DEVELOPMENT PLAN OF THE PORT OF SEMARANG (MEMO)

JUNE, 1978

JAPANESE FEASIBILITY STUDY TEAM
FOR THE SEMARANG PORT DEVELOPMENT

CONTENTS

I. Methods of Estimation of Port Handling Cargo

In estimating the port handling cargo, any of the following methods is employed generally.

1. Method of utilizing the target values of a national or regional economic plan

The cargo volume is estimated in use of the specific indexes shown in the production plans of the agriculture, forestry, fishery and industries, plans for demand and supply of principal products, plans for export and import of raw materials and products, etc.

2. Method of utilizing the result of analysis of the past movements of port cargos

The volume of port handling cargos is apt to change in a correlationship with GDP, population or any other factor so that such relationship is clarified through analysis of the past data and is extrapolated for estimation of the cargo volume in the future.

3. Summing up method

In the case of planning an industrial port, the cargo volume can be estimated by summing up the incoming and outgoing materials, products, etc. if the plans of the types, scales, production targets, etc. of the industries to be located are known.

4. Method of utilizing an economic structure model

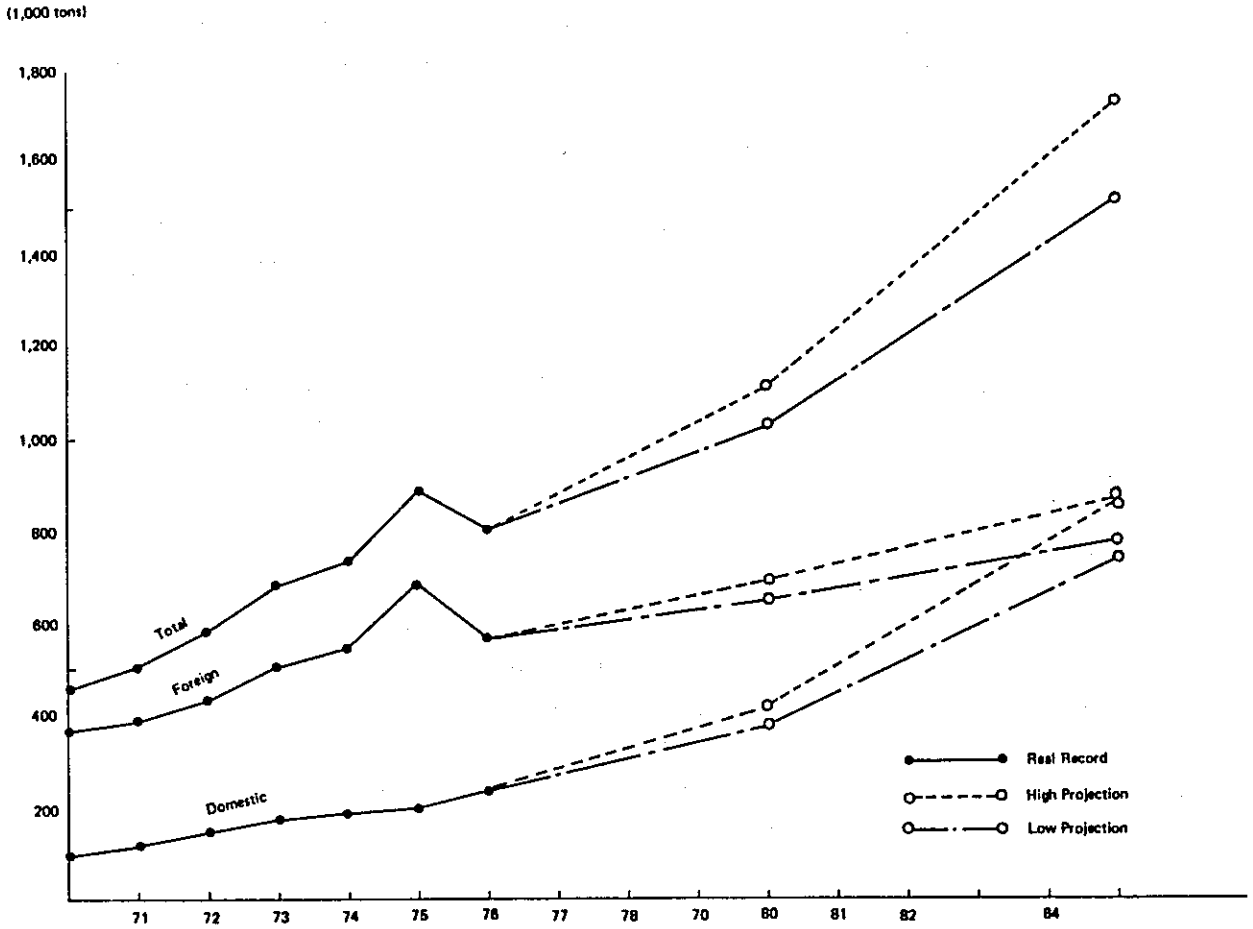
Where it is possible to clearly set forth the structure of the activities of industries, consumption, transportation, trade, etc. in the area, the volume of marine transport can be resolved by using a weighted economic model, and this method is considered to be the most idealistic method theoretically.

Where it is desired to estimate the volume of handling cargos of a particular port, a service area having a strong bond with the port in the aspect of transport as well as economy is established, and any of the foregoing procedures is applied to such area.

As discussed in the report, the service area of the port of Semarang is considered to comprise part of the Central Java province and the area of D.I. Yohyakarta. But, as the result of investigation, it was found that the target values of the economic plan for the area were not yet established specifically. Thus, through comparison and analysis of the current situation of the area with the conditions in the other areas, the Survey Team assumed the future aspect of the area and took it as the target value of the economic development.

