THE REPUBLIC OF THE PHILIPPINES

THE PRE-FEASIBILITY STUDY REPORT ON THE INTEGRATED STEEL MILL PROJECT

DECEMBER 1977

JAPAN INTERNATIONAL COOPERATION AGENCY

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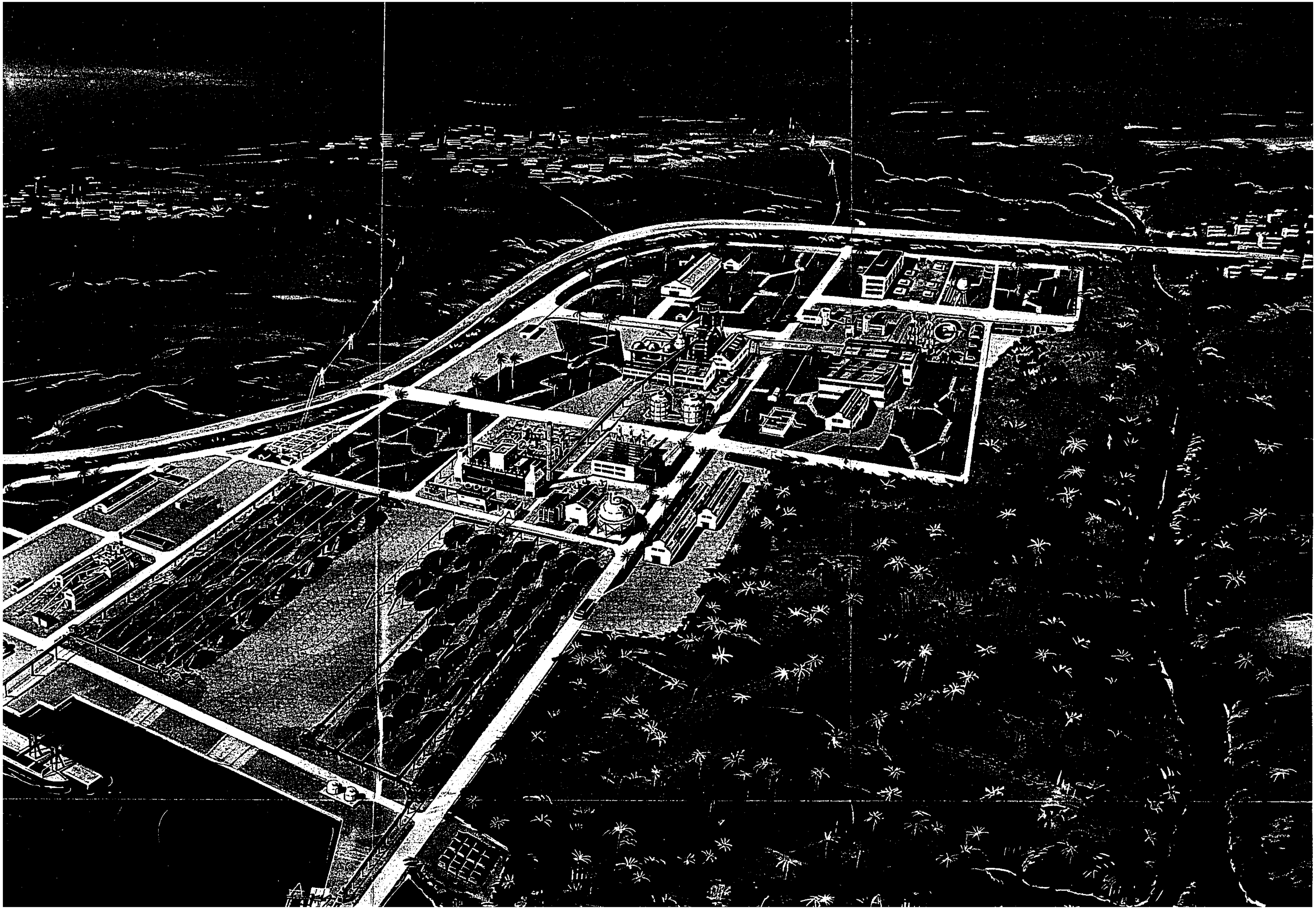

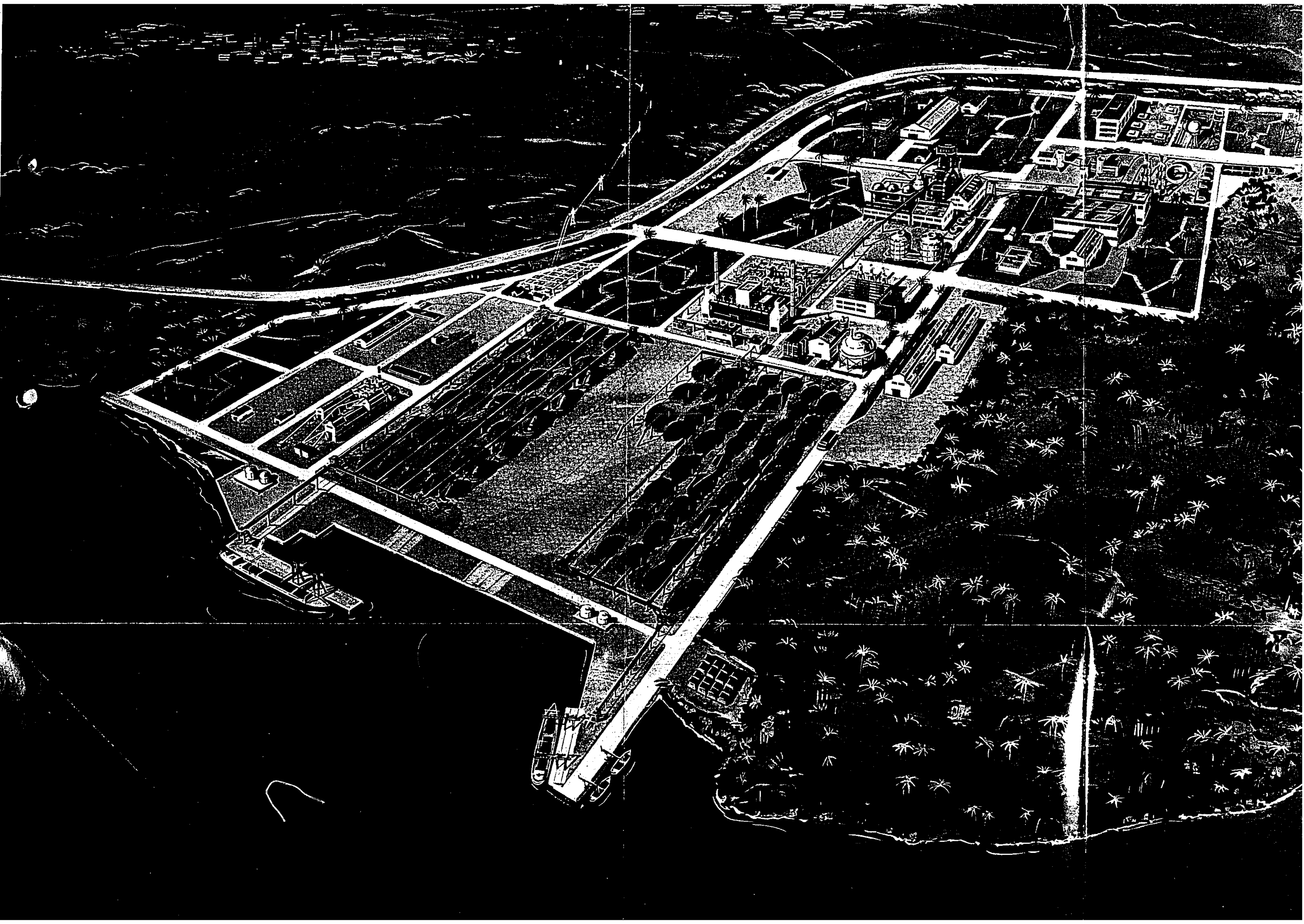

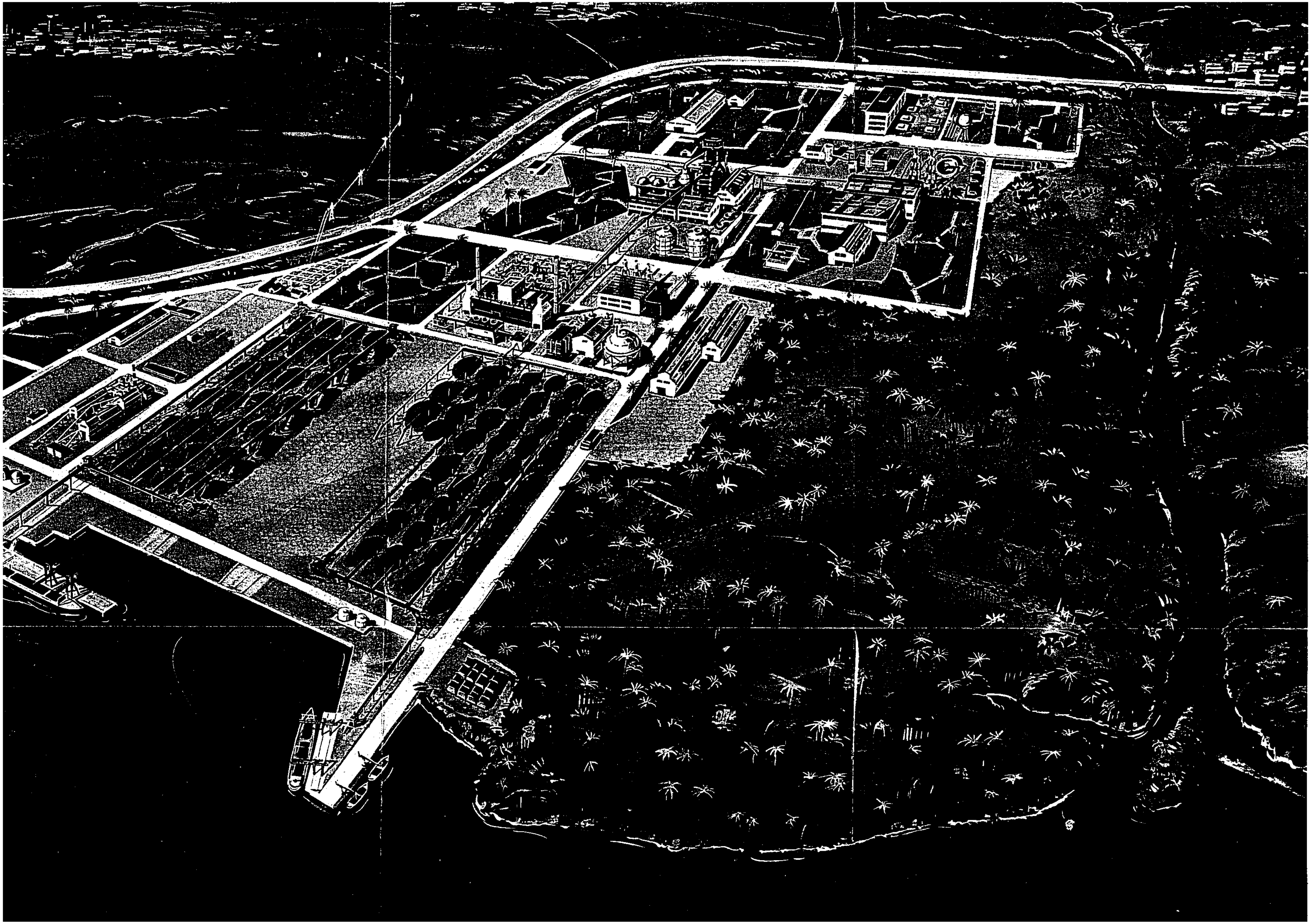

PREFACE

In response to a request from the Government of the Philippines, the Japanese Government asked the Japan International Cooperation Agency to undertake a pre-feasibility study concerning a plan to build an integrated steel mill in the Philippines.

The Agency organized and sent a 15-member team headed by Mr. Toshihiko Ariga (of Nippon Steel Corporation) to the Philippines to conduct an on-site investigation for 17 days from February 22 to March 10, 1977.

The objectives of the study team were to confirm the steel policy of the Philippine Government, review the present status of the steel industry and related industries in the Philippines and take account of any changes that had taken place in the country in the interim period following the completion of the Fact Finding Study in August, 1975. The study team also sought to gather and review relevant data for the purpose of determining major technological considerations in the construction of the integrated steel mill.

The above group of Japanese experts met and had discussions with their Philippine counterparts from both the public and private sectors, and also visited some representative industrial plants in the Philippines. On-site surveys were also conducted at a projected plant site at Cagayan de Oro in Mindanao.

The plan to build the integrated steel mill in such a way as to make it functionally related to the existing facilities of National Steel Corporation (NASCO), as proposed by the Philippine counterpart team, was practicable enough to merit in-depth study. Thus, a second team composed of three members headed by Mr. Toshiharu Kawamoto (Nippon Steel) visited the Philippines to study the interrelations of the new mill and the existing facilities of NASCO.

Upon return to Japan, the study team reviewed and analyzed the gathered data and information from the standpoints of technical and economic feasibility, and compiled the draft of the study report. The Agency sent a 5-member team headed by Mr. Toshihiko Ariga to the Philippines to explain and discuss the draft report with the Philippine counterparts, from September 19th to 25th, and at that time it was eventually finalized by both parties of the members.

We hereby submit the study report for your attention and perusal with all our best wishes for the success of the first integrated steel mill project in the Philippines.

Lastly, we would like to express our sincere appreciation to the Philippine Government and other authorities concerned for their kind cooperation and assistance extended to the team, without which the survey work could not have been carried out so successfully.

Shinsaku Hogen
President
Japan International Cooperation Agency
Tokyo, Japan

MEMBERS OF THE TEAM AND STUDY ASSIGNMENTS

Leader	Mr. TOSHIHIKO ARIGA Nippon Steel Corp.	(general)
Sub Leader	Mr. SHOHEI SAITO Kawasaki Steel Corp.	(energy)
	Mr. HIROSHI Ootsuka Nippon Steel Corp.	(plant engineering)
	Mr. TOKUSHIGE ITO Nippon Steel Corp.	(finance)
	Mr. KEISUKE MORI Nippon Steel Corp.	(iron making)
	Mr. SHINSUKE HASHIMOTO Nippon Steel Corp.	(steel making)
	Mr. HIROSHI KANEDA Nippon Steel Corp.	(rolling)
	Mr. SADAMASA KURAHASHI Nippon Steel Corp.	(related industries)
	Mr. YOICHI SUZUKI Nippon Steel Corp.	(man power)
	Mr. HISAO SHIMIZU Kawasaki Steel Corp.	(infra structure)
	Mr. AKIRA ODA Kawasaki Steel Corp.	(raw materials)
	Mr. OSAMI ARITA Kawasaki Steel Corp.	(transportation)

Mr. HIROMOTO TODA (economic analysis)

The Japan Iron and Steel Federation

Mr. YASUO UCHINAKA (Steel industrial policy)

Ministry of International Trade and Industry

Mr. TOSHIYUKI NAGASAWA (coordination)

The Japan International Cooperation Agency

ITINERARY FOR THE JAPANESE PRA FEASIBILITY STUDY MISSION ON THE PHILIPPINE INTEGRATED STEEL MILL PROJECT

Date	Activities	
Feb. 22	Tokyo ——► Manila	
23	Courtesy Call on the Japanese Ambassador and Consultation with Embassy Officials	
	Consultation with the Philippine Counterparts over the Schedules	
	Courtesy Call on Honorable Vincent T. Paterno, Department of Industry	
	Meeting with Dr. Antonio V. Arizabal, Head of the Philippine Counterparts	
24	First Meeting with the Philippine Counterparts	
	Second Meeting	
25	Visit to Bataan Export Process Zone, Bataan Shipyard & Engineering Corp and Ford Motor Car assembly line	
26	Visit to Philippine Blooming Mills and Elizalde Consolidated Steel	
27	Discussion and Paper works	
28	Third Meeting with the Philippine Counterparts	
	Fourth Meeting	
March 1	Visit to buildings or factories under Construction in MANILA	
	G-Ⓐ Visit to Manila Sea Port	G-Ⓑ Visit to Atlantic Gulf Corp (A.G.P.), Mechanical Center of Manila Inc. and AETNA Industry Inc.
2	Departure for CAGAYAN de ORO City by air	
	Visit to Philippine Sinter Corp. (PSC) and Tagoloan Villanueva Industrial Estate	

Date	Activities	
March 3	Departure for Iligan City by Car	
	Visit to Iligan Integrated Steel	
	G- Ⓐ Visit to National Power Corp. (NPC)	G- Ⓑ Visit to Ferro Alloy Chemical Industry U/C
4	Departure for CAGAYAN by car	
	G- Ⓐ Visit to Water Resources and Thermal power plant	G- Ⓑ Departure for CEBU by air
		Visit to Shipyard
5	G- Ⓐ Detail Study on Plant Site	G- Ⓑ Visit to Forging Plant
	Departure for MANILA	Departure for MANILA
6	Discussion and Paper Works	
7	Fifth Meeting with the Philippine Counterparts	
	Discussion and Preparation of an Interim Observation Report	
8	Final drafting of the Interim Observation Report and it's typing out	
9	Consultation with the Japanese Embassy and finalizing the Interim Observation Report	
	Explanation of the Interim Report to Honorable Vincent T. Paterno	
	Explanation and presentation of the Interim Report to the Philippine Counterparts	
10	Manila ——→ Tokyo	

NASCO SURVEY TEAM

Members of the team and study assignments

Leader	Mr. TOSHIHARU KAWAMOTO Nippon Steel Corp.	(plant engineering)
	Mr. SEIJI TSUJIHATA Nippon Steel Corp.	(mechanic)
	Mr. TAKAYOSHI SOEJIMA Nippon Steel Corp.	(electric)

Date	Activities
Mar. 25	TOKYO ——→ MANILA
26	Courtesy Call on the Japanese Ambassador Consultation with COCIS Visit to ELIZALDE
27	MANILA ——→ CAGAYAN ——→ ILIGAN
28	NASCO Survey
29	Discussion on the Expansion plan of the NASCO Steckel mill
30	ILIGAN ——→ CAGAYAN
31	CAGAYAN ——→ MANILA Discussion with COCIS
April 1	MANILA ——→ TOKYO

MEMBERS OF THH PHILIPPINE COUNTERPART GROUP

His Excellency, the Secretary,		
	Mr. VICENTE T. PATERNO	(Secretary of Industry)
Head:	Dr. ANTONIO V. ARIZABAL	(Chairman of the B.O.I.)
Members:	Technology Group	
	Mr. NICANOR VILLASENOR	(Phil. Iron & Steel Institute)
	Mr. ALEXANDER SAYSON	(B.O.I.)
	Mr. FERDIE ONG	(Dep't of Industry)
	Mr. WILLIE ORTALIZ	(Dep't of Industry)
	Mr. DIONISIO RIVERAL	(MIRDC)
	Mr. POLICARPIO BENITEZ	(National Steel Corporation)
	Mr. RUBEN GOMEZ	(National Steel Corporation)
	Mr. NEMENSIO TIGLAO	(National Steel Corporation)
	Infrastructure Group	
	Mr. ROMEO HONASAN	(PHIVIDEC)
	Mr. EDUARDO ABESAMIS	(National Power Corporation)
	Mr. SALVADOR CABALQUINTO	(National Power Corporation)
	Mr. PEDRO ESTOQUE, JR	(B.O.I.)
	Mr. AMANDO DUMLAO	(Phil. Iron & Steel Institute)
	Mr. FELICIANO MAXIMO	(National Steel Corporation)
	Mr. JOSE MABANTA	
	Labor & Administration Group	
	Mr. JOACQUIN CHIPECO	(Phil. Iron & Steel Institute)
	Mr. RICARDO CASTRO	(National Steel Corporation)
	Miss CHITA ANGELES	(MIRDC)
	Miss PACITA CARIASO	(MIRDC)

Transport Group

Mr. LUIS LIWANAG	(Maritime Industry Authority)
Miss JANE QUIMPO	(Maritime Industry Authority)
Mr. COL. EUSTAQUIO BACLING	(Phil. Ports Authority)
Mr. MARIANO GUEVARRA	(Phil. Ports Authority)
Mr. MARIO MERCADO	(Phil. National Railways)
Mr. DANILO FLORES	(Luzon Stevedoring Corp.)
Mr. ROMULO ROBLES	(Luzon Stevedoring Corp.)
Mr. COL. SIXTO BELEN	(National Steel Corp.)
Mr. MANUEL SABALBURO	(National Steel Corp.)
Mr. BONIFACIO CUTILLAS	(Phil. Iron & Steel Institute)

Market Group

Mr. FLORENTINO CUASAY	(MIRDC)
Mr. DIONISIO VON CRUZ	(Dep't of Industry)
Miss MARILYN ALARILLA	(National Steel Corp.)
Mr. FRANCISCO TONG	(Phil. Iron & Steel Institute)

Finance Group

Mr. ROMEO MANSERAS	(National Steel Corp.)
Mr. AGAPITO L. KALINGKING, JR	(B.O.I.)

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CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

Object of the study

The Japan International Cooperation Agency conducted the Fact Finding Study in August 1975 in accordance with the memorandum exchanged between the Japanese Government and the Philippine Government. The present study is a follow-up of the above-mentioned Fact Finding Study. Starting from the basic concepts described in the Fact Finding Study report, therefore, the present study aims principally at seeking after the most realistic picture of an integrated BF-BOF steelworks to be constructed for the first time in the Republic of the Philippines.

The object of the present study is to arrange and examine various conditions indispensable for the construction of a new integrated steelworks which have been made clear after the Fact Finding Study through the investigations by various agencies and organizations of the Philippine Government on the promotion of the construction of a new steelworks and on the present state of the existing steel industry and related industries.

CHAPTER 2

SUMMARY

CHAPTER 2 SUMMARY

2.1 Basic concepts

Various data obtained on the domestic demand for steel mill products in the Philippines were scrutinized. No specific factors necessitating major modifications in the basic trend since the Fact Finding Study were found out.

Accordingly, the present study has been made in line with the idea of producing around one million tons of crude steel at the first Stage and more than two million tons at the second Stage on the basis of the recommendations given in the Fact Finding Study report. For the first Stage, however, a goal of crude steel production has been set at 1,050,000 tons in consideration of the total production capacity of all down-stream equipment to be installed after the blast furnace.

This production amount will be enough to substitute for imports of iron and steel products with a view to constructing an iron and steel supply base for the existing steel industry. Export of products is not under consideration.

Stepping up from the first Stage to the second Stage should be decided and carried out with due consideration of the experience gained through the construction and operation at the first Stage and the growth of demand in each sector. This Prefeasibility Study places special emphasis on the first Stage program, and gives only considerations on layout, infrastructure, etc. for the second Stage.

2.2 Outline of new steelworks

2.2.1 Production process

Since this is the first steelworks for producing 1.05 million tons of crude steel by the BF process in the Philippines, scruplous consideration has been given to ensure the stable operation. Moreover, special attention has been paid to the following points in selecting the production process for the new steelworks.

(1) As the new steelworks is constructed as a national project of the Republic of the Philippines, the capacities of equipment at all processes must be mutually balanced.

(2) The relation between the existing domestic steel industry and the new steelworks must be clarified and adjusted.

With these points in mind, the product mix has been selected so as to enable the supply of semi-finished products to NASCO and other existing steel manufacturers. The ratio of non-flat steel to flat steel has been decided at approximately 20:80 in steel product equivalent. To save construction costs and to make efficient use of accumulated operational techniques, it is recommended to modify and expand the NASÇO's rolling facilities without constructing rolling equipment for the new steelworks at the first Stage.

2.2.2 Conditions of location

The site is favorably located with respect to transportation, labor market, industrial water, climatic conditions, soil, topography, etc.

The area to be utilized at the first Stage is approximately 3,180,000 m^2. Of this area, about 120,000 m^2 are on the sea to be reclaimed.

The ground height of the site has been determined with consideration on the prevention of the submersion of the site under water due to the waves or high tide from the sea and flood from the Tagoloan.

2.2.3 Raw materials

Reserves of iron ores in the Philippines are said to be approximately 100 million tons. At present, it is difficult to have a realistic outlook for the development of iron mines in the very near future. Accordingly, this study is based on the assumption that the use of domestic iron ore is limited to iron sand only and other iron ores will be imported. Unloading of iron ores and the anufacture of sintered ore will be contracted to P.S.C. (Philipp Sinter Corporation) and the shortage will be covered by importi ellets. Coal reserves in the Philippines are also said to be approximately 100 million tons. As greater part of Philippine coal is steam coal which is not suitable for use in blast furnaces, this study has been made on the assumption that all coking coal required will be imported. Coke is produced completely domestically, It is assumed that auxiliary materials such as scrap, manganese ore, fluorite and soda ash will be imported but domestic dolomite, silica and ferroalloys will be used.

2.2.4 Outline of equipment

The blast furnace is 1,800 m^3 in inner volume and is to produce 965,000 tons of pig iron annually. To enable the production of 1,050,000 tons of molten steel annually, two converters, each having a capacity of max. 110 tons/heat, are installed, with one on stand-by. The layout of these converters has been decided with due consideration so that one more converter can be installed at the second Stage. Molten steel is mostly processed into slabs and blooms by continuous casting machines. Blooms are rolled into from 50 to 115 square billets by the billet mill. For some high-grade steels, however, the ingotmaking process must be used. For such grades, therefore, molten steel is cast into ingots. Majority of slabs and entire quantity of ingots are to be rolled by NASCO. Electric power is generated in an amount of 35,000 kW by using blast-furnace gas and cokeoven gas so that power requirements can be met by the self-sufficiency system. However, facilities for receiving electric power from external sources should be installed to provide for shutdown due to periodical inspection and the like. Other major facilities include oxygen generators, power and piping systems, water supply facilities, water recirculation facilities, intra-works transportation facilities, maintenance facilities and test and analysis facilities. Of the maintenance facilities, the central maintenance station is installed in the vicinity of the new steelworks but not within the steelworks according to the suggestion from the counterpart. This is with the consideration of the related industries located outside the steelworks and of the necessity of securing the space for expansion at the second Stage.

As the district in which the steelworks is to be constructed is subject to possible frequent earthquakes, special consideration has been given to the resistance against earthquake in the preparation of the ground or the design of structures.

2.2.5 Construction plan

The term of construction means a period from the commencement of basic planning to the start-up of operations. The period from the commencement of the basic planning to the contracting including the preparation of specification and bidding was planned to be 20 months. Construction schedule was calculated after this for each equipment in a way that the overall schedule was adjusted to the start-up of blast furnace which has the longest construction period of 55 months. It is desirable also that the land preparation work would be commenced as soon as possible to be in time for the need.

The manning program has been prepared on the assumption that the Head Office is located in Manila and is in charge of financing, purchasing and sales and that the steelworks office takes charge of operation, maintenance and control, etc.

The total number of employees is 3,610, including 160 at the Head Office and 3,450 at the steelworks. The study on the training program of engineers and skilled laborers abroad, seeing that this works is the first integrated iron and steel works in the Philippines, concluded that 470 man-month at minimum is necessary.

2.3 Modification of NASCO's steckel mill

In carrying forward the present study, it is a must to study the expansion of the rolling facilities at NASCO which will receive ingots and most part of slabs produced at the new steelworks. For details, refer to Chapter 14. In short, the modification of the existing steckel mill with minimum investment has been studied. As the result, we came to the conclusion that it would be most suitable to install one more reheating furnace and to replace the existing mill by a 5-stand tandem mill (with an annual production capacity of 760,000 tons in hot rolled coil equivalent).

The investment required amounts to approx. 46 million dollars. The investment required for the installation of a new hot strip mill at the new steelworks amounts to 130 million dollars. As this installation requires the construction of additional infrastructure, facilities for utilities, etc., however, the total investment will amount to an enormous sum.

2.4 Financial analysis

2.4.1 Construction costs

It is expected that the total construction cost of the new steelworks will amount to 813 million dollars, including indirect costs. As the production amount of molten steel is 1,050,000 tons, the construction cost per ton of molten steel is 774 dollars.

Table 2.1 Estimate of construction costs

(Unit: one million dollars)

Item	Amount
Direct construction cost	670
Engineering fee	27
Expenses for education, training and operational guidance	7
Expenses for materials to be prepared for operation and spare parts	24
Initial organization cost	8
Interest during construction	77
Total	813

Assumptions for calculation

(1) Equipment to be purchased: Imported (free of duty and compensating tax)

(2) Construction at site: Domestically available

(3) Materials for construction: Materials that are not domestically available will be imported.

(4) Price level: As of March, 1977

(5) Exchange rate of currencies: US$ 1 = 7.3 pesos = ¥ 282.8

2.4.2 Raising of funds

The required funds are raised on the assumption that 220 million dollars are met by the capital and 593 million dollars by borrowing. For borrowing, it is assumed that the effective interest rate is 9% and the principal will be repaid equally in ten years after operation start.

2.4.3 Production cost

The production costs of major products under the normal condition were calculated, the results of which are as given in Table 2.2. The total production cost in the normal year amounts to 242 million dollars, the fixed cost accounting for 38%. The ratio of fixed cost becomes inevitably high, as the heavy industry will. For this reason, a high production level should be maintained.

Table 2.2 Production costs of major products

(Unit: $/ton)

Product	Cost
Sintered ore	37.6
Coke	118.8
Molten iron	154.8
Molten steel	199.5
Slab	234.3
Bloom	241.8
Ingot	225.2
Billet	293.3

Table 2.3 Breakdown of production cost
(in the normal year)

(Unit: one million dollars)

Item	Amount	Ratio
Raw materials cost	177	
Deduction of by-products	△ 43	
Other variable expenses	16	
(Total variable costs)	(150)	62%
Fixed materials cost	16	
Labor cost	5	
Other fixed expenses	71	
(Total fixed costs)	(92)	38%
Total	242	100%

Assumptions for calculation

(1) Price level: As of March, 1977

(2) Raw materials fuels, machinery and materials: Those which are not domestically available will be imported.

(3) Price of iron ore and coal: Prices C&F Philippines are estimated based on international market prices.

(4) Labor cost: In accordance with the data submitted from the counterpart

(5) Depreciation: Straight line method

Service life { Buildings and structures --- 25 years
Machinery and equipment --- 15 years

(6) Electric power and water:

Purchasing power : 0.0055 dollar/kWh

Price of raw water: Free

(7) Taxes: For raw materials, the reduction of and exemption from import duty, advance sales tax, specific tax and other taxes are not considered.

Real property tax to be imposed: 2.25%

2.4.4 Financial analysis

Financial estimate and analysis have been made by assuming two basic cases for sales price. Case A is the case where the current purchasing price corresponding to the price of imported steel product plus 30% duty is set as the sales price. Case B is the case where the cost plus appropriate profit is set as the sales price. A comparison between sales price and total cost in Cases A and B is shown in Table 2.4. Financial estimate was made for both cases A and B. Financial estimate for Case A is as shown in Table 2.5. Judging from large minus figures appearing in the net cash flow at the time of start-up and blast furnace relining, Case A involves problems in the cash flow, indicating the necessity of taking some measures against the shortage of funds. The production level at the break-even point is as high as 86%. Case B has allowance for both earning power and cash flow as shown in Table 2.6. It should be, however, understood that the sales price in Case B is not necessarily realistic. As far as balance of prices is concerned, Case A is desirable.

Assumptions for calculation

(1) Corporate form : Joint-stock company

(2) Capital : 220 million dollars

(3) Start-up : Blast furnace: 6 months

Converter: 11 months

Continuous casting: 23 months

Billet mill: 17 months

(4) Blast furnace relining: Every 7 years (Relining period: 5 months)

(5) Taxes : National taxes other than income tax are exempted as a pioneer industry.
Income tax: 35%

(6) Terms of sales : FOB at main ports which are nearest to customers

(7) Terms of short-term loan : Interest rate: 16% annually
Repayment in one year

Table 2.4 Sales price and total cost (Cases A and B)

(Unit: Dollar/ton)

Product	Sales price (A)	Total cost			Profit and loss (A - B)
		Production cost	General administration expenses, interest, etc.	Total (B)	
(Case A)					
Cast pig iron	220	154.8	22.9	177.7	42.4
Slab	295	234.3	25.4	259.7	35.3
Billet	310	293.3	36.9	330.2	Δ20.2
Ingot	250	225.2	22.3	247.5	2.5
(Case B)					
Cast pig iron	216	154.8	24.6	179.4	36.6
Slab	337	234.3	28.1	262.4	74.6
Billet	447	293.3	41.2	334.5	112.5
Ingot	310	225.2	25.2	250.4	59.6

Table 2.5 Financial estimate (Case A)

(Unit: One million dollars)

Year (after commissioning)	Turnover	Total cost	Profit & loss (before income tax)	Net cash flow	For reference
1	233	260	-27	-34	
2	285	278	8	1	
3	288	272	16	9	Production
4	288	274	14	4	level at
5	288	269	19	6	break-even
6	288	271	17	5	point: 86%
7	143	183	-40	-92	
8	288	260	28	22	
9	288	261	26	15	
10	288	256	32	14	
11	288	260	28	69	
12	288	260	28	69	
13	288	263	25	67	
14	143	172	-29	-23	
15	288	263	25	203	

(Remarks) (1) For cash-in at the fifteenth year, correction has been made for the remaining value of fixed property, etc.

Table 2.6 Financial estimate (Case B)

(Unit: One million dollars)

Year (after commissioning)	Turnover	Total cost	Profit & loss (before tax reduction)	Net cash flow	Remarks
1	277	261	16	4	
2	349	279	70	39	
3	351	273	78	44	Production
4	351	276	76	43	level at
5	351	270	81	46	break-even
6	351	273	78	44	point: 59%
7	174	184	-10	-62	
8	351	262	89	55	
9	351	265	86	50	
10	351	260	91	53	
11	351	265	86	107	
12	351	265	86	107	
13	351	268	83	105	
14	174	174	0	5	
15	351	268	83	232	

The ROI and ROE rates in Cases A and B are as shown in Table 2.7

Table 2.7 ROI and ROE

	ROI rate	ROE rate
Case A	4.8%	-
Case B	10.0%	13.7%
Case A (National taxes, including income tax, and local taxes are exempted for 15 years)	7.6%	-

As the sensitivity analysis, effects of changes in various conditions on the total cost were calculated, the results of which are given in Table 2.8.

Table 2.8 Effects of changes in conditions on total cost

(Unit: Dollar/ton)

	Condition	Mold pig iron	Slab	Billet	Ingot	Remarks
Normal case	Total cost (Case A)	177.7	259.7	330.2	247.5	
Increase or decrease in cost	(1) Production level: ∓10%	±6.9	±11.7	±18.0	±10.4	
	(2) Construction cost ±10%	±3.6	± 6.6	±10.5	± 5.8	
	(3) Long-term loan Interest: ±2%	±2.0	± 3.6	± 5.6	± 3.2	Basic case: 9%
	(4) Short-term loan Interest: ±5%	±2.6	±2.6	±2.6	±2.6	Basic case: 16%
	(5) Price of ore and pellet: ±10%	±3.6	±3.6	±3.7	±3.5	
	(6) Price of coal: ±10%	±5.6	±5.5	±5.7	±5.3	
	(7) Labor cost: ±20%	±0.4	±0.8	±1.5	±0.9	

2.5 Effect of the construction of a new steelworks on the Philippines' balance of payments

The effect of the construction of a new steelworks on the balance of payments was calculated, the results of which are shown in Table 2.9. The balance of payments will be in deficit for seven years after commissioning of the new works mainly due to the interest charge on and repayment of the borrowing from foreign countries, but will move into the black from the 8th year onwards. This means that the completion of repayment of the borrowing puts the balance of payments into substantial surplus.

It is expected that the balance of payments during 15 years will run in surplus by 208 million dollars.

Judging from this situation, it is expected that the balance of payments will continue in a surplus of 77 million dollars annually in normal years from the 16th year onwards, as in the years following the 11th.

Raw materials are mostly imported. For domestically available materials, however, their domestic production should be promoted. This will surely yield a favorable effect on the improvement of balance of payments.

Table 2.9 Effect on savings of foreign currencies

(Unit: One million dollars)

Year	Savings of foreign currencies (Substitute of imported steel products)	Outflow of foreign currencies				Net savings of foreign currencies
		Imported raw materials	Interest on borrowed foreign currencies	Repayment of borrowed foreign currencies	Sub-total	
1	158	86	49	59	194	-36
2	193	117	45	59	222	-29
3	195	117	40	59	217	-22
4	195	117	35	59	212	-16
5	195	117	29	59	206	-11
6	195	117	24	59	201	-6
7	97	64	19	59	142	-45
8	195	117	13	59	190	5
9	195	117	8	59	185	10
10	195	117	3	59	180	16
11	195	117	0	0	118	77
12	195	117	0	0	118	77
13	195	117	0	0	118	77
14	97	64	0	0	64	33
15	195	117	0	0	118	77
Total (15 years)						208

(For reference)

(1) Import substitute of steel products and raw materials were calculated on the C&F basis.

