Chapter IX Preliminary Study on Construction of New Hot Rolling Mill

1. Background of Preliminary Study

In this Chapter the result of pre feasibility study on the hot rolling mill plant, the construction of which is to be planned after the start-up of the cold rolling mill complex, is given. Although the Master Plan for an integrated steelworks was made in the past, the huge amount of investment required resulted in the postponement of the construction of the integrated steelworks. Regardless of the said situation, 270,000 tons of hot coils were imported in 1999 and the demand of hot coils is expected to increase, and furthermore, an additional demand of hot coils as mother coils for the planned new cold rolling mill complex is expected.

Considering these circumstances it has been decided that a new hot rolling mill plant is to be planned apart from the one to be constructed in the integrated steelworks. Accordingly, it is taken for granted that the slabs to be supplied to the hot rolling mill plant are to be totally imported.

2. Site Selection for Construction of New Hot Rolling Mill

In general the steel works is constructed considering the following conditions ;

1) Close to the mines of raw materials such as coal and irons ore, and/or
2) Close to the major customers of steel products such as industrial complex

These can be summarized as an advantage in transporting the raw material and/or the products. The above item 1) is obviously related to the transportation of raw material. In the case of new hot rolling mill all the slabs are to be imported and thus the port facilities and the distance between the port and the hot rolling mill are to be taken into consideration. On the other hand, the above item 2) is related to the transportation of products. In the case of new hot rolling mill the distances from itself both to the cold rolling mill and to other customers are to be taken into consideration. A comparison of major items including the said two viewpoints in selecting the site for the new hot rolling mill is made. Three candidate site, namely North area, Central area and South area are considered, and for South area Phu My is assumed.

The criteria for selection are as follows ;

1) Port facilities to receive and handle raw materials, namely slabs
2) Distance to the major customers, including that to the planned cold rolling mill
3) Availability of utilities

The result of comparison is shown in Table IX-2-1.

Table IX-2-1 Comparison of Sites for HSM Plant Area

	South (Phu My)	Central	North
Port Facilities	◎ Berth for maximum 60,000 tons vessel	× No laerge port at the present	△ Berth for only 5,000 to 6,000 tons vessel
Distance to Major Customers	◎	△	×
Utilities	◎	(no information)	(no information)
Total	◎	△	○

◎ : Excellent ○ : Good △ : Satisfactory × : Poor

1) As was mentioned above, all the slabs are to be imported and 3,000 tons to 5,000 tons of slabs are to be used, and thus to be handled daily on an average. (Refer to 3.2 for detail.) Accordingly, port facilities are key items for the selection. As is shown in Table IX-2-1, a large amount of slabs equivalent to more than a few day consumption can be receives at one time at Phu My port. Compared to other two candidate sites, Phu My has an advantage with regard to the port facilities.

2) With regard to the distance to the major customers, South area is more advantageous than other two sites partly because the major customers of hot rolled products are located in the

south area, as those of cold rolled products and also partly because the planned cold rolling mill which is the possible largest single customer is to be constructed in the south area. It is a fact that there exist some hot rolling mills which are located far away from the cold rolling mills, however in these cases the transportation of hot coils to the cold rolling mill requires inevitably a long distance, thus giving a disadvantage in terms of cost.

3) Sufficient utility such as electricity and water for the hot rolling mill is expected to be secured in the south area although further detailed investigation is required.

Based on the above judgment, south area, namely Phu My and the site adjacent to the cold rolling mill complex is recommended for the site of construction of the new hot rolling mill. In addition, when the hot rolling mill is constructed adjacent to the planned cold rolling mill complex, the following advantages are expected ;

1) Sufficient information exchange with the cold rolling mill can be made, and this enables the mill to accelerate the quality improvement.
2) Improvement of technical knowledge and know-how of technical staff can be made by having technical discussions with the staff of cold rolling mill.
3) Maintenance work both for hot rolling mill and for cold rolling mill can be made by one department, resulting in the reduction of the workers.
4) Inventories such as bearings can be used by both mills.
5) Machines and/or devices for maintenance can be used by both mills.
6) Machines and/or devices for chemical analysis and inspection of products can be used by both mills.

Considering the above all, it can be said that the construction of the hot rolling mill adjacent to the cold rolling mill is quite advantageous when the hot rolling mill is to be constructed independently.

3. Product Mix, Production Capacity and Required Quality

3.1 Product Mix

The new hot rolling mill plant will be the first one in Viet Nam and a wide range of flat products is to be produced and supplied to various customers. Accordingly, heavy plate products mainly for ship building are also taken into consideration in this FS. The kind of products which is expected to be produced in the planned hot rolling mill is shown in Table IX-3-1.

Table IX-3-1 Kind of Products

Kind of Products	Remarks
Hot coil for cold rolling mill	Totally for new cold rolling mill for the time being
Hot coil for general use	Low and middle carbon steel, high strength steel (TS= 50N/mm class), low alloy steel, For pipe and section, general use and so on.
Heavy plate	To be manufactured without coiling For ship building, etc.

Nearly all the customers in Viet Nam do not have enough capacity to handle large coils. Accordingly, coil dividing and sheet manufacturing facilities are considered as well.

(1) Product Size

1) Product Width

The maximum width is to be decided from the following viewpoints

a) The maximum width is to cover most of the products demanded in Vietnamese market

b) An excessive initial investment cost is to be avoided

Considering the above a) and b), the maximum width of products is determined to be five feet ranging from 600 mm to 1,600 mm. For reference, the distribution of width of all flat product found in the report of JICA Master Plan is shown in Table IX-3-2. It can be found that most of the demands can be covered with the maximum width of five feet.

Table IX-3-2 Width Distribution of All Flat Products

Width range	Ratio
- 1,600 mm (5 feet)	88 %
1, 600 (5 feet) - 1,900 mm (6 feet)	7 %
1, 900 (6 feet) -	5 %

Source: JICA Master Plan report (1998)

2) Product Thickness

The minimum strip thickness for new cold rolling mill is 1.6 mm. Based on this minimum thickness, that of 1.5 mm, which is commonly used in the thickness range covering that of 1.6 mm, is adopted for the hot rolling products. On the other hand, the maximum thickness for coiled products is 12.7 mm, namely half inch which is common specification for hot rolled products, and that for heavy plate is 32 mm, for which an excessive initial investment for equipment can be avoided.

3) Maximum Coil Weight

The maximum coil weight is dependent on that of the imported slabs. The weight per unit width of 18 kg/mm, namely 1,000 PIW is recommended which is commonly used in the world, and slabs with these weight specification are easy to procure. This condition of unit width gives the maximum weight of 29 tons, which is used as a precondition for this FS.

The slab dimensions purchased are to be as follows ;

a) Thickness : Approximately 160-250 mm
b) Width :Approximately 600-1,600 mm
c) Length : Approximately 5,000-10,400 mm
d) Maximum Weight : Approximately 29 ton

3.2 Production Capacity

3.2.1 Production Capacity

The production capacity of the hot rolling mill which is agreed between JICA Team and Vietnamese side is shown in Table IX-3-3.

Table IX-3-3 Planned Production Capacity

	Annual Production Capacity	Ratio of Heavy Plate	For Cold Rolling Mill
Step 1	800,000-1,000,000 tons/year	10%	217 ,000 tons/year
Step 2	1,200,000-1,500,000 tons/year	10%	500,000 tons/year (after expansion of CRM)

As there is virtually no difference in composition of the equipment within each range specified for Step 1 and Step 2, the production capacities of 1,000,000 tons/year and 1,500,000 tons/year for Step 1 and Step 2 respectively are used for this FS. These figures are those of products. The material flows including manufacturing volume at each process for Step 1 and Step 2 are shown in Fig. IX-3-1 and Fig. IX-3-2 respectively. To study the said material flows, the following preconditions are used ;

1) The capacity of hot shear line is 240,000 tons/year.

2) The ratio of as hot coils and skinpassed coils is 30% and 70% respectively.
(This value does not include hot rolled products for cold rolling mill.)
3) The planned yield at each process is specified in accordance with that of Master Plan.

With the above preconditions, the production capacities based on the slabs consumed are 1,050,000 tons/year and 1,567,000 tons/year for Step 1 and Step 2 respectively.

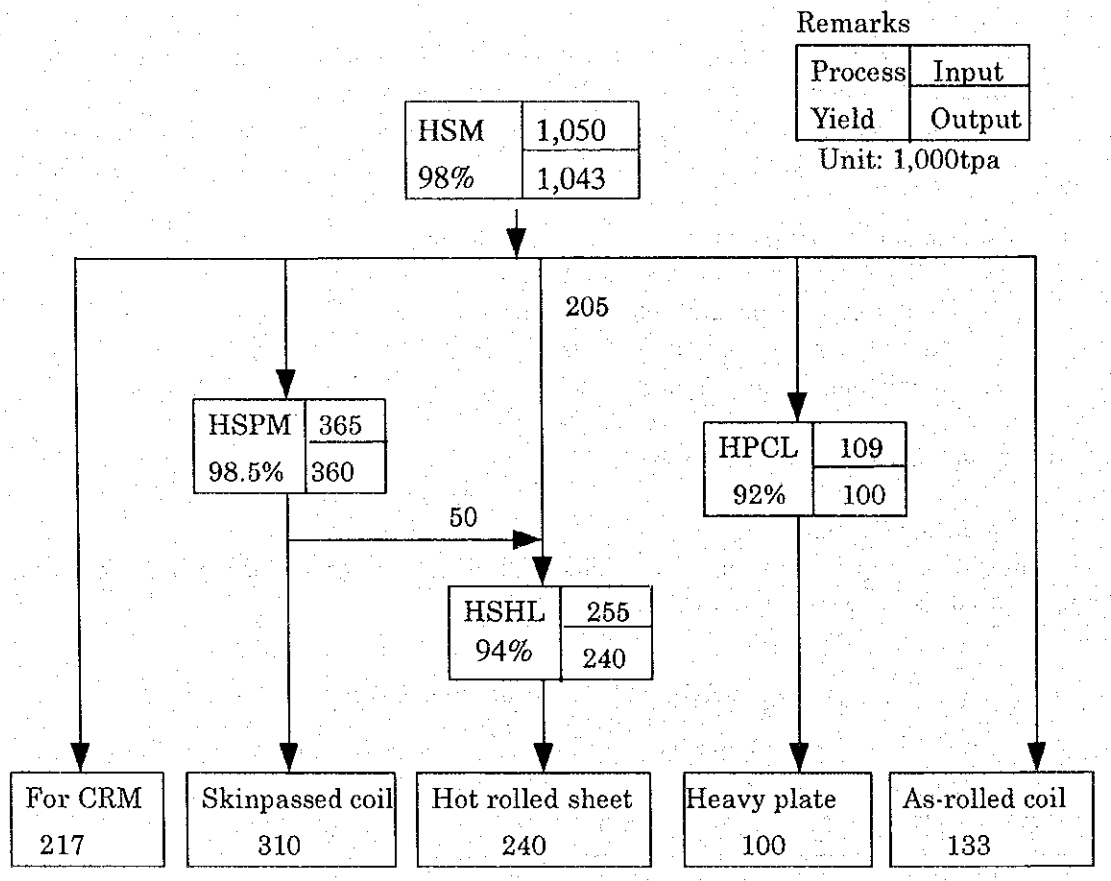


Fig. IX-3-1 Production Flow for Step 1

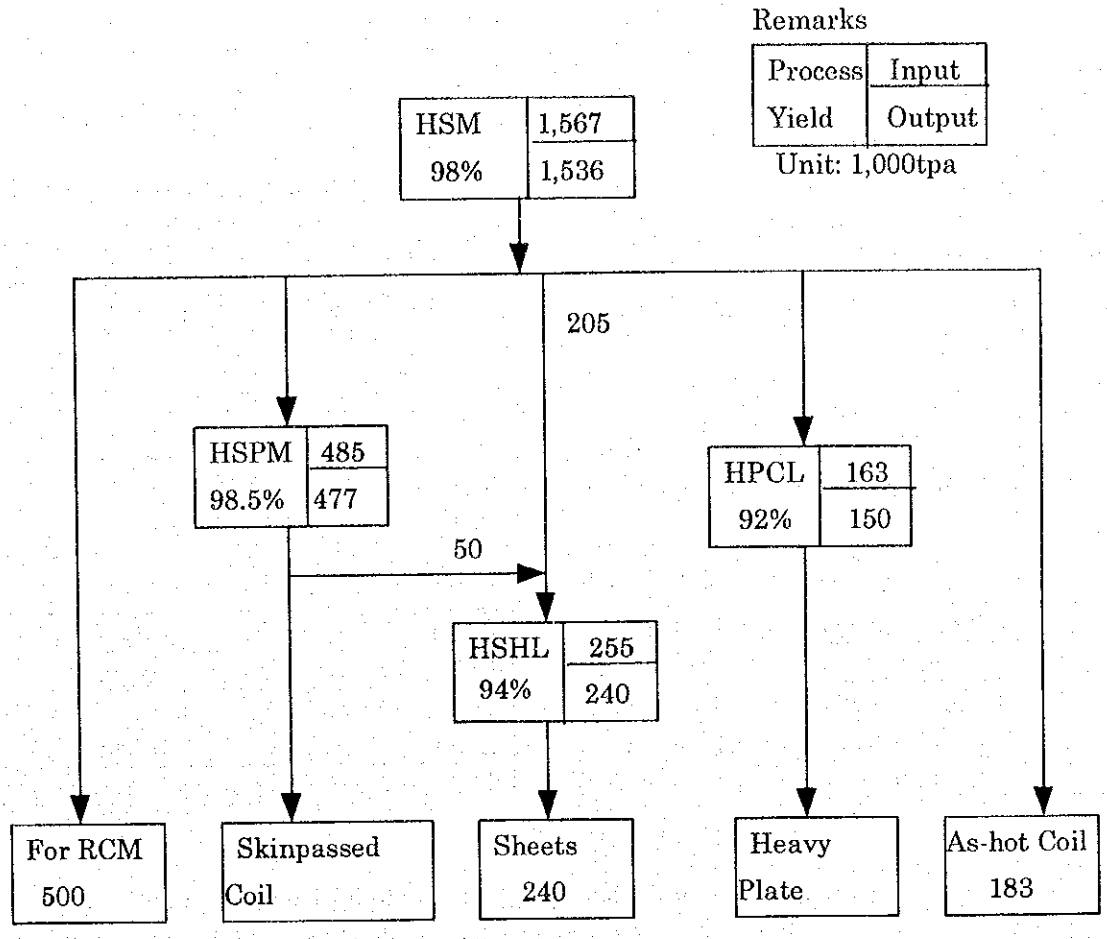


Fig. IX-3-2 Production Flow for Step 2

3.2.2 Operating Indices Planned for Production Capacity

(1) Working ratio and production efficiency

In general the production capacity of hot rolling mill is decreased by manufacturing heavy plate. For the production of heavy plate a combination line of hot rolling mill and hot finishing lines is required, and the operation is interfered by line stops for inspection and/or waiting time before line-off of the heavy plate products. The said effect of the production of heavy plate is also taken into consideration at the time of studying the production efficiency. As a precondition the hourly production of heavy plate is assumed to be 100 tons/hour based on the operating indices in Japan.

