No. 52

THE STUDY ON THE DEVELOPMENT OF RAJANG PORT IN MALAYSIA

VOLUME III SHORT-TERM PLAN

FEBRUARY 1992

JAPAN INTERNATIONAL COOPERATION AGENCY

SSF
CR(3)
92-006

Final Report

THE STUDY
ON
THE DEVELOPMENT
OF
RAJANG PORT

IN
MALAYSIA

VOLUME III
SHORT-TERM PLAN

FEBRUARY, 1992

J I C A

Japan International Cooperation Agency

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1.1 Demand Forecast for Short-term Plan

1.1.1 International trade

(1) Cargo volume

Cargo handling volume at each wharf and anchorage of Rajang Port in 1997 is forecast as shown in **Table-1.1.1.1** (ref.II.4.3.2 and **II.5.1.1**(1)).

Table-1.1.1.1 Cargo Handling Volume Forecast
Sibu, Sarikei, Bintangor,
Sungei Merah and Tg. Manis Area
(1997, 1000 F/T)

Commodity	Sibu	Sarikei	Bintang	S.Merah	Tg. Manis		Tg.Manis Anchorage	Total
					Timber T.	Coal T.		
EXPORT								
Timber Log	0	0	0	0	0	0	2917	2917
Timber Prod.	0	0	0	0	868	0	408	1275
Plywood/etc.	0	0	0	0	334	0	122	456
Sawn Timber	0	0	0	0	466	0	285	751
Wood Chips	0	0	0	0	68	0	0	68
Coal	0	0	0	0	0	250	0	250
Palm Oil	0	26	0	0	0	0	0	26
Agr. Prod.	29	40	2	0	6	0	0	77
Petroleum Prod.	0	0	0	187	0	0	0	187
Others	23	4	0	0	0	11	0	38
Container(t)	28	22	1	0	210	0	0	261
Container(TEU)								
Laden	2300	1800	100	0	10600	0	0	14800
Empty	0	0	0	0	0	0	0	0
Pallet(t)	8	9	0	0	1	0	0	18
(total)	88	101	3	187	1085	261	3325	5049
IMPORT								
Motor Veh.	38	0	0	0	8	0	0	46
Food	72	5	0	0	2	0	0	79
Feed/Fertilizer	54	20	15	0	0	0	0	89
Petroleum Prod.	19	4	0	349	4	8	0	384
Others	249	8	3	0	6	8	0	274
Container(t)	134	4	1	0	5	0	0	144
Container(TEU)								
Laden	11200	300	100	0	400	0	0	12000
Empty	0	0	0	0	2800	0	0	2800
Pallet(t)	57	5	2	0	1	0	0	65
(total)	623	46	21	349	26	16	0	1081
T O T A L	711	147	24	536	1111	277	3325	6130
Riverine								
Timber P.(in)	0	0	0	0	409	0	0	409
Coal(in)	0	0	0	0	0	500	0	500
Container(t)	0	0	0	0	0	0	0	0
Container(TEU)								
Laden	0	0	0	0	0	0	0	0
Empty(out)	8900	0	0	0	0	0	0	8900
Empty(in)	0	1500	0	0	7400	0	0	8900

(2) Ship calls

Number of ship call at each wharf and anchorage of Rajang Port in 1997 is forecast as shown in **Table-1.1.1.2** (GRT) and **Table-1.1.1.3** (DWT) (ref.II.5.1.1(2)).

Table-1.1.1.2 GRT Distribution of Ships for International Trade (1997)

	Sibu	Sarikei	Bintang.	S.Merah	T.Manis (timber)	T.Manis (coal)	T.Manis Anchorage
Below 1000	218	223	65	-	6	15	35
1000 - 1999	129	145	39	-	3	12	17
2000 - 2999	152			-	18		112
3000 - 3999	144			-	45		289
4000 - 4999	14			-	40		253
5000 - 5999	38			-	15		92
6000 - 6999	16			-	7	1	46
7000 - 7999				-	1	3	2
8000 - 8999				-	1	3	6
9000 - 9999				-	3	2	17
10000 - 14999				-	4	8	22
15000 - 19999				-	4		22
Over 20000				-	1		6
T O T A L	711	368	104	534	148	44	919

Table-1.1.1.3 DWT Distribution of Ships for International Trade (1997)

	Sibu	Sarikei	Bintang.	S.Merah	T.Manis (timber)	T.Manis (coal)	T.Manis Anchorage
Below 1000	140	144	42	374			23
1000 - 1999	118	124	35	40		27	18
2000 - 2999	104	100	27	120			12
3000 - 3999	125				13		79
4000 - 4999	123				24		153
5000 - 5999	101				31		200
6000 - 6999					25		166
7000 - 7999					17		94
8000 - 8999					11		55
9000 - 9999					6		28
10000 - 14999					9	8	35
15000 - 19999					4	9	17
Over 20000					8		39
T O T A L	711	368	104	534	148	44	919

1.1.2 Coastal and riverine cargo

At Sibu, general cargo transported between Sibu and Kuching and rice shipped out of Sibu are handled at private wharves. This situation is expected to continue. Then, future cargo volume handled at Sibu, Sarikei, Tg. Sebubal and Bintangor is as follows (ref.II.4.3.3):

Table-1.1.2.1 Coastal and Riverine Transportation Forecast at Sibu, Sarikei, Bintangor and Tg. Sebubal (Government Wharves, unit: ton)

Coastal Transportation (1997)

	General Cargo		Rice		Cement	TOTAL
	OUT	IN	OUT	IN	IN	
Sibu	27900	14200	0	0	94200	188400
Sarikei	5600	10500	0	8400	0	24500
Tg. Sebubal	0	3100	0	2400	0	5500
Bintangor	400	6000	0	3500	0	9900

Riverine Transportation (1997)

	General Cargo		Rice		Cement	TOTAL
	OUT	IN	OUT	IN	IN	
Sibu	28400	6000	0	0	0	34400

Table-1.1.2.2 Coastal and Riverine Transportation Forecast at Sibu, Sarikei, Bintangor and Tg. Sebubal (Private Wharves, unit: ton)

Coastal Transportation (1997)

	General Cargo		Rice		Cement	TOTAL
	OUT	IN	OUT	IN	IN	
Sibu	9200	28600	14300	0	0	52100

1.1.3 Passenger

Future passenger volume at Sibu, Sarikei, Bintangor and Tg. Sebubal is as follows (ref.II.4.4.2):

Table-1.1.3.1 Passenger Volume Forecast at Sibu, Sarikei, Bintangor and Tg. Sebubal (1997, 2 ways)

WHARF	---- Riverine ---- Service			Coastal Service
	U-st.	D-st.	Other	
Sibu	1849	327	1674	0
Sarikei	0	0	1675	407
Bintangor	0	0	565	0
Tg. Sebubal	0	0	70	0

U-st.: upstream, D-st.: downstream

And the required frequency of boat service at each wharf is expected as follows:

Table-1.1.3.2 Passenger Boat Frequency Forecast at Sibu, Sarikei, Bintangor and Tg. Sebubal (1997, 2 ways)

WHARF	---- Riverine ---- Service			Coastal Service
	U-st.	D-st.	Other	
Sibu	42	5.5	23	0
Sarikei	0	0	24	2
Bintangor	0	0	23	0
Tg. Sebubal	0	0	1	0

U-st.: upstream, D-st.: downstream

1.2 Required Facilities

1.2.1 Mooring facility

(1) International trade

As stated in **II.5.2**, facilities to be developed in the short-term plan scheme are as follows:

Table-1.2.1.1 Short-term Plan for Mooring Facilities

Wharf	Facility
Sungei Merah	jetty (1 unit, -5.0m)
Tg.Manis Timber Products Terminal	berths (-10m, 300m) berths(-5m, 180m)
Tg.Manis Coal Terminal	berth (-10m, 165m) berths (-5m, 150m)

(2) Coastal and riverine cargo transportation

General cargo transported between Sibu and Kuching and rice shipped out of Sibu are handled at the private wharves of Sibu, and this situation is expected to continue. Therefore, the required berth number is calculated based on the cargo at government wharves (ref.**II.5.3**).

Table-1.2.1.2 Required Number of Berths for Coastal and Riverine Transport (1997)

WHARF	Annual Service Days	Annual Berth Open Days	Required Berth Nos	Berth Occupancy
Sibu	904	350	6	0.43
Sarikei	140	350	1	0.4
Bintangor	57	350	1	0.16
Tg. Sebubal	31	350	1	0.09

Consequently, we can get the required number of berths as follows:

Table-1.2.1.3 Required Berths for Coastal and Riverine Transportation at Sibu, Sarikei, Bintangor and Tg. Sebubal (1997)

WHARF	Present		Required		To be Constructed	
	L	N	L	N	L	N
Sibu	135.5	4	180	6	60	2
Sarikei	26	1	30	1	0	
Bintangor	45.6	1	30	1	0	
Tg. Sebubal	0		30	1	30	1

·L: length(m), N: number

(3) Passenger service

i) Existing facilities

Table-5.4.2.1 shows the existing facilities for passenger boats.

Table-1.2.1.4 Existing Passenger Boat Wharf

WHARF	LENGTH	STRUCTURE
Sibu	140m	Pontoon
Sarikei	50m	Pontoon
Bintangor	20m	Pontoon

ii) Required berth length

We calculated the required berth length based on the future frequency shown in **Table-1.1.3.2**

a. Sibu

The total departures and arrivals of coastal and riverine passenger boats a day is expected to be 70.5 round trips in 1997, and will increase by 6 round trips from 1990.

The main reason why the passenger boat wharves are congested is that idling boats are mooring at the wharves. Therefore, we recommend preparing idling wharves and separating embarkation/disembarkation wharves.

At present, the maximum number of boats alongside a wharf is three, even if they moor up to an hour before their actual sailing time. Disembarking the passengers does not take more than 15 minutes per ship, and it takes about the same time to discharge the small amount of cargo they may carry from time to time.

So, we assume that 6 boats embark or disembark simultaneously at one wharf and that the number of boats which moor at the wharf simultaneously is the same as half of the daily round trips.

Therefore, 6 embarkation/disembarkation berths at the each existing wharf and, 12 idling berths at the each existing wharf will be required in 1997.

b. Sarikei

The total departures and arrivals of riverine passenger boats a day is expected to be 24 round trips in 1997 and will increase by 5 round trips from 1990.

One berth for coastal passenger service between Kuching and Sarikei, and a couple of berths for riverine service between Sarikei-Sibu and Sarikei-Tg. Sebubal will be required.

Presently, Sarikei has a 50m-long pontoon, and the pontoon will be enough for the demand up to 1997.

c. Bintangor

The total departures and arrivals of riverine passenger boats a day is expected to be 23 round trips in 1997 and will increase by 4 round trips from 1990.

A couple of berths for riverine service between Sarikei-Bintangor-Sibu will be required.

Presently, Bintangor has a 20m-long pontoon, and the pontoon will be enough for the demand up to 1997.

d. Tg. Sebubal

Passenger boat service will be operated to/from Sarikei. Therefore, one berth is required.

1.2.2 Cargo storage/sorting facility

As stated in **II.5.2,** facilities to be developed in the short-term plan scheme are as follows:

Table-1.2.2.1 Short-term Plan for Storage/Sorting Facilities (1997)

Wharf	Facility
Tg. Manis Timber products Terminal	Transit Shed/CFS (12,800m^2+19,200m^2(surrounding)) Open Storage Area /Container Yard (31,600m^2)
Tg. Manis Coal Terminal	Coal Yard (25,000m^2)

1.2.3 Cargo handling equipment

The required cargo handling equipment is shown in **Table-1.2.3.1** (ref.II.5.2.3).

Table-1.2.3.1 Short-term Plan for Cargo Handling Equipment (1997)

Equipment (Capacity)	No	Remarks
Tractor Head + Chassis (20/40t)	5	Containers
Forklift (25/42t)	4	Containers
Forklift (3t)	6	General Use
Dump Truck (10t)	4	Coal Terminal
Shovel Loader (3m^3)	2	Coal Terminal
Shovel Loader (1m^3)	2	Coal Terminal
Shiploader (250t/h)	1	Coal Terminal

1.2.4 Ancillary facility

Table-1.2.4.1 shows ancillary facilities to be developed for the terminal in the short-term plan scheme.

Table-1.2.4.1 Short-term Plan for Ancillary Facility (1997)

Tg. Manis Timber Products Terminal	Administration Building Maintenance Shop Van Washing Facility Road and Others
Tg. Manis Coal Terminal	Water Processing Facility Road and Others

(1) Administration building

The floor area was obtained assuming that 50 persons would work in the building as follows:

$20\ m^2/\text{person} \times 50\ \text{persons} = 1{,}000\ m^2$

And parking lots and other exterior space will be needed, so 4,000 m^2 will be needed in total for the administration building.

(2) Maintenance shop

i) Container van

Required space for container van maintenance can be calculated by following formula.

$$A = (a20 \times C20 + a40 \times C40) \times (1 + r) \quad (1.2.4.1)$$

where,

A: required space (m^2)

a20 = 14.9 : space for 20-foot container (m^2)

a40 = 29.8 : space for 40-foot container (m^2)

C20: no. of 20-foot container

C40: no. of 40-foot container

r = 1.9 : ratio for forklift operation space

According to the record on break down and repair in Japan, 10 percent of containers handled at a terminal need repair, about 3 containers can be repaired per day and additional space is required for repair of containers damaged badly. So, the no. of container to be repaired can be obtained as follows:

$$C = CO \times 0.1 / 3 / Dy + 1 \qquad (1.2.4.2)$$

Where,

C: no. of containers to be repaired

CO: no. of containers handled in the terminal

Dy: annual working days

In 1997,

CO = 21200

Dy = 350

then,

$$C = 21200 \times 0.1 / 3 / 350 + 1 = 3$$

if assumed that C40 = 1, then, C20 = 2 and consequently,

$$A = (14.9 \times 2 + 29.8 \times 1) \times (1 + 1.9) = 173 \ (\fallingdotseq 200m^2)$$

ii) Cargo handling equipment

$500m^2$ is required for repair of cargo handling equipment.

iii) Conclusion

Therefore, the total shop area will be about $700m^2$. In addition, pass, container handling space, parking space for equipment to be repaired, etc. will be also required. So, 1,600 m^2 will be required in total.

(3) Van washing facility

Based on the examples in Japan, a washing facility for a container van needs $400m^2$ and more $500m^2$ is required for pass, van pool, etc.

(4) Road and others

About 30% of the total area is normally used for road and others.

(5) Water processing facility

About $40m^2$ per coal stock of 1000 tons is required for water processing facility at a coal yard according to examples in Japan. Since the stock capacity in 1997 will be 125,000 tons, $5,000m^2$ is needed. In addition, area of $2,000m^2$ for road, administration house, etc. will be needed.

(6) Conclusion

Table-1.2.4.2 shows short-term plan for ancillary facilities.

Table-1.2.4.2 Short-term Plan for Ancillary Facility (m^2)
(1997)

	Floor Area	Others	Total
Timber Products Terminal			
Administration Building	1,000	3,000	4,000
Maintenance Shop	700	900	1,600
Van Washing Facility	400	500	900
Road and Others	-	29,900	29,900
Coal Terminal			
Water Processing Facility	-	-	5,000
Road and Others	-	-	2,000
T O T A L	2,100	34,300	36,400

1.2.5 Navigation aids

(1) Navigation marks

1) Racons (Transponders)

Although radar primarily is used avoid collisions and for short range coastal navigation, it is also often used for making landfall. In places where the landfall is flat and featureless, Racon can be usefull for locating a particular point. Racon may be considered similar to radio beacons, but the information appears on a vessel's radar screen, simplifying their location relative to the vessel's position.

Thus, at least one Racon annexed to one major lighthouse of the estuary i.e. Tg.Jerijeh of the Rajang estuary should be highly effective.

2) Replacement with the new Lighted buoys

Throughout the Rajang port area, the waterways are fairly narrow and shallow, relative to large seagoing vessels, and mariners need a more accurate position and a greater monitoring of vessel behaviour. Navigable waterways must be indicated by lighted navigation marks fitted with efficient radar reflectors and placed sufficiently close together.

Among the 51 lighted buoys, which necessitate in the whole port waterways (shown in **Appendix Figure-II.5.2**), the eight lighted buoys (five lateral marks, two isolated danger marks and one safe water mark) are particularly important for vessels trading from/to Tg.Manis new port area, and should be replaced with the new lighted buoys conforming to the IALA buoyage system.

3) Remodeling of leading marks/heading marks

The existing three leading marks and two heading marks in Tg.Manis area should be remodeled with higher towers, stable solid foundations and solar electrification. The trees surrounding the marks should be cut down.

4) Maintenance and reliability

i). The energy source for the mark itself should be reliable to ensure continuity of service in a very hostile environment. Thus, the back-up system of energy source and solar electrification for remaining lighted marks should be executed.

ii). A prerequisite for a reliable and trouble free operation is regular preventive maintenance. Nevertheless, when an incident does occur, maintenance personnel must be available to restore normal conditions with the least possible delay; careful thought must be given to the means by which such personnel may be rapidly transported to the site of the incident.

iii). An incident procedure is also important, whereby the Marine Department and the mariner or pilot are quickly informed on any accident to a navigation mark. In the case of an interruption to service due to routine maintenance this can be accomplished in advance by means of Notices to Mariners. When the interruptions are due to an accident or equipment failure, the mariner or pilot should be informed by radio.

iv). Periodical confirmation, relocation and dissemination of the existing buoys position. The Kl.Rajang inner buoy at the south end of the Bohari Bank of the Rajang estuary, a very important signal for vessels approaching or leaving the Rajang port, is apparently shifting with the movement of the Bank. The shift of the Buoy from its original position on the chart datum might result in false information for passing vessels, thereby increasing the chance of a potential sea casualty. A countermeasure against the shifting of a buoy might be to replace the buoy with a beacon, which the hard stratum could support.

* The two shallows of the Bohari Bank and the Wong Sand have been changing their shape and depth owing to the characteristic natural activities of the estuary. Accordingly, the placement of a port hand lighted beacon with a solid foundation at the present south end of the Bohari Bank, which would necessitate fixing the port hand boundary of the entrance waterway, is not advisable under the circumstances.
* Should a vessel collide with a fixed beacon by mishandling, serious damage would occur to both the vessel and the beacon.
* The construction of a lighted beacon on an off shore site is very troublesome work involving heavy expenditures. Also, at this point in time it would not be advisable to fix the actual position of the beacon because the increase in the number of calling vessels cannot yet be determined.

Having taken the circumstances into consideration, we recommend the following practical countermeasures:

* The placement of a port hand lighted buoy, which conforms to the IALA Bouyage System, at the present south end of the Bohari Bank.

* Correcting the chart datum on the position of the new buoy.
* Implementing periodical sounding in and out of the waterway to confirm the buoy position, and relocating the buoy whenever it is necessary.
* Disseminating the exact buoy's position as soon as it becomes available.

(2) Other safety back-up facilities

1) Allocation of Tug boats

With regard to the manoeuvravility of a large seagoing vessel in the turning basin of an internal port, the main engine and the rudder are incapacitated. A tug boat to assist the vessel, in the final phase of the manoeuvre, is indispensable as the lateral and turning force source. Thus, the Rajang Port Authority will need to have on-hand a capable tug boat fleet to maintain safe ant efficient use of the wharves by the time the facilities are completed.

As stated in **VOLUME II,5.2.2**(1) Tug boats, we recommend allocating one 2,000ps Z-type tug and one 1,000ps Z-type tug at the Tg.Manis new port site.

2) Placement of weather/tidal observation facilities

Direction and force of the wind, current measurement and state of the tide should be observed at suitable sites; we therefore recommend that:

- an anemometer, anemoscope and barometer should be placed at Tg.Manis and Rajang estuary,
- a tidal gauge should be placed at Tg.Manis and the Rajang estuary.

A recommendable data transmission system between the unmanned observatories and the key station might be the Meteor Burst system. And, the data transmitted to the traffic control authority should be disseminated at a vessel's request.

(3) Exclusion of obstacles

Drifting logs and other floating obstacles should be routinely cleaned, for example, by multipurpose tug boats.

(4) Readjustment of traffic control system

1) Partial revision of traffic regulations

Although a study for updating regulations is now underway among authorities, we recommend that the revisions should set new standards in the following points:

- definition of vessels --i.e. "large vessels", "waterway vessels", "miscellaneous vessels" and "raft",
- definition of "waterway", "anchorage" and "port limit",
- definition of a large vessel's obligation to the authorities of prior notification of entry and departure, with reference to information on ship's name, size, cargoes, ETA, etc.
- designation of the waterway/anchorage/wharf for the large vessels,
- restriction on entering/leaving/proceeding in the port at night, except under specified conditions,
- priority of large vessels to proceed in the waterway,
- restriction on anchoring within the waterways in porinciple,
- restriction on overtaking/parallel proceeding within specified waterways,
- traffic separation scheme in the waterways off Tg. Binjei,
- priority of departing vessels in possible meetings at the fairways of the estuaries,
- designation of the preferred/secondary waterways at critical junctions i.e. Tg.Leba-an, Tg.Payang, Tg.Singat, near the Pulau Selalo, and Tg.Engkilo,
- restriction on the maximum proceeding speed in specified sections of the waterways,
- restriction on the length/width and the operation of rafts,
- preservation of the environment of the waterways.

2) Introduction of a compulsory pilot system

i). Necessity of a compulsory pilot system

In addition to the placement of a sufficient number of navigation marks, a compulsory pilot system would contribute to securing a safe and sound growth of the Rajang port traffic.

The compulsory pilot system requires that certain vessels, navigating in areas with a high traffic density, in channels, in circum-stances where visibility is reduced, or in difficult meteorological or hydrological conditions, entrust manoeuvring of the vessel to a licenced pilot. This system has been widely accepted in main ports and difficult waterways around the world as an effective way of ensuring the safe and smooth flow of vessel traffic.

In the case of the Rajang port waterways:

* As stated in **II.6.1 Present Situation of the Waterway within Rajang Port,** the waterways have inherent characteristics of a complex and problematic nature, making the Rajang port a difficult area to navigate for seagoing vessels calling at Rajang for the first time.
* With the development of the Port and the Delta area, either the size or number of calling vessels will show a tendency to grow larger.
* To prevent the foreseeable sea casualties likely to occur to vessels unfamiliar with local conditions, compulsory piloting should be abopted instead of optional piloting.
* To keep the whole port area safe against the environmental pollution caused by a wrecked vessel.
* To keep a smooth and effective flow of vessel traffic.
* To ensure that mutual communication/understanding is maintained between a vessel, a tug boat and line handling men.

As well, the Rajang port has sufficent meanings to implement the compulsory pilot system.

ii). The necessity of double pilots manning a single vessel between Sibu and Kl.Paloh

Vessels usually take seven to eight hours to navigate the 73 mile stretch from Sibu to Kl.Paloh; frequently they must wait four to five hours for a favourable tide. In addition, a pilot spends at least three hours going and returning to/from a vessel, thus the working hours of a pilot at on the Paloh waterway reach 10 to 15 hours in one shift.

