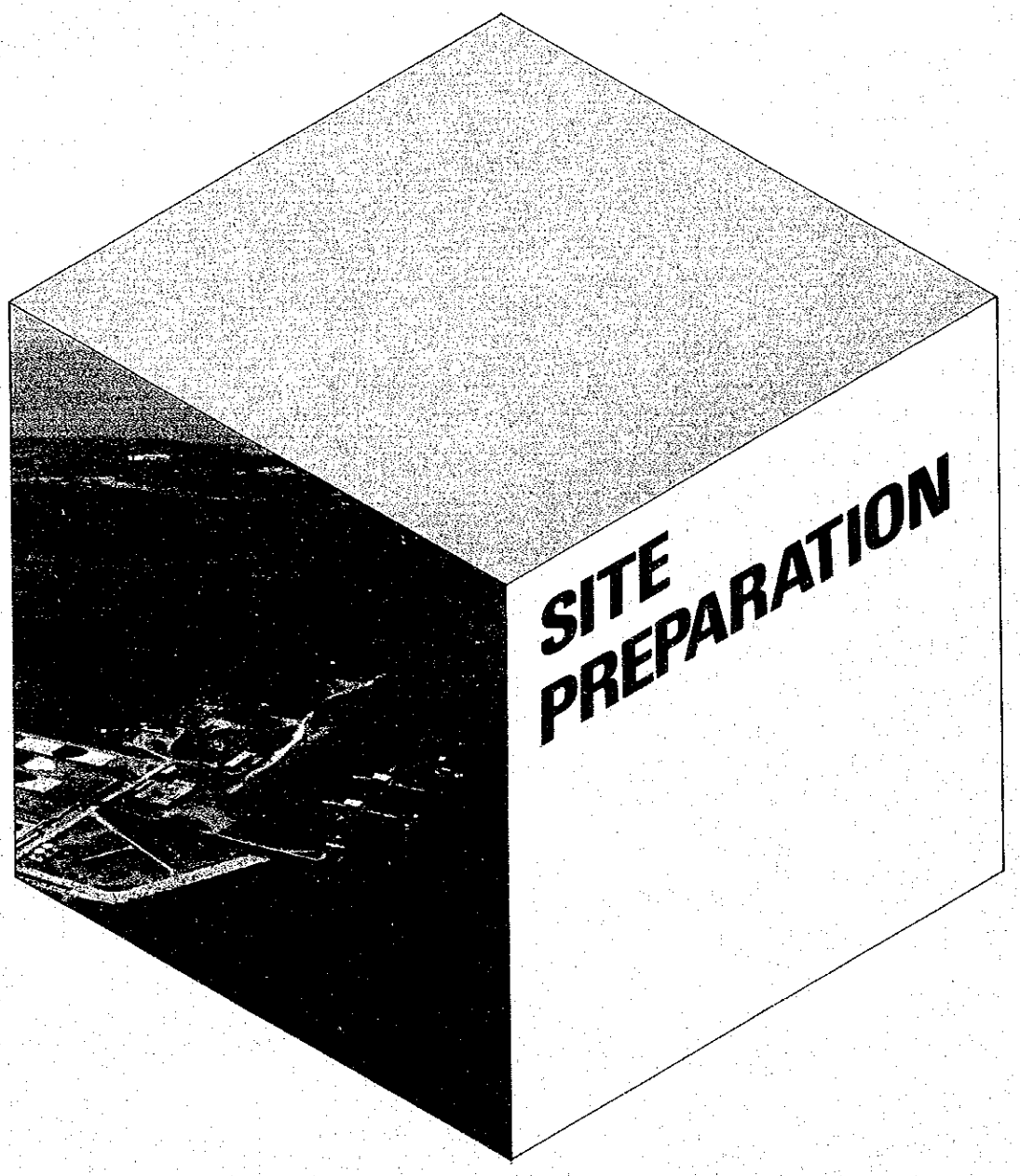
CHAPTER 13

DETAIL PLANT DESCRIPTION

CHAPTER 13-1



CHAPTER 13 DETAIL PLANT DESCRIPTION

13-1 Site preparation

13-1-1 General

The site preparation which is basic to plant construction goes into effect in advance of all other works. According to plans which have been made in basis of surveys conducted beforehand. On land, access roads construction, tree-felling works, top soil disposal, cutting, banking and other earth works are undertaken, while reclamation work is performed at sea area. At these stages, there are other necessary jobs such as water and power supplies and construction of field offices, lodging quarters, warehouses, hospital and other facilities including construction plants like a ready-mixed concrete plant.

These shall be carried out as part of the overall program.

Most of steel mills in the world are built on seaside reclaimed land. This is because it is most economical to procure sufficient port facilities and large plant site at seaside, which are necessary for operations of steel mills. The reclaimed land is usually prepared flat so that trailers and freight cars loaded with heavy goods in site of the steel mill can easily run about. The new steel mill has advantages that port facilities and site can be obtained without carring out a large scale land reclamation.

However, the site has undulations and is required to be prepared flat. In order to reduce works for site preparation, a ground undulation allowance has been determined such as not to interfere operations of the new steel works. The study of site preparation has been carried out in Pre F/S. A construction of hot strip mill has been added in F/S. Then land to be prepared for stage I and stage II plans is 376.5^{ha} including reclaimed land. The construction plan is subject to land for stage I and stage II plans, because the site preparation plan should be made in consideration of transportation distance and amount of soil, temporary storing places for construction materials and equipment and influence on steel mill operations.

For planning of layout and site preparation of the steel mill, the followings are necessary:

① Correct survey and investigation of the site including ground level, trees, drainage channels, roads, buildings.

② Sounding survey at the sea area.

③ Soil investigation at the site of proposed factories and port facilities to be utilized.

In this section, the guidance required to these investigations will be explained.

13-1-2 Preconditions

Total area of the site to be prepared for the new steel mills covers 643^{ha} including reclaimed land. The site preparation is to be undertaken in accordance with the following preconditions.

① Ground levels shall be such as to insure their full function as the new steel works site.

② Ground levels shall be sufficiently high to prevent from being submerged under water due to waves or high tide in the front sea area or flooding from the area behind.

③ Plans shall be such as to eliminate possibility of rainwater coming from outside the site.
④ At the time of site operation, consideration shall be given to earth work in such a way as to minimize use of soil brought from outside.
⑤ In the site preparation plan, topographical maps surveyed and prepared by NASCO in 1974 shall be used.
⑥ Charts issued by B.C.G.S. shall be used.

13-1-3 Layout plan

Layout of the site preparation is shown in *Fig. 13-1-1*. In terms of configuration and works layout, the site is divided into 6 zones. The site preparation plans of each zone is shown in *Table 13-1-1*.