1) Working ratio

Working hours and scheduled maintenance time commonly used at the feasibility study are shown in Table IX-3-4.

Table IX-3-4 Working Hours

Item	Time (hours/year)	Remarks
Calendar hours	8,760	24 hours/day×365 days/year
Scheduled Maintenance	552	1)+2)
1) Annual Maintenance	(240)	24 hours/day ȝ 10 days/year
2) Periodical Maintenance	(312)	12 hours/time ȝ 26 times/year
Hours for Operation	8,208	
Actual Operating Hours	6,977	Availability 85% assumed

2) Production Efficiency

The required production efficiency which is calculated considering the time for manufacturing heavy plate is shown in Table IX-3-5.

Table IX-3-5 Required Production Efficiency

	Production Quantity (Slab basis)	Required Time (hours)	Efficiency
Step 1	Heavy plate : 110,000 tons/year	1,100	100 ton/hr
	Hot rolled coil : 939, 000 tons/year	5,867 (=6,977−1,100)	160 ton/hr
Step 2	Heavy plate : 166, 000 tons/year	1,660	100 ton/hr
	Hot rolled coil : 1,401, 000 tons/year	5,317 (=6,977−1,660)	263 ton/hr

The specifications of equipment of the hot rolling mill are to be determined to realize the above production efficiency with the sizes of the products taken into consideration.

(2) Product yield and major unit consumption

The expected product yield and major unit consumption of utilities are shown in Table IX-3-6. The more precise figures are to be obtained after the detailed study on specifications of the equipment.

Table IX-3-6 Product Yield and Major Unit Consumption

	Planned value
1 Yield	98 %
2 Unit consumption	
1) Electricity	110 kWh/ton
2) Fuel	300,000 kcal/ton
3) Roll	0.6 kg/ton

3.3 Required Quality for Hot Rolled Product

Setting the required quality is very important as it affects quite a lot the equipment to be introduced and the required functions of the equipment. However, demands from the customers differ from one customer to another, and it is virtually impossible to specify the required quality in .general terms. Accordingly, in this FS the target figures of quality items for operation in the mills which export the hot rolled products to international market are shown as an example in Table IX-3-7. These figures are to be used for studying the equipment and functions of hot rolling mill in the following sections.

Table IX-3-7 Example of Required Quality of Hot Coil

Item	Operating target level
Thickness Accuracy	Within ±0.03 mm
Width Accuracy	Target width ±5 mm
Temperature Accuracy	Within ±20℃
Crown at 25 mm Position from the Coil Edge	Within ±0.03 mm
Flatness	30 I- unit

4. Comparison and Technical Evaluation of Hot Rolling Processes and Specifications of Major Equipment

4.1 Comparison and Technical Evaluation of Hot Rolling Processes

Main equipment in the hot rolling mill is shown in Fig. IX-4-1

Fig. IX-4-1 Main Equipment of HSM

The reheating furnace and coiler can cope with an increase of production quantity simply by increasing the number offacilities. For roughing mill and finishing mill, on the other hand, the mill type affects the production capacity. Accordingly, in this FS the mill types for roughing mill and finishing mill are compared and evaluated. In addition, the production of heavy plate is also planned, which affects the production capacity and quality. The process for it is also considered.

4.1.1 Finishing Mill Type

In the past Steckel mill type was considered in Viet Nam, and the possibility of adoption of this mill type was studied. The comparison between Steckel mill type and the conventional mill type is shown in Table IX-4-1. The criteria for the selection of the finishing mill type are

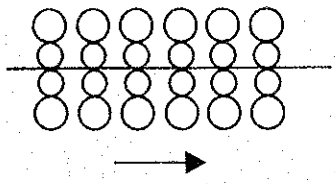
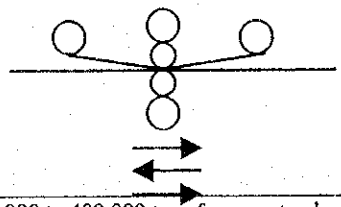
1) Production capacity, and
2) Quality

For the conventional type, the rolling is made in one direction with one reduction at each stand, and the production capacity can be large depending on that of the roughing mill. For Steckel mill type, on the other hand, the rolling is made with multiple passes in the same manner as the reversing cold rolling mill shown in Chapter V. As the rolling is made by reversing, the production capacity is relatively small, and the maximum production capacity reaches only 600,000 to 800,00 tons/year even when two stands are installed. This highlights the inappropriateness of Steckel mill type as the process for the hot rolling mill as the production capacity of 1,500,000 tons/year can not be achieved at the second phase of the Project.

In addition, as is shown in Table IX-4-1, there exist some quality problems for Steckel mill type. As the reversing rolling is made at Steckel mill type, the rolling speed for the head and tail ends is to be slowed down. This slow down of speed results in a large temperature drop at the head and tail ends. This temperature drop becomes large as the thickness of the coil goes down, and results in the variation of mechanical properties. To overcome the problem of temperature down, the descaling is often stopped for the head and tail ends, resulting in a poor surface quality of products due to the residual scale. In the planned cold rolling mill products with good formability and for high class use are expected to be rolled, the minimum thickness of hot coils is 1.6 mm. From the viewpoints of

mechanical properties and surface quality, an international competitiveness can not be maintained with Steckel mill type. Accordingly, the conventional type is to be adopted in this FS.

Table IX-4-1 Comparison of Finishing Mill Type

	Conventional type	Steckel mill type
Schematic image		
Annual production capacity	maximum 3,000,000 to 4,000,000 tons	300,000 to 400,000 tons for one stand 600,000 to 800,000 tons for two stands
Quality		
Temperature	◎	△
Thickness	◎	◎
Surface	◎	△
Major Products	Normal steel, special steel	Stainless steel, special steel
Investment cost	Large	Small

◎ : Excellent ○ : Good △ : Poor

4.1.2 Roughing Mill Type

Although there are several possibilities for the roughing mill type, typical three types are selected for comparison. Schematic drawings of the said three roughing mill types are shown in Fig. IX-4-2. The first one type is called semi-continuous type and the maximum production capacity is 3,000,000 tons /year. The second type is also called semi-continuous type but with a coil box and in these days some CBMs have been constructed. (hereinafter this mill type is abbreviated CBM.) The third one has multiple rolling mills, thus resulting in a large production capacity. In this report an example of so-called three quarter type is shown, and there also exists a full continuous type roughing mill with possibly much larger production capacity.

The comparison of these mill types is shown in Table IX-4-2. The criteria for the selection are as follows ;

1) Production capacity
2) Investment cost
3) Stability of operation

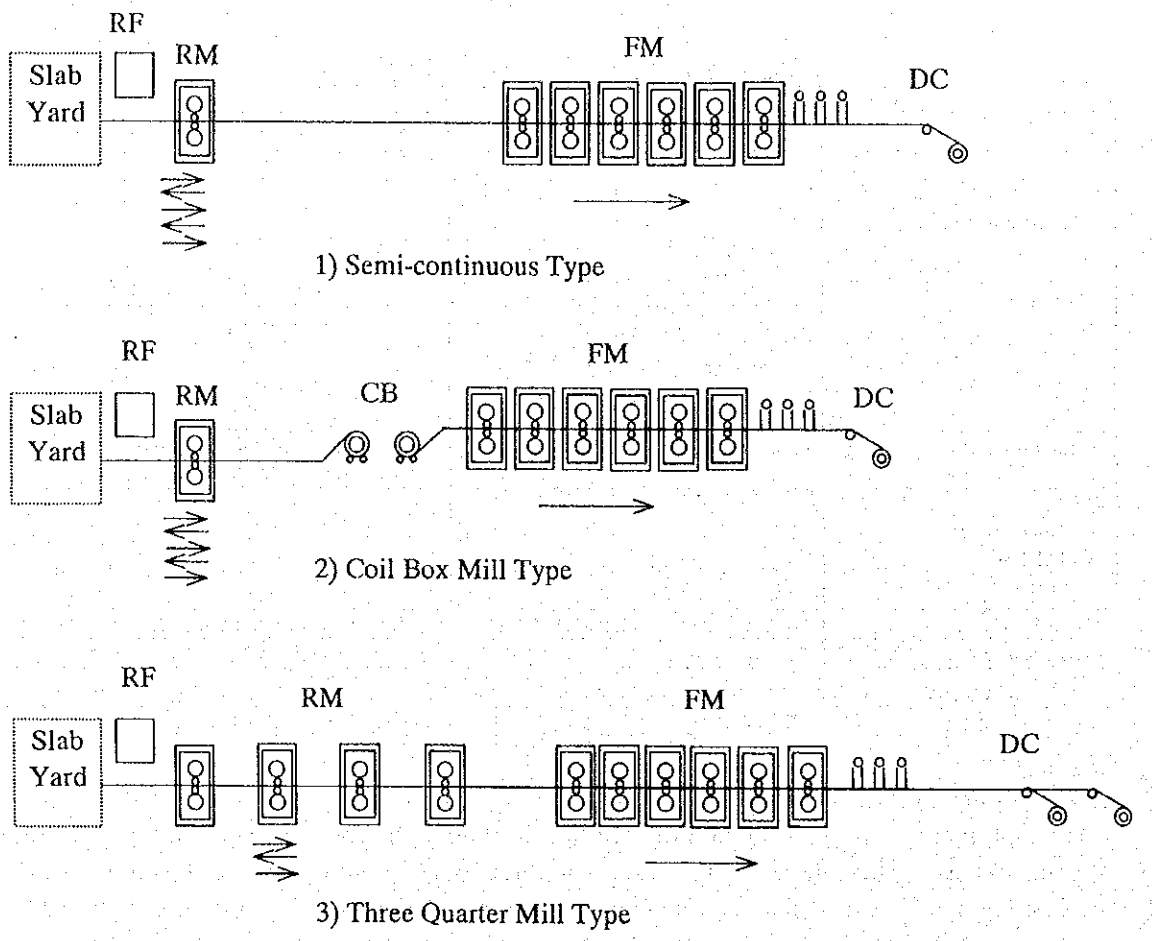


Fig. IX-4-2 Schematic Drawing of Roughing Mill

The three quarter type has an excessive production capacity compared to that of 1,500,000 tons/year planned here and requires a large initial investment cost. Accordingly, this mill type can be eliminated from the possible mill types for this FS. For the production of 1,000,000 to 3,000,000 tons/year, semi-continuous mill type and coil box mill type are commonly adopted. At the semi-continuous type, slabs are rolled after being discharged from the reheating furnace by being reversed at the mill and then transferred directly to the finishing mill. At the coil box mill, on the other hand, a coil box is installed in front of the finishing mill. From the viewpoint of production capacity both the semi-continuous type and the coil box mill type are feasible.

When the comparison is made between semi-continuous mill type and coil box mil type, there exist the following advantages at coil box mill type.

1) At CBM type, the transfer bar delivered from the roughing mill is coiled in the coil box, resulting in a reduction of the required line length between the roughing mill and finishing mill.
2) At semi-continuous mill, the temperature towards the tail end of the transfer bar decreases during rolling. To overcome this temperature decrease, an accelerated rolling is inevitable, for which a large motor power is required. At CBM type, on the other hand, the temperature decrease towards the tail end is avoided as the transfer bar is once coiled in the coil box. Accordingly, the temperature of the transfer bar stays constant, and the finishing rolling can be made with a constant speed without acceleration, for which a large motor power is not required resulting in a smaller initial investment cost.
3) At CBM type the rolling at the finishing is made with a constant speed without acceleration, resulting in a reduction of the required length of cooling zone after the finishing. This reduction of the length for cooling zone is to certainly result in the reduction of the initial investment cost.

As is described in the above 1) to 3), for CBM mill the investment cost for the coil box itself is certainly increased. However, due to the reduction of motor power of the finishing mill, table length between roughing mill and finishing mill and length of cooling zone the total initial investment cost is not increased much compared to the semi-continuous type mill.

4) At CBM type the finishing rolling is made with the constant speed without acceleration. This certainly improve the stability of operation, giving an advantage of stability of quality as well.

Considering the above 1) to 4), the coil box type mill is recommended as this satisfies the production capacity, low initial investment cost and stability of operation and quality.

Table IX-4-2 Comparison of Roughing Mill Type

	Semi-continuous Type	Coil Box Mill Type	Three Quarter Mill Type
Annual Production Capacity	800,000 to 3,000,000 tons	800,000 to 3,000,000 tons	3,000,000 to 5,000,000 tons
Rolling at Finishing Mill	Accelerated rolling	Rolling with constant speed	Accelerated rolling
Quality	Possible disturbance due to acceleration	Little disturbance due to no acceleration	Possible disturbance due to acceleration
Line Length	Medium	Short	Long
Initial Investment Cost	(base)	same as semi-continuous	+ 150 - 300 million

4.1.3 Process for Heavy Plate Production

Heavy plate production at hot rolling mill can be classified into three groups, depending on the place of "line-off" where the plate is discharged from the hot rolling mill. The three possibilities are shown in Fig.IX-4-3.

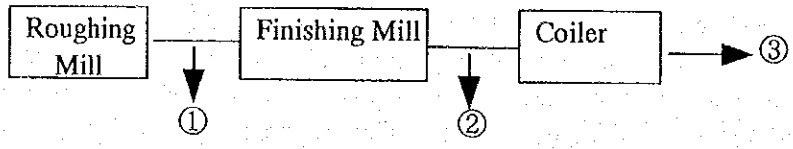


Fig. IX-4-3 Type of Heavy Plate Process

The comparison of these three types is shown in Table IX-4-3. (Type①, ②, ③in the table corresponds to those in Fig. IX-4-3.) The criteria for the selection are as follows ;

1) Quality
2) Production capacity

Table IX-4-3 Comparison of Heavy Plate Process Type

Items	Type①	Type②	Type③
Discharging Point	Exit at Roughing Mill	Exit at Finishing Mill	Exit at Coiler
Maximum Length of Products (=Production efficiency)	Equivalent to the length of RM to FM ○	Equivalent to the length of RM to FM ○	Equivalent to the length of FM to Shear ◎
Width of Product	Equivalent to RM width	Equivalent to FM width	Equivalent to FM width
Quality (Thickness accuracy・ Surface quality)	△	◎	◎
Conveyance of Thin Plate at ROT	◎	○	◎
Overall Evaluation	△	○	◎

◎ : Excellent ○ : good △ : Poor

1) For type①, there is a possibility of manufacturing wider products, different from the width of the rolled products, by widening the width of roughing mill. However, the roughing mill does not have any control facilities for thickness and shape, thus giving poor quality compared to other two types. In addition, at the coil box type mill the length between the roughing mill and finishing mill may not be long, resulting in a poor production efficiency of heavy plates.
2) For type②and③, the finishing mill is used for rolling, and higher level of quality is expected.
3) For type②, an extractor of heavy plates is to be installed at the run out table, and there might

exist some difficulty of conveying thin gauge strips.

