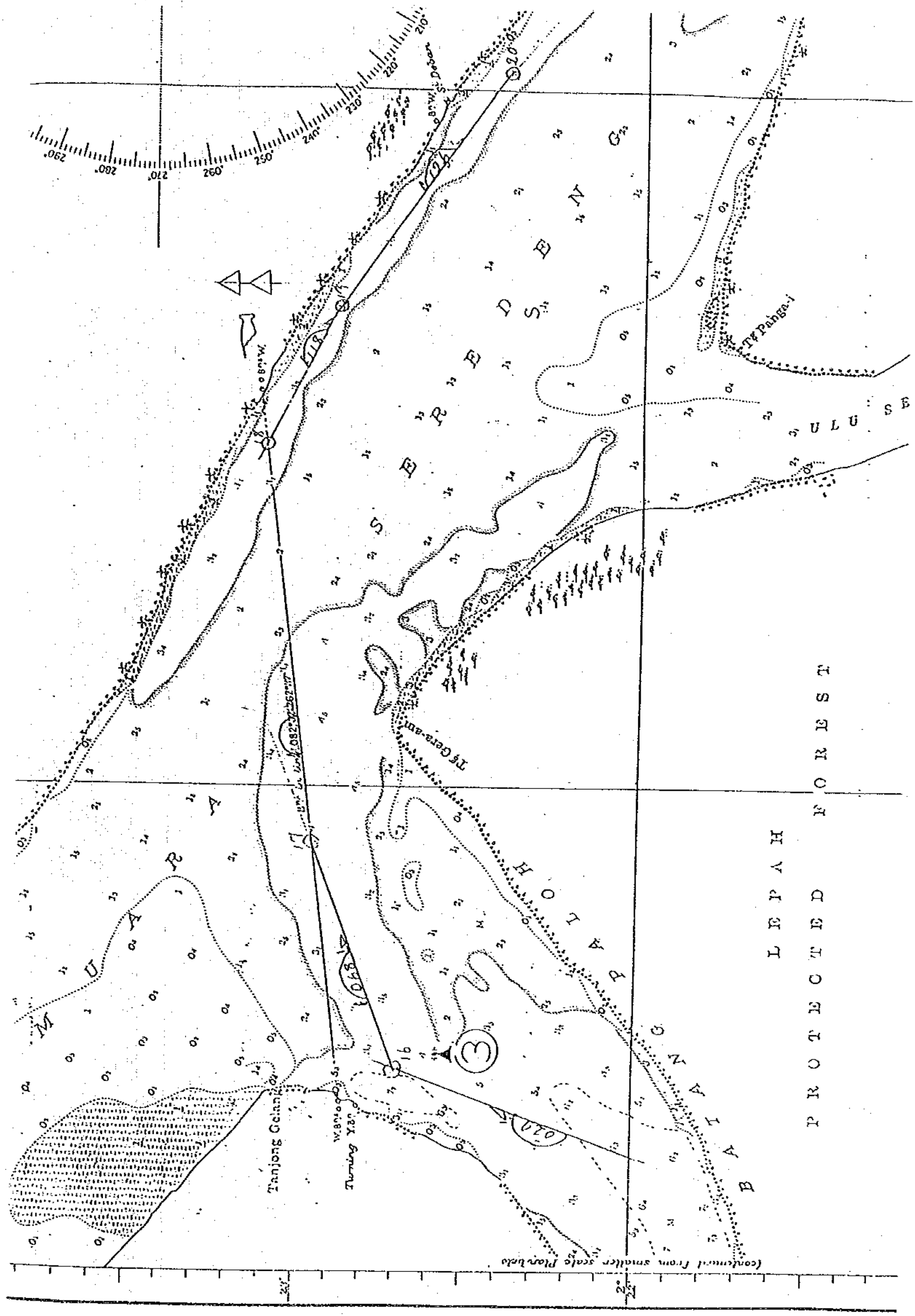


Figure-6.2.1(21)

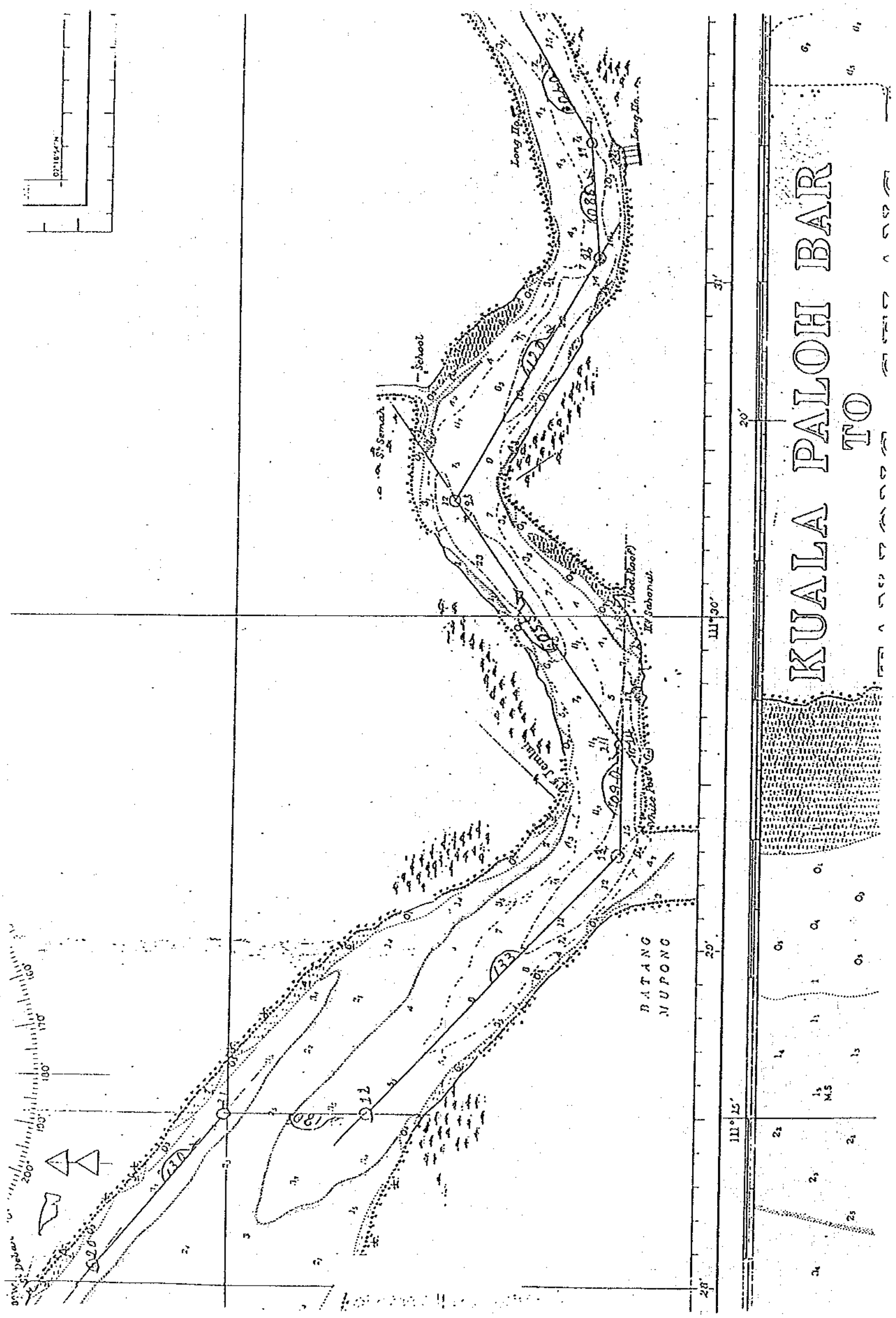


Figure-6.2.1(22)

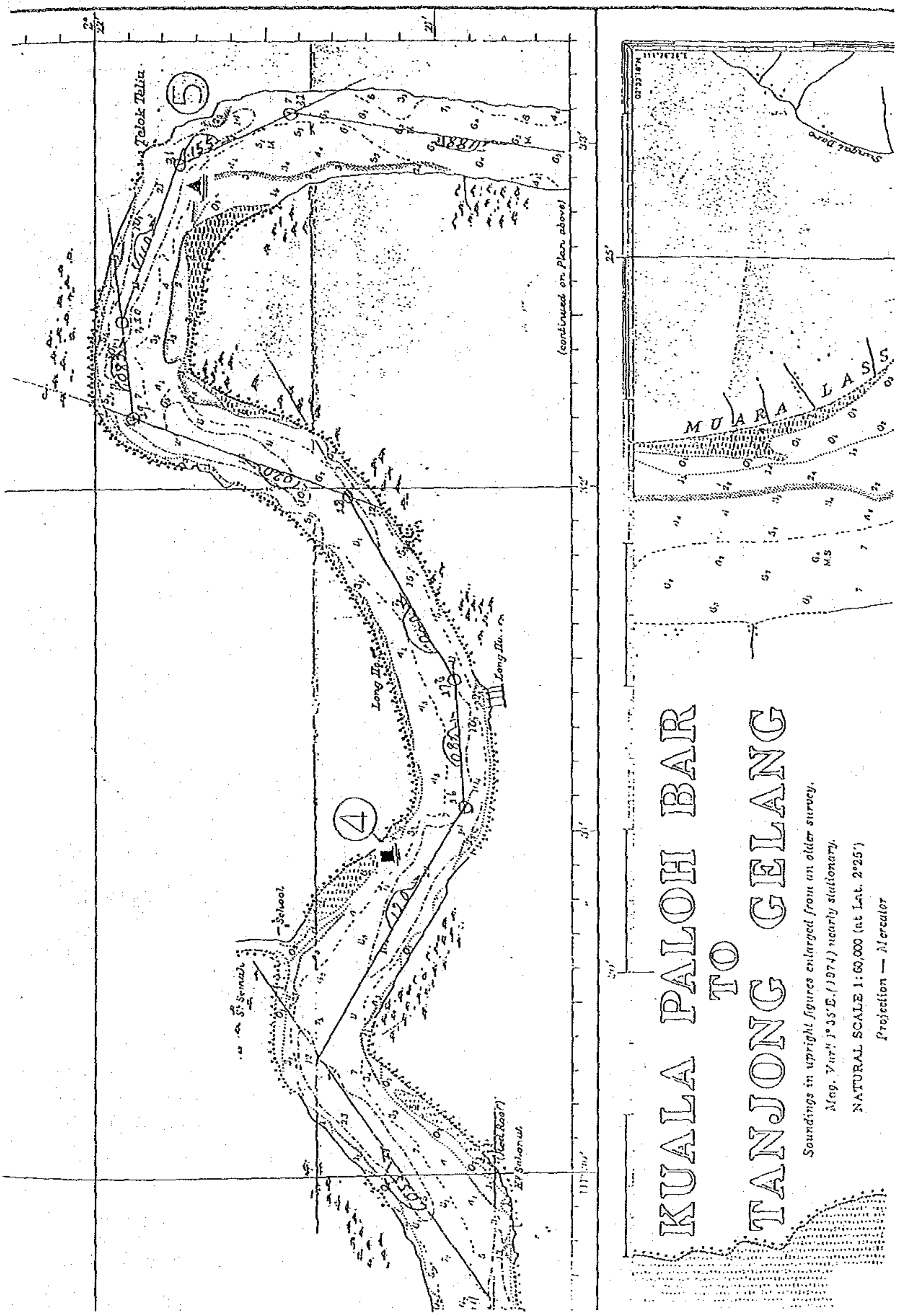


Figure-6.2.1(23)

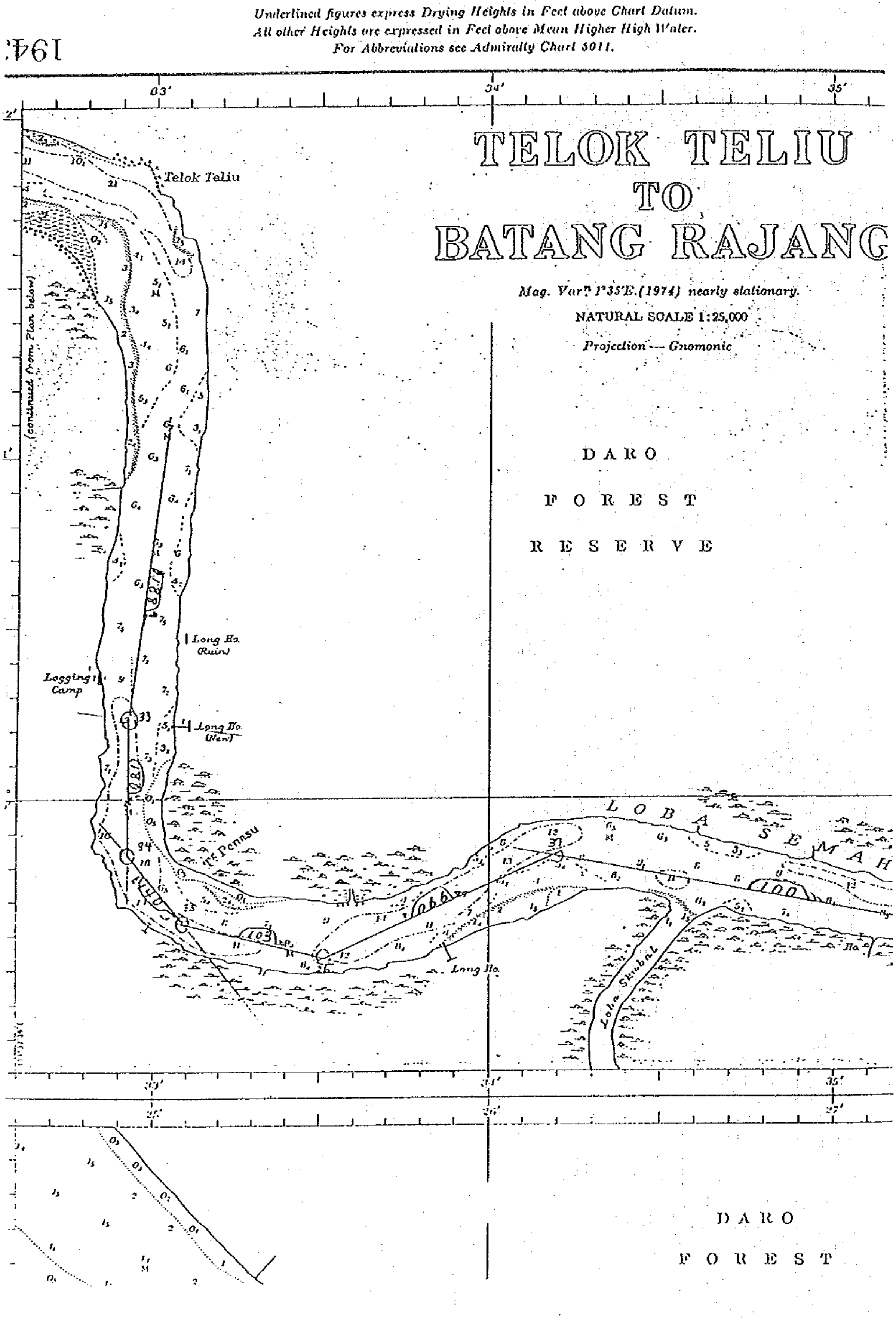


Figure-6.2.1(24)

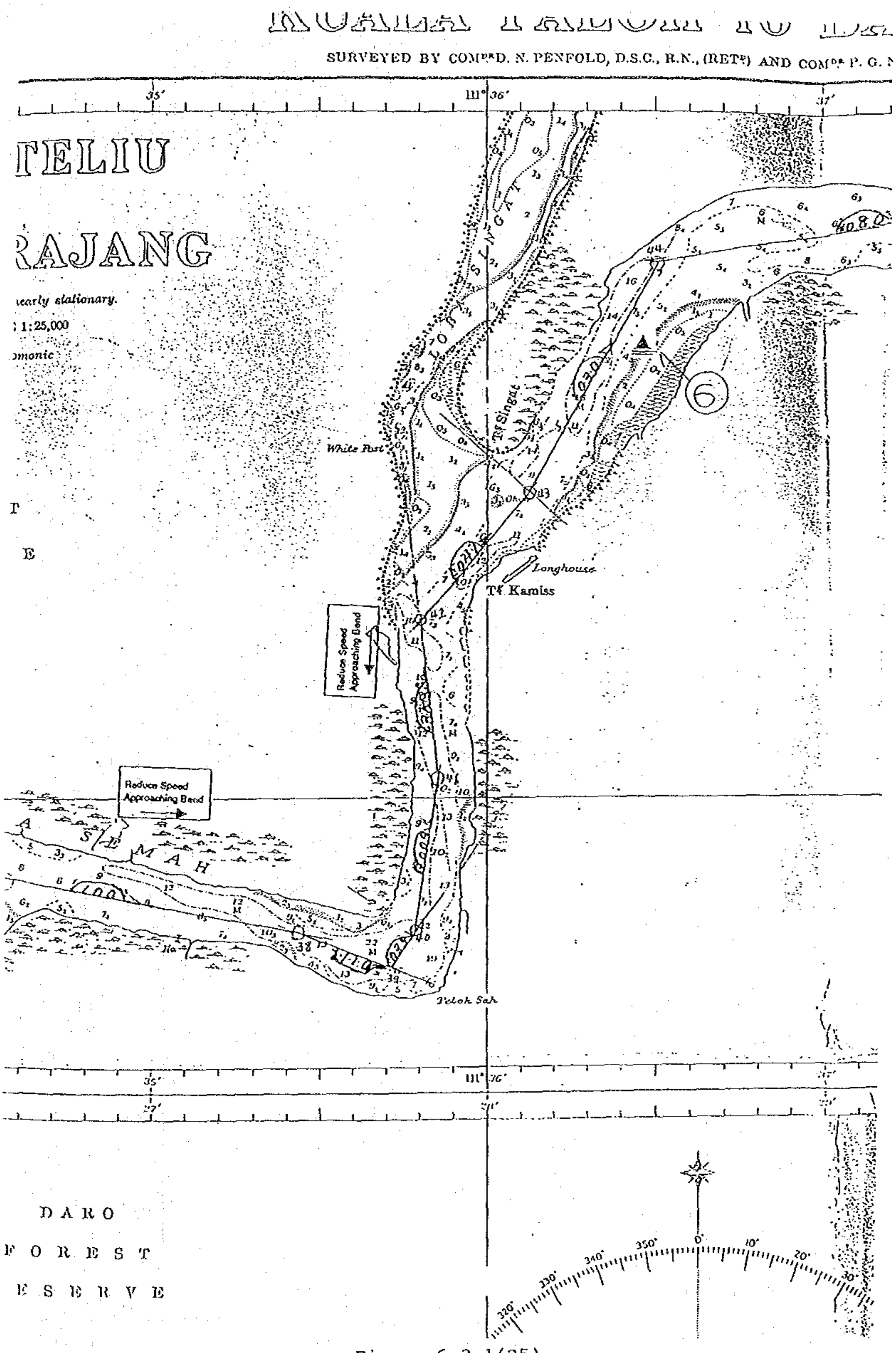


Figure-6.2.1(25)