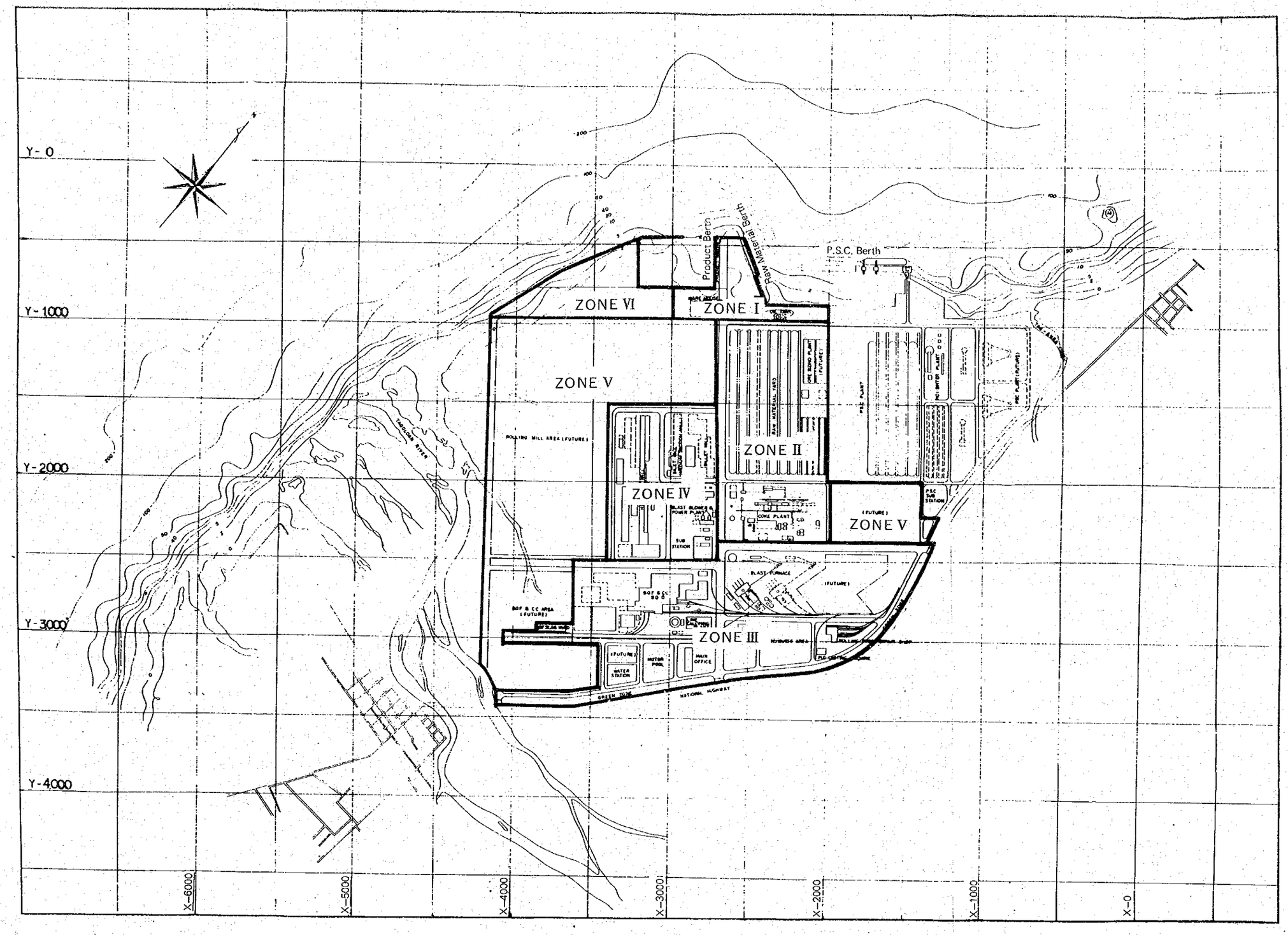


Fig. 13-1-1 Layout of land reclamation plan

Table 13-1-1 Site preparation plan

Stage	Zone	Area (ha)	Existing GL (m)	Planned GL (m)	Top Soil Disposal (m^3)	Calculation result (m^3)		
						Cutting	Banking	Balance
first & second	I	23.4	−0.2	+4.0		820,000	710,000	
	II	101.0	+4.8	+5.0	303,000	685,000	1,437,000	752,000
	III	181.5	+7.1	+6.4	545,000	2,102,000	1,398,000	704,000
	IV	70.6	+5.9	+5.5	212,000	714,000	425,000	289,000
	total II to IV	353.1			1,060,000	3,501,000	3,260,000	421,000
future	V	233.9			future plan			
	VI	32.6			future plan			
Total	I to VI	643.0						

For main drainage, open channels shall be built around the site to drain from the entire site. These drainage channels shall also be used for draining from the power station. The drainage way of each zone shall be built in parallel with the main road, connecting each plant with the outer drainage channels.

13-1-4 Technical explanation

(1) Ground levels

Zone I is a reclaimed land having port function. Taking into consideration the oceanographical conditions such as waves and high tide, the ground level has been determined at $+4.00^m$ with allowance of 2.90^m against M.H.W.L. Zone II is mainly an area of the raw materials yard. Its level is $+5^m$, same as that of P.S.C. Ore Yard. Zone III is an area for blast furnace and steel making, where rails for freight cars loaded with heavy goods shall be built, and a flatness of the configuration is an important factor. Taking the overall earth work into consideration, the level at $+6.4^m$ has been set. Zone IV is an area for the rolling mill. In terms of the total soil amount balance, its level has been set $+5.5^m$ diminishing a difference from that of zone III.

(2) Drainageways

The drain channels shall be built around the contour of the site and planned in conjunction with the slope face treatment of the site to be prepared. The standard cross-section of the drainage ditch is illustrated in *Fig. 13-1-2*. While future expansion possibilities and estimated maximum rainfall are not clear, it is desirable that the drainage structure can be easily altered. But the drainageway along the ore yard on north side shall be of concrete structure in consideration of volume of water discharged from the power plant. As for the

drainageway outlet, one necessary condition is that it should be away from the cooling seawater intake. So long as this condition is met, discharging into the existing creek or other natural drainageways that can be utilized may be economical. As for the drainageways inside the site, a concrete structure is planned for drainage to run smoothly into the outer drainageways, which are open channels. The main road is outlined in *Fig. 13-1-3.*