The present practice of demmanding each pilot to work more than eight hours in one shift should be improved; implementing a pilot shift system at the half leg of the waterway would be a good solution. However, a pilot station for relief is currently no available and therefore a double pilot method should be adopted instead.

iii). The types of vessels that should adopt the compulsory pilot

Having considered the present situation of the waterways in the Rajang port, the calling vessel's dimension and their maneuvering characteristics, the following types of vessels should adopt the compulsory pilot. (a usual practice in main ports of the world)

* Vessels used interstate trading ------------------- more than 500GRT
* Vessels trading within the state of Sarawak ------ more than 1,000GRT
* Vessels carrying dangerous cargoes (oil tanker) ---more than 300GRT

However, the following vessels should be exempted

* Malaysian Navy Ships
* Malaysian Government Vessels
* A similar vessel manoeuvred by a captain, who has called the Rajang port more than 10 times in the last year and has been endorsed by the Maritime Authority.

iv). The required number of pilots

Presupposing aforesaid conditions in (2), (3), and on the following detailed assumption, a estimation of the required number of pilots in 1997 is shown in the **Table-1.2.5.1.**

Table-1.2.5.1 Calculation of Required Pilots

Item	Sibu	S.Merah	Bintangor	Sarikei	Tg.Manis
A. No.of calling vessels	602	347	72	257	1084
B. vessels>2,000GRT(P)	364	120	-	-	-
BB.vessels<2,000GRT(R)	238	227	72	257	1084
C. Piloting frequency(P)	728	240	-	-	-
CC. " (R)	476	454	144	514	2168
D. Monthly frequency (P)	60	20	-	-	-
DD. " (R)	40	38	12	43	180
E. Daily frequency (P)	2	0.7	-	-	-
EE. " (R)	1.3	1.3	0.4	1.4	6
F. Pilot's work hours(P)	10-15(7+3+t)	10-15(7+3+t)	-	-	-
FF. " (R)	9(6+3)	10(7+3)	7(5+2)	5.5(4+1.5)	4(2+2)
G. No.of duty pilots (P)	2 x 2	0.7 x 2	-	-	-
GG. S/B " (P)	2	0.7	-	-	-
GGG. off " (P)	2	0.7	-	-	-
H. No.of duty pilots (R)	1.3	1.3	0.4	1.4	3
HH. S/B " (R)	0.65	0.65	0.2	0.7	1.5
HHH. off " (R)	0.65	0.65	0.2	0.7	1.5

t: wating hours for tide rising P: Paloh Route, R: Rajang Route

S/B: Stand by

Number fo requird pilots for the Paloh waterway (Sibu) : G + GG + GGG = 11
---------------- " --------------- Rajang ------- (Sarikei): H + HH + HHH = 15

* The number of calling vessels in 1997 is based on **Table-1.2.5.2.**
* Among the calling vessels from the above table, the number of vessels that required compulsory pilot by wharf would be a half of those less than 1,000GRT, and all those more than 1,000GRT ------------------ A
* Among vessels calling at Sibu/Sg.Merah:
  vessels more than 2,000GRT taking the Paloh waterway ----------- B
  vessels less than 2,000GRt taking the Rajang waterway ---------- BB
* The required frequency of piloting a year of 1997 by waterway and by wharf is double the number of calling vessels:
  the Paloh waterway ----------------- Bx2 ---------------------- C
  the Rajang waterway ---------------- BBx2 ---------------------- CC
* Monthly mean frequency of piloting:
  the Paloh waterway ----------------- C÷12 --------------------- D
  the Rajang waterway ---------------- CC÷12 -------------------- DD
* Daily mean frequency of piloting:
  the Paloh waterway ----------------- D÷30 --------------------- E
  the Rajang waterway ---------------- DD÷30 -------------------- EE
* Required hours for piloting service by wharf and by waterway:
  the Paloh waterway --- F
  the Rajang waterway -- FF
* Required number of Paloh pilots on duty --------------------------- G
  --------------- " -------------- stand by --- Gx½ --------------- GG
  --------------- " -------------- off duty --- Gx½ --------------- GGG
* Required number of Rajang pilots on duty -------------------------- H
  --------------- " -------------- stand by --- Hx½ --------------- HH
  --------------- " -------------- off duty --- Hx½ --------------- HHH

Table-1.2.5.2 GRT Distribution of Ships for International Trade (1997)

WHARF / GRT	Sibu	S.Merah	Bintang.	Sarikei	Tg.Manis		
					Timber	Coal	Anchor
Below 1000	218	374	65	223	6	15	35
1000 - 1999	129	40	39	145	3	12	17
2000 - 2999	152	120	-	-	18	-	112
3000 - 3999	144	-	-	-	45	-	289
4000 - 4999	14	-	-	-	40	-	253
5000 - 5999	38	-	-	-	15	-	92
6000 - 6999	16	-	-	-	7	1	46
7000 - 7999	-	-	-	-	1	3	2
8000 - 8999	-	-	-	-	1	3	6
9000 - 9999	-	-	-	-	3	2	17
10000 - 14999	-	-	-	-	4	8	22
15000 - 19999	-	-	-	-	4	-	22
Over 20000	-	-	-	-	1	-	6
Total	711	534	104	368	148	44	919

v). Conclusion

The general view of a navigation aids plan (short-term) is shown in **Figure-1.2.5.1.** And the costs for the plan is shown in **Table-1.2.5.3.**

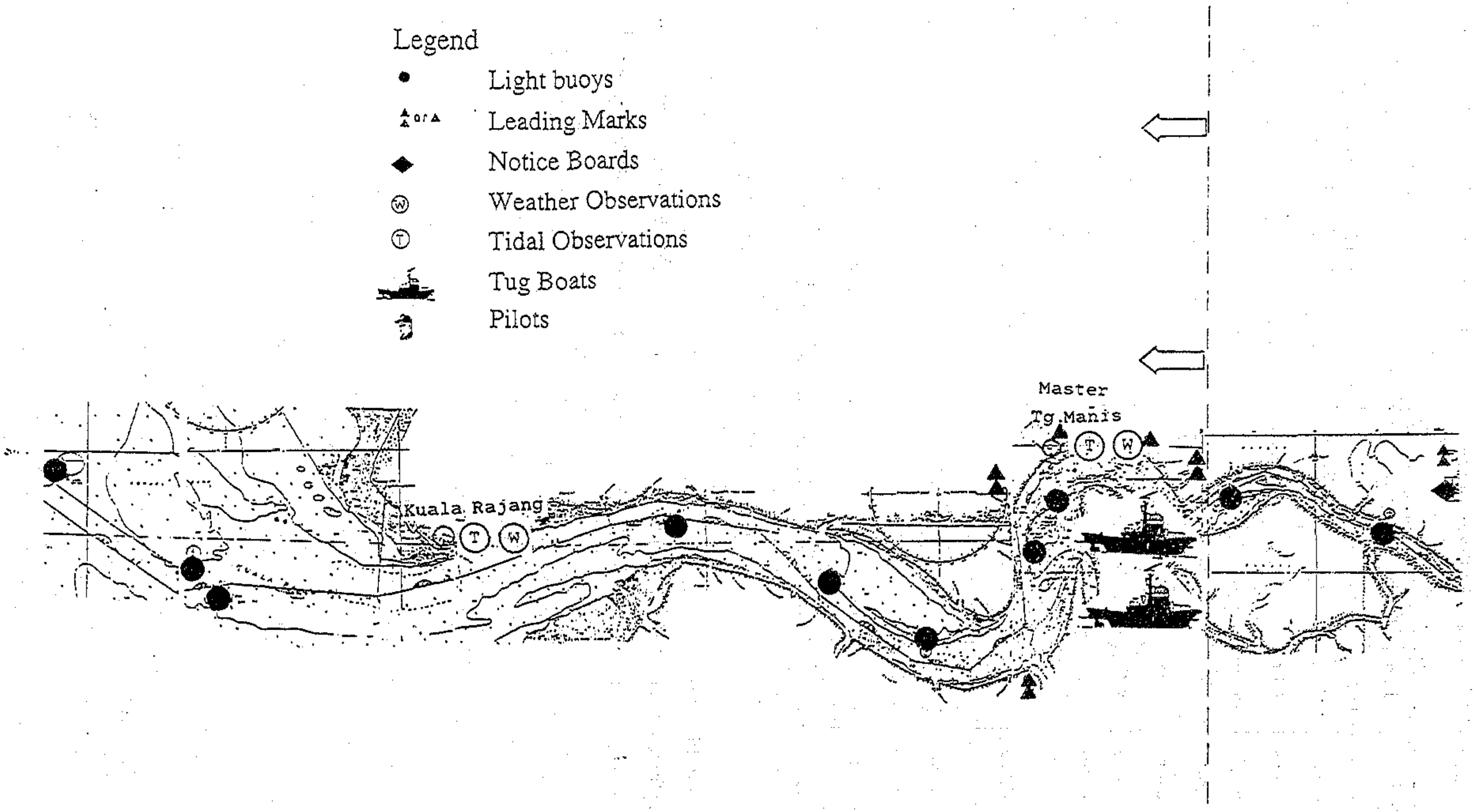


Figure-1.2.5.1 A Plan of Navigation Aids (Short-Term Plan)

Table-1.2.5.3 Cost Estimates of Navigation Aids

No.	Description	Unit Cost (1,000M$)	Short-term Plan Quantity	Short-term Plan Amount (1,000M$)	Master Plan Quantity	Master Plan Amount (1,000M$)
1.	Navigation marks					
	1.1 Racons	466	1	466	1	466
	1.2 Light Buyos (off shore)	386	4	1,544	6	2,316
	Light Buyos (waterway)	155	4	620	23	3,565
	Buyos (waterway)	70	0	—	22	1,540
	1.3 Leading marks	—	3	—	13	—
	1.4 Heading marks	—	2	—	2	—
2.	Other safety backup facilities					
	2.1 Tug boats 2,000 PS	6,795	1	6,795	2	13,590
	Tug boats 1,000 PS	5,094	1	5,094	1	5,094
	2.2 Weather/Tidal observatories	2,600	1 (master)	2,600	1 (master)	2,600
	Weather/Tidal observatories	473	1 (master)	473	8 (master)	3,784
3.	Exclusion of obstacles					
	3.1 Wrecks	—	—	—	—	—
	3.2 Sunken rocks	—	—	—	—	—
	3.3 Drifting logs	—	—	—	—	—
4.	New traffic control					
	4.1 Revision of traffic regulation	—	—	—	—	—
	4.2 Compulsory pilot system	—	—	—	—	—
	Total			17,592		32,955

1.2.6 Infrastructure and utility related to terminal development

The timber products terminal will need the following infrastructures and utilities for terminal operation. The costs of these infrastructures and utilities will be equivalent to about 4% of the cost needed for terminal construction.

Road (from a main road to the terminal)
Fence
Gate house
Weighing bridge
Electricity transmission line (within the terminal)
Electricity transformer station
Stand-by electricity generator
Water supply pipeline (from a main pipeline to the terminal)
Water tank
Drainage
Fire department

The timber products terminal will need road connection with the hinterland and a main water supply pipeline installed near the terminal; electricity can be supplied from generators which would be installed in the TPZ. And the coal terminal will need a main water supply pipeline (a road will not be required, nor does the coal terminal required much electricity).

On the other hand, as stated in **II.3.1.3** (3), a water supply pipeline to be installed between Sarikei and Tg.Sebubal has already been proposed by JKR, and a road from Belawai to Tg.Sebubal via Rajang village is under construction. Therefore, if these terminals are constructed on the east shore of Tg.Sebubal, an alternate plan for water supply and a road will not be required. The estimated cost for installation of the water supply pipeline from Sarikei to Tg.Sebubal would be 20 million Ringgit (25km, 800,000 Ringgit/km).

Moreover, port development would generate more land traffic on the urban road network adjacent to the port. Therefore, both port development and urban road development should be implemented in harmony each other.

1.3 Facility Layout Plan

1.3.1 International trade

Figure-1.3.1.1, 1.3.1.2 and **1.3.1.3** show the Short-term Facility Layout Plan of Rajang Port.

1.3.2 Coastal and riverine cargo transportation

(1) Sibu

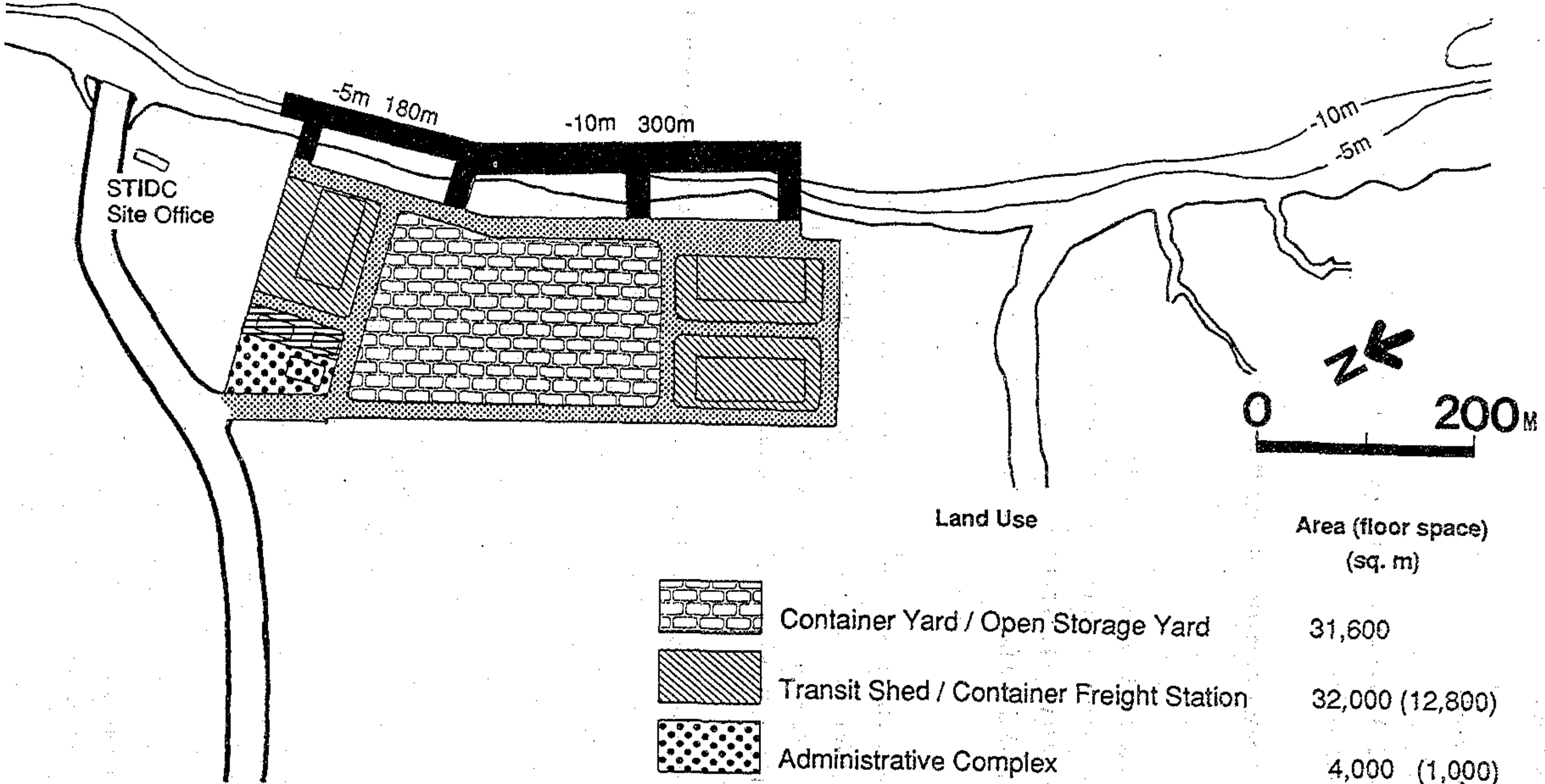
The entire waterfront of central Sibu town has been fully used. So, the additional coastal and riverine wharf could be located in front of the JKR equipment base (**Figure-1.3.2.1**).

Figure-1.3.2.2 shows the facility layout plan up to 1997 and 2010.

(2) Tg. Sebubal

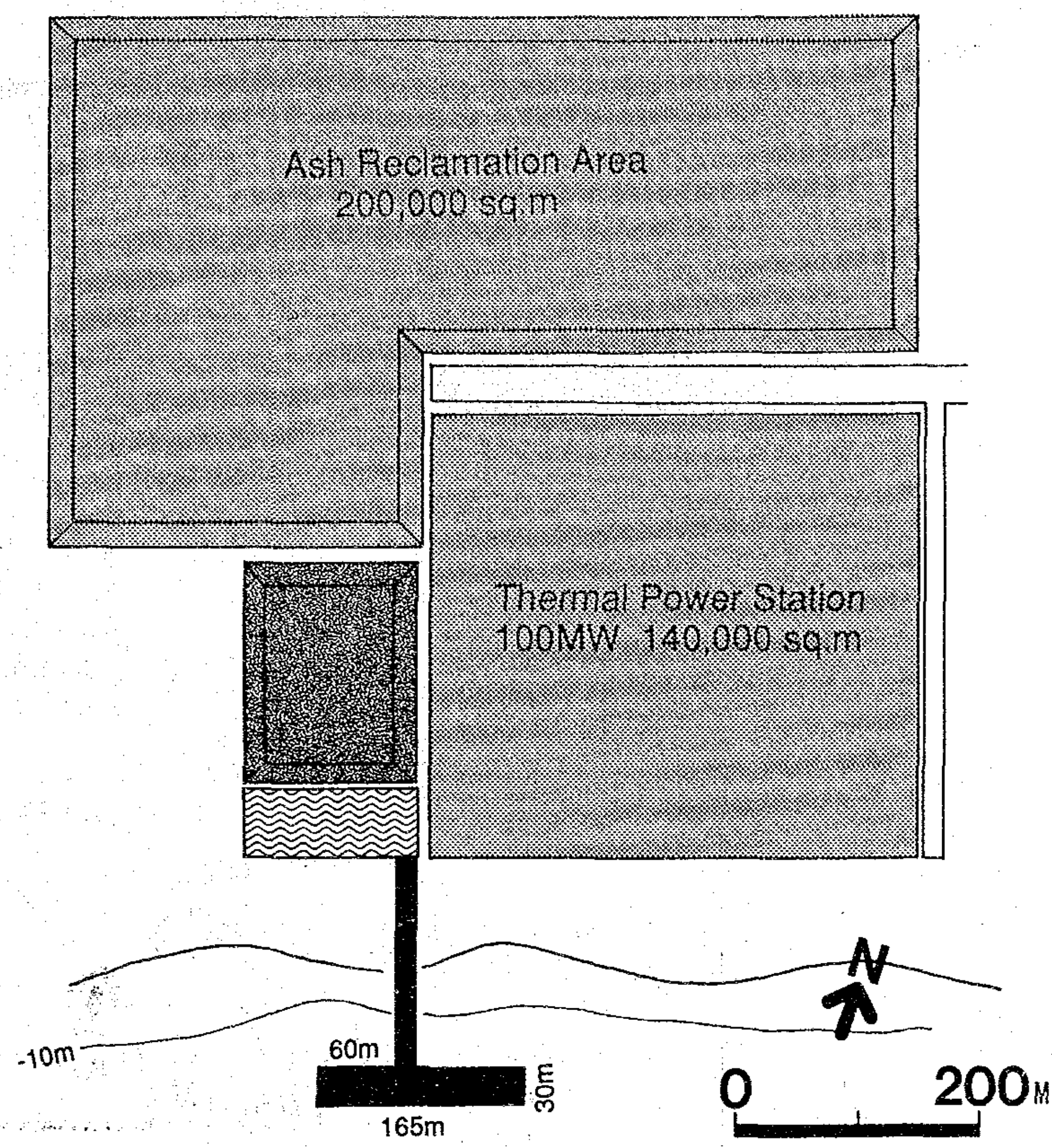
A coastal cargo wharf as well as a passenger wharf needs connection with land transportation. Therefore the wharf should be located next to the road which runs from Belawai to Tg. Sebubal through Rajang village and the TPZ. **Figure-1.3.2.3** shows a plan for a new coastal cargo wharf.

The details of the coastal and riverine wharves are shown in **Appendix-III.1.3.1.**



Land Use	Area (floor space) (sq. m)
Container Yard / Open Storage Yard	31,600
Transit Shed / Container Freight Station	32,000 (12,800)
Administrative Complex	4,000 (1,000)
Utility (Maintenance/Washing)	2,500 (1,100)
Road and Others	29,900
Total	100,000

Figure-1.3.1.1
Timber Products Terminal
SHORT-TERM PLAN Terminal Layout



Land Use	Area (sq. m)
Coal Yard	25,000 (125,000t)
Water Processing Pond and Others	7,000
Total	32,000

Figure-1.3.1.2
Coal Terminal
SHORT-TERM PLAN Terminal Layout

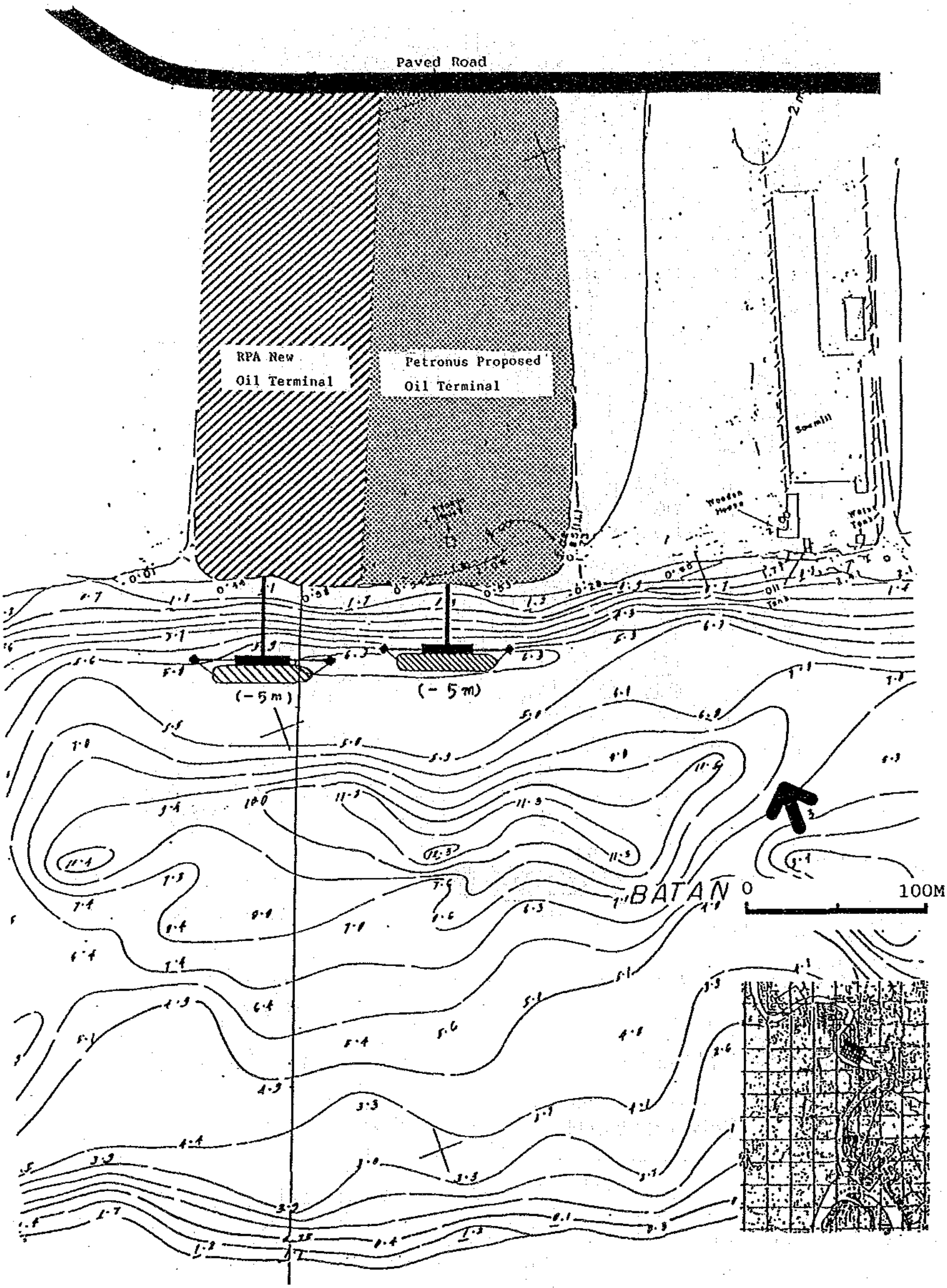


Figure-1.3.1.3 New Oil Terminal Site and plan for New Oil Jetty
(Short-term)