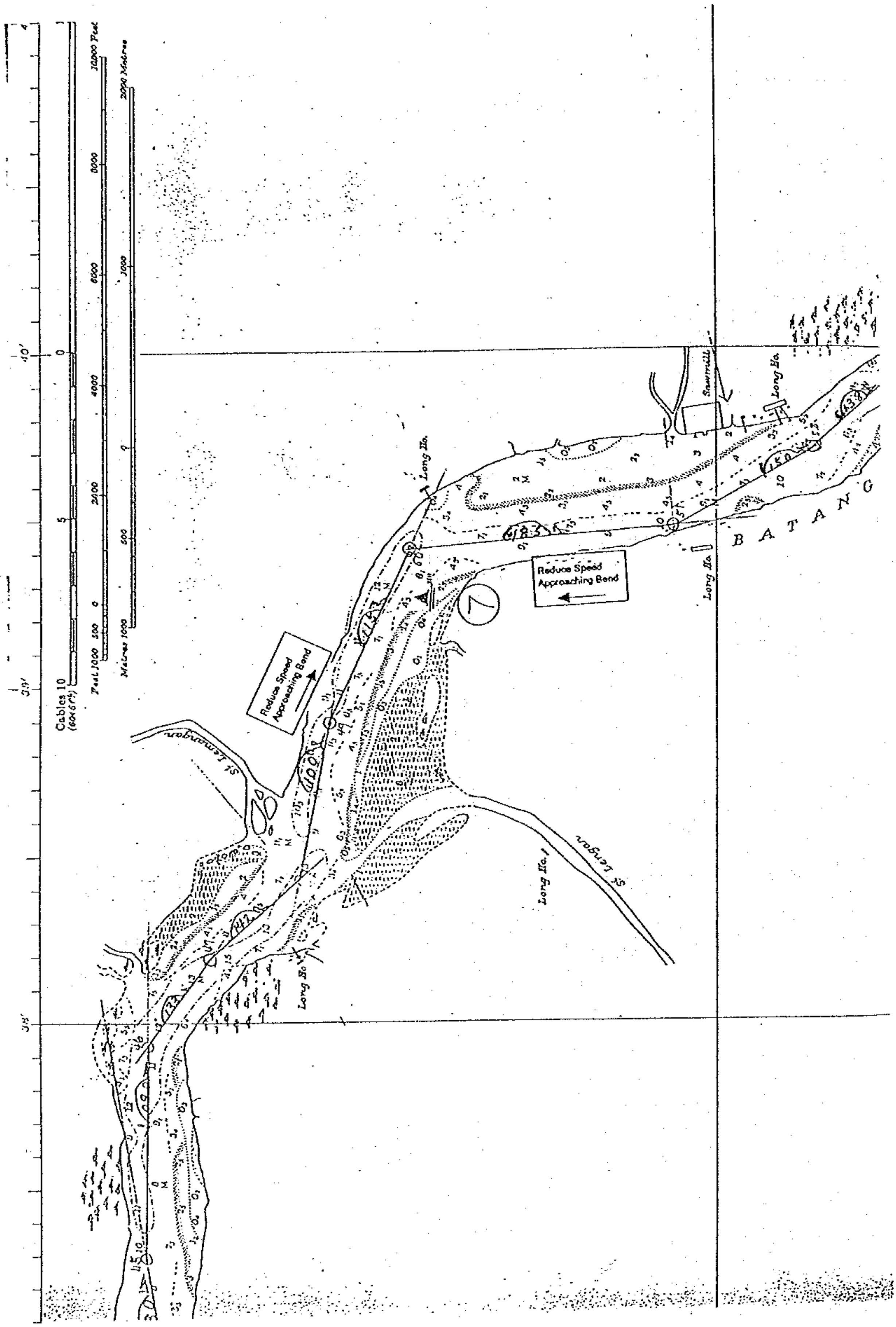


Figure-6.2.1(26)

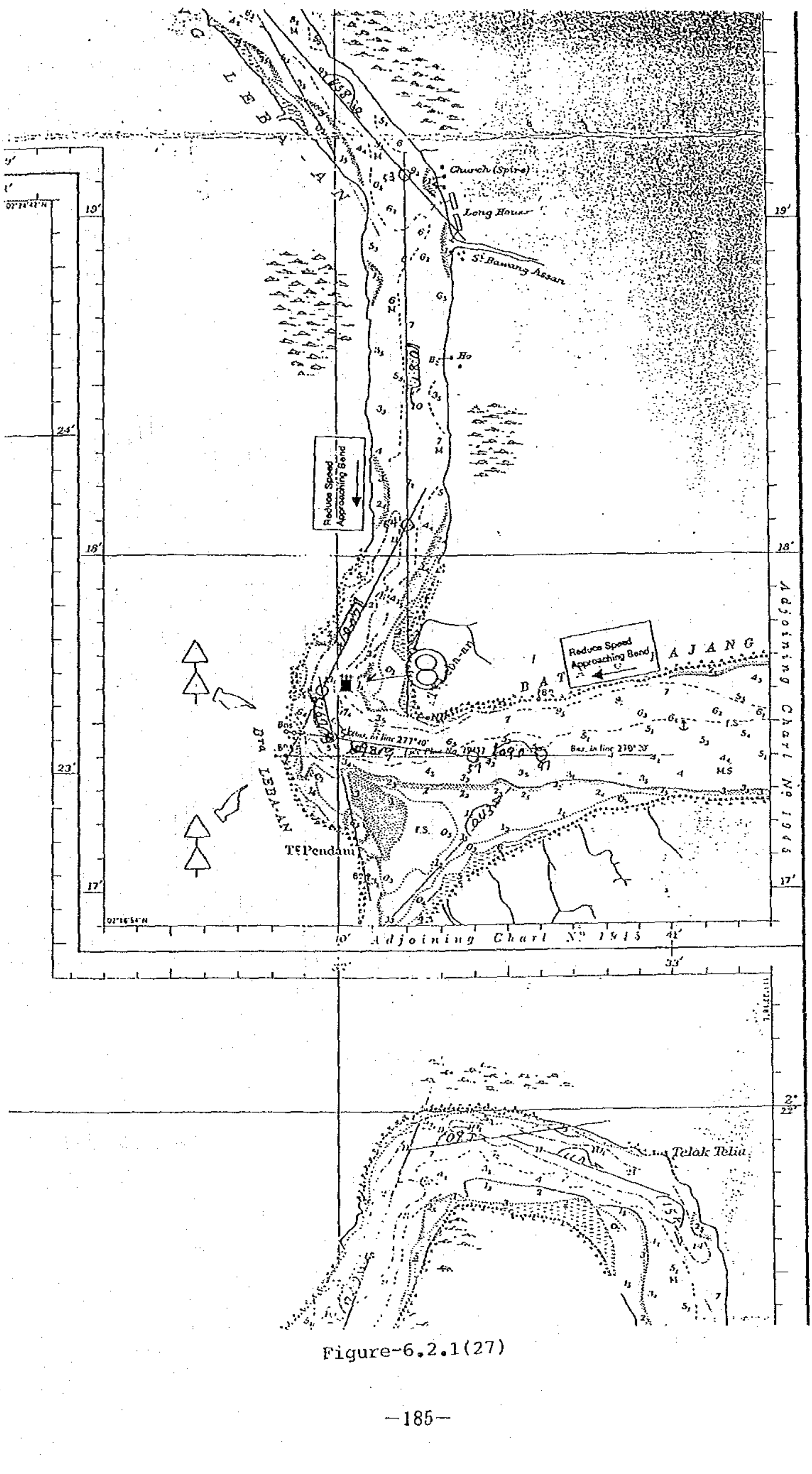


Figure-6.2.1(27)

Appendix-III.1.3.1 Typical Cross Section and Rough Cost of Coastal/Riverine Cargo Wharves and Passenger Wharves

We designed preliminarily the cross sections of the coastal/riverine cargo wharves and passenger wharves at Sibu and Tg. Sebubal for short-term scheme.

1. Typical Cross Section

(1) Coastal/riverine cargo wharf at Sibu

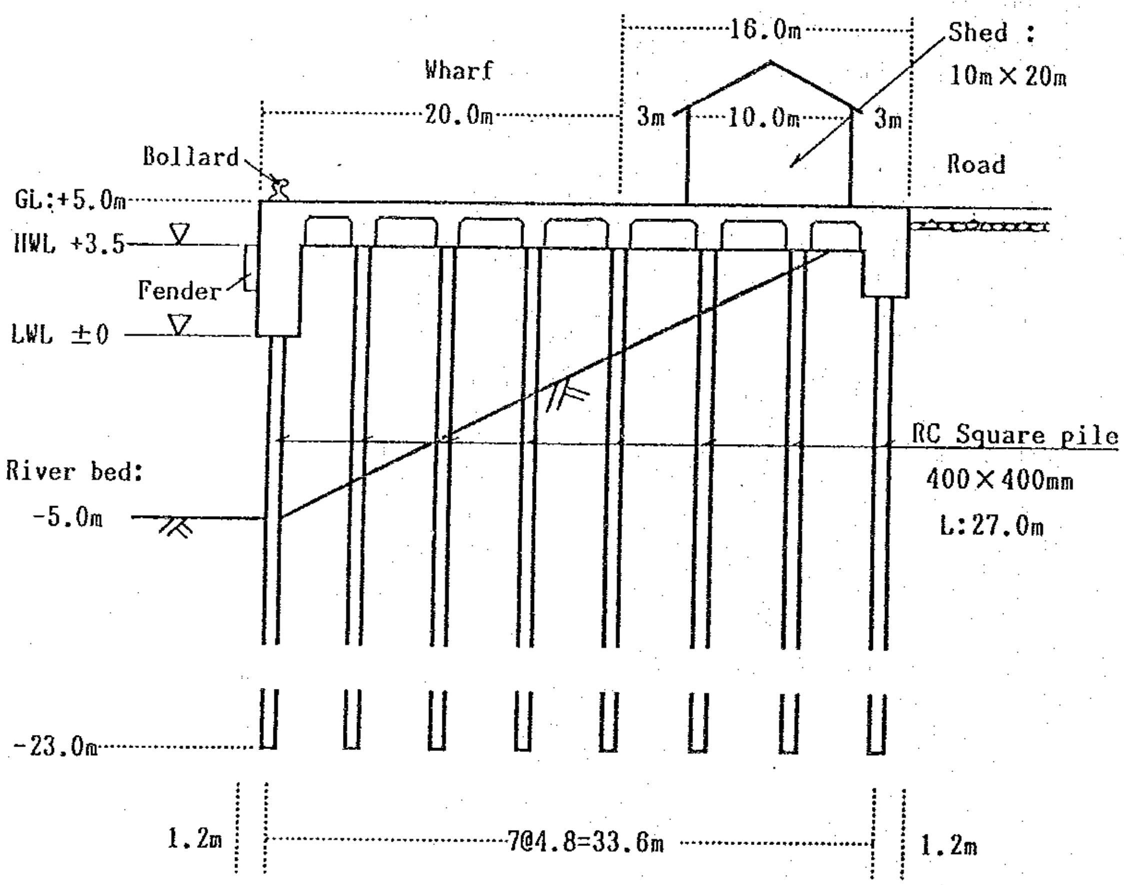


Figure-1 Typical Cross-section of Coastal Cargo Wharf
(in front of JKR Equipment Base in Sibu)

(2) Coastal cargo wharf at Tg. Sebubal

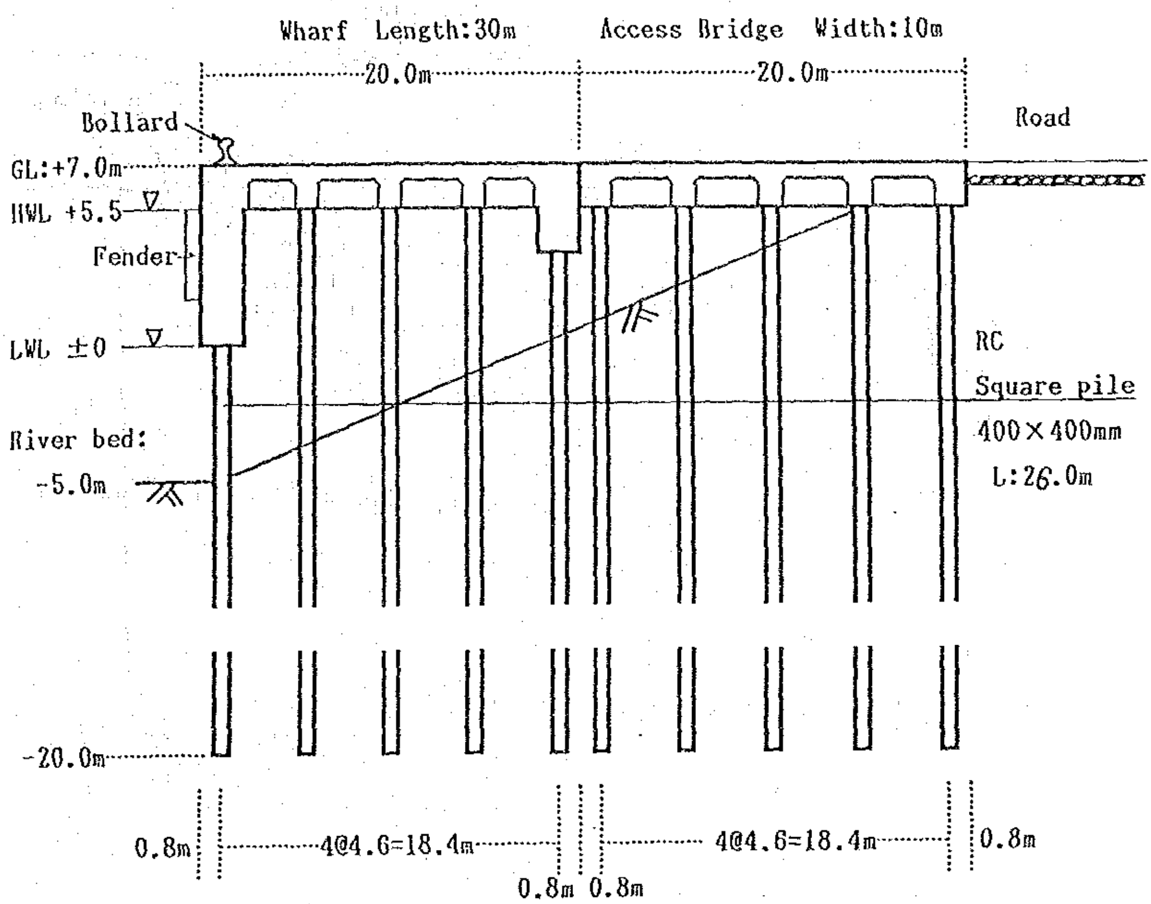


Figure-2 Typical Cross-section of Coastal Cargo Wharf
(Tg. Sebubal, next to the Timber products Terminal)

(3) Passenger wharf improvement at Sibu

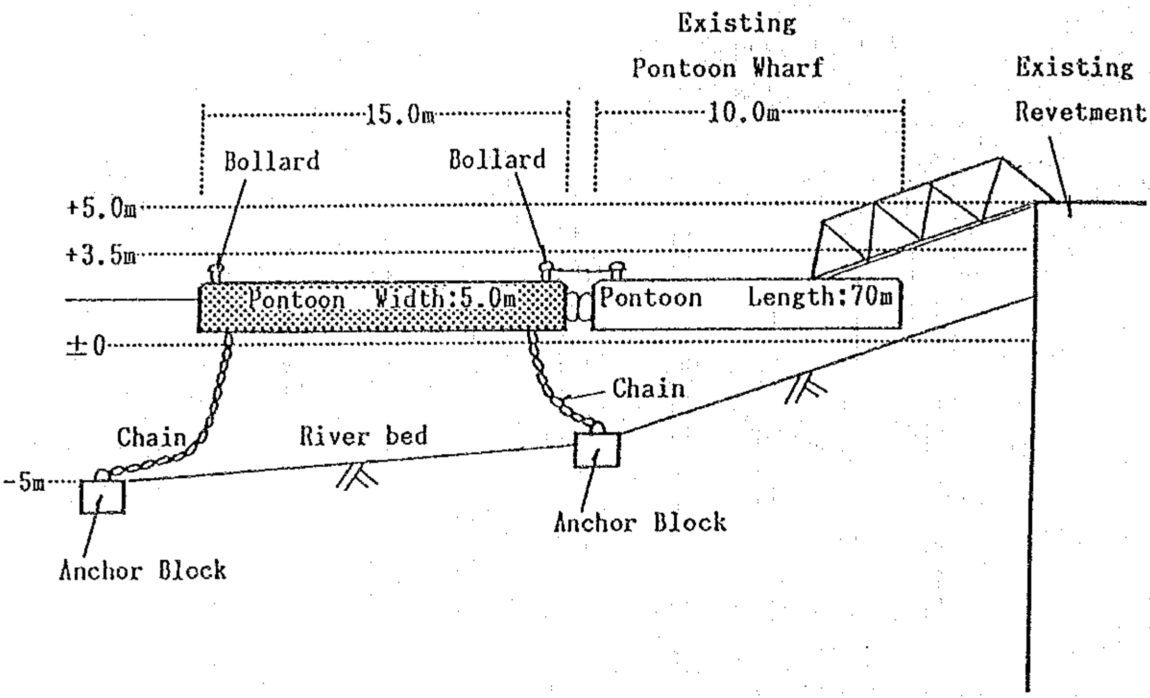


Figure-3 Typical Cross-section of Passenger Wharf Improvement
(Downstream and upstream Express Wharves at Sibu)

(4) Passenger wharf at Tg. Sebubal

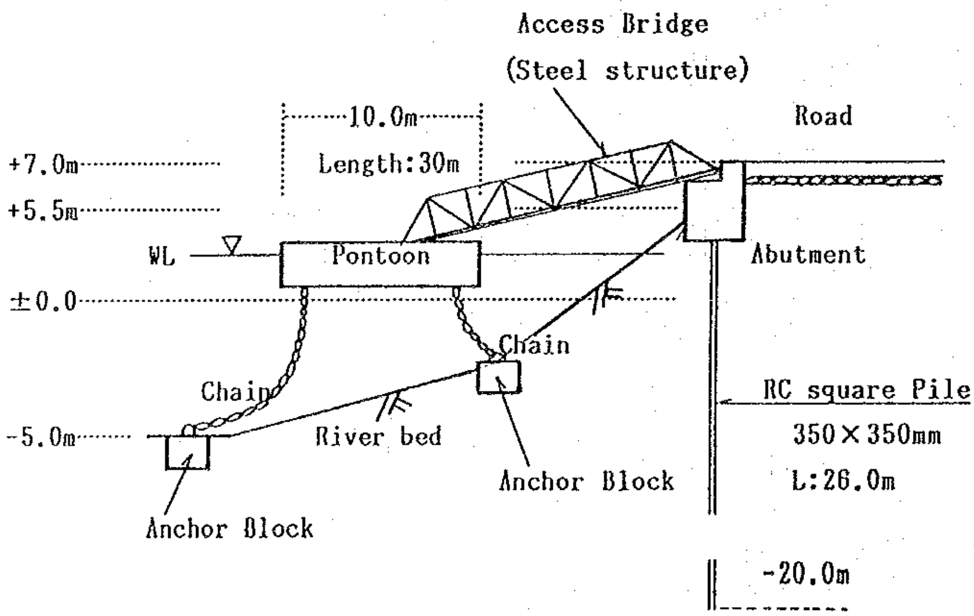


Figure-4 Typical Cross-section of Passenger Wharf
(Tg. Sebubal, next to the Timber Products Terminal)