4) For type③, the length of the heavy plate products can be increased up to the shear equipment of heavy plates, thus giving higher productivity. In addition, this type does not have the disadvantages which can be found in type②. However, the total line length of the hot rolling mill is to become longer.

Considering the above 1) to 4), type③is recommended for heavy plate production from the viewpoint of quality and productivity.

4.2 Specifications of Main Equipment

4.2.1 Configuration of Hot Rolling Mill

The configuration of the hot rolling mill is shown in Table IX-4-4, and the detailed configuration is shown in Table IX-4-6.

Table IX-4-4 Configuration of Hot Rolling Mill

	Step 1	Step 2
Slab Yard	Area for slab stock of 30day operation	Area for slab stock of 30 day operation
Reheating Furnace	1	2
Roughing Mill	1 stand	1 stand
Coil Box	1	1
Finishing Mill	6 stands	6 stands
Down Coiler	1	1
Roll Shop	2 roll grinders	3 roll grinders

(1) Slab yard

As slabs are to be procured from overseas, it is required to reserve the slab stock equivalent to 30 day consumption.

(2) Reheating Furance

1) Required Function

Heating-up of slabs from room temperature to the required rolling temperature
The heating capacity up to about 1250℃ is required.

2) Numbers of furnaces

At the stage of Step 2 the planned production quantity can be achieved by even one 320 tons/hour furnace. This is estimated from the efficiency described in 3.3.2(2) with an assumption of the slab average weight of 80% of the value. In this sense, there certainly exists the possibility of installing only one furnace from the beginning of Step 1. However, the furnace requires a long shut-down for repair once per three to five years, and in case of one furnace operation the production is to stop during the repair of the furnace.

Accordingly, it is better to have multiple furnaces, if possible, and it is recommended that Step-1 is to start with one furnace and then the second furnace is to be installed for Step-2.

Recommended plan Step 1 : Approximately 200 ton/hr × 1 furnace
Step 2 : Approximately 200 ton/hr × 2 furnaces

(3) Roughing Mill

1) Required Function

Reduction of slab thickness down to that suitable for finishing mill by product size.

2) Items to be considered with regard to the equipment

a) The edger rolls are to be installed in front of horizontal rolls to minimize the width spread caused by horizontal rolling.

b) One position type coil box is adopted as the interval of rolling is rather large.

(4) Finishing Mill

1) Required Function

Realization of the required quality such as size accuracy, temperature and so on

2) Items to be considered with regard to the equipment

a) A crop shear and finishing scale breaker are to be installed in front of the finishing mill stands, and a set of instrumentation and strip cooling equipment at the delivery side.

b) The finishing mill is to be consisted of six stands considering the rolling of minimum thickness of 1.5 mm.

c) The finishing mill is to be equipped with the following functions for the high quality products.

- For thickness control : Hydraulic AGC
- For profile control : Pair cross system, CVC system or other relevant technology
- For uniform roll wear function : On-line roll grinding system or work roll shifting system

(5) Down Coiler

1) Required function

Stable coiling

2) Items to be considered with regard to the equipment

a) The products up to 12.7 mm are coiled by the down coiler, but the products thicker than 12.7 mm are to be carried over to heavy plate cutting line without coiling.

(6) Others

1) Roll shop

Roll grinder and chock tilting equipment for maintenance are to be installed. Installation plan of roll grinders is as follows ;

Step 1 : Total 2 grinders (1 for WR of FM, 1 for WR of RM and BUR of RM and FM)

Step 2 : Total 3 grinders (2 for WR of FM, 1 for WR of RM and BUR of RM and FM)

(Note : WR :Work Roll, BUR :Back Up Roll)

2) Electricity, Computer and Instrumentation

a) The motors for the main equipment such as rolling mills are to be AC motors considering the maintenance and the control capability.

b) Automatic operation is to be realized with level-1 and level-2 computers as there are various control functions for high quality products at the finishing mill.

c) Instrumentation such as thermometer, thickness gauge and width gauge is to be installed.

4.2.2 Configuration of Hot Finishing Facilities

The configuration of the hot finishing facilities, which is based on the production flow of the hot rolling mill plant, is shown in Table IX-4-5. The figures of capacity in Table IX-4-5 are a little larger than those described in the production flow as the processing of the unscheduled coils is sometimes required for inspection of the surface quality due to the occurrence of defects. In addition, there exists only one processing equipment even for Step-2, and the production capacity of each equipment is to be designed from the beginning to satisfy the requirement of Step-2. In this FS the slitting line is not planned, and it is to be considered when the demand increases.

Table IX-4-5 Configuration of Hot Finishing Facilities

	Quantity	Capacity	Thickness Range
Hot Skinpass Line	1	700,000 tons/y	1.5 - 6 mm
Hot Shear Line	1	300,000 tons/y	1.5 - 13 mm
Heavy plate line	1	150,000 tons/y	9 - 32 mm

(1) Hot skinpass line

1) Required function

a) Improvement of flatness, shape and mechanical properties

b) Inspection of strip surface to ensure the surface quality

c) Dividing coils into the weight required by the customers

2) Items to be considered with regard to the equipment

a) Roll bending devices or other equivalent system are to be installed for correcting the strip shape.

b) The thickness gauge is to be installed to guarantee the thickness required by customers.

(2) Hot shear line

1) Required function

a) Cutting of coils into the length required by customers

b) Inspection

c) Piling of sheets

2) Items to be considered with regard to the equipment

a) The flying shear is to be installed.

b) Side trimmer for edge trimming is to be installed.

(3) Heavy plate cutting line

1) Required functions

a) Cutting of heavy plate into the length required by customers

b) Inspection

c) Piling of sheets

2) Items to be considered with regard to the equipment

a) The plates are cut after being rolled.

b) The leveler for shape correction is to be installed.

(4) Coil yard

1) Required function

a) Cooling down of hot coils

The hot coils with temperature of 500~600℃ are air cooled down to almost room temperature, then transported to the cold rolling mill, charged to the hot finishing lines or transferred to the packing area.

b) Packing of coils and sheets for shipping, and storage before shipping

2) Items to be considered with regard to the equipment

a) The hot coils for cold rolling mill are to be transported after five days of cooling.

Only the transportation facility within the hot rolling mill is considered as the site of the hot rolling mill has not yet been decided.

b) The storage area for other coils are considered for the quantity equivalent to 15 day production.

4.2.3 Utilities and Ancillaries

(1) Utilities

1) Electricity power : The electricity power is to be purchased from an electricity company.

2) Water : The water is to be used by re-circulation, and only the volume equal to that of the waste is to be added to the water re-circulation system. The water re-circulation and treatment system such as scale pits, cooling towers and pump systems are to be installed in the hot rolling mill complex.

3) Heavy oil :The heavy oil is used as fuel for reheating furnace, and is to be purchased

from outside and transported by tank lorry. Tanks for storage are to be installed in the hot rolling mill complex.

4) Compressed air : The compressed air is to be generated by compressors in the hot rolling mill complex
5) Steam :The steam is to be generated by a small boiler in the hot rolling mill complex
6) Others : Gases such as nitrogen gas, oxygen gas and so on are to be purchased in bottle.

(2) Ancillaries

Other main ancillaries which are not described in the above are as follows ;

1) Level-3 computer system
2) Maintenance shop
3) Office
4) Others

Table IX-4-6 Equipment List of HSM Plant

No.	Equipment	Quantity		Description
		Step 1	Step 2	
1	Hot Rolling Mill	1 set	1 set	Step 1 : 1,000,000 tons/year Step 2 : 1,500,000 tons/year
1.1	Slab Yard Facilities	1 set	1 set	
1.2	Reheating Furnace	1	2	200 tons/hour, Waking Beam Type
1.2.1	Slab Charging Facilities	1	2	
1.2.2	Main Equipment	1	2	
1.2.3	Slab Discharging Facilities	1	2	
1.3	Roughing Mill	1 set	1 set	Reversing type
1.3.1	Edger	1	1	
1.3.2	Mill Equipment	1	1	
1.3.3	Coil Box	1	1	1 position type
1.4	Finishing Mill	1 set	1 set	Tandem type
1.4.1	Crop Shear	1	1	Drum type
1.4.2	Scale Breaker	1	1	High pressure Water type
1.4.3	Mill Equipment	6 std.	6 std.	with hydraulic screw down, profile control, etc.
1.4.4	Strip Cooling Facilities	1 set	1 set	Laminar flow type
1,5	Down Coiler	1 set	1 set	
1.6	Roll Shop	1 set	1 set	Step 1 :2 roll grinders Step 2 :3 roll grinders
1.7	Crane & lifting equipment	1 set	1 set	

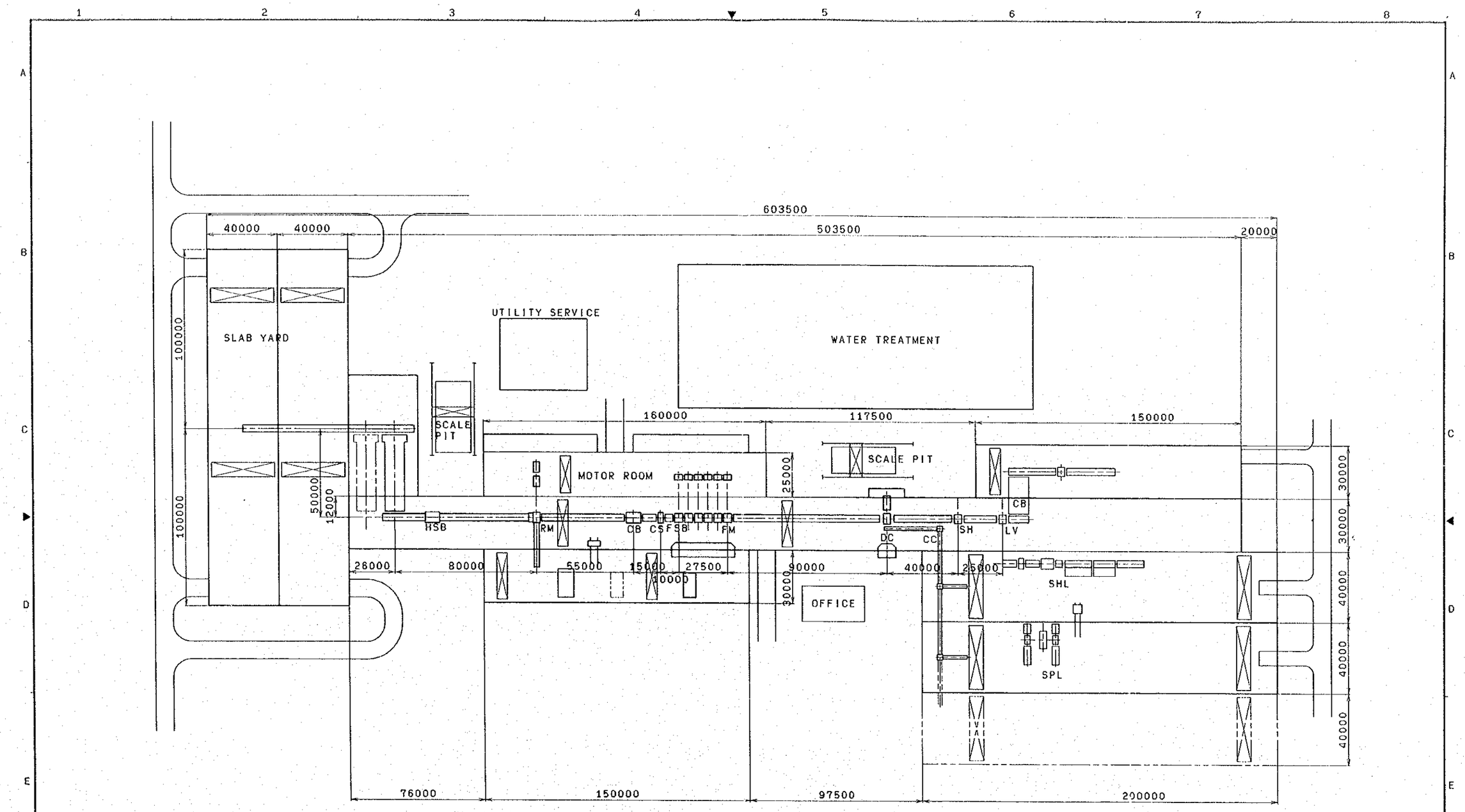
2	Hot Finishing facilities			
2.1.1	Hot Skinpass line	1	1	
2.1.2	Packing Facilities			Off-line manual type
2.2.1	Hot Shear Line	1	1	
2.2.2	Packing Facilities			Off-line manual type
2.3	Heavy Plate Cutting Line	1	1	
2.4	Coil Yard Facilities	1 set	1 set	
2.4.1	Coil Cooling Yard	1 set	1 set	
2.4.2	Coil Shipping Yard	1 set	1 set	
2.4.3	Coil Conveyor	1 set	1 set	
2.5	Crane & Lifting Equipment	1 set	1 set	

3	Utilities & Ancillaries			
3.1	Water Treatment Facilities	1 set	1 set	
3.2	Water Re-circulation System	1 set	1 set	
3.3	Compressed Air System	1 set	1 set	
3.4	Steam Generation System	1 set	1 set	
3.5	Oil Storage & Supply System	1 set	1 set	
3.6	Others			
3.6.1	Level-3 Computer System	1 set	1 set	
3.6.2	Maintenance Shop	1 set	1 set	
3.6.3	Office	1	1	
3.6.4	Others	1 set	1 set	

5. Layout

The layout of the hot rolling mill plant is shown in Fig. IX-5-1.

The layout is drawn only based on a rough study. Accordingly, the layout is to be modified by the limitation of land configuration, detailed study of equipment size and location, location of scale pits and so on.