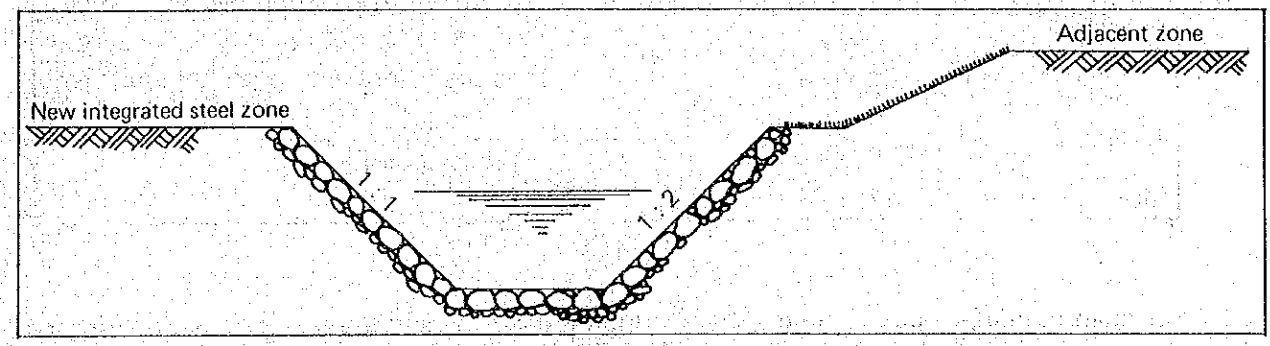


Fig. 13-1-2 Ditch for drainage

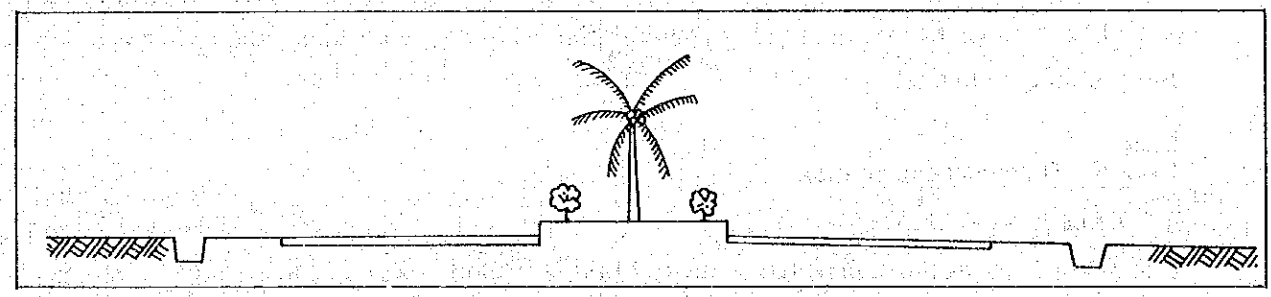


Fig. 13-1-3 Standard section of road

(3) Ground Level Difference in the Site

As previously explained, there is a ground level difference in each zone in the site. For such difference, roads shall be at a grade that enables heavy vehicles to move over, and other boundaries shall have a slope face shown in *Fig. 13-1-4.* Next comes a question of the ground level difference between areas outside and inside the site. A road connection to the national highway may be done at the green belt intersection. The exact location of the connection will probably need to be examined in relation to mutual plans.

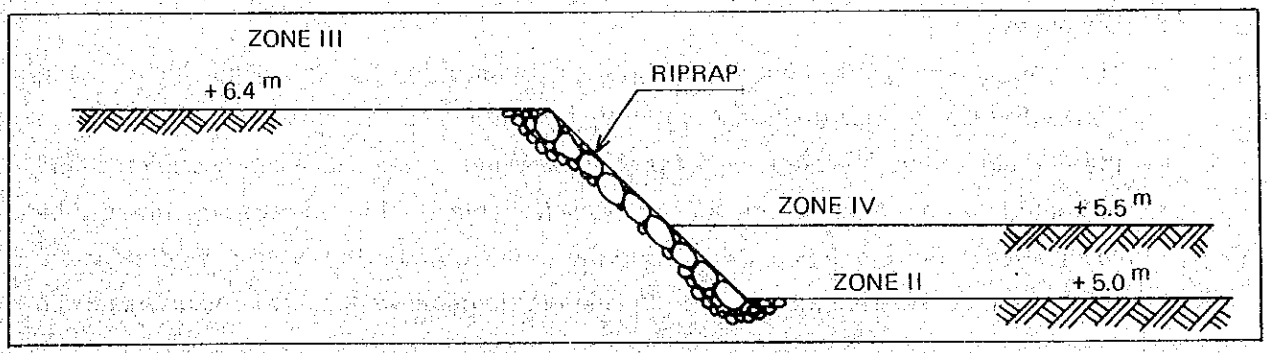


Fig. 13-1-4 Standard section of boundary

13-1-5 Pre-investigation

For making plans of steel mill layout and site preparation, investigations of weather, sea conditions, nature of soil, configuration are important. This is because in steel mill there shall be heavy structures like the blast furnace areas for heavy loads like ore yard and also large scale port facilities. In this section, it is explained how to carry out the soil investigation and configuration investigation. The scale of the investigations is based on the requirement of F/S. The standards of the investigations are subject to JIS or ASTM.

(1) Soil Investigation

A principal purpose of the soil investigation which will be required to each facilities is to obtain the changes of the soil strata in whole area inside the site. It will be very helpful for making the layout plan to confirm the bearing layers for foundation pile and to study a safety problem of storing ore in the ore yard. The second purpose is to know the nature of soil in vertical direction. With this knowledge, rational basic type of each structure can be determined and also correct construction cost estimate can be obtained.

1) Investigation Locations

Investigation points are shown in *Fig. 13-1-5*. The objective investigation points are main facilities; 21 places on the land and 9 places on the sea, 30 places in total. There are two methods for decision of investigation places. One is of being based on the layout plan. Another is to carry out borings at regular intervals without sticking at the layout when the plan is expected to be changed. The same number of boring may be good enough on both methods. On the latter method, it is convenient that the boring points coincide with the survey standard points.

2) Boring

Boring depth shall be over 30^{m} below the current ground level. Borings shall be made until ground having standard penetration test value "N" of over 50 has been confirmed continuously more than 5^{m}.

3) Standard Penetration Test

With winch-knocking system, standard penetration tests shall be carried out at regular depth of 1^{m}.

This test is done by a method that ① mounts a specialized sample (sample collecting tube) onto the bottom of the boring rod and lower at the bottom of the boring hole, ② strikes the knocking head at the top of the rod with standard hammer (weights 63.5^{kg}) under conditions of tfree drop with 75^{cm} height, ③ counts the striking number (N) that enable the sampler to go into stratum 30^{cm}.

For making tests, boring with diameter of 75^{mm} shall be rdone upto measuring depth.

Rotary type core boring machine is used for this boring. Count number of "N" at depth of every 1^m.

4) Sampling

Make samplings at each layer and collect samples for laboratory test.

5) Laboratory Test

Make the following laboratory tests.

Item	Classification	Sandy	Clayey
Physical test	Water content test	O	O
	Bulk density test	O	O
	Specific gravity test	O	O
	Grain size analysis	O	O
Mechanical test	Consolidation test		O
	Unconfined compression test		O
	Tri-axial compression test		O

(2) Configuration Survey

Configuration survey consists of land and sea surveys. It is important to bring positions of both surveys with geographical base points authorized by government. Standard for level survey is usually different on land and sea. At this stage, adjustments are necessary.

1) Land Survey

① Survey of Standard points

As shown in *Fig. 13-1-5,* base points are established at 25 places. Accuracy of the survey is traverse error of closure of within 1/10,000 and level of each standard point is that round difference is within $\Delta h = 3^{cm} \cdot \sqrt{X}$: x is measuring distance between each base point and its unit in km.

Standard of co-ordinates is that authorized by Philippines government. Newly established base points shall be calculated and described on the drawing together with their levels.

② Particulars Survey

Survey all things (creeks, roads, drainage channels, houses, trees, poles, etc.) inside the site including future plan of the new steel mill, and specify them on the drawing.

Obtain levels of places at regular distance of 30^m, where are in parallel and at right angle with the standard line and write down them clearly on the drawing. Also, draw contour lines at regular distance of 0.5^m. If the configuration is very complicated, set measuring interval at 15^m.

2) Sounding Survey

Surveying area is the sea in front of the steel mill. By using an echo sounder, carry out the survey at regular interval of 30^{m} in parallel and at right angle with the land standard line. Standard level is M.L.L.W. $= \pm 0.000^{m}$. Measure both government base points and PSC base points and write down them clearly with unit of cm on the drawing. Contour lines are to be drawn at every 1^{m}. The depth survey shall be made until it has been confirmed that the bottom of the sea is below -20^{m}. If the configuration of the bottom of the sea is complicated, the survey shall be done until it is below -30^{m}.