In estimating the volume of handling cargos of the port of Semarang, it was thought from the foregoing result of investigation that clarifying the demand and supply relationship in the service area and also the future structure of transportation in the Java Island would involve a great difficulty as well as inprobability so that with the record of the cargo handling in the port of Semarang in 1970 to 1976 taken as a base and said target value of economic development broken down to the GDP growth rates by industrial sector, as discussed in the report, the future cargo volume was estimated in use of them. That is, the handling cargos were grouped by item into the agricultural products, industrial products, construction materials, etc. then using the GDP growth rates of the corresponding industrial sectors for such groups, and for the general consumption commodities, considering the rate of growth of population and that of GDP per capita, the volume of port handling cargos was calculated, while for the cement, fertilizers, etc., consideration was made for adjustment between the foreign and domestic imports upon assumption that their indigeneous supply would be achieved.

Further, upon check of any relationship between the GDP and the volume of port handling cargos, a very high correlationship was found between the total GDP in Central Java in 1970 to 1975 and the volume of handling cargos of the port of Semarang, and there was obtained a correlational coefficient at 0.994. Now looking the past trend of the volume of cargos handled at the port of Semarang, the annual growth rate during 7 years of from 1970 to 1976 is 9.9% average. Then, assuming that the cargo handling will continue to grow at said rate, the total of the cargos will be 1,170,000 tons in 1980 and 1,880,000 tons in 1985, in conformance to the case of a high growth estimated this time.



Forecast for Port Traffic Port of Semarang

II. Calculation of the Revenue and Expenditure in Fianncial Analysis

1. Revenue

For the tariff, it was assumed that it would be increased at a rate of 9 percent every year during the period of the Short Term Development Program (1979-1985). Then, taking the tariff in 1985 against that in 1976, it was 2.0 times greater than that in 1976, while the handling cargo volume was 2.1 times, so that the revenue in 1985 would increase by 2.0 x 2.1 = 4.2 times.

The revenue was calculated in the following six items according to the current system of classification of the port of Semarang.

(1) Harbour dues: Calculated by first estimating the number of incoming vessels in the respective years upon the forecasted values of the volume of port handling cargos, then multiplying the tariff, and summing up the values thus obtained.

(2) Quay dues: Calculated by summing up the mooring and unmooring fees upon the number of calling vessels by type and size as estimated in (1) above.

(3) Facility rental: Dues for use of the facilities such as transit shed, open storage and warehouse were calculated upon the past records.

(4) Pilotage dues: Calculated in consideration of the number of incoming vessels by type and size and the pilotage in the respective years.

(5) Land rental: Estimated upon the values in the past.

(6) Support revenue: Estimated, with the revenues from water supply, passage, etc. taken as objects, upon the values in the past.

2. Expenditure

The expenditure was classified in the following four items.

(1) Personnel expense: Calculated by first setting the unit of the volume of port handling cargos per official upon the actual value in 1976, then multiplying the required number of officials in the respective years. The personnel expense per official was assumed to increase at a rate of 5 percent a year after 1976 and was calculated by multiplying by said number of officials.

(2) Interest payable: Assuming that the investment would be made equally every year for two years of Urgent Improvement Program or five years of Short Term Development program, the interest payable in the respective years was calculated according to the investment for the respective cases. For the time of start of the repayment, the tenth year from the start of intial loan was taken as the first time of repayment.

(3) Administration expense: Calculated in consideration of the actual expenses of operation of the port of Tg. Priok, etc.

(4) Depreciation: Calculated by summing up the depreciations according to the last years of the works.

III. Evaluation of Safety Precautions against Circular Failure and Consolidation Settlement of Open Storage Area

1. Circular Failure

(1) Surcharge

The surcharge (q) on that section of the open storage area extending 20.5m immediately behind the apron is assumed to be 2.0 t/m^2, and for the surcharge on the 69.5m section farther in the rear, the following two cases were considered:

Case 1 – Surcharge q = 1.5 t/m^2, and
Case 2 – q = 2.0 t/m^2.

(2) Soil condition

F.L ▽ + 2.60^m

± 0.0 $\left\{ \gamma_t = 1.8\ t/m^3, \phi = 30° \right.$

- 22.0^m $\left\} \gamma_t{}' = 0.53\ t/m^3, \phi = 0, C = 0.6 + 0.14Z\ (t/m^2), \text{base} + 1.00m \right.$

(3) Result of circular failure calculations

Results of computerized calculations for circular failure are as follows. (See Fig. 1):