(2) The interest and repayment of borrowed foreign currencies are based on the conditions used in this study.

(3) The effect to be derived from the 16th year onwards will be same as that from the 11th year onwards.

CHAPTER 3

PREREQUISITE

CHAPTER 3 PREREQUISITE

3.1 Infrastructure

3.1.1 Government-sponsored infrastructure preparatory to new steelworks construction

In the induction of integrated iron- and steelmaking plants or in the promotion of industrial and municipal developments, the extent to which and the speed at which a related infrastructure is built up by the Philippine Government more or less determines the rate at which the new steelworks project will be expedited in the future. The greenfield project being a national issue of long standing, the positive attitude of the government towards the steel project is apparent in the following facts.

In August 1974, the presidential decree P.D. No. 538 was issued, providing for the establishment of the Phividec Industrial Estate Authority (PIE-A). As soon as it was founded, the PIE-A selected an industrial district in the northern Mindanao, and in the same year schemed the formation of a 3,000 hectares of land for the construction of heavy and related industries and partly initiated extensive regional developments including town planning, and

a large sinter plant of Philippine Sinter Corporation (P.S.C.) was commissioned in May 1977 in the same region.

A national highway is under construction between this industrial area and cities of Cagayan de Oro and Iligan in the northern Mindanao. Planned by Bureau of Public Highway (B.P.H.), the national route will play an increasingly important role as a vital interregional link.

Power resources are also being developed by National Power Corporation (N.P.C.) under a Mindanao Grid program to provide motive power for industrial development.

These and other government-sponsored infrastructural developments are not only desirable but also indispensable in the furtherance of the PIE-A project and are therefore to be given top priority. In this sense, the policies being pursued by the Philippine government are quite reasonable.

In the promotion of the new steelworks project, the government is urged to make early preparations and take positive measures for a variety of undermentioned infrastructure buildup programs.

(1) In the first phase of the greenfield steel plant project, 318.4 hectares of land is needed as a minimum lot directly concerned with plant operations. However, it is considered to be necessary to expropriate in addition to the above, sufficient area for the immediate and future uses.

(2) In river improvements, the diversion of the Pugaan River (the construction of a diversion canal from Sta. Ana) must be preceded prior to the preparation and land grading of the proposed steelworks site. On completion of the waterway diversion, the drained river on the plant site will naturally be reclaimed. According to the Bureau of Public Works (B.P.W.), flood flows are scheduled to be partly overflowed to the old river even after its diversion. However, collected drains and peripheral storm water must be prevented from entering the plant site. To accomplish this, the construction of drainage ditches and the timing of the provision of related facilities must be thoroughly studied, and on this basis, the drainage of the peripheral areas must be planned.

Incidentally, earth dike work on the Tagoloan River is being scheduled by B.P.W., but this should be accelerated as early as possible as part of the "peripheral flood prevention project" independently of the new steel mill construction plan.

(3) The harbor improvement project is of a large scale and has an important bearing upon the steel project. Currently, the port facilities of P.S.C. are generally in good order and are functioning properly. It should be here remembered that in the construction of the plant, provision and improvement of public berths (Water depth: -5 m, Length: 200 m, Use: unloading of construction materials and machinery) are prerequisite. Under PIE-A infrastructure program, public berths are also planned on the west side of the Tagoloan River. These berths must be completed before the start of the steelworks construction. Understandably, in the construction of the steelworks, concentrated arrivals of construction materials and equipment are expected in amounts ranging from 300,000 through 500,000 tons. The use of the P.S.C.'s cargo berths alone to cope with these influxes would be not only insufficient but might also invite confusions in the handling of cargoes and in the construction schedule. If suitably planned and maintained, the public berths may also serve as an important front door by which men and materials enter the hinterland during and after the steelworks mill construction.

Next on a list of priorities is the provision of a signal station (a position on the bay from which signals are made to incoming or outgoing ships) and a coastal station (a radio station installed in shore for issuing radio navigational aids to ships). They are needed for the control of ships in port and should accordingly be planned on consultations with the Philippine Port Authority (P.P.A.), Coastguard, B.C.C.S., PIE-A, and other agencies concerned. Provision of these stations, therefore, must be made in compliance with the requirements of these agencies.

3.1.2 Town planning

The issue indirectly related to the plan to attract enterprises is a town planning involving peripheral areas. The projected employees of the first stage of the steelworks operation will be numbered 3,000 to

4,000. When their families are included, population growth induced by the project may exceed 20,000. This population increase will be supported by the attendant influx of commercial and industrial people, whose presence altogether is likely to double or treble the local population.

Here lies the necessity of town planning. It should be noted that disorderly housing construction, if it is left unchecked, may, not only disturb the development of the project itself, but also will pose serious financial problems when housing redistribution or relocation is necessitated in the future.

Government guidance is also desired in the provision of schools, hospitals, churches, recreation centers and other facilities, whose existence will indirectly maintain industrial activities.

Among the unavoidable problems attending urbanization are the environmental controls and the prevention of calamities. The provision of communication facilities and of distribution networks indispensable to the maintenance of municipal function is necessary. Also necessary in this regard is the arrangement of air-routes to Manila, etc. These essentials are incorporated in the PIE-A program, but they need a review by the government in line with the new steelworks construction project.

3.1.3 Preliminary investigations into the plant site

Induction of enterprises to the industrial site is conditional upon the availability of preliminary data concerning the construction site and regarding the necessary measures involved. Preparatory investigations in this connection are therefore necessary.

The proposed site covers 650 hectares of land. Subjected to the impact of large rivers for innumerable centuries, the industrial site is estimated to comprise diversified layers. Accordingly, a plan to build heavy industries in such a land necessarily calls for careful studies on the following items.

(1) Topographic surveys of the land part were made by a NASCO's surveying partly in 1974. The survey data are sufficient in the stages of planning but will require detail surveying for subsequent execution drawing preparations.

(2) As for depths of water in the sea area, a chart was completed by B.C.G.S. in October 1976. Further detailed sounding is needed before dredging and reclamation designs are prepared.

(3) For soil explorations, a boring survey must be conducted at points where major structures are to be built. This should be accompanied by physical and chemical tests, etc., in order to provide foundation design data. In addition, sonic prospecting etc., must be done to survey the geological states of the seabed. This will furnish valuable data for offshore structural designs.

(4) To test the ground for direct soil bearing power relative to important structures, bearing tests are to be conducted by pile driving, and loading tests carried out for a check on land subsidence.

(5) Concerning subterranean water, according to the test results of P.S.C., the depth of water-bearing strata, their water qualities, pumping water volume, are found to vary abruptly by locations.

(6) Observations of tidal currents and a check on the status of littoral drift sand under the impact of the Tagoloan River will take time to complete, but their results are required as materials of oceanic conditions as well as for harbor planning.

These items from (1) through (6) constitute important preliminary surveys concerned with the building of steelworks at the new location.

They are essential as data for execution design and should desirably be prepared by the government.

3.1.4 Industrial water supply plan

Iron- and steelmaking is an excessively water-consuming industry. The water for the use comprises sea water and freshwater, whose supplies from vicinities are economical from operational points of view.

The construction site being on a coastal area, sea water can be easily taken from the sea. This water-intake will be included as one of facilities of the steelworks.

Freshwater is available in large quantities (2,500 million tons/year) from the Tagoloan River adjacent to the plant site. This water source can supply the steelworks and/or other facilities with sufficient amounts of water. Water examinations have revealed that the freshwater is qualitatively sufficient for industrial uses and can be supplied to vicinities as drinking water after sterilization and other treatments.

The water source for the steelworks is planned to have its intake installed at Malitobug (Altitude: +29 m), upstream of the Tagoloan River, from which water is supplied by pipe line (over a distance of approximately 8.5 km) to the plant by means of gravity.

The amounts of water required for the first stage of the plan are provisionally estimated at approximately 33 thousand tons/day. The construction costs to cover the water supply are so large that, as with power supply, it must be provided by the government-sponsored infrastructure.

Water rates should be discussed separately to set it at a reasonable costs. The annual water supplies to the new steelworks are tabulated in Table 3.1.

Table 3.1 Amounts of feedwater

Item	Quantity of water (m^3/year)	Remarks
Seawater	158,650,000	435,000 m^3/day
Freshwater	11,950,000	(River water) 33,000 m^3/day

3.2 Utility

3.2.1 Promotion of power plant construction program

The steel industry is a large consumer of electricity. The power features large load fluctuations and an extensive impact upon the safety of steel mills during service interruption.

On the other hand, steel plants produce blast furnace gases, coke oven gases and other by-product gases, whose recycling for home power generation often provides electric power in excess of intramural consumption until large-sized rolling mills are completed. Under the present project, the steel plant's loads are scheduled to be fed by home generation.

Generating sets, however, have to be periodically inspected and on rare occasions are visited by catastrophic failures, during which periods steelworks' loads must be partly or wholly supplemented from external electric power. Such utility power must be stable and strong enough to serve as a backup as is evident from the aforementioned features of steelmaking electricity.

It should be reminded in this regard that the hydroelectric power station planned on Mindanao should be promoted as scheduled since it is an absolute necessity. Under the current plan, total power generation will reach 800 MW by around 1983, when the greenfield steel plant comes on-stream -- a level describable as generally, if not absolutely, satisfactory.

The 138 kV transmission line to the steel plant's power receiving station, scheduled for construction by the Philippines, is so vital that two circuits must be provided from the very start, so that in case of a trouble with one circuit, the steelworks may continue its operation by means of the other circuit.

Under the present power plant program, lower equipment costs and simplified, highly efficient (high availability) operations are aimed at, and to achieve this objective, a generator and a blast furnace blower are coupled to a steam turbine on one and the same axis, as a result of which a normal power supply/demand balance as roughly tabulated in Table 3.2.1 may be attainable.

The supply/demand balance given in this table concerns the production steps up to and including the billet mill at the exclusion of a hot strip mill. When the hot strip mill is added, load variations become so large that far stabler power will be needed.

Table 3.2.1 Power supply/demand balance

Generator capacity Blast furnace blower	23 MW 2 units 15 MW 2 units (Normally 11 MW)		
	All units in operation	One unit operating (Periodical inspection or failure)	All units shutdown (Failure)
Amounts of generation	35 MW	12 MW	0
Average plant loads	23.6 MW	23.6 MW	23.6 MW
Average amounts of power received	0	11.6 MW	23.6 MW
Average amounts of utility power	11.4 MW	0	0
Annual amounts of generation (" of transmission)	247,000 MWH (227,000 ")		
Amounts of power received	12,730 "		
Amounts of utility power	30,990 "		

Incidentally, unlike commercial power plants where solid and liquid fuels are used, this bond power-plant is mostly gas-fired, so much so that it is attended with dangers of explosion and poisoning. Gas handling, therefore, must be made with sufficient knowledge and training.

3.3 Recruitment of engineers and workers

As described below, the integrated iron- and steelmaking plant scheduled for construction in the Philippines is planned to take a blast furnace--converter approach. In this approach, which is diametrically different from the electric furnace system, molten iron and molten steel are handled in fused states, demanding safety operations with each equipment item. Safety operations in turn are dependent on the techniques of high level of the engineers and of workers engaged in the running and maintenance of each equipment. In the erection of this steelworks also, many engineers and workers are required at the same time, and their techniques and skills will obviously exert large influence upon the progress of the construction. This is why the acquisition of excellent engineers and skilled workers poses a greatest problem in the erection and operation of steel plants.

It is with this in view that the Philippine Government is requested to consider the following points as items needing advance preparations.

(1) The contents of the construction of the steelworks must be grasped and domestic contractors be checked for their levels in terms of quality and quantity. Workers must be trained as necessary.

(2) Engineers and workers must be trained in indegenous and overseas enterprises, the techniques of which are similar to ones required in the operation of steelworks.

(3) Engineering orientation and training centers and vocational training courses must be established as required.

CHAPTER 4

PRODUCTION PROCESSES AND START-UP PLAN

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4.1 Production processes

Equipped with one blast furnace (inner volume: 1,800 m^3), the new steel works is planned on an integrated production setup geared to the manufacture of approximately one million tons of crude steels per year. It will serve as a supply base for NASCO and other Philippine steel manufacturers, the products to be supplied them consisting basically of semi-products, namely slabs and billets. The steelworks will be a modern steel plant compatible with the circumstances of the Philippines, with its production process planned as follows.

First, the ratio of sinter and pellet in blast furnace materials will be set at 80 percent, of which approximately 60 percent will be produced on commission as sintered ore by P.S.C. and about 20 percent, imported as pellets, the amounts of the latter being so small. For ores, sizing equipment will be installed to provide suitably sized ores to the blast furnace. For coke production, coke ovens will be furnished to supply required amounts of blast furnace fuel on a self-sufficient basis.

Secondly, for steelmaking, converters (Max. 110 tons/heat x 2 units) are used to match the capacity of the blast furnace. Hot metal ratio is set at approximately 85 percent to keep converter operations at an optimum level. This will require scrap purchases since the return scrap from NASCO etc., alone will be insufficient to feed the converters. For the production of slabs and billets, continuous casting will be basically adopted in view of its prevailing worldwide use on up-to-date steel plants. Accordingly, continuous slab casters and continuous bloom casters will be installed, but as concerns the types of steel unfit for continuous casting or with respect to emergency casting steels, part of steels will be processed into ingots by a steel ingotmaking process.

After conditioning of continuous casting slabs, they are to be shipped to NASCO and plate manufacturers. Ingots will be delivered to NASCO's combination mill and rolled into slabs for hot coils.

Since small sizes are in demand, billet is to be processed on a continuous bloom caster to billet mill system. The billets thus produced are going to be shipped to domestic bar and shape makers.

These production processes, on arrangement into a production balance, will acquire a basic production balance as shown in Fig. 4.1.

Fig. 4.2 shows a material balance of raw materials, by-products, and products based on the basic production balance.

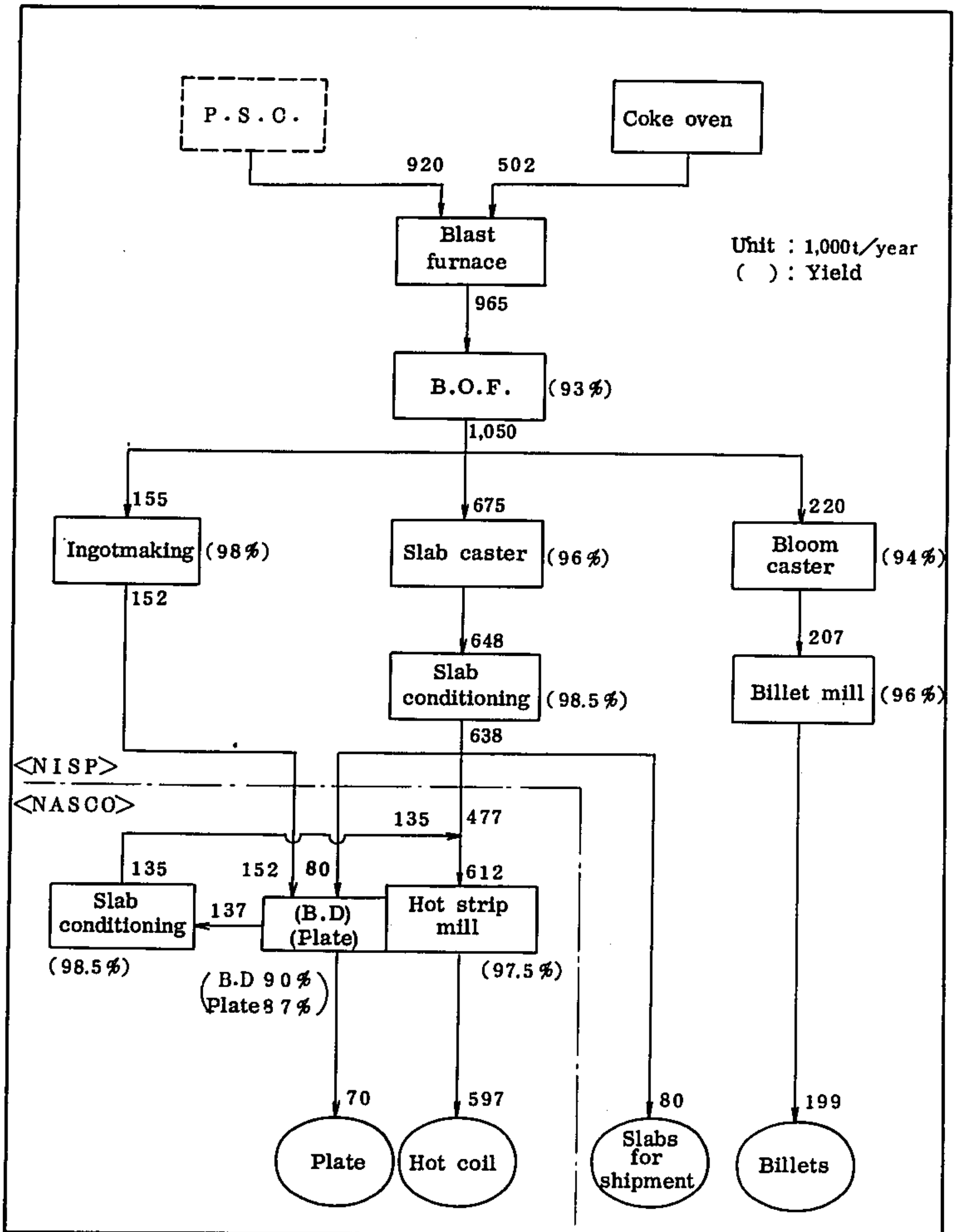


Fig. 4-1. Basic production balance

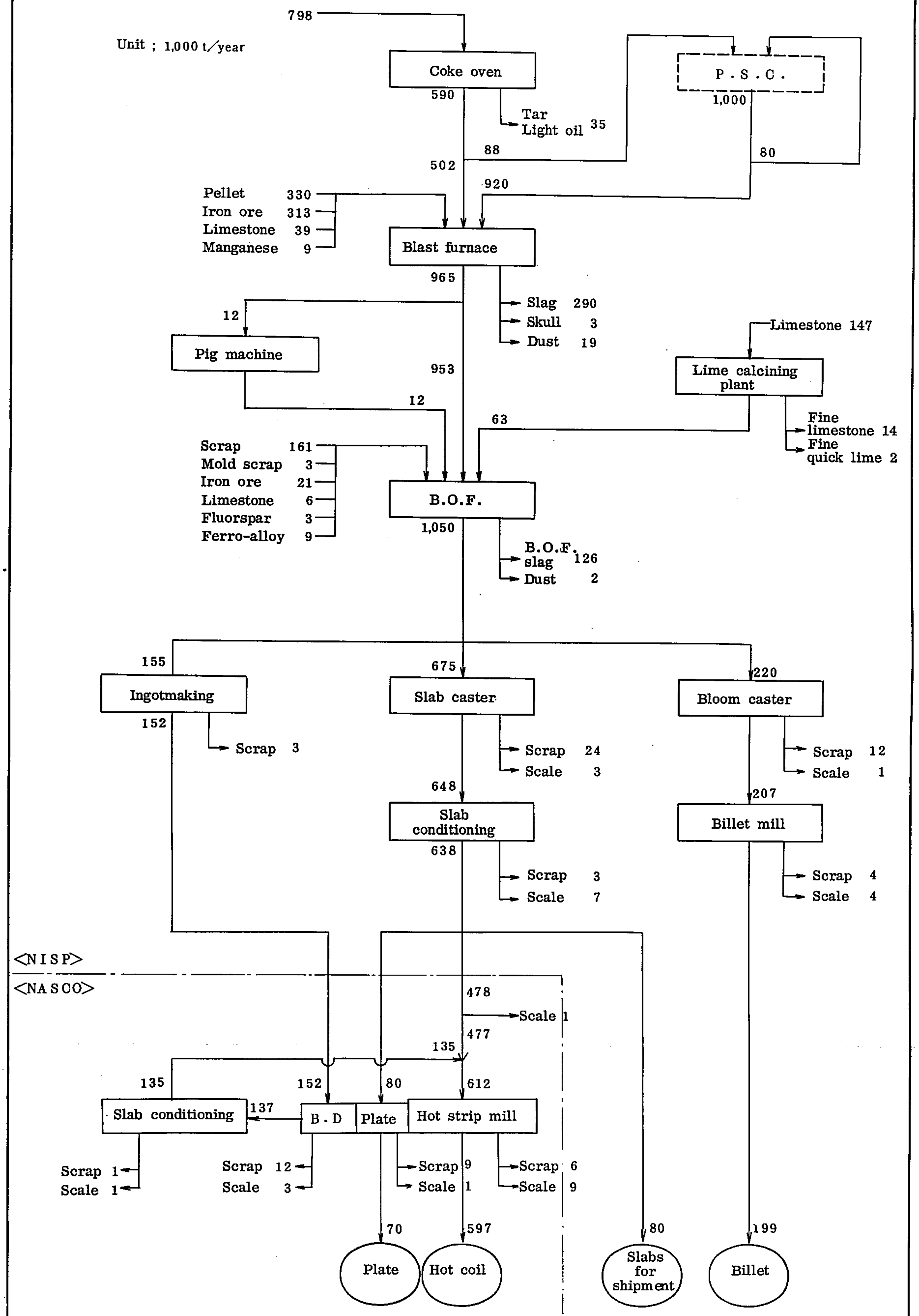


Fig. 4-2. Material balance flow sheet

4.2 Production start-up plan

The start-up plan for each equipment will be mapped out as in Table 4.1, considering that a blast furnace, a converter, and continuous slab casters are new to the Philippines.

Table 4.1 Start-up periods for each equipment item

Equipment	Start-up period	Remarks
Coke oven	6 months	
Blast furnace	6 "	
LD converter	11 "	
Continuous slab caster	23 "	
Continuous bloom caster	17 "	
Billet mill	17 "	For the billet mill alone, 12 months is enough, but considering the relations with CC, 17 months is allotted.

For coke oven and blast furnace, a start-up time is identically six months. Normally, the coke oven is started up one month before the blowing-in of the blast furnace, in order that coke and test coke oven gas are prepared beforehand. Subsequently, the operating rate of the coke oven is gradually raised while maintaining a balance with the coke consumption of the blast furnace.

Since the start-up time of the converter differs from that of the blast furnace, hot metal is produced in excess during the 11 month start-up period, which compels steelworks to make cast pig iron in amounts estimated to total 180 thousand tons.

Start-up times for continuous casters differ from that of a converter, the difference being 12 months between converter and continuous slab caster and six months between converter and continuous bloom caster.

During these periods, ingotmaking is run at full capacity to keep up with production volumes. At this time, ingot output is maximized at 37,500 tons/month or thereabouts.

Fig. 4.3 shows the estimated trends of output during the above-mentioned start-up period.

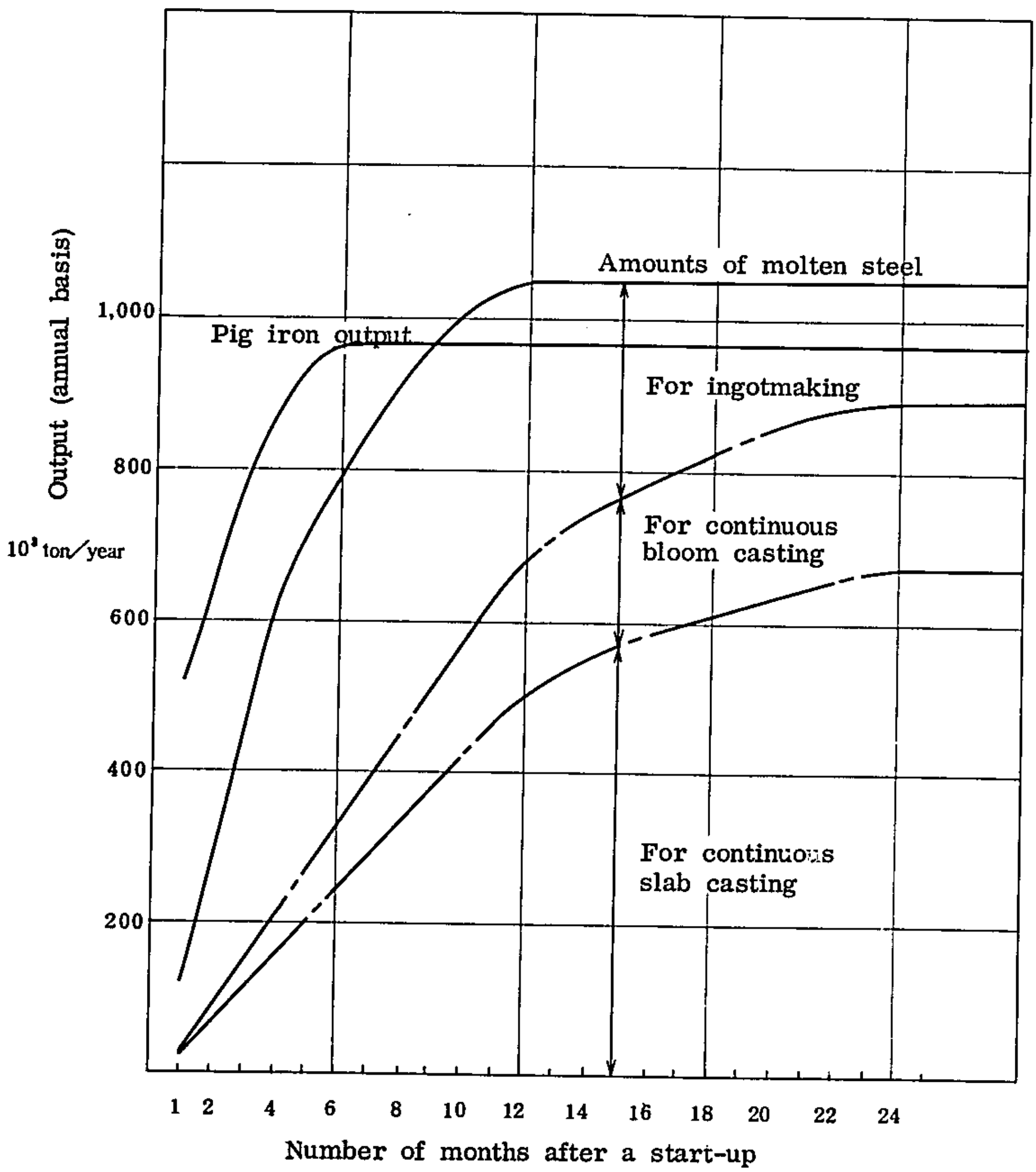


Fig. 4-3 Output trends during start-up period

4.3 Summary of consumption and generation

During the first stage of the project, major equipment will be served with raw materials, with utilities and with by-products at unit consumption and in amounts per year tabulated in Table 4.2.

Table 4.2 Summary of consumption and generation

Equipment	Output 10^3 t/y	Raw materials									Remarks
		Raw materials	Specific consumption	Consumption/ year	Utilities	Specific consumption	Consumption/ year	By-products	Specific generation	Specific generation year	
Raw materials treatment	--				Power	-	5.8×10^6 KWH				
					Industrial water	-	0.2×10^6 m^3				
Coke/chemical plant	Coke	Coal	1.35t/t Coke	798×10^3 t	C.O.G.	20 Nm^3/t - Coal	16×10^6 Nm^3	C.O.G.	320Nm^3/t Coal	$255.2 \times 10^6 Nm^3$	
					Mixed gas	650Nm^3/t - Coal	$518.6 \times 10^6 Nm^3$	Coke breeze	0.11t/t Coal	88×10^3 t	
					Steam	49.4 kg/t - Coal	39.4×10^3 t	Tar	0.035t/t Coal	28×10^3 t	
					Nitrogen gas	0.5 Nm^3/t - Coal	402×10^3 Nm^3	Light oil	0.009t/t Coal	7×10^3 t	
					Power	28.5KWH/t- Coal	22.7×10^6 KWH				
					Seawater	16.5 m^3/t - Coal	13.1×10^6 m^3				
					Industrial water	17.4 m^3/t - Coal	1.4×10^6 m^3				
Blast furnace plant	Pig iron	Sinter	953 kg/t	920×10^3 t	Blast air	1,360 Nm^3/t	$1,312 \times 10^6 Nm^3$	B.F.G.	1,980 Nm^3/t	$1,910 \times 10^6 Nm^3$	
		Pellet	342 kg/t	330×10^3 t	Heavy oil	40 kg/t	38.6×10^6 t	Slag	300 kg/t	290×10^3 t	
		Sized ore	325 kg/t	313×10^3 t	B.F.G.	660 Nm^3/t	636.9×10^6 Nm^3	Skull	3 kg/t	3×10^3 t	
		Manganese ore	9 kg/t	9×10^3 t	C.O.G.	2 Nm^3/t	1.9×10^6 Nm^3	Dust	20 kg/t	19×10^3 t	
		Limestone	40 kg/t	39×10^3 t	Steam	15 kg/t	14.5×10^3 t				
		Coke	520 kg/t	502×10^3 t	Power	20 KWH/t	19.3×10^6 KWH				
					Seawater	15 m^3/t	14.5×10^6 m^3				
					Industrial water	30 m^3/t	29×10^6 m^3				
					Pure water	0.5 l/t	483 m^3				
Lime calcining plant	Quick lime	Limestone	2.33 t/t	147×10^3 t	C.O.G.	322.2 Nm^3/t	20.3×10^6 Nm^3	Fine limestone	224 kg/t	14×10^3 t	
					Power	55 KWH/t	3.5×10^6 KWH	Fine quick lime	25.6 kg/t	2×10^3 t	
					Industrial water	44.9 m^3/t	2.8×10^6 m^3				
B.O.F. plant	Molten steel 1,050	Iron ore	20 kg/t	21×10^3 t	C.O.G.	2 Nm^3/t	2.1×10^6 Nm^3	Converter slag	120 kg/t	126×10^3 t	
		Quick lime	60 kg/t	63×10^3 t	Oxygen gas	55 Nm^3/t	57.8×10^6 Nm^3				
		Limestone	6 kg/t	6×10^3 t	Nitrogen gas	9 Nm^3/t	9.5×10^6 Nm^3	Dust	2 kg/t	2×10^3 t	
		Scrap	153 kg/t	161×10^3 t	Power	23 KWH/t	24.2×10^6 KWH	Scrap	3 kg/t	3×10^3 t	
		Mold scrap	3 kg/t	3×10^3 t	Industrial water	6.3 m^3/t	6.6×10^6 m^3				
		Fluorspar	3 kg/t	3×10^3 t	Soft water	11.0 m^3/t	11.6×10^6 m^3				
		Ferro-alloy	8 kg/t	9×10^3 t							

Equipment	Output 10^3 t/y	Raw materials									Remarks
		Raw materials	Specific consumption	Consumption/ year	Utilities	Specific consumption	Consumption/ year	By-products	Specific generation	Specific generation year	
Continuous slab caster	Slab 648				C.O.G.	6 Nm^3/t	3.9×10^6 Nm^3	Scrap	42.5 kg/t	27×10^3 t	
					Oxygen gas	7 Nm^3/t	4.5×10^6 Nm^3	Scale	14.2 kg/t	10×10^3 t	
					Argon gas	0.12 Nm^3/t	77×10^3 Nm^3				
					L.P.G.	1.33 kg/t	862 t				
					Power	20 KWH/t	4.1×10^6 KWH				
					Industrial water	21.8 m^3/t	17.4×10^6 m^3				
Continuous bloom caster	Bloom 207				C.O.G.	6 Nm^3/t	1.2×10^6 Nm^3	Scrap	56.4 kg/t	12×10^3 t	
					Oxygen gas	2.5 Nm^3/t	0.5×10^6 Nm^3	Scale	7.4 kg/t	1×10^3 t	
					Argon gas	0.12 Nm^3/t	25×10^3 Nm^3				
					L.P.G.	0.475 kg/t	98 t				
					Power	20 KWH/t	4.1×10^6 KWH				
					Industrial water	21.8 m^3/t	4.5×10^6 m^3				
Billet mill plant	Billet 199				C.O.G.	100 Nm^3/t bloom	20.7×10^6 Nm^3	Scrap	20 kg/t bloom	4×10^3 t	
					Power	30 KWH/t bloom	6.2×10^6 KWH	Scale	20 kg/t bloom	4×10^3 t	
					Industrial water	82.2 m^3/t bloom					
Power and B.F. blower plant	-				B.F.G.	-	639.2×10^6 Nm^3				
					C.O.G.	-	111.3×10^6 Nm^3				
					Power	-	22.1×10^6 KWH				
					Seawater	-	109×10^6 m^3				
					Pure water	-	163×10^3 m^3				
Oxygen plant	-				Steam	-	4.4×10^3 t				
					Power	-	48.2×10^6 KWH				
					Seawater	-	9.6×10^6 m^3				
					Industrial water	-	0.2×10^6 m^3				

CHAPTER 5

CONDITIONS OF THE SITE LOCATION

CHAPTER 5 CONDITIONS OF THE SITE LOCATION

5.1 Physical and geographical conditions

Of all conditions of the site location for an integrated steelworks, those physical and geographical conditions exert the largest impact upon its construction and operational costs. These conditions include the following.

(1) An abundant supply of labor force in the vicinities

(2) The facility with which raw materials, machineries, and products can be procured and transported

(3) Availability of rich feedwater

(4) Stable meteorological and oceanic conditions

(5) Geological conditions favorable to the construction of heavy structures

(6) Low costs at which land can be reclaimed or graded.

Many of the existing Japanese steel plants sought coastal areas for their location. They dredged sea channel to reclaim level land, built a calm anchorage, and located their heavy structures in geologically suitable sectors.

As described earlier, the present site under discussion is favored with the following advantages corresponding to the six aforesaid conditions of the site location.

(1) Cagayan de Oro, the largest city in northern Mindanao, and its neighboring areas, have rich supplies of labor force.

(2) To the satisfaction of its requirements to carry in and/or out its raw materials and products by sea, the proposed steelworks can be provided with a harbor and deep sea routes in its calm sea area. Moreover, an industrial complex of heavy and light industries is planned there, part of which are already operating.

(3) Use can be made of rich water supplies from the Tagoloan River.

(4) Area is seldom affected by typhoons.

(5) Comparatively excellent geological conditions -- formed by the Tagaloan River -- seem to favor the site.

(6) Flat land promises future extensions of the site.

From the standpoint of industrial site location for a steel mill, this site can be said to be in a best position. In this Chapter, geographical and physical conditions are to be outlined on the basis of the data obtained from the Philippine Government agencies concerned and those from P.S.C. regarding sinter plant and other construction. This Chapter also points up the need for future investigations.

5.1.1 Topography and geology

The construction site is in one corner of a fan naturally formed by deposit from the Tagoloan River, and is traversed by the Pugaan River.

The Tagoloan River is flanked by terraces, indicating that the river has settled in its meandering state after changes in its course during floods.

Generally, the site gradually slopes down seawards at a gradient of 1 : 200 --- 1 : 300.

Formed of deposit from the Tagoloan River, the coastline is developed on the sea side, with shoals occurring in the sea area (close to the river mouth particularly) in front of the site. This is indicative of the accumulation of deposit in the deep sea over long periods of time. The gradient of the seabed becomes abruptly steep to 1 : 2 --- 1 : 3 at a water depth of -10 m, beyond which the downward slope plummets to -50 --- -100 m.

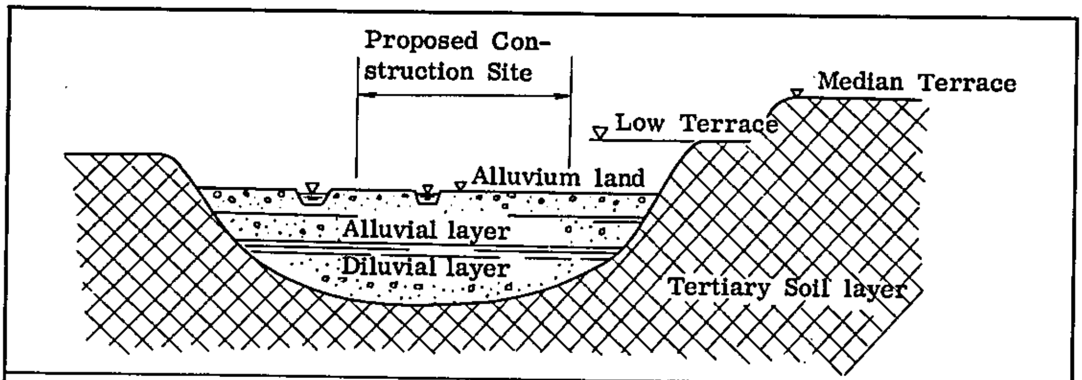


Fig. 5.1 Typical geological stratification

Fig. 5.1 shows a typical geological stratification of the construction site. This alluvium land is founded on a tertiary soil layor with accumulations thereon of a diluvium deposit and of an alluvium deposit. A sedimentary layer is considered to comprise a group of gravel, sand, silt and clay layers alternating or mixed up with each other, and seems to be of complicated composition in view of several past changes in the course of river flow. The diluvial layer and the alluvial layer are probably extended to the sea area at a gentle slope.

