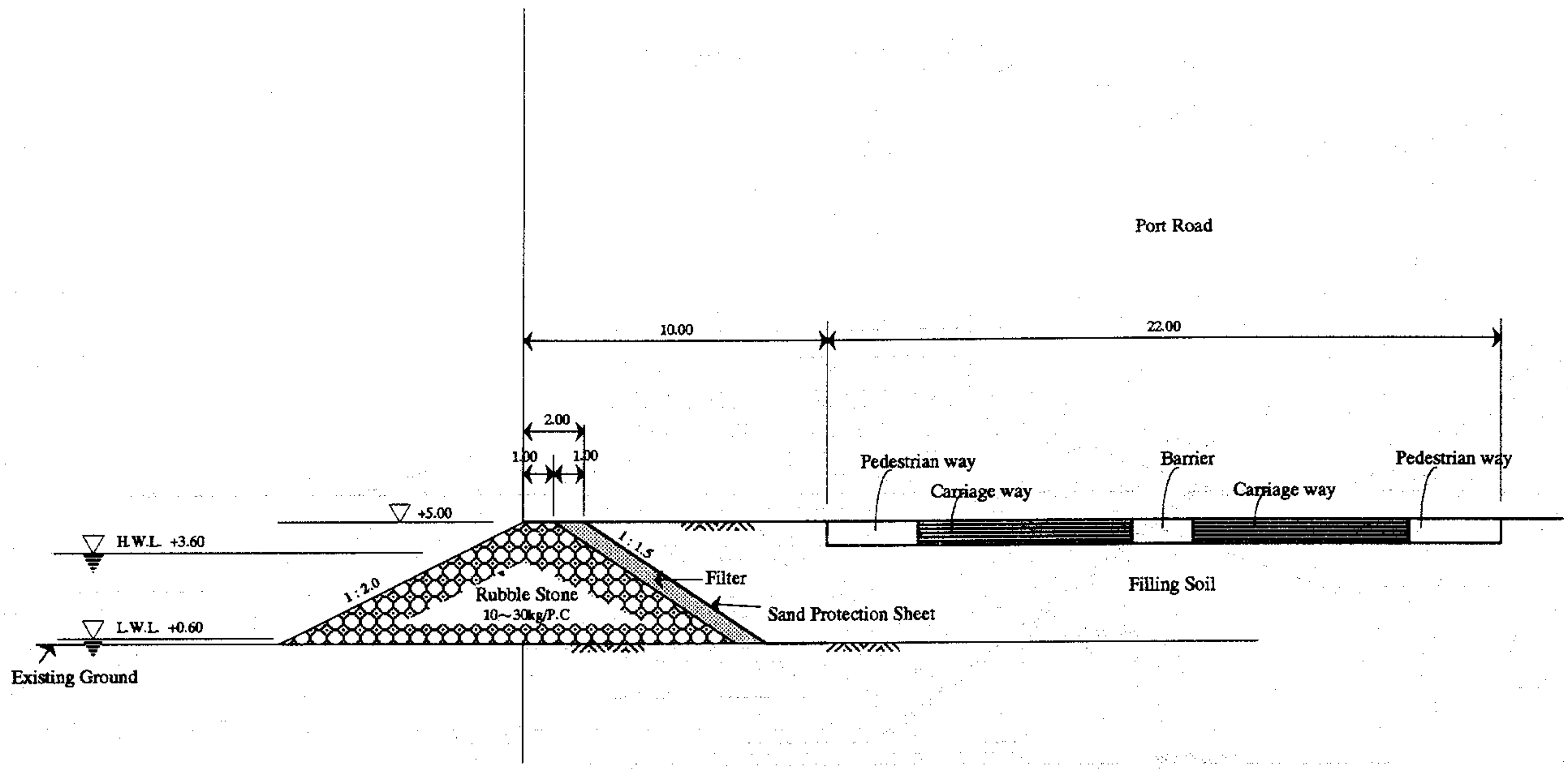
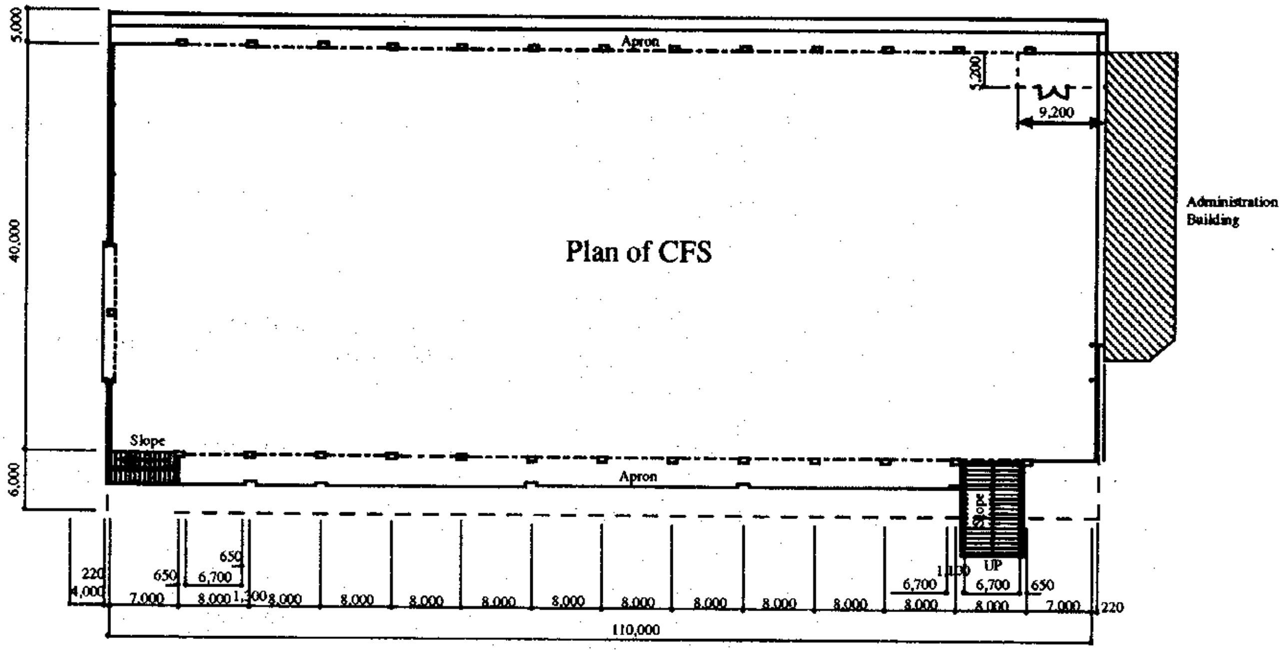
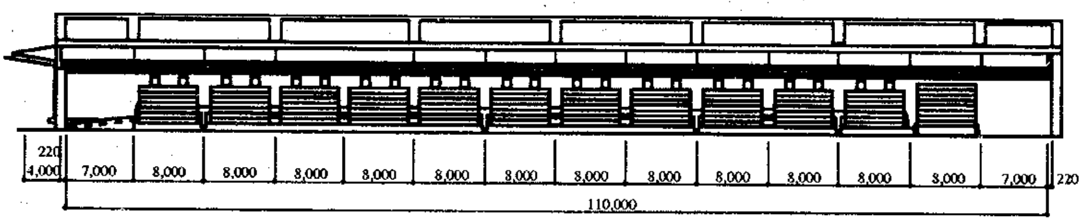
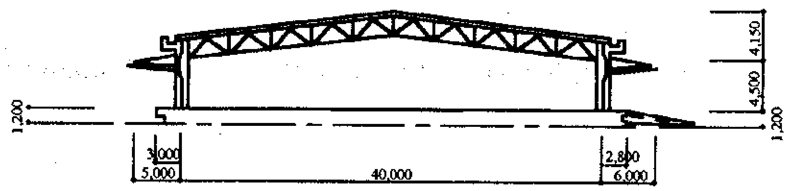