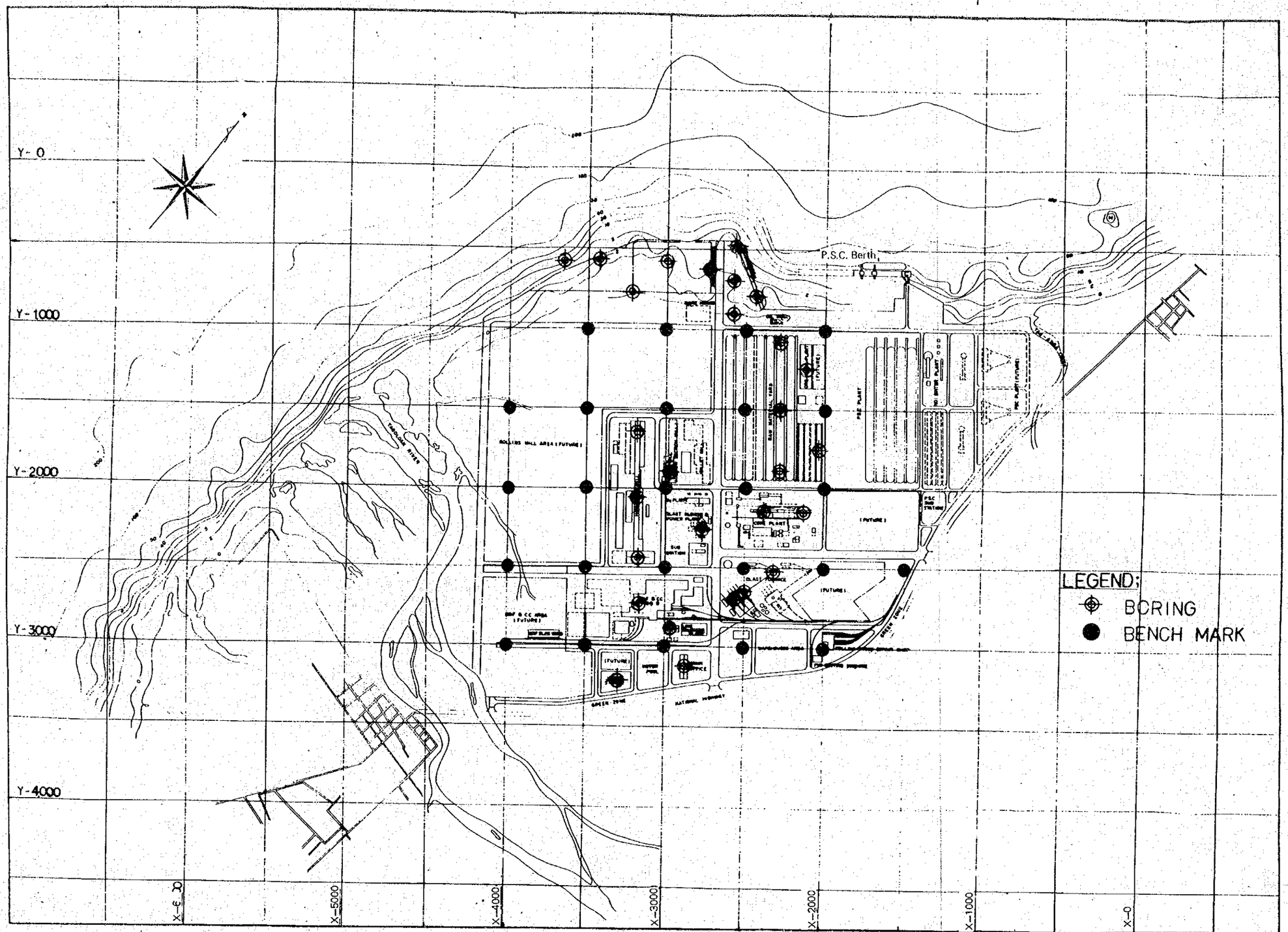
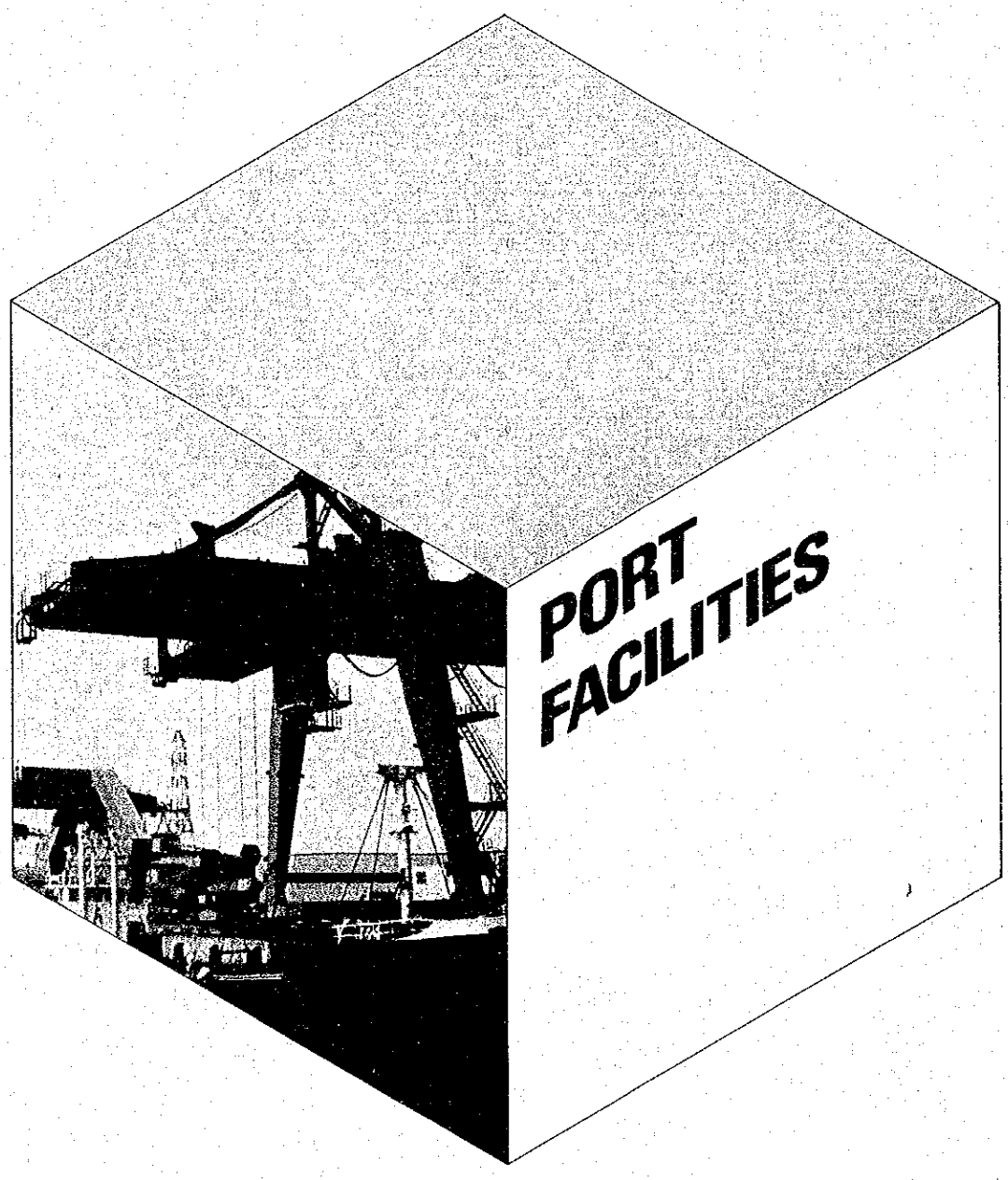