The layout of the steelworks is to be synthetically determined with geological conditions taken into account. The blast furnace and other equipment comprising heavy structures had better be built on a good soil ground to save foundation costs. Pier construction costs are also largely influenced by geological conditions. Geologic survey --- a survey of the depth of a bearing layer or of good soil --- prior to layout finalization, is indispensable for the construction of steel plants having many pieces of heavy equipment. Also, depending on the type of structures (heavy or light structures), various foundation types corresponding to their functions can be considered. In choosing a type of foundations, detailed geologic survey and highly accurate load tests are sure to provide an effective weapon to slash construction expenses.

5.1.2 Meteorological and oceanic conditions

Situated south of lat. 10^{o} N., Mindanao Island is to the west of the area where typhoons normally brew. In winter the islands is affected to a certain extent by typhoons during their formative and deepening stage, but otherwise Mindanao is a calm region as compared to the rest of the Philippine Archipelago. As regards oceanic conditions, sea waves often swell to a height of two meters or thereabouts and the shores are occasionally washed by landward coastal currents. This, however, is no impediment to the steering of ships. Near the construction site, wind frequently blows from the north or northwest. According to Cagayan's data, wind speeds average 2.1 knots. The maximum average wind speed of 26 knots is by no means high. With temperatures averaging 25 -- 29^{o}C, humidities 70 --- 85 percent, and rainfall 1500 -- 2000 mm/year, the meteorological conditions of the area can be described as generally favorable.

5.1.3 Earthquakes

Situated on the circum-Pacific seismic zone, Mindanao Island experienced many large earthquakes in the past. Records show that an earthquake of the order of magnitude of 7.2 occurred within 50 km of the site. This pinpoints the need to thoroughly consider measures against earthquake. This construction site is also classified by the Philippine Building Code as an earthquake-prone district, whose regional design seismic factor is large.

5.2 Land utilization plan

The site is comparatively even but is partly traversed by Pugaan River and San Martin Creek and is edged on the seaside by a humid zone. This river being part of the plant site, has to be diverted upstream to Tagoloan River in the future.

A topographic map indicates that the ground height near the national highway is approximately +9 m above the mean lower low water (M. L. L. W.) and near the shoreline is +1 m -- +2 m. Ground heights must be determined rationally considering steel plant functions, economically efficient earthwork balances and flood impacts. In this connection, a basic conceptual approach concerning the landside lots is to consider the grading of a 300 hectare site needed in the first phase without preparing the rolling mill site, which belongs to future undertaking. As concerns the reclaimed land for harbor facilities, it is not ideally located or shaped in relation to sea waves but has been determined by preponderantly minimizing the amounts of dredging and of reclamation, in view of the sea area being calm. The ideas underlying this approach are that the future extension of the P.S.C.'s 250,000 DWT ore berth should not entail any troubles and that a coal bearth can be added to the planned coal berth. Ground heights have been comparatively studied by using a rough survey drawing. Fig. 5.2 shows the study results. As illustrated, ground heights have been set at +4.0 m for the reclaimed land; +5.0 m for the power plant, raw materials yard and for coke ovens; and +6.4 m for the blast furnace, blooming, slabbing, and steelmaking sectors. In prescribing ground heights, economically efficient land formation (reclamation) was considred. It is necessary to determine the ground heights on the basis of more accurate topographic surveys and sounding to be made in the future.

Fig. 5.2 Ground heights based on rough survey drawing

CHAPTER 6

RAW MATERIALS

CHAPTER 6 RAW MATERIALS

6.1 Iron ore

6.1.1 Domestic iron ore resources

The data submitted by the Bureau of Mines and MIRDC (Metal Industries Research and Dvelopment Center) estimate the iron ore reserves in the Philippines at approximately 100 million tons and iron sand reserves at about 60 million tons.

Currently, however, iron ores are scarcely mined excepting iron sand.

Larap, the largest Philippine iron mine in the past, has been closed since 1974 on account of lowering ore grade and because of rising costs after the oil crisis. Santa Inez, long believed to replace Larap, has been studied on several occasions for its feasibility but its development is yet to be officially decided.

The proposed construction of the integrated steelworks will possibly expedite the development of domestic resources. But as things stand now, prospects of such exploitation are not at all definite. The present study, therefore, is premised on the idea that all iron ores are to be imported with the exception of indigenous iron sand.

6.1.2 Iron ore imports

Iron ores will be imported from Australia and Brazil, the two import sources for P.S.C. (Philippine Sinter Corporation), plus India, a new source, which is geographically at a short distance. These imports are planned to be made in the form of pellets, lump ores and fine ores. Burdens charged to blast furnace will comprise 80 percent of sinter and pellets and 20 percent of sized lump ores. The size ores will be used also in the steelmaking plant.

In determining the amount of iron ore purchases, the amount of pellets is first determined such that together with sinter, pellets constitute

80 percent of ore charges into the blast furnace. The amount of sized ore requirements is then obtained, followed by the determination of the amount of lump ores from the yield of sized lumps in the sizing plant. The amount of fine ore requirements can be calculated from sinter feed requirements and quantities of screened fines generating from pellets and lump ores. The amounts of brandwise use of lump and fine ores are to be suitably adjusted considering their chemical composition.

Table 6.1 shows the amounts of ores consumed in accordance with their uses.

Table 6.2 depicts the chemical analysis of the iron ores to be used in the current project.

Table 6.1 Ore consumption by uses

	Sintering (Fines)	Blast furnace (Lumps)	Steelmaking (Lumps)	Totals	Remarks
Pellets	17,000	330,000	-	347,000	
Lump ore	275,000	313,000	21,000	609,000	
Fine ore	400,000	-	-	400,000	
Imported iron ore	692,000	643,000	21,000	1,356,000	
Sinter	80,000	920,000		1,000,000	
Sinter plus pellet		1,250,000			
Ore for BF charge		1,563,000			

Table 6.2 Chemical analysis of iron ores

	Chemical analysis			
	Fe	SiO_2	Al_2O_3	TiO_2
Australian pellet	63.8	4.93	2.99	0.13
Australian lump ore	64.8	3.15	1.67	0.07
Brazilian "	66.4	2.18	0.95	0.07
Indian "	63.0	3.01	3.29	0.14
Australian fine ore	61.4	6.25	2.89	0.12
Brazilian "	65.4	4.67	0.88	0.12
Indian "	61.3	3.95	3.56	5.86

6.1.3 Production of sinter

Situated adjacent to the construction of the new steelworks, P.S.C. has a sinter plant and raw material unloading equipment and manufactures sinter for Japan on commission.

Under the new steelworks project, the unloading of iron ores and the production of sinter will be entrusted to P.S.C. with the exception of sintering fuels and limestone, all other relevant raw materials are to be procured by the steelworks to supply them to P.S.C. in the form of composite materials. Commissions to be paid for sinter production should be the same with those for the sinter destined for Japan.

6.2 Coals

6.2.1 Domestic coal resources

According to data of the Philippine Bureau of Mines and of MIRDC, the coal reserves in the Philippines are estimated at around 100 million tons. Most of these coals are non-coking coals unfit for the production of coke for blast furnace. Among many mines Lumbog mine in Malangas district, southeast of Mindanao, alone is said to have tapable soft coking coal deposits. Lumbog mines are reported to have coal deposits amounting to approximately 2.5 million tons but no prospects of their tapping are in sight.

In this study, coking coals are assumed to be imported. But if domestic soft coking coal is available, it may replace imported soft coking coal in amounts reaching 100 thousand tons/year.

6.2.2 Coking coal imports

As a source of coking coal imports, Australia is geographically the closest to the Philippines. However, from the experience in Japan, blending of U.S. coal, of a low volatile type in particular, is indispensable to give necessary strength to coke for the blast furnace. Accordingly, in the present study, Australian coals are presumed to be used in the main, with U.S. coals added thereto in amounts required. Tablé 6.3 shows a blending schedule for coking coals.

Table 6.3 Coking coal blending schedule

Kind of coal	Blending ratio (%)	Annual consumption (dry t)	Ash content (%)	Sulfer content (%)	Volatile matter (%)	Notes
U.S. (L.V.)	8	64,000	7.0	0.69	18.9	
(M.V.)	15	120,000	7.3	0.82	30.0	
Australian (Hard)	25	199,000	10.5	0.40	19.5	
(Semi-hard)	40	319,000	8.8	0.68	32.0	
(Soft)	12	96,000	9.1	0.63	38.0	
Totals	100	798,000	8.9	0.63	28.2	

For the unloading of coking coal, an exclusive coal berth will be used instead of the P.S.C.'s raw materials berth. This is because the occupied time of the P.S.C.'s wharf, and operating time of unloaders are likely to substantially increase in the future, and accordingly shipping congestion and demurrage are to be prevented, and so is the possibility of iron ores mixing with coking coal as a result of the common use of the unloader and of conveyors.

6.3 Limestone

6.3.1 Limestone for sintering

Currently, P.S.C. mines limestone on Bohol Island to use it as materials for sinter production. In this situation, costs of the limestone required for the manufacture of self-fluxing sinter should be included in the costs of production on commission.

6.3.2 Lump limestone

The limestone for blast furnace or for steelmaking use must be non-crystalline, impurities-scant lumps sized to 10 -- 30 mm.

The Bohol limestone now used at P.S.C. is also non-crystalline and is of high grade. But since it is supplied to the sinter plant as run-of-mine, an investment is called for to fund the addition of a crushing and screening equipment at the mine, so as to obtain sized limestone from run-of-mine.

According to the information of P.S.C, Bohol limestone is low in lump yield. If so, to obtain desirable lumps, substantial amount of crushing and screening may be necessary, as well as a study to balance lump/fine demands.

Bohol limestone has no calcining records, and therefore, before its use in a lime plant, it is desirable to subject it to calcining tests. In the present study, Bohol limestone is supposed to be purchased in the form of sized lumps, with its prices assumed to rest somewhere between the existing crude limestone costs for P.S.C. and the estimated prices of sized lumps to be supposedly imported from Japan.

As for the supply of quality lump limestone, the Philippine side should continue the effort to promote survey and study regarding this matter.

6.4 Other raw materials

6.4.1 Other ironmaking materials

For adjustment of chemical composition of pig iron and of slag, it is necessary to use manganese ore, serpentine or dolomite, and quartzite.

The Philippines has many manganese ore mines, but their reserves are moderate and for economic reasons, their operations have mostly been discontinued. The present study presupposes the import of manganese ores from India but the construction of the steel plant may leave doors open for the revival of indigenous manganese ore mines.

As regards MgO source, serpentine or dolomite are necessary. In the present study, domestic dolomite, whose exploitation plan in Cebu Island is underway, is presumed to be used. However, if serpentine is available, it is possible to conserve the use of quartzite. Therefore, survey and development of serposition quarry should be promoted by Philippine government.

Quartzite as SiO_2 source also abounds domestically and the development of its deposits is considered to be comparatively easy in Bohol Island and at other points in proximity. The use of this quartzite is therefore considered in this study.

As concerns the development of quartzite mines, the Philippine side is required to study and expedite the exploitation.

6.4.2 Other steelmaking raw materials

Steelmaking raw materials should include ferroalloys, fluorite, soda ash, and scrap.

In the Philippines, MCCI (Maria Cristina Chemical Industries Inc.) is the only manufacturer of ferroalloys. A joint venture however is being planned to produce ferroalloys. Accordingly, the steelworks in Mindanao is to depend on domestic sources for ferroalloy supplies. In the present study, however, import prices have been used with some of the ferroalloys whose domestic prices are not on record.

Fluorite is supposed to be imported from Thailand, but its import from China is feasible.

Soda ash to desulfur molten irons is to be imported.

If home scrap does not suffice, scrap requirements will be supplemented by imports.

CHAPTER 7

GENERAL PLANT DESCRIPTION

CHAPTER 7 GENERAL PLANT DESCRIPTION

7-1. Basic concept

In its basic oncept, the equipment program in the present preparatory feasibility study is limited within the scope of the first stage plan (single blast furnace operation stage) with production capacity scheduled corresponding with the basic production balance diagrammed in Fig. 4-1.

The following is the outline of equipment sets.

(1) Land reclamation

Land reclamation and preparation is the building up of a basis for the construction of the steel plant and must be therefore preceded before all other construction works.

The total area of the new steelworks site is approximately 6.51 million m^2, of which 6.06 million m^2 is to be purchased on land and 450 thousand m^2 is to be reclaimed from the sea.

The area of site necessary for the first phase is planned to cover approximately 3.18 million m^2, most of which is natural land but the remaining approximately 120 thousand m^2 must be reclaimed from the sea. The ground level of the steelworks site must be high enough to prevent the site becoming water-logged either by sea waves or high tides from the sea area in front or by floods from the rear so that the steelworks can fully function as such. In preparing the land, earthwork balance (scheme of haul) must be considered in order to preclude the necessity of bringing earth in from outside the construction site. Ground level heights will be set as follows.

Berth area	M. L. L. W.	+ 4.0 m
Raw materials area (including coke plant area)	"	+ 5.0 m
Blast furnace and steelmaking area	"	+ 6.4 m

Major drainage canals must be open channels excavated without timbering on the site peripheries in consideration of future expansion needs and construction costs, and must drain the site and its outside peripheral areas.

Another drainage canal to run along the northern side of the ore yard will be used as permanent facilities in common with the captive power plant, to drain seawater and other effluents, and must therefore be of concrete structure.

(2) Port facilities

On Macajalar Bay, a large-sized berth (water depth -23 m x length 351 m) has already been built by P.S.C. in anticipation of the integrated steelworks project, and is accepting iron ore and limestone for the P.S.C.'s sintering plant. This berth will be utilized by the new steelworks also when it accepts these raw materials. During the first stage, a coal and scrap unloading berth, a heavy oil unloading dolphin, and a product loading berth will be installed. During the construction periods, a berth for the receipt of construction materials will be needed, but it is excluded from the present considerations on the understanding that a public berth shall be provided.

Bank revetments will be limited to the minimum and will be planned in two types: a permanent revetment to comply with intended objects and a tentative revetment to serve future plans. For lighterage limits, a minimum expanse of waters in front of berths will be planned to facilitate the incoming and outgoing ships — covered in the first phase — to come alongside or leave the berths.

(3) Loading and unloading facilities

For raw material unloading equipment, two unloaders (capacity 500 t/hr/each) will be furnished on the coal berth to unload coals, scrap, and miscellaneous materials. For product loading equipment, two loaders (lifting load 20 t/each) will be provided to load ingot, slabs and billet.

For the transportation of scrap and miscellaneous materials from the coal berth, and for the shipping of ingot, slabs and billets to the product berth, use of road transport will be the rule, for which purposes necessary automotive vehicles will be planned.

(4) Raw material handling facilities

The raw material handling facilities are intended to accept, store, size, blend, and supply ores, coals, limestone and other raw materials, and comprise a stacking/reclaiming system-based crude ore yard, a coal yard, a sinter/miscellaneous materials yard, a blending yard, and sizing equipment. P.S.C. will be entrusted with the production of sinter, but since chemical composition differs between sinter for Japan and that for the new steelworks, their simulataneous production will be difficult. For this reason, sinter for the new steelworks is planned to be manufactured once a month in amounts enough for one month's supply and be stored for subsequent delivery.

The storage capacity of each yard is planned as follows on the basis of the assumption of each material's maximum necessary stock level.

Yard	Storage capacity
Ore yard	360,000 t
Coal yard	270,000
Sinter/miscellaneous materials yard	360,000
Blending yard	90,000

(5) Coke oven plant and by-product plant

A coke oven must have a capacity to produce blast furnace coke (lump coke 502,000 t/year) by one battery (38 ovens x 2).

The by-product plant consists of equipment to recover coke oven gas (hereunder called C.O.G.), tar, light oil, and other by-products; gas delivery equipment for ammonia gas and ammonia liquor treatment; an ammonia cracker; and biological treatment facilities.

After cracking, the ammonia content of a C.O.G. is burned in a boiler to let out into the air.

(6) Blast furnace plant

One blast furnace will produce 965,000 tons of pig iron per year. The blast furnace's profile is inner volume: 1,800 m^3, hearth diameter: 9,400 mm, number of iron tapholes: 2, number of slag notches: 2, and number of tuyeres: 24. Three hot blast stoves are to be provided with blast temperature of 1,050 °C. To treat blast furnace gas (hereinafter referred to as B.F.G.), a gas cleaning equipment will be installed. Slag treatment will be made on a dry-pit system. To anticipate converter and/or continuous caster shut-down, a pig casting machine (capacity: 35,000 t/month) will be provided to cast molten iron into pig.

(7) Lime calcining plant

In order to burn lime stone to produce quick lime required for converter operations, one calcining furnace of 250 t/day capacity will be provided.

The calcining furnace will be of a rotary kiln type, in which quick lime is transferred from a storage bunker directly to the flux hoist equipment in a converter shop.

(8) B.O.F plant

The B.O.F plant will have two 110 t/heat converters installed to achieve a production level of 1,050,000 t/year (molten steel bases). The mode of operation will be the 1/2 operation system, in which one converter operates while the other is under maintenance. In the future, when another converter may well be afforded as the present plan anticipates, the 2/3 operation system will be adopted, where two converters operate while one is under maintenance. For converter waste gas treatment, a noncombustion type will be taken, and in consideration of equipment cost curtailments and a gas balance, the gas is not recovered but is burned and disposed into the atomosphere. Hot metal is transfereed to the converter shop by a torpedo car, and then poured into the hot metal ladle inside a pit.

Flux will be kept in an underground bunker outside the shop and will be hoisted to the converter top by means of a belt conveyor.

B.O.F. slag will be brought out to slag yard by slag pot car on rail.

(9) Continuous casting plant and ingot-making facilities

For continuous casting plant, two 1-strand continuous casting machines will be installed to produce slabs for hot-rolled coils and slabs for plates in amounts reaching 648,000 t/year (slab base). In addition, one 4-strand continuous casting machine will be installed to cast 206,800 t/year (bloom base) blooms for billet production.

The cast slabs and blooms sizes will be as follows.

	Thickness	Width	Length
Slabs	200 x	(900 1,900) x	(5,000 6,000) mm

	Cross section	Length
Blooms	200 x 260 x	5,000 (Max) mm

Slabs for hot rolled coils are to be cast in multiple widths of six feet (6') and because their slitting into smaller widths can be made more advantageously at NASCO, provision of slitting equipment is not considered inside the new steelworks.

Slabs for plates will be cast in a maximum length of 6,100 mm. For the same reason as above, the secondary cutting of these slabs is to be made by the plate maker, and accordingly no cutting equipment will be provided in the new steelworks.

Ingot making facilities will be prepared to make steel ingots of the materials unfit for continuous casting, to serve as an emergency standby for continuous casters, and to ensure continued steelmaking operations during a start-up of cintinuous casters.

The ingot-making facilities are of a top-pouring type, and capacity of maximum 13 heats/day (approx. 37,500 t/month) is planned.

(10) Billet mill plant

The capacity of the billet mill is planned such that 220 x 260 mm (cross section) blooms are processed into 115φ, 80φ, and 50φ billets at a ratio of 25 : 25 : 50 for these sizes, the amount of the billets thus produced reaching 198,500 t/year. One reheating furnace (capacity: 40 t/hr) will be installed. Blooms are cold charged in the reheater, for whose fuel C.O.G. will be exclusively used.

For billet mills, one reversible roughing mill and two continuous finishing mills will be arranged. 80φ and 115φ billets will be rolled on the roughing mill, whereas 50φ billets will be rolled, first on the rougher and then on the finishing mills.

Also planned, depending on trends of billet sizes, is the addition of two more finishing mills to increase capacity. Billet length is planned at 5,000 mm for each size and no scarfing is to be made.

(11) Power receiving and distribution facilities

The power receiving and distribution facilities include a plant-wide power receiving unit (primary power source), a power distribution unit, a telephone equipment set, and a tentative power supply.

Power receiving voltage (primary voltage) is 138 kV, whilst power distribution voltage (secondary voltage) is set at 34.5 kV considering estimated power consumption in the future and economic efficiency.

The 138 kV power receiving equipment is planned on a two circuit basis in order to preclude the occurrence of total power failure during maintenance, inspections, or troubles.

The 34.5 kV power distribution unit will be on a double bus basis, in which power is divided between utility power system (purchase) and captive power system (power generating).

(12) Power plant and B.F. blower plant

In order to effectively utilize steelworks' B.F.G. and C.O.G., a blast furnace blower as well as a power generating plant will be installed. They will form two units of a most economical turbin-generator-blower system.

Normally, these units operate as follows.

	Turbine output	Generator output	Blower axial input
No.1 unit	23,000 kW	12,000 kW	11,000 kW
No.2 unit	23,000	23,000	-
Totals	46,000	35,000	11,000

(13) Oxygen plant

Oxygen producers (6,200 Nm^3/hr x 2) will be installed to generate and supply oxygen gas, nitrogen gas and argon gas for in-works consumption. A liquid oxygen equipment will be installed to secure 70 percent of oxygen gas generation and to enable continued oxygen gas supply when one of the oxygen producers is in trouble or during periodical repairs (14 days).

(14) Gas, heavy oil, and steam equipment

This equipment is designed to supply B.F.G., C.O.G., heavy oil, and steam, and for its efficient operations, a fuel distribution center is installed. For effective gas utilization, a B.F.G. holder (40,000 m^3 x 1) and a C.O.G. holder (30,000 m^3 x 1) are furnished to absorb fluctuations in the amounts of generation and of consumption of B.F.G. and C.O.G. To cope with abrupt variations, each holder is provided with a combustion/dispersion tower. To supply steam for general purposes, lower pressure boilers (7 t/hr x 2) will be installed. When large quantities of steam are required as during a blast furnace blow-off, steam is supplied at reduced pressure and temperature from the power plant's high pressure boilers.

(15) Main piping system

The main piping system comprises the pipe arrangement (including blast furnace blowpipe) of utility equipment, leading up from a point of generation to points of use, and is planned on an aerial route basis.

Planned capacity is set to a level required during the first stage, but with regard to main routes for part of B.F.G. and for C.O.G., considerations are given up to and including the second stage.

(16) Water supply equipment

The water supply equipment concerns beyond the industrial water receiving pond, as well as seawater intake, treatment, and supply.

For industrial water, 33,000 m^3/day of water is received in a receiving pond (60,000 m^3 x 1) for delivery to points of use through an elevated water tank.

Seawater is taken in (intake: 21,000 m^3/hr) at a deep point of the sea near the coal berth jetty and is pumped to points of consumption in two routes, i.e., a power plant route and a coke plant oxygen plant blast furnace route.

Planned capacity is set at a level required during the first stage, but as concerns the industrial water receiving pond and the seawater conducting facilities, their capacity is planned to involve the second stage also.

(17) Water recirculation facilities

Water recirculation facilities are to be installed independently at seven points (blast furnace, coke/by product plant, B.O.F., continuous casting, lime calcining, billet mill, and oxygen plant) in close proximity to each plant. The capacity is planned at a level sufficient for the first stage.

Water recirculation facilities are planned to be compatible with the required quantity and quality of each plant at 35°C basically. The temperature of water for such equipment as BOF gas treatment, lance, and a part of dust collectors was planned at above 40°C.

(18) Transportation facilities

In materials-handling between plants or shops, railroad transport is to be the rule for the handling of certain weighty, high temperature loads, namely molten iron, B.O.F. slag and ingot, whilst road transport should be resorted to for the handling of all other materials. For molten iron transport, 200 ton capacity torpedo cars are used, their track gauge being planned at 1,435 mm considering the use of large-sized vehicles. For road transport vehicles, trailors are planned to haul blooms and the materials for under maintenance, and mainly dump trucks, to carry other items.

(19) Maintenance shop

Maintenance shop should be on a scale required for normal maintenance works. As a rule, special maintenance equipment sets (high quality items or large-sized items) and spare parts are planned to be purchased.

Maintenance setup should be on an independent centralized system, which is roughly divided into central maintenance station and local maintenance shops. Under the central maintenance station, apparatus and equipment are repaired and/or manufactured. The central maintenance station comprises a plant concerned with foundry, forging, metal forming and machining, plus another plant involving repairing of machinery, vehicles, electrical equipment/instrumentation, civil engineering facilities.

On the other hand, the local maintenance shops are divided into seven areas, and are deployed in major plants to conduct inspections, maintenance, and servicing.

(20) Testing and analysis equipment

Testing and analysis equipment is planned within a range of requirements of normal operations in the new steelworks.

This equipment includes raw materials testing equipment to conduct raw materials acceptance tests and to exercise raw materials quality control. Also to be included is an analysis equipment whereby blast furnace and converter operations are controlled, chemical products are inspected, and ingots, slabs and billet, checked for chemical composition.

7-2. General layout

7-2-1. Space

The general layout of the greenfield steelworks is to be studied on the basis of an approximately 6.51 million m^2 of space provided by the Philippines in Tagoloan Villanueva, Mindanao Island.

Already, in the neighborhood of this area is operating a sinter plant of P.S.C., whose sea berth has also been built for raw materials acceptance. In preparing the layout, its scope is limited, for the time being, to a production capacity of about 2 million tons set for the second stage, with as much space as possible left for future use.

7-2-2. General arrangement

As mentioned earlier, the existence of a sinter plant and the fact that an effective coastline runs only in one direction limit the number of general layouts to emerge. The best approach may be to install a raw materials yard adjacent to the P.S.C.'s yard and to arrange the subsequent plants and equipment in a shape of letter U as in Fig. 7-1, so as to facilitate the materials flow and physical distribution from raw materials receptions to products shipments. Raw material, coke oven, blast furnace, steelmaking and billet mill plants are all laid out compactly and effectively.

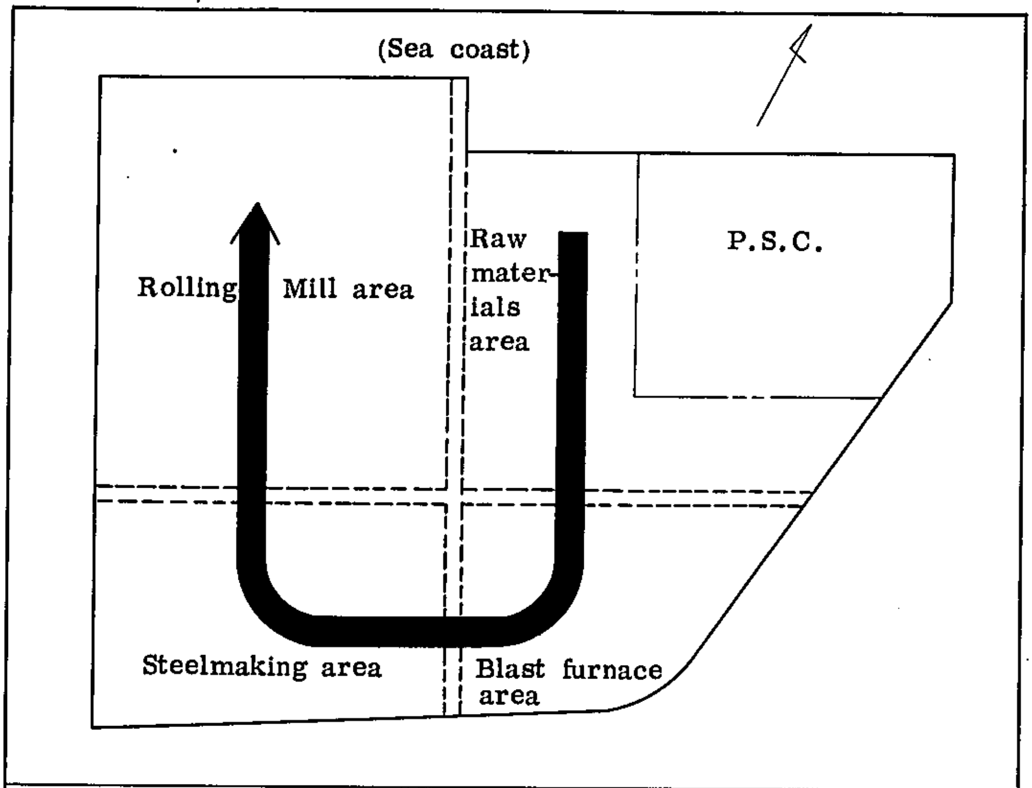


Fig. 7-1 General arrangement plan

7-2-3. Features of the layout

The general layout given in Fig. 7-2 features the following points.

(1) Raw materials

Raw materials are to be received at P.S.C.'s existing raw material berth by means of belt conveyors. A raw materials yard to accept the materials is arranged parallel to the neighboring P.S.C.'s yard.

As a coal berth, a -13 m x 270 m berth is planned on the northeast side of the yard. In planning, spatial allowance should be made for the possible doubling of P.S.C.'s existing raw materials berth capacity.

(2) Coke oven

The coke oven is compactly arranged between raw materials yard and blast furnace plant, in order to simplify the coal and coke transport routes.

(3) Blast furnace

The No. 1 blast furnace is located close to the converter plant. Molten iron is planned to be directly transferrable to the B.O.F. on a torpedo car without the shunting of engines.

(4) B.O.F. plant and CC plant

In the steelmaking area, the B.O.F. plant, the continuous casting (CC) plant, and the lime calcining plant are efficiently arranged so as to make direct transfer of quick lime possible. The ingot making yard is compactly arranged in employing cross-traversing teeming wagon system. Ingot yard is provided outside the converter shop. Railroad transport serves up to the ingot yard, whence a trailer serves as far as the berth. B.O.F. slag is planned to be transported by rail, slab and bloom, by trailors.

(5) Billet mill

For the first stage, the only plant to be built in the rolling mill area is a billet mill. In case a wire rod mill etc., is coupled directly to the rear of the billet mill in future, the present layout will have to be reviewed. For the rolling mill area, a maximum of area has been reserved to afford the construction of any type of rolling mills in the future. (For example, a hot strip mill is laid out in Fig. 7-2.)

(6) Auxiliary equipment

1) To facilitate product shipments, a major road plan is considered and a product berth is planned in rear of the coal berth.

2) Railroad transport is minimized and the track is made as short as possible.

3) A power station doubles as a primary substation and is to be situated in the rough center of the steelworks, i.e., central to working loads.

4) Water recirculation facilities are to be provided separately at each plant.

5) On consultation with the Philippine side, the central maintenance station is furnished not inside but close to the outside of the steel-works. This is meant to effectively secure as much space as possible inside the works premises in light of the relationship with related industries and in view of future plans yet to take shape.

Fig. 7-2 General Layout

7-3. Main specifications

The major specifications of each item of equipment to be installed in the first stage of new steelworks construction are as follows.

Table 7-1 Major specification of each equipment item

Equipment	Quantities	Major specification
1. Land preparation and reclamation		
Purchased land	6,058,000 m^2	Includes 2,992,000 m^2 for the future
Reclaimed and otherwise prepared land	3,184,000 m^2	From (land area) 3,065,000 m^2 From (sea area) 119,000 m^2
Drainage canal construction	1 set	Open drainage canal Length: 16,850 m
2. Port facilities		
Coal berth	270 m	Water depth: -13.0 m (Type of ship covered: 50,000 D/W) Pipe pile type
Product berth	330 m	Water depth: -7.0 m (Type of ship covered: 5,000 D/W) Sheet pile type
Heavy oil berth	1 berth	Water depth: -5.0 m (Type of ship covered: 2,000 D/W) Dolphin type
Revetment	1 set	Frontal revetment -10 m x 120 m Attached revetment -3.0 m x 200 m Masonry revetment 590 m
3. Loading and unloading facilities		
Unloader	2 units	Capacity 500 t/hr Horizontal luffing crane
Loader	2 units	Capacity 20 t Bridge crane
Transportation	1 set	35 t trailer x 7, Tractor x 3, Forklift x 1, Bulldozer x 3, Truck crane x 2, 18 t Dump truck x 3, 2 t Truck x 1
4. Raw material handling facilities Ore yard	1 group	Ore storage capacity 360,000 t Receiving conveyor 3,600 t/hr x 1 line Stacker 3,600 t/hr x 1 unit Reclaimer 800 t/hr x 1 unit Delivery conveyor [illegible] t/hr x 1 line
Sizing equipment	1 set	Crushing and screening equipment 400 t/hr

Equipment	Quantities	Major specification
Sinter and miscellaneous materials yard	1 group	Storage capacity 360,000 t
		Receiving conveyor 800 t/hr x 1 line
		Stacker 800 t/hr x 1 unit
		Reclaimer 800 t/hr x 1 unit
		Delivery conveyor 800 t/hr x 1 line
Blending yard	1 group	Storage capacity 90,000 t
		Receiving conveyor 1,500 t/hr x 1 line
		Stacker 1,500 t/hr x 1 unit
		Reclaimer 1,500 t/hr x 1 unit
		Delivery conveyor 1,500 t/hr x 1 line
Coal yard	1 group	Storage capacity 270,000 t
		Receiving conveyor 1,000 t/hr x 1 line
		Stacker 1,000 t/hr x 1 unit
		Reclaimer 300 t/hr x 1 unit
		Delivery conveyor 300 t/hr x 1 line
5. Coke/by-product plant		
Coal blending bin	16 bins	Capacity 200 t/bin
Coke oven	76 ovens	Coke chamber volume 5,000 mm(H) x 430 mm(W) x 15,800 mm(L)
		Effective inner volume 29.6 m^3/oven
Coke transportation equipment	1 system	Belt conveyor capacity 180 t/hr
Gas cooler	4 unit	Type: Indirect vertical water pipe
		Gas treatment volume 11,500 Nm^3/hr-unit
Ammonia cracking	1 set	Type: Carl still type
		Final gas cooler 35,000 Nm^3/hr x 1 unit
		Ammonia scrubber 35,000 Nm^3/hr x 2 units
		Ammonia still 20 m^3/hr x 1 unit
Light oil recovery equipment	1 set	Type: Petroleum series absorption oil scrubbing
		Benzene scrubber 35,000 Nm^3/hr x 2 units
		Light oil distillation 80 m^3/hr
Bilogical treatment facilities	1 set	Capacity 480 m^3/day
6. Blast furnace equipment		
Blast furnace	1 unit	Inner volume 1,800 m^3 Hearth diameter 9,400 mm
		Cooling of the furnace proper : Stave cooling
		Furnace support : Free standing type
		Iron taphole x 2, Slag notch x 2, Tuyere x 24
		Charging system : Belt conveyor

Equipment	Quantities	Major specification
Hot blast stove	3 units	Cowper type Blast temperature 1,050°C
Gas cleaning equipment	2 units	Venturi type, Wet type gas cleaner
Ore bunker	1 set	270 m^3 x 6 bins 90 m^3 x 6 bins
Coke bunker	1 set	400 m^3 x 4 bins
Slag treatment equipment	1 set	Dry pit 21,000 mm(W) x 40,000 mm(L) x 3
Pig casting machine	1 unit	Fixed roller type Capacity 35,000 t/month
7. Lime calcining plant		
Limestone receipt/ water-washing equipment	1 set	Capacity 200 t/hr
Limestone storage silo	1 unit	Storage capacity 600 t
Calcining furnace	1 unit	Type : Rotary kiln Approx. 3,000 mmø x 47,000 mmL Capacity 250 t/day Fuel COG
Product bunker	1 set	1,800 t
8. B.O.F Plant		
Converter	2 units	Capacity 110 t/heat Inner volume Approx. 107 m^3
Lance and lance hoist rigs	1 set	Quick change type Oxygen delivery capacity Max. 28,000 Nm^3/hr
Waste gas treatment	2 units	Type : Noncombustion type Amount of waste gas : Approx. 66,000 Nm^3/hr Dust content of waste gas : 0.1 gr/Nm^3 Induced draft fan : 66,000 Nm^3/hr x 2 Combustion/dispersion stack : Height 75 m
Flux transportation equipment	1 set	Underground bunker, Belt conveyor system
Hot metal charging ladle	3 units	Capacity 120 t
Hot metal weighing car	2 units	Capacity 180 t
Steel ladle	15 units	Capacity 110 t
Steel ladle car	2 units	Capacity 180 t Motor-driven self-propelled type
Crane	7 units	Hot metal charging crane 180 t/30 t x 1 unit Scrap charging crane 60 t/50 t x 1 unit Scrap loading crane 15 t x 2 unit Steel ladle service crane 60 t/20 t x 1 unit and others