Figure 13-4-11 Revetment Ⓘ-Ⓘ





Front View of CFS



Cross Section of CFS

Figure 13-4-12 Container Freight Station

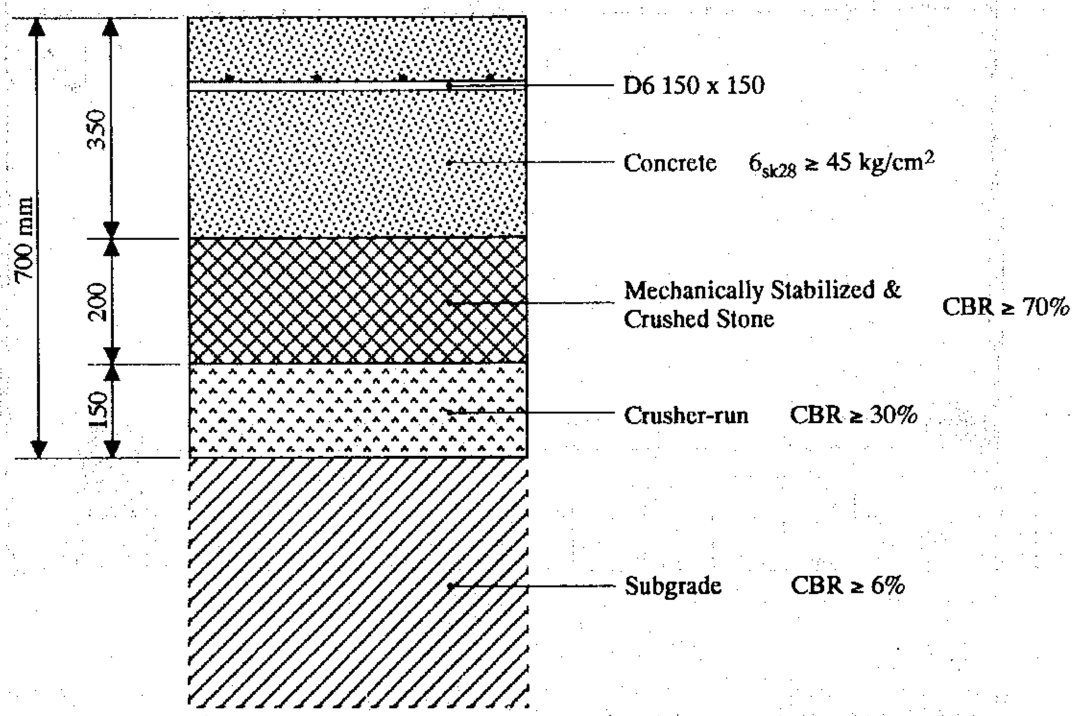


Figure 13-4-13 Typical Cross Section of Concrete Pavement of Container Yard

CHAPTER 14 IMPLEMENTATION PLAN FOR SHORT TERM PORT DEVELOPMENT PLAN

Through interviews with state and private contractors, the present construction activities in the Northern part of Vietnam is investigated.

14 .1 General Construction Situation

Before the new economic system (DOIMOI) all construction works were conducted by the state contractors managed under each Ministry, such as Construction, Transportation, Forestry, Agriculture and Fishery.

Since DOIMOI three types of construction companies have emerged ; 1) the State company 2) Private company and 3) State + Private joint venture company.

At present private companies do not have sufficent construction equipment. Most construction equipment is held by the State companies, however there is little variety. The capacity of mobile and crawllor cranes ranges from 15~40 tons. The floating equipment for marine construction, tug, dredger, floating crane, is limited and only one state company, Dredging Company No.1, holds these machines. Other state companies such as Water Way Construction have to rent the floating equipment from Dredging Company No.1. As to small scale dredger and floating equipment the state construction company under the Ministry of Agriculture/Irrigation holds some equipment and they use this equipment mainly for maintenance of irrigation canal.