2. Rough Cost Estimate

Table-1 Cost Estimate for Coastal/Riverine Cargo Wharf and Passenger Wharf up to 1997

Wharf	Amount (1,000 Ringgit)	Remarks
Sibu		
Coastal/Riverine Cargo Wharf	2,100	Length: 60m Width; 20m, Shed
Passenger Wharf Improvement	690	Downstream Express Wharf Upstream Express Wharf 15m x 5m pontoon, 3 units each
Tg. Sebubal		
Coasts Cargo Wharf	810	Length: 30m, Width: 20m
Passenger Wharf	460	30m x 10m pontoon

Appendix-III.2.3.1 Design Calculation of Timber Products Wharf at the east shore of Tg. Sebubal (with Diagonal Piles)

2.3.1.1 Proposed typical cross-section of wharf

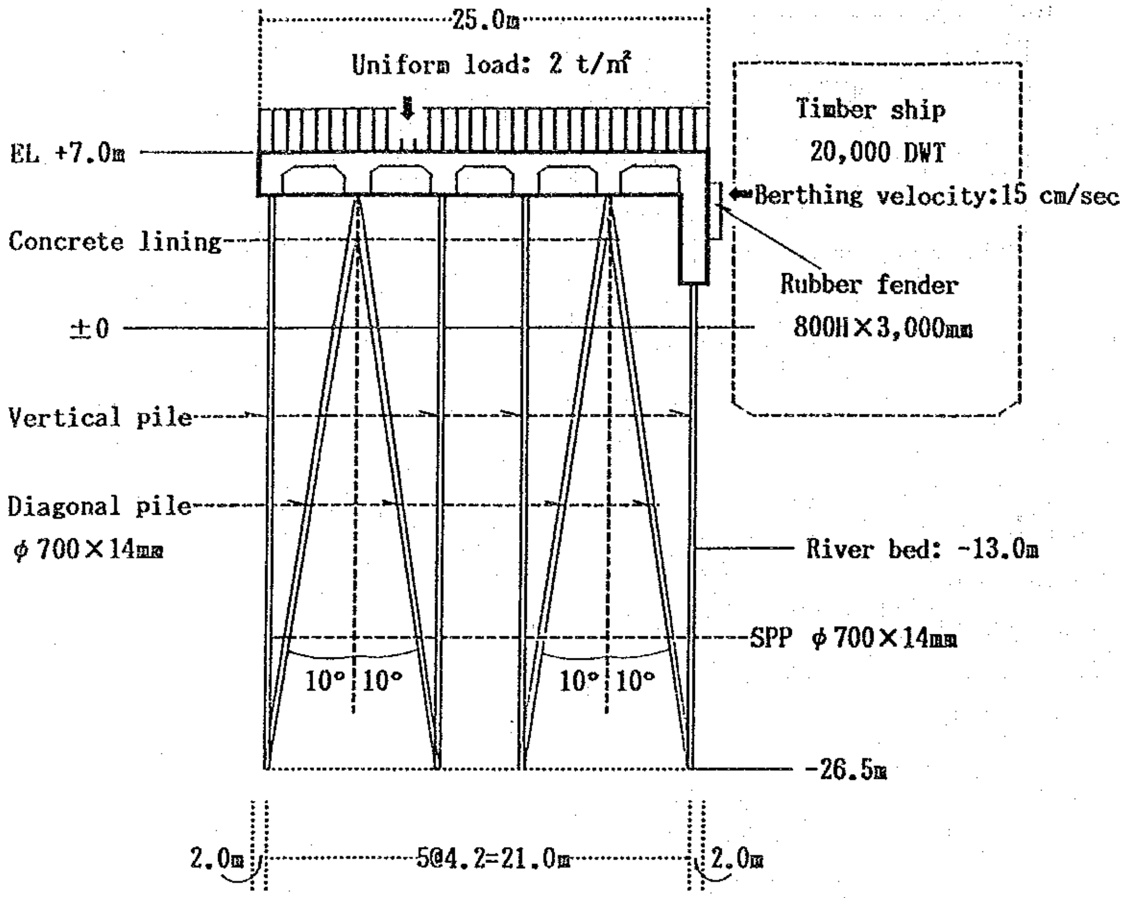


Figure-2.3.1.1 Proposed Typical Cross-Section of Wharf

2.3.1.2 Design conditions

(1) Size of ship to be accommodated	:	20,000 DWT
(2) Berthing velocity	:	15 cm/sec
(3) Water depth at berth front	:	-13.0 m (minimum depth)
(4) Elevation at apron	:	+ 7.0 m
(5) Surcharges uniform load	:	2.0 t/m^2
movable load	:	Crane, Heavy forklift, Tractor/shassiss, etc.

(6) Reserved thickness of steel for corrosion in water : Δt=0.1mm/year, 0.1x30years=3.0mm

Reserved thickness of steel for corrosion in soil : Δt=0.03mm/year, 0.03x30years=1.0mm

(7) Soil condition

River bed: -13.0 m		
	Soft to stiff clayey SILT	γ'=0.7 t/m^2 q_u=40 KN/m^2=0.4 kg/cm^2
-20.0 m		
	Dense silty SAND	γ'=1.0 t/m^2 N = 18
-26.5 m		
	Hard sandy GRAVEL	γ'=1.0 t/m^2 N > 50

2.3.1.3 Berthing force of ship

1) Berthing energy : 23.18 t.f/m (See the Table below)

Table-2.3.1.1 Berthing Energy for General Cargo Ship

DWT	Dis-placed tonnage (ton)	Over-all len-gth (m)	Brea-dth (m)	Depth (m)	Full load drau-ght (m)	Addi-tional weight (ton)	Esti-mated weight (ton)	Berthing energy(t-m)	
								Berthing speed at 0.10m/sec	Berthing speed at 0.15m/sec
700	1,100	51	8.5	4.6	3.8	600	1,700	0.44	0.99
1,000	1,600	58	9.5	5.1	4.2	800	2,400	0.61	1.38
2,000	3,000	74	11.7	6.3	5.1	1,500	4,600	1.17	2.63
3,000	4,400	86	13.2	7.2	5.9	2,400	6,800	1.74	3.92
4,000	5,800	95	14.4	7.8	6.4	3,100	8,900	2.28	5.12
5,000	7,100	103	15.4	8.4	6.8	3,800	11,000	2.80	6.30
6,000	8,500	124	16.9	9.5	7.2	5,200	13,600	3.48	7.83
7,000	9,800	129	17.6	10.0	7.5	5,800	15,600	3.99	8.97
8,000	11,100	135	18.3	10.4	7.8	6,600	17,700	4.51	10.16
9,000	12,400	139	18.9	10.8	8.0	7,200	19,500	4.98	11.22
10,000	13,700	144	19.7	11.2	8.2	7,800	21,500	5.47	12.31

to be continued

DWT	Dis- placed tonnage (ton)	Over- all len- gth (m)	Brea- dth (m)	Depth (m)	Full load drau- ght (m)	Addi- tional weight (ton)	Esti- mated weight (ton)	Berthing energy (t-m)	
								Berthing speed at 0.10m/sec	Berthing speed at 0.15m/sec
15,000	20,000	162	21.4	12.7	9.1	10,800	30,800	7.85	17.66
20,000	26,100	177	23.1	13.8	10.0	14,200	40,400	10.30	23.18
30,000	38,200	199	26.3	15.7	11.0	19,400	57,600	14.69	33.05
40,000	50,000	217	28.0	17.2	11.9	24,700	74,700	19.07	42.90
50,000	61,600	232	30.0	18.4	12.7	30,100	91,700	23.40	52.66

[Note] 1) Additional weight: When the ship is berthing and the movement stopped by the fender, the berthing energy is calculated by the energy of the ship plus the energy of the water moving with the ship. Additional weight is the weight of the water moved by the ship.

2) Estimated weight = Displacement tonnage + Additional weight

3) Source: Technical Data by Sumitomo Rubber Co., Ltd.

4) The under-lined figures are applicable in this case.

2.3.1.4 Reaction on Fender : In case using in 800H x 3,000L

(Quality of Rubber Grade C4)

R = 79.2 t (See Table below)

Table-2.3.1.2 Characteristics of Fender of 800H

Grade	C 1		C 2		C 3		C 4	
Length (mm)	R (ton)	E (ton-m)	R (ton)	E (ton-m)	R (ton)	E (ton-m)	R (ton)	E (ton-m)
1,000	52.8	16.1	44.0	13.4	35.2	10.8	26.4	8.1
1,500	79.2	24.2	66.0	20.2	52.8	16.1	39.6	12.1

to be continued

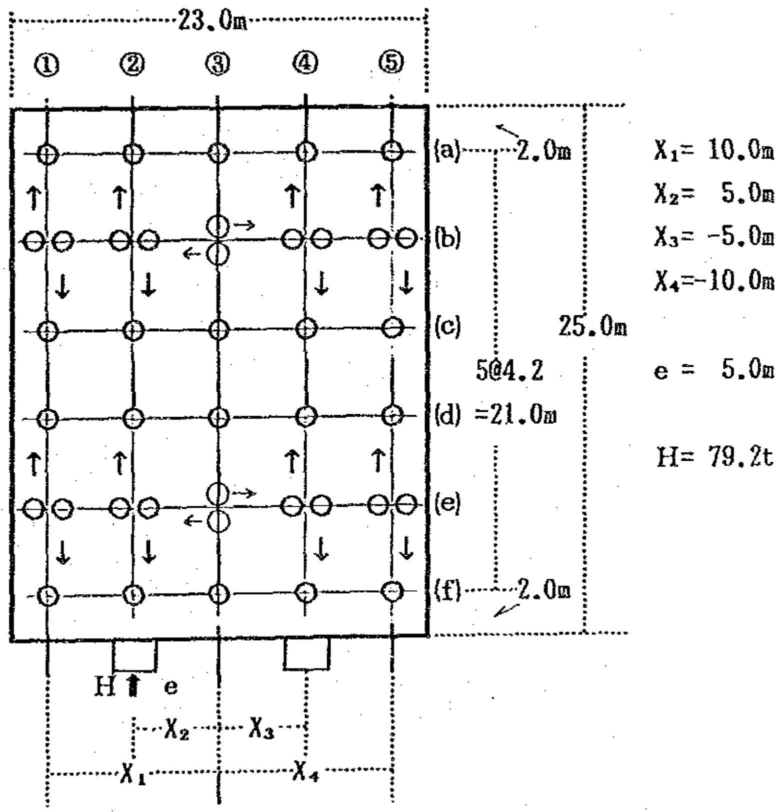
Grade	C 1		C 2		C 3		C 4	
Length (mm)	R (ton)	E (ton-m)	R (ton)	E (ton-m)	R (ton)	E (ton-m)	R (ton)	E (ton-m)
2,000	105.6	32.3	88.0	26.9	70.4	21.5	52.8	16.1
2,500	132.0	40.3	110.0	33.6	88.0	26.9	66.0	20.2
3,000	158.4	48.4	132.0	40.3	105.6	32.3	79.2	24.2

[Note] 1) R : Reaction force, E: Energy absorption

2) The under-lined figures are applicable in this case

2.3.1.5 Determination of Structural Section

The structural dimension of the wharf will be assumed as shown in the following sketches.



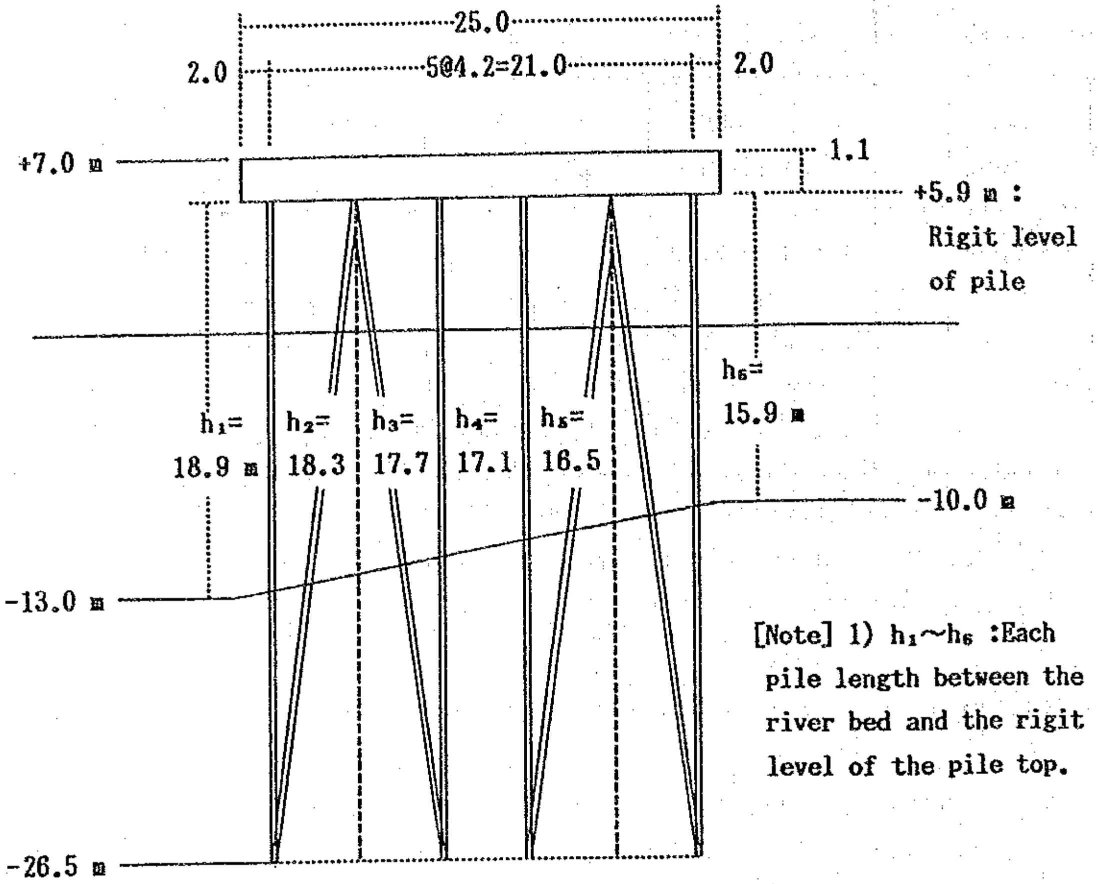


Figure-2.3.1.2 Assumed Structural Dimensions of Timber Wharf at Tg. Sebubal

The sectional property of the steel pipe pile of ϕ 700x14 mm is shown in table below.

Table-2.3.1.3 Sectional Property of SPP of ϕ 700x14 mm

	Area (cm^2)	Section Modulas Z :(cm^3)	Moment Inertia I :(cm^4)	Radius r :(cm)
Original Section	301.7	5,070	178 × 10^3	24.3
Reduced Section	236.0	3,960		

[Note] Reduced Section: Sectional property reduced allowance (3mm) of thickness for corrosion

2.3.1.6 Calculation of pile

(1) Coefficient of Horizontal Subgrade Reaction (K_h)

The coefficient of horizontal subgrade reaction (K_h) can be obtained in accordance with formula (2.3.1.1)

K_h = 0.15 N .... (2.3.1.1)

where N : N-value of the ground from the surface to the depth of about $1/\beta$

= 4 . q_u

where q_u : Unconfined compressive strength = 0.4 kg/cm^2

∴ N = 4 x 0.4 = 1.6

∴ K_h = 0.15N = 0.15 x 1.6 = 0.24 kg/cm^3

(2) Vertical Fixed Points

Design can be made by analyzing the rigit frame composed with the piles and the supersturcture. In this case, it can be assumed that the piles are fixed at I/β below the virtual ground surface. Where, β is calculated in accordance with formula (2.3.1.2).

$$\beta = \sqrt[4]{\frac{K_h \cdot B}{4\ EI}} \quad \cdots\cdots\cdots\cdots \quad (2.3.1.2)$$

where K_h : Coefficient of horizontal subgrade reaction = 0.24 kgf/cm^3

B : Diameter or width of a pile = 70 cm

EI : Flexual rigidity of a pile = $2.1 \times 10^6 \times 178 \times 10^3$ $kgf.cm^2$

$$\beta = \sqrt[4]{\frac{0.24 \times 70}{4 \times 2.1 \times 10^6 \times 178 \times 10^3}} = 1.83 \times 10^3 cm^{-1}$$

The depth from the virtual ground surface (Virtual fixed points):

$1/\beta$ = 5.46 m

(3) Axial allowable compressive stress in SKK-41

For vertical pile:

The free length of the pile is;

1 =18.9 + 5.46 = 24.36 m

1/r=24.36/0.243 = 100.2 > 93

$$\sigma_{ca} = \frac{12{,}000{,}000}{6{,}700 + (1/r)^2} = \frac{12{,}000{,}000}{6{,}700 + (100.2)^2} = 716\ kg/cm^2$$

For diagonal pile:

1 =17.7/cos 10^o + 5.46 = 23.43 m

1/r = 23.43/0.243 = 96.4 > 93

$$\sigma_{ca} = \frac{12{,}000{,}000}{6{,}700 + (1/r)^2} = \frac{12{,}000{,}000}{6{,}700 + (96.4)^2} = 750 \text{ kg/cm}^2$$

For acting on piles:

i) Vertical load

Vertical load	Dead load of Upper structure	25.0x23.0x2.1=1,207.5 t
	Uniform load on deck	25.0x23.0x2.0=1,150.0 t
Total		2,357.5 t

Numbers of pile : 6 lines x 5 files = 30

Dead load per one pile : N = 2,357.5/30 = 78.58 t

N' = 1,207.5/30 = 40.25 t

(in case without uniform load)

[Note] When the ship is berthing, the tractive force acting on diagonal piles in case without uniform load is bigger than that in case with uniform load. Therefore, more critical case shall be applied in design calculation.

ii) Horizontal load

Horizontal force (=Reaction on fender : R = 79.2 t)

Number of diagonal pile : 2 lines x 4 piles = 8 piles

a) Horizontal force to be distributed on each diagonal twin piles

$$Hi = \frac{1}{n} H + \frac{Xi}{\Sigma Xi^2} \cdot eH$$

where, n : Number of the diagonal twin piles : 8 piles

$$\Sigma Xi^2 = [10.0^2+5.0^2+(-5.0^2+(-10.0)^2] \times 2 = 500$$

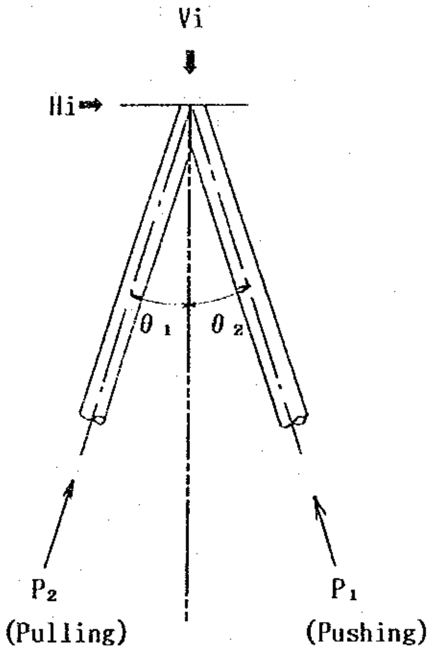
$$H① = \frac{1}{8} \times 79.2 + \frac{10.0}{500} \times 5 \times 79.2 = 17.82 \text{ t}$$

$$H② = \frac{1}{8} \times 79.2 + \frac{5.0}{500} \times 5 \times 79.2 = 13.86 \text{ t}$$

$$H③ = \frac{1}{8} \times 79.2 + \frac{(-5.0)}{500} \times 5 \times 79.2 = 5.94 \text{ t}$$

$$H④ = \frac{1}{8} \times 79.2 + \frac{(-10.0)}{500} \times 5 \times 79.2 = 1.98 \text{ t}$$

iii) Pushing/Pulling force acting on pile group : (See figure below)



a) In case with uniform load

$$P_1 = \frac{Vi \sin\theta_2 + Hi \cos\theta_2}{\sin(\theta_1 + \theta_2)}$$

$$= \frac{78.58 x \sin 10^o + 17.82 x \cos 10^o}{\sin(10^o + 10^o)}$$

$= 91.21$ t (Max. load in berthing)

$$P_2 = \frac{Vi \sin\theta_1 + Hi \cos\theta_1}{\sin(\theta_1 + \theta_2)} = \frac{78.58 x \sin 10^o - 17.82 x \cos 10^o}{\sin(10^o + 10^o)}$$

$= -11.41$ t

b) In case without uniform load

$$P_1' = \frac{40.25 x \sin 10^o + 17.82 x \cos 10^o}{\sin 20^o} = 71.75 \text{ t}$$

$$P_2' = \frac{40.25 x \sin 10^o + 17.82 x \cos 10^o}{\sin 20^o} = -30.88 \text{ t}$$

Stress acting on pile :

$$\sigma_{sa} = \frac{P_1}{A'} = \frac{91.21 x 10^3}{236.0} = 386.5 \text{ kg/cm}_2 < \sigma_{sa} = 750 \text{ kg/cm}^2$$

Bearing capacity :

1) Safety ratio of bearing force :

Ultimate bearing capacity shall be calculated in accordance with formula (2.3.1.3)

$R_u = 30\ N\ A_p$ ....(2.3.1.3)

where R_u : Ultimate bearing capacity
N : N-value of the ground at the pile shoe = 50
A_p : Bearing area of pile = $(70\ cm)^2 \times \pi/4$

$\therefore R_u = 30 x 50 x 0.7^2\ \pi/4 = 577\ t$

Safety ratio of bearing force : $F_a = 577/91.21 = 6.3 < 2.5$ O.K.