Equipment	Quantities	Major specification
9. Continuous casting Plant & ingot making facilities		
(1) Continuous casting plant		
Continuous slab caster	2 units	Type : Low-head curved mold type Number of strands : 1 Slab dimensions : Thickness 200 mm x Width (900～1,900) mm x Length (5,000～6,100) mm Casting speed Max. 1.5 m/min
Continuous bloom caster	1 unit	Type : Low-head curved mold type Number of strands : 4 Bloom dimensions : 220 mm x 260 mm x 5,000 mm Casting speed : Max. 1.5 m/min
Hot metal handling equipment		
Ladle turret	3 units	Capacity 180 t, 1 r.p.m.
Tundish and tundish car	1 set	
Cast slab/bloom delivery equipment		
Roller table	1 set	For slab : 2 units, For bloom : 4 units
Pusher	4 units	For slab : 30 t x 2 units, For bloom : 50 t x 2 units
Piler	2 units	Capacity 30 t (slab)
Cooling bed	4 units	For slab : 20 m x 50 m x 2 units For bloom : 5 m x 10 m x 2 units
Crane	20 units	Molten steel ladle crane 180 t/30 t x 2 units Continuous caster service crane 120 t/40 t x 1 unit Slab delivery tong crane 30 t x 2 units " lifting magnet crane 20 t x 2 units Slab scarfing lifting magent crane 20 t x 2 units Bloom delivery lifting magnet crane 10 t x 1 unit and others
(2) Ingot making facilities		
Teeming car	8 units	Capacity 100 t Self-propelled type Teeming line 4 tracks
Stripper crane	1 unit	Capacity 35 t
Mold cooling bed	1 set	400 m^2

Equipment	Quantities	Major specification
10. Billet mill plant		
Reheating furnace	1 unit	Type : Pusher type Capacity : 40 t/hr Fuel : Exclusively COG firing Recuperator : Stack type metallic recuperator
Rolling mill equipment		
Rougher	1 unit	Type : Reversing 2-high mill Roll dimensions : 1,100 ø x 3,000 mm L Motor : DC 2,000 kW
Finishing mill	2 units	Type : Continuous 2-high mill Roll dimensions : 700 ø x 1,200 mm L Final rolling speed : Max. 2.5 m/s Motor : DC 500 kW
Shear	2 units	Small shear x 1 (Motor-driven downcut type) Maximum shearing dimensions 150 □ø Flying shear x 1 (Motor-driven rotary type) Maximum shearing dimensions 80 □ø
Cooling equipment	1 set	Pusher x 2 Cooling bed x 2 Bundling machine x 2
Crane	8 units	Bloom receiving beam crane 10 t x 1 Bloom delivery lifting magnet crane 10 t x 1 Rolling mill crane x 2 (30 t x 1, 20 t x 1) Electric room crane 30 t/5 t x 1 Roll shop crane 50 t/10 t x 1 Billet delivery lifting magnet crane 10 t x 2
11. Power receiving/ distribution facilities		
Power receiving equipment (Primary power receiving unit)	1 set	Primary voltage 138 kV, Double bus Distribution (secondary) voltage : 34.5 kV, Double bus Transformer : 30 MVA x 2 units
Power distribution equipment (Secondary power distribution unit)	1 set	Cable length Approx. 8,100 m
Telephone exchange equipment	1 set	Automatic exchanger x 1, Telephone x 500

Equipment	Quantities	Major specification
12. Power plant and B.F. blower plant		
Boiler	2 units	Capacity 95 t/hr
Steam turbine	2 units	Output 23,000 kW, 3,600 r.p.m.
Generator	2 units	Output 23,000 kW, Voltage 11,000 V
Blower	2 units	Normally 2,710 Nm^3/min x 3.2 kg/cm^2 Axial input required 11,000 kW
Pressure/temperature reducer (Emergency use)	1 unit	Steam volume 30 t/hr
13. Oxygen plant		
Air separation equipment	2 sets	Raw air compressor 38,500 Nm^3/hr x 5.1 kg/cm^2 x 2 units Air separator O_2 = 6,200 Nm^3/hr x 2 units N_2 = 2,500 Nm^3/hr x 2 units
Compressed oxygen gas delivery equipment	2 units	Medium pressure oxygen compressor 6,200 Nm^3/hr x 5 kg/cm^2 x 2 units High pressure oxygen compressor 6,200 Nm^3/hr x 30.5 kg/cm^2 x 3 units
Argon rectifier	2 sets	Argon rectifying tower 30 Nm^2/hr x 2
Nitrogen gas compressor	2 units	2.500 Nm^3/hr x 6.0 kg/cm^2
Liquid oxygen equipment	1 set	Liquid oxygen storage tank 1,000 t Oxygen pump 2,500 Nm^3/hr x 1
14. Gas/heavy oil/steam equipment		
B.F.G. equipment	1 set	B.F.G. holder 40,000 m^3 x 1 unit Combustion/dispersion tower 160,000 Nm^3/hr
C.O.G. equipment	1 set	C.O.G. holder 30,000 m^3 x 1 unit Combustion/dispersion tower 34,000 Nm^3/hr Blower 6,000 Nm^3/hr x 2 units
Heavy oil equipment	1 set	Fuel oil tank 3,500 t x 1 unit pump 15 t/hr x 2 units
General use boiler	2 units	7 t/hr x 12 kg/cm^2
15. Main piping equipment	1 set	B.F.G. piping : Pipe diameter 1,500 ~ 3,200 ø C.O.G. piping : " 200 ~ 1,800 ø Blast furnace blower piping : " 1,400 ø Steam piping : " 50 ~ 250 ø Fuel oil piping : " 100 ø Oxygen gas piping : " 150 ø Nitrogen gas piping : " 25 ~ 150 ø

Equipment	Quantities	Major specification
16. Water supply equipment		
Water receiving pond	1 set	Quantity of water received 35,000 m^3/day Water receiving pond 60,000 m^3 x 1
Potable water & industrial water equipment	1 set	Amount treated : Industrial water 1,460 m^3/hr Potable water 670 m^3/hr Treatment equipment x 1 set Elevated tank x 1 (Industrial water 200 m^3, Potable water 100 m^3) Potable water piping x 1 set, Industrial water piping x 1 set
Seawater equipment	1 set	Amount of intake : 21,000 m^3/hr Intake x 2 Seawater supply pump x 8 Seawater supply piping x 2 systems
17. Water recirculation facilities		
Blast furnace water recirculation	1 set	Amount of water conveyed Approx. 4,060 m^3/hr Plant feedwater pump x 11 units Cooling tower x 2 units, Thickener x 2 units Piping x 1 set
Coke/by product water recirculation	1 set	Amount of water conveyed Approx. 330 m^3/hr Plant feedwater pump x 5 units Cooling tower x 1 unit Piping x 1 unit
B.O.F. water recirculation	1 set	Amount of water conveyed Approx. 2,050 m^3/hr Water softening 80 m^3/min Plant feedwater pump x 15 units, Cooling tower x 2 Thickener x 2, Piping x 1
Continuous casting water recirculation	1 set	Amount of water conveyed Approx. 5,350 m^3/hr Plant feedwater pump x 13 units Cooling tower x 2 units Elevated tank x 2 units, Piping x 1
Lime calcining water recirculation	1 set	Amount of water conveyed Approx. 330 m^3/hr Plant feedwater pump x 8 units, Cooling tower x 1 Thickener x 1, Piping x 1
Billet mill water recirculation	1 set	Amount of water conveyed Approx. 2,140 m^3/hr Plant feedwater pump x 8 units, Cooling tower x 2 Elevated tank x 1, Piping x 1

Equipment	Quantities	Major specification
Oxygen plant water recirculation	1set	Amount of water conveyed 35 m^3/hr Plant feedwater pump x 2 units, Cooling tower x 1 Piping x 1
18. Transportation facilities		
Railroad transportation equipment	1 set	200 t torpedo car x 8 20 t slag pot car x 6 100 t ingot buggy Diesel locomotive x 6 (60 t x 5, 25 t x 1) 35 t rail-mounted disesl crane x 1 unit Railroad line 7,230 m
Road transportation equipment		11 t dump truck x 21, Tractor x 2 60 t trailor x 1, 35 t trailor x 3 20 t self-loading truck x 1 Shovel car x 3 Bulldozer x 3 Crawler crane x 2 Road : Length approx. 16,310 m (Paved area : approx. 286,000 m^2)
19. Maintenance facility		
Central office	1 unit	Building 3,000 m^2
Mechanical repair shop	1 set	Building 3,600 m^2 Hydraulic press x 2, Balancing machine x 1
Machine shop	1 set	Building 3,600 m^2 Lathe x 20, Boring machine x 5, Milling machine x 5
Structural shop	1 set	Building 3,600 m^2 Hydraulic press x 3, Bending roller x 2 Heat treating furnace x 2 units
Foundry shop	1 set	Building 6,600 m^2 Electric furnace x 3
Forging shop	1 set	Building 1,000 m^2, Air hammer x2 Furnace x 1
Electric & instrumentation rapair shop	1 set	Building 4,500 m^2
Civil/construction/ waterworks repair shop	1 set	(Building : on the mechanical repair shop premisses)
Rolling stock repair shop	1 set	Building 4,200 m^2

Equipment	Quantities	Major specification
Car repair shop	1 set	Building 2,250 m^2
local maintenance shop	7 shops	Building 1,100 m^2/shop
Warehouse	4	Spare parts warehouse 6,000 m^2 Greases and oils warehouse 500 m^2, Refractories Warehouse 7,500 m^2, General materials warehouse 2,000 m^2
20. Testing and analysis		
Raw materials testing center	1 set	Ruilding 1,204 m^2 Sample preparation device x 1 set (Jaw crusher etc.) Testing device x 1 set (Fluorescence X-ray spectrometer etc.)
Analytical center	1 set	Building 2,000 m^2 Sample preparation device x 1 set (High-speed cutter etc.) Analyzer x 1 set (Emission spectrometer etc.)
21. Office	1 set	Main office 10,000 m^2 Plant security office 1,670 m^2 Gate x 3, Fence 4,000 m

CHAPTER 8

IMPLEMENTATION PLAN

CHAPTER 8 EXECUTION PLAN

8.1. Construction schedule

The term of construction works here means a period from the commencement of the basic planning to the start-up of operations. The term of construction works with respect to individual equipment is determined on the basis of the contents and the composition of the equipment item.

Within this term of works, a period from the commencement of the basic planning through a contract award to a manufacturer is planned to cover 20 months, namely

Basic planning period	6 months	Total 20 months
Specification preparation period	4 months	
Bidding period	4 months	
Bid evaluation and contract award	6 months	

Generally, when an integrated steelworks is constructed, an entire equipment/production setup is normally arranged centering on blowing-in of a blast furnace. On fewer occasions, a rolling mill precedes all other construction considerations, with slabs etc., brought in from other steelworks to put the rolling mill-centered steel plant on-stream.

With the new integrated steelworks under consideration, however, the blowing-in of its blast furnace should preferably mark the start of the semi-products works operation in view of its objective to supply semis.

To blow in a blast furnace, it must be fed with coke, for whose supply a coke oven must normally be started up one month before the blowing-in. This in turn requires the commencement of coal acceptance and storage two months perior to the commissioning of the coke oven into use. This accordingly presupposes that raw material unloading and handling facilities should be complete by that time.

Meanwhile, since the molten iron from a blast furnace requires further treatment, a B.O.F. start-up must coincide with the commissioning of the blast furnace. Furthermore, sub subsequent production steps comprising a continuous casting machine and a billet mill should also come into production at the same period.

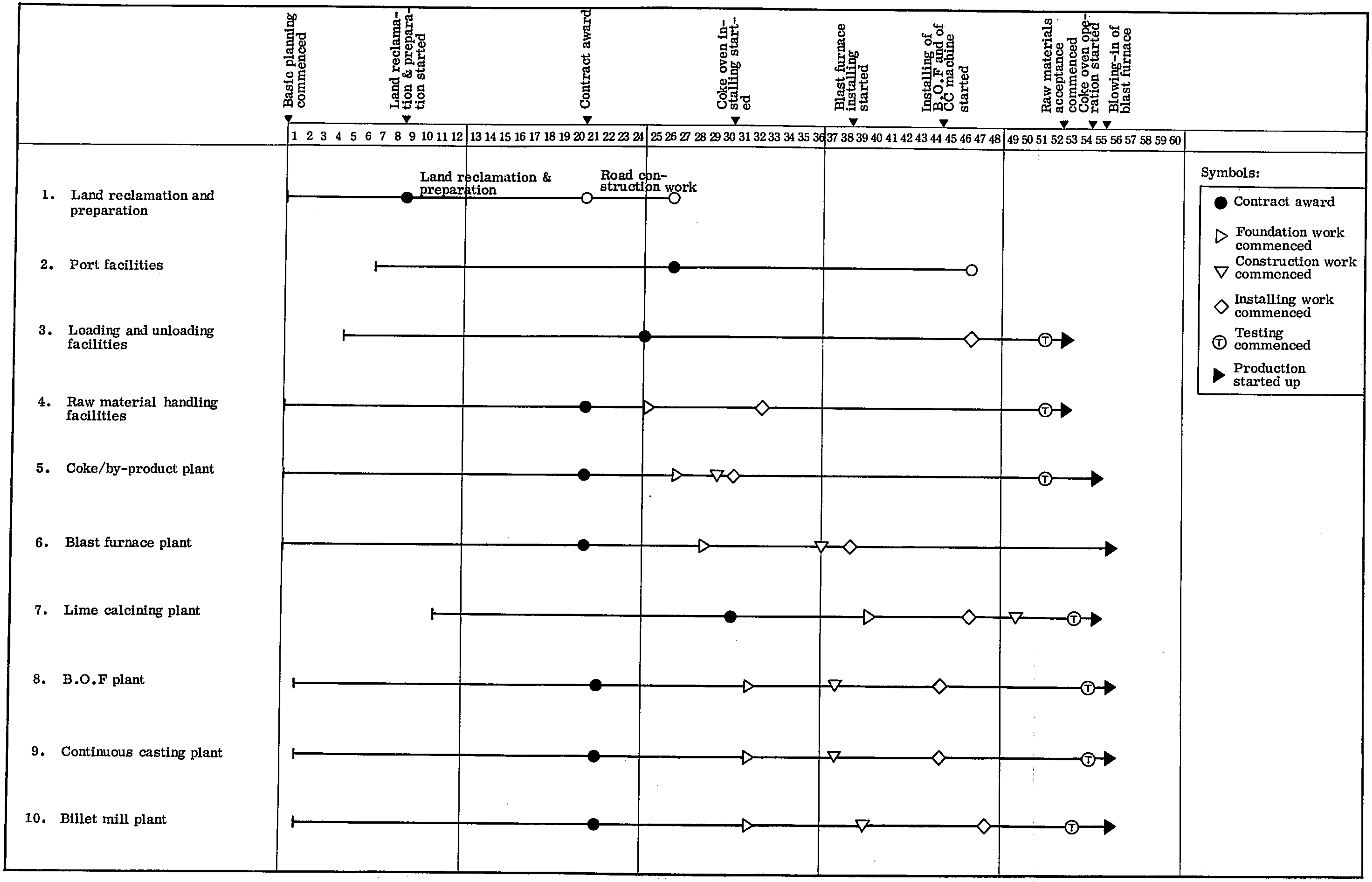
A lime calcining plant and an oxygen plant which go with B.O.F. must be prepared to start during a testing of B.O.F., in order that they become operative one month before B.O.F. start-up.

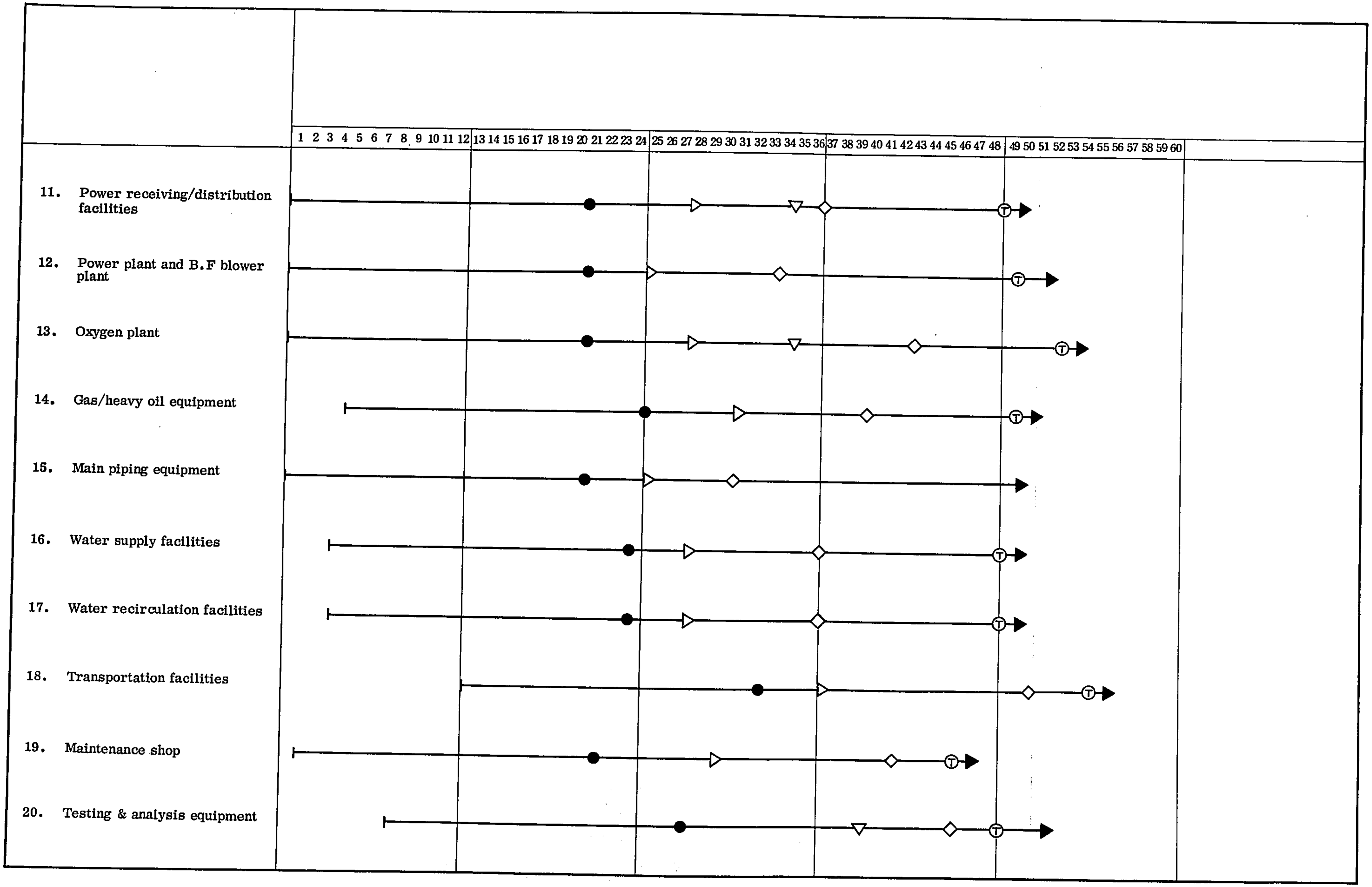
Starting periods of auxiliary facilities can be determined in correlation with the major aforementioned plants.

The engineering and construction schedule in Table. 8-1 is what emerged from the arrangement of the stages of execution of works on the above-mentioned premise. Accordingly 55 months elapse after the commencement of the basic planning, before an integrated production setup is established as intended.

The reclamation and preparation of construction site is presupposed to be prepared and completed at an earlier date without heed to the aforesaid premises.

Table 8-1 Engineering and Construction schedule




1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60
11. Power receiving/distribution facilities
12. Power plant and B.F blower plant
13. Oxygen plant
14. Gas/heavy oil equipment
15. Main piping equipment
16. Water supply facilities
17. Water recirculation facilities
18. Transportation facilities
19. Maintenance shop
20. Testing & analysis equipment
T

8.2. Necessary personnel program

8.2.1. Necessary personnel calculations

In estimating needed personnel for the greenfield steelworks, peripheral conditions of the steelworks must be considered on the assumption of the following conditions.

1) For the organization of the new steelworks, an organization chart shown in Fig. 8-1 is considered. To be located in Manila, the head office will concern itself with management, planning, purchasing, sales, and the business requiring close tieup with the central authorities.

   Accordingly, the organization of the steelworks will concern direct production, and comprise production management and equipment control.

2) All equipment will be operated by employees under direct contract.

3) As regards shops needing continuous operations, 20 percent of the necessary shop workers under assistant foremen will be added to fill up otherwise vacant positions.

4) Division of labor between operational sector and maintenance sector will be as follows.
   To enhance equipment availability (operating rate), a preventive maintenance program will be introduced wherein the maintenance sector will be established independently of the operation sector considering successful Japanese experience with the program.
   In the operation sector, operating personnel are responsible up to and including routine inspections, oiling and greasing, and minor repairs.

8.2.2. Personnel program

Table 8-2 shows a classified list of main office personnel.
Table 8-3 is a tabulation of steelworks personnel.

Men necessary thus total 3610.

These personnel must have the following qualitative requirements.

1) Desirably, managerial personnel and engineers should satisfy the following conditions.

① They have finished their required college or university technology courses. Advisably, managerial personnel particularly should be finishers of highest technology courses.

② They should be very enthusiastic about the construction and operation of the steel industry in the Philippines, should be highly motivated with a sense of mission, and should at the same time be men of action.

③ They must have at least five years or longer experience with business in the area of their specialities.

2) As concerns foremen and skilled workers, they must be excellent, if not of the same levels as above. For ease of training etc., they should be recruited from among highly educated classes of people.

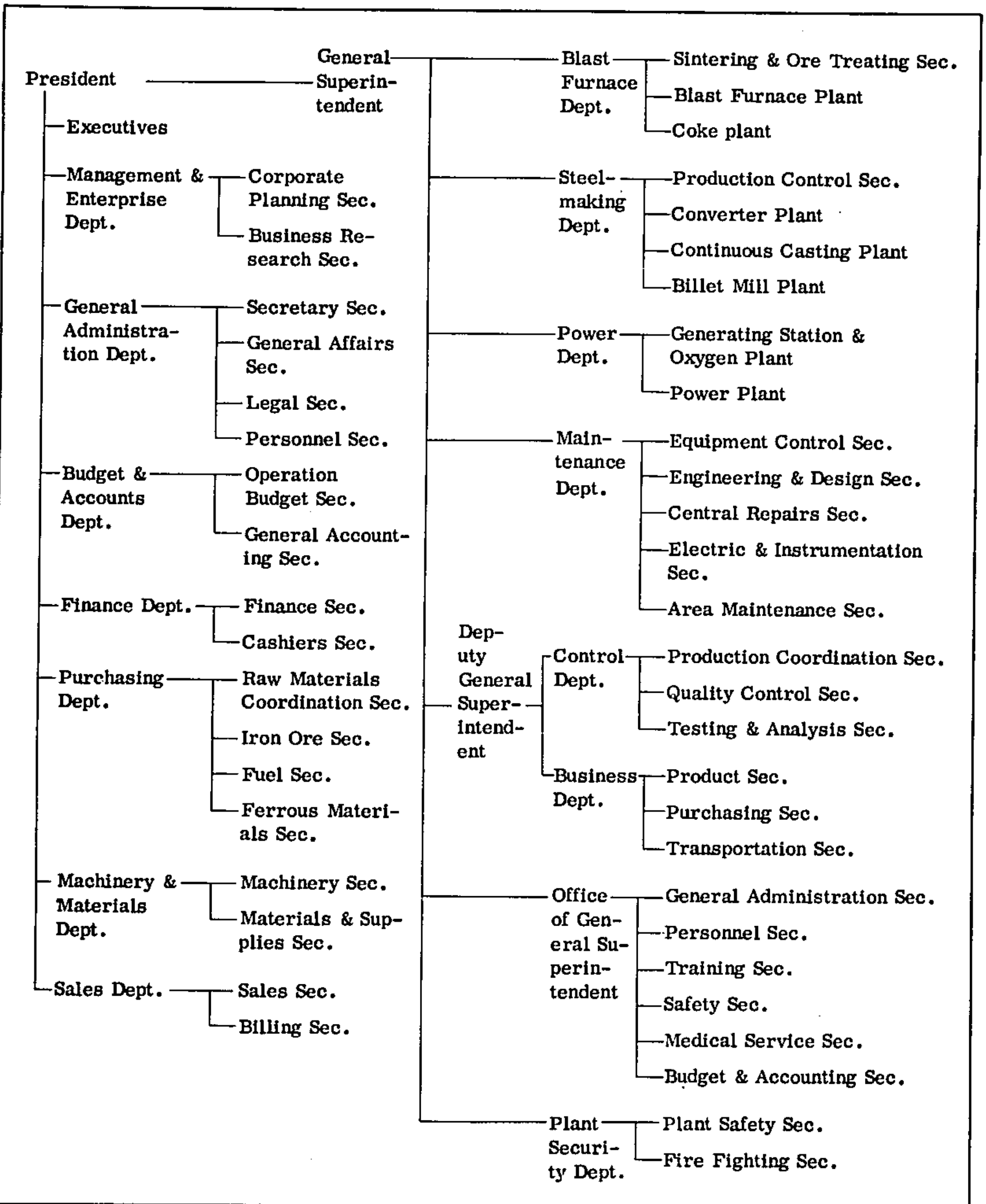


Fig. 8-1 Organization chart

Table 8-2 Personnel needed for the main office

Department	General manager	Super-intend-ent	Assist-ant su-perin-tendent	Staff	Assist-ant clerk	Fore-man	Assist-ant foreman	Regular workers	Total
Management & enterprise	1	2	4	3	5				15
General Ad-ministration	1	4	8	7	14				34
Budget & Ac-counts	1	2	4	3	6				16
Finance	1	2	3	2	5				13
Purchasing	1	4	7	7	9				28
Machinery & materials	1	2	10	10	8				31
Sales	1	2	4	4	8				19
Totals	7	18	40	36	55				156
	President 1, Executives 3								160

Table 8-3 Personnel needed for the steelworks

Department	General manager	Super-intent-ent	Assist-ant su-perin-tendent	Staff	Assist-ant clerk	Fore-man	Assist-ant foreman	Regular workers	Total
Office of general su-perintendent	1	6	14	72	44			100	237
Plant safety	1	2	7	60	3				73
Control	1	3	5	18	6	2	8	79	122
Business	1	3	10	24	14	13	44	319	428
Power	1	2	6	15	3	8	30	102	167
Blast furnace	1	3	7	16	3	19	69	370	488
Steelmaking	1	3	10	23	8	25	143	774	987
Maintenance	1	5	23	72	5	32	161	647	946
Totals	8	27	82	300	86	99	455	2390	3448
	General superintendent 1, Deputy general superintendent 1								3450

8.2.3. Roles of engineers

As occasionally pointed out earlier, the running of an integrated steelmaking plant is a series of continuous production processes from blast furnace through converter to continuous casting, in all of which molten iron or molten steel are handled. These whole processes, forming as they are a consolidated energy flow, must be operated smoothly without troubles.

These equipment being normally exposed severe and high temperature environment, cannot wholly avoid emergencies occurring from catastrophic failures even in developed countries. Engineers and skilled laborers therefore are required to be technically competent and skilled to prepare for such contingencies. These techniques and skills, however, cannot be acquired without actual practice and experience. This is why engineers are to be sent overseas as undermentioned to learn by experience methods of operation. On returning back from those countries, they must take charge of actual equipment for an extended period of time, on a three shift. These practical operations alone ensure the emergence of a next generation of qualified engineers and of skilled laborers.

By a combined strength of engineers, the new steelworks will be operated trouble-free and will thus be provided with the basis upon which to properly determine expansion plans for the second stage of the steelworks project.

8.3. Technical training and skill cultivation program

The training program consists of the three following factors.

(1) Guidance by manufacturers during construction stages.

(2) Overseas training

(3) Operational guidance after a hot run

These three factors are related to each other and mutually influence the contents of respective training. Items (1) and (3) may differ much with the choice of manufacturers etc. Here description will therefore be limited to item (2), which suggests the overseas training of a required number of engineers and workers geared to the minimum maintenance of the operation of the steelworks when it comes on-stream. The training program is tabulated in Table 8-4.

As a rule, of various equipment pieces of the steelworks, those whose types are known to exist in the Philippines have been omitted from the training program. Of the managerial personnel, those assuming general manager or manager posts are required principally to grasp the states of equipment and control, whereas assistant managers and engineers are primarily required not only to acquire a technical knowledge but also to experience and practise actual operations. Their training therefore may be deeper in substance than that for workers.

Table 8-4 Training Program

	Managerial personnel (Men x Month)			Workers (Men x Month)			Total
	General Manager; Manager	Assistant Manager	Engineers	Foremen	Assistant foremen	Regular workers	
(Under General Superintendent)	1 x 1						
General Administration	1 x 1						
Personnel	1 x 1						
Training	1 x 1						
Safety	1 x 1						
Finance & Accounting	1 x 1						6
(Control)	1 x 1						
Production Control	1 x 1	1 x 2					
Quality Control	1 x 1	1 x 2	1 x 3				
Testing & Analysis	1 x 1	2 x 2	1 x 3	1 x 3	1 x 3		24 24
(Business)	1 x 1						
Products	1 x 1						
Transportation	1 x 1	1 x 2	1 x 3	1 x 3	2 x 3		
Purchasing	1 x 1						18
(Power)	1 x 1						
Power Generation	1 x 2				1 x 3		
Oxygen							
Power Fuel	1 x 2	1 x 3	1 x 2	1 x 3	1 x 3		
Waterworks		1 x 3	1 x 2	3 x 3	3 x 3		40
(Ironmaking)	1 x 1						
Sintering & Ore Treatment	1 x 2	1 x 2		3 x 3			
Blast Furnace	1 x 2						
Casthouse operation		1 x 3	4 x 3	3 x 3	3 x 3	3 x 3	
Furnace operation		1 x 3	2 x 3	3 x 3	3 x 3		
Coke Coke	1 x 2	1 x 3	1 x 3	3 x 3	3 x 3		
Chemical		1 x 3	1 x 3	1 x 3	2 x 3		123
(Steelmaking)	1 x 1						
Converter Converter	1 x 2	1 x 3	4 x 3	3 x 3	3 x 3		
Operation		1 x 3		3 x 3			
Continuous casting	1 x 2	1 x 3	4 x 3	3 x 3	3 x 3		
Billet Rolling	1 x 2	1 x 3	4 x 3	3 x 3			
Process		1 x 3	1 x 3				112
(Maintenance)	1 x 1						
Equipment control							
Equipment technology	1 x 2	2 x 3	3 x 3				
Central maintenance	1 x 2			3 x 3			
Electricity and instrumentation repairs	1 x 2	2 x 3					
Area maintenance	1 x 2						
Sintering & Ore treatment							
Coke		2 x 2	1 x 3	3 x 3		2 x 3	
Blast Furnace							
Converter		1 x 3	1 x 3	3 x 3		2 x 3	
Continuous casting		1 x 3	1 x 3	1 x 3		2 x 3	
Billet		1 x 3	1 x 3	3 x 3		2 x 3	
Power		1 x 3	1 x 3	3 x 3		2 x 3	147
Totals							470

CHAPTER 9

ESTIMATION OF CONSTRUCTION COST

CHAPTER 9 ESTIMATION OF CONSTRUCTION COST

In this chapter, direct and indirect construction costs are estimated for the new steelworks. Further, these estimated construction costs are allocated to cost centers as they will be used as base figures for production cost estimation in chapter 10.

9.1 Basic concepts of direct construction cost accounting

The basic concepts of construction cost accounting adopted in this study are shown below. It should be noted, however, that, because no effect of future changes in commodity prices is taken into account, review of these figures is necessary at the time of construction.

9.1.1 Division between import and domestic procurement

The division made between import and domestic procurement is as follows.

(1) Equipment to be purchased: Import

(2) Construction work at site : Domestic procurement

(3) Construction materials : Whatever materials obtainable in the domestic market are classified as of domestic procurement (reinforcing bars, cement, common brick, etc.), others being of import.

9.1.2 Estimate bases

(1) Equipment to be purchased

The cost of all the equipment items is first estimated on the basis of the Japanese price level as of March, 1977 of the equivalents, and then converted to the CIF, Philippine port figures. In the estimate, an assumption is made that these items are all exempted from duties, compensating tax, etc. as an incentive given in the Investment Incentives Act.

(2) Construction work cost

The field construction work cost is estimated by reference to recent cost data and pertinent information material for the Philippines.

(3) Construction materials cost

Construction materials are divided into two categories, shown in 9.1.1, and for those of import category the cost is estimated on the basis of the Japanese price level as of March, 1977 of the equivalents, and then converted into the CIF figures, the same as in (1) above.

(4) Currency and exchange rate used in estimation

Estimate is first made mostly on the yen base and in part on the peso base, but in either case further conversion into U.S. dollars is made. The rate of exchange used is as of March, 1977, which is 1 U.S. dollar = 7.3 pesos = 282.80 yen. Keen attention should be paid to the exchange rate as its fluctuation is anticipated.

9.2 Required construction cost

9.2.1 Direct construction cost

The direct construction cost for the new steelworks is as shown in Table 9.1. The total expenditure is 669,849,000 dollars, which is divided into 461,222,000 dollars of import and 208,627,000 dollars of domestic procurement. The ratio between import and domestic procurement is 69 : 31.

9.2.2 Other costs necessary before start-up

Indirect cost to be incurred relative to the construction and other costs necessary before start-up are estimated and shown in Table 9.2.

(1) Engineering fee

Engineering fee depends on the division of scope between the steelworks and the engineering firm. Here, only approximation is made on the basis of a level of fee generally adopted.

(2) Training and education cost, and operational guidance fee

These are the costs necessary for training the personnel of the steelworks in the operating techniques before the start-up of the steelworks and for receiving operational guidance from overseas. (Refer to Chapter 8)

(3) Spares and supplies cost

This is the expenditure for procuring required quantities of spares and replacements for equipment items prepared before the start-up of the steelworks.

(4) Initial organization cost

This cost consists of expenditures for founding the corporation, employment of personnel, construction management, and others necessary to establish a setup by which the steelworks operates, prior to the start-up of the steelworks.

(5) Interest during construction

Construction payments will be made by appropriation of the company's capital and loans. For payment of interest incurred on these loans, a further loan will have to be obtained, since no income source is available during construction period. The interest payable during the construction period is estimated to amount to 77 million dollars. For details, refer to Chapter 11.

9.2.3 Total required capital expenditure

The total capital expenditure required for the new steelworks including direct construction cost and others is estimated at 813 million dollars. Since the planned molten steel production is 1,050,000 tons, the construction cost per ton of molten steel is 774 dollars.

For reference purposes, the expenditure for the hot sprip mill expansion plan of NASCO is estimated to be 46 million dollars for the first phase of the plan. The details of the plan are shown in Chapter 14.

Table 9.1 Breakdown of direct construction cost

(Unit: 1,000 dollars)

Plants, equipment & facilities	Import	Domestic	Total	Remarks
1.1 Land reclamation	712	19,969	20,681	Cost of purchasing land is included
1.2 Civil engineering work	877	21,896	22,773	Drainage, road construction, etc.
2. Port facilities	8,460	14,110	22,570	
3. Products and materials handling facility	8,610	1,305	9,915	
4. Raw materials preparation facilities	44,116	18,678	62,794	
5. Coke oven plant and by-products facility	51,528	15,705	67,233	
6. Blast furnace plant	58,165	20,389	78,554	
7. Burnt lime calcining plant	8,016	1,828	9,844	
8. B.O.F. plant	43,228	14,689	57,917	
9.1 Ingot-making plant	6,765	2,797	9,562	
9.2 Slab continuous casting equipment	46,029	11,202	57,231	
9.3 Bloom continuous casting equipment	25,113	5,732	30,845	
10. Billet mill	24,491	7,528	32,019	
11. Power receiving and distributing station	7,784	2,675	10,459	Road lighting and communication lines are included
12. Power plant and B.F. blower	28,095	6,345	34,440	
13. Oxygen plant	13,618	4,706	18,324	
14. Gas and heavy oil facility	8,506	2,383	10,889	
15. Yard piping facility	5,755	3,065	8,820	
16. Water supply facility	13,403	10,515	23,918	
17. Water recirculating facility	16,172	6,438	22,610	
18. Transport facility inside steelworks	11,004	2,182	13,186	
19. Maintenance and repair shops	26,815	10,876	37,691	Warehouse of ordinary materials is included
20. Testing and analysis facility	2,249	537	2,786	
21. Plant administrative office	1,711	3,077	4,788	
Total	461,222	208,627	669,849	

Table 9.2 Fund requirements

(Unit: 1,000 dollars)

1.	Direct construction cost	669,849
2.	Engineering fee	27,000
3.	Training and education cost, and operational guidance fee	7,000
4.	Spares and supplies cost	24,000
5.	Initial organization cost	8,000
6.	Interest during construction	76,715
	Total	812,564
	NASCO's expansion plan (first phase)	(45,969)

Notes: (1) Of the items above, the direct construction cost, engineering fee and interest during construction are regarded as composing the acquisition price of fixed assets.