Fig. 13-1-5 Boring point and bench mark

CHAPTER 13-2



13-2 Port facilities

13-2-1 General

Port plan is an important factor for location of steel mill. As steel making is said a transportation, a huge amount of raw materials are delivered into steel mill and products manufactured there are shipped. Many modernized steel mills in the world locate seaside because marine transportation of the great amount of cargoes is economical. Therefore, port that ships for the marine transportation sail in and out is a significant factor of steel mills. In order to organically connect the port and facilities behind it, it is necessary to layout belt conveyor and stock yard. Of the port facilities needed by the steelworks, those planned for construction at stage I are unloading berth for raw materials, products loading berth, and heavy oil unloading berth. The raw materials berth can berth ships of a maximum of 50,000 DWT, and two units of 500$^{t/hr}$ are installed there.

Vessels of a maximum of 5,000 DWT berth at the products loading berth, where two units of RTC (Rose Trolley Crane) with a 25^{t} lifting capacity are installed. Occupation of PSC's seaberth for 250,000DWT class vessels almost comes to the limit capacity at stage I. At the stage II, an extension of the products berth is needed and also a consideration of extension of the PSC seaberth is necessary. Unloading berth for construction materials and equipment is also necessary for the construction of the new steelworks. For this purpose, it is possible to utilize the public berth of the PSC and the products berth which are newly constructed (construction works shall start in advance).

The site on land of the new steelworks has a space for large scaled expansion in future. The stage I plan location has been determined so that the plan of the port facilities can flexibly match this. However the plan is studied without geologic investigation and detailed configuration investigation at the bottom of the sea. At the time when results of these investigations have become clear, the plan's review is necessary. Investigations which should be carried out hereafter are ① geological investigation, ② sounding survey and ③ tidal current survey.

13-2-2 Preconditions

Selection of the location, size, etc. of the berth is based on the following conditions.

(1) Raw materials berth: Coal (1,289,000 $^{t/y}$) is imported and the berth size is for accommodating a maximum of 50,000 DWT class vessel. Also, on this berth, scrap (415,000 $^{t/y}$) etc. are unloaded. One berth is to be constructed for this time. Future extention will be done in both directions of the land and sea.

(2) Product berth: Since products for domestic users are to be handled on this berth, the berth size will be of a maximum of 5,000 DWT class vessels. In consideration of working efficiency, however, the size will be such as to enable accommodating concurrently two

3,000 DWT ships and one 1,500 DWT ship at the same time.

(3) Put it into consideration to extend P.S.C. berth by the same size of the existing berth.

(4) Charts (PCGS 4649) issued by the Philippine government shall be used for reference of the shape of the sea bottom. IESC Project No. 8672, depth survey chart, offered by NATIONAL IESC Project STEEL CORP., shall be used as a complement data of charts.

(5) It is assumed that the nature of the sea bottom soil is about the same degree of sandy ground as at the P.S.C. main berth point.

13-2-3 Equipment plan

(1) Equipment specifications

Berth names are shown in *Fig. 13-2-1* and specifications of each berth in *Table 13-2-1*. Plan of equipment specifications is detailed later in chapter 13-3.

Table 13-2-1 Specifications of port facilities

Name	Structural type	Water depth	Applicable vessel	Description
Type A (Raw material berth)	Steel pipe-pile type quay	−13.0 m	50,000 DWT coal carrier (bulk cargo)	LLC unloader (500 t/hr) x 2 units Coal unloading conveyor Temporary scrap storage
Type B (Product berth)	Steel sheet-pile type quay	−7.0 m	5,000 DWT Cargo vessel	RTC loading crane (25 t hoist) x 2 unit Temporary product storage
Type C (Oil berth)	Dolphin type quay	−5.0 m	2,000 DWT bunker boat	
Type D (Attached revetment)	Steel sheet-pile type revetment	−3.0 m ~−5.0 m	–	Seawater intake installed
Type E, F (Attached revetment)	Steel sheet-pile type revetment	±0 m ~−3.0 m		
Type G	Stone masonry type revetment	±0 m	–	

(2) Layout

The port layout is illustrated in *Fig. 13-2-2* and *Fig. 13-2-3*. *Fig. 13-2-2* shows the shape of reclamation area, the vessels' approaching routes to the berths and the necessary range of dredging. It is the condition for selecting the reclamation location that ① the water depth should be as shallow as possible to minimize the volume of earth to be dredged, ② the location should be adjacent to the land facilities, and ③ the layout should be so drawn up as to permit easy future expansions of facilities. Since the raw material berth and the product berth differ entirely from each other not only in their character but also in their

facilities and transport system, these two are not to be laid out on the same line because such a layout will hamper the flexibility of future plans. Hence, quay type berths were adopted for the layout.

Here, attention is drawn to the point in which the present layout markedly differs from the earlier study. Namely, the location of the tip end of the jetty has now receded 100^{m} landward. This is due to the new discovery made by the recent study which revealed the presence of a suddenly steepening trench (−28^{m}), locally cutting across the contour line of −10^{m} water depth, like the blade of knife. (Refer to Sounding Chart attached to N.S.C. Report on IESC Project No. 8672.) Since this location of the trench must be averted by all means, the layout has had to be reviewed and modified accordingly. Consequently, the planned location of the product berth for construction at stage II and subsequent stages has also been pulled back 100^{m} toward the land, thereby to secure a space for extension of the product berth of stage I.

Fig. 13-2-3 shows the location of berths and the way of using the reclaimed land. The product berth will be a quay, 330^{m} long, made of steel sheet piles, and will have a product stock yard behind it.

The raw material berth will be a 270^{m} long quay made with steel pipe piles, equipped with belt conveyors for hauling unloaded raw materials and also with a scrap yard. At the tip of the reclaimed land, a seawater intake and pumping station will be installed to be connected via underground piping to the land facilities. A small oil berth is planned at the starting neck part of the raw material berth. If the road along the coastline is taken as a boundary, the reclaimed land will cover an area of 23.4^{ha}.

(3) Explanation of relations to facilities of stage II

Fig. 13-2-1 and *Fig. 13-2-2* also show a general idea of how the port facilities of stage I are planned in anticipation of those to be installed in stage II.

At stage II, it will become necessary to construct another product berth at a location along the coastline. As far as stage I is concerned, a simple, stone masonry revetment will be built on the planned location to prevent a possible landslide which may be caused by the dredging work.

The construciton of the berth is already so planned as to make it possible later to build a steel pile wall in front of the revetment. The future plan will call for a seaward extension of the raw material berth and for the construction of a breakwater for maintaining the calmness in the port. Anyway, an overall plan should be made later on when the final scale of the new steelworks is decided.