2) Pulling force :

The adhesion of pile in clayey soil shall be calculated in accordance with formula (2.3.1.4)

$$R_u = C_a \cdot A_a + \frac{N \cdot A_a}{5} \quad \text{.........................} \quad (2.3.1.4)$$

where R_u : Adhesion of pile
C_a : Mean adhesion of pile with the ground
$C_a = C = q_u/2 = 0.4\ kg/cm^2/2 = 4.0\ t/m^2/2 = 2\ t/m^2$
A_a : Frictional area of pile = D x (26.5-13.0=13.5m)
-13.0 - 20.0 = 7.0 m
-20.0 - 26.5 = 6.5 m
Total 13.5 m

$$\therefore R_u = 2.0 \times 0.7 \times 7.0 + \frac{18 \times 0.7 \times 6.5}{5} = 82.25\ t$$

The allowable adhesion of pile shall be calculated in accordance with formula (2.3.1.5)

$$R_u = W_p + \frac{R^u}{F} \quad \text{.................................} \quad (2.3.1.5)$$

where R_a : Allowable adhesion of pile

W_p : Weight of pile = 0.237 kg/mx26 m = 6.2^t

F : Safety factor = 2.5

P_2 : Virtual pulling stress

$$\therefore R_u = 6.1 + \frac{\qquad}{\qquad} = 33.5^{\,t} > |P_{max}| = -30.88 \text{ t O.K.}$$

Appendix-III.2.3.2 Design Calculation on Coal Wharf (at the opposite side of Tg. Sebubal)

2.3.2.1 Design Condition

(1) Ship Size to be accommodated : 30,000 DWT Coal carrier

(2) Berthing Velocity : v = 15 c/sec

(3) Berthing Energy : Ef = 33.05 tf/m (Please refer Table-III.2.1.1)

(4) Reaction of Fender : H = 131 t (Please refer Table-III.2.1.2
The fender of P_1-800Hx3,000L
Grade-C2 is applied)

(5) Berth Configuration : Depth of berth front -13.0m (Minimum -10.0) below C.D.

Apron Elevation	+ 7.0m
Apron Width	30.0m

(6) Surcharge : Uniform load 2 t/m^2
Moving load T-20 Mobil Crane

(7) Reserved thickness of Steel Pipe Pile of Corrosion :

Under water Δt = 0.1 mm/year x 30 year = 3.0 mm
In soil Δt = 0.03mm/year x 30 year = 1.0 mm

(8) Soil Condition : Representative soil strata as follows :

-13.0m ~ -14.0m	Stiff to very stiff clayey SILT	q_u = 40 KN/m^2 = 0.4 kg/cm^2
-14.0m ~ -16.0m	Medium dense sandy SILT	N = 18
-16.0m ~ -20.0m	Dense silty SAND	N = 42
below -20.0m	Very dense sandy SILT (Weathered Rock)	N > 50

The trial calculation using the steel pipe pile of ϕ 600x16mm ($I=125x10^3$ cm^4) is shown as bellow.

Pile Length to be penetrated against the horizontal force is;

$$\beta = \sqrt[4]{\frac{K_h \cdot B}{4\ EI}} = \sqrt[4]{\frac{2.7x60}{4x2.1x10^6x125x10^3}} = 3.52x10^{-3}\ cm^{-1}$$

$\therefore\ 3/\beta = 8.52$ m

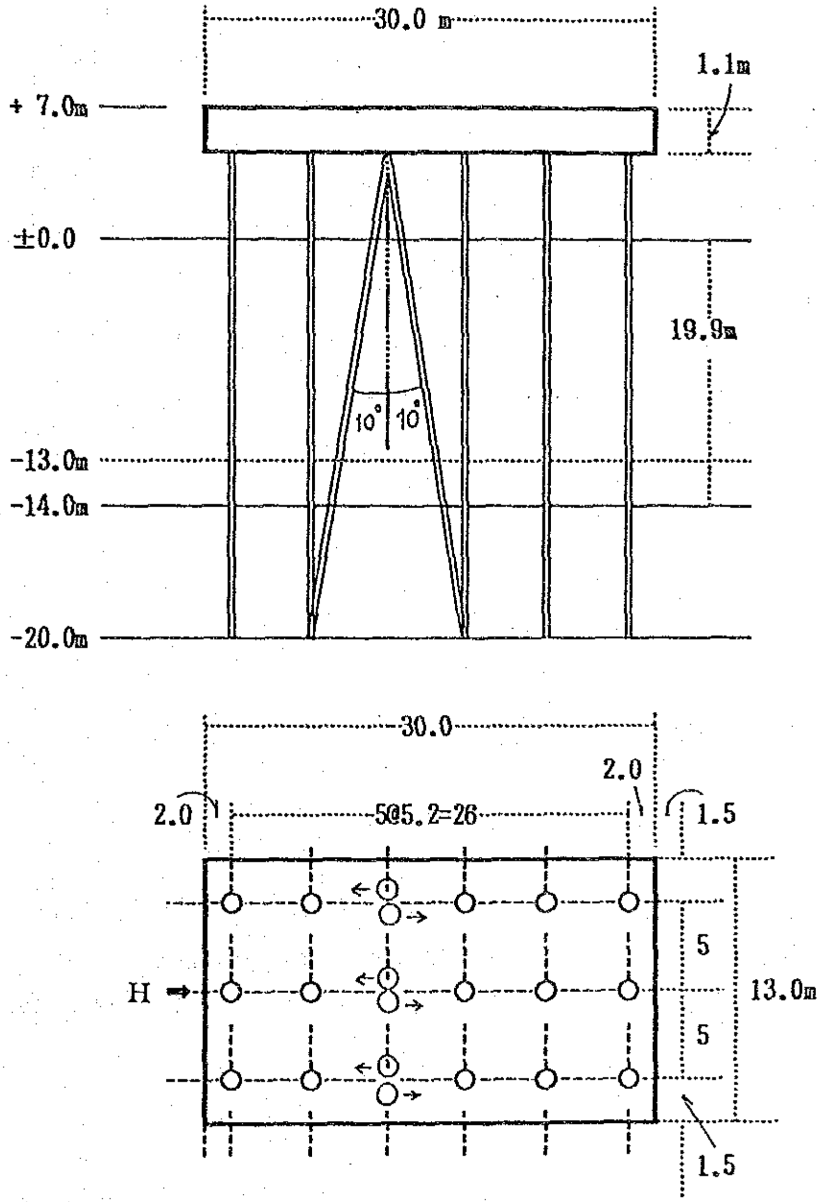
The depth of pile bottom to be penetrated is;

(-14.0) + (-8.52) = -22.5 m

It is very difficult to penetrate the pile into bellow -20.0m due to the weathered rock layer with N value over 50. Therefore, the diagonal twin piles shall be applied for this structure.

2.3.2.2 Stress calculation of Pile

The arrangement of the pile foundation will be shown as following in the trial case.



The section property of the steel pipe pile of ϕ 700x14mm is;

	Area (cm^2)	Section Modulas (cm^3)	Moment Inertia I:(cm^4)	Radius r:(cm)
Original section	301.7	5,070	$178x10^3$	24.3
Reduced section considering allowance for corrosion	236.0	3,960		

$$\beta = \sqrt[4]{\frac{K_h.B}{4\ EI}} = \sqrt[4]{\frac{(0.15x18)\ x\ 70}{4x2.1x10^6x178x10^3}} = 3.35x10^{-3}\ cm^{-1}$$

$1/\beta = 2.98$ m

Allowable compressive stress:

For vertical pile
$1 = 19.9 + 2.98 = 22.88$
$1/r = 22.88/0.243 = 94.2>93$
$\sigma_{ca} = 1,400 - 8.4(1/r-20) = 777\ kg/cm^2$

For inclined pile
$1 = 19.9/cos10^o + 2.98 = 23.19$
$1/r = 23.19.0.243 = 95.4>93$
$\sigma_{ca} = 1,400 - 8.4(1/r-20) = 766\ kg/cm^2$

Forces acting on piles:

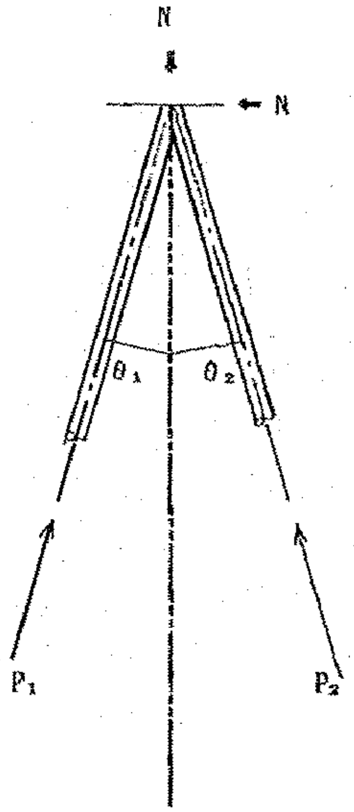
i) Vertical load

Dead load of Upper structure	30.0x13.0x2.0=780t
Uniform load on deck	30.0x13.0x2.0=780t
Total	1,560t

Dead load per one pile: N = 1,560/18 = 86.7t
N'= 43.3t (in case without uniform load)

ii) Horizontal load $H = 131/3 = 43.7t$

iii) Tractive force acting on pile group:



$$P_1 = \frac{N \sin\theta_2 + H \cos\theta_2}{\sin(\theta_1 + \theta_2)}$$

$$= \frac{86.7x\sin 10^{\circ} + 43.7x\cos 10^{\circ}}{\sin(10^{\circ} + 10^{\circ})}$$

$= 169.85t$ (Max. load in berthing)

$$P_2 = \frac{N \sin\theta_1 + H \cos\theta_1}{\sin(\theta_1 + \theta_2)}$$

$$= \frac{43.3x\sin 10^{\circ} + 43.7x\cos 10^{\circ}}{\sin(10^{\circ} + 10^{\circ})}$$

$= 103.85t$ (Max, load in berthing)

$$P_1' = \frac{86.7x\sin 10^{\circ} + 10^{\circ}}{\sin 10^{\circ}} = 44.2t \text{ (normal time)}$$

According to the above calculation, the tractive force is too strong for the group of 3 files. Therefore, the group of 6 files shall be considered.

$H = 131/6 = 21.8t$

$$P_1 = \frac{86.7 \times \sin 10^{\circ} - 21.8 \times \cos 10^{\circ}}{\sin (10^{\circ} + 10^{\circ})} = 106.8 \text{ t}$$

$$P_2 = \frac{43.3 \times \sin 10^{\circ} - 21.8 \times \cos 10^{\circ}}{\sin (10^{\circ} + 10^{\circ})} = -40.8 \text{ t}$$

Allowable stress:

i) Normal case

$$\sigma_{ca} = \frac{N}{A'} = \frac{86.7 \times 10^3}{236.0} = 367 \text{ kg/cm}^2 < \sigma_{ca} = 777 \text{ kg/cm}^2$$

ii) Berthing time

$$\sigma_{ca} = \frac{N}{A'} = \frac{106.8 \times 10^3}{236.0} = 453 \text{ kg/cm}^2$$

Bearing capacity:

1) Safety Ratio of Bearing force:

$R_u = 30 \text{ N } A_p = 30 \times 50 \times 0.7^2 \ /4 = 577\text{t}$

$F_a = 577/106.8 = 5.4 > 2.5$

2) Tractive force:

Weight of pile	0.237 kg/m x 26 m	= 6.2t
Weight of concrete filling	0.7^2 /4 x 20 m x 1.3 t/m^3	= 10.0t
Total	W_p	= 16.2t

$$R_u = \frac{N A_a}{5}$$

$N A_a$: 18 x D x 2 m

40 x D x 4 m

Total 196 D

= 196 D/5 = 86t

$$R_a = W_p + \frac{R_u}{F} = 16.2 + \frac{86}{2.5} = 50.6 \text{ t} > P_2 = 40.8 \text{ t}$$

Appendix-III.2.3.3 Design Calculation on Oil Jetty at Sg. Merah

2.3.3.1 Design Condition (for Breasting Dolphin)

(1) Ship Size to be accommodated: 3,000 DWT Oil Tanker

(2) Berthing Velocity: 15 cm/sec

(3) Berthing Energy: Ef = 3.78 tf/m (Please refer Table-III.2.3.1)

(4) Reaction of Fender: H = 33.8t
(Please refer Table-III.2.3.2. The fender of P_1-400H x 2,500L Grade-C4 is applied)

(5) Berth Configuration:

Depth of berth front	- 7.5m below C.D.
Apron Elevation	+ 5.0m
Apron Width	10.0m

(6) Surcharge: Uniform load 0.5 t/cm^2

(7) Reserved Thickness of Steel Pipe Pile for Corrosion:

Under water Δt = 0.07 mm/year x 30 years = 2.0mm
In soil Δt = 0.03 mm/year x 30 years = 1.0mm

(8) Soil Condition: Representative soil strata as follows;

- 7.5m	
	Loose SAND N = 8 ~ 10 γ' = 1.0 t/m^3
-19.5m	
	Medium dense SAND N = 12 ~ 29 γ' = 1.0 t/m^3
-37.5m	
	Dense SAND N = 31 ~ 36 γ' = 1.0 t/m^3

Table-III.2.3.3.1 Berthing Energy for Tanker

DWT	Dis-placed tonnage (ton)	Over-all len-gth (m)	Bread-th (m)	Depth (m)	Full load drau-ght (m)	Addit-ional weight (ton)	Esti-mated weight (ton)	Berthing energy(t-m)	
								Berthing speed at 0.10m/sec	Berthing speed at 0.15m/sec
700	1,100	50	8.5	4.5	3.7	600	1,700	0.41	0.92
1,000	1,500	57	9.4	4.6	4.2	800	2,300	0.58	1.31
2,000	2,900	73	11.4	5.4	5.1	1,500	4,400	1.12	2.52
3,000	4,200	85	12.8	6.6	5.9	2,400	6,600	1.68	3.78
5,000	6,900	102	14.7	7.9	6.9	3,900	10,800	2.75	6.18
10,000	13,300	139	19.0	9.3	8.1	7,300	20,600	5.26	11.83
15,000	19,500	157	21.7	11.4	9.0	10,200	29,800	7.60	17.10
20,000	25,700	171	23.8	12.1	9.8	13,200	38,900	9.93	22.35
30,000	37,900	194	27.2	14.4	10.9	18,600	56,400	14.39	32.38
40,000	49,800	211	29.9	15.5	11.7	23,300	73,100	18.64	41.94
50,000	61,600	226	32.1	16.4	12.5	28,400	90,100	22.98	51.70
70,000	85,000	250	35.9	18.2	13.6	37,200	122,200	31.17	70.14
100,000	119,400	270	39.0	19.0	14.6	46,300	165,700	42.28	95.14
150,000	175,800	291	44.2	23.5	17.9	75,100	250,900	64.00	144.00
200,000	231,300	325	47.2	24.6	19.0	94,500	325,800	83.11	187.00
250,000	286,200	348	51.8	25.6	20.0	112,100	398,300	101.60	228.61

[Note] 1) Additional weight: When the ship is berthing and the movement stopped by the fender, the berthing energy is calculated by the energy of the ship plus the energy of the water moving with the ship. Additional weight is the weight of the water moved by the ship.

2) Estimated weight = Displacement tonnage + Additional weight

3) Source: Technical Data by Sumitomo Rubber Co., Ltd.

4) The under-lined figures are applicable in this case.