Most of the equipment owned by the state construction company was made in Russia and is severely deteriorated.

As per the observation at some construction works site in HANOI city, man-power input is maximized because of low cost and availability.

(1) Ready Mixed Concrete

Regarding ready-mixed concrete factories, in the northern area there are three state companies near HANOI city area. From February 1994 a joint venture between an Australian and state company, Concrete Material Construction Company under People's Committee of Ha Tay Province, commenced operation. These factories are located between HANOI city and HADON. In Vietnam, cement for construction is manufactured. The available types are P300 (300 kg/sq.cm) and P400 (400 kg/sq.cm : equivalent to Type I cement) far. However due to the recent construction boom, often supply shortages occur. The supply of aggregates for concrete as well is not sufficient, because the crashing plant is old and capacity is low.

Now five types of concrete are produced in Vietnam, 15 MPa, 20 MPa, 25MPa, 30MPa and 40MPa. MPa is equivalent to 10 kg /sq.cm, so 40MPa is 400 kg /sq.cm at 28 days strength.

In the case of using local cement, more than 40 MPa strength concrete could not be guaranteed due to the low quality of cement. For stronger concrete, the imported cement mainly from China and Taiwan is reqired. The cost of cement is 70 US$/ton for local and 90 US$/ton for imported.

Because of low production against the recent demand, supply of cement has been short. The quality of aggregate and sand meets the standard, but supply capacity is insufficient due to aged machines.

The factory of VIET-UC READYMIXED CONCRETE LTD. exists in HADONG TOWN, 10 km from the center of HANOI. The plant capacity is about 60- 70 cum per hours. So far five agitators of 2 cum capacity are operating. Up to 20 agitators are planned to be operated by the end of this year.

(2) Other Materials

Regarding steel materials, steel bar, steel plate are imported from mainly CHINA and RUSSIA. The quality is out of JIS or BS in terms of carbon. In order to maintain the structures at the standard quality of JIS or BS, the major materials shall be imported from the qualified countries.

Cement is available in the local market, but factory product is insufficient and there is a shortage under the construction rush. Factories should adjust their production to meet the recent demend.

Generally a large volume of rocks of various sizes are necessary for construction works of marine and port projects. For CAI LAN port development project, hard rock that satisfies to the international standard is available in CAI LAN area.

Other available materials are listed in Table 14-3-1 with unit price surveyed in June and July 1994.

14.2 Available Construction Machine and Conditions

In Vietnam the available construction machines are listed in Table 14-2-1. However most machines are aged and efficiency is quite low. Their fuel consumption likely is large compared to efficient machine standards.

The floating equipment for marine and port construction is listed in Table 14-2-2 with the rental cost at local bases.

Table 14-2-1 Construction Machine for Onshore Activity

No	Type of Machines	Unit	VND (1,000)	US$
I	**Crane**			
	Tire wheeled Crane 16 tons	Shift	1,453	132.09
	Tire wheeled Crane 25 tons	Shift	2,012	182.91
	Tire wheeled Crane 40 tons	Shift	2,925	265.91
	Chain-wheeled Crane 16 tons	Shift	1,327	120.64
	Chain-wheeled Crane 25 tons	Shift	1,889	171.73
	Chain-wheeled Crane 28 tons	Shift	1,973	179.36
	Chain-wheeled Crane 40 tons	Shift	2,704	245.82
II	**Truck**			
	Dump-car 10 tons	Shift	979	89.00
	Dump-car 12 tons	Shift	1,122	102.00
	Dump-car 15 tons	Shift	1,183	107.55
	Truck 10 tons	Shift	847	77.00
	Truck 12 tons	Shift	952	86.55
	Trainer 20 tons	Shift	189	17.18
	Chain-wheeled tractor 130 PS	Shift	892	81.09
	Tire-wheeled tractor 215 PS	Shift	1,376	125.09
III	**Soil works**			
	Bulldozer 140 PS	Shift	1,303	118.45
	Bulldozer 160 PS	Shift	1,463	133.00
	Tire-wheeled roller			
	Tire-wheeled roller 16 tons	Shift	638	58.00
	Tire-wheeled roller 17.5 tons	Shift	665	60.45
	Tire-wheeled roller 25tons	Shift	801	72.82

(continued)

No	Type of Machines	Unit	VND (1,000)	US$
	Excavator :			
	Excavator 0.65 m3	Shift	1,160	105.45
	Excavator 1.00 m3	Shift	1,544	140.36
	Excavator 1.20 m3	Shift	1,900	172.73
	Wheeled roller (Pavement works)			
	Wheeled roller 8.5 tons	Shift	417	37.91
	Wheeled roller10.0 tons	Shift	472	42.91
	Wheeled roller 12.2 tons	Shift	494	44.91
13	Mixing Station 60 m3/hour	Shift	1,702	154.73
14	Cement Pump 6m3/hour	Shift		
	Cement Pump 6m3/hour	Shift	168	15.27
	Cement Pump 6m3/hour	Shift	186	16.91
15	Concrete Mixer			
	Concrete Mixer 250 litres/hour	Shift	128	11.64
	Concrete Mixer 425 litres/hour	Shift	138	12.55
16	Generator 112 KW	Shift	1,043	94.82
17	Diesel compressor 5,5 m3/hour	Shift	51	4.64
18	Asphalt Concrete Sprayer 190 PS	Shift	1,495	135.91
19	Asphalt Concrete spray	Shift	677	61.55
20	Tire-wheeled crane 65 tons	Shift	3,929	357.18
21	Tire-wheeled crane 90 tons	Shift	5,040	458.18
22	Chain-wheeled crane 50 tons	Shift	2,902	263.82
23	Chain-wheeled crane 63 tons	Shift	3,844	349.45
24	Chain-wheeled crane 100 tons	Shift	4,864	442.18
25	Asphalt Concrete Mixing Station:			
	- Capacity 25 tons/hr	Shift	16,280	1,480.00
	- Capacity 80 tons/hr	Shift	26,523	2,411.18
	- Capacity 150 tons/hr	Shift	30,569	2,779.00

Note : One shift is equivalent to 8 working hours.