	q t/m^2	Fs min	R m
Case 1	1.5	1.38	66.1
Case 2	2.0	1.32	63.7

2. Consolidation Settlement

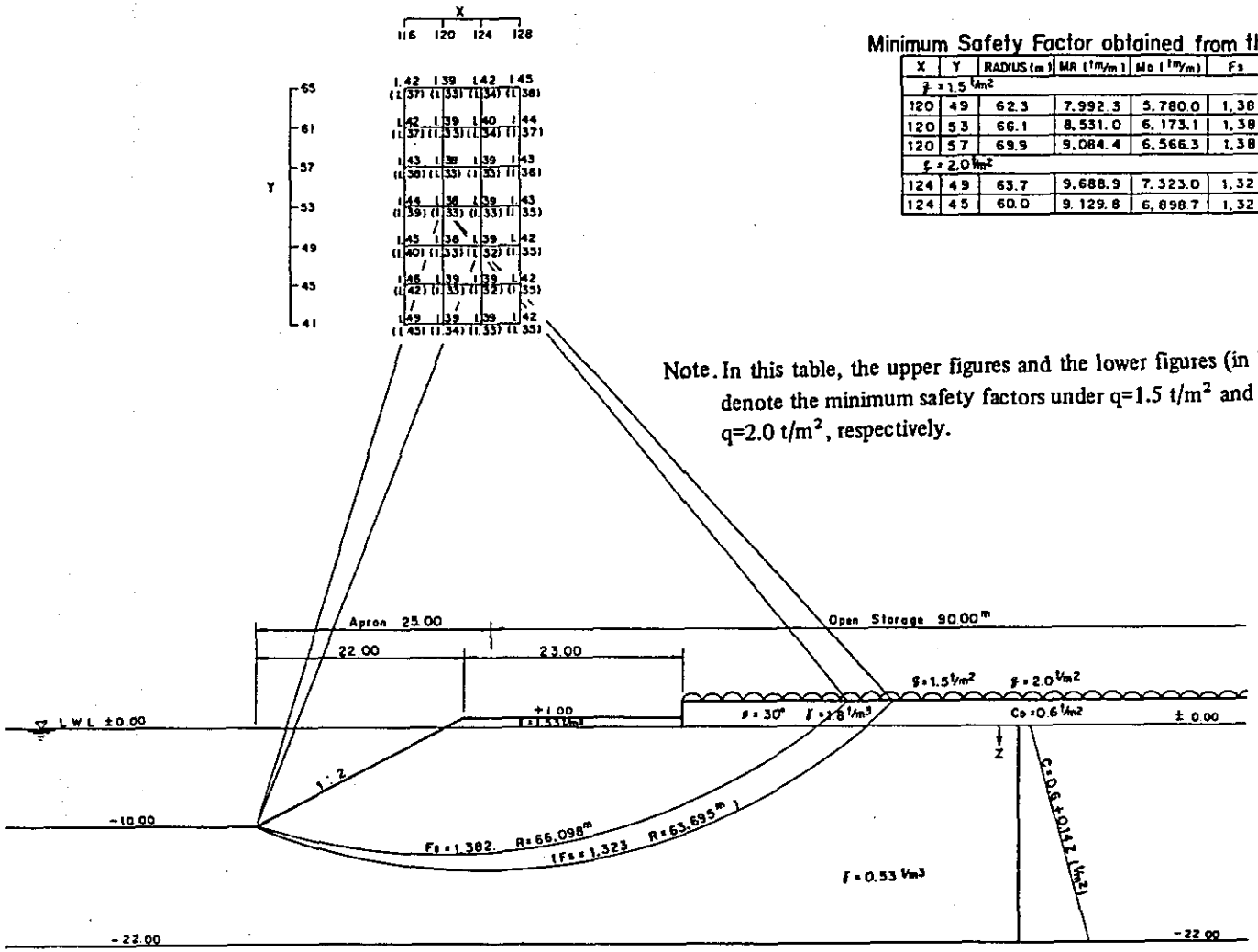
Consolidation settlement in the reclaimed area having no pile foundation was analyzed under the following assumption.

2-1 Conditions of analysis

a) Stratification

Taking into account the soil profile of Borehole No. 2 prepared by the Japanese Study Team, the same cosolidation characteristics as for Borehole No. 3 were used for Borehole No. 2.

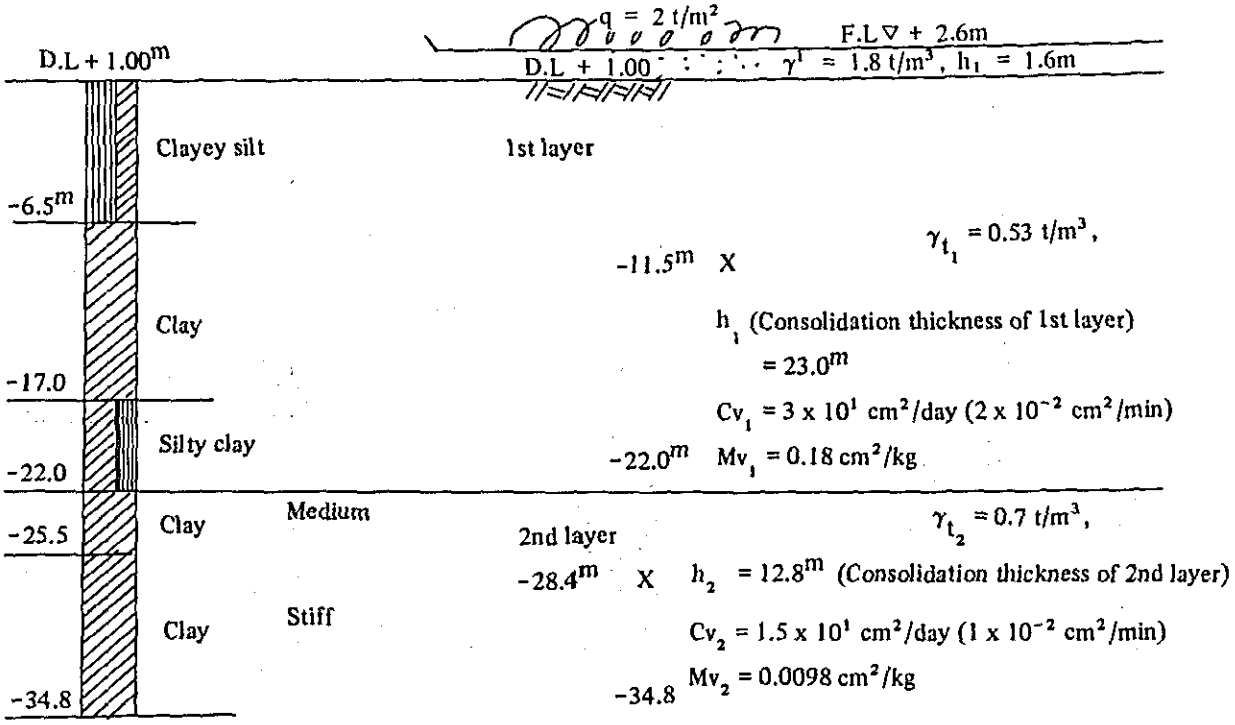
Fig. 1 Results of Circular Failure Caluculations for Open Storage with Pile Foundation



Minimum Safety Factor obtained from the Calculation.