Table-III.2.3.3.2 Characteristics of Fender in 400H

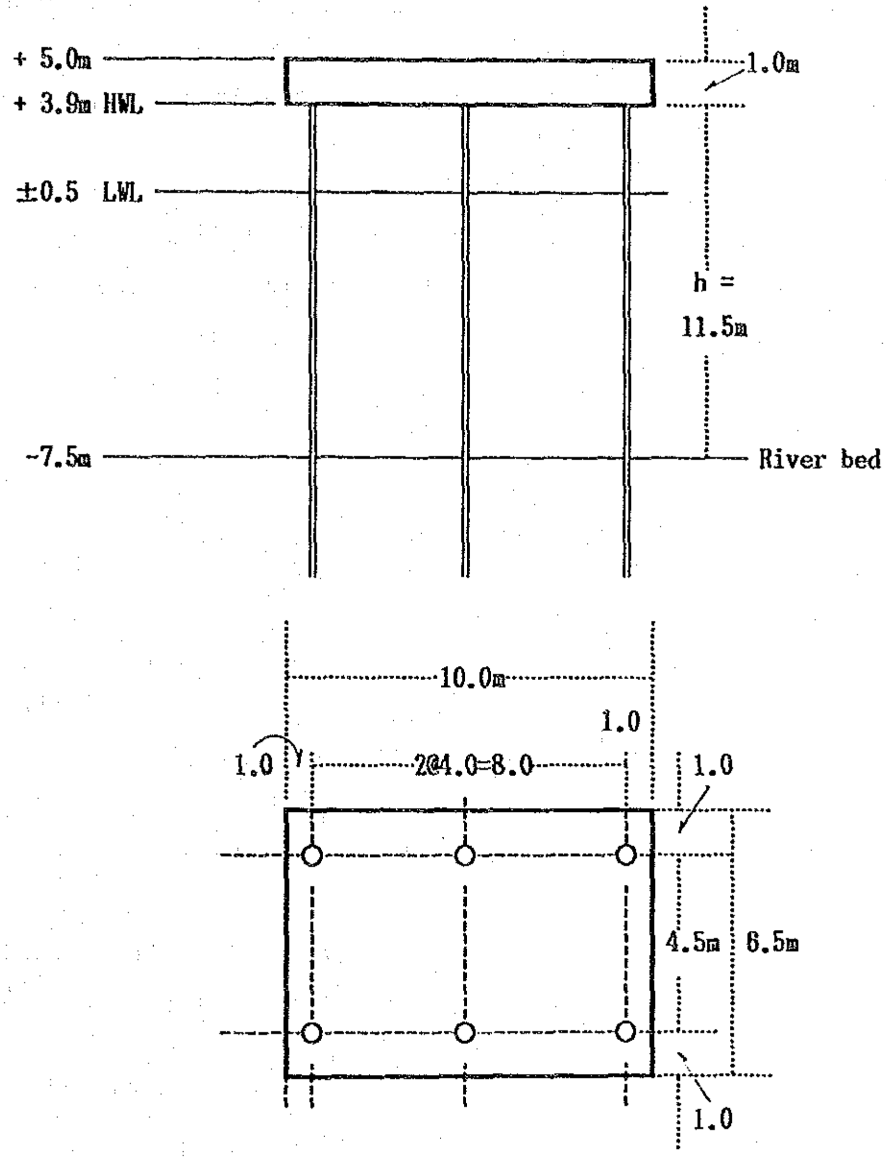
Grade	C 1		C 2		C 3		C 4	
Length (mm)	R (ton)	E (ton-m)	R (ton)	E (ton-m)	R (ton)	E (ton-m)	R (ton)	E (ton-m)
1,000	26.4	4.0	22.0	3.4	17.6	2.7	13.2	2.0
1,500	39.6	6.0	33.0	5.0	26.4	4.0	19.8	3.0
2,000	52.8	8.1	44.0	6.7	35.2	5.4	26.4	4.0
<u>2,500</u>	66.0	10.1	55.0	8.4	44.0	6.7	<u>33.0</u>	5.0
3,000	79.2	12.1	66.0	10.1	52.8	8.1	39.6	6.0

[Note] 1) R : Reaction force, E: Energy absorption

2) The under-lined figures are applicable in this case

2.3.3.2 Assumption of Structural Section

A trial arrangement of the pile foundation is shown below:



2.3.3.3 Stress Calculation of Pile

(1) Steel Pipe Pile to be used

The sectional property of the steel pipe pile of ϕ 550x14mm is;

	Area (cm^2)	Section Modulas (cm^3)	Moment Inertia I:(cm^4)	Radius r:(cm)
Original section	235.7	3,080	$84.7x10^3$	19.0
Reduced section considering allowance for corrosion	201.3	2,620	$71.7x10^3$	

$$\beta = \sqrt[4]{\frac{K_h \cdot D}{4\ EI}} = \sqrt[4]{\frac{1.35 \times 55.0}{4 \times 2.1 \times 10^6 \times 84.7 \times 10^3}} = 3.196 \times 10^{-3}\ cm^{-1}$$

$\therefore K_h = 0.15N = 0.15 \times 9 = 1.35\ kg/cm^3$

$1/\beta = 3.13$ m

Free length of pile: $1 + 1/\beta = 11.5 + 3.13 = 14.63$

$1/r = 14.63/0.19 = 77.0 < 93$

Allowable compressive stress:

$\sigma_{ca} = 1,400 - 8.4(1/r-20) = 921\ kg/cm^2$

- ditto in un-normal case:

$\sigma_{ca} = 1.5\ \sigma_{ca} = 1.5 \times 921 = 1,381\ kg/cm^2$

(2) Stress by horizontal force

Horizontal Forces:

$H = 33.8/6 = 5.63$ t/pile

Moment at pile top:

$M = 1/2\ (h + 1/\beta).H = 1/2\ (11.5+3.13) \times 5.63 = 41.18$ t-m

Stress: $\sigma_{ca} = M/Z' = 41.18 \times 10^5/2,620 = 1,572\ kg/cm^2$

(3) Stress by vertical force

Vertical load	Dead load of Upper structure	10.0x6.5x2.0 =	130.0 t
	Uniform load on deck	10.0x6.5x0.5 =	32.5 t
	Total		162.5 t

Dead load per one pile: $N = 162.5/6 = 27.08$ t

Vertical load by Moment: $$P_h = \frac{41.18 + 41.18 \times 0.6}{4.0} = 16.47\ t$$

Total vertical force: $P = 27.08 + 16.46 = 43.55$ t

Compressive stress: $\sigma_c = 43.55 \times 10^3/201.3 = 216\ kg/cm^2$

(4) Counter check of stress

$$\frac{\sigma_c}{\sigma_{ca}'} + \frac{\sigma_b}{\sigma_{ca}'} = \frac{216}{1,381} + \frac{1,572}{2,100} = 0.156 + 0.749 = 0.905 < 1.0 \text{ O.K.}$$

2.3.3.4 Penetration Length of Pile

Penetration length required against lateral reaction:

$-7.5 - 3/\beta = -7.5 - 3x3.13 = -16.89$

$-16.89 + (-7.5) = -24.39 \fallingdotseq -25m$

Ultimate bearing capacity : $R_u = 30\ N\ A_p + N\ A_a/5$

here, N : N value at bottom of pile (16+15)/2 = 15.5

A_p : Area at bottom of pile = $\pi D^2/4 = 0.55^2\ \pi/4 = 0.237\ m^2$

N : Mean N value = 9

A_a : Total surface area of pile = $\pi D\ L = \pi x0.55x(25.0-7.5) = 30.24m^2$

$R_u = 30 \times 15.5 \times 0.237 + (9x30.24)/5 = 110 + 54 = 164$ t

Safety ratio of bearing force:

Normal case: Dead load of deck + Uniform load = 27.08 t
Dead load of pile 20.5m x 185kg/m = 5.46
Total P = 32.54 t

Safety ratio $F_s = R_u/P = 164/32.54 = 5.04 > 2.5$ O.K.

Berthing time: Dead load of deck + Uniform load + Vertical load
by Moment = 43.55 t
Dead load of pile 29.5m x 185kg/m = 5.46
Total P = 49.01 t

Safety ratio $F_s = R_u/P = 164/49.01 = 3.35 > 1.5$ O.K.

2.3.3.5 PC Pile

A trial calculation is made for the Prestressed Concrete (PC) Pile of ø 800x120mm (Class A).

The sectional property of the pile is as follows.

Area : $A=2,620cm^2$

Section Modulas : $Z=390x10^2$,

Moment Inertia : $I=156x10^4$

$$\beta = \sqrt[4]{\frac{1.35 \times 80}{4x4.0x10^5x156x10^4}} = 2.565 \times 10^{-3} cm^{-1}$$

$1/\beta = 3.90m$

$M = 1/2\ (11.5+3.9) \times 5.63 = 43.35\ ^{t-m}$

Dead Weight of Deck : $P_{v1} = (10.0x6.5x2.0) \times 1/6 = 21.67$

Uniform load : $P_{v2} = (10.0x6.5x0.5) = 1/6 = 5.42$

Axis load by horizontal force: $P_h = (43.35x1.6)/4.0 = \pm 17.34$

$$\sigma_c = \sigma_{ca} + M/Z + P/A$$

$$= 40 + \frac{43.35 \times 10^5}{390 \times 10^2} + \frac{(21.67+5.42+17.34)x10^3}{2,620}$$

$$= 40 + 111 + 17 = 168\ kg/cm^2 < \sigma_{ca} = 250\ kg/cm^2$$

$$\sigma_c = 40 - 111 + \frac{(21.67-17.349 \times 10^3}{2,620} = -69\ kg/cm^2 > \sigma_{ca}' = -30\ kg/cm^2$$

According to the above calculation, the PC pile with Class B is required.

* Loading Platform : The PC Piles of ϕ 600x100 with 5 m pitch is arranged in the trial case.

The sectional property of the pile is as follows:

$\sigma_{ce} = 40\ kg/cm^2$,
$I_e = 522 \times 10^3$,
$A_e = 1{,}600\ cm^2$, $W = 408\ kg/m$

Vertical load:	Dead Weight of Deck	: (5.0x5.0x2.0)	= 50 t
	Uniform load	: (5.0x5.0x2.0)	= 50 t
	Total		N =100 t/pile

$$\sigma_c = \sigma_{ce} + MZ + P/A = 40 + 0 + \frac{100\times10^3}{1{,}600} = 102.5\ kg/cm^2 < \sigma_{ca}$$

$= 135 kg/cm^2$

* Buckling:

$$\beta = \sqrt[4]{\frac{135 \times 60}{4\times4.0\times10^5\times522\times10^3}} = 3.138\times10^{-3} cm^{-1}$$

$1/\beta = 3.19m$

Length of buckling: 1 = 11.5 + 3.19 = 14.69 m

$$\text{Buckling load: } P_{cr} = \frac{\pi^2 EI}{4\ 1^2} = \frac{\pi^2 \times 4.0\times10^5\times522\times10^3}{4 \times 1{,}469} = 238\ t > N{=}100t$$

* Penetration Depth : The piles is assumed to penetrate until -35.0m.

$R_u = 30\ N\ A_p + \sum N.A_s/5$
where, N = (25+29)/2 = 27,

$A_p = 0.62\ \pi/4 = 0.28m^2$

Water depth in $-7.5 \sim -9.5m$: $N = 9$,

$A_s = \pi D l = \pi 0.6x12 = 22.62\ m^2$

Water depth in $-19.5 \sim -35m$: $N = 20$,

$A_s = \pi D l = \pi 0.6x15.5 = 29.22\ m^2$

$\sum N.A_s = 9x22.62 + 20\ x\ 29.22 = 788$

$R_u = 30x27x0.28 + 788/5 = 226 + 157 = 383\ t$

Own weight of pile : $W = 39m\ x\ 0.408 = 16\ t$

$F_s = 383/(100+16) = 3.30 > 2.5$

2.3.3.6 Mooring Dolphin

Pull load by ship : $\log G.T = -0.336 + 1.014 \log DWT$

$= -0.336 + 1.014 \log 3,000 = 3,190$

$GT = 1,548\ t$

Pull load to Bollard : $T = 25\ t$

Four Steel Pipe of ø 550x14mm will used as the bollard:

$M = 1/2(11.5+3.13)\ x\ 25/4 = 45.72^{t-m}$

$\sigma_b = M/Z = 45.72\ x\ 10^5/2,620 = 1,745kg/cm^2 < \sigma_{ba}' = 1,900\ kg/cm^2$

Appendix-III.2.3.4 Consolidation Settlement of Soil (Tg. Sebubal East)

2.3.4.1 Soil Condition

(1) The typical soil profile at the site is assumed in the figure below:

+ 5.0m

Very soft sandy clayey SILT

q_u = 16 KN/m^2

γt = 1.5 Mg/m^3

+ 0.20m

Very soft sandy clayey SILT

q_u = 40 KN/m^2

γt = 1.6 Mg/m^3

- 3.40m

Very soft sandy clayey CLAY

q_u = 60 KN/m^2

γt = 2.0 Mg/m^3

- 5.30m

Very soft sandy clayey SAND

q_u = 60 KN/m^2

γt = 2.01.5 Mg/m^3

- 9.80m

Firm clayey SILT

N = 6 ～ 9

- 20.2m

Dense to very dense silty SAND

(Weathered sandstone)

N = 32 ～ 50 over

(2) Lavaratory test results: as follows

Br. No. BH7 GH +5.00m

No.	Depth (m)	Gravity Gs	Water content w (%)	Wet unit weight γ_t (Mg/m^3)	Void ratio e	Unconfined compressive strength q_u (KN/m^2)	Consoli-dation yield stress pc (KN/m^2)	Cofficient of compressi-bility Cc
	5.00							
BH-U1	1.70	2.65	58	1.547	1.787	16.64	50.50	0.58
U2	-1.30	2.65	65	1.630		40.47		
U3	-4.30	2.65	22	2.012	0.568	61.24	55.00	0.11
	-5.30							

Br. No. BH7

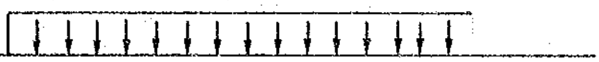
No.	Soil Strata			Wet unit weight in water γ_t (Mg/m^2)	Overburden pressure Pc (KN/m^2)	Pre-consoli-dation pressure Po (KN/m^2)
	Elevation (m)	Thickness Hc (m)	Depth Z (m)			
BH-U1	5.00~ 0.20	4.80	2.60	0.547	13.13	13.13
U2	0.20~-3.40	3.60	-1.60	0.630	37.60	37.60
U3	-3.40~-5.30	1.90	-4.35	1.012	58.55	58.55
		10.30				

2.3.4.2 Consolidation Load

The consolidation load is assumed to act as shown in the figure below:

Uniform load: 30 KN/m^2

Design Height +8.5m



Enbankment with good sand

$\Delta p = 1.8\ Mg/m^3 \times 2.5m$

$= 45\ KN/m^2$

Existing ground elevation +5.0m

2.3.4.3 Consolidation Settlement

The soil strata to be consolidated is assumed as the soft clayey layer below +5.0m above -5.3m. There is the soft clayey layer below -9.8 above -20.2m. This layer is a firm clayey silt and it is estimated that its cohesion is about c=100 KN/m^2 with the settlement of a few cm. Therefore, the settlement of this layer is negrectable.

* Final Consolidation Settlement : $S_f = \Sigma \dfrac{e_{oi} - e_{ofi}}{1 + e_{oi}} \times H_{ci} = 82$ cm

Load	Δ p (KN/m^2)	Final Consolidation stress P_f (KN/m^2)	Original Void ratio e_o	Final Void ratio e_f	Final Settlement S_f (m)
Uniform load	30.00	88.13	1.67	1.40	0.49
Enbankment	45.00	112.60	1.58	1.36	0.30
		133.55	0.53	0.50	0.04
Σ	75.00				0.82

Appendix-III.2.3.5 Circular Slip Calculation of river Shore Slope

According to the result of subsurface soil survey, the strata at the proposed site consist of mainly clayey silt and contain some soft layers. Therefore, circular slip calculation should be made for safety of the river shore slope.

The result of the calculation is shown in Figure-2.3.5.1. This calculation is based on the survey result at the site of approximately 200m land side from the proposed wharf site, but not at the exact points of the proposed site. Furthermore, the strata at this area is much undulated. It is therefore, required to carry out additional borings in the stage of detailed design.

CIRCULAR ARC SLIDING

(BH4 BY STIDC)

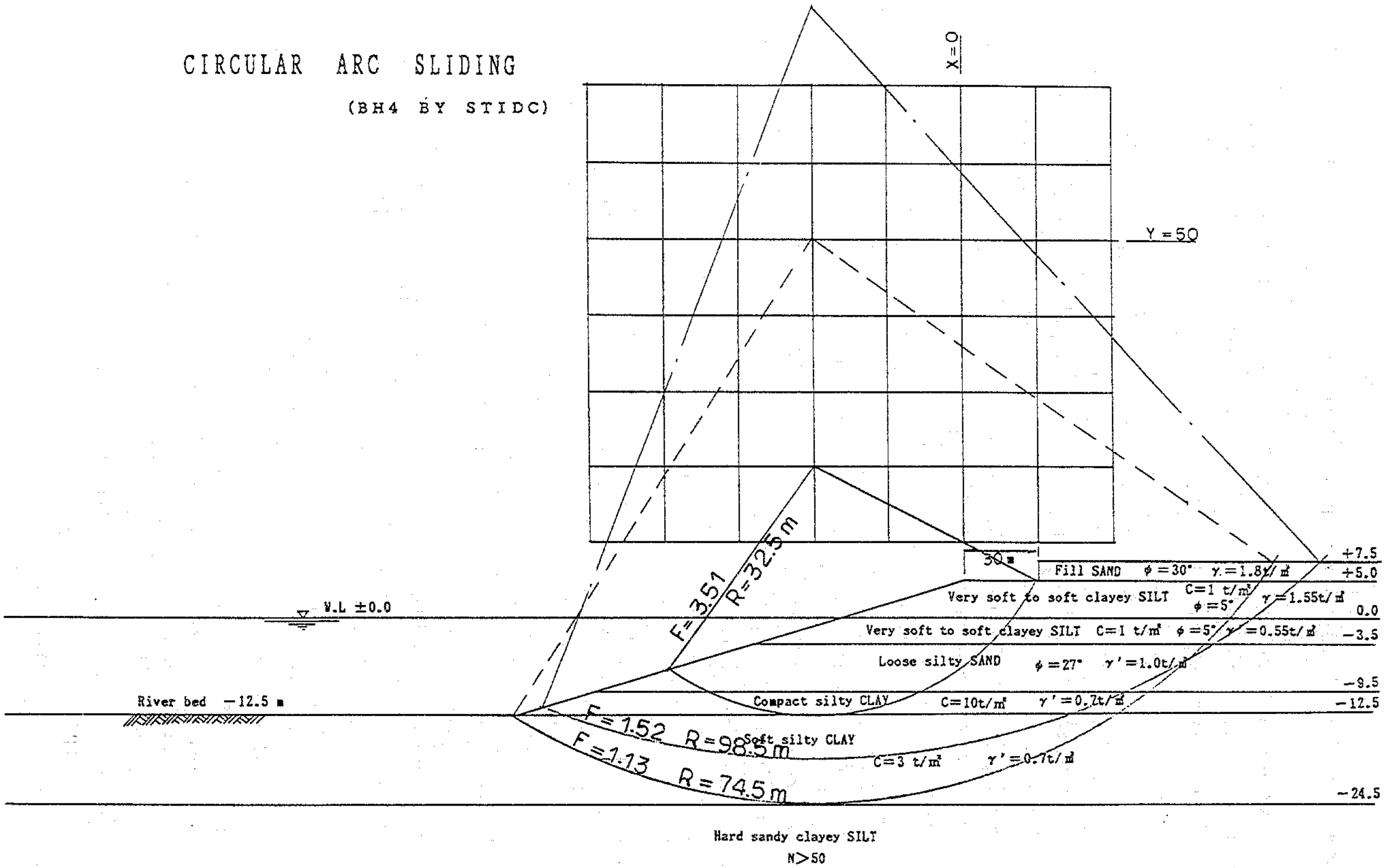


Figure-2.3.5.1 Circular Arc Sliding Calculation of River Shore Slope

Appendix-III.2.3.6 Shore Revetment and Slope protection

The type of the shore revetment and slope protection shall be determined based on the natural conditions at the site, availability to procure the material, and workability of the construction and cost.

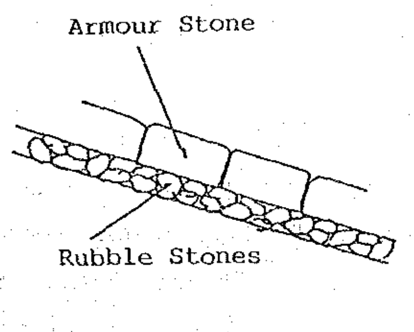
Five methods described in Chapter-2.4.6 Volume-III are summerized as follows.