CLIENT: New Hot Strip Mill

TITLE: General layout

Fig. IX-5-1 Layout of HSM Plant

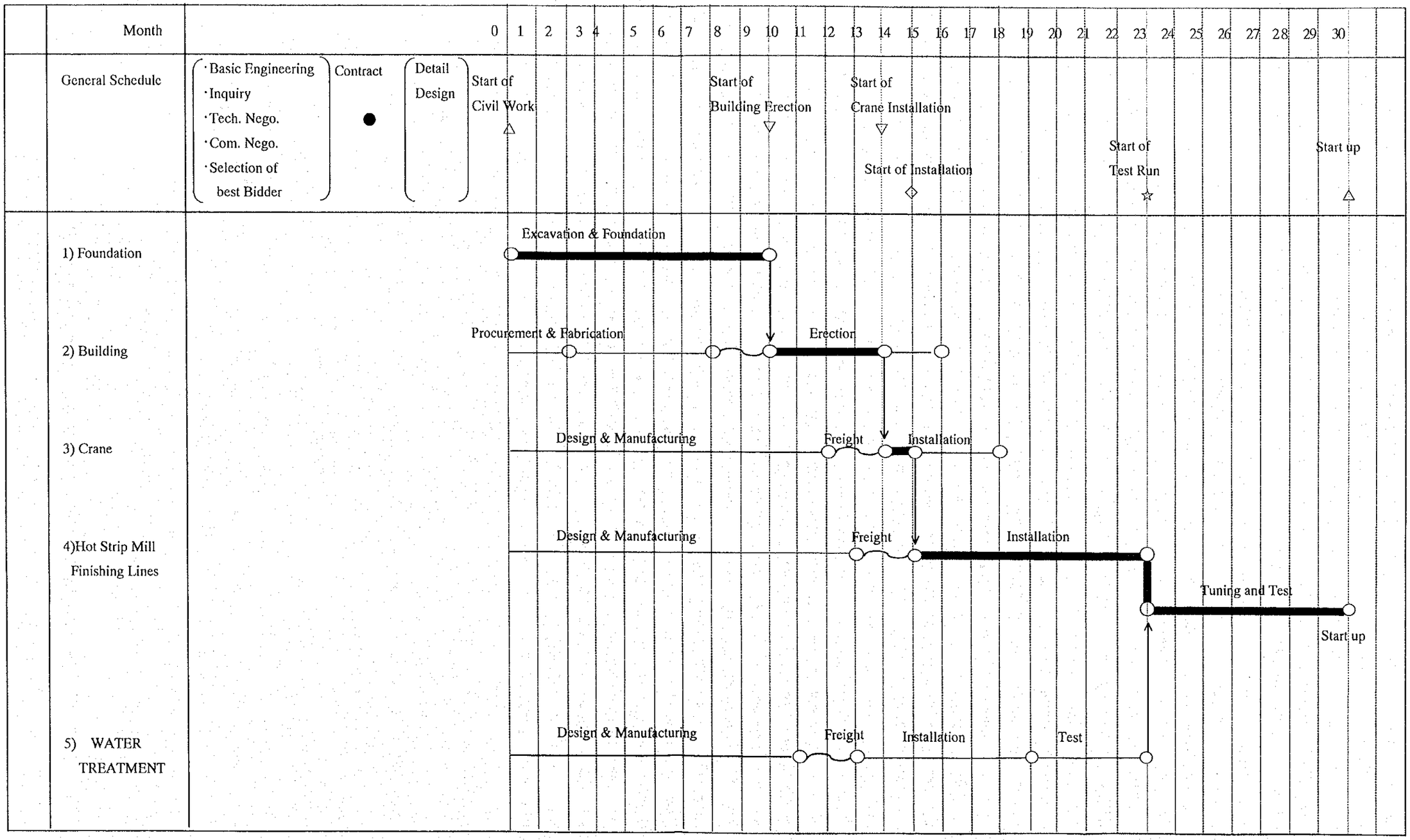
6. Construction Schedule

The rough construction schedule is shown in Table IX-6-1.

This schedule covers the period from the commencement of civil work to start-up of the hot rolling mill. The following preparatory works are required before this schedule ;

1) Investigation to decide the contractors for each equipment and for each work
2) Contracting
3) Detailed designing after contract up to the commencement of civil work

Table. IX-6-1 Construction Schedule



7. Construction Cost

A rough estimation of construction cost of hot rolling mill complex is shown in Table IX-7-1. The following preconditions are used for this estimation ;

1) The equipment is to be purchased and imported in principle from overseas. Some equipment is to be manufactured in Viet Nam depending on the availability.
2) Civil work, erection and installation are to be done by contractors in Viet Nam. However, some portion of construction materials is to be imported.

Table IV-7-1 Rough Estimation of Construction Cost

Item	Cost (mil. US$)	Remarks
(1)Equipment	230	including installation and SV
(2)Civil and building	40	
(3)Inventory	9	
(4)Pre-operational expense	8	
(4)Contingency	10	
(5)Engineering and technical assistance	9	
Total	306	

Note : Interest during construction is excluded

Note : Cost for Step 2 is excluded

Appendices

1. Results of Noise Measurement in Phu My Industrial Zone

Noise measurement was executed to get noise data to execute noise simulation and to compare before/after the construction of the New Cold Rolling Mill Complex.

1.1 Conditions of Noise Measurement

Noise measuring condition is mentioned below.

1) Measuring Date: July 1st, 2000
2) Measuring Points; Refer to Fig. A-1-1
3) Measuring timing;
   a) Morning
   b) Afternoon
   c) Night
   d) Midnight
4) Measuring device; RION NA-20
5) Frequency adjustment;
   a) A weighting
   b) C weighting
   c) Flat
6) Measuring speed; Fast & Slow

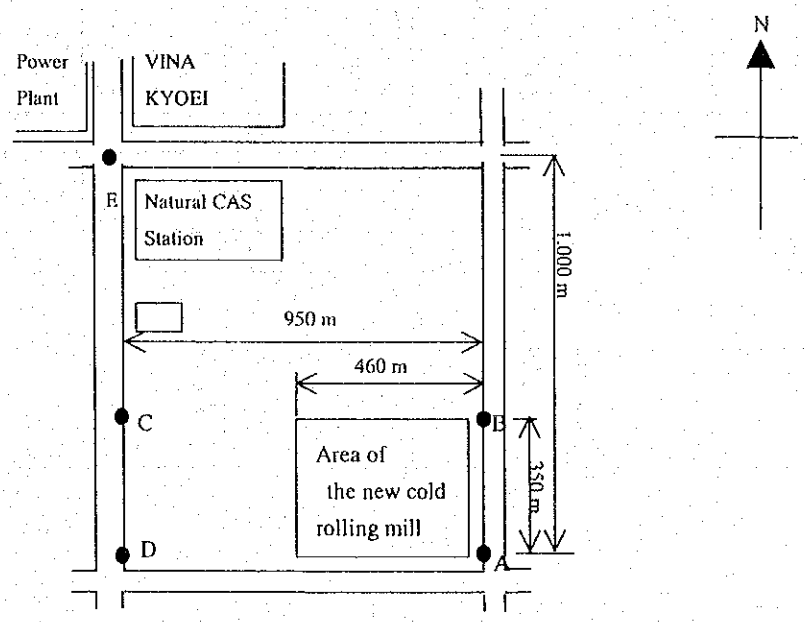


Fig. A-1-1 Noise Measuring Points Near Phu My Industrial Zone

1.2 Results of Noise Measurement

The results of the noise measurement are shown in Table A-1-1.

The results show Phu My Industrial Zone is very quiet. It can be concluded that the present noise level needs not to be considered in the noise simulation.

Table A-1-1 Results of Noise Measuring Near Phu My Industrial Zone (Unit : dB)

Measuring timing	Frequency adjustment	Measuring speed		Measuring points A	B	C	D	Remarks
Morning Time; 10-12	A weighting	Fast	Peak	38	37	39	35	bird singing and automobile running 50
			Ave.	36	34	37	33	
		Slow		36	35	38	34	
	Flat	Fast	Peak	68	68	76	73	
			Ave.	66	64	73	69	
		Slow		67	65	74	72	D windy 75
After-noon Time; 15	A weighting	Fast	Peak	44	43	43	42	
			Ave.	41	40	40	40	
		Slow		41	38	40	41	
	Flat	Fast	Peak	64	64	72	72	D windy 80
			Ave.	60	61	70	69	D windy 70
		Slow		63	63	70	68	
Night Time; 21	A weighting	Fast	Peak	42	44	46	40	
			Ave.	41	41	45	39	
		Slow		42	43	45	40	E point 55
	Flat	Fast	Peak	65	68	78	74	
			Ave.	61	65	74	70	
		Slow		62	67	76	72	E point 85
Mid-night Time; 23	A weighting	Fast	Peak	39	39	37	37	
			Ave.	35	37	36	36	
		Slow		37	38	37	36	
	Flat	Fast	Peak	63	66	73	67	
			Ave.	60	63	71	64	
		Slow		62	64	72	65	

2. Result of Soil Investigation

2.1 Outline of Investigation

The soil investigation for Feasibility Study on Steel Flat Product Mills was made at Phu My Industrial Park, Ba Ria-Vung Tau province. The field work was carried out from July 1st to 11th.

(1) Contractor

Enterprise for Construction Investigation and Mineral Exploration Exploitation (ECI-MEE) belonging to Union for Soil Investigation and Foundation Engineering (USIFE)

(2) Items of investigation

1) Field work

a) Drilling : 6 boreholes(LK1 to LK6) with a total depth 261.8m
b) Sampling : 43 undisturbed samples and 23 disturbed samples for laboratory test
: underground water samples
c) Standard Penetration Test (SPT) : every 1m with a total number of 250SPTs
d) Measurement : underground water level

2) Laboratory test

a) Natural water content
b) Specific gravity
c) Grain size analysis
d) Atterberg limits
e) Bulk density
f) Direct shear test
g) Unconfined compression test
h) Triaxial compression test
i) Chemical analysis of underground water

All of sampling and testing were made according to ASTM (American Society for Testing and Materials) standards.

(3) Location and Boring Logs

1) Fig.A-2-1 shows the location of 6 boreholes and Fig.A-2-2 to A-2-9 show the boring logs. Depth of each borehole is as follows ;

a) LK1 : 40.45m
b) LK2 : 40.45m
c) LK3 : 50.0m
d) LK4 : 50.0m
e) LK5 : 40.45m
f) LK6 : 40.45m

2.2 Results of Soil Investigation

(1)Soil characteristics

According to the field test and the laboratory test, soil characteristics of the investigation area can be classified into ten (10) layers. Table A-2-1 shows the detailed description of soil, thickness and N values. Table A-2-2 shows the other engineering data of soil for the detailed design.

Table A-2-1 Soil Characteristics and N value

Layer's No.	Soil Characteristics	Elevation		Thickness		N value (by SPT)	
		Top	Bottom	Min~ Max	Ave.	Min~ Max	Ave.
1	Surface Soil cultivated soil, very loose	+5.7~ +7.5m	+5.1~ +7.1m	0.4~ 0.6m	0.5 m	-	-
2	**Fat Clay** stiff to very stiff, mixed with gravel	+4.0~ +7.1m	-1.9~ +0.5m	5.5~ 7.6m	6.3m	7~20	12
3	**Clayey Sand** medium dense, mixed with coarse sand and gravel	-1.9~ +0.5m	-6.9~ -3.0m	1.8~ 6.0m	3.9m	9~31	12
4	**Lean Clay** stiff, mixed with organic matters (only encountered west part:LK1,3,5)	-5.0~ -4.4m	-8.9~ -7.9m	3.5~ 4.1m	3.7m	7~11	9
5	**Well graded Sand** medium dense, mixed with silty clay and coarse sand	-8.9~ -3.0m	-14.9~ -3.9m	0.9~ 8.0m	3.9 m	9~32	15
6	**Silty Clayey Sand** medium dense, mixed with silty clay and coarse sand	-14.9~ -3.9m	-32.9~ -23.5m	11.0~ 23.0m	16.1 m	10~45	17
7	**Organic Clay** stiff, mixed with thin layer organic matters	-32.9~ -23.5m	-35.4~ -25.0m	0.5~ 6.3m	2.6m	8~18	12
8	**Silty Clayey Sand** medium dense, mixed with coarse sand and gravel	-35.4~ -25.0m	-35.3~ -28.5m	1.9~ 9.0m	5.4m	11~42	19
9	**Fat Clay** stiff to very stiff	-35.4~ -25.0m	-39.5~ -38.9m	1.6~ 5.5m	3.6m	13~39	26
10	**Basalt Stone** very hard	-39.5~ -38.9m	-	-	-	>50	>50

Table A-2-2 Soil Data for Design

Layer's No.	Soil Characteristics	Thickness (m)	γ wet unit weigh(t/m³)		C Cohesion (t/m²)		Φ Angle of Internal Friction(°)		Cc Coefficient of consolidation	
			Min ~ Max	Ave.	Min ~ Max	Ave.	Min ~ Max	Ave.	Min ~ Max	Ave.
1	Surface Soil cultivated soil	0.5	-	-	-	-	-	-	-	-
2	**Fat Clay** stiff to very stiff	6.3	1.91 ~ 2.04	**1.98**	1.75 ~ 7.5	**4.90**	-	-	0.032	**0.032**
3	**Clayey Sand** medium dense	3.9	2.04 ~ 2.13	**2.09**	-	-	9° 56 ~ 30° 58	**14° 30**	-	-
4	**Lean Clay** stiff	3.7	1.92 ~ 2.03	**1.97**	1.50 ~ 3.0	**2.44**	-	-	0.14	**0.14**
5	**Well graded Sand** medium dense	3.9	2.06 ~ 2.12	**2.09**	-	-	24° 14 ~ 30° 58	**27° 36**	-	-
6	**Silty Clayey Sand** medium dense	16.1	1.99 ~ 2.19	**2.13**	-	-	27° 42 ~ 37° 53	**31° 54**	-	-
7	**Organic Clay** stiff	2.6	1.89 ~ 2.00	**1.96**	1.0 ~ 3.0	**1.97**	-	-	0.029 ~ 0.038	**0.034**
8	**Silty Clayey Sand** medium dense	16.1	2.0	**2.0**	-	-		**28° 49**	-	-
9	**Fat Clay** stiff to very stiff	2.6	1.93 ~ 2.05	**1.98**	3.0 ~ 6.0	**4.17**	-	-	0.11	**0.11**
10	**Basalt Stone** very hard	-				-	-	-	-	-