X	Y	RADIUS (m)	MR (t·m/m)	Mo (t·m/m)	Fs
q = 1.5 t/m²					
120	49	62.3	7,992.3	5,780.0	1.38
120	53	66.1	8,531.0	6,173.1	1.38
120	57	69.9	9,084.4	6,566.3	1.38
q = 2.0 t/m²					
124	49	63.7	9,688.9	7,323.0	1.32
124	45	60.0	9,129.8	6,898.7	1.32

Note. In this table, the upper figures and the lower figures (in brackets) denote the minimum safety factors under q=1.5 t/m^2 and under q=2.0 t/m^2, respectively.



b) Drainage

The clay beneath the depth of -22m should be considered as an impermeable layer from its grain size distribution and consolidation characteristics (Cv, k).

Thus, assuming the reclaimed area to be a permeable layer, the drainage is considered as a single upward drainage.

2-2 Result of analysis

The equation used in calculation for the consolidation settlement is

$$S_0 = Mv.\Delta p.H$$

where S_0: Final settlement,

Δp: Consolidation stress at the center of the consolidated layer under consideration (kg/cm^2).

Mv: Coefficient of volume compressibility (cm^2/kg).

and

H: Thickness of consolidation stratum.

Substituting the conditions noted in paragraph 2-1 into the foregoing equation, the amount of settlement was obtained for the 1st and 2nd layers as below.

$$S_0 = S_1 + S_2 = 2.03 + 0.06 \fallingdotseq 2.1\text{m}$$

Period of consolidation:

Assuming a single drainage, the period required for consolidation was calculated by the formula

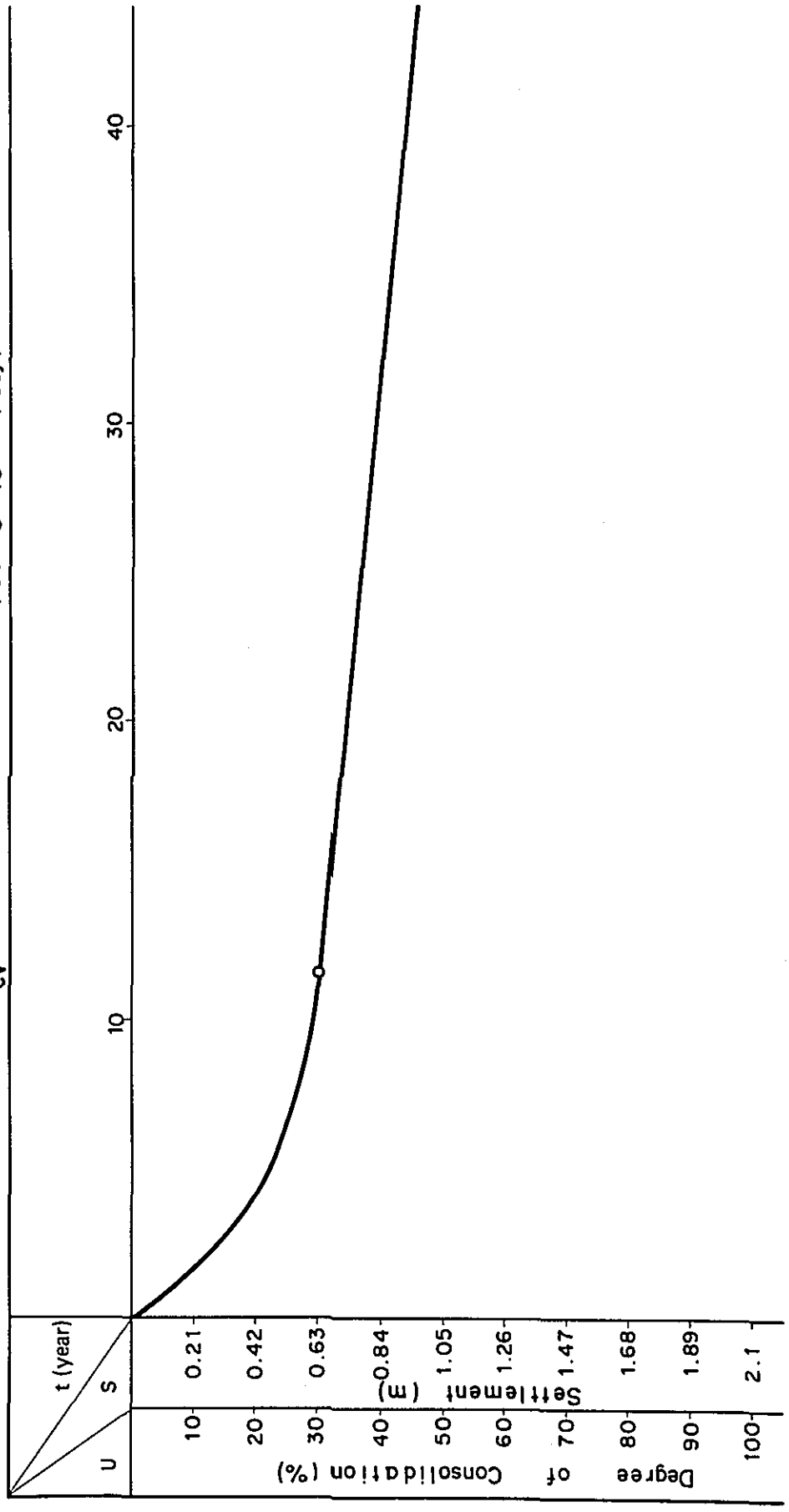
$$t\,(\text{day}) = \frac{h_1^2}{Cv_1} Tv$$

where Tv: Time factor for single drainage,
h_1: Consolidated thickness of 1st layer,
Cv_1: Coefficient of consolidation for 1st layer.

The consolidation settlement curve is shown in Fig. 2.

The period required for 80% consolidation is approximately 200 years, the period required for 50% consolidation about 50 years, and the period required for 30% consolidation about 12 years.
According to the carrently avaiable data, the amount of settlement occurring over a period of about 12 years is estimated at about 60cm.