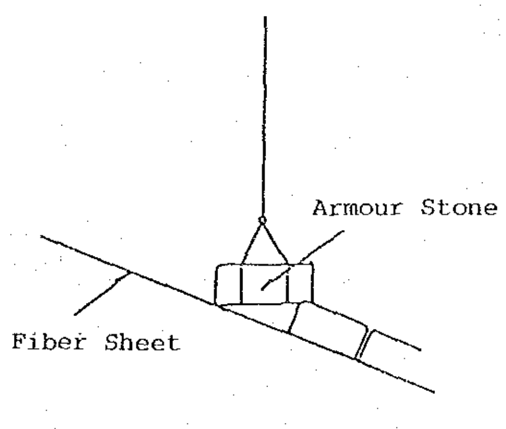
1) Armour Stone: This method is usually used at the slope of structures on sea shore facing to rough wave such as the breakwater or cause-way. Therefore, the stones shall be made of the cubic large size.

However, the method of armour stone has the following three disadvantages.

a) Quarries in Sarawak are incapable of supplying a sufficient quantity and quality of materials in Sarawak.

b) It is very difficult to install stones at the site, which is on the very soft silt strata and in a very muddy deep river bed.
The rubble stones are usually installed underneath the armour stones as a cusion material on designing. However, these rubble stones are also very difficult to install with the required level and thickness because of site conditions. Without the rubble stones, it is feared that the fiber sheet lied on the river bed to protect the soft silt flow-away will be damaged. (Please refer to the sketches below.)





c) The stone is very costly.

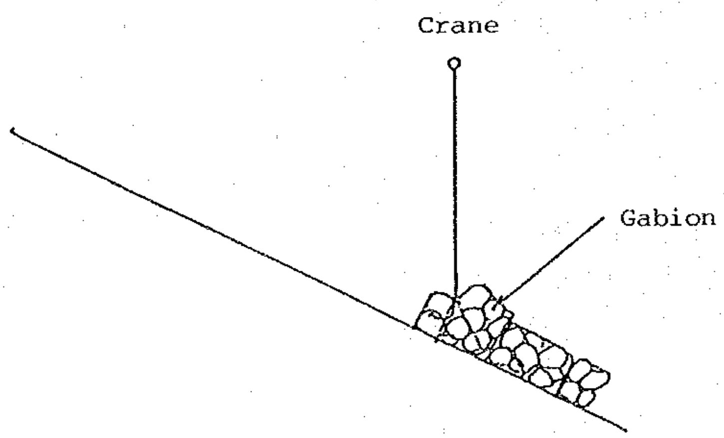
2) Concrete Block: This method is similar to that used with armour stone. Concrete blocks come in many sizes and in shapes, which very useful for river or sea shore protection. However, as with armour stone, this method faces disdvantages of installation and cost.

3) Stone: This is a more cheaper method than item 1), 2) and gabion. However, the stones are similar to the rubble stones, so that they are very difficult to install with the required level and thickness under the site condition.

4) Gabion: This method is usually used at the river revetment or shore slope. Main situations in which gabion is used are as follows.

a) In places where it is difficult to supply large stones.

b) Gabions can be installed more easily and safely than the armour stone.
(Please refer to following sketch shown as a failed case to install, but it shows safely on design purpose.)



c) To save the cost.
However, as gabion consist of stones packed in steel wires, these wires will rust and corrode as time passes. The reason to use the gabion is to facilitate installation easily when the construction work is carried out. After the installation of the gabions, even if the wires are rusted and corroded, the stones will be settled in the river bed, therefore, there is no disdvantage in protecting the shore slope for the purpose to be required on the design.

5) Sand Bag: This method is the cheapest one. The sand shall be packed in the chemical fiber sheet or an equivalent material which has suffifient strength to protect the slope. The method is also easy to install on the site.

However, the sand bags are not as strong as the stones, so that observation of the slope is frequently required to judge whether the additional action is required or not.

A technical compaarison on the alternatives of the shore protection method is summarized as shown in following table.

Table-4.2.6.1 Technial Comparison of Alternatives on Shore Protection Method

Item	Availability to supply	Workability to install	Cost			Appraisal/ Remarks
			Capital	Maintenance	Total	
Armour Stone	Difficult	Difficult	277 M$/m²	125 M$/m² /30years	402 M$/m²	×××
Concrete Block	Easy	Difficult	355 M$/m²	150 M$/m² /30years	505 M$/m²	○××
Stones	Easy	Difficult	200 M$/m²	60 M$/m² /30years	260 M$/m²	○×○
Gabion	Easy	Moderate	196 M$/m²	60 M$/m² /30years	256 M$/m²	○△○

[Note] The maintenance cost will be estimated about 1 % per year·capital cost.

According to the fore-mentioned study, gabions at the important places with sand bags surrounding them are recommended as the revetment and the river shore slope protection in the proposed sites.

Appendix-III.4.1.1 Cost Comparison with Steel Pipe Pile & PC Pile

Cost Comparison with Steel Pipe Pile & PC Pile

The cost per one pile is shown in the following table.

Table-1 Cost Comparison with Steel Pipe & PC Pile

Unit: Yen per Pile

Kind of Pile	Material	Transportation	Total
Steel Pipe Pile φ700×14(12)	Weight: w=0.237 t/m(t:14mm) w=0.204 t/m(t:12mm) Total weight: (0.237×20)+(0.204×13) = 7.392 t/pile Length: L=33.0 m Thickness: 14mm(L:20m) 12mm(L:13m) Unit cost: M$ 2,100/t= ¥ 111,300/t Cost: 7.392t×¥111,300/t = ¥ 822,700/pile	From KL to site Unit cost: M$ 70.0= ¥ 3,710/t Freight tonnage: 0.70×0.70≒0.50t/m Cost: 0.5×33m×3,710 = ¥ 61,200/pile	¥ 883,900 /pile
PC Pile φ800×120 Grade-B	Weight: w=0.666 t/m 0.666×33m=22.0 t/pile Unit cost: ¥ 25,000/m Cost: ¥ 25,000/m×33m = ¥ 825,000/pile	From Japan to site Unit cost: US$70.00=¥ 10,388/t Cost: 22t×10,388/t = ¥ 228,500/pile	¥ 1,053,500 /pile
Balance			¥ 169,600 (19.2%)

[Note] 1) Exchange Rate: M$ 1.00 = ¥ 53.00, US$ 1.00 = M$ 2.80 = ¥ 148.40
2) PC Pile of φ800×120 Grade-B is not available in Malaysia and shall be imported.
3) The transportation cost of piles shall be accounted in the freight tonnage.

Total Material Cost for Timber Products Wharf

Steel Pipe Pile	: ¥883,900/pile x 522 piles	= ¥461,395,800
PC Pile	: ¥1,053,500/pile x 522 piles	= ¥549,927,000
Balance	: ¥549,927,000 - ¥461,395,800	= ¥88,531,200
		(=M$1,670,400)
		(19.2 %)

Piling Cost of PC piles will be double of Steel Pipe Pile because of the difficulty in the piling operation. Furthermore, it is a disadvantage to make the damaged piles by the crack during the production, transportation and piling operation.

It is concluded that the PC Pile is not recommendable to this wharf.

Appendix-III.6.4.1 Economic Prices of Coal Terminal Construction Costs

(Category 3)

('000 ringgit)

Item	Market Price '000ringgit	F/C 1.000	Local Currency Non-tradable 0.958	Skilled Labo 0.949	Unskilled La 0.365	Transfer Ite 0.000	OCF	Economic Price	1994	1995	1996
Coal Wharf(-10,-5m)	15106	25.63%	60.05%	3.72%	7.44%	3.16%	0.89	13,506	3,376	10,129	
Coal Wharf Bridge	5629	5.13%	76.60%	4.74%	9.49%	4.03%	0.86	4,868		4,868	
Coal Yard	100	0.00%	80.75%	5.00%	10.00%	4.25%	0.86	86			86
Port Road	226	0.00%	80.75%	5.00%	10.00%	4.25%	0.86	194			194
Reclamation	870	80.00%	16.15%	1.00%	2.00%	0.85%	0.97	845	845		
Water Processing Fac	300	0.00%	80.75%	5.00%	10.00%	4.25%	0.86	257			257
Coal Handling Equip.	3066	96.93%	2.18%	0.15%	0.61%	0.11%	0.99	3,047		1,524	1,524
Utilities	890	50.00%	40.38%	2.50%	5.00%	2.12%	0.93	827			827
Temporary Facilities	480	50.00%	40.38%	2.50%	5.00%	2.12%	0.93	446	223	223	
Mobi& Demobilization	1200	100.00%	0.00%	0.00%	0.00%	0.00%	1.00	1,200	600		600
Sub Total	27867	45.31%	47.96%	12.86%	7.98%	2.12%		25,276	5,045	16,744	3,488
Consulting Services	2786	50.00%	4.75%	45.00%	0.00%	0.25%	0.97	2,710	903	903	903
Physical Contingency	1672	34.87%	47.44%	5.63%	7.76%	4.30%	0.88	1,480	493	493	493
Total	32325							29,465	6,441	18,140	4,884

Appendix-III.6.5.1 Annual Costs and Benefits in Economic Prices

(Category 3)

('000 ringgit)

No.	Year	Cost				Benefits								
		With Case			Total	Without Case			Staying Cost of Vessels	Tugboat Barge Cost	Interest Cost	Stevedor Cost	Total Benefit
		Construction & Purchase	Operation & Maintenance	Renewal Investment	Cost	Berth for Coal	Shed & Storage for TPZ	Coal Yard for Power S.					
1	1994	6,411			6,411								0
2	1995	18,140			18,140								0
3	1996	4,884			4,884	1,819		598					2,417
4	1997		1,278		1,278				4,662	274			4,936
5	1998		1,278		1,278				4,662	274			4,936
6	1999		1,278		1,278				4,662	274			4,936
7	2000		1,278		1,278				4,662	274			4,936
8	2001		1,278		1,278				4,662	274			4,936
9	2002		1,278		1,278				4,662	274			4,936
10	2003		1,278	3,066	4,344				4,662	274			4,936
11	2004		1,278		1,278				4,662	274			4,936
12	2005		1,278		1,278				4,662	274			4,936
13	2006		1,278		1,278				4,662	274			4,936
14	2007		1,278		1,278				4,662	274			4,936
15	2008		1,278		1,278				4,662	274			4,936
16	2009		1,278		1,278				4,662	274			4,936
17	2010		1,278	3,066	4,344				4,662	274			4,936
18	2011		1,278		1,278				4,662	274			4,936
19	2012		1,278		1,278				4,662	274			4,936
20	2013		1,278		1,278				4,662	274			4,936
21	2014		1,278		1,278				4,662	274			4,936
22	2015		1,278		1,278				4,662	274			4,936
23	2016		1,278		1,278				4,662	274			4,936
24	2017		1,278	3,066	4,344				4,662	274			4,936
25	2018		1,278		1,278				4,662	274			4,936
26	2019		1,278		1,278				4,662	274			4,936
27	2020		1,278		1,278				4,662	274			4,936
28	2021		1,278		1,278				4,662	274			4,936
29	2022		1,278		1,278				4,662	274			4,936
30	2023		1,278	-9,947	-8,669				4,662	274			4,936
Total		29,435	34,506	-749	63,192	1,819	0	598	125,874	7,398	0	0	135,689

Appendix-III.6.5.2 Calculation of Economic Internal Rate of Return (Category 3)

(Base Case)
EIRR (%): 10.6 ('000 ringgit)

No.	Year	Cost	Benefit	Bnft.-Cost	P. Cost	P. Bnft	P. Value
1	1994	6,411	0	-6,411	6,411	0	-6,411
2	1995	18,140	0	-18,140	16,408	0	-16,408
3	1996	4,884	2,417	-2,467	3,996	1,977	-2,018
4	1997	1,278	4,936	3,658	946	3,653	2,707
5	1998	1,278	4,936	3,658	855	3,304	2,448
6	1999	1,278	4,936	3,658	774	2,988	2,215
7	2000	1,278	4,936	3,658	700	2,703	2,003
8	2001	1,278	4,936	3,658	633	2,445	1,812
9	2002	1,278	4,936	3,658	573	2,211	1,639
10	2003	4,344	4,936	592	1,760	2,000	240
11	2004	1,278	4,936	3,658	468	1,809	1,341
12	2005	1,278	4,936	3,658	424	1,636	1,213
13	2006	1,278	4,936	3,658	383	1,480	1,097
14	2007	1,278	4,936	3,658	347	1,339	992
15	2008	1,278	4,936	3,658	313	1,211	897
16	2009	1,278	4,936	3,658	284	1,095	812
17	2010	4,344	4,936	592	872	991	119
18	2011	1,278	4,936	3,658	232	896	664
19	2012	1,278	4,936	3,658	210	810	601
20	2013	1,278	4,936	3,658	190	733	543
21	2014	1,278	4,936	3,658	172	663	491
22	2015	1,278	4,936	3,658	155	600	444
23	2016	1,278	4,936	3,658	140	542	402
24	2017	4,344	4,936	592	432	491	59
25	2018	1,278	4,936	3,658	115	444	329
26	2019	1,278	4,936	3,658	104	401	297
27	2020	1,278	4,936	3,658	94	363	269
28	2021	1,278	4,936	3,658	85	328	243
29	2022	1,278	4,936	3,658	77	297	220
30	2023	-8,669	4,936	13,605	-472	269	740
Total		63,192	135,689	72,497	37,679	37,679	0

Note: P. Cost ..Present Value of Costs
P. Bnft ..Present Value of Benefit

Appendix-III.6.6.1 Sensitivity Analysis

1. Category 1

(Case A)

EIRR (%): 19.6 ('000 ringgit)

No.	Year	Cost	Benefit	Bnft.-Cost	P. Cost	P. Bnft	P. Value
1	1994	50,982	0	-50,982	50,982	0	-50,982
2	1995	79,658	7,769	-71,889	66,612	6,497	-60,116
3	1996	16,648	30,710	14,062	11,642	21,475	9,833
4	1997	15,667	36,604	20,937	9,162	21,405	12,243
5	1998	9,567	41,311	31,744	4,678	20,201	15,523
6	1999	9,567	41,311	31,744	3,912	16,893	12,981
7	2000	9,567	41,311	31,744	3,271	14,126	10,855
8	2001	9,567	41,311	31,744	2,736	11,813	9,077
9	2002	14,344	41,311	26,967	3,430	9,878	6,448
10	2003	12,939	41,311	28,372	2,587	8,261	5,673
11	2004	16,147	41,311	25,164	2,700	6,908	4,208
12	2005	9,567	41,311	31,744	1,338	5,776	4,439
13	2006	9,567	41,311	31,744	1,119	4,830	3,712
14	2007	9,567	41,311	31,744	935	4,039	3,104
15	2008	9,567	41,311	31,744	782	3,378	2,596
16	2009	14,344	41,311	26,967	981	2,825	1,844
17	2010	32,291	41,311	9,021	1,846	2,362	516
18	2011	16,147	41,311	25,164	772	1,975	1,203
19	2012	9,567	41,311	31,744	383	1,652	1,269
20	2013	9,567	41,311	31,744	320	1,381	1,061
21	2014	9,567	41,311	31,744	267	1,155	888
22	2015	9,567	41,311	31,744	224	966	742
23	2016	14,344	41,311	26,967	280	808	527
24	2017	12,939	41,311	28,372	212	675	464
25	2018	16,147	41,311	25,164	221	565	344
26	2019	9,567	41,311	31,744	109	472	363
27	2020	9,567	41,311	31,744	91	395	304
28	2021	9,567	41,311	31,744	76	330	254
29	2022	9,567	41,311	31,744	64	276	212
30	2023	-32,797	41,311	74,108	-183	231	414
Total		446,267	895,701	449,434	171,549	171,549	0

Note: P. Cost ..Present Value of Costs
P. Bnft ..Present Value of Benefit

2. Category 1

(Case B)

EIRR (%): 19.3 ('000 ringgit)

No.	Year	Cost	Benefit	Bnft.-Cost	P. Cost	P. Bnft	P. Value
1	1994	46,347	0	-46,347	46,347	0	-46,347
2	1995	72,416	6,992	-65,424	60,692	5,860	-54,832
3	1996	15,135	27,639	12,505	10,631	19,414	8,783
4	1997	14,243	32,944	18,701	8,385	19,393	11,009
5	1998	8,697	37,180	28,483	4,291	18,344	14,053
6	1999	8,697	37,180	28,483	3,596	15,374	11,778
7	2000	8,697	37,180	28,483	3,014	12,885	9,871
8	2001	8,697	37,180	28,483	2,526	10,799	8,273
9	2002	13,040	37,180	24,140	3,174	9,050	5,876
10	2003	11,763	37,180	25,417	2,400	7,585	5,185
11	2004	14,679	37,180	22,501	2,510	6,357	3,847
12	2005	8,697	37,180	28,483	1,246	5,328	4,082
13	2006	8,697	37,180	28,483	1,044	4,465	3,421
14	2007	8,697	37,180	28,483	875	3,742	2,867
15	2008	8,697	37,180	28,483	734	3,136	2,403
16	2009	13,040	37,180	24,140	922	2,629	1,707
17	2010	29,355	37,180	7,825	1,739	2,203	464
18	2011	14,679	37,180	22,501	729	1,846	1,117
19	2012	8,697	37,180	28,483	362	1,547	1,185
20	2013	8,697	37,180	28,483	303	1,297	994
21	2014	8,697	37,180	28,483	254	1,087	833
22	2015	8,697	37,180	28,483	213	911	698
23	2016	13,040	37,180	24,140	268	763	496
24	2017	11,763	37,180	25,417	202	640	437
25	2018	14,679	37,180	22,501	212	536	325
26	2019	8,697	37,180	28,483	105	449	344
27	2020	8,697	37,180	28,483	88	377	289
28	2021	8,697	37,180	28,483	74	316	242
29	2022	8,697	37,180	28,483	62	265	203
30	2023	-29,815	37,180	66,995	-178	222	400
Total		393,516	1,034,252	640,737	156,821	156,821	0

Note: P. Cost ..Present Value of Costs
P. Bnft ..Present Value of Benefit

3. Category 1

(Case C)

EIRR (%): 16.9 ('000 ringgit)