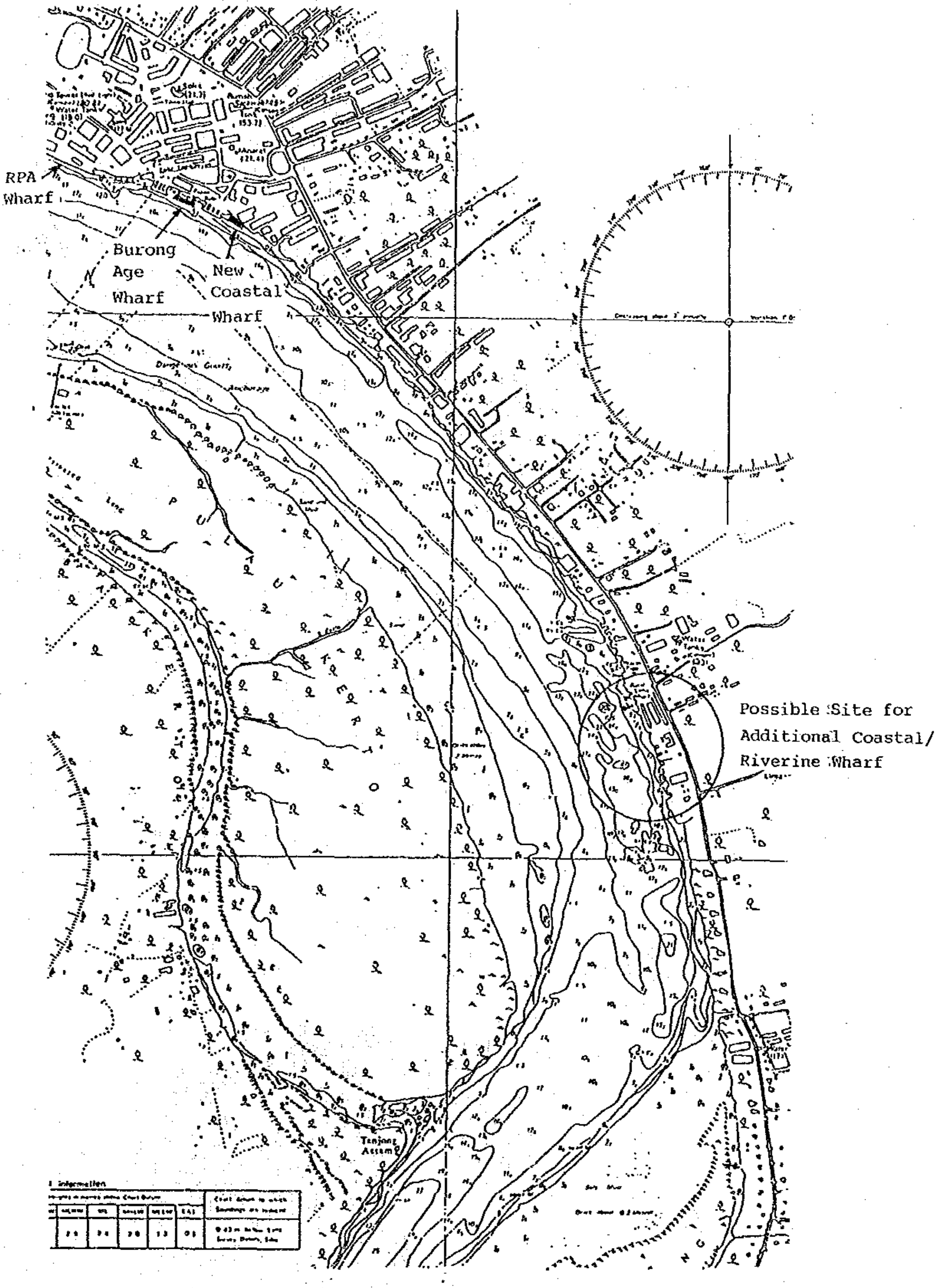


Figure-1.3.2.1 Location of Additional Coastal and Riverine Wharf at Sibu

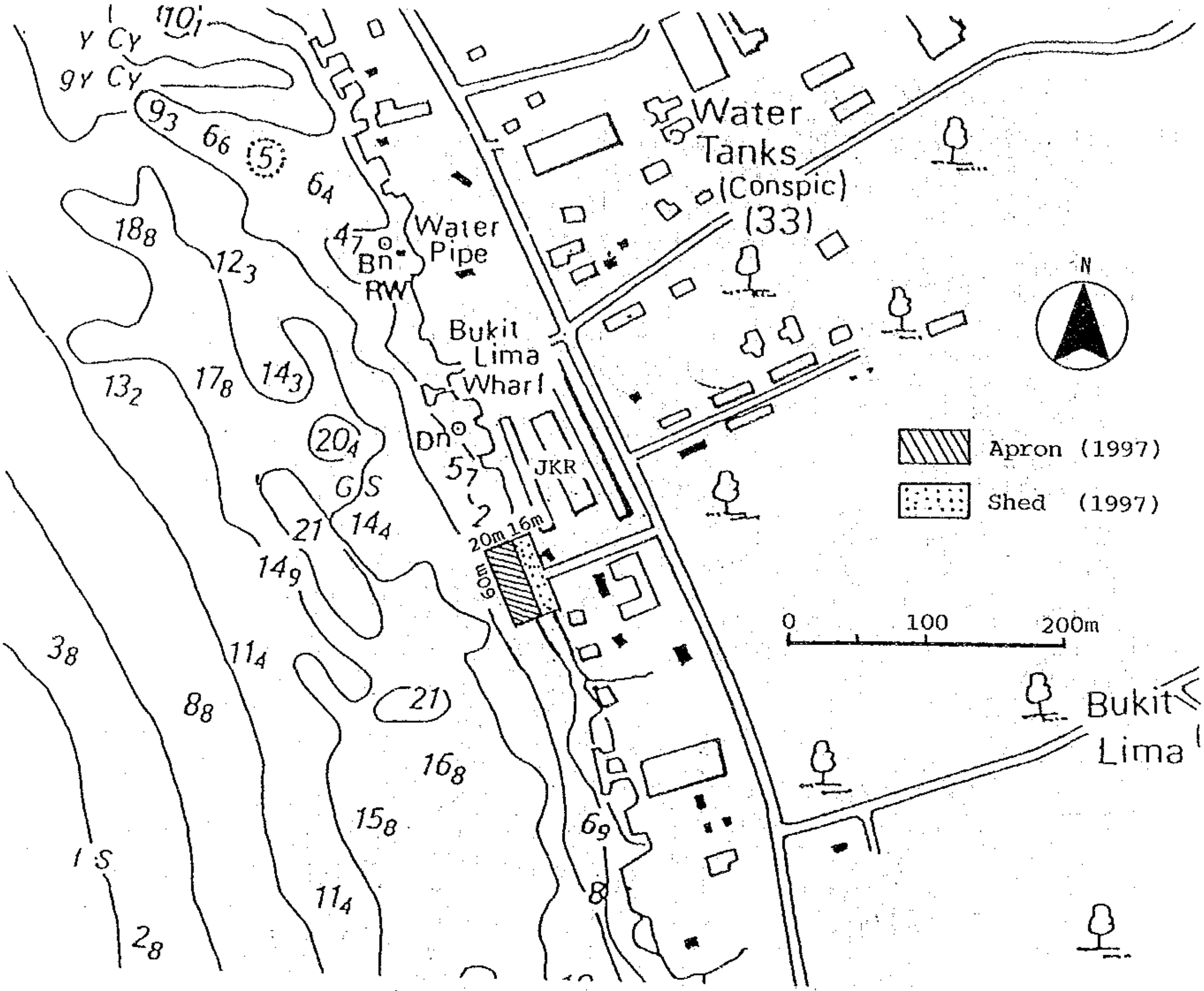


Figure-1.3.2.2 Plan for Additional Coastal and Riverine Wharf at Sibu

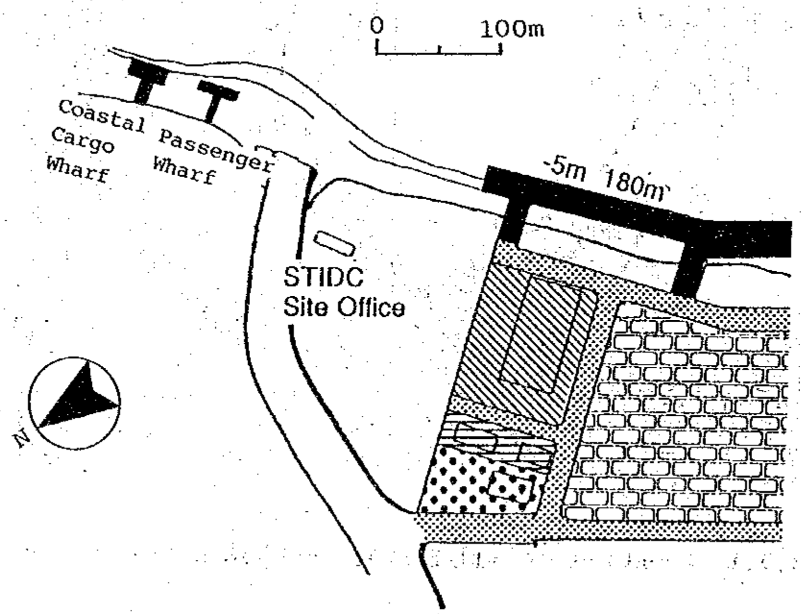


Figure-1.3.2.3 Plan for Coastal Cargo Wharf and Passenger Wharf at Tg.Sebubal

1.3.3 Passenger service

(1) Sibu

Figure-1.3.3.1 shows the plan for improvement of the Upstream and Downstream Expressboat Wharves which can accommodate 6 boats for embarkation/disembarkation and 7 idling boats. Moreover, 10 berths for idling boats will be required in 1997. The possible location of the idling berth is in front of Lee Hua Hotel or on Igan River.

(2) Sarikei

The existing facility (50m pontoon) will be enough for the future demand. No expansion will be required.

(3) Bintangor

The existing facility (20m pontoon) will be enough for the future demand. No expansion will be required.

(4) Tg. Sebubal

30m-long pssenger boat wharf will be required (pleases see **Figure-1.3.2.3**).

The details of the passenger wharves are shown in **Appendix-III.1.3.1.**

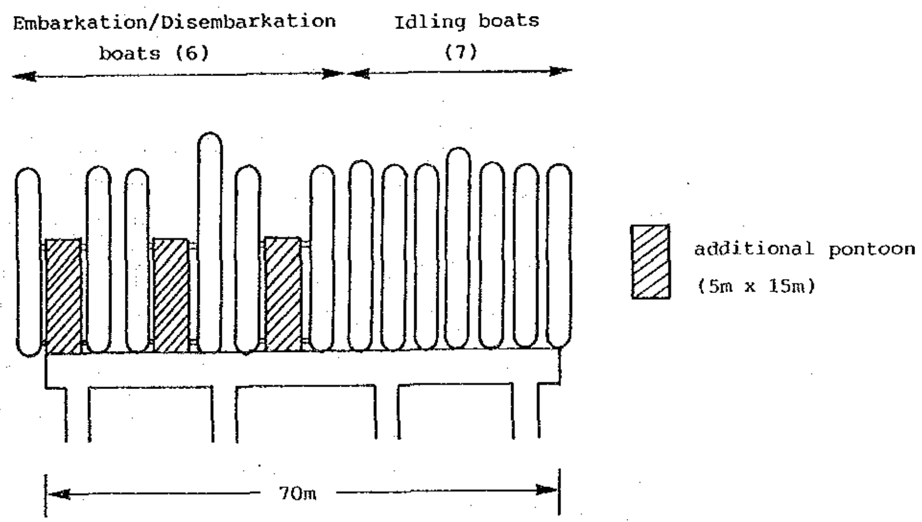


Figure-1.3.3.1 Improvement Plan of the Upstream and downstream Express boat Wharves at Sibu Center

2. PRELIMINARY DESIGN

2.1 Structural Study on the Existing RPA Mooring Facilities

2.1.1 General

This chapter presents the preliminary design of the main port facilities. Design conditions are based on the short-term plan in Chapter 1 of Volume III and the results of natural condition survey in Chapter 2 of Volume I. The purpose of the preliminary design is to provide a foundation on which an approximate cost estimation, economic analysis and financial analysis of the project can be conducted.

It shall be noted that Detailed Design is further required for actual construction works of the Project. The Detailed design shall be conducted based on additional soil investigation results as well as the original one. The preliminary design shall be re-evaluated on this stage. (Please also refer to **Appendix-III.2.3.5**)

It is essential to examine and analyze the structure of the existing facilities in advance of the Preliminary Design. Structural elements of the existing main facilities owned by RPA in Btg. Rajang are summarized in the following table.

Table 2.1.1.1 Structural Summary of Existing RPA Mooring Facilities

No	Location	Facilities	Berth Configuration Length (m)	Depth (m)	Width (m)	Apron Elev. (m)	Tidal Range (m)	Max. Ship Size (DWT)	Year built	Structural Study & Remarks
1	Sibu	GC Wharves No.1~3	148.0	-8.5	8.5	+4.7	3.4	6,000	1933/55	Old wharves:Built up Steel Box Pile with concrete filling
2		GC/CTN Wharves No.4~5	295.6	-8.5	18.3	+4.7	3.4	8,000	1977	PS octagonal concrete piles 24" dia. σ_{ac}=420kg/cm², Surcharge on deck:3.3t/m²
	Sibu	Transit Shed	1 CFS : 360'×140'×20' 2 sheds: each 360'×100'×20'							Portal frame Portal frame
3	Sarikei	GC Wharf	60.4	-7.6	9.1	+5.85	5.5	3,000	1970	Built up LARSSEN-3 Steel Box Pile L:36'
4	Bintangor	GC Wharf	48.5	-4.6	6.1	+5.5	5.0	1,000	1989	RC squre Piles : 380×380mm
5	Sg. Merah	Oil Jetty	48.8	-4.6	8.2		3.4	1,500 LOA:74.7m	1983	SPP:dia.450mm×18.2m with concrete fill

[Note] GC: General Cargo, CTN: Container, LOA: Length of Overall,
PS: Prestressed, Elev.: Elevation, dia.: diameter,
SPP: Steel Pipe Pile, RC: Reinforced Concrete,
Sg: Sungai (River), CFS: Container Freight Station,
$\sigma_{ac.}$: Allowable compressive stress of concrete

2.1.2 Sibu Center

The first wharf was constructed in 1933, and the second wharf was built in 1955. These are currently designated as old wharves. To cope with an increasing volume of cargo, the port expanded by approx. 300m in 1977. The existing layout of the port is shown in **Figure-2.1.2.1.** Since the existing old wharves are timeworn, they will be renovated in the near future to accommodate increasing container volume. (**Figure-2.1.2.2**)

(1) The existing old wharves

Foundation of the existing old wharves consists of a built-up box pile with concrete filling as shown in **Figure-2.1.2.3.**

Although the foundation of the built-up box piles is secure at present (in 1990), almost all superstructures such as the slabs, beams, decks and fenders have been timeworn. For example, some parts of the reinforced steel bars at the bottom of the concrete slabs are noticeably exposed to the air.

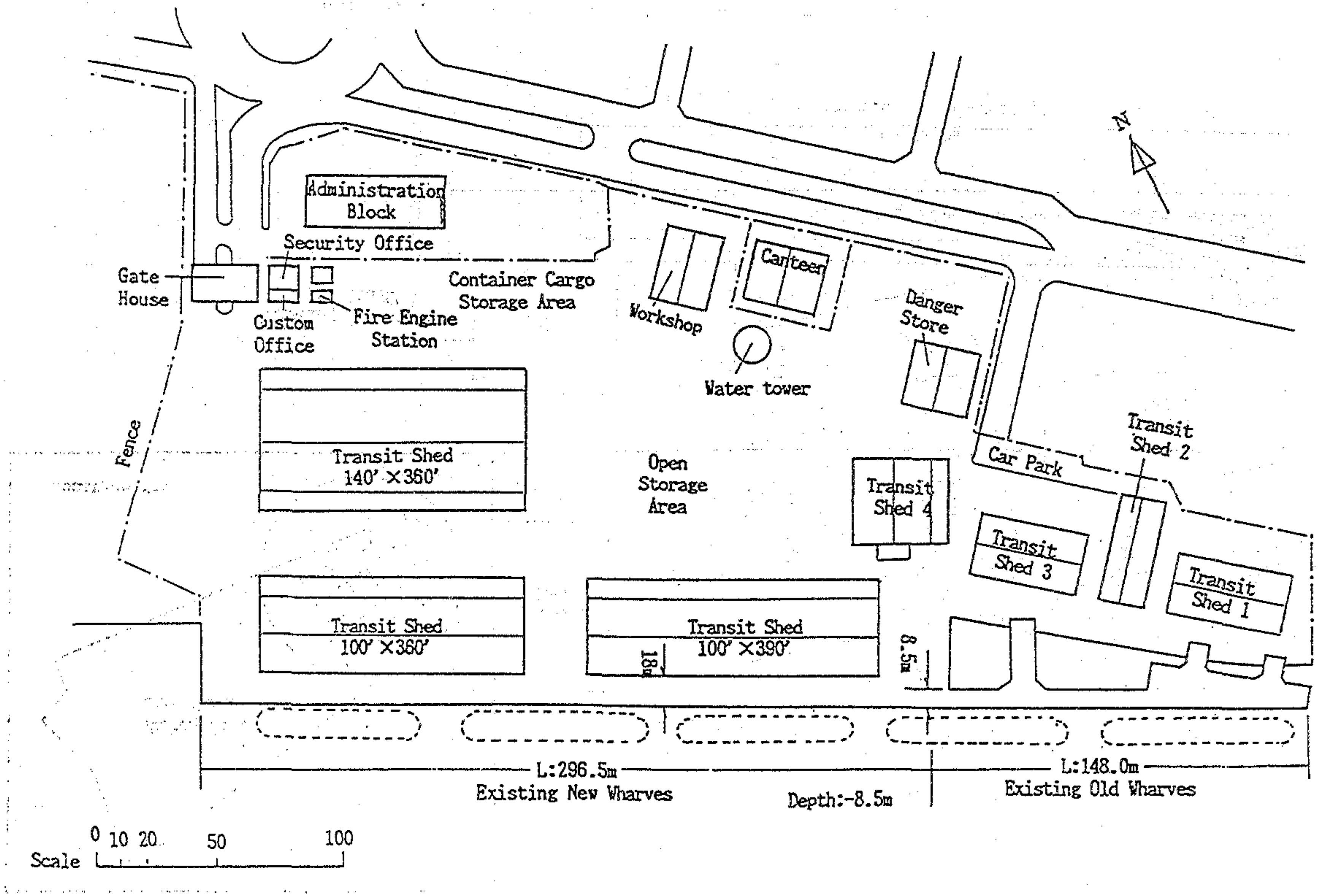


Figure-2.1.2.1 Layout of Existing Rajang Port at Sibe Center

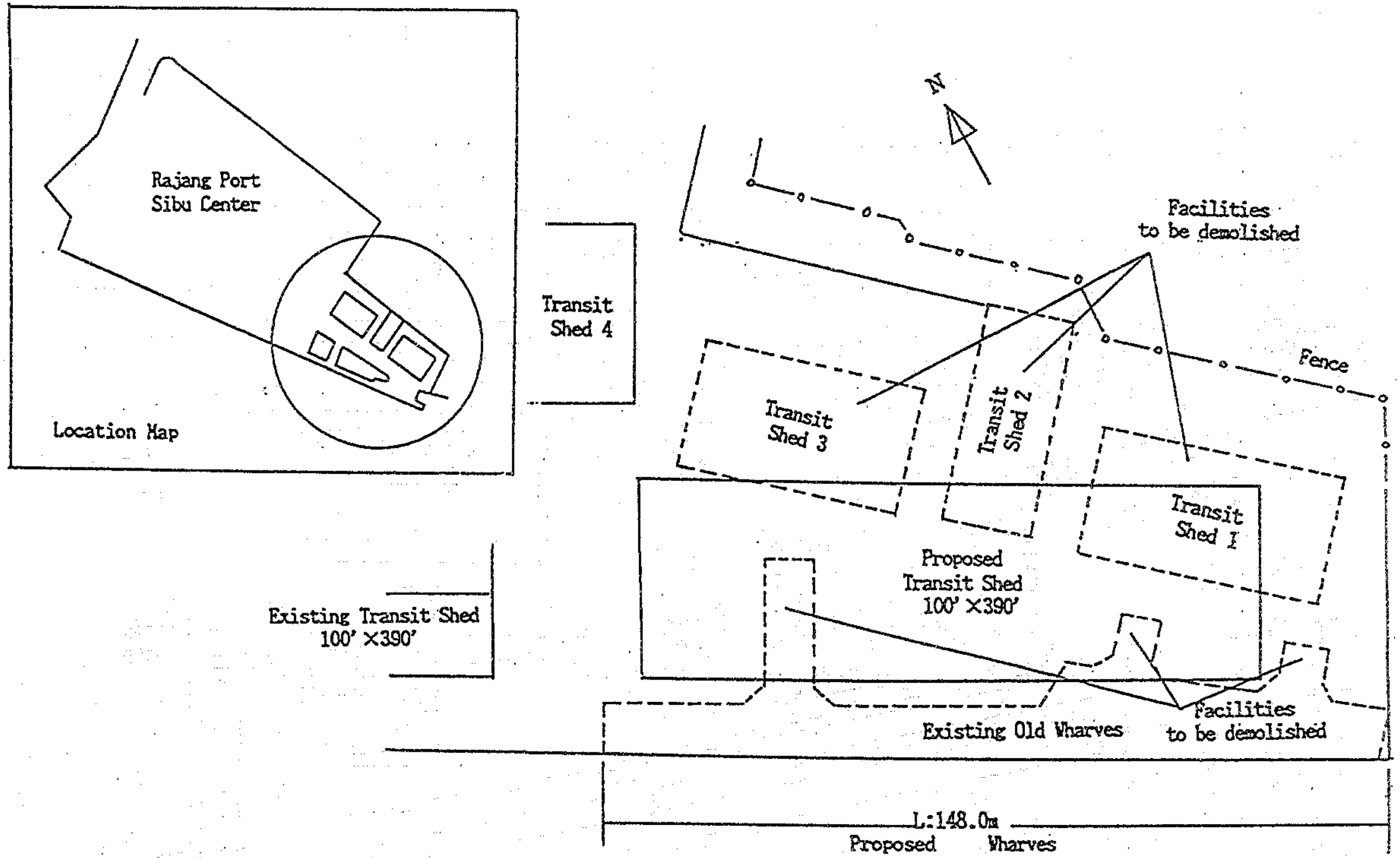


Figure-2.1.2.2 Renovation Plan of Rajang Port at Sibu Center

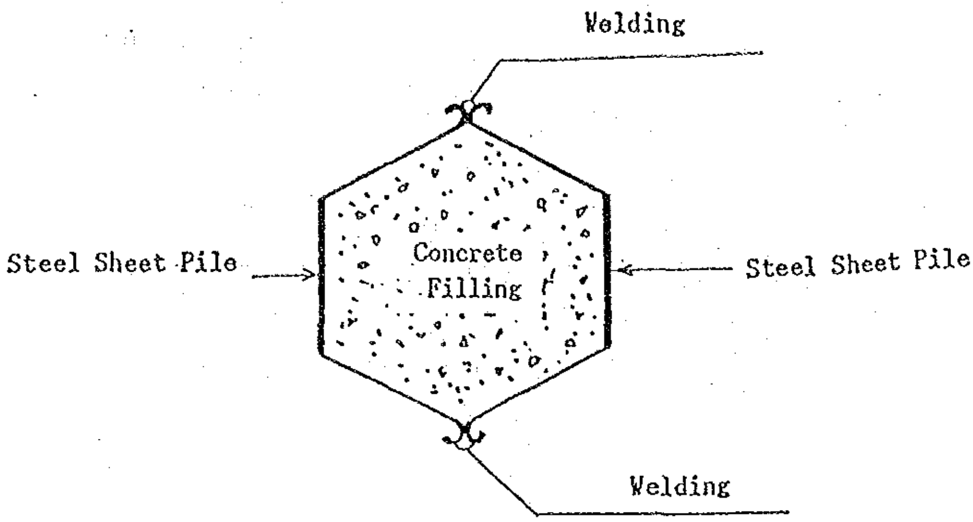


Figure-2.1.2.3 Cross-Section of Pile in Existing Old Wharf

(2) The existing new wharves

The new wharves were constructed in 1977 as multi-purpose berths for general cargo and container. The foundation of these berths consists of pre-stressed (PS) octagonal concrete piles of 24" diameter and approx. 100 ft long. Design conditions of the berths are as follows:

Allowable compressive stress of the concrete pile	:	420 kg/sq.cm
No. of ship to be accommodated	:	2 ships of 152.4m LOA each
Uniform load on the apron	:	3.32 t/sq.m (672 lb/sq.ft)
		2 stacks for 20 ft container
		1 stack for 40 ft container

A Cross-section of the PS octagonal concrete pile is shown in **Figure-2.1.2.4.** A cross-section of the new wharf is shown in **Fig. 2.1.2.5.**

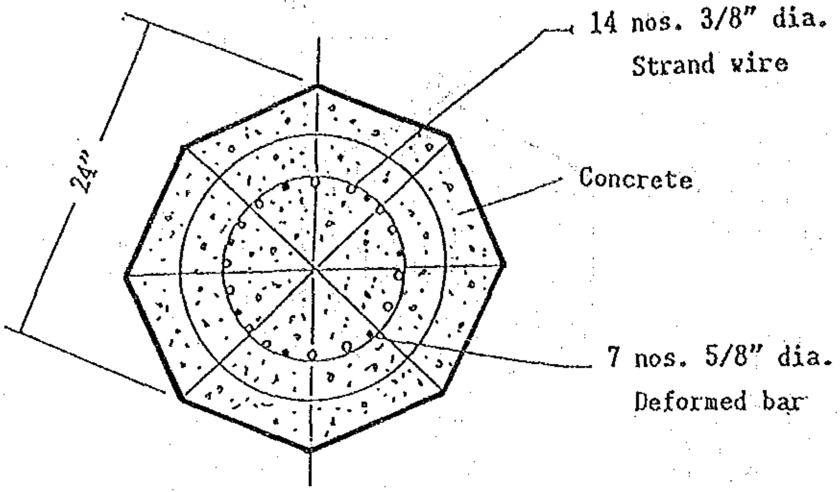


Figure-2.1.2.4 Typical Cross-Section of PS octagonal pile in Existing New Wharf

All of the foundation piles are vertical and are designed to support the berth deck and the transit shed.

The wharf has been well maintained except some damaged connecting points between wooden fenders and wharves.