Table 14-2-2 FLOATING EQUIPMENT

No	Equipment	Unit	VND (1,000)	US$
1	Cutter suction (300PS) for river dredging	m3	47	4.30
2	Cutter suction for off-shore dredging	m3	61	5.50
3	Sea Multi-scurf dredger for channel	m3	62	5.60
4	Berth Bottom excavator (inside ports)	m3	105	9.50
5	Tug 150 PS	shift	1,845	167.70
6	Tug 360 PS	shift	3,211	291.90
7	Tug 600 PS	shift	4,048	368.00
8	Barge with Capacity :			
	100 tons	shift	380	34.50
	200 tons	shift	706	64.20
	250 tons	shift	825	75.00
	300 tons	shift	1,046	95.10
	4000 tons	shift	1,363	123.90
	800 tons	shift	2,435	221.40
9	Piling Barge with weight of hammer at 2.5 ton	shift	4,700	427.30
10	Floating crane 30 tons	shift	3,678	334.40
11	Floating crane 35 tons	shift	4,119	374.50
12	Floating crane 100 tons	shift	5,612	510.20
13	Floating Concrete mixed	shift	5,006	455.10
14	Floating excavator with1.2 - 1.5 m3 bucket	shift	4,027	366.10
15	Diving boat	shift	1,200	109.10

Note : One shift is equivalent to 8 working hours

14.3 Conditions of Construction

Based on the foregoing limitations and restrictions, the following factors have been assumed in assessing the amount of available working time for the estimation of the costs of construction. Working time will be lost because of important social events and public holidays, restrictions on noise, dust and hazards, and weather and sea limitations.

14.3.1 Workable Days of Major Work Activities

(1) Sundays and Public Holidays

For the purposes of estimating construction costs it has been assumed that the following days will not be worked ;

- Sundays 52 days per year
- Official Public Holidays 11 days per year

New Year	Jan. 1
Lunar New Year	Jan.23, 24, 25
The Foundation of Communist Party of Vietnam	Feb. 3
The Liberation of Saigon	Apr. 30
International Labor Day	May 1
Hochi Minh's Birth Day	May 19
Buddha's Birth Day	June 4
National Day of the S.R.V	Sept. 2
Christmas	Dec. 25

Lost time due to additional provincial holidays has not been allowed for.

(2) Working Hours

Eight hours per day : From 7:3o a.m to 12:00 a.m
From 1:oo p.m to 4:30 p.m

(3) Wet Weather

Generally only work on land will be affected by wet weather. Daily rainfall figures are recorded at Cai Lan. It is estimated that on average 15% of the working time is lost due to wet weather.

(4) Sea Conditions

All work offshore will be affected to some degree by the strength of the wind, the height of the waves and the speed of the currents. However Bai Chay Bay is sheltered and calm throughout the year.

(5) Tidal Conditions

Tide condition will not affect the effective working days. This condition shall be considered as working hours for concrete works onshore.

(6) Workable Days

For each of the major works activities, all of the aforementioned factors which directly affect the ability to work are summarized in Table 14-4-1.

Table 14-4-1 Workable Days of Major Work Activities

Typical Works	Total Days per Year (1)	Total Holidays (2)	Sub-total (3)=(1)-(2)	% not Working days due to wet weather (4)=(3) x 15%	Working Days (5)=(3)-(4)
1. Earth Works	365	63	302	45	260
2. Concrete Works	365	63	302	45	260
3. Other Works	365	63	302	0	302

14.3.2 Construction Materials

(1) Rock

One quarry site will be developed at YEN CU for exclusive use. All rock material will be transferred from the quarry site.

(2) Concrete Aggregate

The total volume of concrete aggregate required for the construction works is not large enough to justify the costs of setting up a crushing plant to produce concrete aggregate. There are a number of existing quarries near Cai Lan site which can produce concrete aggregate which will comply with the specification.

(3) Cement

Portland cement is produced in Vietnam, and is available from suppliers in Cai Lan and Hanoi. In general, the quality of the cement is reasonable. Cement of sufficient quality to comply with the specification is attainable in Vietnam. In the case requiring more than 400 Kg/cm strength concrete, imported cement shall be used in order to attain the specified quality.

(4) Reinforcing Steel

Plain round reinforcing steel bars that comply with the specification are available from suppliers in Hanoi and Hai Phong. Larger size deformed steel bar shall be imported from Singapore, Taiwan or Japan.

(5) Structural Steel

Structural steel sections for the construction of temporary works are available from suppliers in Hanoi, Hai Phong. Steel pile, steel sheet pile shall be imported from Singapore, Taiwan or Japan.

14.3.3 Construction Facilities

(1) Site Establishment

The contractors will be required to establish their own temporary site facilities, such as site offices, storehouses, workshops, construction yards, ablution facilities, stockpile areas, access roads and temporary jetties.

(2) Electric Power Supply

Electrical power from the public supplier is available at the construction sites. However, it is considered that the contractors will supply their own electric power generators which can be moved about the site, as required.

(3) Water Supply

The contractors will be required to provide their own water supply. This could be provided by way of ground water wells or transport to site by tankers.

(4) Sanitary Waste Disposal

The contractors will be required to provide their own sanitary waste disposal systems, to the approval of the relevant Local Authorities.

14.4 Implementation Program

During design stage another months are required intermittently for tendering of the contractor , evaluation and negotiation which culminates in the awards of the contracts. The construction works therefore will start from January 1997. For the Short Term Development Plan, a construction period or about four years construction period is allocated.

In accordance with the tentative implementation program, some preparation works shall be done on time in order to avoid any delay of the implementation of the project. The necessary actions are listed below.