(2) Elevation of underground water

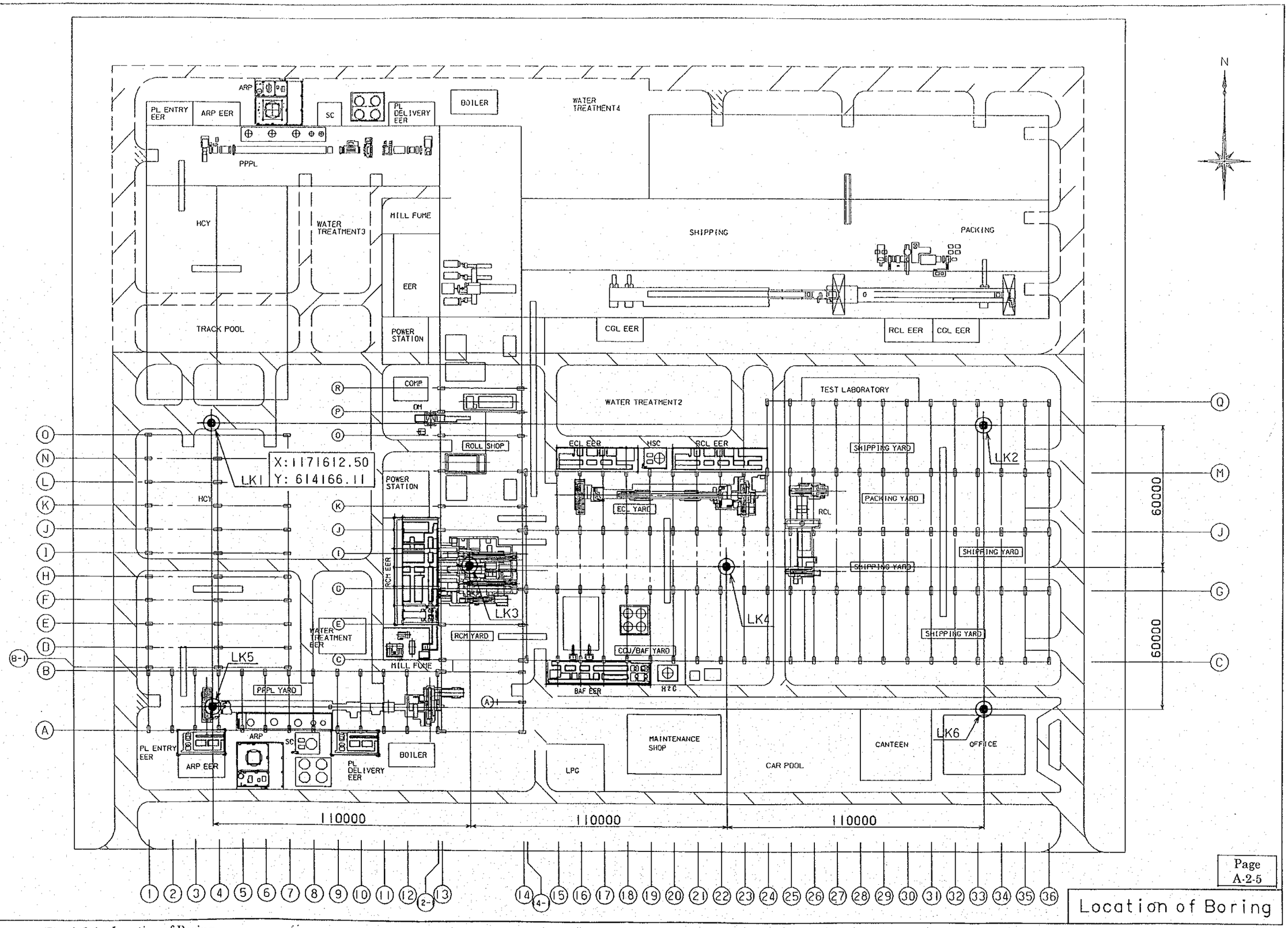
Table A-2-3 shows the underground water level measured at each borehole.

Table A-2-3 Elevation of underground water

Borehole No.	LK1	LK2	LK3	LK4	LK5	LK6	Ave.
Borehole Elevation	+5.70	+7.50	+5.70	+3.96	+6.09	+6.45	-
Underground Water Elevation	+2.90	+3.00	+2.92	+2.13	+2.15	+2.50	**+2.58**

(3) Evaluation results of soil Investigation

1) Generally speaking, soil condition of the investigated area is fairy good.
2) Except the first layer, N value is almost constant along the depth of soil layer and has high penetration resistance.
3) Especially the second and third layers possess high bearing capacity. Almost all foundation of the new cold rolling mill complex can be sustained by spread foundation (without pile) in these layers.
4) Study on bearing capacity is shown in pages V-5-9 and V-5-10 (Study on allowable capacity of soil at PHU MY).
5) In general, the consolidation settlement should be evaluated when utilizing spread foundations. In the case of this project, the objectives of evaluation is the second and fourth clay layers. However, consolidation settlement will not occur in this investigation area because the clay layers are very stiff (the value of cohesion is high and the coefficient of consolidation is very low).
6) Consequently, spread foundations (without pile) are strongly recommended for the new cold rolling mill complex.



Page
A-2-5

Location of Boring

Fig. A-2-1 Location of Boring

USIFE
General Directory

BOREHOLE LOG N^0 - HÌNH TRỤ LỖ KHOAN SỐ: LK1

PROJECT: SOIL INVESTIGATION FOR STEEL FLAT PRODUCT MILL (PHASE I: FEASIBILITY STUDY ON COLD ROLLING MILL)
LOCATION: PHU MY INDUSTRIAL PARK, BA RIA - VUNG TAU PROVINCE
CÔNG TRÌNH: KHẢO SÁT ĐẤT NỀN NHÀ MÁY SẢN XUẤT TẤM LỢP THÉP (GIAI ĐOẠN I: NGHIÊN CỨU KHẢ THI NHÀ MÁY CÁN NGUỘI)
ĐỊA ĐIỂM: KHU CÔNG NGHIỆP PHÚ MỸ, TỈNH BÀ RỊA - VŨNG TÀU

Prof.Dr.Sc. Pham Xuan

Drilling equipment - Thiết bị khoan:	XY-1 (Made in China)	Scale - Tỷ lệ:	1/200
Depth of borehole - Chiều sâu lỗ khoan:	40.45 m	Water level - Mực nước tĩnh:	2.80 m
Date - Thời gian thực hiện:	03/7/2000 - 06/7/2000	Co-ordinate - Toạ độ:	X= 1171612.50 m
Descripted by - Người mô tả:	Nguyễn Việt Cường		Y= 614166.11 m
Checked by - Người kiểm tra:	Mai Thăng Long		Z= 5.70 m

Number of layer Số hiệu lớp	Level of bottom layer Cao độ đáy lớp (m)	Depth of bottom layer	Thickness of layer Bề dày lớp (m)	STRATA LOG CỘT ĐỊA TẦNG	DESCRIPTION OF SOIL AND ROCK MÔ TẢ ĐẤT VÀ ĐÁ	STANDARD PENETRATION TEST (SPT) THÍ NGHIỆM XUYÊN TIÊU CHUẨN (SPT) Symbol / Ký hiệu; Number of blows/15cm / Số búa /15cm; N/30	Symbol and depth of soil samples Số hiệu và chiều sâu mẫu đất
1	+5.1	0.6	0.6		Made ground: Fill soil, clay, sandy clay, blackish grey, brownish grey, very loose Đất lấp: Sét, sét pha, xám đen, nâu đen, lẫn mùn thực vật, bở rời, tơi xốp.	SPT1 2 2 3 5 SPT2 3 3 5 8	
2	-0.5	6.2	5.6		Fat CLAY (CH), greenish grey, white grey, yellowish brown, stiff occasionally very stiff, mixed with gravel laterilic. Sét có tính dẻo cao (CH), màu xám xanh, xám trắng, nâu vàng, trạng thái dẻo cứng đôi khi nửa cứng, lẫn sạn sỏi laterit.	SPT3 3 5 7 12 SPT4 3 7 10 17 SPT5 5 10 19 29 SPT6 5 8 12 20	UD1:4.5-5.0 UD2:5.5-6.0
3	-4.8	10.5	4.3		Clayey SAND (SC), greenish grey, white grey, yellowish grey, medium dense, saturated water. Cát pha sét (SC), màu xám xanh, xám trắng, xám vàng, kết cấu chặt vừa, bão hoà nước.	SPT7 4 5 7 12 SPT8 4 4 6 10 SPT9 4 5 7 12 SPT10 4 6 9 15	UD3:6.5-7.0 UD4:10.5-11.0
4	-8.9	14.6	4.1		Lean CLAY (CL), black-greenish grey, light grey, mixed with organics matter, firm to stiff. Sét có tính dẻo thấp (CL), màu xám xanh nhạt, xám sáng, lẫn tàn tích thực vật, trạng thái dẻo mềm đến dẻo cứng.	SPT11 1 3 4 7 SPT12 3 4 5 9 SPT13 2 3 4 7 SPT14 2 3 5 8	UD5:11.8-12.0 UD6:12.5-13.0 UD7:13.5-14.0
5	-11.30	17.0	2.4		Well graded SAND with silty clay (SW-SC), yellowish brown, brownish red, yellowish grey, mixed with silty clay and medium to coarse sand, medium dense, saturated water. Cát cấp phối tốt lẫn sét pha bụi (SW-SC), nâu vàng, đỏ nâu, xám vàng, lẫn ổ sét pha và cát hạt trung đến thô, kết cấu chặt vừa, bão hoà nước.	SPT15 5 7 12 19 SPT16 4 9 11 20 SPT17 4 5 5 10	SPT17-17-17.45
6	-23.7	29.4	12.4		Silty clayey SAND (SM-SC), yellowish brown, brownish red, yellowish grey, mixed with silty clay and medium to coarse sand, medium dense, saturated water. Cát pha sét và bụi (SM-SC), nâu vàng, đỏ nâu, xám vàng, lẫn ổ sét pha và cát hạt trung đến thô, kết cấu chặt vừa, bão hoà nước.	SPT18 2 4 7 11 SPT19 4 5 6 11 SPT20 3 5 7 12 SPT21 3 5 8 13 SPT22 3 6 6 12 SPT23 4 6 7 13 SPT24 5 6 8 14 SPT25 7 8 9 17 SPT26 5 6 8 14 SPT27 6 7 8 15 SPT28 6 8 8 16 SPT29 6 12 18 30	SPT22-22-22.45 UD8:25.5-26.0
7	-30.0	35.7	6.3		Organic CLAY (OL), light grey, darkish grey, mixed with thin layer of organics matter, stiff. Sét hữu cơ (OL), màu xám ghi, xám tối, đôi chỗ xen kẹp các lớp mỏng tàn tích thực vật, trạng thái dẻo cứng.	SPT30 2 3 5 8 SPT31 3 4 4 8 SPT32 4 4 5 9 SPT33 3 4 5 9 SPT34 4 5 7 12 SPT35 4 6 6 12	UD9:33.5-34.0
8	-34.75	40.45	4.75		Silty clayey SAND (SM-SC), light yellow, yellowish brown, greenish grey, darkish grey, mixed with much quartz gravel and coarse sand, medium dense, saturated water. Cát pha bụi và sét, màu vàng nhạt, nâu vàng, xám xanh, xám tối, chứa nhiều sạn sỏi và cát hạt thô, kết cấu chặt vừa, bão hoà nước.	SPT36 4 5 6 11 SPT37 5 6 8 14 SPT38 5 6 9 15 SPT39 5 6 8 14 SPT40 7 8 11 19	

SPT GRAPH
ĐỒ THỊ SPT
0 10 20 30 40 50
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0 22.0 24.0 26.0 28.0 30.0 32.0 34.0 36.0 38.0 40.0

Fig. A-2-2 Boring Log : LK1

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General Directory

BOREHOLE LOG N^0 - HÌNH TRỤ LỖ KHOAN SỐ: LK2

PROJECT: SOIL INVESTIGATION FOR STEEL FLAT PRODUCT MILL (PHASE I: FEASIBILITY STUDY ON COLD ROLLING MILL)
LOCATION: PHU MY INDUSTRIAL PARK, BA RIA - VUNG TAU PROVINCE
CÔNG TRÌNH: KHẢO SÁT ĐẤT NỀN NHÀ MÁY SẢN XUẤT TẤM LOẠI THÉP (GIAI ĐOẠN I: NGHIÊN CỨU KHẢ THI NHÀ MÁY CÁN LẠNH)
ĐỊA ĐIỂM: KHU CÔNG NGHIỆP PHÚ MỸ, TỈNH BÀ RỊA - VŨNG TÀU

Prof.Dr.Sc. Pham Xuan

Drilling equipment - Thiết bị khoan:	XY-1 (Made in China)	Scale - Tỷ lệ:	1/200
Depth of borehole - Chiều sâu lỗ khoan:	40.45 m	Water level - Mực nước lỉnh:	4.60 m
Date : Thời gian thực hiện:	09/7/2000 - 10/7/2000	Co-ordinate - Toạ độ:	X= 1171612.50 m
Descripted by - Người mô tả:	Nguyễn Kim Cương		Y= 614496.11 m
Checked by - Người kiểm tra:	Nguyễn Việt Cường		Z= 7.50 m