No.	Year	Cost	Benefit	Bnft.-Cost	P. Cost	P. Bnft	P. Value
1	1994	50,982	0	-50,982	50,982	0	-50,982
2	1995	79,658	6,992	-72,666	68,148	5,982	-62,166
3	1996	16,648	27,639	10,991	12,185	20,229	8,044
4	1997	15,667	32,944	17,276	9,810	20,628	10,818
5	1998	9,567	37,180	27,613	5,125	19,917	14,792
6	1999	9,567	37,180	27,613	4,384	17,039	12,655
7	2000	9,567	37,180	27,613	3,751	14,577	10,826
8	2001	9,567	37,180	27,613	3,209	12,471	9,262
9	2002	14,344	37,180	22,836	4,116	10,669	6,553
10	2003	12,939	37,180	24,241	3,177	9,127	5,951
11	2004	16,147	37,180	21,033	3,391	7,809	4,417
12	2005	9,567	37,180	27,613	1,719	6,680	4,962
13	2006	9,567	37,180	27,613	1,471	5,715	4,245
14	2007	9,567	37,180	27,613	1,258	4,889	3,631
15	2008	9,567	37,180	27,613	1,076	4,183	3,107
16	2009	14,344	37,180	22,836	1,381	3,579	2,198
17	2010	32,291	37,180	4,889	2,659	3,062	403
18	2011	16,147	37,180	21,033	1,137	2,619	1,482
19	2012	9,567	37,180	27,613	577	2,241	1,664
20	2013	9,567	37,180	27,613	493	1,917	1,424
21	2014	9,567	37,180	27,613	422	1,640	1,218
22	2015	9,567	37,180	27,613	361	1,403	1,042
23	2016	14,344	37,180	22,836	463	1,200	737
24	2017	12,939	37,180	24,241	357	1,027	670
25	2018	16,147	37,180	21,033	382	879	497
26	2019	9,567	37,180	27,613	193	752	558
27	2020	9,567	37,180	27,613	165	643	478
28	2021	9,567	37,180	27,613	142	550	409
29	2022	9,567	37,180	27,613	121	471	350
30	2023	-32,797	37,180	69,976	-355	403	758
Total		432,867	1,034,252	601,385	182,299	182,299	0

Note: P. Cost ..Present Value of Costs
P. Bnft ..Present Value of Benefit

4. Category 2

(Case A)

EIRR (%): 22.2 ('000 ringgit)

No.	Year	Cost	Benefit	Bnft.-Cost	P. Cost	P. Bnft	P. Value
1	1994	47,425	0	-47,425	47,425	0	-47,425
2	1995	60,337	7,769	-52,568	49,359	6,355	-43,004
3	1996	6,707	28,293	21,586	4,489	18,934	14,445
4	1997	14,033	31,436	17,403	7,682	17,210	9,527
5	1998	7,932	36,416	28,484	3,552	16,309	12,756
6	1999	7,932	36,416	28,484	2,906	13,341	10,435
7	2000	7,932	36,416	28,484	2,377	10,914	8,537
8	2001	7,932	36,416	28,484	1,945	8,928	6,983
9	2002	12,709	36,416	23,707	2,549	7,304	4,755
10	2003	7,932	36,416	28,484	1,301	5,975	4,673
11	2004	14,512	36,416	21,904	1,948	4,888	2,940
12	2005	7,932	36,416	28,484	871	3,998	3,127
13	2006	7,932	36,416	28,484	712	3,271	2,558
14	2007	7,932	36,416	28,484	583	2,676	2,093
15	2008	7,932	36,416	28,484	477	2,189	1,712
16	2009	12,709	36,416	23,707	625	1,791	1,166
17	2010	27,283	36,416	9,133	1,097	1,465	367
18	2011	14,512	36,416	21,904	478	1,198	721
19	2012	7,932	36,416	28,484	214	980	767
20	2013	7,932	36,416	28,484	175	802	627
21	2014	7,932	36,416	28,484	143	656	513
22	2015	7,932	36,416	28,484	117	537	420
23	2016	12,709	36,416	23,707	153	439	286
24	2017	7,932	36,416	28,484	78	359	281
25	2018	14,512	36,416	21,904	117	294	177
26	2019	7,932	36,416	28,484	52	240	188
27	2020	7,932	36,416	28,484	43	197	154
28	2021	7,932	36,416	28,484	35	161	126
29	2022	7,932	36,416	28,484	29	132	103
30	2023	39,354	36,416	-2,938	116	108	-9
Total		446,267	895,701	449,434	131,648	131,648	0

Note: P. Cost ..Present Value of Costs
P. Bnft ..Present Value of Benefit

5. Category 2

(Case B)

EIRR (%): 22.0 ('000 ringgit)

No.	Year	Cost	Benefit	Bnft.-Cost	P. Cost	P. Bnft	P. Value
1	1994	43,114	0	-43,114	43,114	0	-43,114
2	1995	54,852	6,992	-47,860	44,979	5,734	-39,245
3	1996	6,098	25,464	19,366	4,100	17,122	13,022
4	1997	12,757	28,292	15,535	7,034	15,599	8,566
5	1998	7,211	32,774	25,563	3,260	14,818	11,558
6	1999	7,211	32,774	25,563	2,673	12,151	9,477
7	2000	7,211	32,774	25,563	2,192	9,963	7,771
8	2001	7,211	32,774	25,563	1,798	8,170	6,372
9	2002	11,554	32,774	21,220	2,362	6,699	4,338
10	2003	7,211	32,774	25,563	1,209	5,493	4,285
11	2004	13,193	32,774	19,581	1,813	4,505	2,691
12	2005	7,211	32,774	25,563	813	3,694	2,881
13	2006	7,211	32,774	25,563	666	3,029	2,362
14	2007	7,211	32,774	25,563	546	2,484	1,937
15	2008	7,211	32,774	25,563	448	2,037	1,589
16	2009	11,554	32,774	21,220	589	1,670	1,081
17	2010	24,803	32,774	7,971	1,036	1,369	333
18	2011	13,193	32,774	19,581	452	1,123	671
19	2012	7,211	32,774	25,563	203	921	718
20	2013	7,211	32,774	25,563	166	755	589
21	2014	7,211	32,774	25,563	136	619	483
22	2015	7,211	32,774	25,563	112	508	396
23	2016	11,554	32,774	21,220	147	416	270
24	2017	7,211	32,774	25,563	75	341	266
25	2018	13,193	32,774	19,581	113	280	167
26	2019	7,211	32,774	25,563	51	230	179
27	2020	7,211	32,774	25,563	41	188	147
28	2021	7,211	32,774	25,563	34	154	120
29	2022	7,211	32,774	25,563	28	127	99
30	2023	35,776	32,774	-3,002	113	104	-10
Total		381,439	912,883	531,444	120,302	120,302	0

Note:P. Cost ..Present Value of Costs
P. Bnft ..Present Value of Benefit

6. Category 2

(Case C)

EIRR (%): 19.3 ('000 ringgit)

No.	Year	Cost	Benefit	Bnft.-Cost	P. Cost	P. Bnft	P. Value
1	1994	47,425	0	-47,425	47,425	0	-47,425
2	1995	60,337	6,992	-53,345	50,577	5,861	-44,716
3	1996	6,707	25,464	18,756	4,713	17,892	13,179
4	1997	14,033	28,292	14,260	8,265	16,664	8,399
5	1998	7,932	32,774	24,842	3,916	16,181	12,265
6	1999	7,932	32,774	24,842	3,283	13,564	10,281
7	2000	7,932	32,774	24,842	2,752	11,370	8,618
8	2001	7,932	32,774	24,842	2,307	9,531	7,224
9	2002	12,709	32,774	20,065	3,098	7,989	4,891
10	2003	7,932	32,774	24,842	1,621	6,697	5,076
11	2004	14,512	32,774	18,262	2,486	5,614	3,128
12	2005	7,932	32,774	24,842	1,139	4,706	3,567
13	2006	7,932	32,774	24,842	955	3,944	2,990
14	2007	7,932	32,774	24,842	800	3,306	2,506
15	2008	7,932	32,774	24,842	671	2,772	2,101
16	2009	12,709	32,774	20,065	901	2,323	1,422
17	2010	27,283	32,774	5,491	1,621	1,947	326
18	2011	14,512	32,774	18,262	723	1,632	910
19	2012	7,932	32,774	24,842	331	1,368	1,037
20	2013	7,932	32,774	24,842	278	1,147	869
21	2014	7,932	32,774	24,842	233	961	729
22	2015	7,932	32,774	24,842	195	806	611
23	2016	12,709	32,774	20,065	262	676	414
24	2017	7,932	32,774	24,842	137	566	429
25	2018	14,512	32,774	18,262	210	475	265
26	2019	7,932	32,774	24,842	96	398	302
27	2020	7,932	32,774	24,842	81	334	253
28	2021	7,932	32,774	24,842	68	280	212
29	2022	7,932	32,774	24,842	57	234	178
30	2023	39,354	32,774	-6,579	236	196	-39
Total		419,582	912,883	493,300	139,435	139,435	0

Note: P. Cost ..Present Value of Costs
P. Bnft ..Present Value of Benefit

7. Category 3

(Case A)

EIRR (%): 9.0 ('000 ringgit)

No.	Year	Cost	Benefit	Bnft.-Cost	P. Cost	P. Bnft	P. Value
1	1994	7,052	0	-7,052	7,052	0	-7,052
2	1995	19,954	0	-19,954	18,308	0	-18,308
3	1996	5,372	2,417	-2,955	4,523	2,035	-2,488
4	1997	1,406	4,936	3,530	1,086	3,812	2,727
5	1998	1,406	4,936	3,530	996	3,498	2,502
6	1999	1,406	4,936	3,530	914	3,209	2,295
7	2000	1,406	4,936	3,530	839	2,944	2,106
8	2001	1,406	4,936	3,530	769	2,702	1,932
9	2002	1,406	4,936	3,530	706	2,479	1,773
10	2003	4,778	4,936	158	2,202	2,274	73
11	2004	1,406	4,936	3,530	594	2,087	1,492
12	2005	1,406	4,936	3,530	545	1,914	1,369
13	2006	1,406	4,936	3,530	500	1,756	1,256
14	2007	1,406	4,936	3,530	459	1,612	1,153
15	2008	1,406	4,936	3,530	421	1,479	1,057
16	2009	1,406	4,936	3,530	386	1,357	970
17	2010	4,778	4,936	158	1,205	1,245	40
18	2011	1,406	4,936	3,530	325	1,142	817
19	2012	1,406	4,936	3,530	298	1,048	749
20	2013	1,406	4,936	3,530	274	961	688
21	2014	1,406	4,936	3,530	251	882	631
22	2015	1,406	4,936	3,530	230	809	579
23	2016	1,406	4,936	3,530	211	743	531
24	2017	4,778	4,936	158	659	681	22
25	2018	1,406	4,936	3,530	178	625	447
26	2019	1,406	4,936	3,530	163	573	410
27	2020	1,406	4,936	3,530	150	526	376
28	2021	1,406	4,936	3,530	137	483	345
29	2022	1,406	4,936	3,530	126	443	317
30	2023	-9,536	4,936	14,472	-785	406	1,191
Total		446,267	895,701	449,434	43,725	43,725	0

Note: P. Cost ..Present Value of Costs
P. Bnft ..Present Value of Benefit

8. Category 3

(Case B)
EIRR (%): 8.8 ('000 ringgit)

No.	Year	Cost	Benefit	Bnft.-Cost	P. Cost	P. Bnft	P. Value
1	1994	6,411	0	-6,411	6,411	0	-6,411
2	1995	18,140	0	-18,140	16,668	0	-16,668
3	1996	4,884	2,175	-2,709	4,123	1,837	-2,287
4	1997	1,278	4,442	3,164	991	3,446	2,455
5	1998	1,278	4,442	3,164	911	3,167	2,256
6	1999	1,278	4,442	3,164	837	2,910	2,073
7	2000	1,278	4,442	3,164	769	2,674	1,904
8	2001	1,278	4,442	3,164	707	2,457	1,750
9	2002	1,278	4,442	3,164	649	2,257	1,608
10	2003	4,344	4,442	98	2,028	2,074	46
11	2004	1,278	4,442	3,164	548	1,906	1,357
12	2005	1,278	4,442	3,164	504	1,751	1,247
13	2006	1,278	4,442	3,164	463	1,609	1,146
14	2007	1,278	4,442	3,164	425	1,478	1,053
15	2008	1,278	4,442	3,164	391	1,358	968
16	2009	1,278	4,442	3,164	359	1,248	889
17	2010	4,344	4,442	98	1,121	1,147	25
18	2011	1,278	4,442	3,164	303	1,054	751
19	2012	1,278	4,442	3,164	279	968	690
20	2013	1,278	4,442	3,164	256	890	634
21	2014	1,278	4,442	3,164	235	818	582
22	2015	1,278	4,442	3,164	216	751	535
23	2016	1,278	4,442	3,164	199	690	492
24	2017	4,344	4,442	98	620	634	14
25	2018	1,278	4,442	3,164	168	583	415
26	2019	1,278	4,442	3,164	154	535	381
27	2020	1,278	4,442	3,164	142	492	350
28	2021	1,278	4,442	3,164	130	452	322
29	2022	1,278	4,442	3,164	119	415	296
30	2023	-8,669	4,442	13,111	-745	382	1,126
Total		63,192	122,120	58,928	39,982	39,982	0

Note: P. Cost ..Present Value of Costs
P. Bnft ..Present Value of Benefit

9. Category 3

(Case C)

EIRR (%): 7.4 ('000 ringgit)

No.	Year	Cost	Benefit	Bnft.-Cost	P. Cost	P. Bnft	P. Value
1	1994	7,052	0	-7,052	7,052	0	-7,052
2	1995	19,954	0	-19,954	18,586	0	-18,586
3	1996	5,372	2,175	-3,197	4,661	1,887	-2,774
4	1997	1,406	4,442	3,037	1,136	3,590	2,454
5	1998	1,406	4,442	3,037	1,058	3,344	2,286
6	1999	1,406	4,442	3,037	986	3,115	2,129
7	2000	1,406	4,442	3,037	918	2,901	1,983
8	2001	1,406	4,442	3,037	855	2,702	1,847
9	2002	1,406	4,442	3,037	797	2,517	1,721
10	2003	4,778	4,442	-336	2,522	2,345	-177
11	2004	1,406	4,442	3,037	691	2,184	1,493
12	2005	1,406	4,442	3,037	644	2,034	1,391
13	2006	1,406	4,442	3,037	600	1,895	1,295
14	2007	1,406	4,442	3,037	559	1,765	1,206
15	2008	1,406	4,442	3,037	520	1,644	1,124
16	2009	1,406	4,442	3,037	485	1,531	1,047
17	2010	4,778	4,442	-336	1,534	1,426	-108
18	2011	1,406	4,442	3,037	420	1,329	908
19	2012	1,406	4,442	3,037	392	1,237	846
20	2013	1,406	4,442	3,037	365	1,153	788
21	2014	1,406	4,442	3,037	340	1,074	734
22	2015	1,406	4,442	3,037	316	1,000	684
23	2016	1,406	4,442	3,037	295	932	637
24	2017	4,778	4,442	-336	933	868	-66
25	2018	1,406	4,442	3,037	256	808	552
26	2019	1,406	4,442	3,037	238	753	515
27	2020	1,406	4,442	3,037	222	701	479
28	2021	1,406	4,442	3,037	207	653	446
29	2022	1,406	4,442	3,037	193	608	416
30	2023	-9,536	4,442	13,978	-1,216	567	1,783
Total		69,511	122,120	52,609	46,563	46,563	0

Note: P. Cost ..Present Value of Costs
P. Bnft ..Present Value of Benefit

Appendix-III.7.3.1 Cargo Volume and Revenue

(Unit 1,000Ringgit)

	1996	1997	1998	1999	- - -	2023
(Revenue from Timber Terminal)						
Conventional Cargo (export,import1000F/T)	806.4	896	989	989	989	989
wharfage(2.30/t x 1.2)	2225.664	2472.96	2729.64	2729.64	2729.64	2729.64
stevedorage(6.00/t x 1.2)	5806.08	6451.2	7120.8	7120.8	7120.8	7120.8
RSAD(7.00/tx1.2,exclude cargo from shallow wh.)	3681.72	4090.8	4611.6	4611.6	4611.6	4611.6
sub total	11713.464	13014.96	14462.04	14462.04	14462.04	14462.04
Laden Container(export,import1000TEU)	9.9	11	15.9	15.9	15.9	15.9
wharfage(2.30/t x 39 x 1.2/TEU)	1065.636	1184.04	1711.476	1711.476	1711.476	1711.476
stevedorage(60/TEU x 1.2)	712.8	792	1144.8	1144.8	1144.8	1144.8
RSAD(7.00/t x 1.2)	1625.4	1806	2613.3343	2613.3343	2613.3343	2613.3343
sub total	3403.836	3782.04	5469.6103	5469.6103	5469.6103	5469.6103
Empty Container(import1000TEU)	2.52	2.8	4	4	4	4
wharfage(2.30/t x 39 x 1.2/TEU)	271.2528	301.392	430.56	430.56	430.56	430.56
stevedorage(60/TEU x 1.2)	181.44	201.6	288	288	288	288
RSAD(7.00/t x 25/TEU x 1.2)	0	0	0	0	0	0
sub total	452.6928	502.992	718.56	718.56	718.56	718.56
Timber Products(inbound at shallow wharf)	368.1	409	440	440	440	440
wharfage(2.30/t x 1.2)	0	0	0	0	0	0
stevedorage(6.00/t x 1.2)	2650.32	2944.8	3168	3168	3168	3168
sub total	2650.32	2944.8	3168	3168	3168	3168
Empty Container(inbound at shallow wharf)	6.66	7.4	8.4	8.4	8.4	8.4
wharfage(2.30/t x 39 x 1.2/TEU)	0	0	0	0	0	0
stevedorage(60/TEU x 1.2)	479.52	532.8	604.8	604.8	604.8	604.8
sub total	479.52	532.8	604.8	604.8	604.8	604.8
Revenue from Tug Servicies	246	246	246	246	246	246
Total	18945.833	21023.592	24669.01	24669.01	24669.01	24669.01
Sundry Income (7.6%)	1439.8833	1597.793	1874.8448	1874.8448	1874.8448	1874.8448
Total Revenue from Timber Terminal	20385.716	22621.385	26543.855	26543.855	26543.855	26543.855

Appendix-III.7.4.1 FIRR of the Timber Products Terminal in Case of Tariff Increase 20%

FIRR= 11.13%

(UNIT:1,000Ringgit)

YEAR	REVENUE	COST			REVENUE-COST	PRESENT VALUE IN 1994		
		INVESTMENT	EXPENSE	TOTAL		REVENUE	COST	DIFFERENCE
1994		50,273		50,273	-50,273	0	50,273	-50,273
1995		54,231		54,231	-54,231	0	48,798	-48,798
1996	20,385		9,608	9,608	10,777	16,505	7,780	8,725
1997	22,621	5,982	10,676	16,658	5,963	16,480	12,136	4,344
1998	26,543		11,262	11,262	15,281	17,400	7,383	10,017
1999	26,543		11,262	11,262	15,281	15,657	6,643	9,014
2000	26,543		11,262	11,262	15,281	14,088	5,978	8,111
2001	26,543		11,262	11,262	15,281	12,677	5,379	7,298
2002	26,543	4,343	11,262	15,605	10,938	11,407	6,706	4,701
2003	26,543		11,262	11,262	15,281	10,264	4,355	5,909
2004	26,543	5,982	11,262	17,244	9,299	9,235	6,000	3,236
2005	26,543		11,262	11,262	15,281	8,310	3,526	4,784
2006	26,543		11,262	11,262	15,281	7,478	3,173	4,305
2007	26,543		11,262	11,262	15,281	6,728	2,855	3,874
2008	26,543		11,262	11,262	15,281	6,054	2,569	3,485
2009	26,543	4,343	11,262	15,605	10,938	5,448	3,203	2,245
2010	26,543	11,889	11,262	23,151	3,392	4,902	4,275	626
2011	26,543	5,982	11,262	17,244	9,299	4,411	2,866	1,545
2012	26,543		11,262	11,262	15,281	3,969	1,684	2,285
2013	26,543		11,262	11,262	15,281	3,571	1,515	2,056
2014	26,543		11,262	11,262	15,281	3,213	1,363	1,850
2015	26,543		11,262	11,262	15,281	2,891	1,227	1,665
2016	26,543	4,343	11,262	15,605	10,938	2,602	1,530	1,072
2017	26,543		11,262	11,262	15,281	2,341	993	1,348
2018	26,543	5,982	11,262	17,244	9,299	2,107	1,369	738
2019	26,543		11,262	11,262	15,281	1,895	804	1,091
2020	26,543		11,262	11,262	15,281	1,706	724	982
2021	26,543		11,262	11,262	15,281	1,535	651	884
2022	26,543		11,262	11,262	15,281	1,381	586	795
2023	26,543	-29,285	11,262	-18,023	44,566	1,243	-844	2,086
TOTAL	733,124	124,065	313,096	437,161	295,963	195,497	195,497	0