Fig. 2 Consolidation Settlement Curve.



IV. Breakdown of Construction Cost for Main Facilities

1) Dredging Work

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	RATE			AMOUNT		
				LOCAL CURRENCY US$	FOREIGN CURRENCY US$	TOTAL RATE US$	LOCAL CURRENCY US$1,000	FOREIGN CURRENCY US$1,000	TOTAL RATE US$1,000
(1)	Dredging Cost for 5,020,000 m^3								
	a. Pump Dredger 4,000 p.s.	month	20	50,000	318,250		1,000	6,365	7,365
	b. Piping	month	21	24,100	79,400		506	1,667	2,173
	Total						1,506	8,032	9,538
(2)	Unit Price/m^3	m^3	1	0.3	1.6	1.9			

2) -10m Wharf

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	RATE			AMOUNT		
				LOCAL CURRENCY US$	FOREIGN CURRENCY US$	TOTAL RATE US$	LOCAL CURRENCY US$1,000	FOREIGN CURRENCY US$1,000	TOTAL RATE US$1,000
Unit Price/m									
	a. Steel Pipe Piles, ϕ711.2mm t = 9mm and 12mm, L = 36m Material, deliver and driving	ton	6.5	90	660	750	585	4,290	4,875
	b. Reinforced concrete including form and bars (bar=100 kg/m^3)	m^3	15	150	100	250	2,250	1,500	3,750
	c. Excavation	m^3	330	2.8	0.5	3.3	924	165	1,089
	d. Slope protection of stone	m^3	50	18	4	22	900	200	1,100
	e. Fender H600 x 2.5m	Set	0.07	260	12,000	12,260	18	840	858
	f. Bollard, Cathodic protection and Others	Sum	1				223	605	828
	Total						4,900	7,600	12,500

3) West and North Breakwater (Coupled Pile Type)

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	RATE			AMOUNT		
				LOCAL CURRENCY US$	FOREIGN CURRENCY US$	TOTAL RATE US$	LOCAL CURRENCY US$1,000	FOREIGN CURRENCY US$1,000	TOTAL RATE US$1,000
Unit Price/m									
	a. H type steel pile, H-400 x 400 Vertical pile L=32.5m Batter pile L=35m Material, deliver and driving	ton	7.3	70	620	690	511	4,526	5,037
	b. Steel Sheet Pile, IV type L=9m	ton	1.7	30	600	630	51	1,020	1,071
	c. Coping Concrete	m^3	4	150	100	250	600	400	1,000
	d. Excavation	m^3	6	2.8	0.5	3.3	17	3	20
	e. Foot Protection Stone	m^3	6	18	4	22	108	24	132
	f. Others	Sum	1				13	27	40
	Total						1,300	6,000	7,300

4) East Groin

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	RATE			AMOUNT		
				LOCAL CURRENCY US$	FOREIGN CURRENCY US$	TOTAL RATE US$	LOCAL CURRENCY US$1,000	FOREIGN CURRENCY US$1,000	TOTAL RATE US$1,000
(1)	L-Shape Concrete Type/m								
	a. Rubble Stone	m^3	13	18	4	22	234	52	286
	b. Grading	Sum	1				114	38	152
	c. Bamboo Mattress	m^2	15	10	–	10	150	–	150
	d. Reinforced Concrete	m^3	4.7	150	100	250	705	470	1,175
	e. Placement of R.C. Block	each	0.4	200	200	400	80	80	160
	f. Others	Sum	1				7	10	17
	Total						1,290	650	1,940
(2)	Concrete Sheet Pile Type/m								
	a. R.C. Pile, t=12cm, L=7m	m^3	0.84	120	80	200	100	67	167
	b. Driving, 2.5 each x 7.0 = 17.5m	m	17.5	10	7	17	175	123	298
	c. Others	Sum	1				5	–	5
	Total						280	190	470

5) Foundation of Transit Shed

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	RATE			AMOUNT		
				LOCAL CURRENCY US$	FOREIGN CURRENCY US$	TOTAL RATE US$	LOCAL CURRENCY US$1,000	FOREIGN CURRENCY US$1,000	TOTAL RATE US$1,000
Unit Price/m									
	a. R.C. Pile □500 x 500 x 32m	each	2.8	1,210	700	1,910	3,388	1,960	5,348
	b. Concrete Deck	m^3	24	150	80	230	3,600	1,920	5,520
	c. Others	Sum	1				12	20	32
	Total						7,000	3,900	10,900

V. Guideline for Investigations Related to Dredging Plan

1. Purpose

The following investigations should be carried out to ensure the effective and efficient implementation of the plan for dredging of the access channel and basins as part of the development and improvement project for the port of Semarang.

2. Basic Investigations Required for Formulation of Dredging Plan

(1) Meteorological observation

a) Purpose: Observation should be made of the wind direction and speed in order to determine the characteristics of waves coming onto the port of Semarang.

b) Period and method: The period of observation should be three years. Wind data covering the period of five years immediately preceding the start of the project should be collected. The observation should be made twelve times a day, and the observation data should be processed regularly and compiled statistically. The place of observation will be the present Maritime Meteorological Station of the port of Semarang.

c) Equipment: The observation instrument will be of the self-recording type, and the senser of the instrument will be installed 10m above the ground level.

(2) Tide observation

a) Purpose: Tide observation should be made in order to determine the datum level as well as harmonic constants of tides in the port of Semarang and to insure accuracy of sounding surveys.

b) Period and method: The observation should be made continuously for a long period.

The observation should be carried out at a place which represents the tide movement in the vicinity of the port of Semarang and which is least subject to the influences of waves, etc. Since the observation is to be carried out over a long period of time, the place of observation should be chosen in such a way as not to interfere in the port activities.

c) Equipment: The observation instrument should be an automatic tide gauge of either a buoy or pressure type.