Number of layer Số hiệu lớp	Level of bottom layer Cao độ đáy lớp (m)	Depth of bottom layer	Thickness of layer Bề dày lớp (m)	STRATA LOG CỘT ĐỊA TẦNG	DESCRIPTION OF SOIL AND ROCK MÔ TẢ ĐẤT VÀ ĐÁ	STANDARD PENETRATION TEST (SPT) THÍ NGHIỆM XUYÊN TIÊU CHUẨN (SPT)					Symbol and depth of soil samples Số hiệu và chiều sâu mẫu đất
						Depth Độ sâu	Number of blows/15cm Số búa /15cm			N/30	
1	+7.10	0.4	0.4		Made ground: Fill soil, clay, sandy clay, blackish grey, brownish grey, very loose. Đất lấp: Sét, sét pha, xám đen, nâu đen, lẫn mùn thực vật, bở rời, lỏi xốp.	SPT1	3	4	5	9	
						SPT2	4	5	5	10	
						SPT3	4	5	6	11	
2			6,6		Fat CLAY (CH), greenish grey, white grey, yellowish brown, stiff occasionally very stiff, mixed with gravel laterilic. Sét có tính dẻo cao (CH), màu xám xanh, xám trắng, nâu vàng, trạng thái dẻo cứng đôi khi nửa cứng, lẫn sạn sỏi laterit.	SPT4	3	4	6	10	
						SPT5	4	5	6	11	UD1:4.8-5.0
	+0.50	7.0				SPT6	3	5	6	11	
						SPT7	3	5	6	11	UD2:7.8-8.0
3			3.5		Clayey SAND (SC), greenish grey, white grey, yellowish grey, medium dense, saturated water. Cát pha sét (SC), màu xám xanh, xám trắng, xám vàng, kết cấu chặt vừa, bão hoà nước.	SPT8	3	4	5	9	
						SPT9	3	4	6	10	SPT9:9.0-9.45
	-3.00	10.5				SPT10	3	4	5	9	
5	-3,90	11.4	0,9			SPT11	4	5	6	11	UD3:11.45-12.0
					Well graded SAND with silty clay (SW-SC), yellowish brown, brownish red, yellowish grey, mixed with silty clay and medium to coarse sand, medium dense, saturated water. Cát cấp phối tốt lẫn sét pha bụi (SW-SC), nâu vàng, đỏ nâu, xám vàng, lẫn ổ sét pha và cát hạt trung đến thô, kết cấu chặt vừa, bão hoà nước.	SPT12	4	5	9	14	
						SPT13	4	6	8	14	
						SPT14	4	6	9	15	
						SPT15	4	5	6	11	SPT15:15-15.45
						SPT16	4	6	6	12	
						SPT17	3	6	8	14	
						SPT18	4	7	8	15	
						SPT19	4	7	8	15	UD4:18.45-19
					Silty clayey SAND (SM-SC), yellowish brown, brownish red, yellowish grey, mixed with silty clay and medium to coarse sand, medium dense, saturated water. Cát pha sét và bụi (SM-SC), nâu vàng, đỏ nâu, xám vàng, lẫn ổ sét pha và cát hạt trung đến thô, kết cấu chặt vừa, bão hoà nước.	SPT20	4	6	8	14	
6			21,1			SPT21	3	6	9	15	
						SPT22	4	7	10	17	SPT22:22-22.45
						SPT23	3	9	9	18	
						SPT24	8	15	30	45	
					Organic CLAY (OL), light grey, darkish grey, mixed with thin layer of organics matter, stiff. Sét hữu cơ (OL), màu xám ghi, xám tối, đôi chỗ xen kẹp các lớp mỏng tàn tích thực vật, trạng thái dẻo cứng.	SPT25	4	4	6	10	
						SPT26	3	4	7	11	UD5:26.45-27
						SPT27	3	5	6	11	
						SPT28	3	6	8	14	
					Silty clayey SAND (SM-SC), light yellow, yellowish brown, greenish grey, darkish grey, mixed with much quartz gravel and coarse sand, medium dense, saturated water. Cát pha bụi và sét, màu vàng nhạt, nâu vàng, xám xanh, xám tối, chứa nhiều sạn sỏi và cát hạt thô, kết cấu chặt vừa, bão hoà nước.	SPT29	3	7	11	18	
						SPT30	4	8	11	19	SPT30:30-30.45
	-25.0	32.5				SPT31	3	8	13	21	
7	-25.5	33.0	0.5			SPT32	4	5	7	12	
						SPT33	3	4	8	12	UD6:33.45-34.0
8			3.0			SPT34	3	5	8	13	
	-28.5	36.0				SPT35	4	5	8	13	
						SPT36	4	5	8	13	
					Fat CLAY (CH), light-greenish grey, darkish grey, stiff to very stiff. Sét có tính dẻo cao (CH), màu xám ghi, xám tối, trạng thái dẻo cứng đến nửa cứng.	SPT37	5	6	9	15	
9			4.45			SPT38	5	7	11	18	
						SPT39	5	6	12	18	UD7:38.45-39.0
	-32.95	40.45				SPT40	6	8	12	20	

SPT GRAPH
ĐỒ THỊ SPT

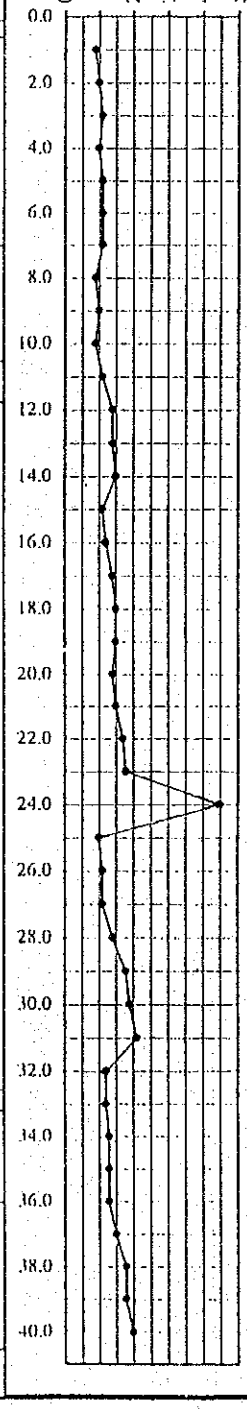


Fig. A-2-3 Boring Log : LK2

USIFE
General Directory

BOREHOLE LOG N^0 - HÌNH TRỤ LỖ KHOAN SỐ: LK3

PROJECT: SOIL INVESTIGATION FOR STEEL FLAT PRODUCT MILL (PHASE I: FEASIBILITY STUDY ON COLD ROLLING MILL)
LOCATION: PHU MY INDUSTRIAL PARK, BA RIA - VUNG TAU PROVINCE
CÔNG TRÌNH: KHẢO SÁT ĐẤT NỀN NHÀ MÁY SẢN XUẤT TẤM LỢP THÉP (GIAI ĐOẠN I: NGHIÊN CỨU KHẢ THI NHÀ MÁY CÁN LẠNH)
ĐỊA ĐIỂM: KHU CÔNG NGHIỆP PHÚ MỸ, TỈNH BÀ RỊA - VŨNG TÀU

Prof.Dr.Sc. Pham Xuan

Drilling equipment - Thiết bị khoan:	XY-1 (Made in China)	Scale - Tỷ lệ:	1/200
Depth of borehole - Chiều sâu lỗ khoan:	40.45 m	Water level - Mực nước lĩnh:	1.04 m
Date - Thời gian thực hiện:	07/7/2000 - 09/7/2000	Co-ordinate - Toạ độ:	X= 1172512.50 m
Descripled by - Người mô tả:	Nguyễn Kim Cương		Y= 614276.96 m
Checked by - Người kiểm tra:	Nguyễn Việt Cường		Z= 3.96 m

Number of layer Số hiệu lớp	Level of bottom layer Cao độ đáy lớp (m)	Depth of bottom layer	Thickness of layer Bề dày lớp (m)	STRATA LOG CỘT ĐỊA TẦNG	DESCRIPTION OF SOIL AND ROCK MÔ TẢ ĐẤT VÀ ĐÁ	Depth Độ sâu	Number of blows/15cm Số búa /15cm			N/30	Symbol and depth of soil samples Số hiệu và chiều sâu mẫu đất
2	-1.54	5.5	5,5		Fat CLAY (CH), greenish grey, white grey, yellowish brown, stiff occasionally very stiff, mixed with gravel laterilic. Sét có tính dẻo cao (CH), màu xám xanh, xám trắng, nâu vàng, trạng thái dẻo cứng đôi khi nửa cứng, lẫn sạn sỏi laterit.	SPT1	2	4	5	9	
						SPT2	4	6	8	14	
						SPT3	4	5	9	14	UD1:2.8-3.0
						SPT4	4	4	5	9	
						SPT5	6	8	9	17	
3	-5.04	9.0	3.5		Clayey SAND (SC), greenish grey, white grey, yellowish grey, medium dense, saturated water. Cát pha sét (SC), màu xám xanh, xám trắng, xám vàng, kết cấu chặt vừa, bão hoà nước.	SPT6	7	11	12	23	UD2:5.8-6.0
						SPT7	5	8	10	18	
						SPT8	7	9	11	20	
4	-8.54	12.5	3,5		Lean CLAY (CL), black-greenish grey, light grey, mixed with organics matter, stiff. Sét có tính dẻo thấp (CL), màu xám xanh nhạt, xám sáng, lẫn tàn tích thực vật, trạng thái dẻo cứng.	SPT9	3	4	7	11	
						SPT10	3	4	5	9	
						SPT11	3	4	5	9	UD3:11.8-12.0
						SPT12	3	4	6	10	
5	-12,54	16,5	4,0		Well graded SAND with silty clay (SW-SC), yellowish brown, brownish red, yellowish grey, mixed with silty clay and medium to coarse sand, medium dense to dense, saturated water. Cát cấp phối tốt lẫn sét pha bụi (SW-SC), nâu vàng, đỏ nâu, xám vàng, lẫn ổ sét pha và cát hạt trung đến thô, kết cấu chặt vừa đến chặt, bão hoà nước.	SPT13	6	>50			
						SPT14	4	11	21	32	
						SPT15	2	5	8	13	
						SPT16	4	7	9	16	SPT16:16-16.45
6	-23.54	27.5	11,0		Silty clayey SAND (SM-SC), yellowish brown, brownish red, yellowish grey, mixed with silty clay and medium to coarse sand, medium dense, saturated water. Cát pha sét và bụi (SM-SC), nâu vàng, đỏ nâu, xám vàng, lẫn ổ sét pha và cát hạt trung đến thô, kết cấu chặt vừa, bão hoà nước.	SPT17	4	5	9	14	
						SPT18	4	5	8	13	
						SPT19	5	4	9	13	
						SPT20	4	6	9	15	UD4:20.45-21.0
						SPT21	5	7	9	16	
						SPT22	3	5	9	14	
						SPT23	3	5	11	16	
						SPT24	4	9	11	20	
						SPT25	4	7	8	15	SPT25:25-25.45
						SPT26	3	6	8	14	
						SPT27	4	8	8	16	
7	-25.04	29.0	1.5		Organic CLAY (OL), light grey, darkish grey, mixed with thin layer of organics matter, stiff. Sét hữu cơ (OL), màu xám ghi, xám tối, dồi chỗ xen kẹp các lớp mỏng tàn tích thực vật, trạng thái dẻo cứng.	SPT28	5	6	7	13	UD528.45-28.85
						SPT29	4	6	8	14	
8	-34.04	38.0	9.0		Silty clayey SAND (SM-SC), light yellow, yellowish brown, greenish grey, darkish grey, mixed with much quartz gravel and coarse sand, medium dense, saturated water. Cát pha bụi và sỏi, màu vàng nhạt, nâu vàng, xám xanh, xám tối, chứa nhiều sạn sỏi và cát hạt thô, kết cấu chặt vừa, bão hoà nước.	SPT30	4	6	9	15	
						SPT31	4	7	10	17	
						SPT32	3	9	10	19	
						SPT33	3	9	11	20	
						SPT34	3	9	11	20	
						SPT35	5	8	15	23	
						SPT36	5	6	8	14	SPT36:36-36.45
						SPT37	5	5	8	13	
9			5.5		Fat CLAY (CH), light-greenish grey, darkish grey, very stiff to hard. Sét có tính dẻo cao (CH), màu xám ghi, xám tối, trạng thái nửa cứng đến cứng	SPT38	5	7	8	15	UD6:38.45-39.0
						SPT39	9	13	22	35	
						SPT40	10	13	24	37	
						SPT41	12	17	17	34	

STANDARD PENETRATION TEST (SPT)
THÍ NGHIỆM XUYÊN TIÊU CHUẨN (SPT)

SPT GRAPH
ĐỒ THỊ SPT

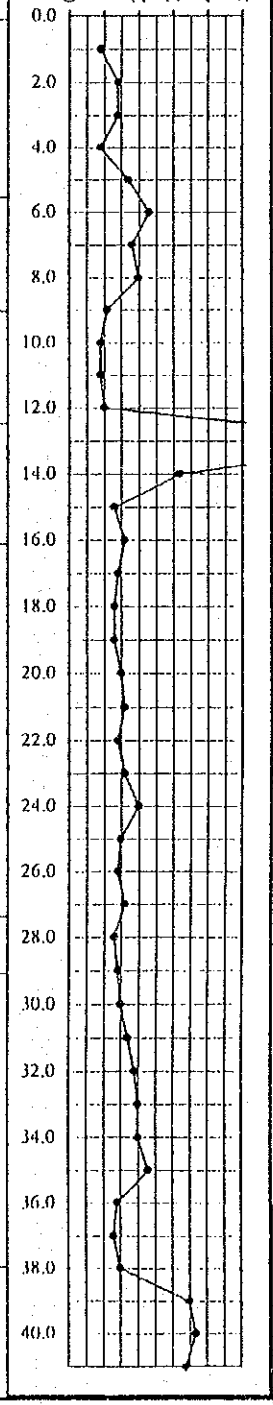


Fig. A-2-4 Boring Log : LK3(1)

USIFE
General Directory

BOREHOLE LOG N^0 - HÌNH TRỤ LỖ KHOAN SỐ: LK3

PROJECT: SOIL INVESTIGATION FOR STEEL FLAT PRODUCT MILL (PHASE I: FEASIBILITY STUDY ON COLD ROLLING MILL)
LOCATION: PHU MY INDUSTRIAL PARK, BA RIA - VUNG TAU PROVINCE
CÔNG TRÌNH: KHẢO SÁT ĐẤT NỀN NHÀ MÁY SẢN XUẤT TẤM LỢP THÉP (GIAI ĐOẠN I: NGHIÊN CỨU KHẢ THI NHÀ MÁY CÁN LẠNH)
ĐỊA ĐIỂM: KHU CÔNG NGHIỆP PHÚ MỸ, TỈNH BÀ RỊA - VŨNG TÀU

Prof.Dr.Sc. Pham Xuan

Drilling equipment - Thiết bị khoan: XY-1 (Made in China)
Depth of borehole - Chiều sâu lỗ khoan: 40.45 m
Date - Thời gian thực hiện: 07/7/2000 - 09/7/2000
Descripted by - Người mô tả: Nguyễn Kim Cương
Checked by - Người kiểm tra: Nguyễn Việt Cường

Scale - Tỷ lệ: 1/200
Water level - Mực nước tĩnh: 1.04 m
Co-ordinate - Toạ độ: X= 1172512.50 m
Y= 614276.96 m
Z= 3.96 m