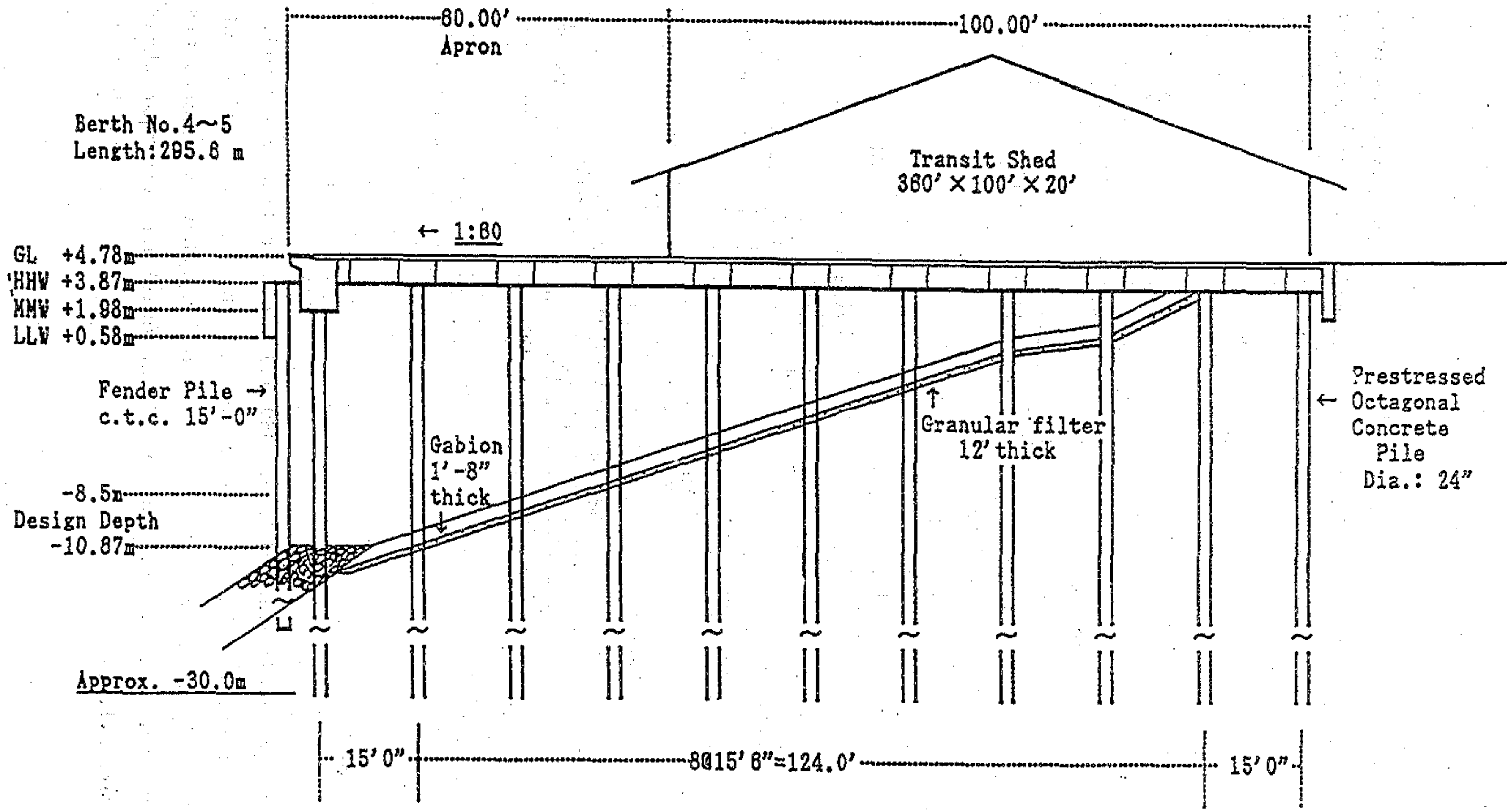


Figure-2.1.2.5 Typical Cross-Section of Existing New Wharf
Rajang Port at Sibu Center

2.1.3 Sarikei

The existing wharf with a T-type pier was constructed 20 years ago (1970). The foundation of the berth consists of built-up steel box piles, similar to those used in the existing old wharves at Sibu. The layout of a existing Sarikei wharf is shown in **Figure-2.1.3.1.**

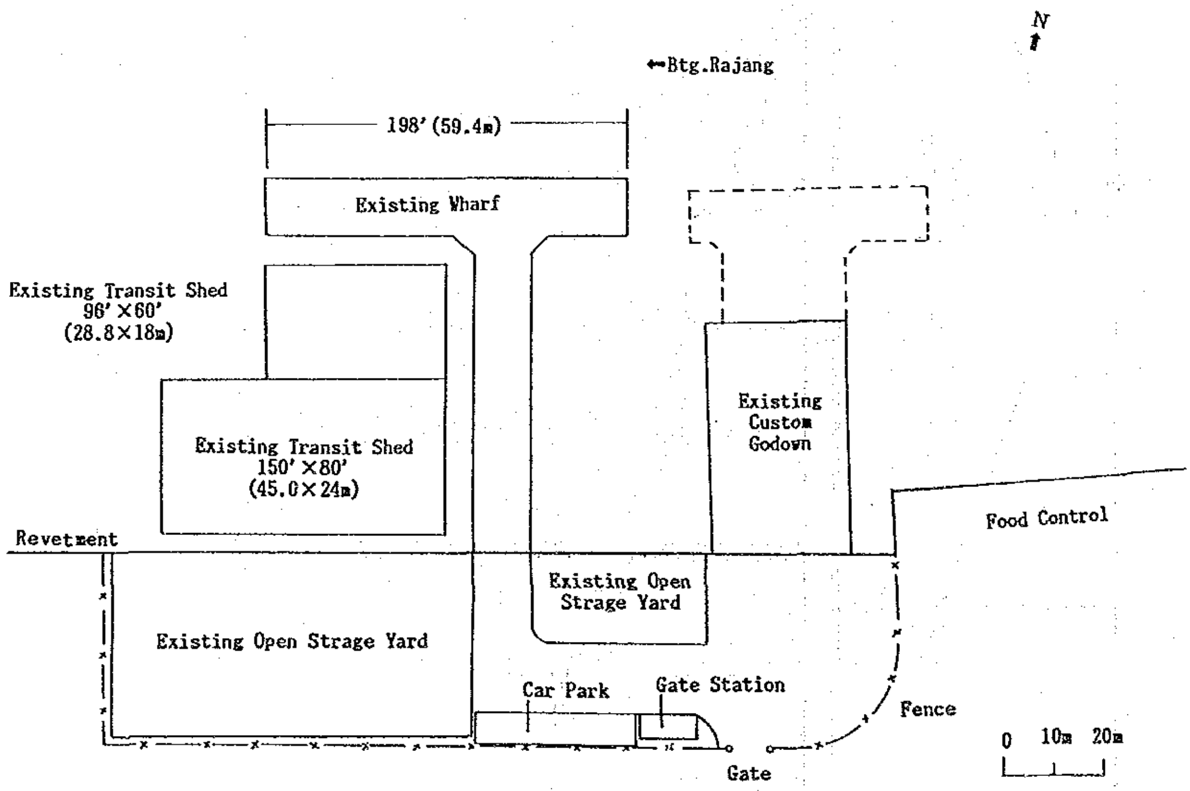


Figure-2.1.3.1 Layout of Existing Sarikei Wharf

2.1.4 Bintangor

The Bintangor wharf was built in 1989 and its structure was similar to that of the Sarikei wharf. The foundation of this berth consists of RC square piles which are common to almost all of the wharves constructed by the JKR along Btg. Rajang. The layout of the existing Bintangor wharf is shown in **Figure-2.1.4.1.**

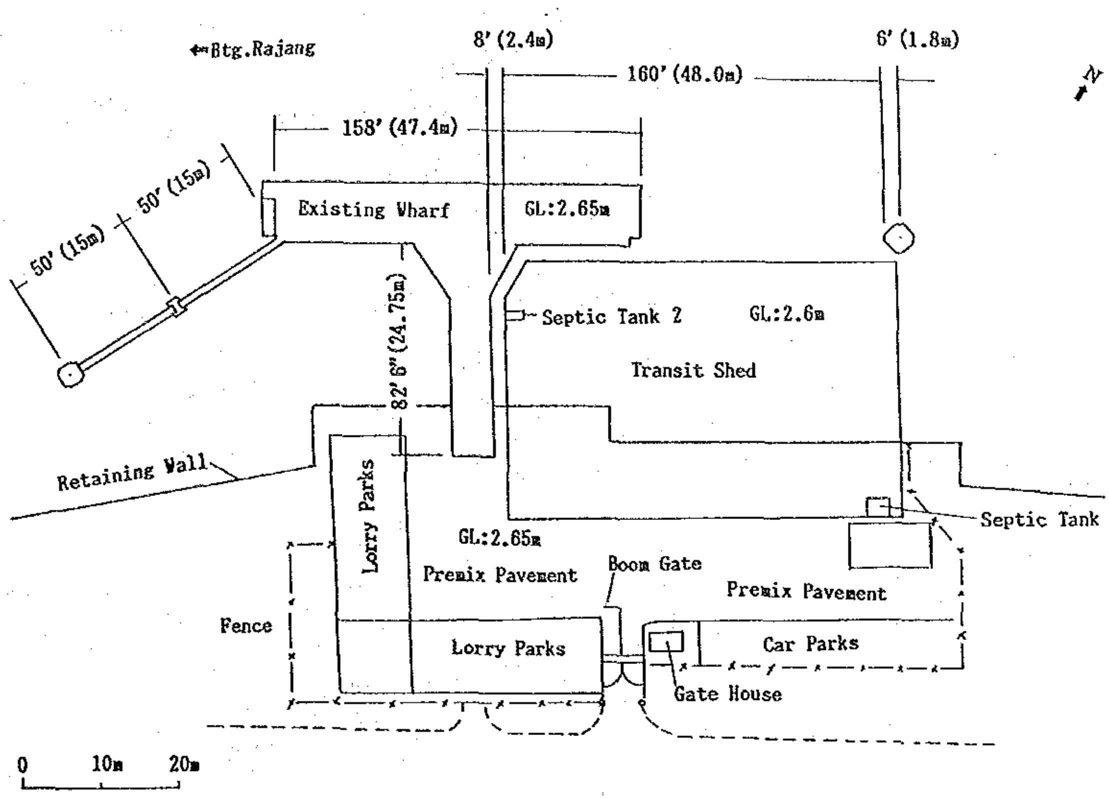


Figure-2.1.4.1 Layout of Existing Bintangor Wharf

2.1.5 Sg. Merah

This oil jetty was constructed in 1983. The jetty type is the T-shape with dolphins, a popular choice among world oil jetties. The foundation of the jetty consists of steel pipe piles of 450 mm diameter with concrete fillings (see **Figure-2.1.5.2**). The layout of the existing Sg. Merah oil jetty in shown if **Figure-2.1.5.1**.

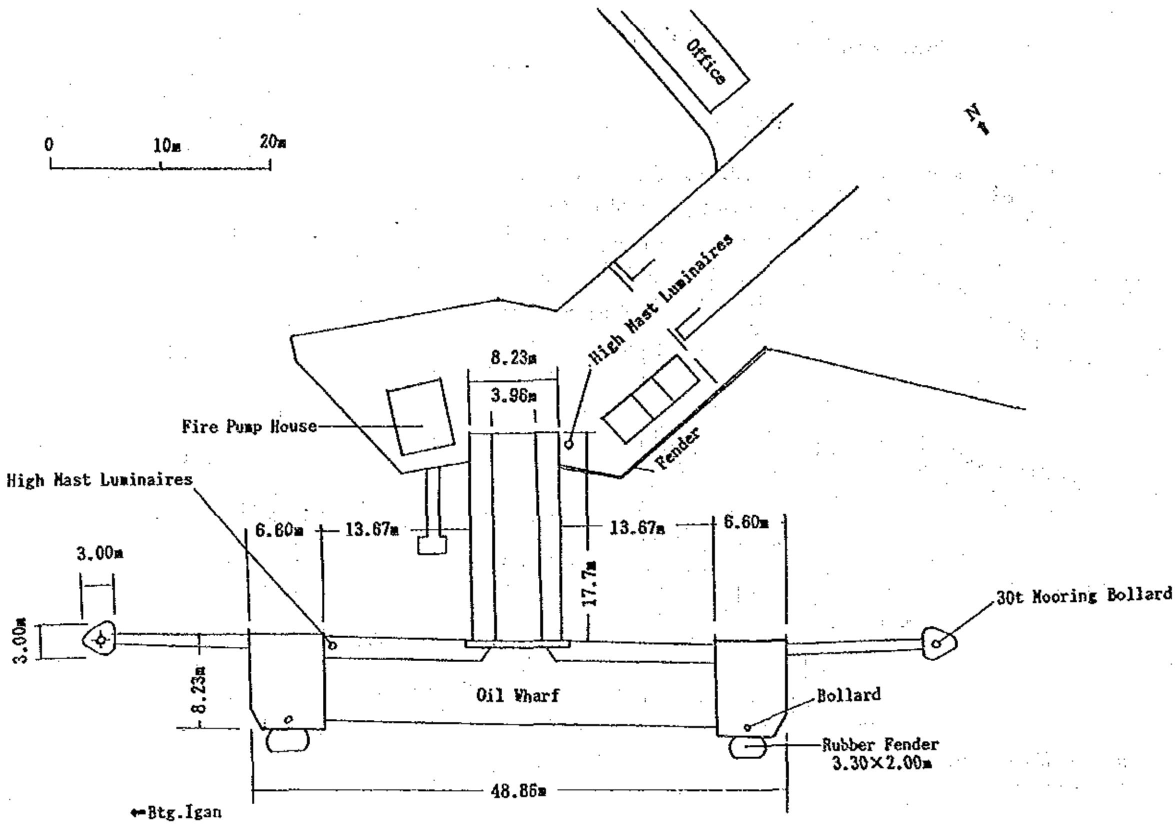


Figure-2.1.5.1 Layout of Existing Sg. Merah Oil Jetty

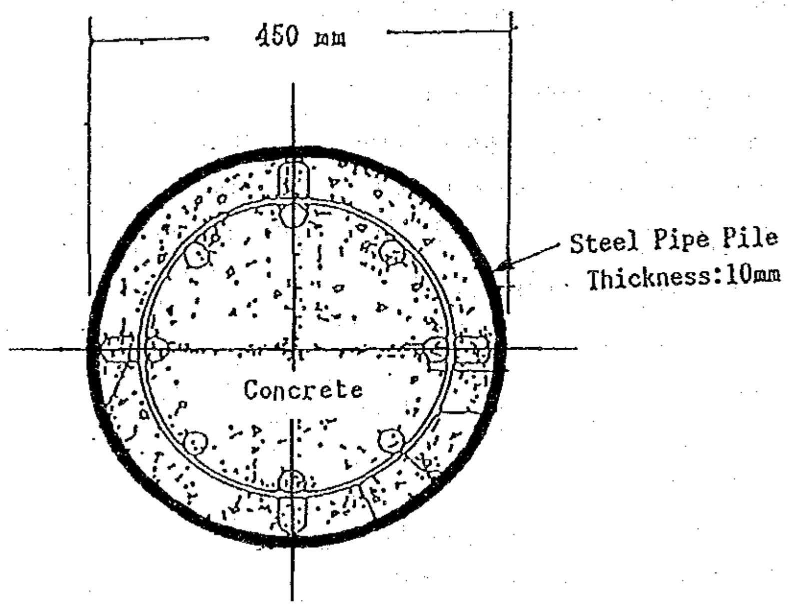


Figure-2.1.5.2 Typical Cross-Section of Pile in Sg. Merah Oil Jetty

2.2 Design Conditions

The design conditions are based on the results of the natural condition survey, port planning and technical standards of Malaysia, Indonesia and Japan as well as B.S and ASTM.

[Note] 1) Technical Standards for Port and Harbour Facilities in Japan (Japan Port and Harbour Association, 1989)

2) Standard Design Criteria for Ports in Indonesia (Maritime Sector Development Programme, Secretariate General of Sea Communication)

2.2.1 Ship Size

The ship size is determined as follows, according to the study on port planning.

For Timber Products Deep Wharf	:	10,000 DWT	at Tg. Manis area
For Timber Products Shallow Wharf	:	1,000 DWT	at Tg. Manis area
For Coal Deep Wharf	:	10,000-30,000 DWT	at Tg. Manis area
For Coal Shallow Wharf	:	1,000 DWT(Barge)	at Tg. Manis area
For GC/CTN Wharf(for Master Plan)	:	3,000 DWT	at Sibu South
For Oil Jetty	:	1,000-3,000 DWT	at Sg. Merah

[Note] GC: General Cargo, CTN: Container

2.2.2 Berth Dimensions

The berth dimensions such as the length and depth of berths and the width of the apron are determined according to the size of the ships.

(1) Length of berth

The length of a berth is determined according to LOA (Length Overall) in Chapter 2.4 of Volume II. The proposed length of the berth is shown in **Table-2.2.2.1.**

(2) Depth of Berth

The depth of the berth is also determined according to full draught in Chapter 2.4 of Volume II. The proposed depth of the berth is shown in Table-2.2.2.2.

Table-2.2.2.1 Proposed Length of Berth

Wharf	Ship Size	Length of berth
T.P. Deep	10,000 DWT	150m
T.P. Shallow	1,000 DWT	60m
Coal Deep	20,000 DWT	165m
Coal Shallow	1,000 DWT	60m
Sibu South	3,000 DWT	110m
Sg.Merah Oil Jetty	1,000~3,000 DWT	100m

[Note] T.P.: Timber Products

Table-2.2.2.2 Proposed Depth of Berth

Wharf	Ship Size	Depth of berth
T.P. Deep	10,000 DWT	-10.0m
T.P. Shallow	1,000 DWT	- 5.0m
Coal Deep	20,000 DWT	-10.0m
Coal Shallow	1,000 DWT	- 5.0m
Sibu South	3,000 DWT	- 6.0m
Sg.Merah Oil Jetty	1,000~3,000 DWT	- 5.0m

[Note] T.P.: Timber Products

(3) Width of Apron

The width of the apron, a critical factor in ensuring the safe and smooth handling of cargo, is determined by taking into account the following points:

1) Type of Shed
2) Type of Cargo Handling Equipment

3) Kind of Cargo

4) Kind of Packing

1) Japanese Standard (JS) gives the following data:

For GC berth:	with Transit Shed (TS)	: 15 to 20 m
	with Open Storage (OS) or Road	: 10 to 20 m

Based on the depth of a berth of		
	less than -4.5 m	: 10 m
	-4.5 to -7.5 m	: 15 m
	-7.5 m over	: 20 m
For container berth		: 40 to 70 m

2) *Indonesian Standard (IS) gives the following:*

Table-2.2.2.3 Width of Apron Based on IS

Description	Width of Apron (m)	Remarks
GC berth for Ocean going vessels	min. 30	
for Inter-island vessels	min. 25	
for Local vessels	min. 10	

[Note] Indonesian Standard (IS), General Cargo (GC)

3) Based on the above study, the approriate width of the apron is given in the following table:

Table-2.2.2.4 Proposed Width of Apron

Cargo	Ship Size (DWT)	Width of Apron (m)	Remarks
GC (TPT)	10,000	25.0	Deep water berth
GC/CTN	5,000	20.0	Shallow water berth
GC/CTN	10,000	30.0	Conbined berth(Deep+Shallow)
Oil	3,000	10.0	
Coal	10,000	30.0	

[Note] General Cargo (GC), Timber Products Terminal (TPT), Container (CTN)

(4) Berth elevation

Berth elevation is determined based on the tidal range and wave height at the site.

According to the IS, berth elevation is given in relation to the depth of the berth as shown in the following table.

Table-2.2.2.5 Berth Elevation above High Water Spring(HWS)

Depth of Berth (m)	Tidal range		Remarks
	3.0 m or over	less than 3.0 m	
-4.5 m or over	0.5 to 1.5 m	1.0 to 2.0 m	
less than -4.5 m	0.3 to 1.0 m	0.5 to 1.5 m	

The elevation shown in **Table-2.2.2.5** can be applied to a berth located in a calm and sheltered site. If a berth is located in an area such as a river mouth or a seashore, where it is susceptible to an ocean swell, wave height should be taken into consideration.

Table-2.2.2.6 shows the proposed elevation of the berths.

Table-2.2.2.6 Proposed Elevation of the Berths

Location	Tidal range (m)	HWS (m)	Allowance	Berth EL (m)	Remarks
Tg.Manis	0 to 5.8 = 5.8	+5.8	1.2	+7.0	
Sibu	0.6 to 3.9 = 3.3	+3.9	0.8	+4.7	For the existing port
			1.1	+5.0	For the new port

[Note] Elevation(EL), High Water Spring (HWS)

In renovation the existing Rajang Port at Sibu Center, the berth elevation should be the same as the existing one. However, when a new port is planned at a new location, it is recommended that the berth elevation shall be slightly higher than the existing one because an allowance of 1.0 m must be taken into account.

(5) Slope apron

The apron of a wharf is designed to have a small inclinations so that heavy rainfall will run off quickly.

The following references are considered for the slope.

JS:	1 to 2%
IS:	0.5 to 1%
Existing Sibu berth:	1.67%

It is recommended that the slope of the apron be between 1.67 % and 2.0 %.

2.2.3 Factors/elements of forces and loads acting on Structures

(1) Berthing Velocity of ships: Berthing velocity is usually given as the following according to JS.

For 5,000 DWT ship	:	15 to 20 cm/sec
For 10,000 DWT ship	:	10 to 15 cm/sec

Therefore, 20cm/sec and 15cm/sec are adopted for 5,000 DWT and 10,000 DWT respectively.

(2) Tractive Force on Bollards: Tractive force is usually given as the following according to JS.

For 5,000 DWT ship	:	25 t
For 10,000 DWT ship	:	35 to 50 t
For 30,000 DWT ship	:	50 to 70 t

Therefore, 35t and 70t are adopted for 10,000 DWT and 30,000 DWT, respectively.

(3) Surcharges

Uniform loads on a deck in container handling are as follows:

1 stack of 20' container :
20.4t/20' container ÷ (2.4m x 6.0m = 14.4m^2) = 1.42t/m^2

1 stack of 40' container :
35t/40' container ÷ (2.4m x 12.0m = 28.8m^2) = 1.22t/m^2

or Straddle Carrier with 40' container:
61t ÷ (16.2m x 4.4m = 71.28m^2) = 0.86t/m^2

or Large Fork-lift with 40' container:
55.6t ÷ (10.4m x 6.1m = 63.44m^2) = 0.88t/m^2)

or Tractor/Chassis with 20' container:
29.7t ÷ (11.0m x 2.5m = 27.5m^2) = 1.08t/m^2

or Tractor/Chassis with 40' container:
37.5t ÷ (16.5m x 2.5m = 41.3m^2) = 0.91t/m^2

In each case the uniform load on the deck is less than 2 t/m2.

Table-2.2.3.1 Shows proposed surcharges on structures.

Table-2.2.3.1 Proposed Surcharges on Structures

Description	Ship Size (DWT)			Remarks
	30,000	10,000	5,000	
Uniform load on the deck		2 t/sq.m	1.5t/sq.m	
40' Top/Side Loader	56 t	56 t	25 t	concentrated load
40' Straddle Carrier	61 t	61 t		concentrated load
Tractor/Shassis	40 ft	40 ft	20 ft	concentrated load

[Note] A load of handling equipment is transmitted through tyre wheels, i.e. a concentrated load, which is usually larger than the above-mentioned uniformed load. For instance, Straddle Carrier has a wheel load of about 10.0 t/wheel. Concrete slabs and beams are designed to support such a concentrated load.

(4) Earthquake

According to the IS, the seismic coefficient (k) is given by the following formula:

$k = k_r \times C_i$

here, K_r : Regional seismic coefficient

C_i : Coefficient of Importance

Regional seismic coefficient is shown in **Figure-2.2.3.1** and **Table-2.2.3.2.** Coefficient of importance is given in **Table-2.2.3.3.**

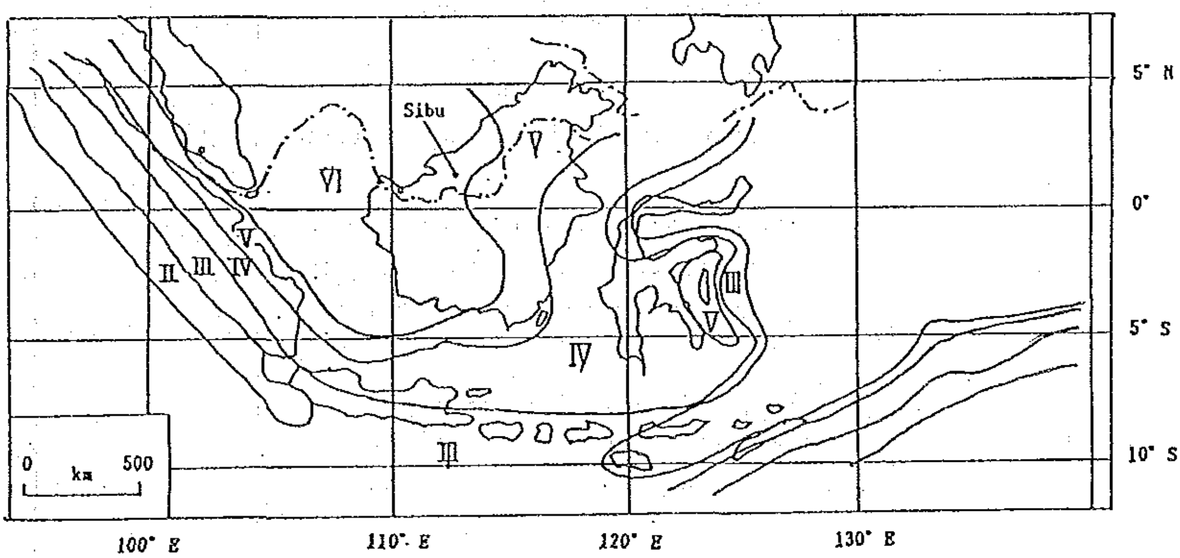


Figure-2.2.3.1. Regional Seismic Coefficient

Table-2.2.3.2 Regional Seismic Coefficient

Soil Type	Zone						Remarks
	I	II	III	IV	V	VI	
Stiff soil	0.09 g	0.07 g	0.05 g	0.03 g	0.01 g	0	g:gravity
Soft soil	0.13 g	0.09 g	0.07 g	0.05 g	0.03 g	0	

According to the above Figure and Table, the seismic coefficient in Btg. Rajang area is 0 as is the area in zone VI.