Taking into consideration the foregoing requirements of tide observation, the tide gauges currently in use, and observation place should be relocated or replaced with new gauges if necessary.

(3) Wave observation

a) Purpose: Long and continuous observation of waves which are a predominant cause of the channel siltation should be made.

b) Method: The point of wave observation should be located at a depth of -6.0m about 50m to the west of the west face line of the projected channel. The wave characteristics to be observed are height, period and direction.

c) Equipment: The instrument to be used should be an automatic wave recorder of such types as a pressure or step type.

(4) Current observation

a) Purpose: The current observation should be carried out to shed lighton the currents in the port and channel and along the coast under the present topographical conditions as well as the mechanism of siltation in the channel.

b) Period and method: The observation should be made once each spring and neap tides during the seasons of northwest and southeast monsoons. Current observation will be made at two points, one at a depth of about -3m in the that portion of the channel which is sheltered by the West Breakwater and which is 100m closer to the inner most part of the port from the head of the West Breakwater and the other located at a depth of about -6.0m on the face line of the projected channel.

Anchored-position observation should be made of current direction and speed every hour during a period of 25 hours.

c) Equipment: The measuring instrument should be a visual-reading current meter (Type CM-2) or equivalent.

(5) Sounding survey

a) Purpose: Sounding survey should be carried out in order to find out precisely the conditions of dredging and siltation of the present channel.

b) Period and method: The survey should be carried out in the channel and basins periodically three times each year, that is, in March, July and November.

In each sounding survey, changes in the depth should be checked and the effects of siltation will also be investigated during northwest and southeast monsoons.

c) Equipment: The equipment to be used should be an echo sounder.

(6) Sludge survey

a) Purpose: A sludge survey should be carried out to determine distribution and thickness of sludge deposits in the approach channel and harbour basin.

b) Period and method: Along with echo-sounding described in paragraph (5) above, sounding with lead will be carried out. The seabed materials should be sampled to determine the properties of sludge, such as grain size distribution, moisture content and bulk density, etc.

3. **Additional Surveys for Clarification of Siltation Mechanism.**

The minimum surveys required for the dredging plan are as described above. However, it is desirable to carry out on a continuous basis, the following surveys which will serve to clarify the mechanism of siltation.

(1) Investigation of the spatial and seasonal changes in wave height and direction.

(2) Current observation twice a year, that is, during northwest and southeast monsoons to determine the current distribution over the 4km width from east to west in the port development area.

(3) Characteristics of breakers (wave height and direction), currents in the breaker zone, and coastal currents.

(4) Measurement of turbidity due to waves and density of suspended materials through sampling of water.

(5) Measurement of salinity.

(6) Investigation of discharged materials from the canal.

VI. Guideline for Soil Survey in Urgent Improvement Program for the Port of Semarang (PLAN A-1)

1. Purpose

This guideline is intended for application to the soil survey required for implementation of the Urgent Improvement Program for the port of Semarang.

2. Survey Points

The survey points will be located, for the -10m wharf, on the planned face line and in a direction perpendicular to the face line and, for the West Breakwater, North Breakwater and East Groin, on the planned center line (See the soil survey plan view in Fig. 1).

3. Details of Survey

(1) The items to be investigated are:

1) Determining the condition of stratification;

2) Confirming the occurrence of the bearing stratum;

3) Collection of undisturbed samples from clayey soil layer, and analysis of physical and mechanical properties, and

4) Standard penetration test in sandy soil layer, and analysis of physical properties.

(2) The number of borings required for the proposed sites of the respective structures and the depth of boreholes will be based on the standard values given in the table below. For the -10m wharf, West Breakwater and North Breakwater, however, boring should bo continued until the bearing stratum can be reached.

After the bearing stratum is reached, the borehole should be drilled for a further minimum depth of 1.5m.