- Loan Arrangement
- Selection of Consultant
- Land Acquisition
- Right of Ways for Site Access and Quarry Site, if required
- Tendering for Contractor

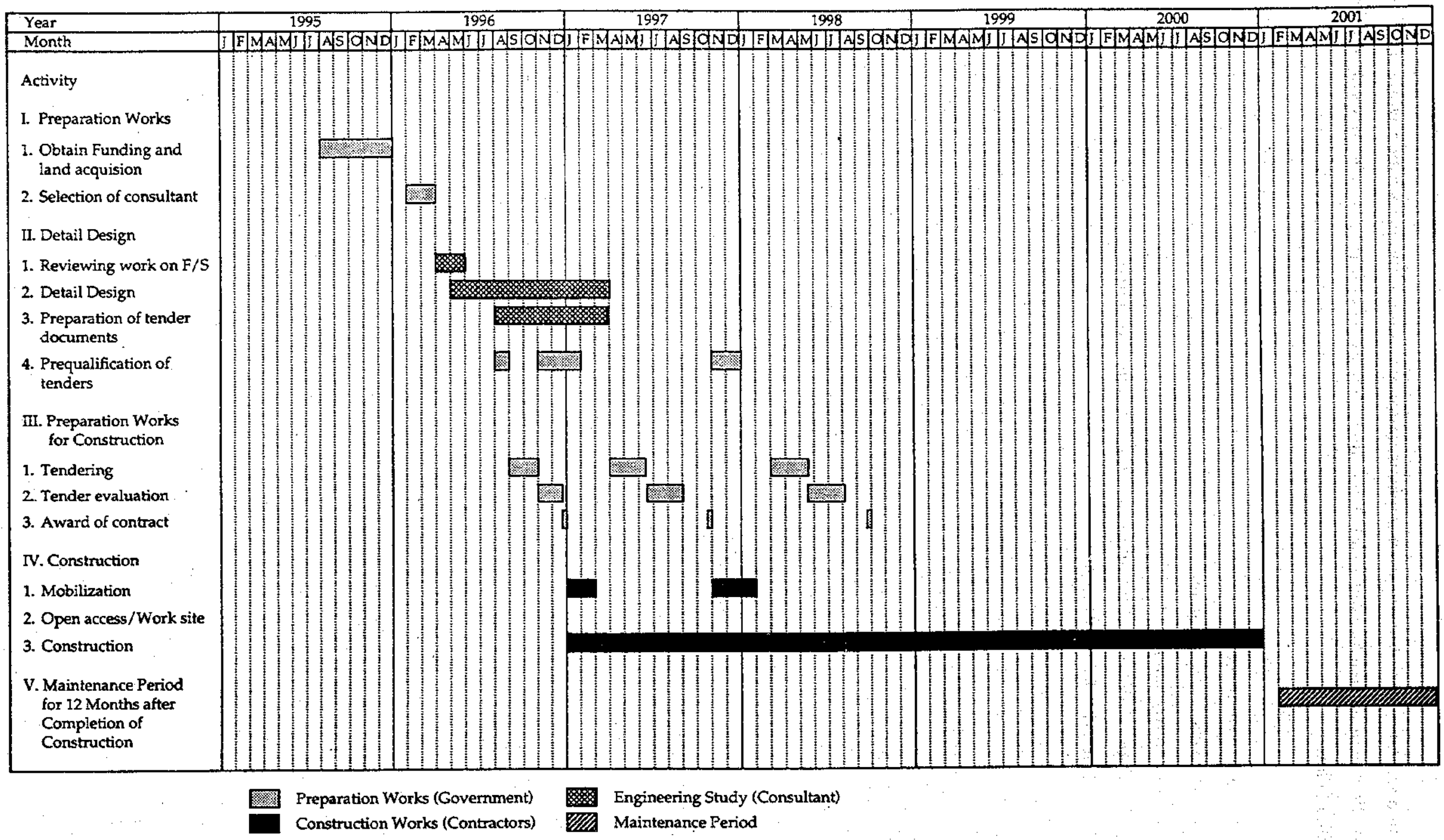


Figure 14-5-1 Tentative Implementation Program of CAI LAN PORT DEVELOPMENT

CHAPTER 15 ENVIRONMENTAL CONSIDERATIONS REGARDING LONG TERM PORT DEVELOPMENT AND OTHER DEVELOPMENTS IN HA LONG CITY

15.1 Introduction

In this chapter, the likely broad effects of the developments which will take place in Ha Long City are outlined and some possible means for managing the effects of these developments are presented.

By the year 2000 it is expected that 7 berths will be present at Cai Lan Port, and around 400,000 m^2 of yard space. Over the following 10 years an additional 14 berths will be constructed and another 800,000 m^2 of yard space. If a total of 21 berths are constructed they can be expected to extend almost 4 km from the existing berth at Cai Lan eastward across the southern shoreline of Bai Chay Bay.

The construction of Cai Lan Port can be seen as a spring-board for the economic advancement of Ha Long City and Quang Ninh Province. Alongside the long term planning for Cai Lan Port numerous other economic developments are under consideration. These were described in Chapter 10.

Locating the port in the semi-enclosed coastal waters of Bai Chay Bay raises concerns about the ability of the environment to absorb the kinds of effects that port developments can have on the environment. The environmental characteristics of Bai Chay Bay were presented in detail in section 7-2. In particular, Bai Chay Bay supports a large area of mangrove forest, mostly around its northern shoreline. If water quality in Bai Chay Bay were to be allowed to degrade as a result of the combined effects of port construction activities, discharge of wastewaters and runoff of pollutants from the port yards and storage areas and from the ships themselves, this could affect the health of the mangrove ecosystem. Loss of productivity of such ecosystems has broader effects than those felt locally. Mangroves serve an important function as primary producers, feeding the base of food webs that extend to the fisheries of the open ocean. The very important functions of the mangrove ecosystem have been described in detail in section 7-3.