(2) The training and education cost, and initial organization cost are regarded as deferred assets and are to be amortized.

9.2.4 Effect of commodity price fluctuations

Although this study does not include the effect of commodity price fluctuations in the estimation of construction cost, it naturally is a factor which cannot be overlooked. Our intention here, however, is only to indicate the magnitude of the effect. If the annual rise of commodity price is, for example, 10%, the commodity price level four years later will be 1.46 times, and if it is 5%, then 1.22 times.

9.3 Allocation of construction cost to cost centers

Of the construction cost items, those which constitute the fixed assets acquisition price should be allocated to cost centers for production costing in Chapter 10. (Description of cost centers will be given in Chapter 10.)

9.3.1 Acquisition price of fixed assets

Direct construction cost of the construction cost, engineering fee and interest payable during construction period are regarded as constituting the acquisition price of fixed assets.

The fixed assets are classified for depreciation purposes into the land, the buildings and structures, and the equipment and machinery.

The breakdown of the acquisition price of fixed assets shows:

Land	21,952,000 dollars
Buildings and structures	201,183,000
Equipment and machinery	550,429,000
Total	773,564,000 dollars

9.3.2 Method of allocating construction cost to cost centers

Because fixed assets except land are to be depreciated, their cost is allocated to cost centers. Changes are made to the cost items of the direct construction cost shown in 9.2. Some of the changes are:

(1) Power plant and B.F. blower are made separate cost centers.

(2) Steam is made an independent cost center.

(3) Water supply facility is divided into sea water, industrial water and potable water facilities.

(4) Of the cost of the transport facility inside the steelworks, that of the facility which is exclusively used for ironmaking and steelmaking is added to the cost of the B.F. plant and that of the B.O.F. plant, respectively.

9.3.3 Allocations of construction cost to cost centers

The allocations of construction cost to cost centers are as shown in Table 9.3.

Table 9.3 Allocations of construction cost to cost centers

(Unit: 1,000 dollars)

Cost centers	Fixed assets acquisition price			Remarks
	Buildings & structures	Equipment & machinery	Total	
Coke oven plant and by-products	5,063	73,850	78,913	
B.F. plant	9,812	91,469	101,281	
B.O.F. plant	19,575	54,759	74,334	
Slab continuous casting plant	12,745	58,729	71,474	
Bloom continuous casting plant	6,081	30,972	37,053	
Ingot-making plant	4,697	6,396	11,093	
Billet mill	6,473	33,903	40,376	
Burnt lime calcining plant	957	13,074	14,031	
Oxygen plant	1,928	19,745	21,673	
Power plant	4,754	30,367	35,121	
B.F. blower	875	13,504	14,379	
Steam facility		492	492	
Seawater facility	8,560	11,810	20,370	
Industrial water facility	5,384		5,384	
Potable water facility	3,152		3,152	
Maintenance & repair shop	18,816	24,908	43,724	
Gas & heavy oil facility	17,464	4,908	22,372	
Raw materials preparation facility	27,335	68,022	95,357	
Product handling facility	10,154	4,402	14,556	
Transport facility inside the steelworks	3,696	5,846	9,542	
Testing and analysis facility	550	2,682	3,232	
Administrative office	33,112	591	33,703	
Total	201,183	550,429	751,612	

Note: The cost of land, 21,952,000 dollars, is not included in the table. Hence, the total cost of fixed assets is 773,564,000 dollars.

CHAPTER 10

ESTIMATION OF PRODUCTION COST

CHAPTER 10 ESTIMATION OF PRODUCTION COST

10.1 Basic philosophy of production cost accounting method

In this chapter, production cost is estimated for the new steelworks using a cost accounting method normally employed in the steel industry of industrial countries.

(1) Basic accounting assumption

1)	Reference date	:	March, 1977
2)	Currency	:	US$
3)	Exchange rate	:	US$1 = 7.3 pesos = ¥282.8
4)	Unit system	:	Metric system

(2) Accounting of normal production cost

Cost accounting is made of production in normal conditions on the basis of production facilities and production flow already described. To this cost accounting are applied the figures of production balance and operational conditions of the production period excluding the period of start-up or that of B.F. relining.

Also, tax reduction or exemption by the Investment Incentives Act is not taken into account. The tax reduction or exemption is reflected later in the estimated profit and loss statement, and the figures for each year in the statement are corrected accordingly.

(3) Cost accounting method

Production cost accounting is made using a normal process costing procedure. Total cost arising in each process (cost center) is estimated and allocated to subsequent processes according to the flows of semi-products or services. The production cost thus allocated takes the form of the cost by product types. The cost centers are as shown in Table 10.1.

The cost of auxiliary departments is estimated using the reciprocal distribution method.

Further, separate cost accounting by processes is also made on the variable cost base and used for long range profit and loss estimation and analysis.

Table 10.1. Cost centers

	Cost centers
Production departments	Sinter
	Coke oven plant and by-products facility
	Blast furnace
	B.O.F.
	Slab continuous casting
	Bloom continuous casting
	Ingot-making
	Billet mill
Auxiliary departments	Lime calcination
	Oxygen
	Power generation
	B.F. blower
	Steam
	Sea water
	Industrial water
	Potable water
	Maintenance & repair
	Gas and heavy oil distribution
	Raw materials preparation
	Product handling
	Transport inside steelworks
	Testing and analysis
	Plant administration

(4) Cost elements

Various costs arising in the steelworks are estimated.
For example, the cost of raw materials is calculated for each brand on the basis of the consumption multiplied by the unit price; the labor cost is obtained for each job grade by multiplying the annual amounts of wages and salaries plus welfare expenses by the number of employees of that job grade; and the expenses are estimated according to the itemized breakdown. In the table of cost by cost centers (cost sheets) are shown these costs collected and combined into appropriate aggregate units. For details, refer to a description of assumptions given later, table of production cost breakdown, and cost sheets by cost centers.

(5) Classification of variable cost and fixed cost

Each cost is classified into raw materials cost, labor cost and expenses, all of which are further divided into variable and fixed costs for use in the analysis and assessment of the economics of the new steelworks. Although there are a number of ways by which classification of variable and fixed costs is made, the classification method adopted in this study takes account of the integrated steelworks being in the heavy industry with blast furnaces requiring uninterrupted continuous operation. Namely, all the labor cost including direct labor cost, equipment cost such as maintenance and repair cost and depreciation, and all the expenses arising irrespective of production level unless operation is stopped are, in principle, all included in the fixed cost.

10.2 Assumptions of cost accounting

For unit prices and cost estimation method, which are prerequisite to cost accounting, the following figures and concepts are adopted in this study as a result of the field survey and discussions with the counterpart group, and on the basis of expertise and experiences of the mission members, etc.

10.2.1 Unit prices of raw materials, fuels and other materials

The unit prices of various materials used in the cost accounting are shown in Table 10.2.

In deciding import or domestic procurement of these materials, any materials which can be supplied in satisfactory quantities and quality in the Philippines are, as much as possible, classified as materials of domestic procurement, and only those out of this category are to be imported.

Because production in normal condition is assumed, as explained previously in 10.1, the landed prices of imported materials include duties and other charges.

(1) Principal raw materials

The unit prices of principal raw materials such as iron ores and coals show landed prices calculated from current international price levels converted into C & F prices plus duties and other taxes, insurance, bank and other charges. For iron ores to be screened before use, the undersize (fine ore) is valued on the basis of average unit price per Fe % of imported fine ores multiplied by Fe % of the iron ores in question, and the remaining value is divided by the tonnage of lump ores to obtain the unit price of the lump ores.

The sources of raw materials are assumed only for study purposes. Obviously, it is necessary to decide the sources and come to concrete terms with suppliers on the prices and other conditions through negotiations before start of operation.

The purchase price of scrap shown is calculated on the basis of import of scrap after excluding from the required quantity those quantities from NASCO and return scrap of the new steelworks itself.

Table 10.2. Unit prices of raw materials, fuels and other materials

(Unit: 1,000 dollars/ton)

Brand	Import or domestic procurement	C & F price	Landed price	Remarks	
Iron ores				lump ore price	undersize price
Australia (unscreened)	Import	18.36	23.84	(25.08)	(22.32)
Brazil (unscreened)	Import	21.06	26.89	(30.11)	(23.01)
India (unscreened)	Import	21.78	27.94	(32.33)	(22.67)
Australia (fine ores)	Import	15.53	20.25		
Brazil (fine ores)	Import	18.97	24.25		
India (fine ores)	Import	14.95	19.32		
				price of lump	price of fines
Pellets	Import	25.28	32.61	(33.16)	(21.97)
Iron sand	Domestic		11.18		
Ferromanganese ore	Import	35.88	45.44	Import from India	
Dolomite	Domestic		7.44		
Silica	Domestic		6.00		
Coals					
U.S.A. (L.V.)	Import	77.30	89.63		
U.S.A. (M.V.)	Import	74.26	86.10		
Australia (hard coking)	Import	53.25	62.38		
Australia (semi-hard)	Import	55.27	64.57		
Australia (soft coking)	Import	45.72	53.58		
Limestone (lump)	Domestic		7.21		
Limestone (fines)	Domestic		6.50		
Fluorspar	Import	75.40	98.16		
Soda ash	Import	199.90	250.07		
Scrap	Import	97.60	122.70		

Brand	Import or domestic procurement	C & F price	Landed price	Remarks
FeMn (HC)	Domestic		493.29	
FeMn (MC)	Import	736.94	1,094.96	
FeMn (LC)	Import	814.80	1,211.91	
FeSi	Domestic		630.28	
SiMn	Import	547.80	810.84	
Shot Al	Import	1,523.25	2,275.60	
Bunker Al	Import	1,403.10	2,095.12	
Heavy oil	Domestic		113.00/t	(109.00/kl) purchase of imported heavy oil
L.P.G.	Import		$0.29/Nm^3$	
Moulds and stools	Import		241.53	Less return scrap
Refractories				
BF trough refractory	Import	530.40	665.25	
BF mud	Import	1,060.82	1,329.33	
Converter brick	Import	629.42	789.22	
Converter ladle brick	Import	198.02	249.11	
Castable refractory	Import	226.31	284.52	
CC tundish brick	Import	510.71	640.60	
CC tundish nozzle	Import	2,094.98	2,624.08	
Rolls	Import		1,687.21	Rolls for billet mill Less return scrap

(2) Other materials

The price setting philosophy is the same as that described in (1) above.

Of the ferroalloys, high carbon ferromanganese and ferrosilicon are considered to be of domestic procurement and others are of import for the sake of this study, though some ferroalloys of import category may be partially procured in the Philippines.

As for heavy oil, domestic purchase of imported heavy oil is considered.

In this study, calculations of refractory prices are made on the basis that all refractories are to be imported from viewpoints of both quantity and quality, though some domestic products may be used.

Landed prices of moulds, stools and rolls are set after return scrap values are deducted. Their return scrap, therefore, is not counted as a deductible by-product in the cost accounting of this study.

10.2.2 Labor cost

Based on Chapter 8 personnel is classified by cost centers and job grades.

Their wages and salaries, shown in Table 10.3, are based in most part on the recent wage and salary data for the Philippines and partly by estimation.

Welfare cost is also based in most part on available data complemented partly by estimation.

10.2.3 P.S.C.-related cost

Closer relationship with P.S.C. (Philippine Sinter Corporation), which is located adjacent to the steelworks, is envisaged and utilization of P.S.C. facilities and cost involved are as follows.

(1) Sintered ore

Production of sintered ores for use by the steelworks is to be subcontracted by P.S.C. The steelworks is to supply major raw materials of sinter such as iron ores, to P.S.C. for sintering operation. The sintered ores thus produced will be returned to the steelworks for use.

The cost of subcontracting sinter production by P.S.C. is studied using a sintering cost of 13.70 dollars/ton of sintered ore. This sintering cost includes coke breeze and limestone and covers labor, services, equipment, administration, etc.

(2) Rental charge of P.S.C.'s sea-berth

Of the raw materials used by the steelworks, iron ores, etc. are to be landed using P.S.C.'s sea-berth at a rental cost of 1 dollar/ton including various charges. The handling volume at the P.S.C.'s sea-berth is supposed to reach 1,690,000 tons/year when normal production level is attained.

Table 10.3. Labor cost and other main costs

(Unit: dollar)

Item	Unit cost	Remarks
Wages and salaries		
President	16,438/man-year	
General superintendent	10,959 "	
Deputy general superintendent	8,219 "	
General manager	7,534 "	
Manager	6,096 "	
Assistant manager	3,066 "	
Engineering staff member	2,368 "	
Clerical staff member	1,218 "	
Foreman	1,644 "	
Assistant foreman	1,166 "	
Skilled worker	1,011 "	
Semi-skilled worker	812 "	
Unskilled worker	734 "	
P.S.C. sintering sub-contracting cost	13.70/t	per ton of sintered ore
P.S.C. sea-berth rental cost	1.00/t	
Electric power (purchase)	0.0055/kWh	

10.2.4 By-products

By-product arisings from various plants of the steelworks are quantified using unit generation and valued, in principle, by their selling or purchasing values (Table 10.4). Return scrap is valued on a level with purchased scrap.

For evaluation of other scrap, etc., Fe% is taken into account.

For sinter fines and mill scales the mean price of purchased fine ores is used.

Gases are assessed on the basis of heavy oil price and weighted by their calorific values.

By-products are made cost-deductible items according to the quantities and assessed values as described above.

Table 10.4. Unit values of by-products

(Unit: dollar)

Item	Unit	Unit value	Remarks
Scrap (return)	t	122.70	
Pig iron scrap	t	110.98	
Mould, stool and roll scrap	t	115.92	
Scales	t	21.96	
BF dust	t	8.53	
COG	Nm^3	0.0519	4,500 $Kcal/Nm^3$
BFG	"	0.0083	800 $Kcal/Nm^3$
Light oil	kl	79.00	
Coal tar	t	59.00	
Coke breeze	t	47.52	
Sinter (fines)	t	21.96	
Argon	Nm^3	1.25	

10.2.5 Maintenance and repair cost

The new steelworks has an independent maintenance and repair department equipped and manned sufficiently for carrying out ordinary repairs. Hence, this department is treated as an independent cost center, and the cost of the department thus ascertained is absorbed by allocating it to other departments.

Repair materials are assessed for individual departments according to quantities required by them and included in their cost.
In the maintenance and repair cost, refractories, etc., the consumption of which varies with the production level of the steelworks, are included in the variable cost items, and others are in the fixed cost items.

10.2.6 Depreciation cost

The depreciable assets held by the steelworks are divided, as discussed previously in Chapter 9, into two classes, namely, buildings and structures as one class and equipment and machinery as another. These are depreciated by the straight-line method over their service lives of 25 years for the buildings and structures and 15 years for the equipment and machinery. The residual value of fully depreciated assets is made nil in this study. Therefore, the yearly depreciation cost from the first year of operation to the fifteenth year amounts to 44,743,000 dollars.

10.2.7 Amortization of training and education cost, and operational guidance fee

The training and education cost before start of operation and operational guidance fee are amortized as deferred assets, and the cost of amortization is included in the cost of plant administration department.

10.2.8 Provision for blast furnace relining

After commissioning, each blast furnace requires major repairs coincided with relining of most brick at several-year intervals. Because the cost of this repair work will amount to a huge sum, it is normal accounting procedure to deduct a provision every year to prepare for such fund requirement.
In this study, special repairs of blast furnace are scheduled at timings shown in Table 10.5., based on data in Japan. The cost of

such repairs is estimated on an assumption that the blast furnace is simply relined during the repair, and accordingly provision is taken care of each year. The annual provision is included in the cost of blast furnace department. It should be added here, however, that, because the blast furnace repair cycle may be shortened or prolonged in actual practice and the cost is also affected by so many uncertainties, the figures shown in Table 10.5 are chosen for the purposes of this study.

Table 10.5. Schedule of blast furnace special repairs

Year of operation	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
							BF special repair (BF relining) for 5 months from Jan. to May of the seventh year							BF special repair (BF relining) for 5 months from Jan. to May of the fourteenth year	

Remark. Special repair cost estimate
$78,554,000 (BF direct construction cost) x 0.5
= $39,277,000

10.2.9 Auxiliary departments

The costs of burnt lime, oxygen, electric power, steam, water, fuels, repair, raw materials preparations, transport inside the steelworks, product handling, testing and analysis, and plant administration which the steelworks requires for the manufacture of its main products are estimated as costs of auxiliary departments as described in the discussion of cost centers.

The costs of auxiliary departments are mutually distributed using appropriate allocation coefficients resulting, in the final analysis, in allocation of them to production departments.

The following will briefly discuss the major points of these auxiliary departments.

(1) Gas and oil facility

The cost of gas and oil facility pertains to the cost of facility for storing and distributing gases, oils and the like.

The cost of distribution is not included in the available prices of these gases and oils consumed by each department.

For the gas and oil facility department the cost of distribution, etc. is estimated mainly on the basis of consumptions and allocated to consumer departments using factors supported by the experiences of the mission members.

(2) Electric power

Balance between power generation and the volumes of COG and BFG generated is sought, on the one hand, so that loss of these gases can be minimized, and, on the other, the idea of maximum power generation is pursued in this study.

As for the demand-supply balance of electric power, purchase of electric power from outside is necessary during scheduled maintenance of generators each year. Conversely, the electric power generated during normal period is in surplus. The sale at cost of this surplus electricity is assumed in this study.

Although the current rate is adopted for the purchase of electricity from outside, sharp hike of the rate is likely in the future.

(3) Steam facility

The cost of this department includes only that of steam for general use in the steelworks. The cost of steam for power generation is included in the cost of electricity department.

(4) Water

Water is classified into seawater, industrial water and potable water for costing purposes.

River water is considered as raw water for production of industrial water and potable water. The water facility from the intake in the river to the reservoir of the steelworks is assumed to be part of infrastructure. Although the cost of the infrastructure is not as yet determined, raw water is taken in this study as free of charge. If it is priced, the cost of water will increase accordingly.

(5) Plant administration cost

The plant administration cost covers such cost as accruing to the general superintendent office, safety and security, production scheduling, quality control, purchasing, contracts planning, and other administrative departments.

For the convenience of this study, the amortization cost of training and education, operational guidance fee, and real property tax is primarily estimated in this cost center.

The plant administration cost is allocated to production departments using allocation coefficients.

10.2.10 Taxes and fees

The taxes and fees payable, which will affect production cost, are considered as follows.

(1) Taxes and fees on raw materials

No reduction or exemption is considered of taxes and fees, such as advance sales tax, specific tax, duties, etc., on raw materials, as stated before, but they are included in the landed prices of raw materials at the current rates. In the profit and loss statement, however, corrections are made according to incentive rates.

(2) Real property tax

Estimation of the value of assessment for real property tax is difficult to make. In this study, fixed assets are divided into three groups of land, buildings and structures, and equipment and machinery, and the value of assessment is taken as 50% of the acquisition price of each object for land, buildings and structures,

and 60% for equipment and machinery.
The tax rate is estimated to be 2.25%.
A grace period of 3 years after start of operation for equipment and machinery is reflected with necessary corrections in the profit and loss statement.

10.2.11 Other costs

Costs of consumables, etc. are estimated by reference to general data in Japan and others.

10.3 Costs of main products and services

In this section, the results of costing done using the costing method and assumptions, stated in 10.1 and 10.2, are described.

10.3.1 Breakdown of production

(1) Table of production cost breakdown

The breakdown of production cost is shown according to cost items in Table 10.6, which is applicable to the production of the new steelworks operating under normal conditions. The total production cost is 242 million dollars, which is broken down into a variable cost of 150 million dollars and a fixed cost of 92 million dollars. The ratios of variable and fixed costs in the total production cost are 62% and 38%, respectively.
Most of the variable cost is the cost of raw and other materials, while more than half of the fixed cost is plant and equipment cost. The duties and taxes included in the cost of raw and other materials amount to 17 million dollars. If 10 million dollars of real property tax is added to it, the tax content in the production cost amounts to 25.7 dollars/ton of molten steel.

Table 10.6. Breakdown of production cost

	Annual quantity required (1,000 t)	Unit price ($/t)	Sum ($1,000)	Remarks
Raw & other materials cost (variable)				
Iron ore & pellets	1,356	23.2	35,482	
Coal	798	68.0	54,223	
Scrap	164	122.6	20,102	
Limestone	192	77.2	1,384	
Ferro-alloys			9,689	Including Al
Brick			14,627	
Fuels			31,316	COG, BFG & heavy oil
Others			10,130	
Subtotal			176,953	
By-products deductible			▲ 42,871	
Expenses (variable)				
P.S.C.-related cost			15,390	
Others			551	
Subtotal			15,941	
Materials cost (fixed)				
Repair materials			15,012	
Others			1,216	
Subtotal			16,228	
Labor cost	persons			
Wages & salaries	3,449	1,195/ person	4,121	
Welfare			788	
Subtotal			4,909	
Expenses (fixed)				
Depreciation			44,743	
Amortization			700	
Provision for BF relining			6,546	
Real property tax			9,941	
Others			9,050	
Subtotal			70,980	
Total			242,139	100
(Total of variable costs)			(150,023)	62.0
(Total of fixed costs)			(92,116)	38.0

Note: The total of duties, advance sales tax and specific tax included in the raw and other material cost is 17,079,000 dollars.

(2). Average cost of products for sale to outside customers Figure 10.1 shows changes in the average cost of products (slabs, billets and ingots) with varying production level, calculated using variable and fixed cost figures given in the breakdown of production cost in (1) above. The average cost of products during normal operation of the steelworks is 244.8 dollars/ton. As clear from the figure, the average cost decreases sharply with the rise of operating rate, indicating the importance of bringing production, as soon as possible, to its full capacity.

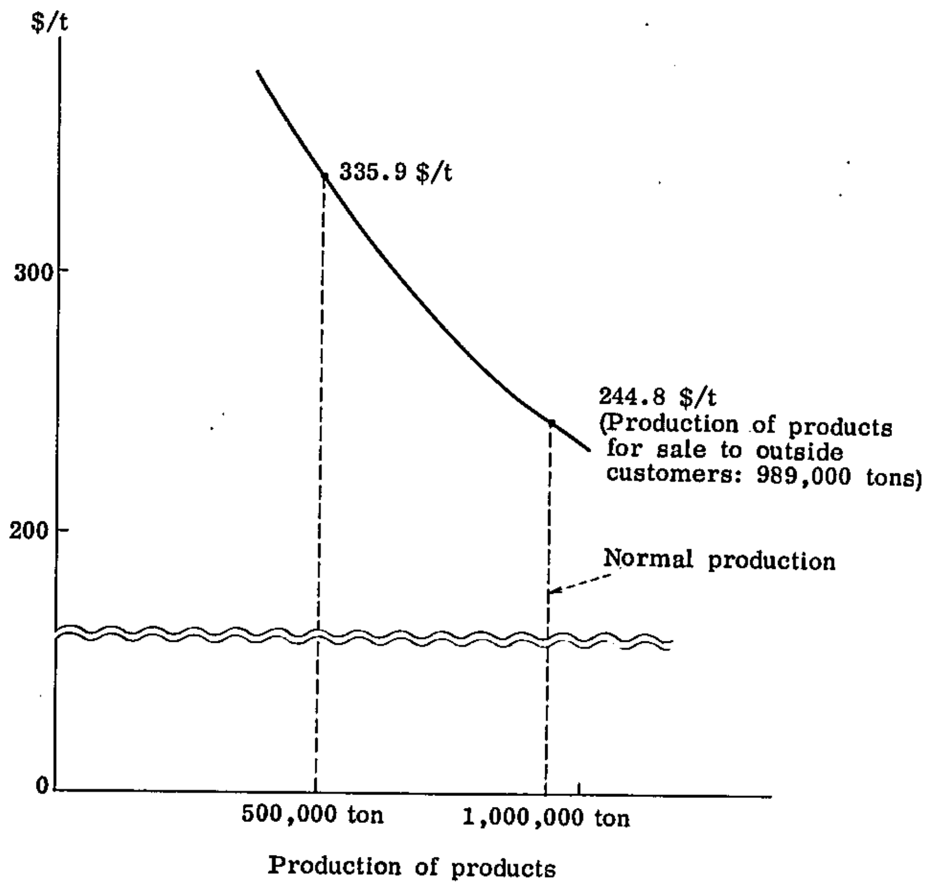


Fig. 10-1 Average cost of products for sale to outside

10.3.2 Costs of main products and services

(1) Cost of main products

The estimated cost of main products of the new steelworks is shown in Table 10.7.

The per ton cost of hot metal is 155 dollars, molten steel 200 dollars, slab 234 dollars, bloom 242 dollars, ingot 225 dollars, and billet 293 dollars.

Main reason for particularly high cost of billet is low productivity in the production of thin billets (50 x 50 mm)

The variable and fixed costs shown in the table differ from those in the cost sheets by cost center attached to 10.4, because they are obtained by adding up all cost contributing factors involved in the production of one ton of particular products through all relevant cost centers as described in 10.1.

Figure 10.2 presents a histogram showing ratios in money terms of general cost groups. Costs A, B and C represent the fixed cost and D and E the variable cost.

Table 10.7. Cost of main products

(Unit: $/T)

	Variable cost	Fixed cost	Production cost
Sinter	34.6	3.0	37.6
Coke	87.1	31.7	118.8
Hot metal	106.0	48.8	154.8
Molten steel	138.6	60.9	199.5
Slab	149.4	84.9	234.3
Bloom	148.1	93.7	241.8
Ingot	149.9	75.3	225.2
Billet	160.4	132.9	293.3

Note: Both variable and fixed costs in the table above are cumulative figures obtained by adding up cost figures shown in the cost sheets by process.

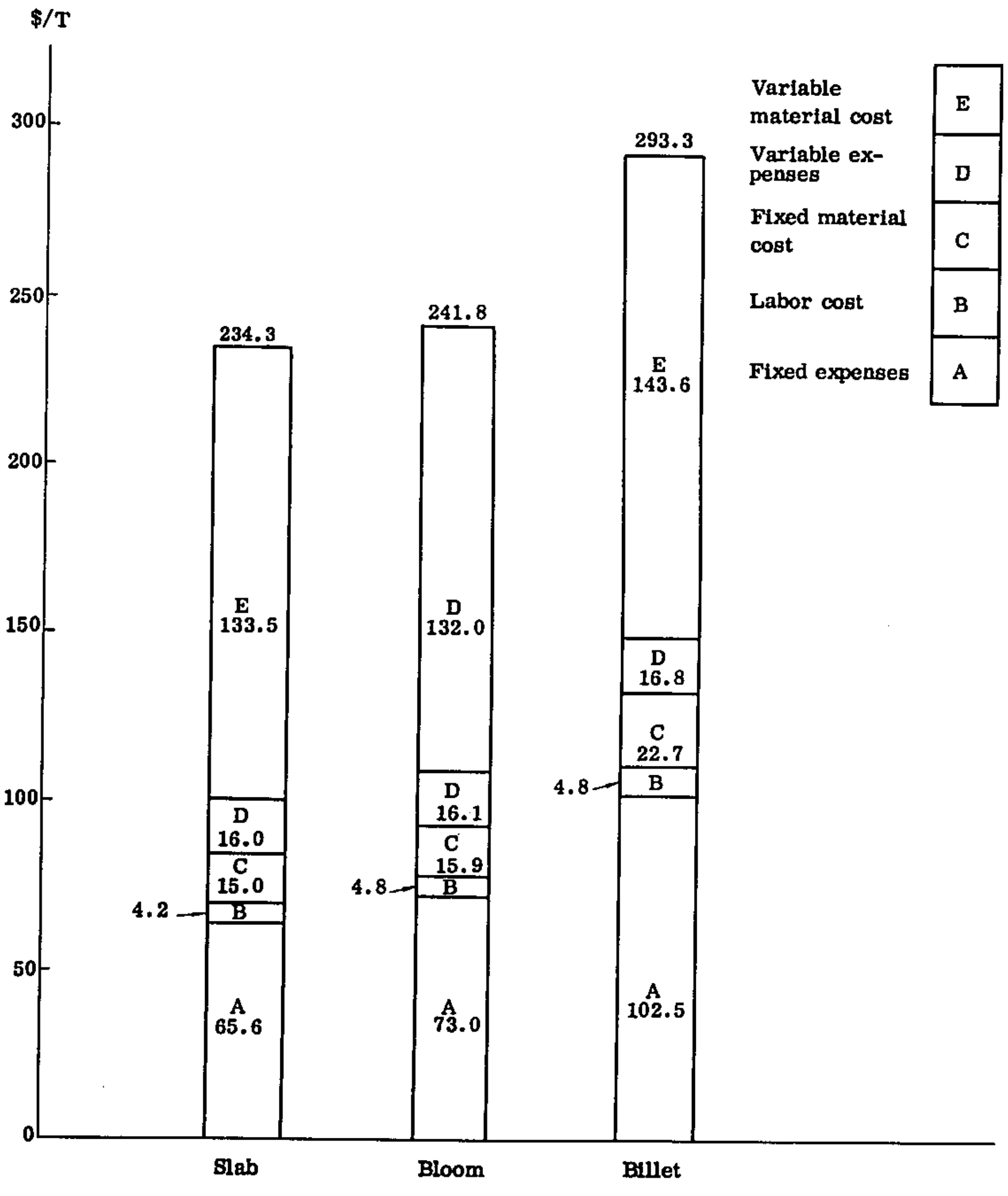


Fig. 10.2. Cost ratios of main products

(2) Costs of auxiliary materials and services

The costs of auxiliary materials produced by the steelworks and major services are as shown in Table 10.8.

Table 10.8. Costs of auxiliary materials and services

Item	Cost (Unit: $)	Remarks
Burnt limestone	65.5/ton	
Oxygen	$0.071/Nm^3$	
Electricity	0.061/kWh	Average of own and purchased electricity rates
Steam	11.3/ton	
Seawater	$0.017/m^3$	
Industrial water	$0.017/m^3$	Average of total consumption including recirculating water
Potable water	$0.055/m^3$	

10.4 Cost sheets by process

Tables 10.9 to 10.1 show the cost sheets of main processes of the new steelworks, listing figures for detailed items.

Table 10.9 Name of cost center: Sinter

Production	920,000 tons/year					
Item	Annual quantity required	Unit cost	Sum in dollar	Unit consumption	Cost per ton	Remarks
Raw and other materials	10^3t	$/t	$10^3$$	kg	$	
Australia (fine ore)	155	20.25	3,139	169	3.41	
Brazil (fine ore)	185	24.25	4,486	201	4.88	
India (fine ore)	60	19.32	1,159	65	1.26	
Australia (undersize)	162	22.32	3,616	176	3.93	
Brazil (undersize)	68	23.01	1,565	74	1.70	
India (undersize)	45	22.67	1,020	49	1.11	
Pellets (undersize)	17	21.97	373	19	0.41	
Sinter (fines)	80	21.96	1,757	87	1.91	
Iron sand	48	11.18	537	52	0.58	
Ferromanganese ore	9	45.44	409	10	0.44	
Mill scale	20	21.96	439	22	0.48	
BF dust	19	8.53	162	21	0.18	
Dolomite	46	7.44	342	50	0.37	
Silica	30	6.00	180	33	0.20	
Subtotal	944		19,184	1,028	20.86	
By-products						
Sinter (fines)	80	21.96	▲1,757	87	▲1.91	
Expenses						Limestone and coke breeze are supplied by PSC
PSC sintering cost			13,700		14.89	
Auxiliary department cost						
Raw materials preparation cost			3,425		3.72	
Total			34,552		37.56	

Table 10.10. Name of cost center: Coke plant

	Production	502,000 tons/year					Remarks
	Item	Annual quantity required	Unit cost	Sum in dollar	Unit consumption	Cost per ton	
Variable cost	Main materials	10^3t	\$/t	10^3\$	kg	\$	
	US coal (LV)	64	89.63	5,763	128	11.43	
	US coal (MV)	120	86.10	10,332	239	20.58	
	Australian coal (hard coking)	199	62.38	12,414	396	24.73	
	Australian coal (semi-hard)	319	64.57	20,598	636	41.03	
	Australian coal (soft coking)	96	53.48	5,134	191	10.23	
	Subtotal	798	67.95	54,214	1,590	108.00	
	By-products	10^3m^3			m^3		
	COG	255,790	0.052	▲13,276	510	▲26.45	
	Tar and others			▲ 6,432		▲12.81	
	Subtotal			▲19,708		▲39.26	
	Other variable costs	10^3m^3	$/Nm^3$		m^3		
	BFG	490,540	0.008	4,071	977	8.11	
		10^3m^3	$/Nm^3$		m^3		
	COG	43,690	0.052	2,268	87	4.52	
		10^3/kWH	/kWH		kWH		
	Electricity	22,740	0.061	1,379	45.3	2.75	
	Steam	39	11.27	444	79	0.89	
		10^3m^3	$/m^3$		m^3		
	Seawater	13,152	0.017	222	26	0.44	
	Raw materials preparation			2,895		5.77	
	Others			1,085		2.16	
	Subtotal			12,364		24.64	
	Total			46,870		93.38	
Fixed cost	Labor	189		241		0.48	
	Repair materials			1,578		3.14	
	Depreciation			5,126		10.21	
	Maintenance department cost			2,307		4.59	
	Plant administration			3,282		6.54	
	Others			241		0.48	
	Total			12,775		25.44	
Grand Total				59,645		118.81	

Table 10.11. Name of cost center: Blast furnace plant

	Production	965,000 tons/year					Remarks
	Item	Annual quantity required	Unit cost	Sum in dollar	Unit consumption	Cost per ton	
Variable cost	Main materials	10^3t	\$/t	10^3\$	kg	\$	
	Sintered ore	920	37.56	34,552	953	35.80	
	Pellets (lump)	330	33.16	10,942	342	11.34	
	Australian ore (lump)	198	25.08	4,967	205	5.15	
	Brazilian ore (lump)	82	30.11	2,469	85	2.56	
	Indian ore (lump)	33	32.33	1,067	34	1.11	
	Subtotal	1,563		53,996	1,620	55.95	
	Auxiliary materials						
	Coke	502	118.81	59,645	520	61.81	
	Heavy oil	39	113.00	4,362	40	4.52	
	Others			690		0.71	
	Subtotal			64,697		67.04	
	By-products			▲14,825		▲15.36	
	Other variable costs	10^3m^3	$/m^2$		m^3		
	BFG	636,900	0.008	5,286	660	5.48	
		10^3m^3	$/m^3$		m^3		
	COG	1,930	0.052	100	2	0.10	
		10^3kWH			kWH		
	Electricity	19,300	0.061	1,171	20	1.21	
	Relining brick			4,749		4.92	
		10^3m^3	$/m^3$		m^3		
	Industrial water	28,950	0.017	490	30	0.51	
		10^3m^3	$/m^3$		m^3		
	Seawater	14,475	0.017	244	15	0.25	
	BF blower cost			5,135		5.32	
	Raw materials preparation			2,647		2.74	
	Others			2,955		3.06	
	Subtotal			22,777		23.60	
	Total			126,645		131.23	
Fixed cost	Labor			230		0.24	
	Repair materials			2,026		2.10	
	Depreciation			6,490		6.73	
	Provision for BF repair			6,546		6.78	
	Maintenance department cost			2,961		3.07	
	Plant administration			4,117		4.27	
	Others			405		0.42	
	Total			22,774		23.60	
	Grand total			149,419		154.84	

Table 10.12. Name of cost center: B.O.F. plant

	Item	Annual quantity required	Unit cost	Sum in dollar	Unit consumption	Cost per ton	Remarks
Production		1,050,000 tons/year					
Variable cost	Main materials	10^3t	\$/t	10^3\$	kg	\$	
	Hot metal	965	154.84	149,419	919	142.30	
	Scrap	161	122.70	19,755	153	18.81	
	Subtotal	1,126		169,174	1,072	161.11	
	Auxiliary materials						
	Iron ore (lump)	21	32.33	679	20	0.65	
	Fluorspar	3	98.16	294	3	0.28	
	Burnt limestone	63	65.49	4,126	6	3.93	
	Ferroalloys	9		9,234	9	8.79	
	Others			391		0.37	
	Subtotal			14,724		14.02	
	By-product (scrap)	3	122.70	▲ 368	3	▲ 0.35	
	Other variable costs	10^3Nm^3					
	COG	2,100	0.052	109	2 Nm^3	0.10	
	Brick			6,803		6.48	
	Electricity	10^3kWH 23,100	0.061	1,401	22 kWH	1.33	
	Oxygen	10^3Nm^3 57,750	0.071	4,101	55 Nm^3	3.91	
	Nitrogen	10^3Nm^3 9,450	0.071	671	9 Nm^3	0.64	
	Others			1,495		1.42	
	Subtotal			14,580		13.89	
	Total			198,110		188.68	
Fixed cost	Labor			287		0.27	
	Repair materials			1,487		1.42	
	Depreciation			4,434		4.22	
	Maintenance department costs			2,173		2.07	
	Plant administration			2,879		2.74	
	Others			124		0.12	
	Total			11,383		10.84	
Grand Total				209,494		199.52	