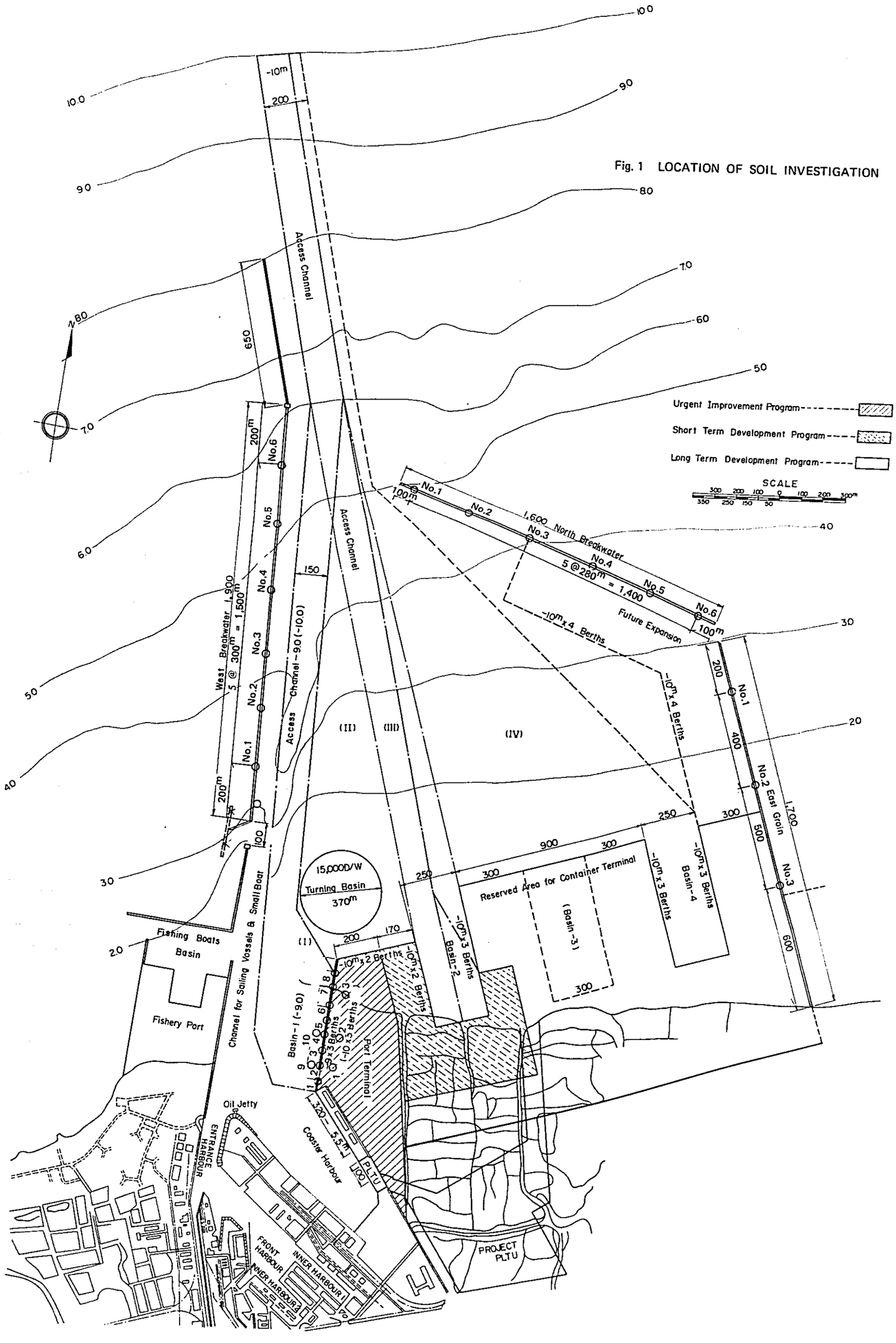


Fig. 1 LOCATION OF SOIL INVESTIGATION

Boring Requirements

Item / Description	No. of borings	Depth		Spacing parallel to face line	Spacing perpendicular to face line	Remarks
		Per. borehole	Total depth			
-10m Quay Wall	10	40m	400m	70m	20m	
West Breakwater	6	40	240	300		
North Breakwater	6	40	240	280		
East Groin	3	2@25m 1@15m	65	400~500		
Transit Shed & Open Storage	3	40	120			
Total	28		1,065			

4. Method of Boring

(1) Equipment

1) For offshore boring operations, a steel tower or a simple scaffolding constructed by erecting steel pipes on the sea should be used, but a pontoon, etc. should not be used.

2) The boring equipment will consist of the main unit, prime mover, pump, bits, casing pipes and winches and should have an adequate capacity to complete the planned number of boreholes during a specified period.

3) The boring machine should have a capacity, adequate for the purpose, depth and other requirements of the survey and be a rotary type with a bore diameter not less than 85mm and a drill pipe outer diameter not less than 97mm.

4) For installation of the steel tower or assembly and erection of the simple scaffolding and their movement, a tug boat, pontoon, and other construction craft should also be provided. Barges or other suitable craft should also be provided for supervision of the boring operations and transport of the workers to the sites.

(2) Method of work

1) For clayey soil layer

a) For collection of undisturbed samples, a stationary piston type thin wall sampler should be used.

b) The sampling tube to be used in the case of ordinary clay layers, should be a brass extraction pipe having a length of 1m, wall thickness of 2.0mm and inside diameter of 75mm. For stiff clay layers, a stainless steel extraction pipe with a length of 1m, wall thickness of 1.5mm and inside diameter of 75mm should be used.

c) To obtain the shear strength and depth distribution of soil for the clay layers, sampling will be made at a spacing of at least 2.5m for the same layer in the same borehole.

d) Prior to collection of samples, any slime and other alien matter on the bottom of the borehole should be removed thoroughly.

e) Meticulous care should be exercised in collecting and transporting samples so as to avoid disturbance due to vibration, impact, or other external forces.

Immediately after collection of a sample both ends of the tube should be sealed to ensure that, the moisture content, and other properties of the sample remain unchanged before it is put to laboratory tests.

2) *For sand layer and stiff clay layer*

a) A in-situ test in the sand layer will be a standard penetration test aimed to obtain the number of blows required for driving the sampler to a depth of 30cm and determine the characteristics of the sandy soil, such as hardness, compactness and relative density.

b) The standard penetration tests should be carried out, as a rule, at an interval of 2.5m.

c) Supplementary tests on the collected samples will be classification tests including mechanical analysis, unit volume weight, etc.

d) In-situ tests in the stiff clay layers will consist of standard penetration tests supplemented by collection of undisturbed samples by means of a stainless steel tube, in order to determine the correlation between the N value and qu value.

(3) Laboratory Tests

1) The undisturbed samples collected at the site should be subjected to laboratory

tests as soon as practicable possible, and an unconfined compression test, should be conducted immediately after sampling at a laboratory located close to the sampling site.

2) The unconfined compression test should be carried out in respect of at least four differents points of each sampling tube in the direction of the depth. However, those portions of the sampler in the tube lying 10cm above the lower end and 20cm under the upper end should not be used in the test.

3) The requirements of the laboratory tests are tabulated below.