Additionally, Ha Long Bay is a tourist destination of national importance. Visitors are attracted primarily by the spectacular island scenery offshore, but the relatively undeveloped nature of the local environment may also be important in the perception of the area as one of unspoilt natural beauty. Development of Cai Lan Port in this area could be seen as a threat to the tourist industry in Bai Chay.

Until recently, human activities around Bai Chay Bay have been of a relatively low-key, small scale nature. Industries around the foreshore include brick and tile manufacturing at Gieng Day and elsewhere, and the storage and shipping of coal at Hon Gai, Dao Sa To, and in the Dien Vong River. The Quang Ninh floating port and the B-12 oil port also add to the shipping activities in the Bay. However, probably the main use of the Bai Chay Bay shoreline has been as a resource for firewood and for the shellfish and other fauna of the mudflats (refer section 7-3).

Over time, the mangrove environment along the northern shore of Bai Chay Bay has been considerably modified by these activities. In the past the inhabitants have reclaimed land along the estuary borders by the construction of low earth dykes. More recently, a major dyke construction project has resulted in kilometres of concrete dykes being constructed in the area. This has mainly occurred in the period 1986 to 1993, according to aerial photographic records.

Although the construction of Cai Lan Port will take place in an area which has already seen considerable modification, there is no doubt that the scale and nature of the port development will have a considerable effect on the physical character of Bai Chay Bay.

Chapter 18 describes the environmental impact assessment which has been carried out to address the likely effects of short term development at Cai Lan Port (to 2000). The types of effects that will result from port development to 2000 can be applied generally to the developments planned over the ensuing 10 years, albeit at a considerably greater scale. Similar management objectives and methods to those described in the EIA will need to be adopted to control and minimise all of the likely and potential effects of the project.

15.2 Outline of Future Developments

Ha Long City is entering a period of rapid economic expansion. To recap on the developments expected by the year 2000, by 2010 and after 2010 (from Chapter 9 of the Feasibility Study), the following are likely to occur:

Stage 1 - by 2000

- Development of the industrial zone of Gieng Day (building material and ship building).
- Canal development next to EPZ in existing estuary.
- Construction of Cai Lan Port (Phase I).
- Completion of:
    - 1 cement factory and associated port facilities.
    - A wheat mill factory.

- A steel billet factory.
- A fertiliser factory.

- Up-grade of Route 18.
  - Railway extension.
  - Cam Pha Port expansion.
  - Tourism development (4 - 5 major hotels in Bai Chay).
  - Residential area development.

Stage 2 - 2000 to 2010

- Development of Cai Lan Export Processing Zone (CLEPZ), the industrial zone of Dong Dang and the high-tech industrial zone.
- Construction of Cai Lan Port (Phase II).
- Completion of:
  - 2 cement factories.
  - 1 electric power plant (thermal).
  - Further up-grade of Route 18.
  - Development of direct railway line to Hanoi.
  - Removal of B-12 Oil Port to Ha Long Bay or Cam Pha.
  - Water supply and environmental hygiene project.
  - Hon Gai Port redevelopment.

Stage 3 - after 2010

- Development of Cai Lan Port (Phase III - Giap khau area).
- Completion of new residential areas.
- Completion of tourism area development.
- Minh Thanh Airport completed.
- Coal ports (Sa To and Hon Gai Ports) moved to Cam Pha.
- Coal screening factory in Hon Gai moved to Cam Pha.

15.3 Potential Environmental Issues and Mitigation Approach

Clearly, during the development of each of the industries outlined above, there will need to be an environmental assessment phase and the development of environmental management methods for each factory or industrial development. Each of these proposals will need to be examined in the light of the overall plan for Ha Long City development. The broad environmental issues that are likely to arise as development proceeds are similar to those already discussed in relation to Cai Lan Port development.

In Chapter 9 of the Feasibility Study a plan is provided which will help minimise the effects of the overall development plans. This provides for the location of industries which are most likely to affect water quality and air quality, at a distance from Bai Chay Bay and from the residential areas. Also, some of the facilities which currently have an adverse effect on water quality in Cua Luc Strait, such as the Hon Gai and Ba Sa To coal ports and the B-12 Oil Port will be removed from Ha Long City in the long term.

Key issues that are likely to arise are briefly described below.

Effects on Local Residents

The scale of developments planned is large. The northern part of the Bai Chay Peninsula will effectively be semi-industrialised by 2000 and fully industrialised by 2010. Residents living in this area will face great changes in their lifestyles over this period. It is important to ensure that the living requirements of local inhabitants can continue to be met. This must be factored into detailed plans to 2000 and into further planning to 2010 and beyond.

The most important effects of the port development in the eyes of the local population are likely to be an increase in economic advantage and an improvement in the standard of living. Balanced against this will be changes in the living circumstances of those in the immediate vicinity of the port and a loss of the rural nature of the environment.

Construction of the port will require a large temporary construction work force. Many of these people area likely to come from outside the area. Once the port is operational, the number of people to be employed as port staff is likely to be in the order of thousands. All of these people will require housing. While in the early stages of port construction the increase in population may be absorbed locally, effects are likely to be felt in the Bai Chay and Gieng Day areas as well. Flow-on effects of this population increase can be expected in the creation of opportunities for employment in the construction sector, as well as in the provision of basic services such as food provisioning. At the same time, industries which are developing to take advantage of the new transport system will be adding to this population increase.

It can be expected that existing public services such as health and education will be under pressure from this population growth. It will be essential that planning for the extension of public services commences at an early stage to ensure that local residents are not disadvantaged by the increased demand. The increased pressure on local services of all kinds is likely to spawn developments of many other kinds. This could include provision of better transport, communication, entertainment and other facilities in the Bai Chay area. If these changes are well planned and managed, this may have an additional positive feed-back effect for tourism as the services available for visitors will also improve.