Table-2.2.3.3 Coefficient of Importance

Classification of Structure	Characteristics of structures	Coefficient of importance
Special Class	Structures for which the characteristics 1-3 of class A are strongly evident	1.5
Class A	1. Structures tending to cause loss of life and property upon seismic damage. 2. Structures playing an important role in reconstruction after earthquake disaster. 3. Structures handling hazardeous materials and tending to cause seismic damage to life or property upon seismic damage. 4. Structures which seriously affect the economic and social activities of the areas concerned upon seismic damage. 5. Structures for which considerable difficulty is envisaged to reconstruct upon seismic damage.	1.2
Class B	Structures other than the special class or class A.	1.0
Class C	Small structures permitting easy reconstruction.	0.5

2.3 Design of Structures

2.3.1 Timber Products Wharf

This wharf is planned for handling containers, sawn-timbers, plywoods, veneers, dowels and mouldings, etc. in the Tg. Manis area.

(1) Type of wharf

Where the water depth is 10.0m in the river, a detached pier (see **Figure-2.3.1.1**) is recommended as the structural model for the wharf, because this type of structure will not substantially disturb the river flow. Furthermore, a detached pier is appropriate under such a ground condition as N value being less than 10.

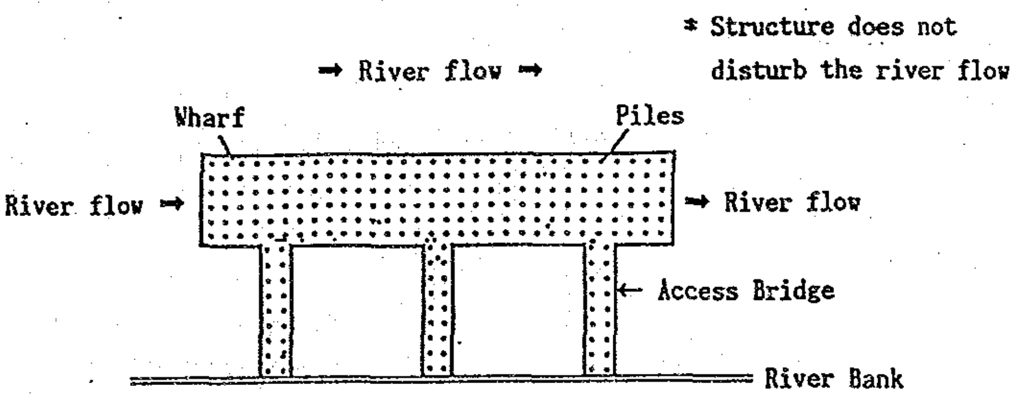


Figure-2.3.1.1 Plane View of Detached Pier

A gravity type (such as Concrete Block, Caisson, Cellar Steel Pile, Monolith Concrete, etc.) or a Sheet Pile type (such as Steel Sheet Pile, Steel Sheet Pipe Pile, etc.) is not recommended as a wharf structures because they significantly disturbs the area and also cannot stand safely on the strata of clayey silt. (see **Figure-2.3.1.2**)

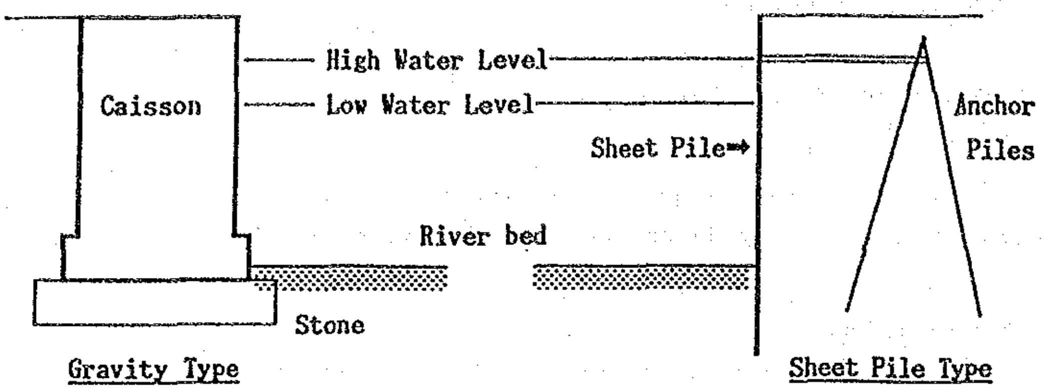


Figure-2.3.1.2 Gravity Type and Sheet Pile Type

(2) Pile for foundation

For the structure of the wharf foundation, Steel Pipe Pile will be used rather than concrete pile. The reasons are;

1) Concrete pile will crack when driven into the strata due to the soil condition at the site

The foundation piles of the wharves will penetrate into the thin hard strata lying at a depth of -20 to -25m below Chart Datum at the site.

Under the circumstances, PS Pile (Pre-stressed Concrete Pile) or RC (Reinforced Concrete) pile will be cracked when driven into the strata. Therefore, the SPP (Steel Pipe Pile) is recommended.

2) Concrete pile with sufficient bending moment resistance is not available in Malaysia.

3) Piling Workability

In consideration of the specific quality of steel, SPP can be driven more safely and quickly than concrete pile, and the steel pile has an advantage in jointing the pile.

4) Economic reason (See **Appendix-III.4.1.1**)

(3) Lining of steel

The steel piles should be sealed with concrete lining or an equivalent sealer above the specific elevation, i.e. splash zone, to prevent corrosion (see Figure-2.3.1.3).

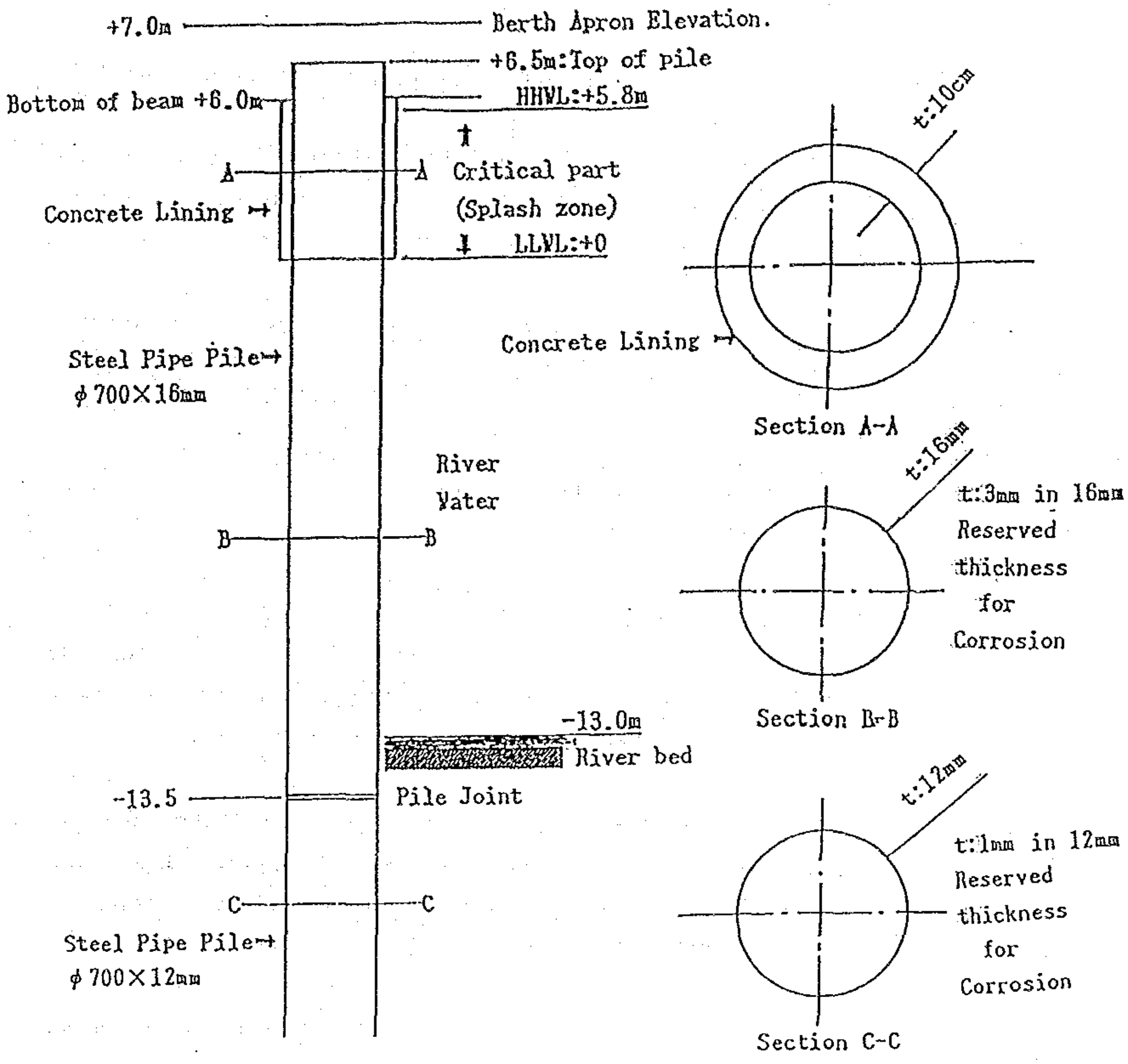


Figure-2.3.1.3 Concrete Lining of Steel Pipe Pile

(4) Pile foundation type

The following two types will be considered for the pile foundation of the deep water wharf:

1) Vertical pile group with the replacement of soft soil by sand to increase lateral resistance

2) Vertical piles and diagonal piles without the replacement of soft soil

However, dredging work at the river bed which is necessary to replace the soil with sand may have some adverse effects on the environment. Moreover, the construction cost of both types are almost the same.

Therefore, Item 2) is recommended for the timber products deep wharf.

(5) Others

Upper structures of the wharf shall be RC (Reinforced Concrete) beams and PC (Pre-stressed Concrete) slabs.

The structures of the shallow water wharf of -5.0 m is also designed as a detached type the same as in the deep wharf of -10.0 m and for the same reason. The foundation of the wharf will consist of vertical steel piles because the degree of lateral resistance will be sufficient.

The typical standard cross-section of the deep wharf (-10.0m) and the shallow wharf (-5.0m) are shown in **Figure-2.3.1.4 & 2.3.1.5.** The plane view of the timber products wharf of -10.0m depth at the east shore side of Tg. Sebubal is shown in **Figure-2.3.1.6.**

The design calculation of the timber products wharf is shown in **Appendix-III.2.3.1.**

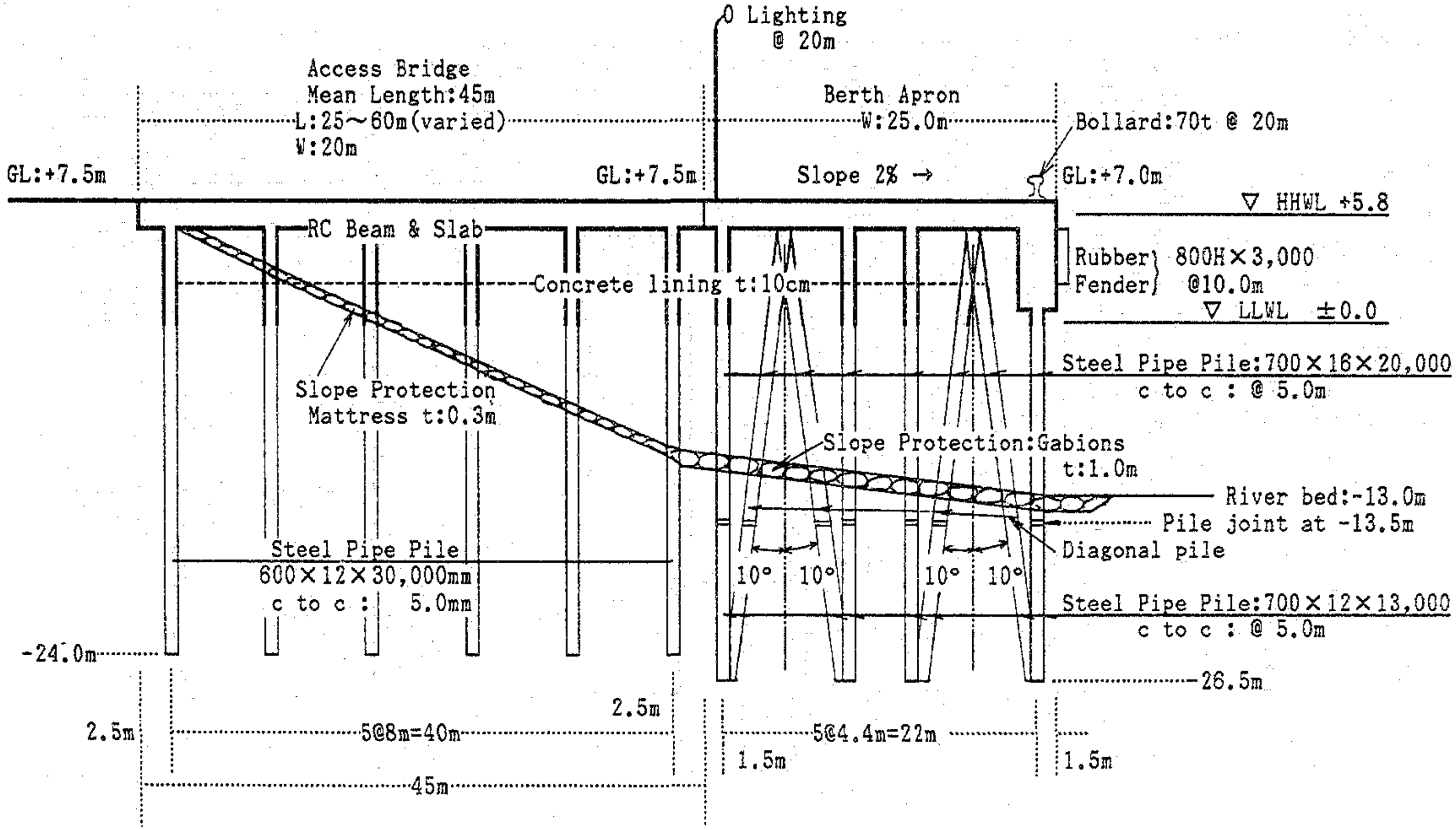


Figure-2.3.1.4 Typical Cross-Section of -10.0m Timber Wharf with Diagonal Piles at Tg. Sebubal East

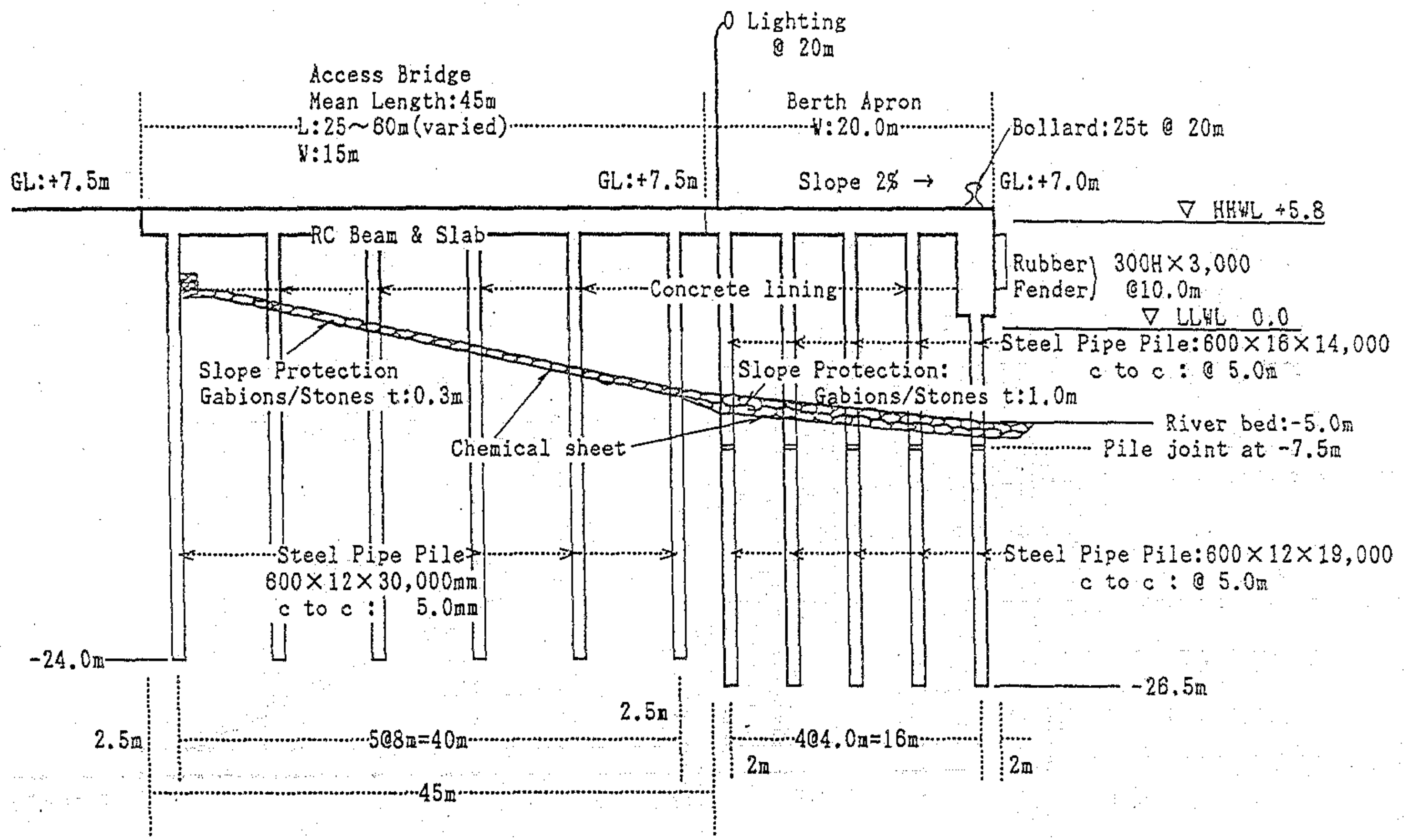


Figure-2.3.1.5 Typical Cross-Section of -5.0m Deep Timber Wharf

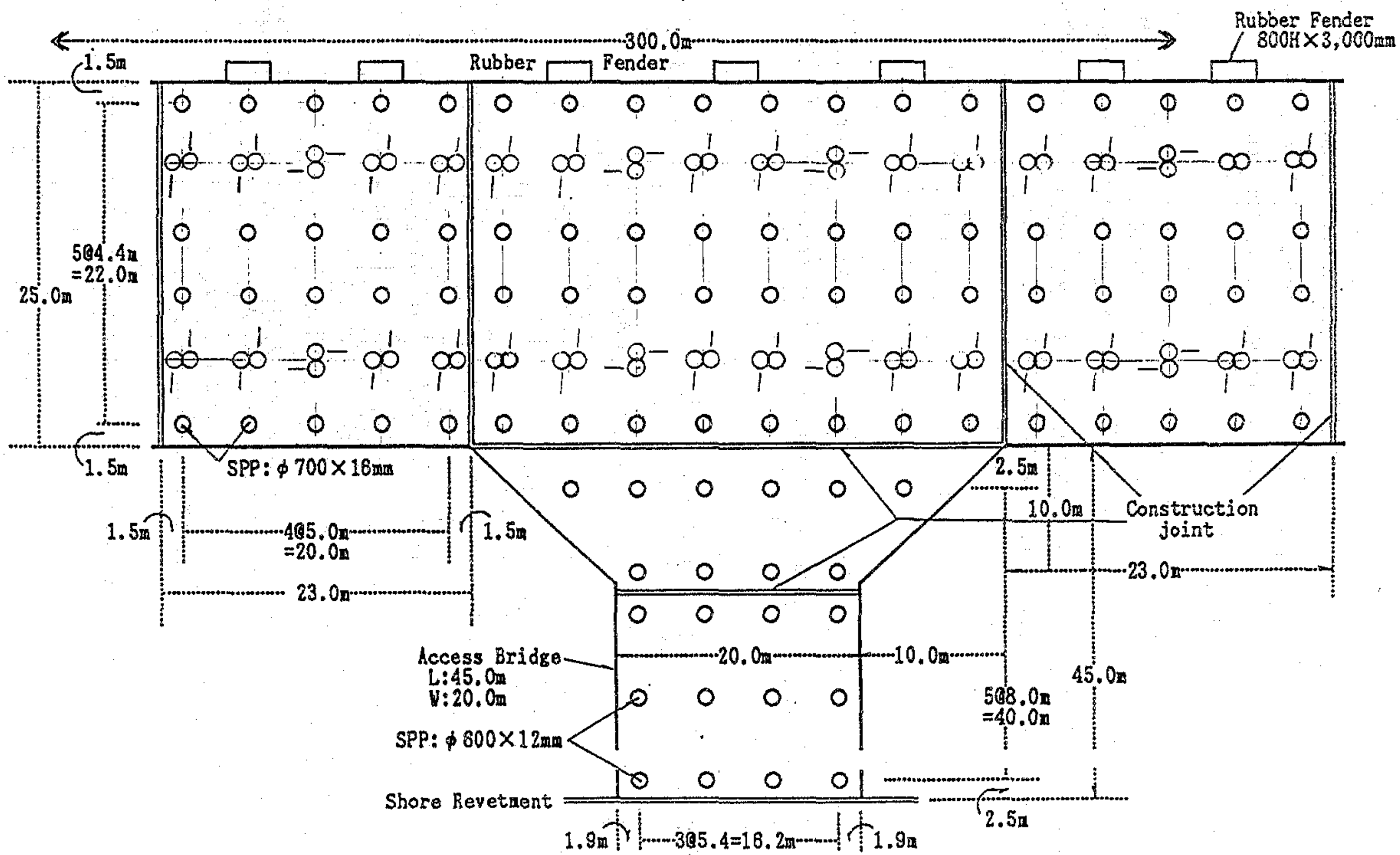


Figure-2.3.1.6 Plane View of timber Products Wharf of -10.0m Depth at Tg. Sebubal East

2.3.2 Coal Wharf

(1) The coal wharves are expected to export and to unload coal for the thermal power station. The volume of coal to be transported from the mine by barges and unloaded at the wharves is estimated as 500,000 t in 1997 (Short-term plan) and 1,100,000 t in 2010 (Master Plan).

(2) In order to reduce construction cost, it is recommended that both -10m and -5m wharves should be combined as shown in **Figure-2.3.2.2** and **Figure-2.3.2.3.** The structure of the deep wharf is of a type similar to the timber products wharves, i.e. the Steel Pipe Piles foundation and RC deck.

(3) The portable belt-conveyor loader such as shown in **Figure-2.3.2.1** is recommended for coal loading.