Number of layer Số hiệu lớp	Level of bottom layer Cao độ đáy lớp (m)	Depth of bottom layer Độ sâu đáy lớp (m)	Thickness of layer Bề dày lớp (m)	STRATA LOG CỘT ĐỊA TẦNG	DESCRIPTION OF SOIL AND ROCK MÔ TẢ ĐẤT VÀ ĐÁ	STANDARD PENETRATION TEST (SPT) THÍ NGHIỆM XUYÊN TIÊU CHUẨN (SPT)					Symbol and depth of soil samples Số hiệu và chiều sâu mẫu đất
						Depth Độ sâu	Number of blows/15cm Số búa /15cm			N/30	
9	-39.54	43.5	5.5		Fat CLAY (CH), light-greenish grey, darkish grey, stiff to very stiff. Sét có tính dẻo cao (CH), màu xám ghi, xám tối, trạng thái dẻo cứng đến nửa cứng	SPT39	9	13	22	35	
						SPT40	10	13	24	37	
						SPT41	12	17	17	34	
						SPT42	10	12	22	34	
						SPT43	11	14	25	39	
10	-46.04	50.0	6.5		BAZAN, strongly weathered, strongly fractured, light-greenish grey, darkish grey, very hard. Đá bazan, phong hoá mạnh, nứt nẻ mạnh, màu xám ghi, xám tối, rất rắn chắc	SPT44	22	>50			
						SPT45	27	>50			

SPT GRAPH
ĐỒ THỊ SPT

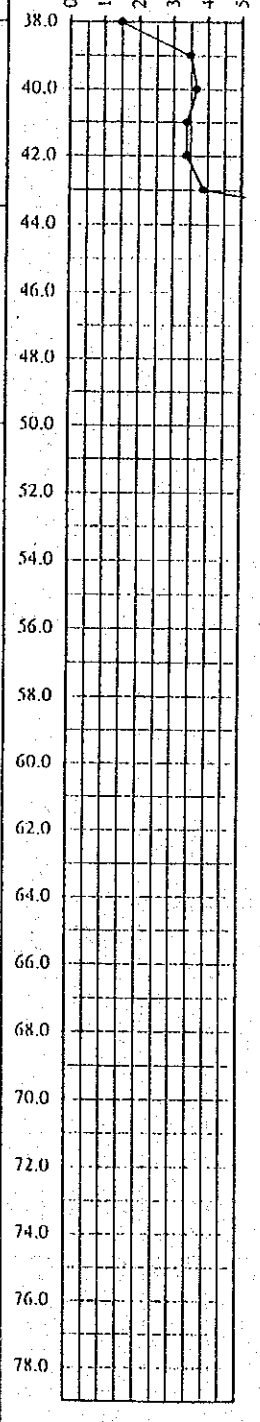


Fig. A-2-5 Boring Log : LK3(2)

USIFE
General Directory

BOREHOLE LOG N^0 - HÌNH TRỤ LỖ KHOAN SỐ: LK4

PROJECT: SOIL INVESTIGATION FOR STEEL FLAT PRODUCT MILL (PHASE I: FEASIBILITY STUDY ON COLD ROLLING MILL)
LOCATION: PHU MY INDUSTRIAL PARK, BA RIA - VUNG TAU PROVINCE
CÔNG TRÌNH: KHẢO SÁT ĐẤT NỀN NHÀ MÁY SẢN XUẤT TẤM LỢP THÉP (GIAI ĐOẠN I: NGHIÊN CỨU KHẢ THI NHÀ MÁY CÁN LẠNH)
ĐỊA ĐIỂM: KHU CÔNG NGHIỆP PHÚ MỸ, TỈNH BÀ RỊA - VŨNG TÀU

Prof.Dr.Sc. Pham Xuan

Drilling equipment - Thiết bị khoan: XY-1 (Made in China)
Scale - Tỷ lệ: 1/200
Depth of borehole - Chiều sâu lỗ khoan: 50.0
Water level - Mực nước tĩnh: 3.96 m
Date - Thời gian thực hiện: 05/7/2000 - 07/7/2000
Co-ordinate - Toạ độ: X= 1171552.50 m
Descripted by - Người mô tả: Nguyễn Kim Cương
Y= 61436.11 m
Checked by - Người kiểm tra: Nguyễn Việt Cường
Z= 6.09 m

Number of layer Số hiệu lớp	Level of bottom layer Cao độ đáy lớp (m)	Depth of bottom layer	Thickness of layer Bề dày lớp (m)	STRATA LOG CỘT ĐỊA TẦNG	DESCRIPTION OF SOIL AND ROCK MÔ TẢ ĐẤT VÀ ĐÁ	Depth Độ sâu	Number of blows/15cm Số búa /15cm			N30	Symbol and depth of soil samples Số hiệu và chiều sâu mẫu đất
1	+5.59	0.5	0.5		Made ground. Fill soil: clay, sandy clay, blackish grey, brownish grey, very loose Đất lấp: Sét, sét pha, xám đen, nâu đen, lẫn mùn thực vật, bở rời, lơi xốp.	SPT1	2	2	4	6	
						SPT2	2	3	4	7	
2	-0.91	7.0	6,5		Fat CLAY (CH), greenish grey, white grey, yellowish brown, stiff occasionally very stiff, mixed with gravel lateritic. Sét có tính dẻo cao (CH), màu xám xanh, xám trắng, nâu vàng, trạng thái dẻo cứng đôi khi nửa cứng, lẫn sạn sỏi laterit.	SPT3	5	7	8	15	UD1:2.6-2.8
						SPT4	5	6	9	15	
						SPT5	3	3	5	8	UD2:5.5-6.0
						SPT6	4	4	6	10	
3	-6.91	13.0	6.0		Clayey SAND (SC), greenish grey, white grey, yellowish grey, medium dense, saturated water. Cát pha sét (SC), màu xám xanh, xám trắng, xám vàng, kết cấu chặt vừa, bão hoà nước.	SPT7	4	4	5	9	
						SPT8	3	4	5	9	
						SPT9	2	4	4	8	
						SPT10	2	4	4	8	UD3:9.50-10.0
						SPT11	3	4	5	9	
						SPT12	2	3	3	6	UD4:12.6-12.8
5	-14.91	21.0	8.0		Well graded SAND with silty clay (SW-SC), yellowish brown, brownish red, yellowish grey, mixed with silty clay and medium to coarse sand, medium dense, saturated water. Cát cấp phối tốt lẫn sét pha bụi (SW-SC), nâu vàng, đỏ nâu, xám vàng, lẫn ổ sét pha và cát hạt trung đến thô, kết cấu chặt vừa, bão hoà nước.	SPT13	1	1	4	5	
						SPT14	3	4	5	9	
						SPT15	3	5	7	12	
						SPT16	4	6	6	12	SPT16:16-16.45
						SPT17	3	7	6	13	
						SPT18	4	5	7	12	
						SPT19	3	5	7	12	
						SPT20	5	6	8	14	UD5:20.45-21.0
6	-32.91	39.0	18,0		Silty clayey SAND (SM-SC), yellowish brown, brownish red, yellowish grey, mixed with silty clay and medium to coarse sand, medium dense to very dense, saturated water. Cát pha sét và bụi (SM-SC), nâu vàng, đỏ nâu, xám vàng, lẫn ổ sét pha và cát hạt trung đến thô, kết cấu chặt vừa đến rất chặt, bão hoà nước.	SPT21	6	7	10	17	
						SPT22	2	7	10	17	
						SPT23	4	7	11	18	
						SPT24	8	10	9	19	
						SPT25	12	25	28	63	
						SPT26	4	5	6	11	
						SPT27	4	4	5	9	
						SPT28	4	4	5	9	SPT28:28-28.45
						SPT29	7	11	11	22	
						SPT30	6	9	10	19	
						SPT31	7	9	13	22	
						SPT32	6	9	13	22	
						SPT33	5	11	15	26	
						SPT34	5	10	14	24	
						SPT35	4	9	14	23	
						SPT36	6	11	13	24	
						SPT37	5	11	12	23	UD6:37.45-38.0
						SPT38	2	3	4	7	
7			2.5		Organic CLAY (OL), light grey, darkish grey, mixed with thin layer of organics matter, stiff. Sét hữu cơ (OL), màu xám ghi, xám tối, đôi chỗ xen kẹp các lớp mỏng tàn tích thực vật, trạng thái dẻo cứng.	SPT39	4	7	8	15	
						SPT40	6	8	10	18	UD7:39.45-40.0

SPT GRAPH
ĐỒ THỊ SPT
0 10 20 30 40 50
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0 22.0 24.0 26.0 28.0 30.0 32.0 34.0 36.0 38.0 40.0

Fig. A-2-6 Boring Log : LK4(1)

USIFE
General Directory

BOREHOLE LOG N^0 - HÌNH TRỤ LỖ KHOAN SỐ: LK4

PROJECT: SOIL INVESTIGATION FOR STEEL FLAT PRODUCT MILL (PHASE I: FEASIBILITY STUDY ON COLD ROLLING MILL)
LOCATION: PHU MY INDUSTRIAL PARK, BA RIA - VUNG TAU PROVINCE
CÔNG TRÌNH: KHẢO SÁT ĐẤT NỀN NHÀ MÁY SẢN XUẤT TẤM LỢP THÉP (GIAI ĐOẠN I: NGHIÊN CỨU KHẢ THI NHÀ MÁY CÁN LẠNH)
ĐỊA ĐIỂM: KHU CÔNG NGHIỆP PHÚ MỸ, TỈNH BÀ RỊA - VŨNG TÀU

Prof.Dr.Sc. Pham Xuan

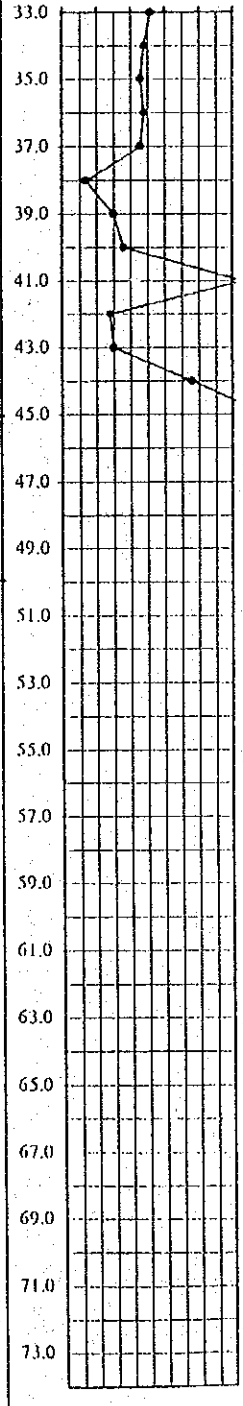
Drilling equipment - Thiết bị khoan:	XY-1 (Made in China)	Scale - Tỷ lệ:	1/200
Depth of borehole - Chiều sâu lỗ khoan:	50.0	Water level - Mực nước lỉnh:	3.96 m
Date - Thời gian thực hiện:	05/7/2000 - 07/7/2000	Co-ordinate - Toạ độ:	X= 1171552.50 m
Descripted by - Người mô tả:	Nguyễn Kim Cương		Y= 61436.11 m
Checked by - Người kiểm tra:	Nguyễn Việt Cường		Z= 6.09 m

Number of layer Số hiệu lớp	Level of bottom layer Cao độ đáy lớp (m)	Depth of bottom layer Độ sâu đáy lớp (m)	Thickness of layer Bề dày lớp (m)	STRATA LOG CỘT ĐỊA TẦNG	DESCRIPTION OF SOIL AND ROCK MÔ TẢ ĐẤT VÀ ĐÁ
6	-32.91	39.0	26.0		Silty clayey SAND (SM-SC), yellowish brown, brownish red, yellowish grey, mixed with silty clay and medium to coarse sand, medium dense to very dense, saturated water. Cát pha sét và bụi (SM-SC), nâu vàng, đỏ nâu, xám vàng, lẫn ổ sét pha và cát hạt trung đến thô, kết cấu chặt vừa đến rất chặt, bão hoà nước.
7	-35.41	41.5	2.5		Organic CLAY (OL), light grey, darkish grey, mixed with thin layer of organics matter, very stiff to hard. Sét hữu cơ (OL), màu xám ghi, xám tối, đôi chỗ xen kẹp các lớp mỏng tàn tích thực vật, trạng thái nửa cứng đến cứng.
8	-37.31	43.4	1.9		
9	-38.91	45.0	1.6		Silty clayey SAND (SM-SC), light yellow, yellowish brown, greenish grey, darkish grey, mixed with much quartz gravel and coarse sand, medium dense, saturated water. Cát pha bụi và sét, màu vàng nhạt, nâu vàng xám xanh, xám tối, chứa nhiều sạn sỏi và cát hạt thô, kết cấu chặt vừa, bão hoà nước.
10	-43.91	50.0	5.0		Fat CLAY (CH), light-greenish grey, darkish grey, stiff to very stiff. Sét có tính dẻo cao (CH), màu xám ghi, xám tối, trạng thái dẻo cứng đến nửa cứng
					BAZAN, strongly weathered, strongly fractured, light-greenish grey, darkish grey, very hard. Đá bazan, phong hoá mạnh, nứt nẻ mạnh, màu xám ghi, xám tối, rất rắn chắc

STANDARD PENETRATION TEST (SPT)
THÍ NGHIỆM XUYÊN TIÊU CHUẨN (SPT)

Depth Độ sâu	Number of blows/15cm Số búa /15cm			N/30
SPT34	5	10	14	24
SPT35	4	9	14	23
SPT36	6	11	13	24
SPT37	5	11	12	23
~~SPT38~~	~~2~~	~~3~~	~~4~~	~~7~~
SPT39	4	7	8	15
SPT40	6	8	10	18
SPT41	10	20	33	53
SPT42	3	6	8	14
SPT43	5	7	8	15
SPT44	8	15	23	38
~~SPT45~~	~~20~~	~~>50~~		

SPT GRAPH
ĐỒ THỊ SPT



Symbol and depth of soil samples
Số hiệu và chiều sâu mẫu đất

UD8:44.5-45.0

Fig. A-2-7 Boring Log : LK4(2)

USIFE
General Directory

BOREHOLE LOG N^0 - HÌNH TRỤ LỖ KHOAN SỐ: LK5

PROJECT: SOIL INVESTIGATION FOR STEEL FLAT PRODUCT MILL (PHASE I: FEASIBILITY STUDY ON COLD ROLLING MILL)
LOCATION: PHU MY INDUSTRIAL PARK, BA RIA - VUNG TAU PROVINCE
CÔNG TRÌNH: KHẢO SÁT ĐẤT NỀN NHÀ MÁY SẢN XUẤT TẤM LỢP THÉP (GIAI ĐOẠN I: NGHIÊN CỨU KHẢ THI NHÀ MÁY CÁN LẠNH)
ĐỊA ĐIỂM: KHU CÔNG NGHIỆP PHÚ MỸ, TỈNH BÀ RỊA - VŨNG TÀU