Effects on Local Population at Cai Lan

There will be direct effects on the local human environment in Cai Lan and along the shoreline where the port construction will take place. It is likely that the living environment in Cai Lan will change from that of a quiet rural settlement to that of a main highway. At present a narrow sealed road is present between Gieng Day and Cai Lan, and a winding metal road between Cai Lan and Bai Chay. Both of these routes will become major access roads for the port. The railway line, which currently stops at Ha Long Station in Gieng Day will be extended to Cai Lan by 2000 and may be extended further at a later date.

The effects of an increase in traffic are likely to be increases in noise, intermittent vibration, dust, exhaust gases and also an increased traffic hazard.

Few houses are present along the shoreline from the existing berth eastward. There are several houses in the small Cai Lan estuary area. If reclamation includes this estuary these houses may need to be relocated. Two pagodas are present near the existing berth and these will be in the path of the port development. It is not yet known whether these will remain or will need to be relocated. Further to the east a cemetery is present on the hillside above the coast. It is not yet clear whether this cemetery could be affected by port construction or operation.

It is possible that improvements to services such as sewage and water reticulation to local inhabitants may occur as port development proceeds.

Air Quality

At present the air quality in the area is good, and dust and exhaust gases are the only emissions of any note. Factories may in future emit other gases such as sulphur dioxide and nitrogen oxides and hydrogen sulphides. These will need to be controlled.

Bai Chay Bay Water Quality

Water use and water discharge are likely to increase rapidly as the developments proceed. Initial estimations of water discharge for the projects listed in Chapter 10 indicate a total hourly discharge from the three cement plants, steel billet and steel plate factories, aluminium smelter, wheat mill, fertiliser plant and power plant of around 6,514 m^3 per hour (or 1.8 m^3 per second). The location of the discharges, especially of the larger discharges such as the steel plate factory and aluminium smelter will need to be carefully managed. Sediment deposition patterns could be affected which could affect the mangrove ecosystem. The effects of reducing the flow rate or volume of the water source will need to be carefully assessed.

A canal may be developed near the western end of Cai Lan Port. Depending on the design of the channel and its intended use (connection to Ha Long Bay or simply as a localised transport option) the channel could affect sediment dynamics in Bai Chay Bay. Careful study of this will be required, also, investigation of the potential effects channel development could have on existing aquaculture in the estuary.

The quality of water entering Bai Chay Bay will need to be carefully controlled and monitored (refer Chapters 7 and 8 of the EIA). Effluent criteria will need to be developed that will allow for the protection of this semi-enclosed environment. The aim will be to preserve the quality of Bai Chay Bay waters in a state that will allow for their continued use for aquaculture, fishing and human contact recreation.

Area-wide solid waste and sewage treatment and disposal methods will be needed to protect water quality and the health environment. Hazardous waste storage and disposal methods will also need to be developed.

Plans for disaster or emergency such as the oil spill contingency plans outlined in Chapter 8 will also need to be prepared. This may include planning for the eventuality of storm surges and seismic events.

Loss of Mangrove Ecosystem

Further reclamation of the shoreline for development of future port facilities and other activities is likely to occur. The plan for Ha Long city provides for many activities to occur along or near to the northern shoreline of Bai Chay Bay. This is likely to include aquaculture as well as reclamation for development of agriculture. Plans for Stage 3 of the port development will focus on the Giap Khau area and there will be further loss of mangroves. It will be important to ensure that large enough areas of mangrove are retained to maintain the functioning of the Bai Chay Bay ecosystem as a fishery resource. Plans need to include areas where the mangroves are reserved for economic uses of the local inhabitants, and areas where no use is allowed. Some replanting and rehabilitation may be required, or mitigation measures such as development of mangrove plantations in areas outside of Bai Chay Bay. Bird sanctuaries and reserves will add to the ecological and tourism values of the area.

Effects on the Terrestrial Environment

Among the direct effects on the physical environment will include removal of the terrestrial vegetation along the areas to be cleared and filled during yard construction or used as a borrow source for reclamation. In general, the vegetation in the area of the port is low scrub or grassland. The original forest cover has long since been removed and the vegetation has been modified. The terrestrial vegetation is not of high ecological value.

Potential Effects of Dredging

During the construction of the port dredging of the channel approach, berth and turning areas will be required. Hundreds of thousands of tons of sediments will need to be removed from the sea bed. Some of this material may be used in reclamation during the port construction project. However, it may be necessary to dispose of the dredged material elsewhere. The details of the dredging programme and the potential locations for any disposal necessary are not yet known. Sediments are currently disposed of to sites in Ha Long Bay. A detailed assessment of the effects of such disposal will need to be carried out.

In addition, changes to the bathymetry which will result from the dredging programme may affect the currents within Bai Chay Bay. If the currents change sufficiently to affect sediment movement patterns and/or sediment deposition dynamics within Bai Chay Bay this could have an effect on the mangrove ecosystem. This matter will also require detailed assessment.

Loss of the Rural Nature of the Environment

The importance likely to be placed on economic development may overshadow the need to maintain a livable, pleasant human environment. While economic progress is clearly a key concern, the quality of life values described in Chapter 4 should not be neglected. Provision of parks and reserves or wild landscape areas should be a part of planning for the future of Ha Long City. This has particular relevance to the local tourist industry development. Although the focus of the development will be on the attractions of Ha Long Bay, as services improve and the length of time tourists stay increases, they will look further afield than the Ha Long beach front. It will be important to maintain an attractive environment in Ha Long City generally, and especially in Bai Chay Bay.

Effects on Shipping

The increase in shipping to Bai Chay Bay is likely to increase the probability of accidents in Cua Luc Strait. At present traffic passing through the strait is limited to coal barges and lighters going to the coal port at Dao Sa To, and to ships going to the B-12 oil port. Ferry crossings number around 236 per day. This will require careful management.