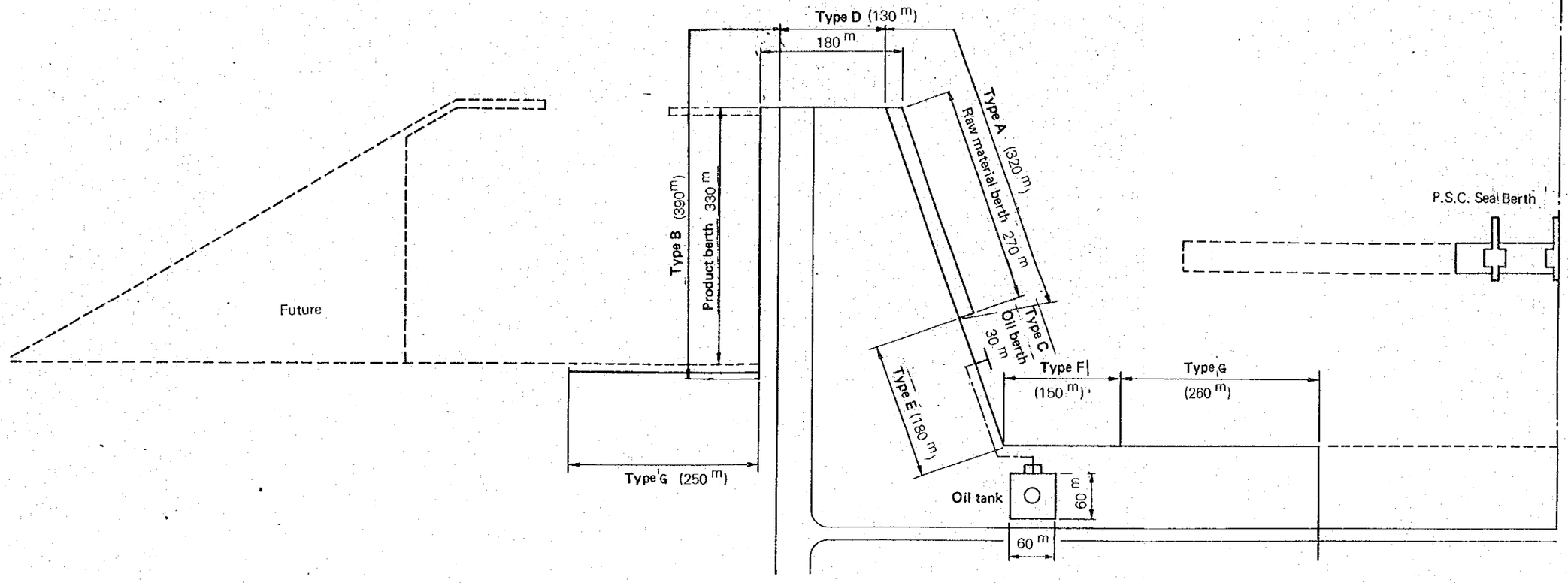


Fig. 13-2-1 Name of the berth

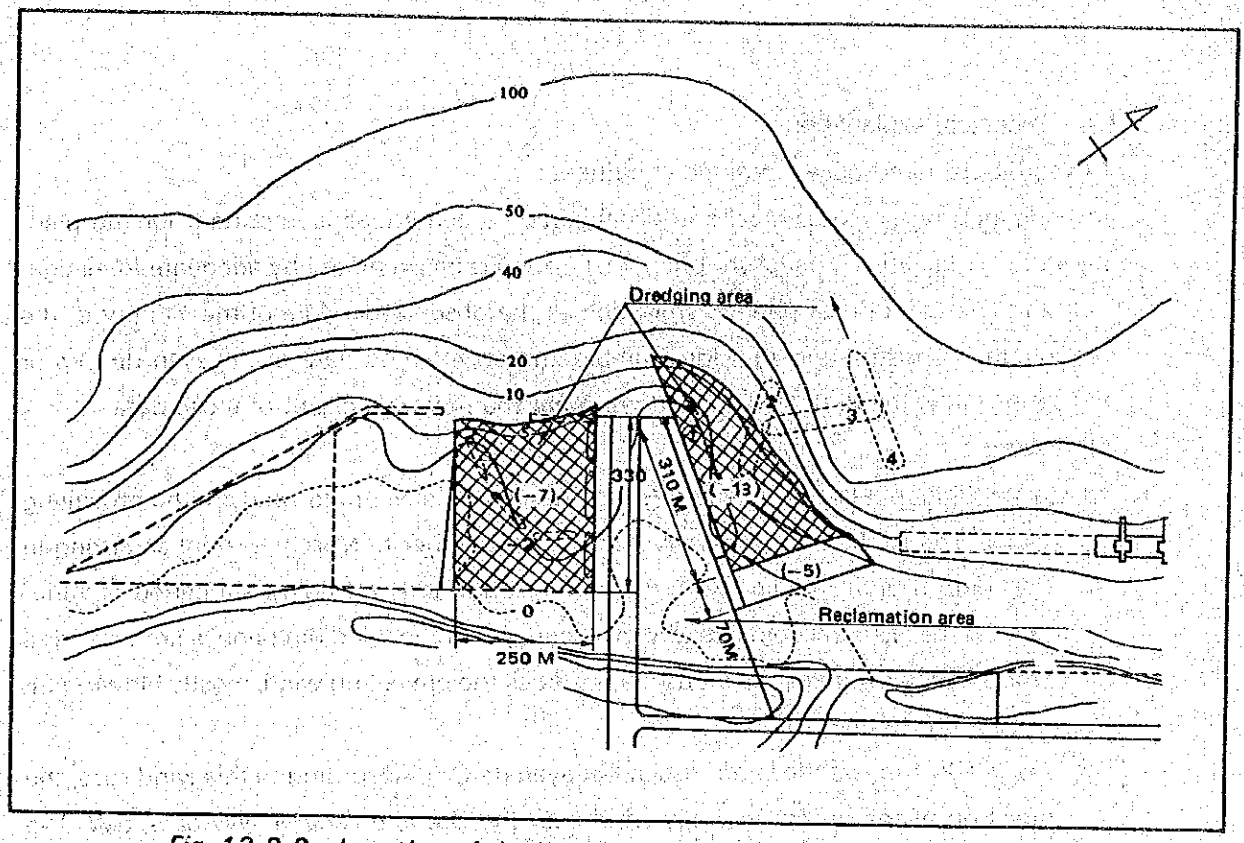


Fig. 13-2-2 Location of dredging and reclamation area

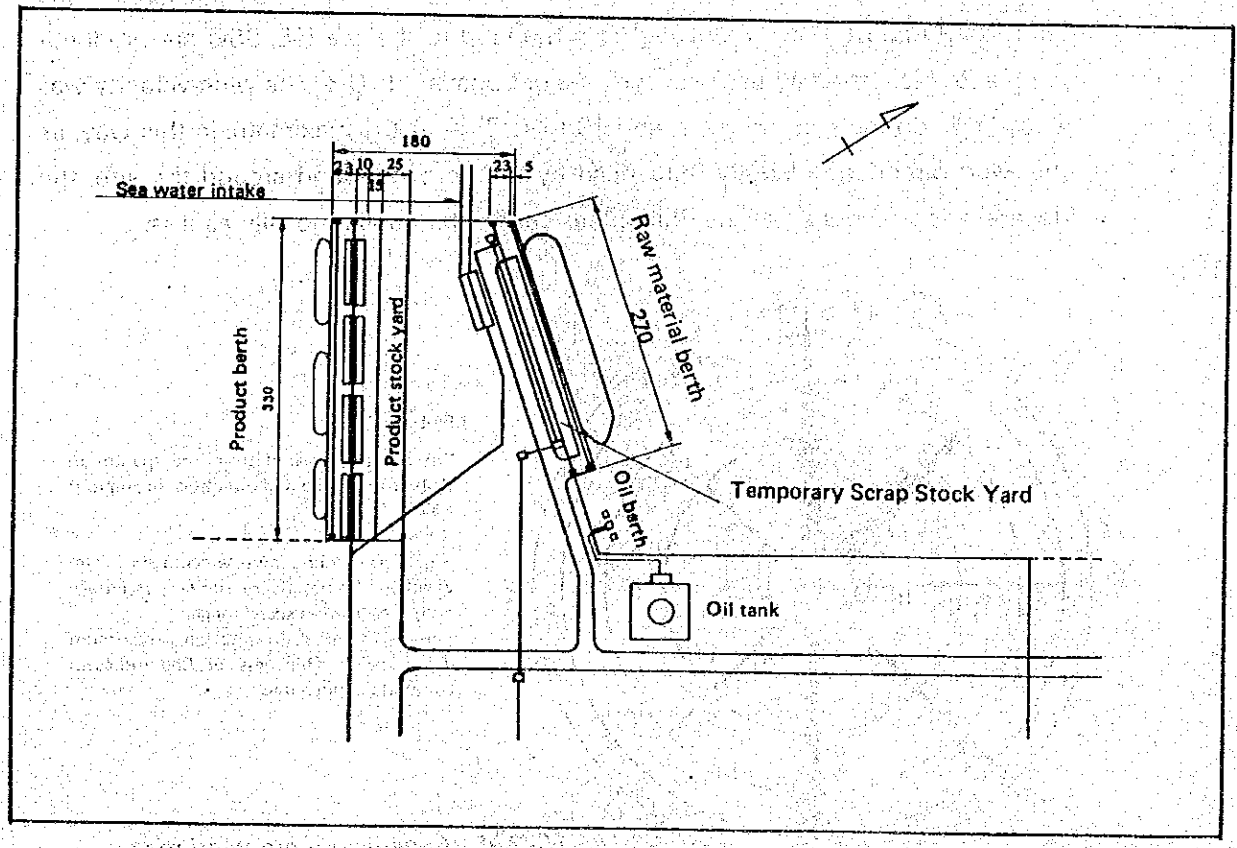


Fig. 13-2-3 Berth lay out

13-2-4 Technical explanation

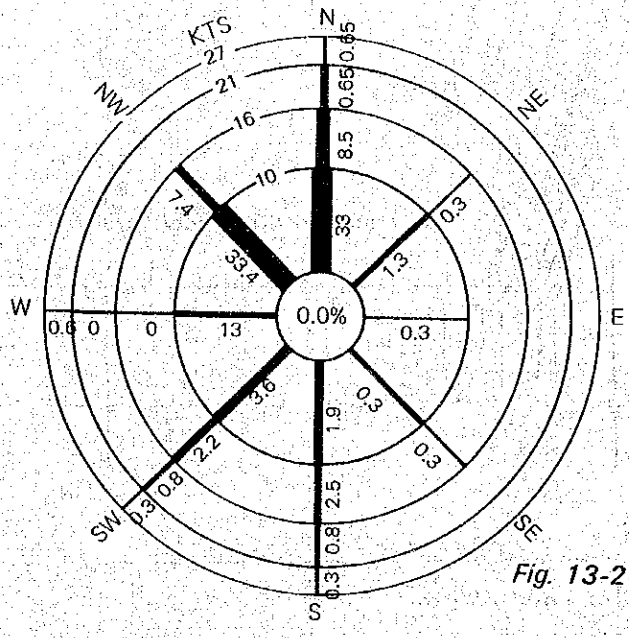
(1) Meteorological and oceanographic conditions

Investigation of meteorological and oceanographic conditions is important for the planning of port facilities. The future phenomena should be predicted by adequate investigation and analysis of past phenomena, such as the observation data of the vicinity of the programmed construction site, for example, the observation data of Cagayan de Oro or PSC. Especially, the data of wind and wave are the most important of those data.

1) Wind

In the Philippines, the NE and SW monsoon and the NE trade wind are the prevailing winds. The NE monsoom usually blows from October to March. It is not so strong in the south islands, but strong in the north islands. March to May is a period of variation for the NE monsoom and SW monsoon, when the wind direction is not constant. From May to October, SW monsoon becomes the prevailing wind, mostly blowing SE or SW, but not constant.

Fig. 13-2-4 shows the wind rose at Cagayan de Oro. According to this wind rose, the direction of the maximum daily wind near the site is mostly N, NW or S, SW. The observation data (1976) at PSC site shows that the wind blowing from the sea to the land (NNW) and the wind blowing from the land to the sea (SE, SSE) are predominant, and this almost agrees with the data of Cagayan de Oro. The wind velocity was 2 to 3$^{m/sec.}$ on the daily average, and 10 to 12$^{m/sec.}$ at the maximum. In this way, as the wind direction is largely influenced by the lie of the land around the site, the general wind tendency of the Philippines cannot be applied locally as it is.



LEGEND;

Wind rose, prepared from the maximum daily wind speed and direction throughout 1971.

KEY

Figure at center shows percentage of calm weather. Radial figure shows percentage within each wind speed range.

Length of radial line indicates maximum daily speed. Thickness of line indicates cumulative percentage.

Fig. 13-2-4 Cagayan de oro wind rose

2) Shape of sea bed