Table 10.13. Name of cost center: Slab continuous casting plant

	Production	638,000 tons/year					Remarks
	Item	Annual quantity required	Unit cost	Sum in dollar	Unit consumption	Cost per ton	
Variable cost	Main material	10^3t	$/t	$10^3$$	kg	$	
	Molten steel	675	199.52	134,674	1,058	211.09	
	By-products						
	Scrap	28	122.70	▲3,387	43	▲5.31	
	Scale	9	21.96	▲ 206	15	▲0.32	
	Subtotal			▲3,593		▲5.63	
	Other variable costs	10^3Nm^3	$/Nm^3$		Nm^3		
	COG	3,890	0.052	202	6.10	0.32	
		10^3kWH	/kWH				
	Electricity	12,960	0.061	786	20 kWH	1.23	
		10^3Nm^3	$/Nm^3$				
	Oxygen	4,540	0.071	322	7 Nm^3	0.51	
		10^3Nm^3	$/Nm^3$		Nm^3		
	Argon	77	1.25	96	0.1	0.15	
		10^3Nm^3	$/Nm^3$		Nm^3		
	LPG	454	0.29	132	0.7	0.21	
	Brick			1,970		3.09	
		10^3Nm^3	$/m^3$				
	Industrial water	17,431	0.017	295	27.3 m^3	0.46	
	Others			2,819		4.42	
	Subtotal			6,622		10.38	
	Total			137,703		215.84	
Fixed cost	Labor			308		0.48	
	Repair materials			1,429		2.24	
	Depreciation			4,425		6.94	
	Maintenance department cost			2,089		3.27	
	Plant administration			2,885		4.52	
	Others			643		1.01	
	Total			11,781		18.47	
Grand total				149,484		234.30	

Table 10.14. Name of cost center: Bloom continuous casting plant

	Production	207,000 tons/year					Remarks
	Item	Annual quantity required	Unit cost	Sum in dollar	Unit consumption	Cost per ton	
Variable cost	Main material	10^3t	\$/t	10^3\$	kg	\$	
	Molten steel	220	199.52	43,894	1,063	212.05	
	By-products						
	Scrap	12	122.70	▲1,423	56	▲6.88	
	Scale	1	21.96	▲ 31	7	▲0.15	
	Subtotal			▲1,454		▲7.02	
	Other variable costs	10^3Nm^3	$/Nm^3$				
	COG	1,240	0.052	64	$6Nm^3$	0.31	
		10^3kWH	/kWH				
	Electricity	4,140	0.061	251	20KWH	1.21	
		10^3Nm^3	$/Nm^3$				
	Oxygen	518	0.071	37	$2.5Nm^3$	0.18	
		10^3Nm^3	$/Nm^3$				
	Argon	25	1.25	31		0.15	
	Brick			1,013		4.90	
		10^3m^3	$/m^3$				
	Industrial water	4,513	0.017	76	$21.8m^3$	0.37	
	Others			184		0.89	
	Subtotal			1,657		8.01	
	Total			44,097		213.03	
Fixed cost	Labor			171		0.83	
	Repair materials			741		3.58	
	Depreciation			2,308		11.15	
	Maintenance department cost			1,083		5.23	
	Plant administration			1,511		7.30	
	Others			149		0.72	
	Total			5,963		28.81	
	Grand total			50,060		241.84	

Table 10.15. Name of cost center: Ingot-making plant

	Production	152,000 tons/year					Remarks
	Item	Annual quantity required	Unit cost	Sum in dollar	Unit consumption	Cost per ton	
Variable cost	Main material	10^3t	$/t	$10^3$$	kg	$	
	Molten steel	155	199.52	30,925	1,020	203.46	
	By-product (scrap)	3	122.70	▲ 368	20	▲2.42	
	Other variable costs						
	Moulds and stools	4	241.53	918	25	6.04	
	Shot Al			455		2.99	
	Electricity	10^3kWH 1,050	0.061	64	kWH 0.7	0.42	
	Product handling			182		1.20	
	Others			252		1.66	
	Subtotal			1,871		12.31	
	Total			32,428		213.34	
Fixed cost	Labor			148		0.97	
	Repair materials			222		1.46	
	Depreciation			614		4.04	
	Maintenance department cost			324		2.13	
	Plant administration			455		2.99	
	Others			35		0.23	
	Total			1,798		11.83	
	Grand total			34,226		225.17	

Table 10.17. Name of cost center: Billet mill

	Production	199,000 tons/year					
	Item	Annual quantity required	Unit cost	Sum in total	Unit consumption	Cost per ton	Remarks
Variable cost	Main material	10^3t	\$/t	10^3\$	kg	\$	
	Blooms	207	241.84	50,060	1,040	251.56	
	By-products						
	Scrap	4	122.70	▲ 491	20	▲2.47	
	Scale	4	21.96	▲ 88	20	▲0.44	
	Subtotal			▲ 579		▲2.91	
	Other variable costs						
	COG	10^3Nm^3 20,700	0.052	1,074	Nm^3 104	5.40	
	Rolls	t 24.84	1,687.21	42	0.12	0.21	
	Electricity	10^3kWH 6,210	/kWH 0.061	377	kWH 31.2	1.89	
	Industrial water	10^3m^3 17,015	/m^2 0.017	288	m^3 85.5	1.45	
	Product handling			239		1.20	
	Others			258		1.30	
	Subtotal			2,278		11.45	
	Total			51,759		260.09	
Fixed cost	Labor			251		1.26	
	Repair materials			808		4.06	
	Depreciation			2,519		12.66	
	Maintenance department cost			1,180		5.93	
	Plant administration			1,682		8.45	
	Others			163		0.82	
	Total			6,602		33.18	
	Grand total			58,361		293.27	

CHAPTER 11 FINANCIAL ANALYSIS

In this chapter, financial forecast and some financial analysis based thereon are made by employing the production plans and forecasts on construction and production costs as major inputs.

The results of the forecast and analysis must be utilized carefully, since considerable assumptions are involved with respect to such principal conditions as concerning corporate management form, fund raising and sales conditions. Despite of this, they will be suggestive of the financial standard and trend of the new steelworks. When any of the assumed conditions are realized, the established actual figures may be substituted therefor.

11.1 Preconditions for Financial Forecast

11.1.1 Corporate form of new steelworks

The corporate form of the new steelworks has not yet been finalized. Whether it is to be operated as a joint-stock company or otherwise, and how the government is to participate in its management remains to be decided.

This study is based on an assumption that the new steelworks will take the form of a joint-stock company.

11.1.2 Capital and equipment funds raising

The funds required for the construction of the new steelworks were estimated in Chapter 9. The time and method of raising them are considered to be as follows:

(1) Times to require and amounts of funds

With regard to the required funds, their payment times and ratios are forecasted on the basis of the construction schedule.

Contract time, equipments manufacturing period, shipping time and acceptance inspection time are considered for the estimation of equipment to be purchased, and contract time, construction period and acceptance inspection time for field work in the Philippines.

CHAPTER 11

FINANCIAL ANALYSIS

Their amounts are as shown in Table 11.1.

(2) Equity capital

The capital fund amounts to approximately 220 million dollars, representing about 30 percent of the aforesaid total required funds minus interest during construction. It is slightly more than the total of domestic construction and initial organization costs. The payment of capital fund is established with consideration for the amount of domestic construction cost and the payment forecast of initial organization cost.

(3) Loans

It is planned to raise the difference between the required funds and the capital paid-in by long-term loans. These loans are considered to be obtained at effective interest rate of 9 percent and repayable equally, in 10 years after the start of operation. The interest payable during the construction period is calculated as an addition to the principal. The amount and conditions of borrowing are of course assumptive ones. Concrete borrowing sources and terms remain to be decided hereafter.

In purchasing equipment from overseas, various financing methods are contemplable. In actuality, various sources and terms will be mixed. In some case, part of the contract amount will have to be paid down in cash. In other case, part of the personnel training fee etc. will have to be paid domestically. Further, interest and repayment terms will also vary considerably.

Table 11.1. Payments and funds raising during construction period (in $1,000)

Item \ Year	Construction period -4	-3	-2	-1	After start 1	Total
Imported equipment & engineering fee	42,687	119,028	211,456	86,719	28,332	488,222
Peronnel training & operation guidance fee				5,300	1,700	7,000
Preparatory equipment & spare parts				24,000		24,000
Domestic construction	35,501	47,217	55,273	70,636		208,627
Initial organization	800	1,600	2,400	3,200		8,000
Total	78,988	167,845	269,129	189,855	30,032	735,849
Funds raised						
Capital (paid in)	40,000	50,000	60,000	70,000		220,000
Loans	38,988	117,845	209,129	119,855	30,032	515,849
Interest during construction	1,754	8,970	24,491	41,499		76,715
Balance of loans (as of year end)	40,742	167,557	401,177	562,532		

11.1.3 Production plan

The construction and production plans of the new steelworks are discussed in related chapters. As the precondition to financial analysis, the production balance as shown in Table 11.2 is assumed here.

In the first year, the ingot-making equipment will be operated as fully as possible, in view of rather slow start-up of the continuous-casting equipments. Since the blast furnace plant reaches the ordinary production level earliest, molten pig iron will be in excess even if its ratio in the basic oxygen furnaces is raised to the maximum. So it will be casted into molded pigs.

In the second year, the blast furnace and basic oxygen furnace plants will be operating at the normal level, but the continuous-casting plant not. Therefore, hot metal not consumed in the continuous-casting plants will be supplied to the ingot-making plant.

In the third year and thereafter, all plants will operate normally.

In the 7th and 14th years, however, the blast furnace will be relined, and the production of pig iron will decrease. Accordingly, production of all plants for these years are lowered proportionally.

Table 11.2. Production plan (in 1,000 tons)

Year after operation start / Products	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Pig iron	876.6	965	965	965	965	965	478.9	965	965	965	965	965	965	478.9	965
Molten	693.9	965	965	965	965	965	478.9	965	965	965	965	965	965	478.9	965
Cast	182.7														
Hot Metal	735.5	1,050	1,050	1,050	1,050	1,050	521.1	1,050	1,050	1,050	1,050	1,050	1,050	521.1	1,050
Slab	250.2	577	638	638	638	638	316.6	638	638	638	638	638	638	316.6	638
Bloom	93.4	199.9	207	207	207	207	102.7	207	207	207	207	207	207	102.7	207
Ingot	364.2	222.2	152	152	152	152	75.4	152	152	152	152	152	152	75.4	152
Billet	89.6	191.9	199	199	199	199	98.8	199	199	199	199	199	199	98.8	199

Notes: 1. The figures for the 1st and 2nd years reflect the influence of the fluctuated initial operation of the individual plants.
2. Normal operation will be insured from the 3rd year and thereon.
3. The blast furnace will be relined in the 7th and 14th years.

11.1.4 Sales volume forecast

The volume of sales is estimated as shown in Table 11.3, based on the production plan discussed in 11.1.3.

Table 11.3. Sales estimation (in 1,000 tons)

Year after operation start / Products sold out	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Cast pig iron	182.7														
Slab	250.2	577	638	638	638	638	316.6	638	638	638	638	638	638	316.6	638
Billet	89.6	191.9	199	199	199	199	98.8	199	199	199	199	199	199	98.8	199
Ingot	364.2	222.2	152	152	152	152	75.4	152	152	152	152	152	152	75.4	152
Total	886.7	991.1	989	989	989	989	490.8	989	989	989	989	989	989	490.8	989

All cast pigs produced during the first year will be sold out.
In this chapter, all products manufactured are assumed to be shipped.
Consideration is given to inventions in the estimation of working capital.
The expected purchasers are given in Table 11.4.

Table 11.4. Expected purchasers

Product	Expected purchaser
Slab	Of ordinary production of 638,000 tons: { 558,000 tons to NASCO; 80,000 tons to Manila area }
Billet	To Manila area
Ingot	To NASCO
Cast Pig Iron	To Manila area

11.1.5 Sales plan

(1) Selling prices

Steel product prices will fluctuate very extensively, since they are liable to be influenced by domestic and overseas economic situations, demand-supply balances and other factors. Since the oil crisis, production cost has risen sharply as a result of an increase in raw materials, equipment and other general commodity prices. Therefore, it is very difficult to establish appropriate product prices at present. Further, the difficulty increases with the semi-finished products to be sold by the new steelworks, since there is not adequate market data on them.

One of the major objects of the new steelworks construction is to supply substitutes for imported steel products. Therefore, the prices of the imported products are first investigated, and then the selling prices to be employed for the purpose of this study estimated.

1) Imported steel product prices

With respect to the semi-finished steel products to be sold by the new steelworks, there is not adequate data that permits accurate estimation of the import prices. Accordingly, the import prices given in Table 11.5 have been established based on some assumption.

Based on 1975 and 1976 data, supplied by counterparts, the C & F prices for slab and billet are estimated to average approximately $200 and $180 per ton, respectively. The billet prices of the new steelworks will be higher than the ordinary level because of its smaller-size-centered product mix, which comprises 50 percent 50 mm square, 25 percent 80 mm square and 25 percent 115 mm square.

The billet price for the new steelworks is therefore estimated as averaging $210 per ton. The cast pig iron and ingot prices are established by adding reasonable differences to the slab price. The landed prices are estimated by adding to such C & F prices the current 10 percent import duty, insurance premium, other charges, and advance sales tax.

Table 11.5. Estimated imported steel product prices

(Dollar per ton)

Product	C & F	Landed Price
Cast Pig Iron	$150	$185
Slab	200	245
Billet	210	260
Ingot	170	210

2) Selling prices (Cases A and B)

Compared with the total cost of sales comprising the manufacturing cost calculated in Chapter 10, general administrative cost and other miscellaneous expenses, it is evident that the new steelworks' products sold at the imported steel product prices estimated under Table 11.5 would yield little profit. Their selling prices must be higher than those prices.

In this study, the selling prices are analyzed in terms of two basic cases that will hereinafter be called Case A and Case B.

(a) Case A

The prices estimated in Case A approximate to the aforementioned imported product C & F prices plus 30 percent import duties. The Philippines' import duties on steel products are 10 percent as a rule. But higher rates are imposed on such products as those whose domestic production has advanced. For instance, 30 percent on cold rolled coil and shapes, and 50 percent on galvanized sheet, tinplate and concrete bars.

The prices for Case A and the total costs of sales in the ordinary years are compared in Table 11.6.

Table 11.6. Selling prices and total costs of sales - Case A (in dollar per ton)

Product	Selling price (A)	Total cost of sales						Profit (A - B)
		Production cost	Duty etc. adjustment	General administrative cost	Transportation cost	Interest	Total (B)	
Cast Pig Iron	220	154.8	▲ 6.6	7.3	4.7	17.5	177.7	42.4
Slab	295	234.3	▲ 9.3	8.4	1.7	24.6	259.7	35.3
Billet	310	293.3	▲ 10.0	8.6	4.7	33.6	330.2	▲ 20.2
Ingot	250	225.2	▲ 9.3	7.7	1.3	22.7	247.5	2.5

Notes:
1. Since the above total cost of sales is for ordinary years, the profit will decrease by the amount of fixed cost during the initial operation stage and blast-furnace overhaul period.
2. "Adjustment of duty etc." means averaged reduction and exemption of duties, advance sales and other taxes that are fully included in production cost.
3. "General administrative cost" includes general administrative cost, amortization of initial organization cost and slaes tax.
4. For details of "transportation cost", refer to Table 11.13.

(b) Case B

In case B, the selling prices are established by adding appropriate profits to costs. With these prices, the rate of return on investment (ROI) of the new steelworks will become 10 percent in terms of the discounted cash flow (DCF) method. (The ROI and DCF will be discussed later.) In evaluating the investment effect, the ROI rate of approximately 10 percent will at least be necessary.

Since the prices in Case B are based on the production costs, those for billet and ingot are considerably high and not realistic. The prices and the total costs of sales in the ordinary years are compared in Table 11.7.

Table 11.7. Selling prices and total costs of sales - Case B (in dollar per ton)

Product	Selling price (A)	Total cost of sales						Profit (A - B)
		Production cost	Duty etc. adjustment	General administrative cost	Transportation cost	Interest	Total (B)	
Cast Pig Iron	216	154.8	▲ 6.6	7.8	4.7	18.7	179.4	36.6
Slab	337	234.2	▲ 9.3	9.8	1.7	25.9	262.4	74.6
Billet	447	293.3	▲10.0	11.7	4.7	34.8	334.5	112.5
Ingot	310	225.2	▲ 9.3	9.4	1.3	23.9	250.4	59.6

3) Amount of sales

The amounts of sales based on the prices in Cases A and B are shown in their respective statements of profit and loss.

11.1.6 Cost of sales, general administrative cost and other costs

The cost of sales and other costs shown in the profit and loss statements will be explained here. For their amounts, refer to the statements.

(1) Variable cost of sales

Of the cost of sales, the variable cost of sales is calculated by multiplying the variable cost per ton calculated in Chapter 10 by the quantity of sold-out products.

(2) Fixed cost of sales

The fixed cost of sales comprises the total of labor cost, fixed materials cost and other fixed expenses that is obtained by deducting depreciation and provision for blast-furnace relining, which affect the cash flow, and the adjustments due to duty and tax reduction and exemption from the fixed cost calculated in Chapter 10.

(3) Taxes and dues

National taxes excepting income tax are estimated by assuming that the reduction and exemption for pioneer companies formulated by the Investment Incentive Act are applicable.

The tax adjustment in the profit and loss include the real property tax that is a local tax.

(a) Customs duty, advance sales tax etc.

The duties, advance sales and specific taxes to be imposed on the raw materials etc. imported and their amounts payable after reduction or exemption are estimated on the current normal rates, as shown in Table 11.8.

Table 11.8. Duties, advance sales and other taxes

(Unit: $1,000)

Year after operation start	Tax imposed	Tax payable	
		Reduction rate	Amount
1	11,964		0
2	17,079		0
3		100%	0
4			0
5			0
6			4,270
7	8,476	75%	2,119
8	17,079		4,270
9			8,540
10		50%	8,540
11			13,663
12		20%	13,663
13			15,371
14	8,476	10%	7,629
15	17,079		15,371

Notes. 1. For imported goods, import duties, advance sales and specific taxes are estimated.

2. The rates of tax reduction are according to the Investment Incentives Act.

(b) Real property tax

The real property tax for every year is calculated based on the conception described in 10.2.10, as shown in Table 11.9.

Table 11.9. Real property tax

(Unit: $1,000)

Year after operation start	Amounts taxable				Tax payable (A)x2.25%
	Land	Building & structure	Machinery & equipment	Total (A)	
1	10,976	100,591.5	(330,257.4)	111,567.5	2,510
2	"	"	(")	"	"
3	"	"	(")	"	"
4	"	"	330,257.4	441,824.9	9,941
⟆	"	"	"	"	"
15	"	"	"	"	"

Notes. 1. Machinery and equipment are assumed to be exempted from taxation for 3 years.

2. The amounts taxable are assumed to be 50 percent of the acquisition price for land, building and structure, and 60 percent for machinery and equipment.

(c) Sales tax

It is assumed that 7 percent sales tax will be imposed on the difference between the sales and the raw materials cost. Then, the tax amount payable is obtained by deducting the tax reduction or exemption. Since the sales differ in Cases A and B, their respective sales taxes are shown in Tables 11.10 and 11.11.

(d) Tax and due adjustments

The full amount, before reduction or exemption, of the duties, advance sales and other taxes under (a) is included in the variable cost of sales as a portion of the raw materials cost. In the profit and loss statement, their reduction or exemption are deducted from the total of real property and sales taxes payable as profit and loss adjustments. The breakdown is shown in Table 11.12.

Table 11.10. Sales tax - Case A (in $1,000)

Year after operation start	Tax imposed	Tax payable	
		Reduction rate	Amount
1	9,661	100%	0
2	10,493		0
3	10,678		0
4			0
5			0
6		75%	2,670
7	5,299		1,325
8	10,678		2,670
9		50%	5,339
10			5,339
11		20%	8,543
12			8,543
13		10%	9,610
14	5,299		4,769
15	10,678		9,610

Table 11.11. Sales tax - Case B (in $1,000)

Year after operation start	Tax imposed	Tax payable	
		Reduction rate	Amount
1	12,734		0
2	14,963		0
3	15,101	100%	0
4			0
5			0
6			3,775
7	7,494	75%	1,874
8	15,101		3,775
9			7,551
10		50%	7,551
11			12,081
12		20%	12,081
13			13,591
14	7,494	10%	6,745
15	15,101		13,591

Table 11.12. Tax and due adjustments - Cases A and B

(Unit: $1,000)

Year after operation start	Import duty, advance sales tax, etc.	Real property tax	Sales tax	Total (Case A)	Total (Case B)
1	▲ 11,964	2,510	0	▲ 9,453	▲ 9,453
2	▲ 17,079	2,510	0	▲14,569	▲14,569
3	▲ 17,079	2,510	0	▲14,569	▲14,569
4	▲ 17,079	9,941	0	▲ 7,138	▲ 7,138
5	▲ 17,079	9,941	0	▲ 7,138	▲ 7,138
6	▲ 12,809	9,941	2,670	▲ 199	907
7	▲ 6,357	9,941	1,325	4,909	5,458
8	▲ 12,809	9,941	2,670	▲ 199	907
9	▲ 8,540	9,941	5,339	6,741	8,952
10	▲ 8,540	9,941	5,339	6,741	8,952
11	▲ 3,416	9,941	8,543	15,068	18,606
12	▲ 3,416	9,941	8,543	15,068	18,606
13	▲ 1,708	9,941	9,610	17,843	21,824
14	▲ 848	9,941	4,769	13,863	15,838
15	▲ 1,708	9,941	9,610	17,843	21,824

(4) Depreciation

The fixed assets depreciation, $44,743,000, the preparative training fee and operation guidance fee amortization, $700,000, and the initial organization cost amortization, $800,000, are totaled. From the 11th year and thereafter, only the fixed assets depreciation remains.

(5) General administrative cost

This item covers the cost needed for the headquarters activities. The headquarters staff are shown in the manning plan in Chapter 8. With this personnel data and the assumption that the labor cost will be $574,000, the annual general administrative cost is estimated as

$3,200,000. It becomes $4,000,000 when the amortization of the initial organization cost is included.

(6) Transportation cost for sold-out products

In this study, the new steelworks' products are assumed to be sold as delivered in the customers side main parts. Therefore, transportation cost must be estimated.

Transportation costs per ton are shown in Table 11.13.

Overland transportation is probable from the new steelworks to NASCO. But only marine transportation is studied here, in consideration of the bulkiness of cargoes and the reasonableness of marine freight over trucking rate.

Since large quantities of cargoes are to be transported constantly, estimation is based not on ordinary tariff but special reduced rate. At present, NASCO is operating an owned vessel on special freight. Based on its actual operation data, this study employs 83 percent of the ordinary tariff as the transportation cost.

Table 11.13. Transportation cost for sold-out products (in dollar per ton)

Product	Cast Pig Iron	Slab	Billet	Ingot
Transportation cost	4.66	1.69	4.66	1.26

Notes: 1. Freights are established as follows:

From new steelworks to Manila

$4.66 per ton

From new steelworks to NASCO

$1.26 per ton

2. The destinations of the sold-out products are as given in Table 11.5.

(7) Loans, interests and working capital

(a) Long-term loan

The amount and terms of long-term loan were discussed in 11.1.2-(3). The repayment schedule and payable interests are given in Table 11.14.

(b) Working capital forecast and short-term loan

The working capital for the new steelworks is estimated as shown in Table 11.15. For this purpose, domestic short-term fund will be used, which is to be borrowed at an interest rate of 16 percent per annum and reimbursed in a year. The effective interest rate of 16 percent comprises 14 percent interest on the unsecured loan and 2 percent bank charges.

Table 11.14. Long-term loan repayment schedule and payable interests (in $1,000)

Year after operation start	Amount borrowed	Amount repaid	Balance at year end	Interest payable (9 percent)
-4 - -1	562,531.7		562,532	
1	30,032.0	59,256.4	533,307.3	49,312.8
2		59,256.4	474,051.0	45,331.1
3		59,256.4	414,794.6	39,998.1
4		59,256.4	355,538.2	34,665.0
5		59,256.4	296,281.9	29,331.9
6		59,256.4	237,025.5	23,998.8
7		59,256.4	177,769.1	18,665.8
8		59,256.4	118,512.7	13,332.7
9		59,256.4	59,256.4	7,999.6
10		59,256.4	0	2,666.5
Total	592,563.7	592,563.7	0	265,302.2

Table 11.15. Working capital forecast - ordinary year

(Unit: $1,000)

Item	Amount Case A	Amount Case B	Forecast preconditions
Assets			
Account receivable	23,992	29,257	Equal to one-month sales
Inventories	49,567	49,567	
Materials	40,246	40,246	Assumed to average 2.5 months' requirement
Semi-finished products	3,268	3,268	Estimated for major semi-finished products
Finished products	6,053	6,053	Assumed to average 0.3 month's production
Liquid assets	11,996	14,628	Assumed to be approximately 0.5 month's sales
Total	85,555	93,452	
Liabilities			
Account payable	33,421	33,421	Assumed to be payable in 3 months on average
Total	33,421	33,421	
Net working capital	52,134	60,031	

(8) Income tax

The Philippine tax law imposes 25 percent income tax on net income of not exceeding 100,000 pesos (approximately $13,700) before tax, and 35 percent on net income above that level.

As an incentive, it is permitted to carry losses during the first 10 years after the start of operation over for 6 years, and deduct them from taxable income.

For calculation convenience, the income tax rate is fixed at 35 percent in this study.

11.2 Statement of Profit and Loss and Break-Even Point

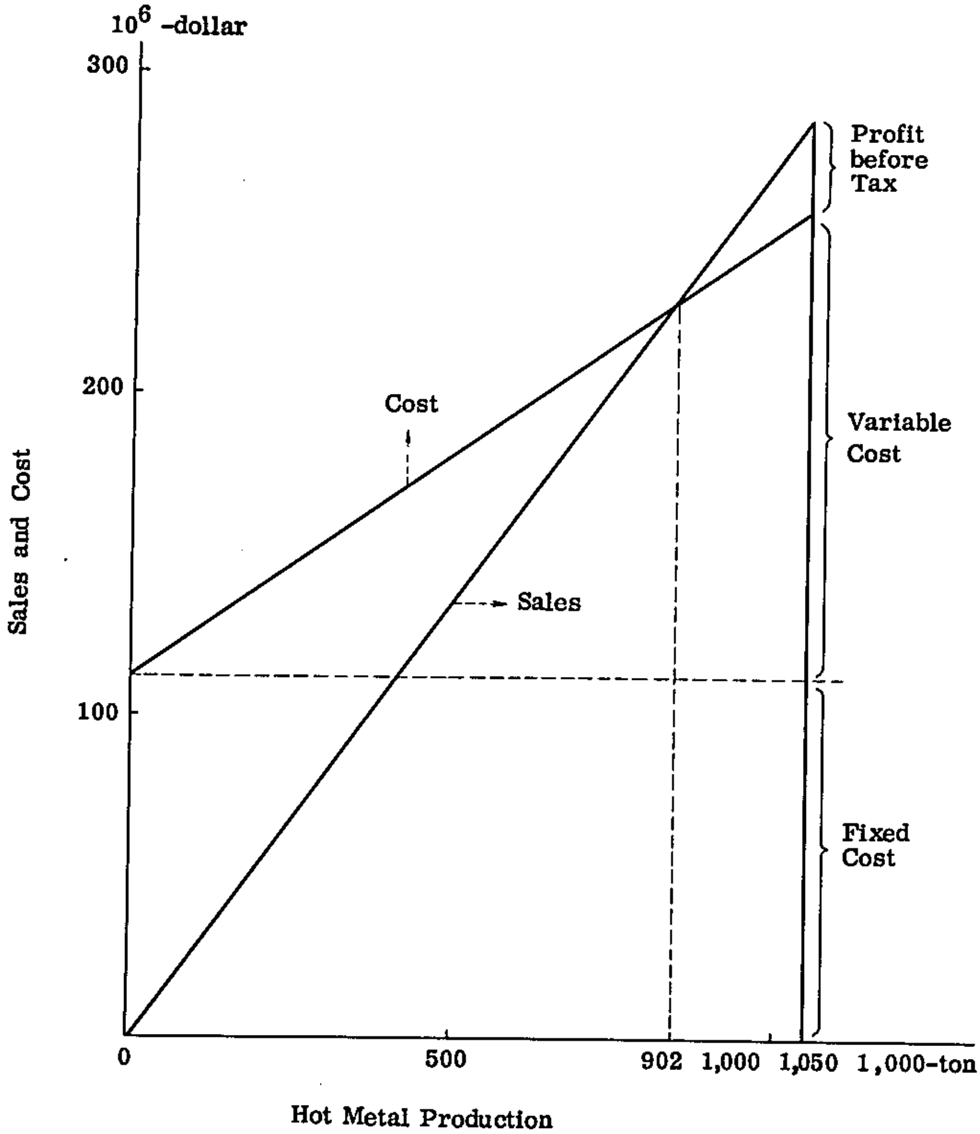
The profit and loss statements for Case A and Case B are prepared according to the preconditions, calculation method and indications discussed in 11.1.

11.2.1 Profit and loss statement for Case A

The statement of profit and loss for Case A is given in Table 11.16. A heavy loss will occur in the first year, but the operation will move into the black from the second year. The profitable operation is expected to continue thereafter, except in the years when the blast furnace relining is scheduled. But the amount of surplus will not be very great.

11.2.2 Break-even point for Case A

The break-even point for Case A is shown in Fig. 11.1. The operation rate at the break-even point is 86 percent of the rated capacity. In consideration of business fluctuation etc., considerable efforts will be required to achieve stable operation at the aforesaid high operation rate.



Break-even point = Production capacity x $\frac{\text{Fixed cost}}{\text{Sales - Variable cost}}$

1,050,000 tons x 85.9 %

= 902,000 tons

Fig. 11.1. Break-even point for Case A

11.2.3 Profit and loss statement for Case B

The statement of profit and loss for Case B is given in Table 11.18. Different from Case A, the operational result will be in the black from the first year. Considerable surplus will remain even after paying income tax.

11.2.4 Break-even point for Case B

The break-even point for Case B is shown in Fig. 11.2. The operation rate at the break-even point is 59 percent of the rated capacity.

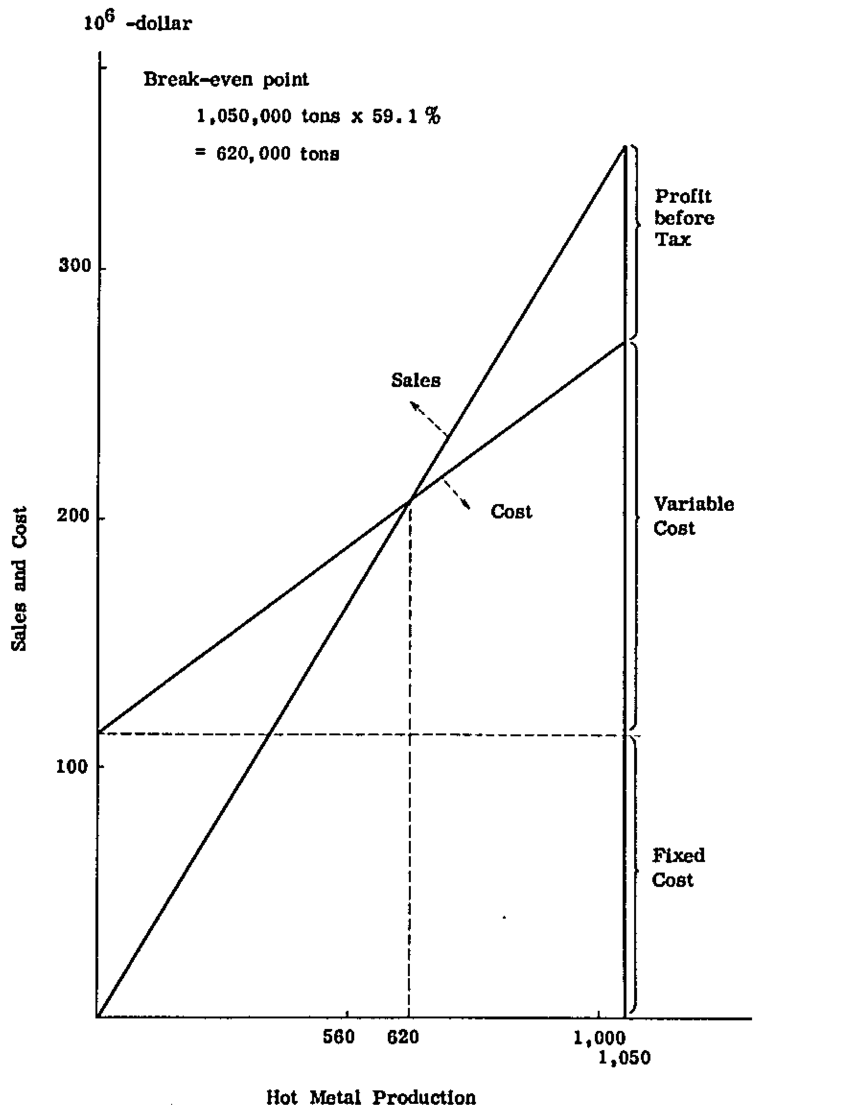


Fig. 11.2. Break-even point for Case B

TABLE 11-16(1) PROFIT AND LOSS ESTIMATE (CASEA)

PROJECT CASH FLOW FORECAST....P/L BLOCK
(000,$ OMITTED)

PROJECT: PHILIPPINE PROJECT
CASE NO: A

CAPITAL OF (000) 812563.
TAX LIABILITY: 35.%

STRAIGHT LINE DEPRECIATION

ROE =
ROI = 4.78%

PROJECT YEAR	PER	-4	-3	-2	-1	1	2	3	4	5	6
CALENDER YEAR	TON	1	2	3	4	5	6	7	8	9	10
:PROFIT PROJECTION:											
SALES VOLUME											
P.IRON		0.	0.	0.	0.	183.	0.	0.	0.	0.	0.
SLAB		0.	0.	0.	0.	250.	577.	638.	638.	638.	638.
BILLET		0.	0.	0.	0.	90.	192.	199.	199.	199.	199.
INGOT		0.	0.	0.	0.	364.	222.	152.	152.	152.	152.
SALES REVENUE											
P.IRON	220.00	0.	0.	0.	0.	40194.	0.	0.	0.	0.	0.
SLAB	295.00	0.	0.	0.	0.	73809.	170215.	188210.	188210.	188210.	188210.
BILLET	310.00	0.	0.	0.	0.	27776.	59489.	61690.	61690.	61690.	61690.
INGOT	250.00	0.	0.	0.	0.	91050.	55550.	38000.	38000.	38000.	38000.
TOTAL		0.	0.	0.	0.	232829.	285254.	287900.	287900.	287900.	287900.
COSTS & EXPENSES											
OPERATING COST											
P.IRON	106.01	0.	0.	0.	0.	19368.	0.	0.	0.	0.	0.
SLAB	149.44	0.	0.	0.	0.	37390.	86227.	95343.	95343.	95343.	95343.
BILLET	160.32	0.	0.	0.	0.	14365.	30765.	31904.	31904.	31904.	31904.
INGOT	149.85	0.	0.	0.	0.	54575.	33297.	22777.	22777.	22777.	22777.
VARIABLE COST TOTAL		0.	0.	0.	0.	125698.	150289.	150024.	150024.	150024.	150024.
FIXED COST		0.	0.	0.	0.	30186.	30186.	30186.	30186.	30186.	30186.
START UP COST		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BF PROVISION		0.	0.	0.	0.	6546.	6546.	6546.	6546.	6546.	6546.
TAXES & FEES		0.	0.	0.	0.	-9453.	-14569.	-14569.	-7138.	-7138.	-199.
DEPRECIATION		0.	0.	0.	0.	46243.	46243.	46243.	46243.	46243.	46243.
TOTAL		0.	0.	0.	0.	73521.	68406.	68406.	75837.	75837.	82776.
GEN ADMINISTRATION		0.	0.	0.	0.	3200.	3200.	3200.	3200.	3200.	3200.
TRANSPORTATION		0.	0.	0.	0.	2151.	2149.	2197.	2197.	2197.	2197.
INTEREST1(LONG)	9.0%	0.	0.	0.	0.	49313.	45331.	39998.	34665.	29332.	23999.
INTEREST2(SHORT)	16.0%	0.	0.	0.	0.	6400.	8284.	8341.	8341.	8341.	8341.
INTEREST TOTAL		0.	0.	0.	0.	55713.	53615.	48339.	43006.	37673.	32340.
TOTAL COST		0.	0.	0.	0.	260283.	277659.	272165.	274263.	268930.	270536.
NET PROFIT PRE-TAX		0.	0.	0.	0.	-27454.	7595.	15735.	13637.	18970.	17364.
PRIOR YRS LOSS CARRY FORWARD		0.	0.	0.	0.	-27454.	-19859.	-4124.	0.	0.	0.
TAXABLE INCOME		0.	0.	0.	0.	-27454.	-19859.	-4124.	9513.	18970.	17364.
INCOME TAX	35.0%	0.	0.	0.	0.	0.	0.	0.	3329.	6640.	6077.
NET INCOME BEFORE RSV		0.	0.	0.	0.	-27454.	7595.	15735.	10308.	12331.	11286.
RESERVE	0.0%	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CUMULATIVE RESERVE		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SPECIAL INCOME		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NET INCOME		0.	0.	0.	0.	-27454.	7595.	15735.	10308.	12331.	11286.