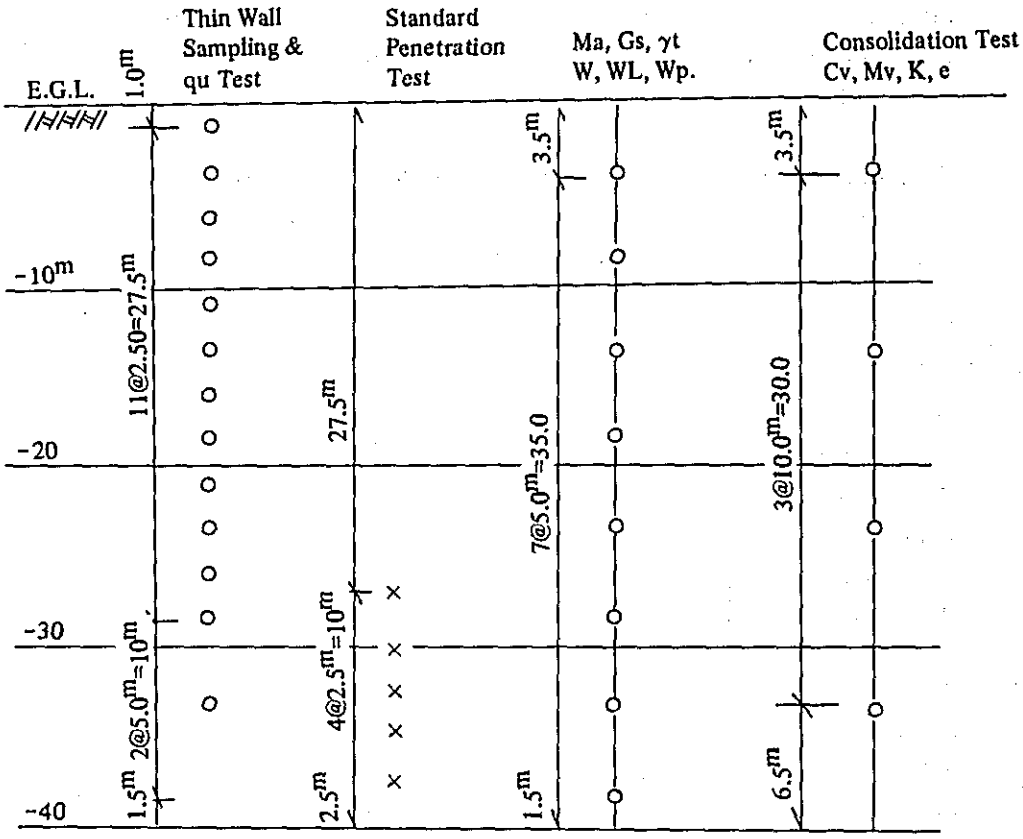
Test item	Number of tubes per borehole	Spacing	Remarks
Physical tests	8	5.0m	
Grain size analysis	8	5	
Unit volume weight, specific gravity	8	5	
Moisture content	8	5	
Liquid limit, plastic limit	8	5	
Mechanical test			
Unconfined compression test	17	2.5	
Consolidation test	4	10	One sample for representative layer

Fig. 2 shows the sampling locations and the borehole depths involved in in-situ tests.

(4) Maintenance

In offshore boring operations, marker lights should be installed at night to assure safety of shipping traffic.

Fig. 2


Thin Wall Sampling & qu Test
Standard Penetration Test
Ma, Gs, γt W, WL, Wp.
Consolidation Test Cv, Mv, K, e
E.G.L.
1.0m
-10m
-20
-30
-40
11@2.50=27.5m
2@5.0m=10m
1.5m
27.5m
4@2.5m=10m
2.5m
3.5m
7@5.0m=35.0
1.5m
3.5m
3@10.0m=30.0
6.5m

VII. Specification of Ground Water Survey for Semarang Port Development Project

1. Purpose

This guidance is intended to specify the execution of the ground water survey which is required in order to confirm the scale and location of the well and obtain basic information of the plan and design of installation of the well for securing the source of water for supply to the vessels and terminal facilities in the port of Semarang.

2. Items of survey

(1) Determination of the maximum safe yeild to be pumped up, and

(2) Water analysis (including temperature).

3. Details of the survey

(1) Place: At an appropriate place within the port of Semarang;

(2) Specification of test well: Depth 200m, finished in a bore of 200mm;

(3) Boring machine: Rotary boring;

(4) Test boring: To be carried out by the above mentioned machine with the records of boring taken and soil samples collected from the slime;

(5) Electrical coring: After drilling of the well, position of aquifer to be confirmed by electric detection (specific resistance and SP detection of the layer);

(6) Finishing the well:

1) In the aquifer providing potable water are installed an adequate casing pipe and strainer for the stratum condition,

2) The aperture around the strainer is to be sufficiently filled with gravel,

3) After installation of the casing, the space around the casing is to be filled with concrete from the top of the highest gravel layer to the ground surface in order to prevent permeation of the brackish water and sewer, and

4) Evacuation of mud water and cleaning the inside of the bore are made,

(7) Pump up tests: With an underwater pump used, a step test and a continuous pump up test (72 hours) are made. During the pump up tests, the following matters should be noted:

1) Percentage of admixed sand to pumped up water,

2) Recovery of water level upon suspension of pumping up,

3) Any effects upon the other wells in the neighborhood,

4) Ground water levels before and after pumping up, and

5) Samples to be collected periodically (at least three times) during the pump up test for water analysis, and

(8) Items of water analysis:

1) Color and turbidity,

2) Sediments,

3) Odor,

4) pH value,

5) Temperature,

6) Iron content detected,

7) Ammoniacal and nitrous nitrogen,

8) Organic matters (Consumption of potassium permanganate),

9) Inorganic ions (Na^+, K^+, Ca^{++}, Mg^{++}, Cl^-, SO_4^{--} and HCO_3^-),

10) Volatile residue,

11) Colon bacteria (MPN), and

12) General bacteria (N/100 cc).

4. Required Reports

(1) Well boring records and results of observation of the samples obtained from the slime.

(2) Result and analysis of electric layer detection.

(3) Results of pump up tests – Data obtained in the pump up tests and analysis upon such data of the coefficient of permeation, coefficient of staying, zone of influence and maximum safe yield to be pumped up.

(4) Result of water analysis and evaluation of the water quality pursuant to the potable water quality standard of Indonesia or similar standards.

(5) General plan of the vicinity including the well.

(6) Cross-section of the completed well, and hydrogeological cross-section of the well.

(7) Evaluation upon the foregoing results of survey and proposals (scale and location of the water supply well).