Appendix-III.7.4.2 FIRR of the Coal Terminal in Case of Tariff Increase 20%

FIRR= 8.86%

(UNIT:1,000Ringgit)

YEAR	REVENUE	COST			REVENUE-COST	PRESENT VALUE IN 1994		
		INVESTMENT	EXPENSE	TOTAL		REVENUE	COST	DIFFERENCE
1994		8,118		8,118	-8,118	0	8,118	-8,118
1995		20,691		20,691	-20,691	0	19,007	-19,007
1996		4,704		4,704	-4,704	0	3,969	-3,969
1997	6,060		2,222	2,222	3,838	4,697	1,722	2,975
1998	6,060		2,222	2,222	3,838	4,315	1,582	2,733
1999	6,060		2,222	2,222	3,838	3,964	1,453	2,510
2000	6,060		2,222	2,222	3,838	3,641	1,335	2,306
2001	6,060		2,222	2,222	3,838	3,345	1,226	2,118
2002	6,060		2,222	2,222	3,838	3,073	1,127	1,946
2003	6,060	3,066	2,222	5,288	772	2,822	2,463	360
2004	6,060		2,222	2,222	3,838	2,593	951	1,642
2005	6,060		2,222	2,222	3,838	2,382	873	1,508
2006	6,060		2,222	2,222	3,838	2,188	802	1,386
2007	6,060		2,222	2,222	3,838	2,010	737	1,273
2008	6,060		2,222	2,222	3,838	1,846	677	1,169
2009	6,060		2,222	2,222	3,838	1,696	622	1,074
2010	6,060	3,066	2,222	5,288	772	1,558	1,359	198
2011	6,060		2,222	2,222	3,838	1,431	525	906
2012	6,060		2,222	2,222	3,838	1,315	482	833
2013	6,060		2,222	2,222	3,838	1,208	443	765
2014	6,060		2,222	2,222	3,838	1,109	407	703
2015	6,060		2,222	2,222	3,838	1,019	374	645
2016	6,060		2,222	2,222	3,838	936	343	593
2017	6,060	3,066	2,222	5,288	772	860	750	110
2018	6,060		2,222	2,222	3,838	790	290	500
2019	6,060		2,222	2,222	3,838	726	266	460
2020	6,060		2,222	2,222	3,838	667	244	422
2021	6,060		2,222	2,222	3,838	612	224	388
2022	6,060		2,222	2,222	3,838	562	206	356
2023	6,060	-10,421	2,222	-8,199	14,259	517	-699	1,216
TOTAL	163,620	32,290	59,994	92,284	71,336	51,879	51,879	0

Appendix-IV.1.1.1 New Strategies in Environmental Management

To meet the national environmental objectives set out above, a three-faceted environmental management strategy has been adopted: namely, pollution prevention, comprehensive land-use planning, and integrated project planning.

a. Pollution Prevention

In the pollution prevention approach, 10 pollution control regulations have been formulated and enforced under the Environmental Quality Act, 1974. In addition, two oil spill contingency plans--one for the Straits of Malacca and another for the South China Sea--have been prepared to combat pollution from oil spills.

b. Land-Use Planning

In the comprehensive land-use planning approach, environmental considerations are incorporated into land-use plans such as regional plans, master plans, structure plans, local plans or development plans. This is the time to apply good conservation and natural resources management principles. A checklist of environmental considerations for comprehensive land-use planning includes the following:

(1) Noise zones surrounding roads and airstrips;

(2) Nature conservation areas or areas where development is prohibited to protect historical buildings;

(3) Distribution of various forms of land use to be based on conservation strategies and other environment;

(4) Outdoor recreational and vacation areas, green belts etc., in the immediate surroundings of built-up areas;

(5) Protection of coastal areas including those set aside as recreational areas, national parks, nature reserves and fishing areas by segregating polluting industries, sewage treatment works, ports and harbors and sand dredging activities;

(6) Protection of hilly and mountain areas from development that might cause severe soil erosion;

(7) Protection of rivers, lakes and sea for various beneficial uses such as water supply, recreation, water way transport, fishing and hydroelectric facilities through the control and reduction of sewage and industrial effluents;

(8) Protection of residential areas from environmental pollution using DOE siting and zoning guidelines;

(9) Air pollution control zones in densely populated areas;

(10) Waste disposal areas for domestic sewage, domestic refuse and toxic and hazardous waste treatment facilities.

In this connection, the Department of environment has drawn up a list of land-use planning guidelines for use by planning agencies.

c. Integrated Project Planning

In the integrated project planning approach, environmental considerations are integrated into project planning and implementation. The Environmental Quality (Amendment) Act, 1985 requires anyone who intends to carry out a prescribed activity to first conduct a study to assess the environmental impact that will arise from the prescribed activity as well as the mitigating measures to overcome them. The report must be approved by the Director General, Department of Environment before the project can be implemented. On 5th November 1987, the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order, 1987 was gazetted for enforcement on 1st April 1988. The Order specified some 19 categories of activities requiring environmental impact assessment.

The above three-point strategy has been translated into corresponding environmental management programms namely pollution control, environmental impact assessment, and comprehensive land-use planning. These programs are in turn supported by other environmental programs such as environmental monitoring; environmental education, information and training, environmental research and development; inter-agency, federal-state cooperation and coordination; as well as bilateral, regional and international cooperation.

d. Promotion of Sustainable Development

The implementation of the above environmental management strategy and program is very much in line with the principle of sustainable development, which was adopted by the United Nations General Assembly on 11th December 1987 and by the ASEAN Head of Government at the Third ASEAN Summit on 14-15 th December, 1987.

Indeed, the principle of sustainable development also calls for the commitment by sectorial development agencies to ensure that their policies, strategies and programs incorporate environmental dimensions. In this respect, the setting up of Environmental Committees at the Federal and State levels and the enforcement of all the environmental Federal legislations in parallel with the Environmental Quality Act, 1974/(Amendment), 1985, will in no small way contribute to the sustainability of development efforts for generations to come.

Appendix-IV.1.4.1 Survey on Effluent of Reclamation Works

As for the concentration of Suspended Solids, the Port and Harbour Reseach Institute, under the anspices of the Ministry of Transport, conducted a survey to estimate the level of SS concentration from the waste way. The result of the survey is as follows.

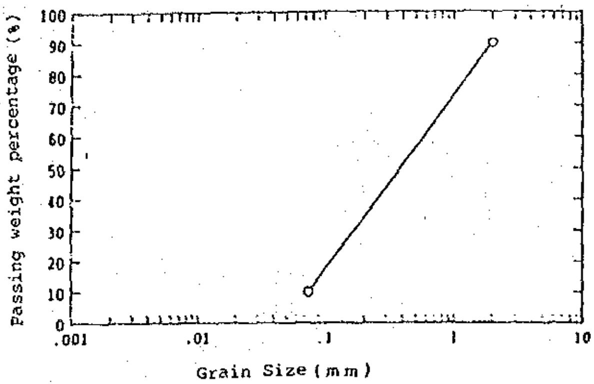
Synopsis

In case of reclamation of pump dredged soft sea bottom materials, it is important to estimate the level of Suspended Solids concentration in the effluent from the overflow weir. In some cases, suitable effluent treatment methods must be adopted to meet environmental quality standards. The authors have conducted model tests and field investigations to establish methods to estimate the level of SS concentration in the effluent. As a part of this research, a survey on effluent etc. of the reclamation works was conducted to obtain data useful in establishing methods to estimate the level of SS concentration in the effluent.

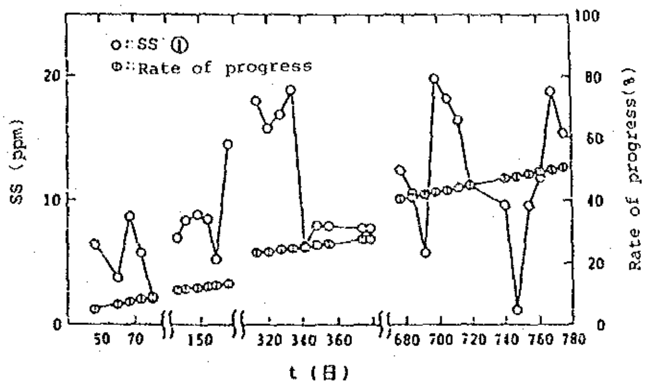
The survey was conducted by questionnaire. The work term, size and structure of the containment area, operation of the pump dredge, properties of the dredged material, SS of the effluent, effluent treatment method etc. were surveyed. The objective ports were selected from the ports which conducted reclamation work with pump dredge, and of those, the Port of Omaezaki, Port of Sakaisenboku, Port of Sakaide, Port of Iwakuni, Port of Mitajirinakanoseki and Port of Nakatsu were chosen for analysis.

As a result of this survey, the following become clear. Data were obtained which relate to the containment area type, including discharge pipe and overflow weir, properties of dredged material, SS of effluent, effluent treatment method etc. of each port. The characteristics of each reclamation area varied according to the type of containment area and the properties of dredged material. The effluent treatment method became evident when the data were arranged in the form of overflow rate vs. turbidity of effluent. Generally, the particle sizes of the dredged materials were smaller in the cases where coagulants were used to treat the effluent. The SS of the effluent in the cases where a coagulant was not used was constant in the first and middle term of the reclamation work and became higher in the last term.

① Port of Omaezaki

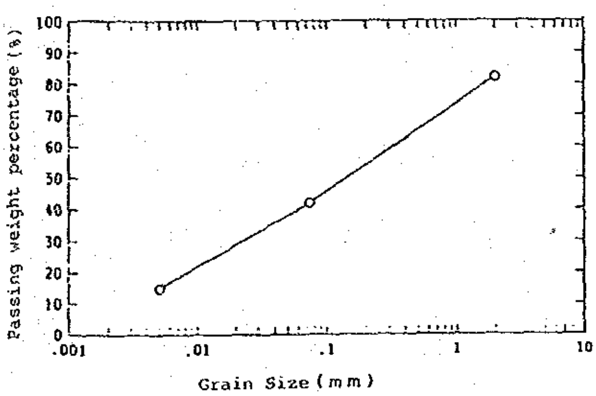


Grain size accumulation curve
of dredged soil

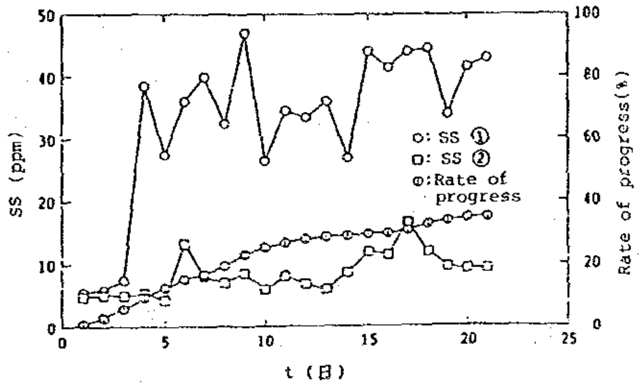


The relationship between progress
rate of reclamation and

② Port of Sakaisenboku

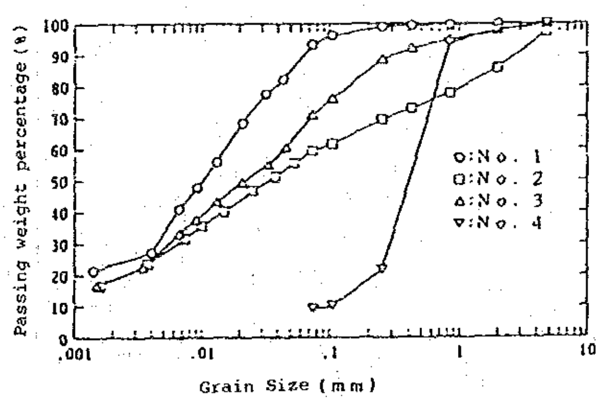


Grain size accumulation curve
of dredged soil

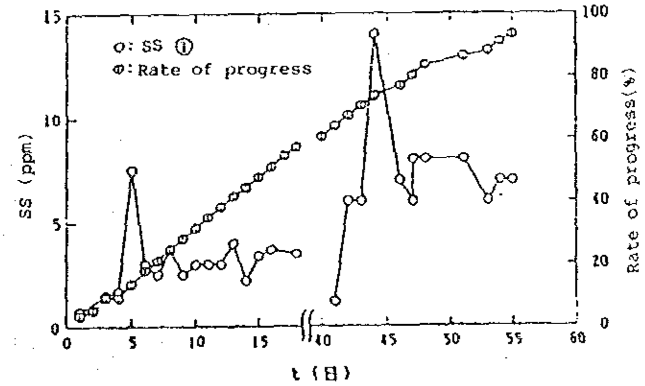


The relationship between progress
rate of reclamation and

③ Port of Sakaide

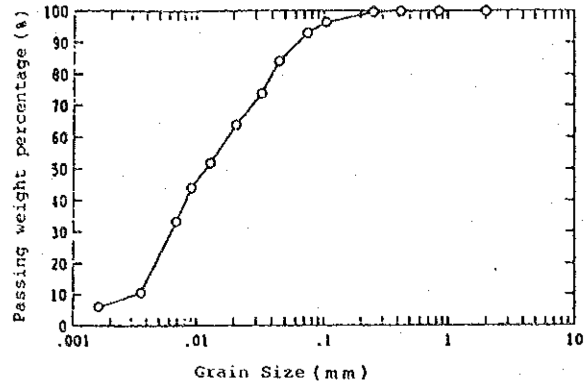


Grain size accumulation curve
of dredged soil

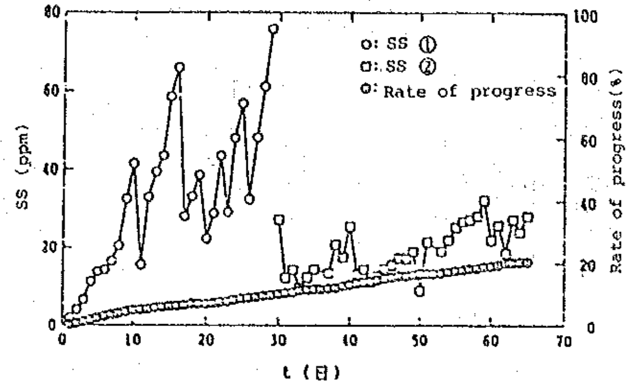


The relationship between progress
rate of reclamation and

④ Port of Iwakuni

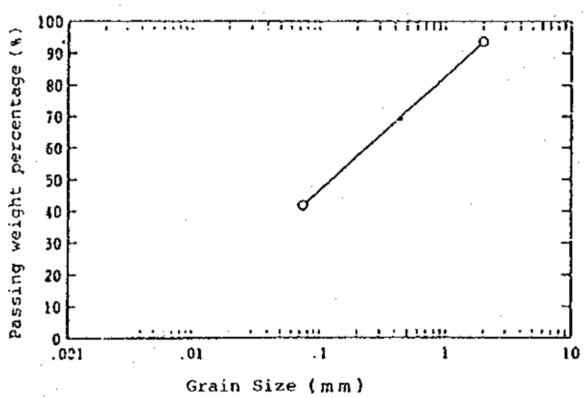


Grain size accumulation curve
of dredged soil

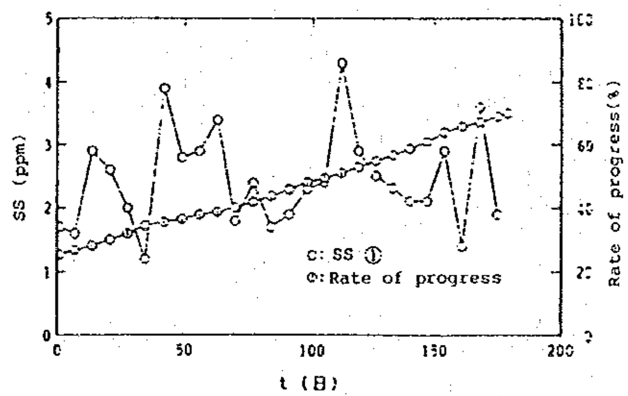


The relationship between progress
rate of reclamation and

⑤ Port of Mitajirinakanoseki

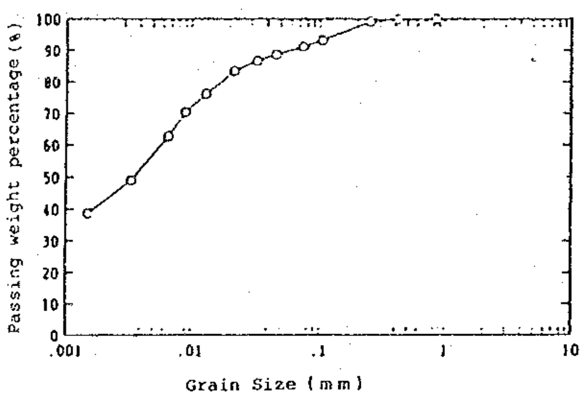


Grain size accumulation curve
of dredged soil

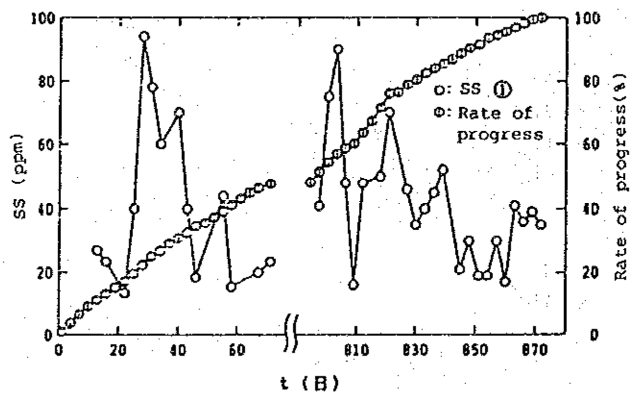


The relationship between progress
rate of reclamation and

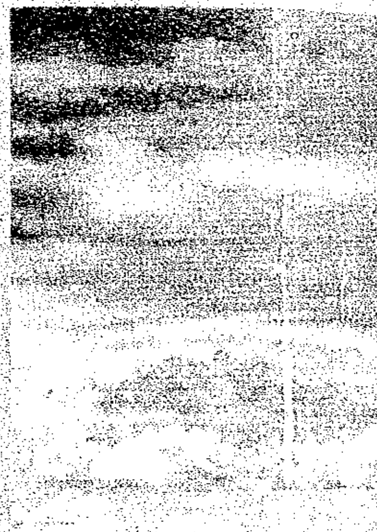
⑥ Port of Nakatsu



Grain size accumulation curve
of dredged soil



The relationship between progress
rate of reclamation and



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