Chart P.C. & G.S. 4649 shows the water depths around the site. According to this, the silting effect from the earth and sand carried down by the Tagoloan river is found especially severe in the sea area in front of the site of the new steelworks. The silt effected area extends especially to the north as far as the neighborhood of Tarum creek, 2^{km} from the river mouth. The earth and sand carried down to the river mouth must have been borne about, spread and deposited along the coastline by the action of the littoral current.

Such a deposit often becomes more finely grained as it is remoter from the neighborhood of river mouth, meaning that its soil composition becomes weaker. Also, in the sea area where littoral drift occurs, the accumulation of deposit in and around the site for dredging work will surely offer a problem. Special attention should therefore be paid to this phenomenon in case of executing the soil investigation or seabed topographic survey.

3) Layout of port facilities

Macajalar Bay, where the site is located, opens toward the sea in a N-NWW direction, as seen in *Fig. 13-2-5*. As the wave-causing wind blows from the sea to the land in a N-NW direction, the site is affected by the waves. The points to be taken care of in this layout plan are as follows:—

(1) As the raw material berth opens to the sea in a N-NW direction, it receives the effects of waves. However, as this berth mainly accommodates large vessels, waves will have little effect on the cargo handling operations. As seen from the uses of P.S.C. berth in the past, the operations have scarcely been affected by the waves, especially when the vessels are large or medium in size.

(2) By contrast, the product berth usually accommodates only small vessels, it will be easily affected by waves. Therefore, this berth has been laid out at a position safe from wave effects. Namely, the waves caused by N-NWW wind will be cut by the breakwater, while the waves caused by NWW-S wind will not rise high because they are waves of small fetch coming only from the opposite shore of Macajalar bay.

(3) Shelter of vessels at typhoon time

Cabulig bay in Jasaan, being sheltered from N-NW wind and waves, is calm even at the time of typhoon, and has been used by vessels (especially of small size) as a shelter area. This bay is adequately deep and large and may be considered suitable as a shelter in the plan for the new steelworks.