The plane view of the combined coal wharf is shown in **Figure-2.3.2.4.** The design calculation of the coal wharf is shown in **Appendix-III.2.3.2.**

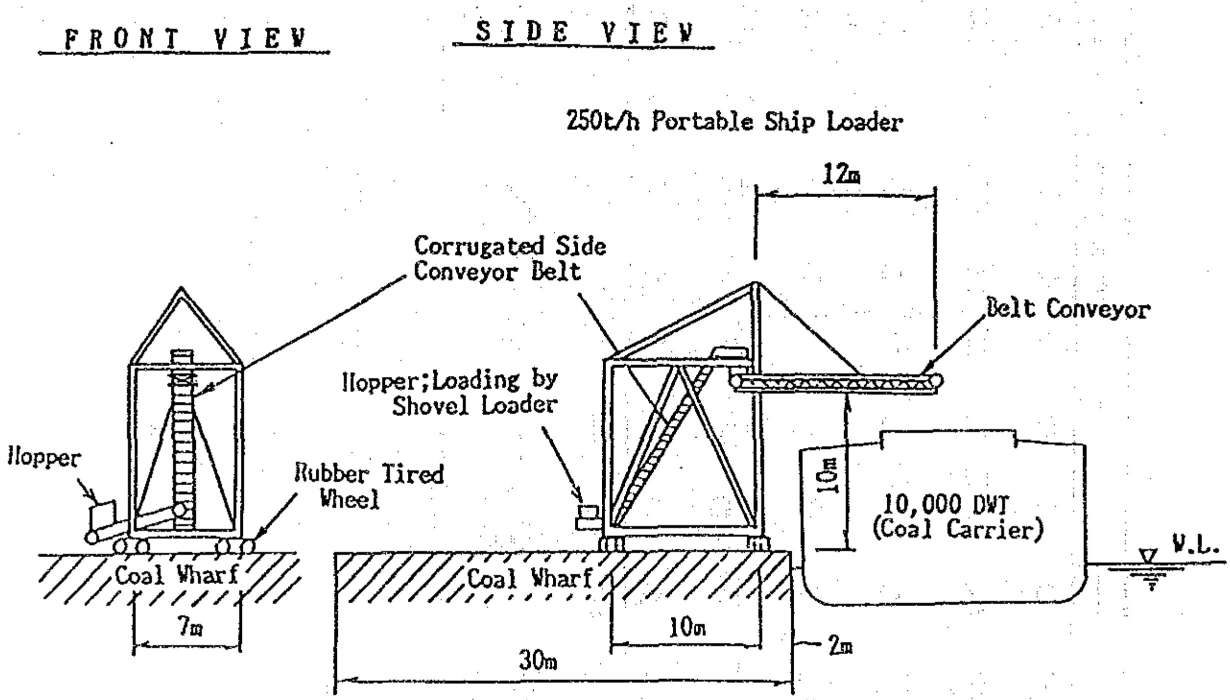


Figure-2.3.2.1 Movable Conveyor System for Coal Loading Operation

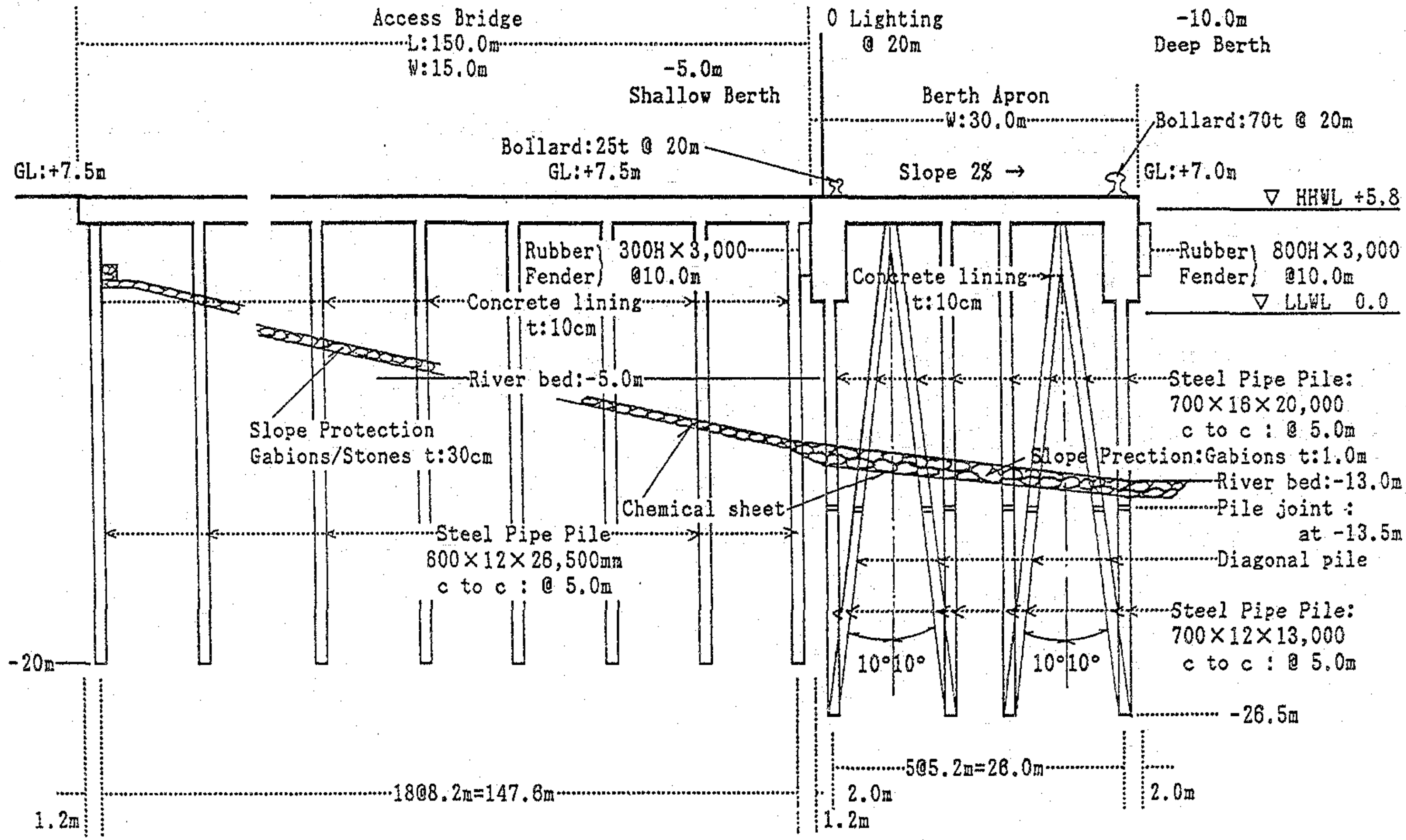


Figure-2.3.2.2 Typical Cross-Section of Combined Coal Wharf
(Depth -10 & -5m)
at Tg. Sebubal East

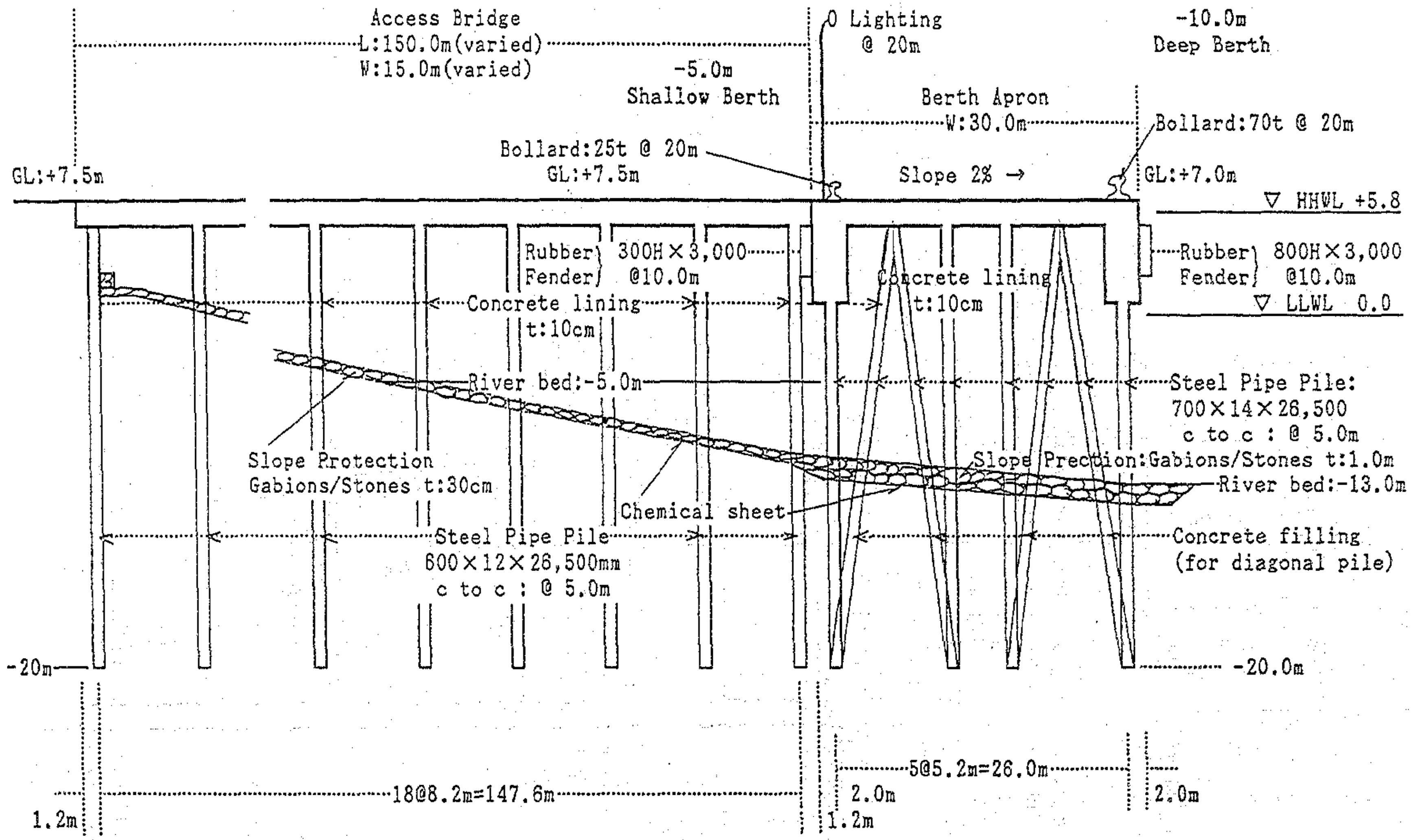


Figure-2.3.2.3 Typical Cross-Section of Combined Coal Wharf
(Depth of -10 to -5m)
at the Opposit Site of Tg. Sebubal

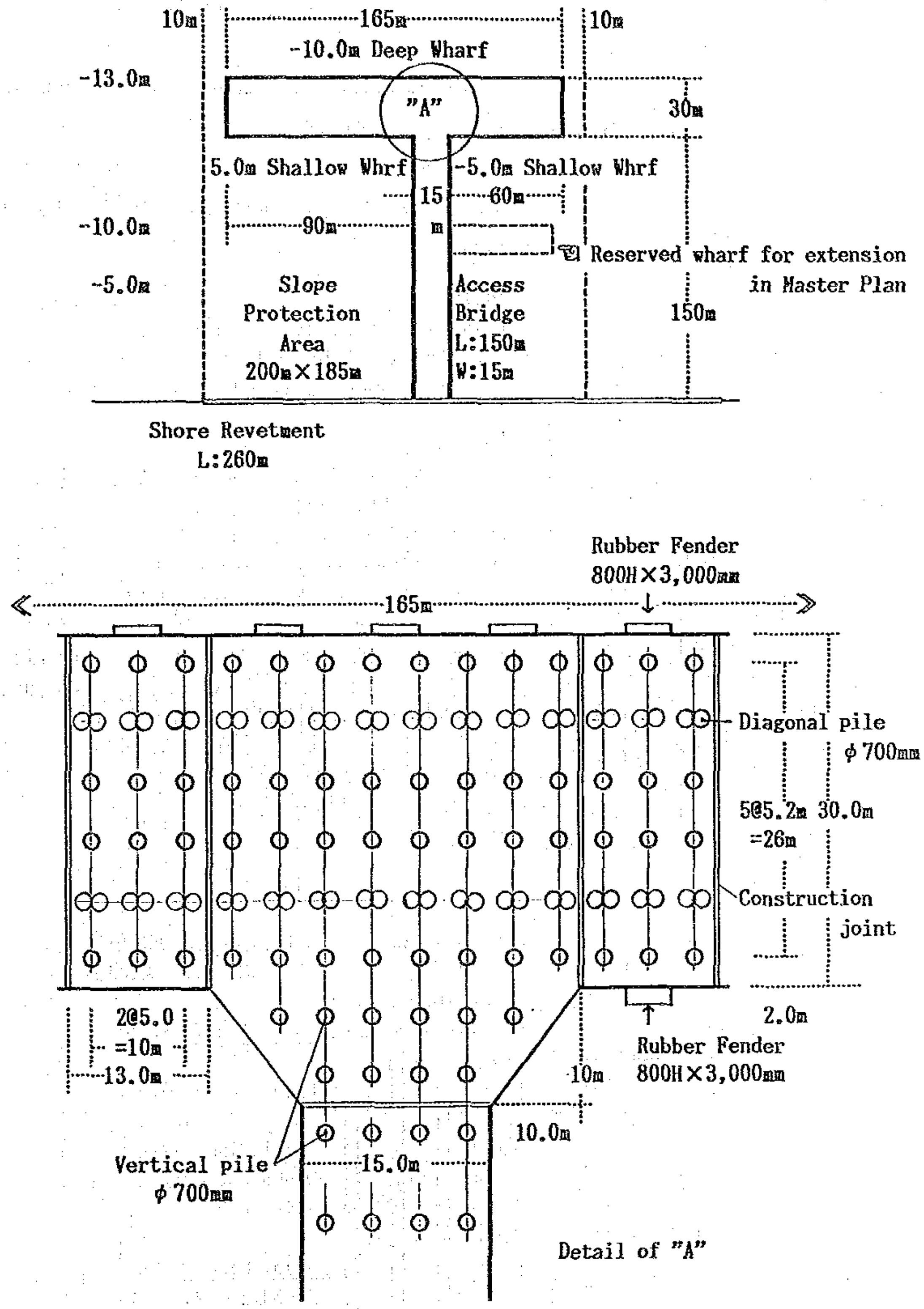
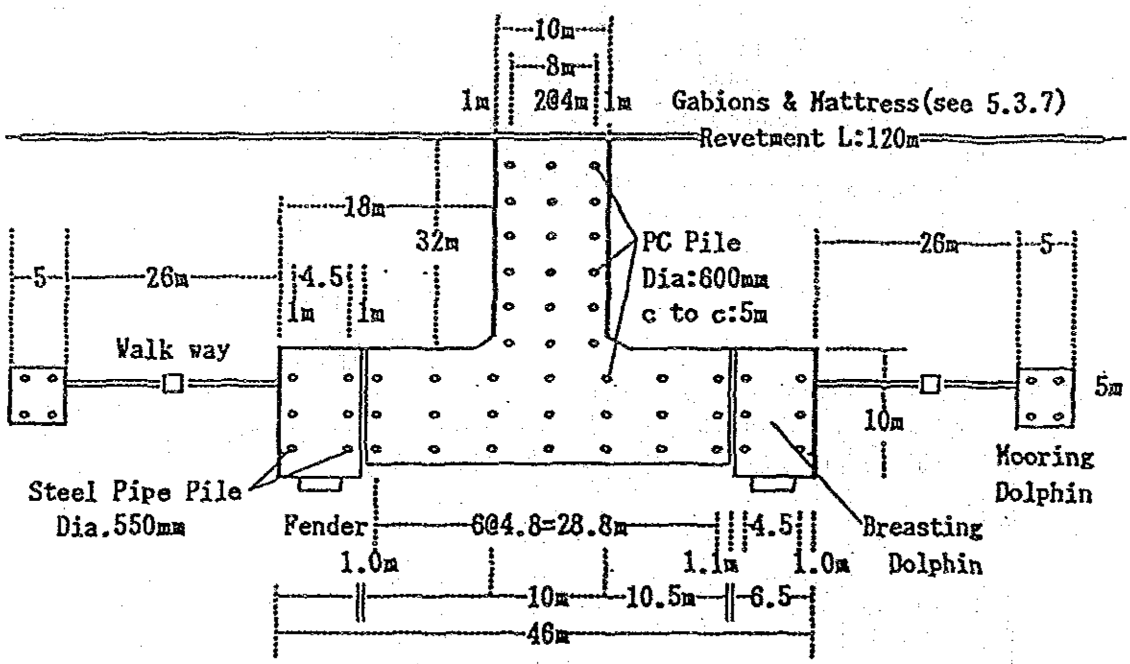


Figure-2.3.2.4 Plane View of Combined Coal Wharf
(Depth of -10.0 & -5.0m)

2.3.3 Oil Jetty

The structure of the new oil jetty shall be similar to the existing one at Sg. Merah, which has a Steel Pipe Piles foundation with concrete filling and RC deck. The plane view and the cross-section of this jetty are shown in the following figures. The design calculation of the oil jetty is shown in **Appendix-III.2.3.3.**



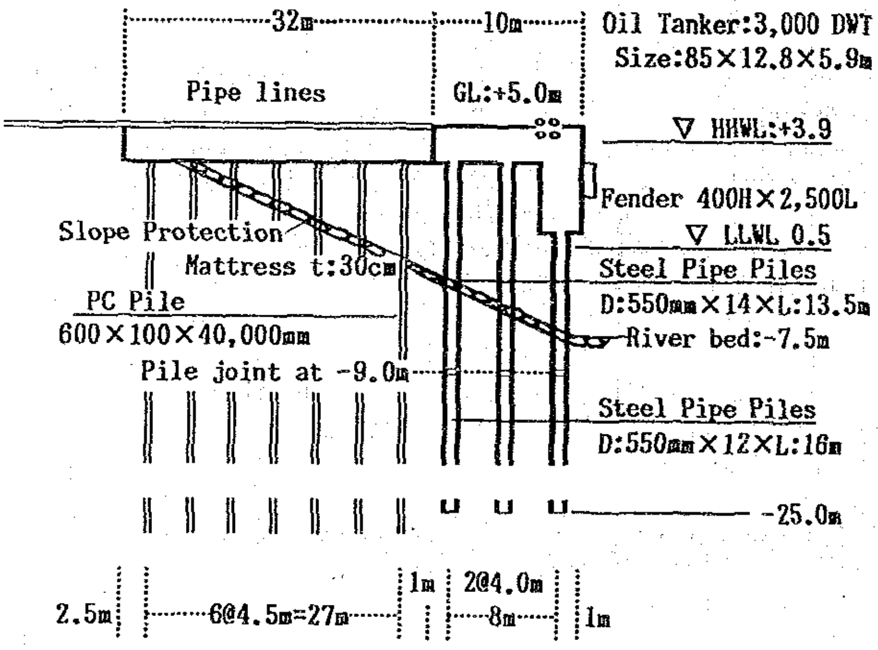


Figure-2.3.3.2 Cross-Section of Oil Jetty

2.3.4 Transit shed and open storage yard

(1) The proposed structure of the transit shed at the Timber Products Terminal is shown in the following sketch. For economic reasons, steel Frame (H-beam, Angle, Channel & Plate, etc.) structure is recommended for the shed.

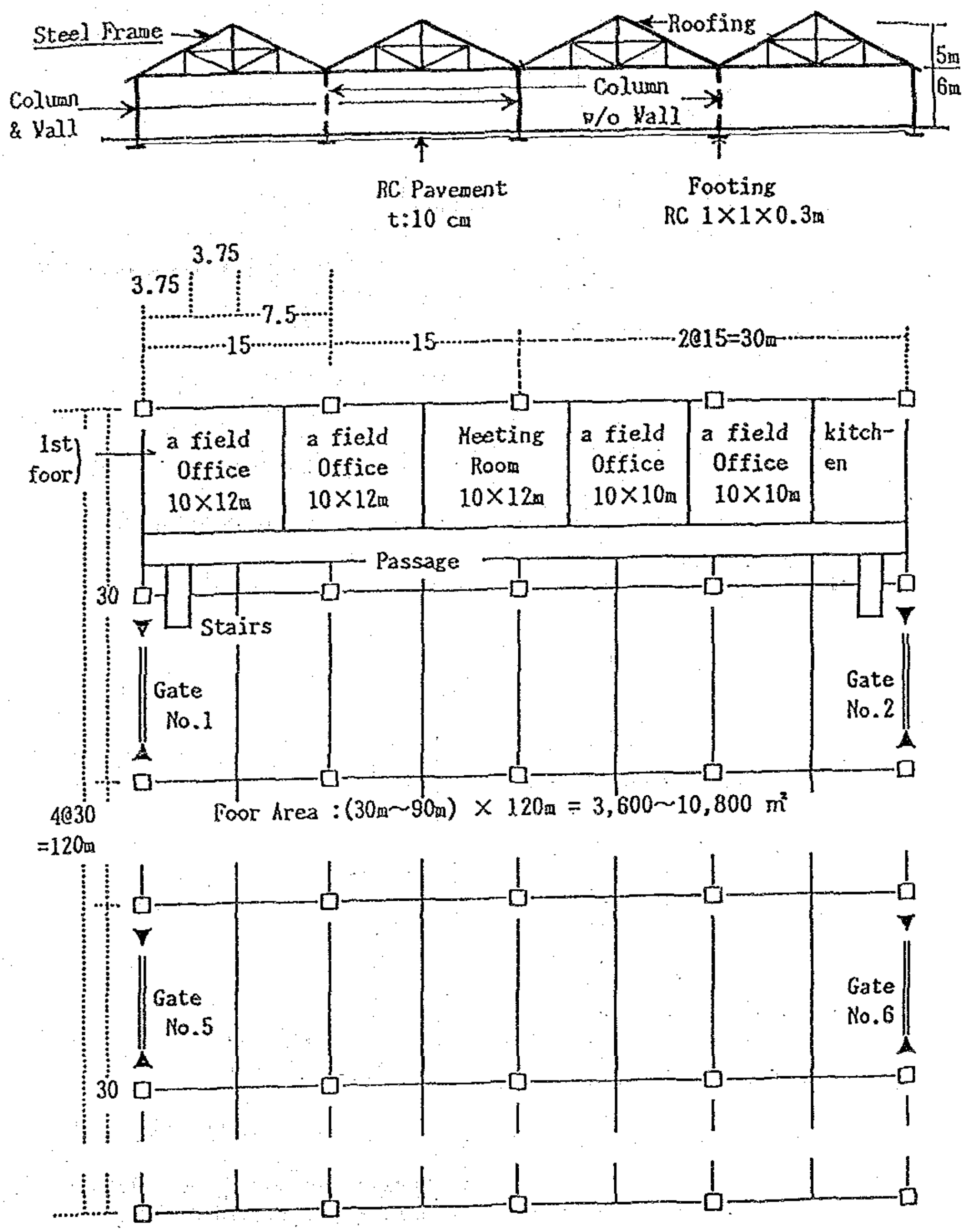


Figure-2.3.4.1 Transit Shed at Timber Products Terminal

(2) Open storage yard: Proposed specification of pavement for the open storage yard is shown in the figures below.

Calculation for consolidation settlement of soil (Tg. Sebubal East) is shown in **Appendix-III.2.3.4.**

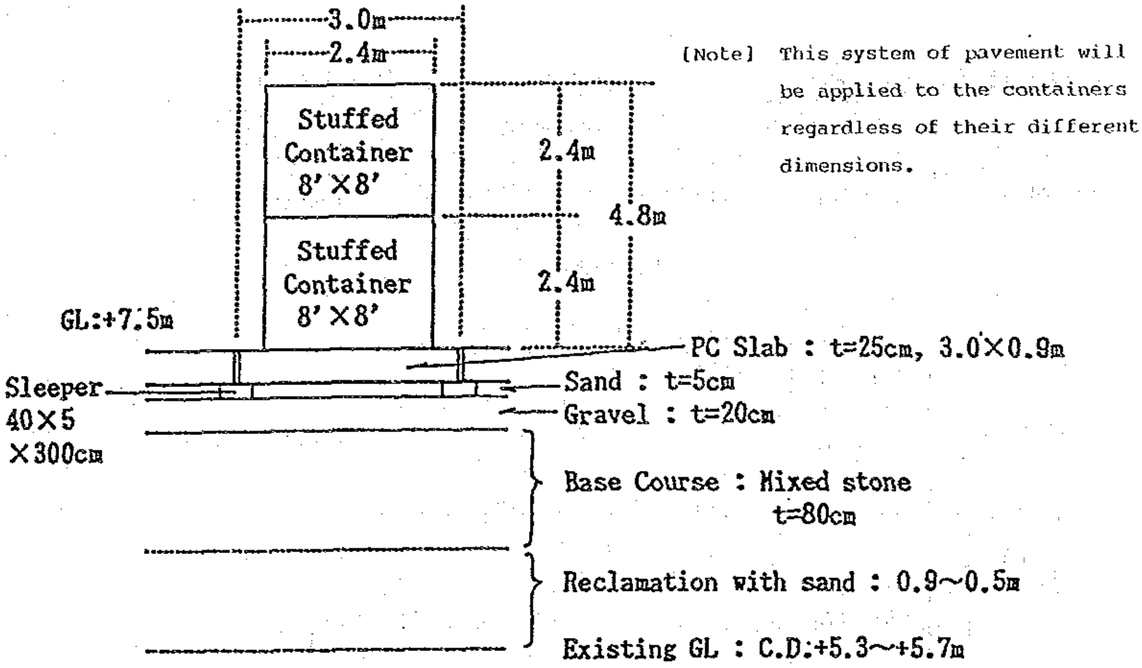


Figure-2.3.4.2 Pavement for Stuffed Container Yard

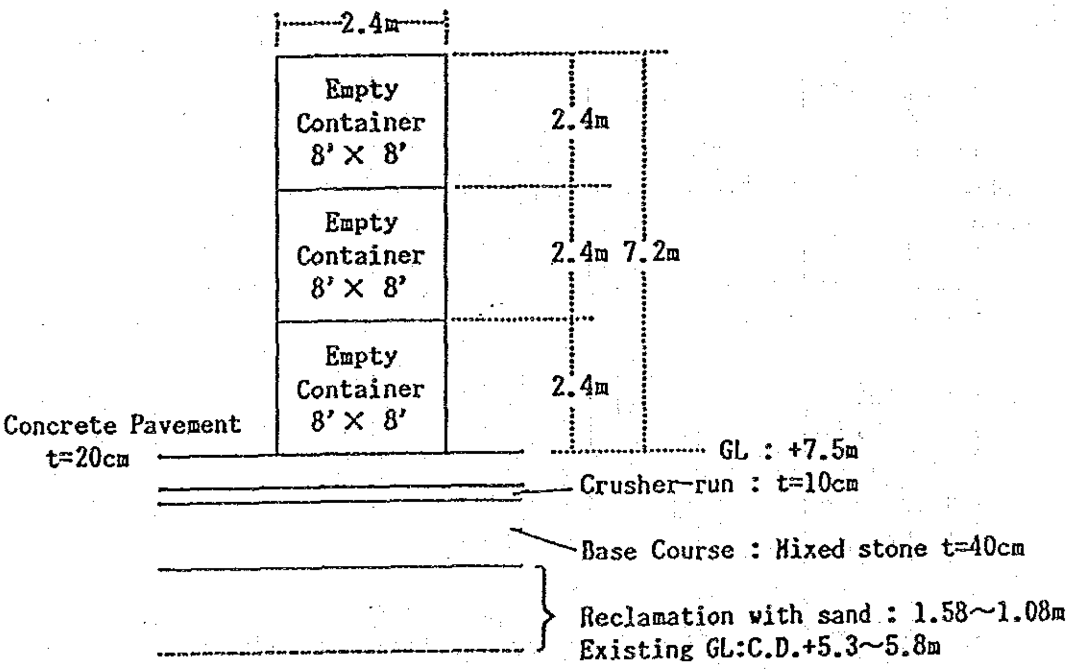
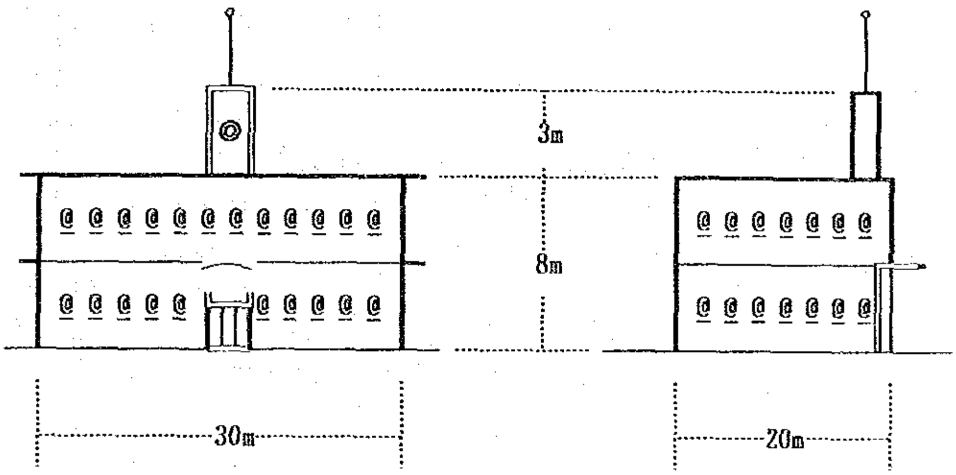


Figure-2.3.4.3 Pavement for Empty Container Yard and General Cargo

2.3.5 Miscellaneous facilities

(1) Administration building

An administration building is necessary at the Timber Products Terminal. This building shall be made of RC structures as shown in the following sketch.