Effects on Landscape

Visual effects of the port development will include a change from a rural natural perspective to that of an industrialised coastline. In terms of the effects on local inhabitants this may be far out-weighed by the economic advantages that the port development will have. However, it will be important to ensure that landscape issues are addressed during the design phase. One key reason for this is the potential effect on visitors or tourists. As the access around Bai Chay peninsula improves, visitors may increasingly travel around the southern road and will inevitably be confronted by a view of Cai Lan Port. The backdrop to the port area will be the expanse of Bai Chay Bay and the hills behind. It will be important to incorporate a landscaping element into the port layout to soften and mote the industrial mature of the scene.

Access to Coastal Resources

Along with a change to the rural nature of the Cai Lan environment and the Bai Chay Bay shoreline will be a loss of access to the shoreline and the resources it offers. Although the mangrove areas along this section of shoreline are small compared to those along the northern shoreline, there is some use of these resources for firewood and shellfish. If those who utilise these resources are not among those who receive employment or some indirect form of economic gain from the port development, their resources may suffer a net decrease. Again, the loss of access to the coast along this section of shoreline may be considered less important by the majority of local inhabitants who anticipate economic advantages from the development.

Effects on Tourism

Effects on tourism could include the landscape changes already outlined and the benefits of an improvement in services. The tourists' overall perception of the nature of Bai Chay and Ha Long Bay may change somewhat as the intensity of port activities increases. It will be important to try to preserve the picturesque nature of Bai Chay and the ferry area which currently adds considerable local flavour and colour to the environment. This has been successfully achieved elsewhere in the world, where large scale port and waterfront activities take place alongside a tourist industry.

One aspect of this is that at present a certain proportion of the tourists are attracted by the less developed nature of the environment. As economic development proceeds in Ha Long City the "village" nature of Bai Chay will be lost. To balance this, planning of the tourist areas must ensure that the key features of this "village" environment are built upon rather than removed.

Another key factor which could affect tourism is an increase in pollution of the coastal waters. Water-based activities such as boat excursions, swimming, fishing and diving are expected to be important future tourist activities. If the unspoilt nature of the marine environment is affected by port development this could be detrimental effect on the tourist industry. The potential effects on water quality are set out in the next section.

15.4 Management Methods

15.4.1 Port Management

In order that the port construction project can proceed without adversely affecting the environment, a comprehensive management system will be required. It is envisaged that once all actual and potential effects of the long term port construction project have been identified, management plans will be developed to deal with each. The development of management plans should occur during the stage of detailed port planning in conjunction with an environmental specialist(s) to ensure that the appropriate measures ares written into the design plans. Examples of such plans would include:

- Noise Management Plan
- Dust Management Plan
- Traffic Management Plan
- Landscape Enhancement Plan
- Sediment Management Plan
- Earthworks Management Plan
- Stormwater Management Plan
- Waste Management Plan

- Oil Spill Contingency Plan

Each plan would need to include:

- Methods by which operations are to be carried out to minimise any effects.
- Methods by which any remaining effects can be mitigated.
- Detailed monitoring programmes setting out the parameters to be monitored, the standards required, the method of data collection and the requirements for reporting, both internally, within the Port Authority, and externally, to the appropriate environmental agency.

An important point as regards the control of environmental effects is the need for an overall management system. This requires a commitment to environmental excellence from all levels of staff, from upper management down to operational staff. Environmental education of all employees is essential to the success of such a management system. By ensuring that all employees are aware of the importance of environmental management and the means by which they can contribute to a cleaner workplace, a much better result will be obtained.

15.4.2 Ha Long City Management

The key aim of planning for the development of Ha Long City is to ensure that tourism, port development, commercial / industrial and residential development can all co-exist in a manner that maximises the benefits to each sector. Ha Long City could be said to comprise two distinctive elements:

- The "inner marine" area comprising an extensive mangrove forest environment, within which the port and industrial / commercial areas with associated residential areas are proposed.

- The "outer coastal" area, comprising Ha Long Bay and the coastal islands, which constitute a tourist resource of national significance.

With careful forward planning and appropriate institutional arrangements, it should be possible to enable significant port and commercial development to occur, whilst at the same time ensuring that the tourism values can be protected and a successful tourist industry established. Key tasks which would need to be carried out to achieve the appropriate level of forward planning would be:

- Confirmation of the long term planning strategy for the area, including the zoning plan.

- Development of Environmental Standards and Management Plans specific to the Ha Long Bay and Bai Chay Bay areas.

- Establishment of an effective and practical Institutional Framework for implementing the standards and plans.

Provisional Environmental Guidelines have already been promulgated on a national basis. These would need to be tailored to the precise requirements of the Bai Chay Bay and Ha Long Bay environments, in the light of the industrial developments planned and the uses required of these waters. The Environmental Performance Standards required would need to cover:

- Atmospheric emissions.
- Noise.
- Water use.
- Effluent discharge criteria.
- Receiving water criteria.

- Waste management.
- Contingency planning.

To ensure that the Standards are properly observed, the Institutional Framework would need the following:

- An overall organisational structure for monitoring development, and to ensure compliance with the plans and standards.

- A practical system to control development, i.e., procedures for permits and for such things as air and water discharges, water use etc.

To ensure that Ha Long City's environment is kept free of pollution in the future, it is recommended that the city begin developing an Environmental Conservation Plan. This will allow all of the management methods and environmental studies to be integrated under one overall system.

15.5 Summary

Ha Long City has only recently been gazetted, and is now embarking on some important industrial developments for the economic advantage of the region. However, another of Ha Long City's primary objectives is to ensure that its already flourishing tourist industry can continue to successfully expand. Because Ha Long City is in its infancy, now is an important time in its development. Decisions made now as to the future directions the City will take, will influence its development for years to come. It is therefore crucial that careful attention be paid to environmental planning at this outset of development, to ensure that industries that establish do so in a way that does not undermine the sustainability of the environment and its many uses for future generations. An Environmental Conservation Plan, as recommended above, would provide the means for integrating environmental management into the city's future in a practical way.