Prof.Dr.Sc. Pham Xuan

Drilling equipment - Thiết bị khoan:	XY-1 (Made in China)	Scale - Tỷ lệ:	1/200
Depth of borehole - Chiều sâu lỗ khoan:	40.45 m	Water level - Mực nước tĩnh:	4.30
Date - Thời gian thực hiện:	07/7/2000 - 09/7/2000	Co-ordinate - Toạ độ:	X= 1171492.50 m
Descripted by - Người mô tả:	Nguyễn Việt Cường		Y= 614166.12 m
Checked by - Người kiểm tra:	Mai Thăng Long		Z= 6.45 m

Number of layer Số hiệu lớp	Level of bottom layer Cao độ đáy lớp (m)	Depth of bottom layer	Thickness of layer Bề dày lớp (m)	STRATA LOG CỘT ĐỊA TẦNG	DESCRIPTION OF SOIL AND ROCK MÔ TẢ ĐẤT VÀ ĐÁ	STANDARD PENETRATION TEST (SPT) THÍ NGHIỆM XUYÊN TIÊU CHUẨN (SPT)					Symbol and depth of soil samples Số hiệu và chiều sâu mẫu đất
						Depth Độ sâu	Number of blows/15cm Số búa /15cm			N/30	
1	+5.95	0.5	0.5		Made ground: Fill soil, clay, sandy clay, blackish grey, brownish grey, very loose Đất lấp: Sét, sét pha, xám đen, nâu đen, lẫn mùn thực vật, bở rời, lỏi xốp.	SPT1	2	3	4	7	
						SPT2	3	5	7	12	
2			5,8		Fat CLAY (CH), greenish grey, white grey, yellowish brown, stiff occasionally very stiff, mixed with gravel lateritic Sét có tính dẻo cao (CH), màu xám xanh, xám trắng, nâu vàng, trạng thái dẻo cứng đôi khi nửa cứng, lẫn sạn sỏi laterit.	SPT3	4	6	8	14	
						SPT4	4	7	9	16	
						SPT5	5	6	10	16	
	+0.15	6.3				SPT6	3	5	9	14	
3			4.5		Clayey SAND (SC), greenish grey, white grey, yellowish grey, medium dense, saturated water. Cát pha sét (SC), màu xám xanh, xám trắng, xám vàng, kết cấu chặt vừa, bão hoà nước.	SPT7	1	2	3	5	
						SPT8	4	4	6	10	SPT8:8.0-8.45
						SPT9	6	6	8	14	UD1:8.8-9.0
	-4.35	10.8				SPT10	12	15	16	31	SPT10:10-10.45
4			3.5		Lean CLAY (CL), black-greenish grey, light grey, mixed with organics matter, stiff. Sét có tính dẻo thấp (CL), màu xám xanh nhạt, xám sáng, lẫn tàn tích thực vật, trạng thái dẻo cứng.	SPT11	3	4	4	8	
						SPT12	4	4	5	9	
						SPT13	3	4	5	9	UD2:12.8-13.0
	-7.85	14.3				SPT14	3	>50			
5			4,7		Well graded SAND with silty clay (SW-SC), yellowish brown, brownish red, yellowish grey, mixed with silty clay and medium to coarse sand, medium dense, saturated water. Cát cấp phối tốt lẫn sét pha bụi (SW-SC), nâu vàng, đỏ nâu, xám vàng, lẫn ổ sét pha và cát hạt trung đến thô, kết cấu chặt vừa, bão hoà nước.	SPT15	5	7	11	18	SPT15:15-15.45
						SPT16	3	8	12	20	
						SPT17	5	7	12	19	
	-12.55	19.0				SPT18	5	7	11	18	SPT18:18-18.45
6			11.2		Silty clayey SAND (SM-SC), yellowish brown, brownish red, yellowish grey, mixed with silty clay and medium to coarse sand, medium dense to very dense, saturated water. Cát pha sét và bụi (SM-SC), nâu vàng, đỏ nâu, xám vàng, lẫn ổ sét pha và cát hạt trung đến thô, kết cấu chặt vừa đến rất chặt, bão hoà nước.	SPT19	6	8	11	19	
						SPT20	4	6	9	15	
						SPT21	6	7	11	18	SPT21:21-21.45
						SPT22	5	8	12	20	
						SPT23	5	9	12	21	
						SPT24	6	10	12	22	SPT24:24-24.45
						SPT25	4	7	9	16	SPT25:25-25.45
						SPT26	3	5	7	12	
						SPT27	4	6	10	16	SPT27:27-27.45
	-23.75	30.2				SPT28	5	7	10	17	
7			1.8		Organic CLAY (OL), light grey, darkish grey, mixed with thin layer of organics matter, stiff. Sét hữu cơ (OL), màu xám ghi, xám tối, đôi chỗ xen kẹp các lớp mỏng tàn tích thực vật, trạng thái dẻo cứng.	SPT29	6	9	11	20	
						SPT30	6	6	4	10	
	-25.55	32.0				SPT31	5	6	9	15	UD3:31.8-32.0
8			7.5		Silty clayey SAND (SM-SC), light yellow, yellowish brown, groenish grey, darkish grey, mixed with much quartz gravel and coarse sand, medium dense, saturated water. Cát pha bụi và sét, màu vàng nhạt, nâu vàng, xám xanh, xám tối, chứa nhiều sạn sỏi và cát hạt thô, kết cấu chặt vừa, bão hoà nước.	SPT32	3	6	10	16	SPT32:32-32.45
						SPT33	4	7	8	15	
						SPT34	5	7	9	16	
						SPT35	5	8	8	16	
						SPT36	5	7	10	17	
						SPT37	13	17	25	42	
						SPT38	11	16	26	42	
	-33.05	39.5				SPT39	12	15	21	39	
9	-34.00	40.45	0.95		Fat CLAY (CH), light-greenish grey, darkish grey, stiff to very stiff. Sét có tính dẻo cao (CH), màu xám ghi, xám tối, trạng thái dẻo cứng đến nửa cứng	SPT40	6	8	11	19	UD4:39.5-39.70

SPT GRAPH
ĐỒ THỊ SPT

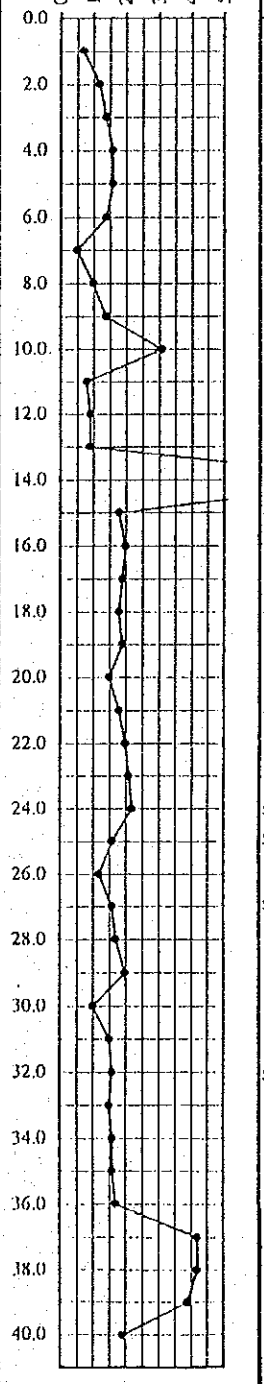


Fig. A-2-8 Boring Log : LK5

USIFE
General Directory

BOREHOLE LOG N^0 - HÌNH TRỤ LỖ KHOAN SỐ: LK6

PROJECT: SOIL INVESTIGATION FOR STEEL FLAT PRODUCT MILL (PHASE I: FEASIBILITY STUDY ON COLD ROLLING MILL)
LOCATION: PHU MY INDUSTRIAL PARK, BA RIA - VUNG TAU PROVINCE
CÔNG TRÌNH: KHẢO SÁT ĐẤT NỀN NHÀ MÁY SẢN XUẤT TẤM LỢP THÉP (GIAI ĐOẠN I: NGHIÊN CỨU KHẢ THI NHÀ MÁY CÁN LẠNH)
ĐỊA ĐIỂM: KHU CÔNG NGHIỆP PHÚ MỸ, TỈNH BÀ RỊA - VŨNG TÀU

Prof.Dr.Sc. Pham Xuan

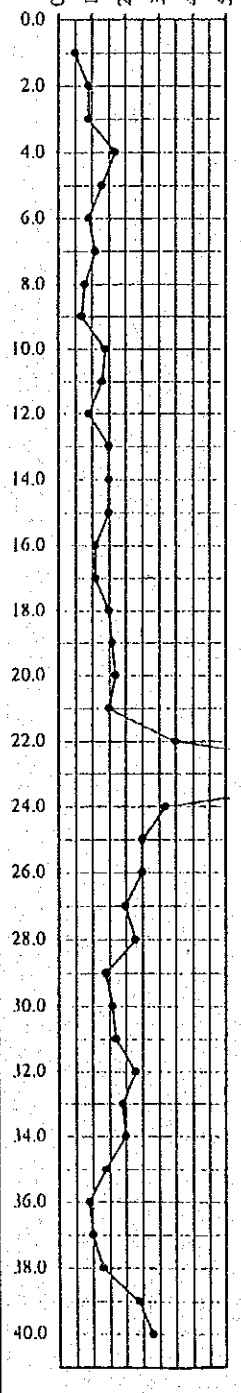
Drilling equipment - Thiết bị khoan: XY-1 (Made in China)
Scale - Tỷ lệ: 1/200
Depth of borehole - Chiều sâu lỗ khoan: 40.45 m
Water level - Mực nước lỉnh: 4.46 m
Date - Thời gian thực hiện: 02/7/2000 - 07/7/2000
Co-ordinate - Toạ độ: X= 1171492.50 m
Descripted by - Người mô tả: Nguyễn Kim Cương
Y= 614496.12 m
Checked by - Người kiểm tra: Nguyễn Việt Cường
Z= 6.12 m

Number of layer Số hiệu lớp	Level of bottom layer Cao độ đáy lớp (m)	Depth of bottom layer	Thickness of layer Bề dày lớp (m)	STRATA LOG CỘT ĐỊA TẦNG	DESCRIPTION OF SOIL AND ROCK MÔ TẢ ĐẤT VÀ ĐÁ
1	+5.72	0.4	0.4		Made ground: Fill soil, clay, sandy clay, blackish grey, brownish grey, very loose Đất lấp: Sét, sét pha, xám đen, nâu đen, lẫn mùn thực vật, bở rời, lợi xốp.
2	-1.88	8.0	7,6		Fat CLAY (CH), greenish grey, white grey, yellowish brown, stiff occasionally very stiff, mixed with gravel lateritic. Sét có lính dẻo cao (CH), màu xám xanh, xám trắng, nâu vàng, trạng thái dẻo cứng đôi khi nửa cứng, lẫn sạn sỏi laterit.
3	-3.68	9.8	1.8		Clayey SAND (SC), greenish grey, white grey, yellowish grey, medium dense, saturated water. Cát pha sét (SC), màu xám xanh, xám trắng, xám vàng, kết cấu chặt vừa, bão hoà nước.
5	-6.88	13,0	3,2		Well graded SAND with silty clay (SW-SC), yellowish brown, brownish red, yellowish grey, mixed with silty clay and medium to coarse sand, medium dense, saturated water. Cát cấp phối tốt lẫn sét pha bụi (SW-SC), nâu vàng, đỏ nâu, xám vàng, lẫn ổ sét pha và cát hạt trung đến thô, kết cấu chặt vừa, bão hoà nước.
6	-29.88	36.0	23,0		Silty clayey SAND (SM-SC), yellowish brown, brownish red, yellowish grey, mixed with silty clay and medium to coarse sand, medium dense to dense, saturated water. Cát pha sét và bụi (SM-SC), nâu vàng, đỏ nâu, xám vàng, lẫn ổ sét pha và cát hạt trung đến thô, kết cấu chặt vừa đến chặt, bão hoà nước. Organic CLAY (OL), light grey, darkish grey, mixed with thin layer of organics matter, stiff. Sét hữu cơ (OL), màu xám ghi, xám tối, đôi chỗ xen kẹp các lớp mỏng tàn tích thực vật, trạng thái dẻo cứng. Silty clayey SAND (SM-SC), light yellow, yellowish brown, greenish grey, darkish grey, mixed with much quartz gravel and coarse sand, medium dense, saturated water. Cát pha bụi và sét, màu vàng nhạt, nâu vàng, xám xanh, xám tối, chứa nhiều sạn sỏi và cát hạt thô, kết cấu chặt vừa, bão hoà nước.
7	-32.58	38.7	2.7		
8	-34.33	40.45	1.75		
3					

STANDARD PENETRATION TEST (SPT)
THÍ NGHIỆM XUYÊN TIÊU CHUẨN (SPT)

Depth Độ sâu	Number of blows/15cm Số búa /15cm			N/30
SPT1	2	2	3	5
SPT2	2	4	5	9
SPT3	3	4	5	9
SPT4	4	7	10	17
SPT5	3	6	7	13
SPT6	2	3	6	9
SPT7	2	4	7	11
SPT8	4	4	4	8
SPT9	2	3	4	7
SPT10	2	5	9	14
SPT11	3	5	8	13
SPT12	3	4	5	9
SPT13	4	6	9	15
SPT14	5	6	9	15
SPT15	4	7	8	15
SPT16	3	5	6	11
SPT17	3	5	6	11
SPT18	4	7	8	15
SPT19	4	7	9	16
SPT20	4	6	11	17
SPT21	3	5	10	15
SPT22	8	15	20	35
SPT23	15	35	>50	
SPT24	12	15	17	32
SPT25	10	12	13	25
SPT26	7	11	14	25
SPT27	5	9	11	20
SPT28	6	8	15	23
SPT29	4	6	8	14
SPT30	5	7	9	16
SPT31	4	7	10	17
SPT32	5	10	13	23
SPT33	5	7	12	19
SPT34	4	8	12	20
SPT35	5	6	8	14
SPT36	3	4	5	9
SPT37	4	5	5	10
SPT38	5	6	7	13
SPT39	8	11	13	24
SPT40	9	12	16	28

SPT GRAPH
ĐỒ THỊ SPT



Symbol and depth of soil samples
Số hiệu và chiều sâu mẫu đất

UD1:4.8-5.0
UD2:5.45-6.1
UD3:8.8-9.0
D1:10.8-11.0
SPT12:12-12.45
UD4:13.45-14.0
D2:23.45-23.65
UD5:26.45-27.0
D3:27.8-28.0
UD6:30.45-31.0
UD7:34.8-35.0
UD8:37.45-38.0
UD9:38.5-38.7

Fig. A-2-9 Boring Log : LK6