Structure : RC
with Air conditioning,
Electricity, Gas,
Water etc.

Floor area: 30m × 20m × 2F=1,200 m²

Figure-2.3.5.1 Administration Building at Timber Products Terminal

(2) A maintenance shop will be erected at the Timber Products Terminal for the purposes of maintenance, repair and of supplying parts for cargo handling equipment. The structure of the shop is recommended as shown in the following sketch.

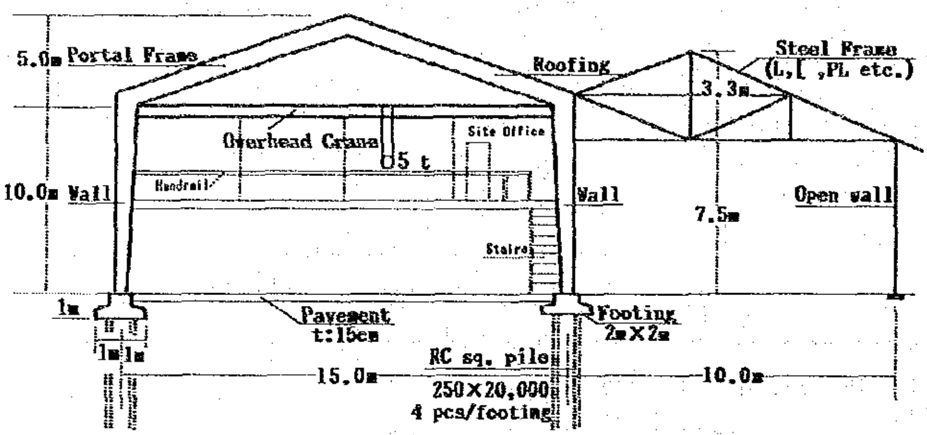


Figure-2.3.5.2 Structural Section of Maintenance Shop

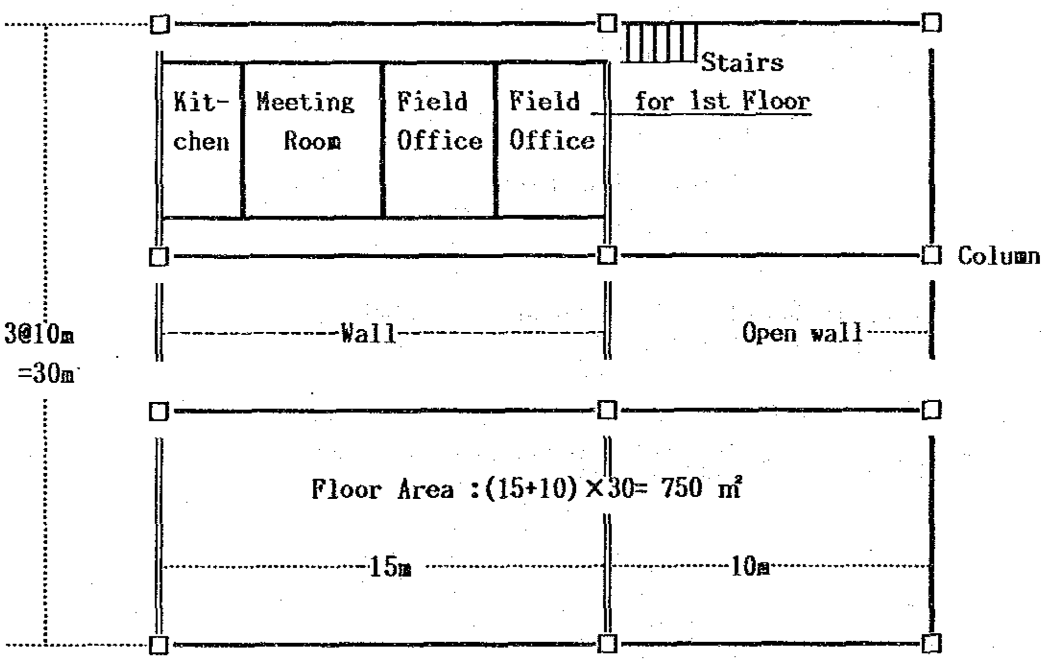


Figure-2.3.5.3 Plane View of Maintenance Shop

(3) Road

The following sketch is recommended as the standard road section in the port terminal area. Concrete pavement is recommended for the area due to the high temperatures at the site.

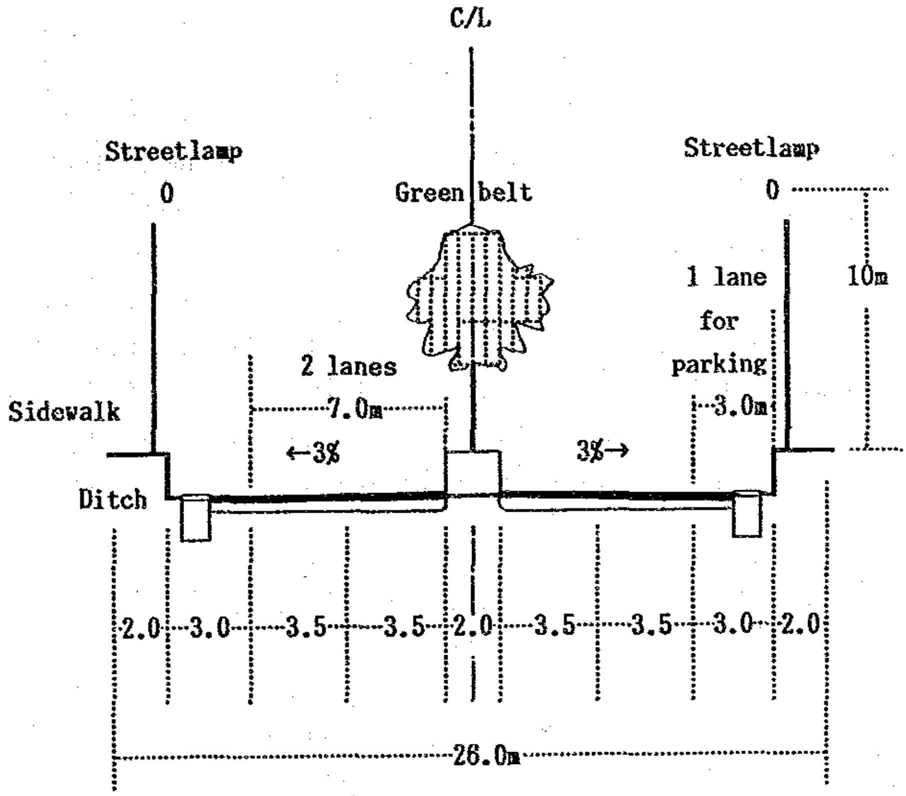


Figure-2.3.5.4 Typical Cross-Section of Road

2.3.6 Shore revetment and slope protection

It is observed that erosion has occurred at several places along the river bank of the proposed site at the east shore of Tg. Sebubal and at the opposite bank of Tg. Sebubal. A detailed description of this erosion is provided in 2.1.5(5) of Volume-I. It is necessary to protect the river bank and structures facing the Rajang river from erosion.

There are many kinds of shore revetment, such as timber piles, stones, sand bags, gabions, concrete blocks, armour stones, sheet piles, RC walls, etc. Stone gabions, stones and sand bags type with chemical fiber sheet as shown in **Figure-2.3.6.1** to **Figure-2.3.6.3** are recommended from the comprehensive view point of construction, maintenance cost and protection effect. The protection work using gabions was performed at Sibu wharf.

[Note] The method on the river shore revetment and slope protection for the proposed site will be considered as follows.

1) Armour stone
2) Concrete block
3) Stone
4) Gabion
5) Sand bag

A technical comparison of the above-mentioned methods is shown in **Appendix-III.2.3.6.**

The circular slip calculation of river shore slope is shown in **Appendix-III.2.3.5.**

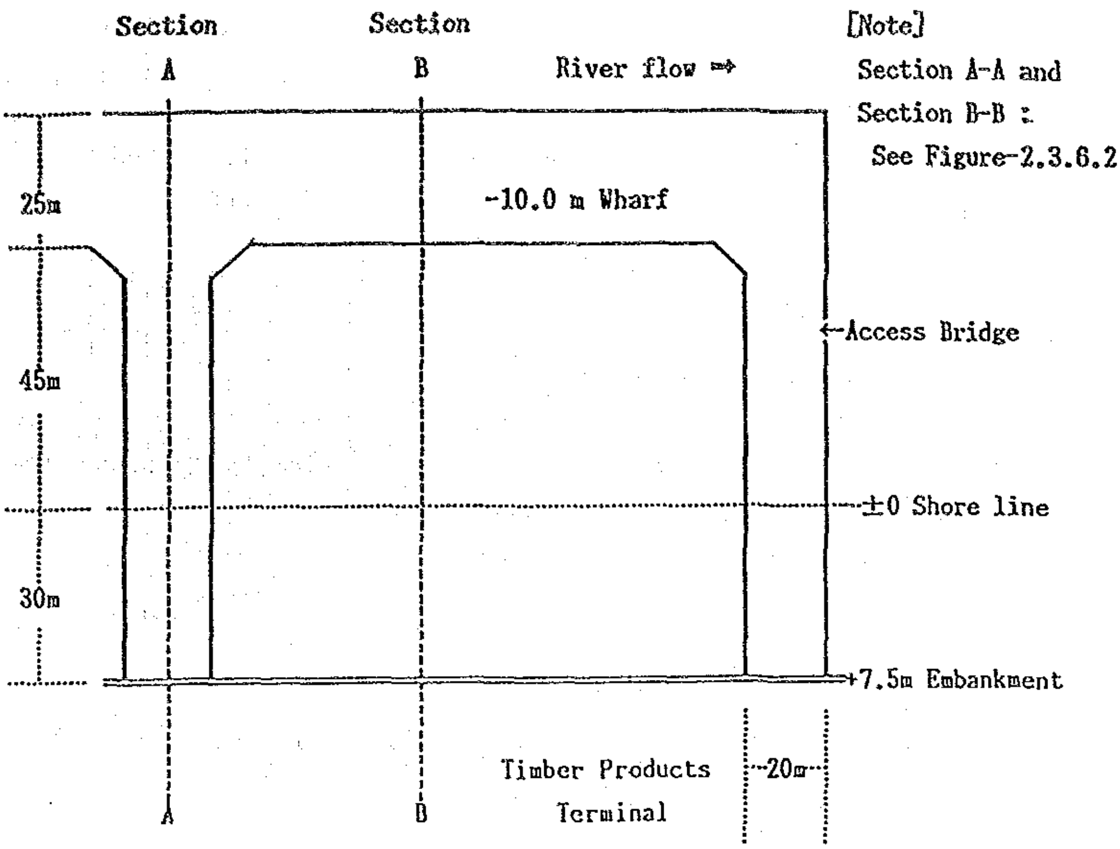
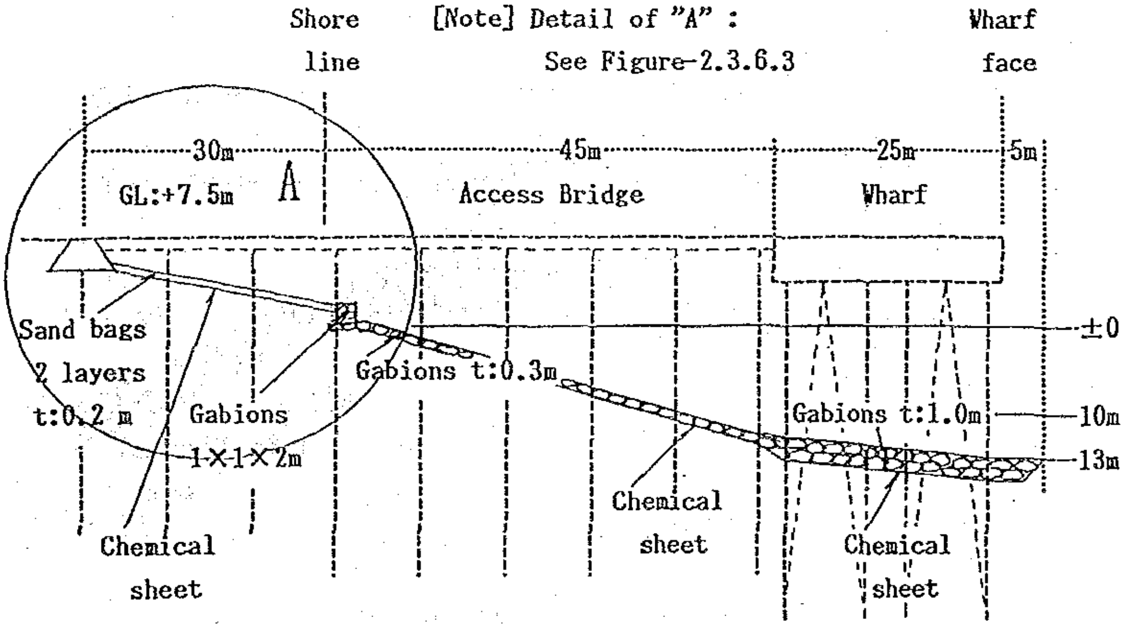
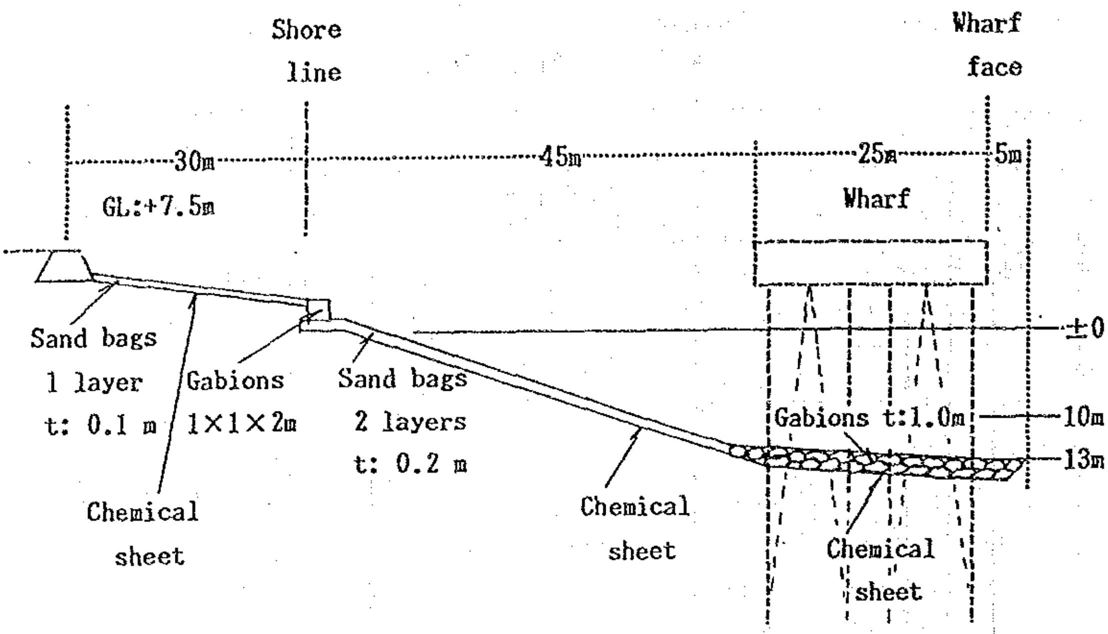


Figure-2.3.6.1 Plane View of Timber Products Wharf

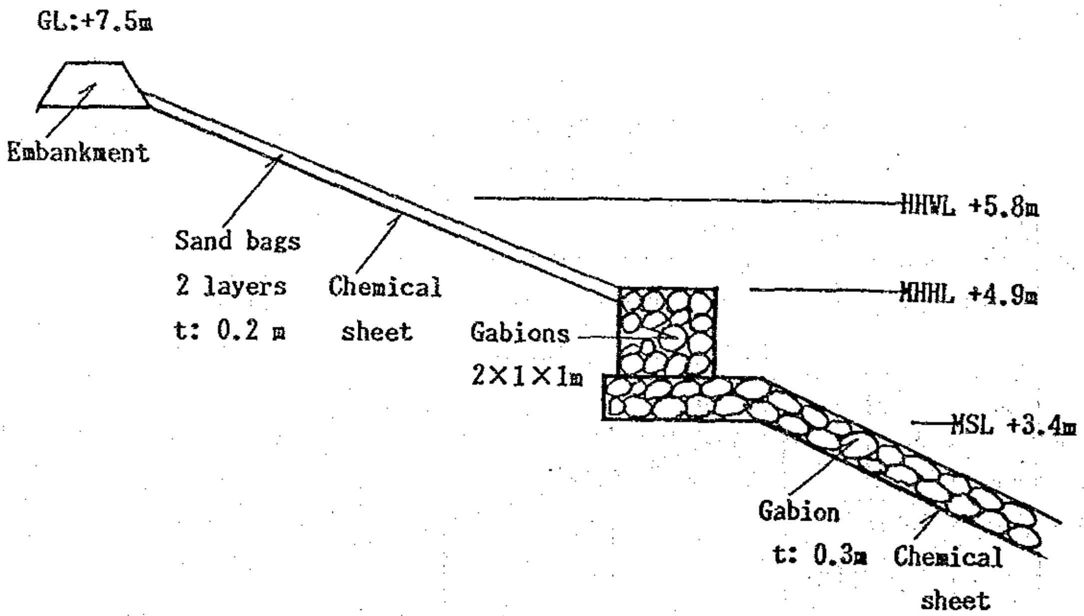


Section A - A



Section B - B

Figure-2.3.6.2 Slope Protection at Timber Products Wharf



Detail of "A"

Figure-2.3.6.3 Detail of "A" in Figure-2.3.6.2

Slope protection of the Oil Jetty at Sg. Merah shall be same type as that of the Timber Products Terminal as shown in **Figure-2.3.6.4.**

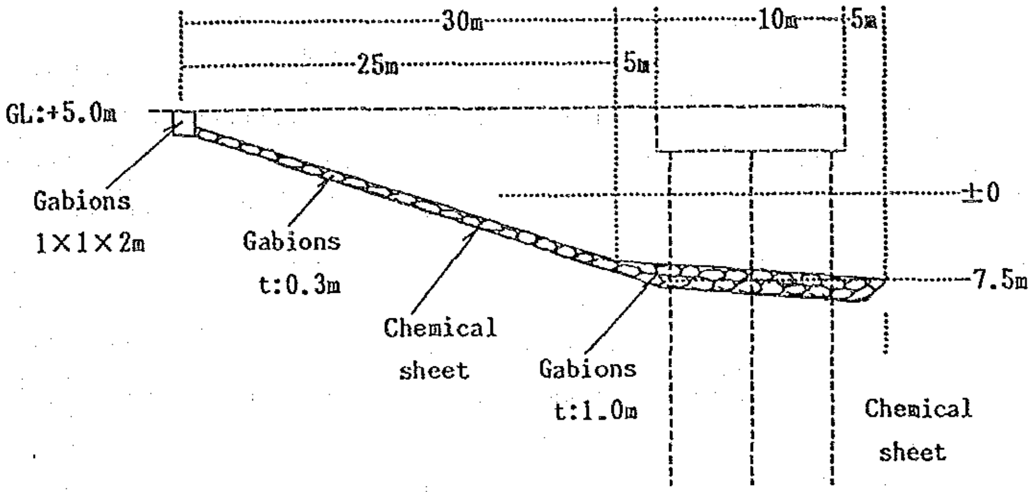


Figure-2.3.6.4 Slope Protection at Oil Jetty

3. CONSTRUCTION PROGRAM

3.1 Site Conditions

3.1.1 Meteorological conditions

The construction sites in short-term plan are Sungai Merah and Tanjung Manis area.

The rainfall, the wind velocity and the wave condition are considered to affect construction works during the construction period.

1) Rainfall

   The data analysis of rainfall at Sibu in 1989 was conducted by the study team.

   Judging from the analysis, 10 % of non working day per year due to rainfall is predicted. Sunday work is not considered.

   As a result, total working days of 23 days per month is assumed.

2) Wind

   Wind velocity is generally moderate in this area and there are no cyclonic storms.

3) Wave

   Wave height is low in this area and there is few difficulties in offshore constructions.

3.1.2 Soil condition

The boring works was conducted at several sites by the study team and the soil profile are showed in Volume 1 of this report.

The soil stratum of Sungai Merah is sandy layer and there are no hard layer to disturb piling works.

The soil stratum of Tanjung Sebubal area is silty or sandy layer and Weathered Sandstone of stiff layer can be found at -26 m. The pile driving in this area is required to reach up to -26 m.

The soil stratum of the site opposite of Tanjung Sebubal is silty or sandy layer and Weathered Siltstone of stiff layer can be found at -20 m. The pile driving in this area is required to reach up to -20 m.

3.2 Construction Materials

3.2.1 Local materials

Major construction materials are available in Malaysia, namely cement, steel products, timber, stone etc.

Required sand volume for reclamation of Master Plan is about 1.5 million m^3 including 0.45 million m^3 of Short-term Plan.

The borrow area of these sand is in front of east shore at Tanjung Sebubal.

The quality and quantity of sand from the borrow area are confirmed by the STIDC Site Investigation Report in 1990.

According to this report titled "Site Investigation Report for Sand Search at Tanjung Manis, Oct. 1990", 17 bore holes were surveyed for about 10 m each from riverbed by rotary wash boring method using drilling barge at east and west shoreline of Tanjung Sebubal.

From boring No. 1 to 7 were performed in east shoreline covering about 200 hectares and boring No. 8 to 17 were performed in west shoreline covering about 300 hectares. Estimated sand volume of these borrow area will be over 20 million m^3.

3.2.2. Import materials

Construction materials that are not available in Malaysia will be imported from aboard, namely rubber fender, bollard, building equipment, etc.

The list of major construction materials are shown in **Table 3.2.2.1.**

Table-3.2.2.1 List of Major Construction Materials for Short-term Plan

No.	Description	Timber Wharf & Bridge Quantity	Coal Wharf & Bridge Quantity	Oil Jetty Quantity	Total
1.	Steel Pipe Pile ϕ700	3,883 ton	2,136 ton	—	6,019 ton
	〃 ϕ600	2,247 〃	1,124 〃	—	3,371 〃
	〃 ϕ550	—	—	111 ton	111 〃
2.	Steel Bar	1,355 ton	606 ton	72 〃	2,033 〃
3.	Concrete	13,550 m^3	6,060 m^3	720 m^3	20,330 m^3
4.	Quarry (5~20 kg)	40,600 ton	17,700 ton	3,000 ton	61,300 ton
5.	Chemical Sheet	52,500 m^2	19,400 m^2	3,100 m^2	75,000 m^2
6.	Rubber Fender 800H	ℓ=3,000、 30 set	ℓ=3,000、 17 set	—	47 set
	〃 400H	—	—	ℓ=2,500、 2 set	2 〃
	〃 300H	ℓ=3,000、 18 set	ℓ=3,000、 15 set	—	15 〃
7.	Bollard 70T	15 〃	8 〃	—	23 〃
	〃 25T	9 〃	8 〃	—	17 〃
8.	P. C. Pile ϕ600	—	—	t=100、 ℓ=40,000 39 nos	39 nos

3.3 Construction Equipment

3.3.1 Equipment available in Sarawak

Conventional type of construction equipment is available in Sarawak, namely bulldozer, grader, back-hoe, truck crane, crawler crane, vibrator, etc.