TABLE 11-16(2)

PROJECT CASH FLOW FORECAST ... P/L BLOCK
(000,$ OMITTED)

PAGE= 2

PROJECT; PHILIPPINE PROJECT
CASE NO: A

CAPITAL OF (000) 812563.
TAX LIABILITY: 35.%

STRAIGHT LINE DEPRECIATION

ROE =
ROI = 4.78%

PROJECT YEAR	PER	7	8	9	10	11	12	13	14	15
CALENDER YEAR	TON	11	12	13	14	15	16	17	18	19
:PROFIT PROJECTION:										
SALES VOLUME										
P.IRON		0.	0.	0.	0.	0.	0.	0.	0.	0.
SLAB		638.	638.	317.	638.	638.	638.	638.	638.	638.
BILLET		199.	199.	199.	99.	199.	199.	199.	199.	199.
INGOT		152.	152.	152.	152.	75.	152.	152.	152.	152.
SALES REVENUE										
P.IRON	220.00	0.	0.	0.	0.	0.	0.	0.	0.	0.
SLAB	295.00	93397.	188210.	188210.	188210.	188210.	188210.	188210.	93397.	188210.
BILLET	310.00	30628.	61690.	61690.	61690.	61690.	61690.	61690.	30628.	61690.
INGOT	250.00	18850.	38000.	38000.	38000.	38000.	38000.	38000.	18850.	38000.
TOTAL		142875.	287900.	287900.	287900.	287900.	287900.	287900.	142875.	287900.
COSTS & EXPENSES										
OPERATING COST										
P.IRON	106.01	0.	0.	0.	0.	0.	0.	0.	0.	0.
SLAB	149.44	47313.	95343.	95343.	95343.	95343.	95343.	95343.	47313.	95343.
BILLET	160.32	15840.	31904.	31904.	31904.	31904.	31904.	31904.	15840.	31904.
INGOT	149.85	11299.	22777.	22777.	22777.	22777.	22777.	22777.	11299.	22777.
VARIABLE COST TOTAL		74451.	150024.	150024.	150024.	150024.	150024.	150024.	74451.	150024.
FIXED COST		30186.	30186.	30186.	30186.	30186.	30186.	30186.	30186.	30186.
START UP COST		0.	0.	0.	0.	0.	0.	0.	0.	0.
BF PROVISION		0.	6546.	6546.	6546.	6546.	6546.	6546.	0.	6546.
TAXES & FEES		4909.	-199.	6741.	6741.	15068.	15068.	17843.	13863.	17843.
DEPRECIATION		46243.	46243.	46243.	46243.	44743.	44743.	44743.	44743.	44743.
TOTAL		81337.	82776.	89715.	89715.	96542.	96542.	99318.	88791.	99318.
GEN ADMINISTRATION		3200.	3200.	3200.	3200.	3200.	3200.	3200.	3200.	3200.
TRANSPORTATION		1090.	2197.	2197.	2197.	2197.	2197.	2197.	1090.	2197.
INTEREST1(LONG)	9.0%	18666.	13333.	8000.	2667.	0.	0.	0.	0.	0.
INTEREST2(SHORT)	16.0%	4085.	8341.	8341.	8341.	8341.	8341.	8341.	4085.	8341.
INTEREST TOTAL		22751.	21674.	16341.	11008.	8341.	8341.	8341.	4085.	8341.
TOTAL COST		182829.	259870.	261476.	256143.	260304.	260304.	263080.	171617.	263080.
NET PROFIT PRE-TAX		-39955.	28030.	26424.	31757.	27596.	27596.	24820.	-28743.	24820.
PRIOR YRS LOSS CARRY FORWARD		-39955.	-11925.	0.	0.	0.	0.	0.	-28743.	-3922.
TAXABLE INCOME		-39955.	-11925.	14499.	31757.	27596.	27596.	24820.	-28743.	-3922.
INCOME TAX	35.0%	0.	0.	5075.	11115.	9659.	9659.	8687.	0.	0.
NET INCOME BEFORE RSV		-39955.	28030.	21349.	20642.	17937.	17937.	16133.	-28743.	24820.
RESERVE	0.0%	0.	0.	0.	0.	0.	0.	0.	0.	0.
CUMULATIVE RESERVE		0.	0.	0.	0.	0.	0.	0.	0.	0.
SPECIAL INCOME		0.	0.	0.	0.	0.	0.	0.	0.	0.
NET INCOME		-39955.	28030.	21349.	20642.	17937.	17937.	16133.	-28743.	24820.

TABLE 11-17(1) CASH FLOW ESTIMATE CCASE A)

PROJECT CASH FLOW FORECAST....C/F BLOCK
(000,$ OMITTED)

PROJECT YEAR / CALENDER YEAR	PER TON	-4 / 1	-3 / 2	-2 / 3	-1 / 4	1 / 5	2 / 6	3 / 7	4 / 8	5 / 9	6 / 10
:CASH FLOW PROJECTION:											
FUNDS PROVIDED:											
EQUITY	220000	40000.	50000.	60000.	70000.	0.	0.	0.	0.	0.	0.
LOAN1(LONG)	592563	38988.	117845.	209129.	119855.	30032.	0.	0.	0.	0.	0.
LOAN2(SHORT)	0	0.	0.	0.	0.	40003.	51774.	52134.	52134.	52134.	52134.
IDC1	9,0%	1754.	8970.	24491.	41499.	0.	0.	0.	0.	0.	0.
IDC2	16,0%	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	592563	40742.	126815.	233620.	161354.	70035.	51774.	52134.	52134.	52134.	52134.
NET INCOME		0.	0.	0.	0.	-27454.	7595.	15735.	10308.	12331.	11286.
DEPRECIATION & AMOR.		0.	0.	0.	0.	46243.	46243.	46243.	46243.	46243.	46243.
BF PROVISION		0.	0.	0.	0.	6546.	6546.	6546.	6546.	6546.	6546.
TOTAL		80742.	176815.	293620.	231354.	95370.	112158.	120657.	115230.	117253.	116209.
FUNDS APPLIED:											
PLANT & PRE-OPE	735849.	78988.	167845.	269129.	189855.	30032.	0.	0.	0.	0.	0.
IDC1	9,0%	1754.	8970.	24491.	41499.	0.	0.	0.	0.	0.	0.
IDC2	16,0%	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDC TOTAL		1754.	8970.	24491.	41499.	0.	0.	0.	0.	0.	0.
BF RELINING		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ADDITIONAL CAPITAL		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WORKING CAPITAL		0.	0.	0.	0.	40003.	11771.	360.	0.	0.	0.
LOAN REPAYMENT1		0.	0.	0.	0.	59256.	59256.	59256.	59256.	59256.	59256.
LOAN REPAYMENT2		0.	0.	0.	0.	0.	40003.	51774.	52134.	52134.	52134.
REPAYMENT TOTAL		0.	0.	0.	0.	59256.	99259.	111030.	111390.	111390.	111390.
TOTAL		80742.	176815.	293620.	231354.	129291.	111030.	111390.	111390.	111390.	111390.
NET CASH FLOW		0.	0.	0.	0.	-33921.	1127.	9267.	3840.	5863.	4819.
:CASH GENERATION:											
ANNUAL		-40000.	-50000.	-60000.	-70000.	-33921.	1127.	9267.	3840.	5863.	4819.
CUMULATIVE		-40000.	-90000.	-150000.	-220000.	-253921.	-252794.	-243527.	-239687.	-233824.	-229005.
DISCOUNT RATE		1,00000	0;97513	0,95088	0,92724	0,90418	0.88169	0.85977	0.83839	0.81754	0.79721
D.C.F.(ROE)		-40000.	-48757.	-57053.	-64907.	-30671.	994.	7968.	3219.	4793.	3842.
ANNUAL		-80742.	-176815.	-293620.	-231354.	11013.	102228.	116502.	106102.	102792.	96415.
CUMULATIVE		-80742.	-257557.	-551177.	-782531.	-771518.	-669291.	-552788.	-446686.	-343894.	-247479.
DISCOUNT RATE		1,00000	0,95439	0,91086	0,86932	0.82967	0,79183	0,75572	0,72125	0,68836	0,65696
D.C.F.(ROI)		-80742.	-168751.	-267448.	-201121.	9137.	80947.	88043.	76527.	70758.	63341.
LOAN1 BALANCE-YEAR END		40742.	167557.	401177.	562531.	533307.	474050.	414794.	355538.	296281.	237025.
LOAN2 BALANCE-YEAR END		0.	0.	0.	0.	40003.	51774.	52134.	52134.	52134.	52134.
TOTAL		38988.	167557.	401177.	562531.	573310.	525824.	466928.	407672.	348415.	289159.

TABEL 11-17(2)

PROJECT CASH FLOW FORECAST....C/F BLOCK
(000,$ OMITTED)

PROJECT YEAR / CALENDER YEAR	PER TON	7 / 11	8 / 12	9 / 13	10 / 14	11 / 15	12 / 16	13 / 17	14 / 18	15 / 19
:CASH FLOW PROJECTION:										
FUNDS PROVIDED:										
EQUITY	220000	0.	0.	0.	0.	0.	0.	0.	0.	0.
LOAN1(LONG)	592563	0.	0.	0.	0.	0.	0.	0.	0.	0.
LOAN2(SHORT)	0	25532.	52134.	52134.	52134.	52134.	52134.	52134.	25532.	52134.
IDC1	9.0%	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDC2	16.0%	0.	0.	0.	0.	0.	0.	0.	0.	0.
	592563	25532.	52134.	52134.	52134.	52134.	52134.	52134.	25532.	52134.
NET INCUME		-39955.	28030.	21349.	20642.	17937.	17937.	16133.	-28743.	24820.
DEPRECIATION & AMOR.		46243.	46243.	46243.	46243.	44743.	44743.	44743.	44743.	44743.
BF PROVISION		0.	6546.	6546.	6546.	6546.	6546.	6546.	0.	6546.
TOTAL		31820.	132953.	126272.	125565.	121360.	121360.	119556.	41532.	230668.
FUNDS APPLIED:										
PLANT & PRE-OPE	735849.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDC1	9.0%	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDC2	16.0%	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDC TOTAL		0.	0.	0.	0.	0.	0.	0.	0.	0.
BF RELINING		39277.	0.	0.	0.	0.	0.	0.	39277.	0.
ADDITIONAL CAPITAL		0.	0.	0.	0.	0.	0.	0.	0.	0.
WORKING CAPITAL		-26602.	26602.	0.	0.	0.	0.	0.	-26602.	-49532.
LOAN REPAYMENT1		59256.	59256.	59256.	59256.	0.	0.	0.	0.	0.
LOAN REPAYMENT2		52134.	25532.	52134.	52134.	52134.	52134.	52134.	52134.	77666.
REPAYMENT TOTAL		111390.	84788.	111390.	111390.	52134.	52134.	52134.	52134.	77666.
TOTAL		124065.	111390.	111390.	111390.	52134.	52134.	52134.	64809.	28134.
NET CASH FLOW		-92245.	21562.	14881.	14175.	69226.	69226.	67422.	-23277.	202534.
:CASH GENERATION:										
ANNUAL		-92245.	21562.	14881.	14175.	69226.	69226.	67422.	-23277.	202534.
CUMULATIVE		-321250.	-299688.	-284807.	-270632.	-201406.	-132180.	-64758.	-88035.	114499.
DISCOUNT RATE		0.77738	0.75805	0.73920	0.72082	0.70289	0.68541	0.66837	0.65175	0.63554
D.C.F.(ROE)		-71710.	16345.	11000.	10217.	48659.	47449.	45063.	-15171.	128719.
ANNUAL		16364.	75890.	90478.	84438.	77567.	77567.	75763.	7410.	133982.
CUMULATIVE		-231115.	-155224.	-64746.	19692.	97259.	174826.	250589.	257999.	391981.
DISCOUNT RATE		0.62700	0.59841	0.57111	0.54507	0.52021	0.49648	0.47384	0.45223	0.43160
D.C.F.(ROI)		10260.	45413.	51673.	46024.	40351.	38511.	35899.	3351.	57827.
LOAN1 BALANCE-YEAR END		177768.	118512.	59256.	-0.	-0.	-0.	-0.	-0.	-0.
LOAN2 BALANCE-YEAR END		25532.	52134.	52134.	52134.	52134.	52134.	52134.	25532.	0.
TOTAL		203300.	170646.	111390.	52134.	52134.	52134.	52134.	25532.	-0.

TABLE 11-18(1) PROFIT AND LOSS ESTIMATE (CASE B)

PROJECT CASH FLOW FORECAST....P/L BLOCK.
(000,$ OMITTED)

PROJECT: PHILIPPINE PROJECT
CASE NO: B

CAPITAL OF (000) 812563.
TAX LIABILITY: 35.% STRAIGHT LINE DEPRECIATION

ROE = 13.71%
ROI = 10.01%

PROJECT YEAR / CALENDER YEAR	PER TON	-4 / 1	-3 / 2	-2 / 3	-1 / 4	1 / 5	2 / 6	3 / 7	4 / 8	5 / 9	6 / 10
:PROFIT PROJECTION:											
SALES VOLUME											
P.IRON		0.	0.	0.	0.	183.	0.	0.	0.	0.	0.
SLAB		0.	0.	0.	0.	250.	577.	638.	638.	638.	638.
BILLET		0.	0.	0.	0.	90.	192.	199.	199.	199.	199.
INGOT		0.	0.	0.	0.	364.	272.	152.	152.	152.	152.
SALES REVENUE											
P.IRON	216.00	0.	0.	0.	0.	39463.	0.	0.	0.	0.	0.
SLAB	337.00	0.	0.	0.	0.	84317.	194449.	215006.	215006.	215006.	215006.
BILLET	447.00	0.	0.	0.	0.	40051.	85779.	88953.	88953.	88953.	88953.
INGOT	310.00	0.	0.	0.	0.	112902.	68682.	47120.	47120.	47120.	47120.
TOTAL		0.	0.	0.	0.	276734.	349110.	351079.	351079.	351079.	351079.
COSTS & EXPENSES											
OPERATING COST											
P.IRON	106.01	0.	0.	0.	0.	19368.	0.	0.	0.	0.	0.
SLAB	149.44	0.	0.	0.	0.	37390.	86227.	95343.	95343.	95343.	95343.
BILLET	160.32	0.	0.	0.	0.	14365.	30765.	31904.	31904.	31904.	31904.
INGOT	149.85	0.	0.	0.	0.	54575.	33297.	22777.	22777.	22777.	22777.
VARIABLE COST TOTAL		0.	0.	0.	0.	125698.	150289.	150024.	150024.	150024.	150024.
FIXED COST		0.	0.	0.	0.	30186.	30186.	30186.	30186.	30186.	30186.
START UP COST		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BF PROVISION		0.	0.	0.	0.	6546.	6546.	6546.	6546.	6546.	6546.
TAXES & FEES		0.	0.	0.	0.	-9453.	-14569.	-14569.	-7138.	-7138.	907.
DEPRECIATION		0.	0.	0.	0.	46243.	46243.	46243.	46243.	46243.	46243.
TOTAL		0.	0.	0.	0.	73522.	68406.	68406.	75837.	75837.	83882.
GEN ADMINISTRATION		0.	0.	0.	0.	3200.	3200.	3200.	3200.	3200.	3200.
TRANSPORTATION		0.	0.	0.	0.	2151.	2149.	2197.	2197.	2197.	2197.
INTEREST1(LONG)	9.0%	0.	0.	0.	0.	49313.	45331.	39998.	34665.	29332.	23999.
INTEREST2(SHORT)	16.0%	0.	0.	0.	0.	7279.	9532.	9605.	9605.	9605.	9605.
INTEREST TOTAL		0.	0.	0.	0.	56592.	54863.	49603.	44270.	38937.	33604.
TOTAL COST		0.	0.	0.	0.	261162.	278907.	273429.	275527.	270194.	272906.
NET PROFIT PRE-TAX		0.	0.	0.	0.	15572.	70203.	77650.	75552.	80885.	78173.
PRIOR YRS LOSS CARRY FORWARD		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TAXABLE INCOME		0.	0.	0.	0.	15572.	70203.	77650.	75552.	80885.	78173.
INCOME TAX	35.0%	0.	0.	0.	0.	5450.	24571.	27177.	26443.	28310.	27361.
NET INCOME BEFORE RSV		0.	0.	0.	0.	10122.	45632.	50472.	49109.	52575.	50812.
RESERVE	0.0%	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CUMULATIVE RESERVE		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SPECIAL INCOME		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NET INCOME		0.	0.	0.	0.	10122.	45632.	50472.	49109.	52575.	50812.

TABLE 11-18(2)

PROJECT CASH FLOW FORECAST....P/L BLOCK
(000,$ OMITTED)

PROJECT; PHILIPPINE PROJECT
CASE NO: B

CAPITAL OF (000) 812563.
TAX LIABILITY: 35.%

STRAIGHT LINE DEPRECIATION

ROE = 13.71%
ROI = 10.01%

PROJECT YEAR / CALENDER YEAR	PER TON	7 / 11	8 / 12	9 / 13	10 / 14	11 / 15	12 / 16	13 / 17	14 / 18	15 / 19
!PROFIT PROJECTION:										
SALFS VOLUME										
P.IRON		0.	0.	0.	0.	0.	0.	0.	0.	0.
SLAB		638.	638.	317.	638.	638.	638.	638.	638.	638.
BILLET		199.	199.	199.	99.	199.	199.	199.	199.	199.
INGOT		152.	152.	152.	152.	75.	152.	152.	152.	152.
SALES REVENUE										
P.IRON	216.00	0.	0.	0.	0.	0.	0.	0.	0.	0.
SLAB	337.00	106694.	215006.	215006.	215006.	215006.	215006.	215006.	106694.	215006.
BILLET	447.00	44164.	88953.	88953.	88953.	88953.	88953.	88953.	44164.	88953.
INGOT	310.00	23374.	47120.	47120.	47120.	47120.	47120.	47120.	23374.	47120.
TOTAL		174232.	351079.	351079.	351079.	351079.	351079.	351079.	174232.	351079.
COSTS & EXPENSES										
OPERATING COST										
P.IRON	106.01	0.	0.	0.	0.	0.	0.	0.	0.	0.
SLAB	149.44	47313.	95343.	95343.	95343.	95343.	95343.	95343.	47313.	95343.
BILLET	160.32	15840.	31904.	31904.	31904.	31904.	31904.	31904.	15840.	31904.
INGOT	149.85	11299.	22777.	22777.	22777.	22777.	22777.	22777.	11299.	22777.
VARIABLE COST TOTAL		74451.	150024.	150024.	150024.	150024.	150024.	150024.	74451.	150024.
FIXED COST		30186.	30186.	30186.	30186.	30186.	30186.	30186.	30186.	30186.
START UP COST		0.	0.	0.	0.	0.	0.	0.	0.	0.
BF PROVISION		0.	6546.	6546.	6546.	6546.	6546.	6546.	0.	6546.
TAXES & FEES		5458.	907.	8952.	8952.	18606.	18606.	21824.	15838.	21824.
DEPRECIATION		46243.	46243.	46243.	46243.	44743.	44743.	44743.	44743.	44743.
TOTAL		81887.	83882.	91927.	91927.	100081.	100081.	103299.	90767.	103299.
GEN ADMINISTRATION		3200.	3200.	3200.	3200.	3200.	3200.	3200.	3200.	3200.
TRANSPORTATION		1090.	2197.	2197.	2197.	2197.	2197.	2197.	1090.	2197.
INTEREST1(LONG)	9.0%	18666.	13333.	8000.	2667.	0.	0.	0.	0.	0.
INTEREST2(SHORT)	16.0%	4712.	9605.	9605.	9605.	9605.	9605.	9605.	4712.	9605.
INTEREST TOTAL		23378.	22938.	17605.	12272.	9605.	9605.	9605.	4712.	9605.
TOTAL COST		184006.	262240.	264952.	259619.	265106.	265106.	268324.	174220.	268324.
NET PROFIT PRE-TAX		-9774.	88839.	86127.	91460.	85973.	85973.	82755.	12.	82755.
PRIOR YRS LOSS CARRY FORWARD		-9774.	0.	0.	0.	0.	0.	0.	0.	0.
TAXABLE INCOME		-9774.	79065.	86127.	91460.	85973.	85973.	82755.	12.	82755.
INCOME TAX	35.0%	0.	27673.	30145.	32011.	30090.	30090.	28964.	4.	28964.
NET INCOME BEFORE RSV		-9774.	61166.	55983.	59449.	55882.	55882.	53791.	8.	53791.
RESERVE	0.0%	0.	0.	0.	0.	0.	0.	0.	0.	0.
CUMULATIVE RESERVE		0.	0.	0.	0.	0.	0.	0.	0.	0.
SPECIAL INCOME		0.	0.	0.	0.	0.	0.	0.	0.	0.
NET INCOME		-9774.	61166.	55983.	59449.	55882.	55882.	53791.	8.	53791.

TABLE 11-19(1) CASH FLOW ESTIMATE (CASE B)

PROJECT CASH FLOW FORECAST.... C/F BLOCK
(000,$ OMITTED)

PAGE= 1

PROJECT YEAR	PER	-4	-3	-2	-1	1	2	3	4	5	6
CALENDER YEAR	TON	1	2	3	4	5	6	7	8	9	10
!CASH FLOW PROJECTION;											
FUNDS PROVIDED!											
EQUITY	220000.	40000.	50000.	60000.	70000.	0.	0.	0.	0.	0.	0.
LOAN1(LONG)	592563	38988.	117845.	209129.	119855.	30032.	0.	0.	0.	0.	0.
LOAN2(SHORT)	0	0.	0.	0.	0.	45492.	59756.	60031.	60031.	60031.	60031.
IDC1	9.0%	1754.	8970.	24491.	41499.	0.	0.	0.	0.	0.	0.
IDC2	16.0%	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	592563	40742.	126815.	233620.	161354.	75524.	59756.	60031.	60031.	60031.	60031.
NET INCOME		0.	0.	0.	0.	10122.	45632.	50472.	49109.	52575.	50812.
DEPRECIATION & AMOR.		0.	0.	0.	0.	46243.	46243.	46243.	46243.	46243.	46243.
BF PROVISION		0.	0.	0.	0.	6546.	6546.	6546.	6546.	6546.	6546.
TOTAL		80742.	176815.	293620.	231354.	138434.	158177.	163292.	161928.	165395.	163632.
FUNDS APPLIED:											
PLANT & PRE-OPE	735849.	78988.	167845.	269129.	189855.	30032.	0.	0.	0.	0.	0.
IDC1	9.0%	1754.	8970.	24491.	41499.	0.	0.	0.	0.	0.	0.
IDC2	16.0%	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDC TOTAL		1754.	8970.	24491.	41499.	0.	0.	0.	0.	0.	0.
BF RELINING		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ADDITIONAL CAPITAL		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WORKING CAPITAL		0.	0.	0.	0.	45492.	14264.	275.	0.	0.	0.
LOAN REPAYMENT1		0.	0.	0.	0.	59256.	59256.	59256.	59256.	59256.	59256.
LOAN REPAYMENT2		0.	0.	0.	0.	0.	45492.	59756.	60031.	60031.	60031.
REPAYMENT TOTAL		0.	0.	0.	0.	59256.	104748.	119012.	119287.	119287.	119287.
TOTAL		80742.	176815.	293620.	231354.	134780.	119012.	119287.	119287.	119287.	119287.
NET CASH FLOW		0.	0.	0.	0.	3654.	39165.	44005.	42641.	46108.	44345.
!CASH GENERATION!											
ANNUAL		-40000.	-50000.	-60000.	-70000.	3654.	39165.	44005.	42641.	46108.	44345.
CUMULATIVE		-40000.	-90000.	-150000.	-220000.	-216346.	-177181.	-133177.	-90536.	-44428.	-83.
DISCOUNT RATE		1.00000	0.87944	0.77342	0.68017	0.59817	0.52606	0.46264	0.40686	0.35781	0.31467
D.C.F.(ROE)		-40000.	-43972.	-46405.	-47612.	2186.	20603.	20358.	17349.	16498.	13954.
ANNUAL		-80742.	-176815.	-293620.	-231354.	43978.	139020.	152589.	146167.	144301.	137205.
CUMULATIVE		-80742.	-257557.	-551177.	-782531.	-738553.	-599533.	-446944.	-300776.	-156476.	-19271.
DISCOUNT RATE		1.00000	0.90903	0.82634	0.75117	0.68284	0.62072	0.56425	0.51292	0.46626	0.42385
D.C.F.(ROI)		-80742.	-160730.	-242630.	-173786.	30030.	86292.	86099.	74973.	67282.	58154.
LOAN1 BALANCE-YEAR END		40742.	167557.	401177.	562531.	533307.	474050.	414794.	355538.	296281.	237025.
LOAN2 BALANCE-YEAR END		0.	0.	0.	0.	45492.	59756.	60031.	60031.	60031.	60031.
TOTAL		38988.	167557.	401177.	562531.	578799.	533806.	474825.	415569.	356312.	297056.

TABLE 11-19(2)

PROJECT CASH FLOW FORECAST... C/F BLOCK
(000,$ OMITTED)

PROJECT YEAR / CALENDER YEAR	PER TON	7 / 11	8 / 12	9 / 13	10 / 14	11 / 15	12 / 16	13 / 17	14 / 18	15 / 19
ICASH FLOW PROJECTION:										
FUNDS PROVIDED:										
EQUITY	220000.	0.	0.	0.	0.	0.	0.	0.	0.	0.
LOAN1(LONG)	592563	0.	0.	0.	0.	0.	0.	0.	0.	0.
LOAN2(SHORT)	0	29452.	60031.	60031.	60031.	60031.	60031.	60031.	29452.	60031.
IDC1	9.0%	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDC2	16.0%	0.	0.	0.	0.	0.	0.	0.	0.	0.
	592563	29452.	60031.	60031.	60031.	60031.	60031.	60031.	29452.	60031.
NET INCOME		-9774.	61166.	55983.	59449.	55882.	55882.	53791.	8.	53791.
DEPRECIATION & AMOR.		46243.	46243.	46243.	46243.	44743.	44743.	44743.	44743.	44743.
BF PROVISION		0.	6546.	6546.	6546.	6546.	6546.	6546.	0.	6546.
TOTAL		65921.	173986.	168802.	172269.	167202.	167202.	165110.	74202.	267536.
FUNDS APPLIED:										
PLANT & PRE-OPE	735849.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDC1	9.0%	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDC2	16.0%	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDC TOTAL		0.	0.	0.	0.	0.	0.	0.	0.	0.
BF RELINING		39277.	0.	0.	0.	0.	0.	0.	39277.	0.
ADDITIONAL CAPITAL		0.	0.	0.	0.	0.	0.	0.	0.	0.
WORKING CAPITAL		-30579.	30579.	0.	0.	0.	0.	0.	-30579.	-53452.
LOAN REPAYMENT1		59256.	59256.	59256.	59256.	0.	0.	0.	0.	0.
LOAN REPAYMENT2		60031.	29452.	60031.	60031.	60031.	60031.	60031.	60031.	89483.
REPAYMENT TOTAL		119287.	88708.	119287.	119287.	60031.	60031.	60031.	60031.	89483.
TOTAL		127985.	119287.	119287.	119287.	60031.	60031.	60031.	68729.	36031.
NET CASH FLOW		-62065.	54699.	49515.	52982.	107171.	107171.	105079.	5473.	231505.
ICASH GENERATION:										
ANNUAL		-62065.	54699.	49515.	52982.	107171.	107171.	105079.	5473.	231505.
CUMULATIVE		-62148.	-7449.	42066.	95048.	202219.	309390.	414469.	419942.	651447.
DISCOUNT RATE		0.27674	0.24337	0.21403	0.18823	0.16554	0.14558	0.12803	0.11259	0.09902
D.C.F.(ROE)		-17176.	13312.	10598.	9973.	17741.	15602.	13453.	616.	22923.
ANNUAL		51148.	106314.	126376.	124509.	116776.	116776.	114684.	40764.	168136.
CUMULATIVE		31878.	138192.	264568.	389077.	505853.	622629.	737314.	778078.	946214.
DISCOUNT RATE		0.38529	0.35024	0.31838	0.28942	0.26309	0.23916	0.21740	0.19763	0.17965
D.C.F.(ROI)		19707.	37236.	40236.	36035.	30723.	27928.	24933.	8056.	30205.
LOAN1 BALANCE-YEAR END		177768.	118512.	59256.	-0.	-0.	-0.	-0.	-0.	-0.
LOAN2 BALANCE-YEAR END		29452.	60031.	60031.	60031.	60031.	60031.	60031.	29452.	0.
TOTAL		207220.	178543.	119287.	60031.	60031.	60031.	60031.	29452.	-0.

11.3 Statement of Fund Application

By-year fund application of the new steelworks will be estimated hereunder.

11.3.1 Statement of fund application for Case A

The statement of fund application for Case A is given in Table 11.17. Net fund shortages by year are expected for the 1st year, and the 7th and 14th years when blast furnace relining is scheduled. In these years, additional funds must be raised. If such shortages are to be made up for by borrowings, net profits will decrease by the amount of interests. Accordingly, the funds needed will be the shortages x $\frac{1}{1 - i}$ (i = interest rate). The shortages in the 1st and 7th years are especially heavy; they will affect the following years. Taking regard of interests incurred, the fund application in Case A is very critical. Some measures to make up for the fund shortage must be considered.

The residual value of fixed assets is adjusted in the cash-in for the 15th year.

11.3.2 Statement of fund application for Case B

The statement of fund application for Case B is given in Table 11.19. The fund position in this case is sound. The only fund shortage expected for the 7th year (the year of blast-furnace relining) will be adequately made up for by the fund brought over until the preceding year.

11.4 ROE and ROI

11.4.1 Explanation on DCF method

It is a common practice to evaluate investment profitability by the discounted cash flow (DCF) method. The concept of this method is to judge the recoverability of invested capital in terms of present value.

Equation is expressed as follows:

$$Co = \frac{R1}{(1+i)} + \frac{R2}{(1+i)^2} + \ldots\ldots + \frac{Rn}{(1+i)^n}$$

where:
- Co = initial investment
- i = rate of return
- Rn = proceeds
- n = number of operating years

That is, this method estimates the rate of return (i) that makes the accumulation of yearly returns (Rn) reevaluated in terms of their present values equal to the initial investment (Co).

The return on equity (ROE) method estimates the rate of return on equity capital, i.e., the probable percentage of dividend.

The return on investment (ROI) method estimates the percentage of return on investment, i.e., the percentage of profit distribution to fund suppliers.

In this study, the project period is considered to comprise a construction stage of 4 years and an operation stage of 15 years. And the ROE and ROI are calculated on the basis of the "present values" in the minus 4th year (i.e., 4 years before the start of operation) when the initial payment is to be made.

11.4.2 ROE and ROI

The rates of ROE and ROI calculated for Cases A and B are shown in Table 11.20.

As mentioned previously, Case A involves considerable fund application problems, and some compensating measures are necessary.

The ROI for Case A is 4.78 percent.

Case B produces surplus even after paying 9 percent interest to borrowed capital. The ROE is as high as 13.7 percent, and therefore considerable dividend is payable.

Table 11.20. ROE and ROI

Case	ROE	ROI
Case A	-	4.78%
Case B	13.71%	10.01%

11.5 Sensitivity Analysis

Some sensitivity analysis will be made hereunder on the basis of the basic cases.

11.5.1 Extensive application of tax reduction and exemption

Let's apply the current tax incentives more extensively to Case A. For instance, Let's assume that national taxes excepting income tax and real property tax be 100 percent exempted for 15 years. Then the ROI becomes 6.38 percent. Even then, however, fund shortage may be eased but not eliminated.

If income tax is exempted for 15 years, in addition to the above step, the ROI will be improved to 7.59 percent.

11.5.2 Influence of factor cost fluctuations on total cost of sales

The influence of fluctuations in operating rate, construction cost, interest rate and other factor costs on the total cost of sales is calculated as shown in Table 11.21. Some major points will be briefly explained hereunder.

(1) Operating rate

The influence of operating rate manifests itself as a change in fixed cost. Its importance will be understood from the extensiveness of the fixed cost changes.

(2) Construction cost

Changes in construction cost are considered to affect depreciation, interest on equipment investment and real property tax.

Incidentally, construction cost for the first stage involves some portion of that for the second stage and thereafter. That is, in adding the same capacity as provided in the first stage, less investment will be needed in the following stages. The ratio of such common investment in the first stage is difficult to determine. But if there is 20 percent common investment, the cost in the second stage will become cheaper than the first stage. The table shows that the costs of slab and ingot will be lower by a little over 10 dollars, and that of billet by a little over 20 dollars.

(3) Interest

The influence of loan interest rate changes on the cost is also calculated.

(4) Raw materials prices

Changes in raw materials prices will exert considerable influence. It is one of the most important cost-determining factors.

Table 11.21. Influence of changes on total cost of sales

(Unit: Dollar/ton)

	Conditions	Molded pig	Slab	Billet	Ingot	Remarks
Ordinary case	Total cost (Case A)	177.7	259.7	330.2	247.5	
Cost fluctuation	① Operating rate ∓10%	± 6.9	±11.7	±18.0	±10.4	
	② Construction cost ±10%	± 3.6	± 6.6	±10.5	± 5.8	
	③ Interest rate on long term loan ±2%	± 2.0	± 3.6	± 5.6	± 3.2	Basic case 9%
	④ Interest rate on short term loan ±5%	± 2.6	± 2.6	± 2.6	± 2.6	Basic case 16%
	⑤ Ore & pellet prices ±10%	± 3.6	± 3.6	± 3.7	± 3.5	
	⑥ Coal price ±10%	± 5.6	± 5.5	± 5.7	± 5.3	
	⑦ Labor cost ±20%	± 0.4	± 0.8	± 1.5	± 0.9	

CHAPTER 12

RECOMMENDATIONS

CHAPTER 12 RECOMMENDATIONS

The Republic of the Philippines planned the construction of an integrated steelworks as the "pivot" of its policy for industrialization and economic development. However, the construction and operation of an integrated steelworks inevitablly involve far greater difficulties as compared with those of a minimill. If the steelworks thus constructed fails to realize the anticipated result, a great loss is incurred to the national economy. Accordingly, careful planning and thoroughgoing preparations are indispensable for the construction and operation of an integrated steelworks.

For sound management of a steelworks, stabilized operation with a high production rate is of paramount importance. Moreover, a high level of management by the works itself and concerted efforts by labor and management for self-reliance should always be kept in mind. It is needless to say that the government's understanding and assistance are the key to success of a new steelworks.

Measures to be taken by the Philippine Government before the construction is started are described below.

12-1 Grant of various incentives

Government of developping countries in many cases provides the favor of extensive protective and encouraging policies in projecting its first integrated iron and steel works. In the Philippines, for example, as the tax will amount to US $ 25.7 (production cost) per ton of molten steel, if the currently enforced taxes are completely levied, and in view of the probable rise in price of materials and equipment and various expenses due to inflation, the government should clarify the contents and extent of incentive measures to be granted to the construction and operation of a new steelworks through, for example, the establishment of the steel industry promotion law. Measures such as described below should be considered.