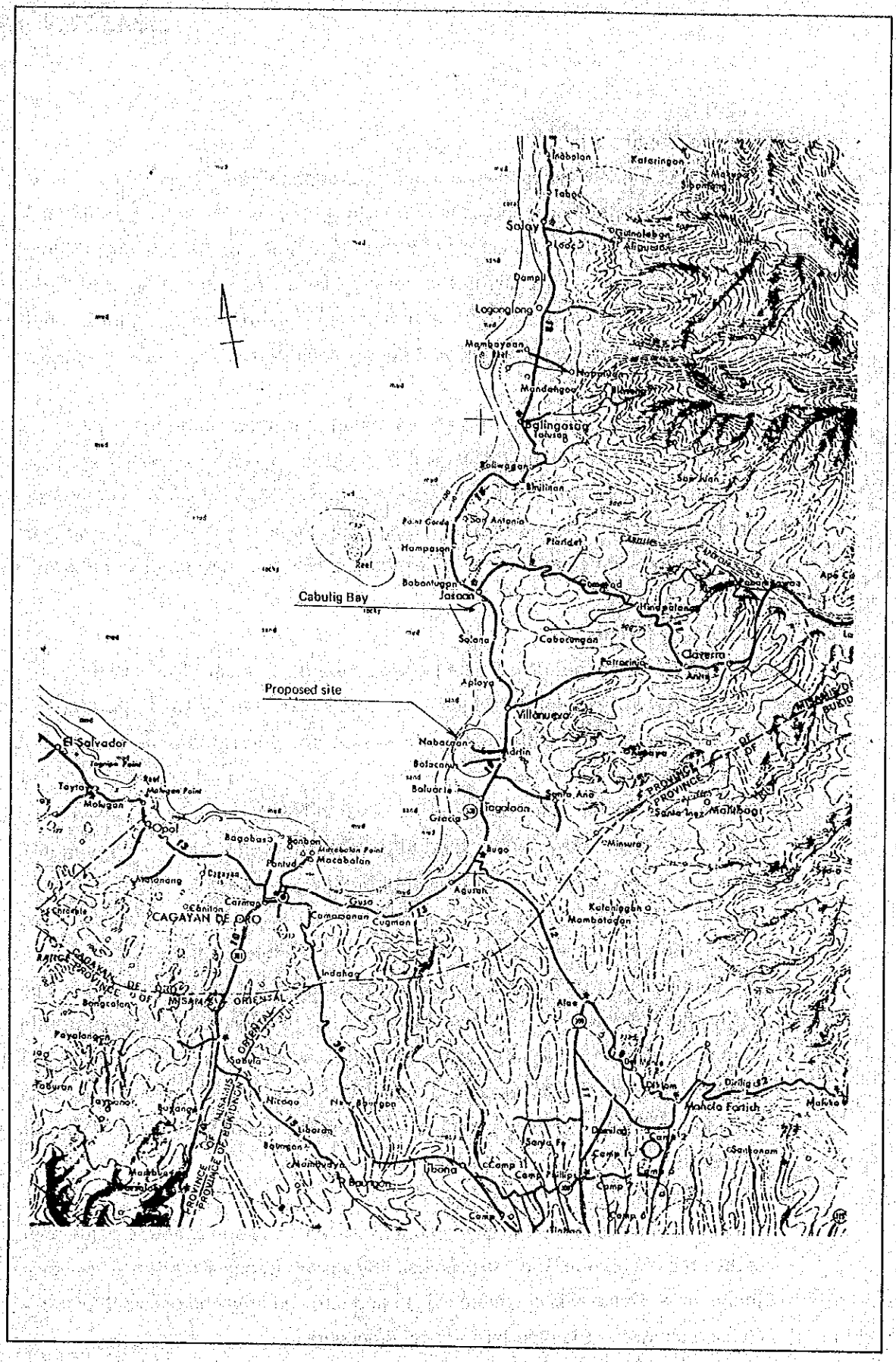


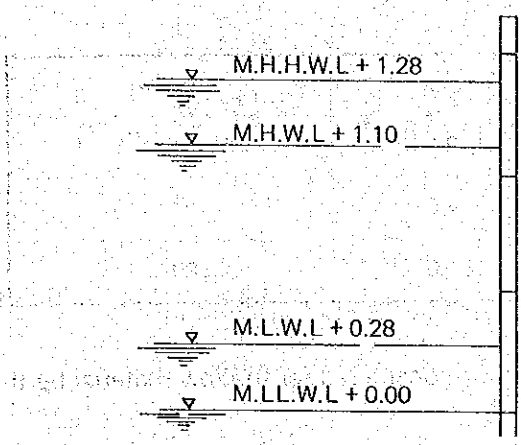
Fig. 13-2-5 Location of proposed site

(2) Design Conditions

1) Wave height and frequency

Due to the lack of observation data on the height of waves in the vicinity, the significant wave height for design purposes is assumed at 2.0^{m} and the wave period at $6.5^{sec.}$

2) Tide levels



3) Design seismic coefficient

According to the building code of the Philippines, k (design seismic coefficient) is 0.15.

4) Ship's quay-approaching speed

Normally, 10 to $12^{cm/sec.}$ is used for large vessels, which, as a rule, rely on the tug boat for coming alongside the quay. Since this port will have no breakwater, a speed of about $15^{cm/sec.}$ is considered desirable.

5) Ground conditions

Boring at the area of proposed port construction must be done. This is indispensable for the quay design, dredging and reclaiming plans. There are the boring data of the adjacent area, obtained at the time of P.S.C. sea berth construction, which point to the comparative complexity of the soil layers there.

6) Load conditions of cargo-handling equipment

Raw material Unloader

Number of wheels: 4 wheels/corner x 4 corners

	Sea side	Land side	Load conditions
During Operation	35 t/wheel	30 t/wheel	Long term

Product Loader

Number of wheels: 4 wheels/corner x 4 corners

	Sea side	Land side	Load conditions
During Operation	34.5 t/wheel	29 t/wheel	Long term

7) Surcharge to wharf

Name of berth \ Location	Quay	Bridge
Raw material berth	3.0 (t/m^2)	(t/m^2)
Product berth	2.0	
Oil berth	1.0	0.5

Temporary storage of scrap is to be considered for the raw material berth, and trailer running for the product berth.

(3) Consideration on mooring facilities

Structural type of berths can be a pier type, sheet-pile type, caisson type, or otherwise. Considering, however, the temporary storage on the apron of wharf and other ways of using as well as the site condition, execution condition and economy, it has been concluded that the sheet-pile type wharf will be advantageous. Likewise, from the standpoint of execution and construction schedule, it has been judged to be advantageous to use steel piles for the structure of foundation.

Fig. 13-2-6 and *Fig. 13-2-7* show the profile of standard structure type of each berth.

(4) Dredging and reclamation

The amount of soil necessary for reclamation is 710,000m^3, and the amount of dredged soil is 820,000m^3. Both the dredged soil of good quality and the mountain soil will be used for reclamation purposes. Besides, the mountain soil is needed also for the construction of wharf. For the dredging work, the cutter suction dredger is to be used. Dredged soil is blown into the reclamation area for land development. The sea area directly facing the wharf will be dredged by the grab dredger, and this soil so dredged will be disposed of in the open sea.