Some kinds of offshore construction equipment is also available, namely flat-barge, crane-barge, tugboat, etc.

3.3.2 Equipment procured outside Sarawak

Large size offshore construction equipment and concrete plant will be mobilized from abroad, namely piling pontoon, cutter suction dredger and automatic concrete batcher plant.

The list of major construction equipment is shown in **Table 3.3.2.1.**

Table-3.3.2.1 List of Major Construction Equipment for Short-Term Plan

No.	Description	Model	Quantity
1.	Cutter Suction Pump Dredger	D-4000 ps	1
2.	Piling Pontoon	D-40	1
3.	Diesel Pile Hammer	D-180 ps	1
4.	Crane Barge	35 ton	1
		5 "	1
5.	Mobile Crane	35 ton	1
		10 "	1
6.	Bulldozer	D-7	1
		D-4	1
7.	Shoveldozer	3 m^3	1
		1.2 "	1
8.	Road Roller	10 ton	1
9.	Motor Grader	2.8 m	1
10.	Automatic Concrete Batcher Plant	30 m^3/h	1
11.	Concrete Pump	30 m^3/h	1
12.	Agitater Truck	3 m^3	4
13.	Dump Truck	11 ton	5
14.	Tug Boat	D-800 ps	2
15.	Flat Barge	200 ton	2
		100 "	2
16.	Diver Boat	D-20 ps	2

3.4 Labor Forces

3.4.1 Unskilled labor

About one hundred unskilled laborers will be required daily at the peak time of this project, however unskilled labor force is now shortage in Sarawak.

Unskilled laborers will be procured not only in Sarawak but also in other states of Malaysia.

3.4.2 Skilled labor

Skilled laborers for onshore works are available in Sarawak, but skilled laborers for offshore works are not available in Malaysia, such as piling crew and dredger's crew.

Skilled laborers for offshore works will be procured from abroad.

3.5 Construction Plan for the Short-term Plan

3.5.1 Offshore works

Dredging and reclamation at Tanjung Sebubal area and steel pipe pilling at Sungai Merah Oil Jetty, Tanjung Sebubal timber berth, coal berth and bridge will be conducted as offshore works.

3.5.2 Onshore works

Transit shed, administration building, maintenance shop, washing facilities, port road, open storage, coal yard and ancillary works at Tanjung Sebubal area will be conducted as onshore works.

3.6 Construction Schedule for the Short-term Plan

The development schedule is projected as follows:

Completion of Feasibility Study by JICA ---------- Dec. 1991

Period of Detailed Design ------------------------ 12 months

Tender Call, Evaluation of Tender & Signing of

Contract -- 6 months

Construction Period ------------------------------ 30 months

The working schedule of various projects in Short-term Plans are shown in **Table-3.6.1.1.**

Table-3.6.1.1. Construction Schedule (Short-Term Plan)

Description	Q'ty \ Year / Month	1991 (6)	1992 (6)	1993 (6)	1994 (6)	1995 (6)	1996 (6)
1. F/S by JICA	L.S.						
2. E/S (D/D & Survey)	L.S.						
3. Tender for Construction	L.S.						
4. *Sungai Merah Oil Jetty*	L.S.						
5. Timber Products Terminal							
1) Deep Wharf (-10m)	300 m						
2) Shallow Wharf (-5m)	180 m						
3) Container Stock Yard	23,300 m²						
4) Transit Shed /C.F.S.	12,800 m²						
5) Admi. Building	1,000 m²						
6) Maintenance Shop	700 m²						
7) Washing Facilities	400 m²						
8) Open Storage Yard	8,300 m²						
9) Port Road	26,900 m²						
10) Parking & Paved Area	23,600 m²						
11) Green Area	3,000 m²						
12) Reclamation	100,000 m²						
13) Utilities	L.S.						
6. Coal Terminal							
1) Deep Wharf (-10m)	165 m						
2) Shallow Wharf (-5m)	150 m						
3) Coal Stock Yard	25,000 m²						
4) Port Road	2,000 m²						
5) Reclamation	32,000 m²						
6) Utilities	L.S.						
7. Cargo Handling Equipment	L.S.						
8. Coal Handling Equipment	L.S.						
9. Navigation Aids	L.S.						
10. Miscellaneous Works	L.S.						
11. Mobilization	L.S.						

4. COST ESTIMATES

4.1 Cost Estimate Factors

1) Prices are shown in Malaysian Ringgit, based on February, 1991 prices.
2) The exchange rate is one year average of year 1990.

   1 US Dollar = 2.8 Malaysian Ringgit.

   1 Malaysian Ringgit = 53 Japanese Yen.
3) Customs duties on Imported materials and equipment are not included.
4) No import duty for the floating equipment.
5) Sales tax in local materials is assumed.
6) Consulting services is assumed.
7) A physical contingency of 6 % is assumed.

Unit prices for wages and materials are shown in **Table 4.2.1.1.**

4.2. Project Cost Estimate in Short-term Plan up to 1997

The total project cost of the short-term plan up to 1997 is estimated as Malaysian Ringgit 144,962,000.- as shown in **Table 4.2.2.1,** of which the local and foreign portions are:

Local portion	M$96,615,000 (67 %)
Foreign portion	M$48,347,000 (33 %)

The component cost is as follows:

The cost of Timber Products Terminal up to 1997 is estimated as Malaysian Ringgit 110,806,000.- as shown in **Table 4.2.2.2,** of which the local and foreign portions are:

Local portion	M$72,334,000 (65 %)
Foreign portion	M$38,472,000 (35 %)

The cost of Coal Terminal up to 1997 is estimated as Malaysian Ringgit 33,513,000.- as shown in Table 4.2.2.3, of which the local and foreign portions are:

Local portion M$21,772,000 (65 %)

Foreign portion M$11,741,000 (35 %)

The cost breakdown of cargo handling equipment and coal handling equipment are shown in **Table-4.2.2.4.**

Table-4.2.1.1 Unit Prices for Wages & Materials

Description	Unit Price (Malaysian Ringgit)		Remarks
1. Wages			
Foreman	1,500	M$/month	EPF is not included.
Skilled Labor	900	"	"
Common Labor	600	"	"
Welder	1,050	"	"
Carpenter	1,050	"	"
Operator	1,200	"	"
2. Materials			
Cement	215	M$/ton	
Re-Bars	1,380	"	
Structural Steel	2,000	"	
Steel Pipe	2,100	"	
Timber	480	"	
Sand	7	"	
Gravel (Quarry Run)	22	"	
Gasoline	1.13	M$/l	
Light Oil (Diesel)	0.64	"	

Table-4.2.2.1 Cost Estimate for The Short-Term Plan

No.	Description	Work Item	Quantity	Unit Price (M$)	Amount (1,000 M$) L/C	F/C	Total
1.	Sungai Merah	Oil Jetty	L. S.	—	3,192	265	3,457
2.	Timber Products Terminal	1) Timber Wharf (−10 m)	300 m	85,684	19,355	6,350	25,705
		2) Timber Wharf (− 5 m)	180 m	70,344	11,278	1,384	12,662
		3) Timber Wharf Bridge	200 m	53,215	9,229	1,414	10,643
		4) Transit Shed/CFS	12,800 m²	582	7,449	—	7,449
		5) Administration Building	1,000 m²	1,140	1,140	—	1,140
		6) Maintenance Shop	700 m²	855	599	—	599
		7) Washing Facility	400 m²	646	258	—	258
		8) Container Stock Yard	23,300 m²	120	2,796	—	2,796
		9) Open Storage Yard	8,300 m²	106	880	—	880
		10) Port Road	26,900 m²	113	3,040	—	3,040
		11) Parking & Paved Area	23,600 m²	106	2,502	—	2,502
		12) Green Area	3,000 m²	4	12	—	12
		13) Reclamation	340,000 m³	8	544	2,176	2,720
		14) Cargo Handling Equipment	L. S.	—	—	4,343	4,343
		15) Utilities	L. S.	—	1,408	1,408	2,816
		Sub Total :			60,490	17,075	77,565
3.	Coal Terminal	1) Coal Wharf	165 m	91,552	11,234	3,872	15,106
		2) Coal Wharf Bridge	150 m	37,527	5,340	289	5,629
		3) Coal Yard	25,000 m²	4	100	—	100
		4) Water Processing Facility	5,000 m²	60	300	—	300
		5) Port Road	2,000 m²	113	226	—	226
		6) Reclamation	108,800 m³	8	174	696	870
		7) Coal Handling Equipment	L. S.	—	94	2,972	3,066
		8) Utilities	L. S.	—	445	445	890
		Sub Total :			17,913	8,274	26,187
4.	Navigation Aids	1) Tug Boat 2,000 PS	1 Unit	6,795,000	—	6,795	6,795
		2) Tug Boat 1,000 PS	1 Unit	5,094,000	—	5,094	5,094
		3) Light Buoy (offshore)	4 Unit	386,000	620	924	1,544
		4) Light Buoy (waterway)	4 Unit	155,000	120	500	620
		5) Buoy	—	70,000	—	—	—
		6) Racon	1 Unit	466,000	208	258	466
		7) Weather/Tidal Station (master)	1 Unit	2,600,000	942	1,658	2,600
		8) Weather/Tidal Station (remote)	1 Unit	473,000	171	302	473
		Sub Total :			2,061	15,531	17,592
5.	Land Acquisition Cost		132,000 m²	32	4,224	—	4,224
6.	Miscellaneous	Temporary Facilities	L. S.	—	600	600	1,200
7.	Mobilization	Mobilization & Demobilization	L. S.	—	—	1,200	1,200
	Sub Total :				88,430	42,945	131,425
8.	Consulting Services	Detailed Design		—	2,826	2,825	5,651
9.	Physical Contingencies		6 %	—	5,309	2,577	7,886
	Total :				96,615	48,347	144,962

Note: US Dollar 1.- = Malaysian Ringgit 2.8 = Japanese Yen 148.-

L/C = Local Currency, F/C = Foreign Currency

Table-4.2.2.2 The Cost of Timber Products Terminal up to 1997

Work Item	Quantity	Unit Price (M$)	Amount(1,000M$)		
			L/C	F/C	Total
Timber Products Terminal					
1. Timber Wharf (-10m)	300m	85,684	19,355	6,350	25,705
2. 〃 (- 5m)	180〃	70,344	11,278	1,384	12,662
3. Timber Wharf Bridge	200〃	53,215	9,229	1,414	10,643
4. Transit Shed/CFS	12,800㎡	582	7,449	—	7,449
5. Admi Building	1,000〃	1,140	1,140	—	1,140
6. Mainte Shop	700〃	855	599	—	599
7. Washing Facility	400〃	646	258	—	258
8. Container Stock Yard	23,300〃	120	2,796	—	2,796
9. Open Storage Yard	8,300〃	106	880	—	880
10. Port Road	26,900〃	113	3,040	—	3,040
11. Parking & Paved Area	23,600〃	106	2,502	—	2,502
12. Green Area	3,000〃	4	12	—	12
13. Reclamation	340,000㎥	8	544	2,176	2,720
14. Cargo Handling Equipment	L.S.	—	—	4,343	4,343
15. Utilities	L.S.	—	1,408	1,408	2,816
16. Navigation Aids	L.S.	—	2,061	15,531	17,592
17. Land Acquisition Cost	100,000m^2	32	3,200	—	3,200
18. Miscellaneous	L.S.	—	360	360	720
19. Mobilization	L.S.	—	—	1,200	1,200
Sub Total			66,111	34,166	100,277
20. Consulting Services	L.S.	—	2,256	2,256	4,512
21. Physical Contingencies	6%		3,967	2,050	6,017
Total			72,334	38,472	110,806

Table-4.2.2.3 The Cost of Coal Terminal up to 1997

Work Item	Quantity	Unit Price (M$)	Amount (1,000M$)		
			L/C	F/C	Total
Coal Terminal					
1. Coal Wharf (- 5m, -10m)	165m	91,552	11,234	3,872	15,106
2. Coal Wharf Bridge	150〃	37,527	5,340	289	5,629
3. Coal Yard	25,000㎡	4	100	—	100
4. Water Process Facility	5,000〃	60	300	—	300
5. Port Road	2,000〃	113	226	—	226
6. Reclamation	108,800㎥	8	174	696	870
7. Coal Handling Equipment	L.S.	—	94	2,972	3,066
8. Utilities	L.S.	—	445	445	890
9. Land Acquisition Cost	32,000m^2	32	1,024	—	1,024
10. Miscellaneous	L.S.	—	240	240	480
11. Mobilization	L.S.	—	—	1,200	1,200
Sub Total			19,177	9,714	28,891
12. Consulting Services	L.S.	—	1,445	1,444	2,889
13. Physical Contingencies	6%		1,150	583	1,733
Total			21,772	11,741	33,513

Table-4.2.2.4 List of Cargo Handling Equipment and Coal Handling Equipment

1. Cargo Handling Equipment

Description	Model	Quantity	Unit Price(M$)	Amount(M$)
Tractor Head	40'	5	113,200	566,000
Chassis	40'	5	56,600	283,000
Fork Lift	42 ton	2	962,300	1,924,600
"	25 ton	2	660,400	1,320,800
"	3 ton	6	41,433	248,600
Total				4,343,000

2. Coal Handling Equipment

Description	Model	Quantity	Unit Price(M$)	Amount(M$)
Dump Truck	10 ton	4	150,000	600,000
Shovel Loader	3 m^3	2	260,000	520,000
"	1 m^3	2	188,000	376,000
Ship Loader	250 t/h	1	1,570,000	1,570,000
Total				3,066,000

5. RECOMMENDATIONS ON PORT MANAGEMENT AND OPERATIONS

5.1 Introduction

The Short-term Development Plan and the Master Plan proposed in this report present the expansion plans for the Rajang Port, and the port facilities of these plans should, in principle, be managed in a unified method with the present facilities. Therefore, basically, the RPA, a port management body of the Rajang Port has to be responsible for these new port facilities. In other words, the RPA should manage and operate the new facilities as it does existing ones. However, there is some room for improvement in existing procedures. We have approached this issue in three steps.

(1) We have studied the present situation of the management and operations.

(2) We have developed some general ideas on management and operation of the facilities in the Short-term Development Plan.

(3) We have prepared a long-term recommendation on management.

5.2 Present Situation of the Management and Operations

5.2.1 Operational speed and efficiency

To achieve the optimum use of port facilities, it is essential to berth vessels and handle cargo with safety and speed. In particular, as for speed, it is a critical issue for port users.

To gauge the speed and efficiency of the Rajang Port, we studied the Sibu Wharf, which is the main wharf of the Rajang Port. We compared its performance of services with that of the Kuching Port which is, under control of the Kuching Port Authority, also located in Sarawak State. Specifically, we looked at: (1) waiting hours for a berth, (2) berthing hours, (3) cargo handling efficiency while staying at port, (4) cargo handling efficiency of gang, (5) situation of volume of cargo by type.

(1) Waiting hours for a berth

Table-5.2.1.1 summarizes the average performance of vessels that visited the ports in 1989.

Table-5.2.1.1 Average Performance of Vessels, 1989

<table>
<tr><td rowspan="3">Sibu
(Total 44.2h)</td><td rowspan="3">Waiting for a Berth
(9.9h)</td><td colspan="3">Berthing Hours (34.3h)</td></tr>
<tr><td colspan="2">Working Hours of Vessel (18.0h)</td><td rowspan="2">Non-Working Hours of Vessel (16.3h)</td></tr>
<tr><td>Gang Hours Worked (10.0h)</td><td>Gang Standby Hours (8.0h)</td></tr>
</table>

<table>
<tr><td rowspan="3">Kuching
(Total 42.2h)</td><td rowspan="3">Waiting for a Berth
(9.5h)</td><td colspan="3">Berthing Hours (32.7h)</td></tr>
<tr><td colspan="2">Working Hours of Vessel (17.3h)</td><td rowspan="2">Non-Working Hours of Vessel (15.4h)</td></tr>
<tr><td>Gang Hours Worked (10.4h)</td><td>Gang Standby Hours (6.9h)</td></tr>
</table>

(Source: RPA & KPA)

Waiting hours for a berth is 9.9 hours at the Sibu Wharf and 9.5 hours at the Kuching Port, virtually the same length of time. Reasons for waiting for a berth are shown in **Table-5.2.1.2.**

Table-5.2.1.2 Reasons for Waiting for a Berth at Sibu in 1989

No. of Vessels	490
No. of Vessels Waiting for a Berth	276
No. of Hours Spent Waiting for a Berth	4,860 (9.9)
-All Berths Occupied	962 (2.0)
-All Labour Gangs Utilized	1,258 (2.6)
-Storage Congestion	20 (0.0)
-Arrival at Night	1,045 (2.1)
-Arrival Uncertain	682 (1.4)
-Vessels Not Ready to Work	727 (1.5)
-Others	166 (0.3)

(Note) ( ) indicates average hours per vessel.

(Source: RPA)

(2) Berthing hours

The berthing hours amount to 34.3 hours at the Sibu Wharf, and 32.7 hours at the Kuching Port.

Berthing hours consist of both the working hours of a vessel and the non-working hours. The non-working hours are 16.3 hours at the Sibu Wharf and 15.4 hours at the Kuching Port. These are almost night time and meal time (total about 14 hours) when they don't handle cargo.

The working hours of a vessel are divided into gang hours worked when port workers are handling cargo, and gang standby hours when they are waiting for cargo to handle. The ratio of these two hours is almost 5:4 in both ports, although gang standby hours are a little longer at the Sibu Wharf. Reasons for gang standby are: rain, opening/closing the hatch, tea break/meal break and gear break down etc., and rain is the No.1 reason for gang standbys.

Table-5.2.1.3 Productivity of Vessel

	Sibu	Kuching
Cargo Volume/Vessel (A)	1,578.7t	1,166.8t
Staying Hours at Port (B)	44.2h	42.2h
Berthing Hours (C)	34.3h	32.7h
Working Hours of Vessel (D)	18.0h	17.3h
Gang Hours Worked (E)	10.0h	10.4h
Handling Volume/Staying at Port (A/B)	35.7t/h	27.6t/h
Handling Volume/Berthing Hours (A/C)	46.0t/h	35.7t/h
Handling Volume/Working Hours of Vessel (A/D)	87.7t/h	67.4t/h
Handling Volume/Gang Hours Worked (A/E)	157.9t/h	112.2t/h

(Source: RPA & KPA)

(3) Productivity while staying at port

Table-5.2.1.3 shows the productivity of an average vessel that visited at the both ports in 1989.

From a vessel's viewpoint, it is important to achieve total efficiency or productivity while staying at port, not just in cargo handling by port workers. Total productivity of Sibu is higher than at Kuching, but it still is not at a satisfactory level because the non-working hours of the vessels are long.

(4) Productivity of port workers

Table-5.2.1.4 shows the productivity of shore-side work, that, in itself, is good. In all categories of cargo, the Sibu Wharf achieves higher productivity than the Kuching Port.

Table-5.2.1.4 Productivity of Shore-side Work

Year	Containerized		Palletized		Non-Palletized	
	Sibu (TEU/Gang Hour)	Kuching (TEU/Gang Hour)	Sibu (Ton/Gang Hour)	Kuching (Ton/Gang Hour)	Sibu (Ton/Gang Hour)	Kuching (Ton/Gang Hour)
1985	17	15	104.5	71.9	51.4	48
1986	16	14	92	81.5	50.6	46
1987	16	13	95	82.2	49.4	48.7
1988	16	13	116.4	74.2	50.3	47.9
1989	17	12	101.4	71.7	58.5	43.2

(Source: RPA & KPA)

(5) Situation of volume of cargo by type

In an analysis of port speed and efficiency in handling cargo, it is important to note current trends in cargo flow: for example, the degree of palletizing and containerizing. **Table-5.2.1.5** shows the change in volume of cargo by type in the past five years. Containerization has progressed year by year in both ports, which indicates that productivity is becoming higher. However, the volume of non-palletized cargo at the Sibu Wharf does not appear to be on a solid down trend.

Table-5.2.1.5 Volume of Cargo by Type

(Unit 1,000t)

	Sibu			Kuching		
	Non-Palletized	Palletized	Containerized	Non-Palletized	Palletized	Containerized
1985	227(100)	36(100)	70(100)	812(100)	140(100)	166(100)
1986	217(96)	35(97)	93(133)	750(92)	137(98)	221(133)
1987	266(117)	38(106)	127(181)	688(85)	169(117)	280(169)
1988	244(107)	44(122)	168(240)	663(82)	173(124)	363(219)
1989	269(119)	44(122)	183(261)	656(80)	175(125)	424(255)

(Note) ( ) indicates the index compared with 1985.

(Source: RPA & KPA)

(6) Summary of operational speed and efficiency

As we said earlier, the efficiency (productivity) of shore-side workers is relatively high, however, from the viewpoint of a vessel's staying at port, productivity is not high. The RPA gives incentives to port workers to raise productivity and gets the good results in this point. Though, for port users, cargo handling productivity is not the sole consideration. It is also important to reduce total staying hours at port. From the viewpoint of the port management body, this point means that port facilities can be used more efficiently.

In this point, non-working hours during berthing, especially gang standby hours seem too long at the Sibu Wharf.

5.2.2 Tariff system

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

Particularly, it should:

1) Cover construction, maintenance and operating cost.
   However, we have some cases where Governments have subsidized construction costs because tae port is considered important for public interest.
2) Collect the proper charges that reflect the services provided.
3) Provide an incentive structure to encourage more efficient port management and operation. In other words, the tariff system should be designed to make cargo and vessel's flow more efficiently.
4) Be a competitive with those at neighboring ports.
5) Be straightforward in its design and method of collecting charges.

With these criteria in mind, the following points can be noted.

(1) The RPA doesn't collect a storage charge on empty containers.

The RPA started to handle containers in 1982. The volume increased year by year rapidly and it reached 12,125 TEU in 1989 (20% up compared with the previous year). In the early days of containerization, free storage may have been an incentive to use more containers. But, if the volume of empty containers continues to increase on the premises of the RPA, it will hinder handling of cargo. It is a right of the port management body to collect storage charges for empty containers as compensation for use of the premises. Indeed, neighbouring ports (the Kuching Port Authority, the Sabah Port Authority, etc.) do. It is very important from a policy viewpoint to limit the storage volume of empty containers in the premises.

(2) Charges don't correspond with actual use of wharves.

Compensation for use of port facilities including wharves is collected as wharfage based on the volume of cargo. In this scheme, charges are based on volume, and there is no connection with vessel's size and length of berthing time. However, these elements need to be incorporated into the rate structure to ensure that charges correspond with services. Adopting these points would also encourage vessels to use wharves efficiently.

5.2.3 Organization of the RPA

To promote use of the port it is essential to establish a more useful and attractive port in terms of both facilities and management and operation for users such as shipping lines, shipping agents, forwarders, shippers, consignees, etc.. For that purpose, it is necessary to have a realtime, broad, systematic grasp of the users' needs and to consider their needs in the practical development and management of the port.

The port should be marketed aggressively, by providing users with pertinent information. The bigger the port and the keener the competition with other ports, the more important marketing and promotion become. At the moment, however, there are few officers in charge of these activities within the organizational structure of the RPA.

5.3 Recommendations on the Existing Management and Operation

5.3.1 Efficient operation at wharves

The RPA should make a further effort to shorten the staying period of vessels at port.

(1) Reconsidering the standard for handling efficiency

The RPA is attempting to raise handling efficiency, but it seems to attach great importance to improving productivity (efficiency) per gang hours worked. However, it would be useful for user service and efficient use of port facilities to raise the productivity (efficiency) during berthing hours.

We believe that there is a flaw in the current incentive program to raise the productivity per gang hour worked, because in the program the RPA does not consider the impact of extended gang standby hours. While the current incentive has had some positive effect, it should be reconsidered by taking gang standby hours into account.

(2) Supply of port workers required

In 1989 the number of port workers was about 150 well below the required number 210. Because of a lack of gangs, some vessels entering the port had to wait for a berth. Total hours waiting for a berth in 1989 were 1,258 because all labor gang were occupied. The RPA needs to ensure that the required number of port workers is on-hand.

(3) Introduction of dockage charges

Dockage charges should be introduced as an incentive to use the wharf efficiently based on vessel's size (GRT/DWT or LOA) and length of berthing hours.

5.3.2 Restructuring the tariff system

There will be a trend towards containerization and larger vessels in the Rajang Port. Port charges will need to reflect these trends.

(1) Introduction of storage charges for empty containers

It is necessary to introduce this charge to cover the cost of storage, to avoid accumulation of containers and to promote efficient use of the container yard.

(2) Introduction of dockage charges (above-mentioned)

It is necessary to introduce dockage charges based on a vessel's size and berthing hours to cover the cost of the various services and to promote efficient use of the wharves.

5.3.3 Reinforcement of the organization of the RPA

(1) Establishment of a Marketing Department

The RPA should establish a marketing department to fulfill both internal and external obligations. For example, the department can collect information on port users' requirements, advertise the advantages of the port and attract customers.

Internally, the department can function as an advisory organization to other departments by providing information collected on users' requirements. Such a cross-departmental function could revitalize the RPA as a whole.

(2) Development and utilization of a statistics system

It is necessary to arrange and utilize statistics on vessels, cargo, etc. to develop and manage/operate ports. At present, statistics are handled manually and they are not arranged regularly or systematically. As the RPA is starting to use computer now, statistics should be filed regularly and systematically in future.