(1) The following taxes should be exempted as far as possible.

1) Corporation tax
2) Real property tax
3) Various enterprise taxes (business tax etc.)
4) Import duties on raw materials and equipment
5) Sales tax
6) Advance sales tax
7) Taxation on technical guidance fee
8) Individual income tax for foreign advisors and instructors.

(2) Guarantee of supply of utilities

1) Industrial water : 33,000 tons/day
2) Electric power : 12,730 MWH/year

(3) The Government funds should be financed at a low interest rate without collateral.

(4) A preferential rate of less than 50% of ordinary tariff should be set up for both marine and land transportation of the new steel mill's products.
Furthermore, free use of public berthes should be permitted.

(5) The Government should construct and run houses, hospitals, training centers, etc. for managements and employees of the new steelworks.

(6) The import licence system should be adopted for steel mill products which are supposed to compete with the new steel mill's products. Import should be approved only when the demand-supply situation compels it. In such cases, however, protective duties should be imposed.

(7) Port facilities, land etc. for the new steelworks should be constructed as government assets and should be leased to the works free of charge.

(8) For borrowing from foreign sources, loans under the most favorable conditions should be obtained under the Government guarantee.

12-2 Development of infrastructure

As described in detail in Chapter 3, the build-up and development of infrastructure as described below should be planned and executed by the Philippine Government. It will not be too much to say that success of a new steelworks is dependent upon the execution and promotion of infrastructure development.

(1) Development of power resources ... Reliable realization of the 800 MW Grid Plan being now planned in Mindano (1983) and guarantee of supply of electric power, amounting to 12,730 MWh/year, to the new steelworks

(2) Land purchase and compensation to inhabitants and land owners

(3) Land improvement of the basin of the Tagoloan River and measures against possible flood

(4) Construction of public port facilities ... For unloading of construction materials and equipment for the new steel mill. These facilities are also important as a transportation terminal to the hinterland. It is also important to provide the signal and coastal stations.

(5) Industrial water supply system

Construction of intake facilities at Malitobug up the Tagoloan River, and laying of water pipe for supplying industrial water over 8.6 km to the new steelworks, and guarantee of supply of approx. 33,000 tons/day of industrial water to the new steelworks

(6) Town planning

The population of the area where the new steelworks is constructed will number 40,000 to 60,000, including the families of employees of the steelworks and workers of related industries. For reception of this population, comprehensive city planning is required. Timely planning and construction of houses, schools, hospitals, churches, recreational facilities, water supply and drainage systems, power transmission and distribution systems and city gas supply systems, improvement of transportation and communication systems and establishment of disaster prevention system are essential.

12-3 Studies necessary for the construction of a new steelworks

(1) Soil survey of the proposed site

As heavy structures are constructed on the site for a new steelworks, the ground on which each structure as shown on the layout is constructed should be surveyed. This site survey is indispensable, because the proposed site was in the basin of the Tagoloan River in the past.

(2) Studies on the availability of required raw materials

1) Study on the measures for securing imported raw materials such as coal, iron ores, scrap, fluorite etc.

2) Study on the exploitation of domestic raw materials, such as limestone, silica, ferroalloys etc. and their quality

3) Comprehensive study of transportation of these foreign and indigenous raw materials

(3) Establishment and improvement of domestic transportation and distribution systems

The role of the new steelworks is to supply high-quality, low-cost products to users in good time. In this sense, transportation has an important significance. Transportation inside of the Philippines is mostly by sea. It is necessary for the Government to study how to lighten the users' burden by reducing the transportation cost through the rationalization of the transportation system. At the same time, the road net-works and bridges must be improved so as to withstand the transportation of large and heavy weight products.

As this new steelworks manufactures semi-finished products and plays a role of a mother plant to the existing iron and steel industry, direct sales from the new steelworks is desirable. This system will not only promote direct communication between the producer and users, thus facilitating the feedback of the information on quality requirements etc. from users to the producer, but also prevent the generation of unnecessary distribution cost.

12-4 Preparatory education and training of engineers and workers

As an integrated steelworks of BF-BOF system handles molten iron, molten steel and metals at high temperatures, all equipment must be operated stably. The iron and steel industry differs basically from process industries (chemical plants, etc.) in that the proper judgement and actions of engineers and workers are of paramount importance to maintain the stabilized operation of all equipment. Even if the most advanced automatic facilities are introduced, the judgement and actions of engineers and workers are the decisive factors. It should be borne in mind that smooth operation cannot be achieved without right judgement and quick actions of engineers and workers. Moreover, engineers must be fully versed in operations to be done in the plants and must be good leaders of workers. They should be given education and training well in advance in parallel with those for managers who will take upon themselves the responsibility of managing the new steelworks in the future. If necessary, they should be given chances to be trained abroad. Even if cooperation from foreign countries is to be asked for, it is desirable that these engineers and managers participate in the planning of the construction or feasibility studies etc. from the very begining. It is essential that they participate positively in the planning, engineering, construction and operation of the new steelworks with their own initiative.

To secure young workers with a good aptitude enough to fill all jobs required at the new steelworks, it is desirable to promote systematic basic education relating to industries at junior and senior high schools and to establish national training centers (of the same or higher level than technical high school) for employees of the new steelworks in the vicinity of the works.

12.5 Scale of the steelworks

As previously confirmed through the discussion between us and our Philippine counterparts, the proposed steelworks is conceived as one primarily based on a combination of blast furnace (BF), basic oxygen steelmaking furnaces (BOF) and continuous casting. It will start as a supply base of semi-finished products (slabs and billets) for NASCO and other domestic steel mills. Provision for its future expansion into an integrated steelworks will be made only in the layout.

The site is adjacent to P.S.C., which is already in normal operations. This location makes it possible to utilize the port facilities owned by P.S.C., as they are, in unloading iron ore and limestone. One important assumption made in this plan is that sinter, which is to be the principal BF burden material, will be produced by P.S.C. on a commission basis and will be supplied to the steelworks at a rate of one million tons a year. Therefore, it has been checked and ascertained that a steelworks with an annual capacity of about one million tons, mentioned in the Interim Report, will be a reasonable scale from the standpoint of raw materials supply conditions.

As a result of studies of the comparative advantages of the two alternatives, i.e., 1) expansion of NASCO and 2) new installation of a hot strip mill, in the aspect of rolling of slabs, it has been reconfirmed that from the standpoints of crude-steel production scale, rolling-capacity balance aimed at in the NASCO expansion plan and the need for reducing construction costs, the NASCO expansion plan will be the most realistic solution to the situation.

If the steelworks is designed for a production capacity of something between 1.5 and 2 million tons a year, the port facilities would have to be expanded, a new sinter plant would have to be built and, moreover, the rolling capacity in the NASCO expansion plan would be found inadequate, necessitating a new hot strip line. All these would lead to considerable increases in the construction cost.

Billets have been studied in the size range of 115□, 80□ and 50□, proposed by the Philippine counterparts, on the assumption that continuous cast blooms (220 x 260) will be rolled on the billet mill. It has been ascertained that manufacturing costs of billets will come out to be as high as $293 per ton.

To cope with combat this problem of high billet production costs, there seem to be three alternative ways:

(1) Billets, rather than blooms, will be continuously cast.

(2) Continuously cast blooms of the steelworks will be further rolled into billets by other domestic mills. (In this case, some modifications of equipment will be required on the part of the domestic mills.)

(3) Slabs and ingots will be produced without producing blooms or billets. Slab casters may have to be three.

Of the three alternatives, (1) or (3) seems reasonable choice. Alternative (1), in particular, is likely to manufacture billets at a cost approximating that of blooms.

Overall, the scale of the proposed steelworks features the maximum utilization of the existing facilities, resulting in substantial reduction of construction costs. Besides, relatively high billet costs can be dealt with adopting either one of the above-suggested alternatives.
Elimination of the need to build a billet mill will make it possible to reduce the construction cost to about $700 per ton. It is requested that the Philippine Government form judgment on this matter, taking into consideration various pertinent circumstances in the Philippines.

Conclusions

This report has described the results of studies undertaken with many assumptions. If the Philippine Government assistance can be obtained for the development of iron and steel industry, protective policies and the construction of infrastructure as recommended above, the new steelworks construction plan will take a great leap toward success.

The Philippine Government should work out the outline of more concrete implementation and construction plan, taking the above-described recommendations into full account. A door to success of a new steelworks will be opened by conducting "A Feasibility Study" on the basis of these plans.

CHAPTER 13

DETAIL PLANT DESCRIPTION

CHAPTER 13-1

SITE PREPARATION

CHAPTER 13 DETAIL PRANT DESCRIPTION

13.1 Site preparation

13.1.1 Outline

The site preparation which is basic to plant construction, goes into effect in advance of all other works. Plans are made according to a survey conducted beforehand. On land, access roads construction, tree-felling work, top soil disposal, cutting, banking and other earth work are undertaken, while land reclamation is performed at sea. 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 a ready-mixed concrete plant. These should be carried out as part of the overall program. In this section, planning and design concerning site preparation and drainage work will be made on the basis of already gathered data.

13.1.2 Preconditions

Site to be prepared in the first Stage Plan of the steel works covers an area of 318.4 ha. 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 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 the possibility of rainwater coming in from outside the site.

(4) At the time of site preparation, consideration shall be given to maintaining a balance of earth work in such a way as to minimize use of soil delivered from outside the site.

(5) In the site preparation plan, topographical maps surveyed and prepared by NASCO in 1974 shall be used for land work.

(6) Charts issued by B.C.G.S. shall be used for reference of sea work.

13.1.3 Layout plan

Preparation layout of the site is shown in Fig. 13.1.1. In terms of configuration and mode of utilization, the site to be prepared can be roughly split into 4 ZONES as indicated. Results of calculating optimum ground levels in consideration of the balance of earth work over the entire site are listed in Table 13.1.1.

Table 13.1.1 Planned ground levels

Name	Area	Current GL (above MLLW)	Planned GL (above MLLW)
ZONE I	18.6 ha	-0.2 m	+4.0 m
ZONE II	117.0 ha	+4.8 m	+5.0 m
ZONE III	183.0 ha	+7.1 m	+6.4 m
ZONE IV	333 ha		

For main drainage ways, open channels will be built around the contour of the site to drain the site and surrounding areas. These drainage channels will also be used for draining from the power plant. The drainageway of each zone will be built in parallel with the main road, connecting each plant with the outer open channel

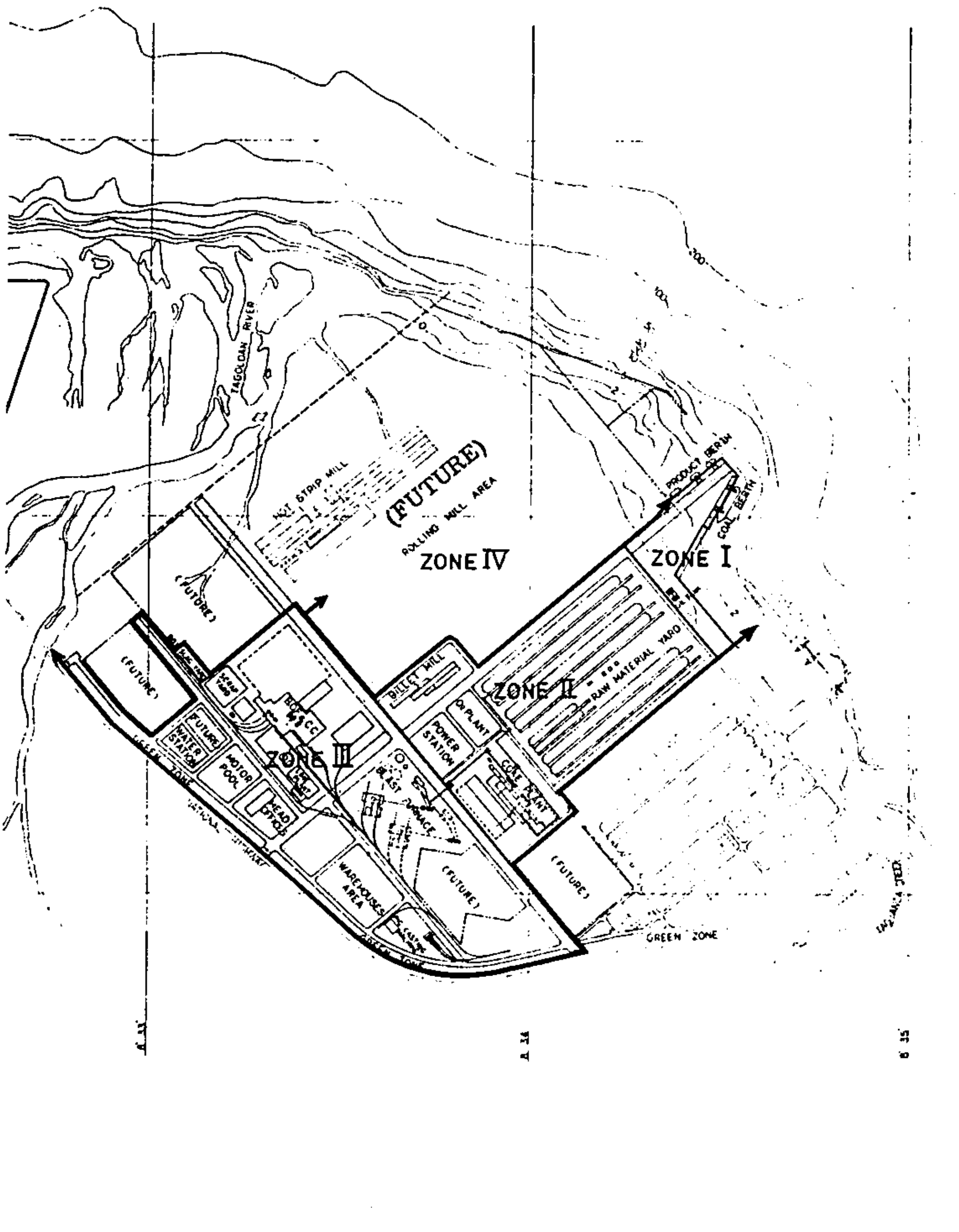


Fig. 13.1.1 Layout plan for site preparation

13.1.4 Technical explanation

(1) Ground levels (GL)

To prepare the site planned with the ground levels specified in Table 13.1.1. the volume of soil to be disposed will reach some 850,000 m^3 for soft top soil and some 2,900,000 m^3 for cutting and banking. Delivery of earth from outside the site will be limited to only part of the reclaimed land. ZONE I is the reclaimed land having the port function so that it is desirable to keep its ground level at the minimum height free from wave-washing. Hence, +4.0 m is planned. ZONE II is the zone centered by the Raw Materials Yard. In consideration of future expansion, it is desirable to have its level equal to the +5.0m GL of P.S.C. Ore Yard. ZONE III is the Blast Furnace/Steelmaking zone, being covered by rails. For the track of torpedo cars with heavy weight, flatness of the lay of the zone is a critical factor. Taking the overall earth work into consideration, we set +6.4m for this zone.

In ZONES I to III, the quantity of soil is put in balance. However, in the case of site preparation for the Rolling Mill in the future, possibilities of dredging the front sea area or utilizing earth produced at the time of developing the land behind should be considered as part of of the overall program.

(2) Drainageways

The outer drainage channels shown in Fig. 13.1.1 are planned in conjunction with work on the slope face of the site to be prepared. 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 drainageway structure be flexible enough for alteration. But, note that the drainageway along the Ore Yard on the north side shall be of concrete structure in view of the 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 inlet. 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.

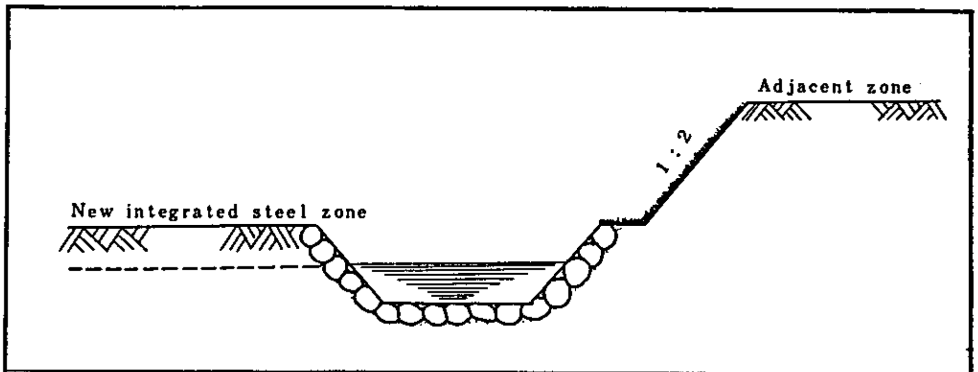


Fig. 13.1.2 Ditch for drainage

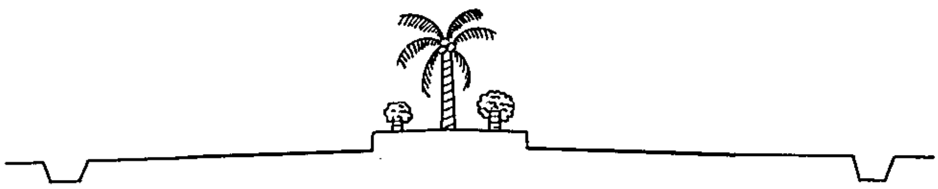


Fig. 13.1.3 Standard section of road

(3) Difference in GL in the site

As previously explained, there is a difference in ground levels for each zone in the site. For such difference, a road will be built at a grade that enables heavy vehicles to move over, and other boundaries will have the slope face shown in Fig. 13.1.4.

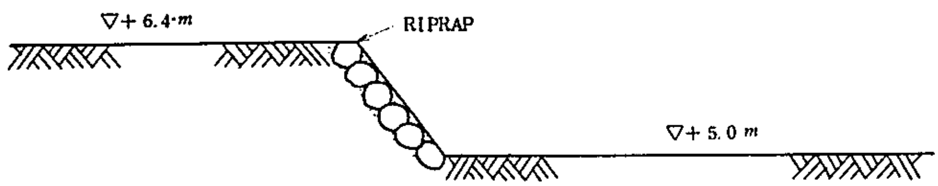


Fig. 13.1.4 Standard section of boundary

Next comes a question of the GL difference between areas outside and inside the site. A road connected to the national highway may be connected at the green belt intersection. The exact location of the connection will probably need to be examined in relation to mutual plans.

CHAPTER 13-2

PORT FACILITIES

13.2 Port facilities

13.2.1 Outline

In order to give a full play to the function of the coastal steelworks, it is necessary to maintain an organic flow much like a belt conveyor between the port facilities and plants behind them. A well-known fact is that as a large harbor, Macajalar Bay already has a giant P.S.C. berth (pier 23m deep, 351m long and 31m wide) for the 250,000 D/WT class vessel. Normally, the port plans are very often subject to limitations imposed by existing facilities. Fortunately, the P.S.C. berth has been included as part of the overall port program in consideration of the integrated steel works plan. It has been prearranged, and the current site is in the location best suited for port facilities as mentioned in the section on conditions of location.

(1) Quay plan

Of the port facilities needed by the steelworks, those planned for construction at this time are 1) the unloading berth for coal and scrap, 2) product loading berth, and 3) heavy oil unloading berth. The coal and scrap berth can berth ships of a maximum of 50,000 D/WT, and 2 units of the LLC (level luffing crane) having the unloading capacity of 500 t/h will be installed there.

Vessels of a maximum of 5,000 D/WT can berth at the product berth, where a RTC (Rope trolley crane) with a 20t lifting capacity will be installed.

Selection of these berth types is made from an overall standpoint by considering such factors as contour of the coastline, sea bottom depth, nature of the soil, waves, required depth in water, and mode of utilization of areas behind the berth. Since a sufficient space for the product/scrap stock yard is needed behind the planned port facilities, the quay will be of the upright sheet-pile structure.

Generally, the port facilities of the integrated steel works require a large raw materials berth and a berth for delivering construction materials and equipment. However, use of the P.S.C. berth or public berth is planned at this time, and so construction of such berths is omitted from the current consideration.

(2) Revetment plan

Depending on the purpose, 2 types of revetment -- permanent revetment and temporary revetment taking future plans into account -- are planned at this time.

(3) Establishment of tugging zone

A tugging zone of the minimum scale will be planned in front of the wharf to facilitate the maneuvering of incoming and outgoing vessels anticipated for the first stage as shown in Fig. 13-2-1.

(4) Other facilities

This study is to use jointly public berths for berthing small ships necessary for port operations, e.g., quarantine vessel, pilot boats, tug and tow boats. Hence, no special consideration is given to the small ship area.

Conditions of the coastline, depth in water, relationships with adjacent facilities, etc. are examined, and the location and configuration of these port facilities are planned in such a way as to provide economical construction. Their arrangement is best suited for receiving at the Raw Materials Yard and bringing products to the quay.

13.2.2 Preconditions

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

(1) Coal berth: Importing is assumed for coal (860,000 t/y), and the berth size will be for accommodating a maximum of 50,000 D/WT class vessel. Also, on this berth, scrap unloading (120,000 t/y)

will be carried out. Construction of one berth is planned currently with enough room for extension in the future.

(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 D/WT class vessel. In consideration of working efficiency, the size will be such as to enable accommodating concurrently two 3,000 D/WT ships and one 1,500 D/WT ship at the same time. There will be room for future berth extension.

(3) There will be room at the P.S.C. main berth for its future berth extension of the same size as the existing berth.

(4) Charts issued by B.C.G.S. will be used for reference of the shape of the sea bottom.

(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 Layout

Port layout is illustrated in Figs. 13.2.1 and 13.2.2. In Fig. 13.2.1, shape of the reclaimed land, status of vessels' coming alongside the quay and the necessary range of dredging are indicated. Selection of the location of reclamation is in terms of shallow depth of water, minimizing the volume of earth dredged, and adjacency to land facilities.

The berth location and status of utilization of the reclaimed land behind are shown in Fig. 13.2.2. The product berth, having the product stock yard, will consist of a steel sheet pile quay (330m long).

The coal berth having the belt conveyor to haul unloaded coal and the temporary scrap stock yard, will be made up of a steel pipe pile quay (270m long). Also, at the tip of the reclaimed land will be installed a seawater intake and pumping station, and connection will be made to the land facilities via underground piping. A small oil berth is planned at the originating end of the coal berth. If the road along the coastline is taken as a boundary, the reclaimed land will cover an area of 18.6 ha, the dredged area being 12.5 ha. which are shown in Fig. 13.2.1 Location of dredging and reclamation areas.

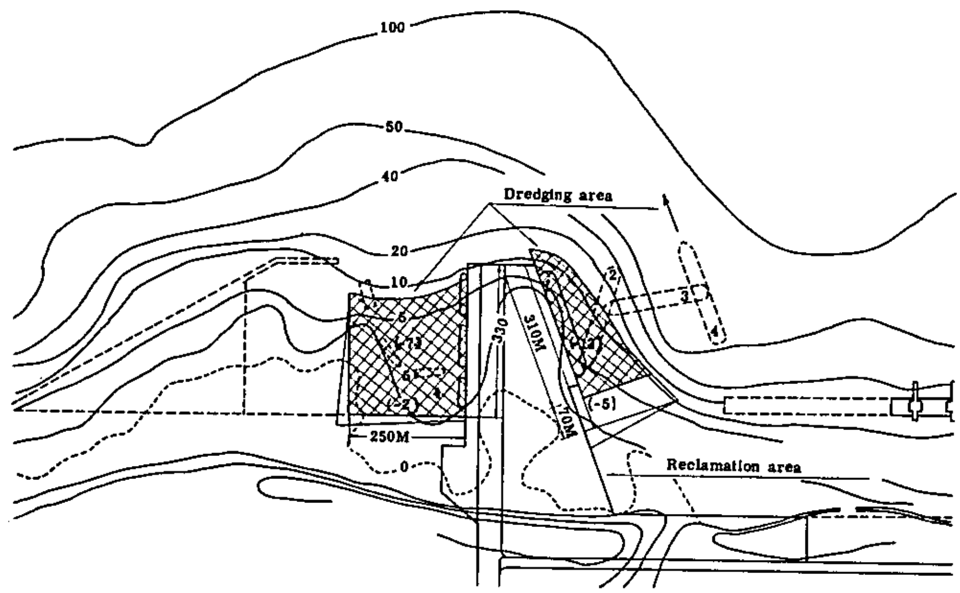


Fig. 13.2.1 Location of dredging and reclamation area

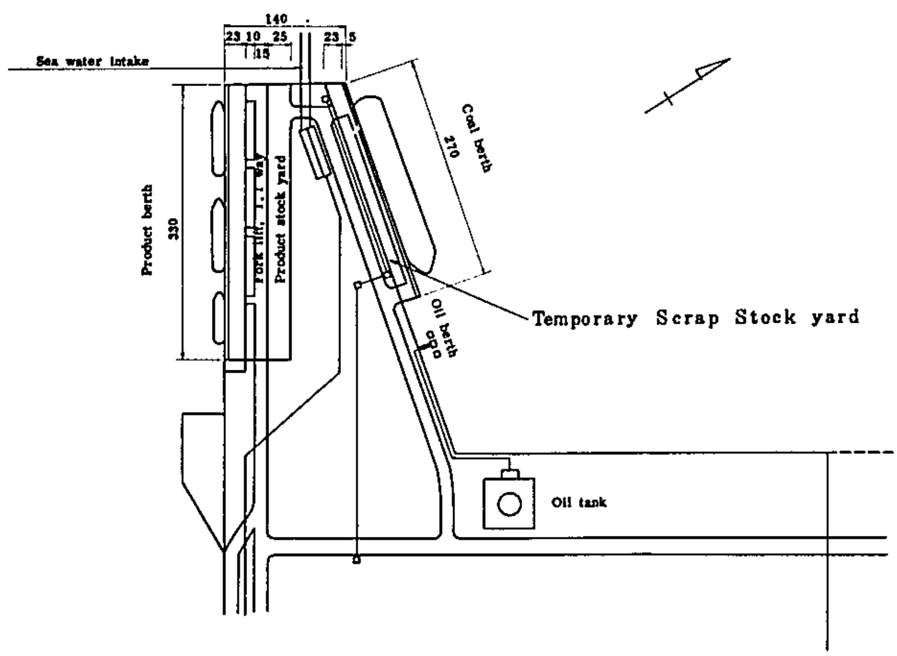


Fig. 13.2.2 Berth layout

13-2-4 Equipment Specifications

Fig. 13.2.3 indicates the berth name by type. Standard structural type for each berth is shown in Figs. 13.2.4 - 13.2.9.

Specifications of each type are also listed in Table 13.2.1.

Table 13.2.1 Equipment specifications

Name	Structural type	Water depth	Applicable vessel	Description
Type A (Coal berth)	Steel pipe-pile type quay	-13.0m	50,000 DWT coal carrier (bulk cargo)	LLC unloader (500 t/h) x 2 units Coal unloading conveyor 1 belt; temporary scrap storage
Type B (Product berth)	Steel sheet-pile type quay	-7.0m	5,000 DWT cargo vessel	RTC loading crane (20t hoist) x 2 units Temporary product storage
Type C (Oil berth)	Dolphin type quay	-5.0m	2,000 DWT bunker boat	
Type D (Tip-attached revetment)	Steel pipe-pile type revetment	-10.0m	-	Seawater inlet installed
Type E (Attached revetment)	Steel sheet-pile type revetment	-3.0m	-	
Type F	Stone masonry type revetment	±0m -1.0m		

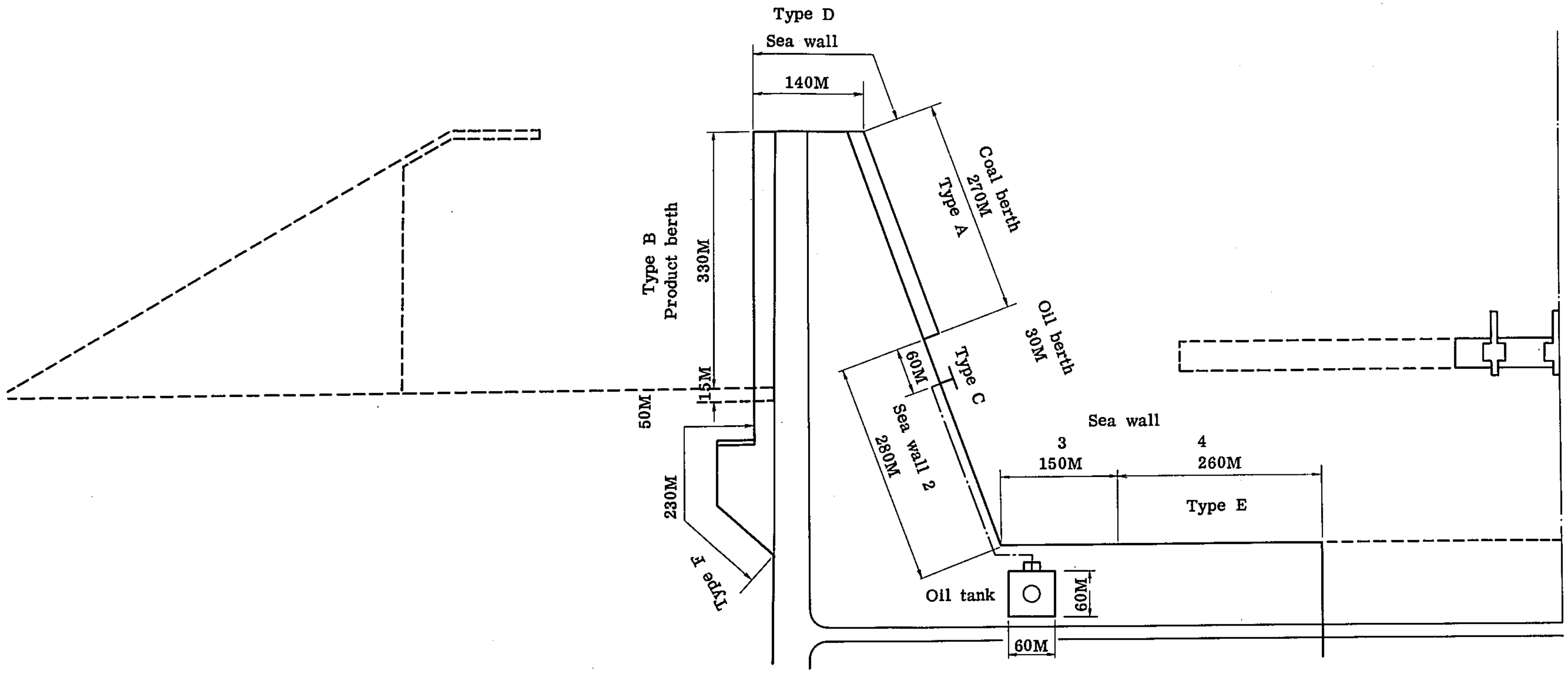


Fig. 13.2.3 Name of the berth

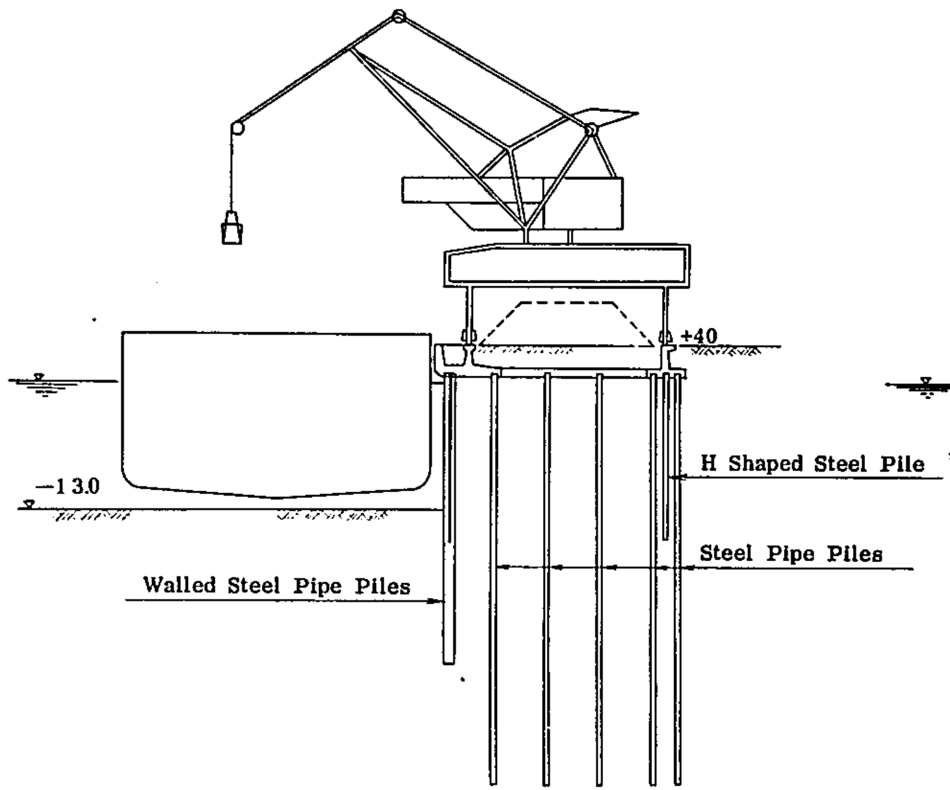


Fig. 13.2.4 Coal berth (Type A)

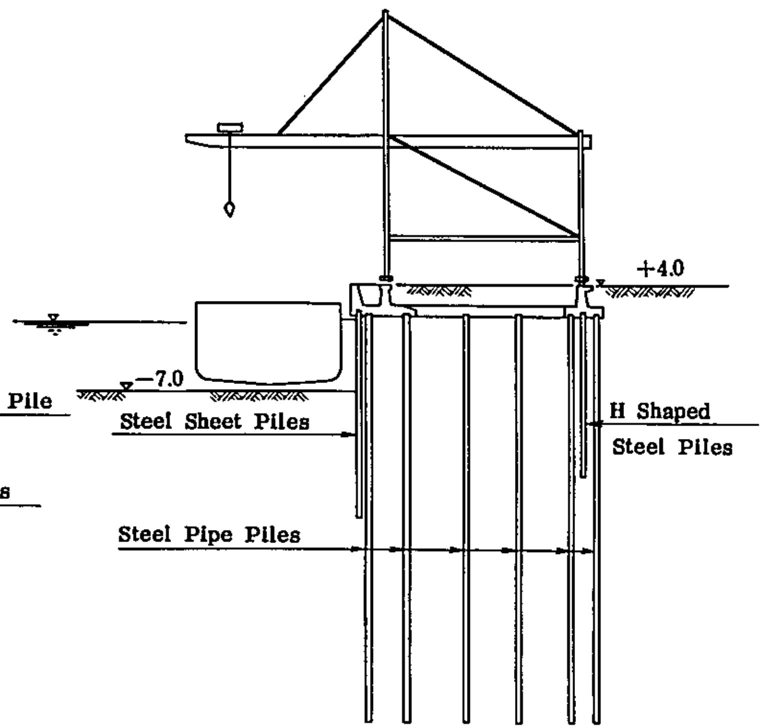


Fig. 13.2.5 Product berth (Type B)

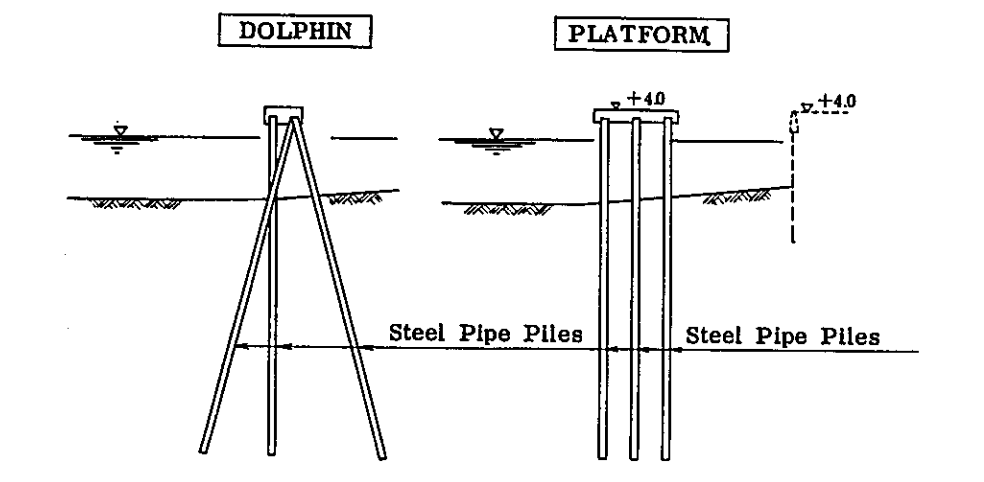


Fig. 13.2.6 Oil berth (Type C)

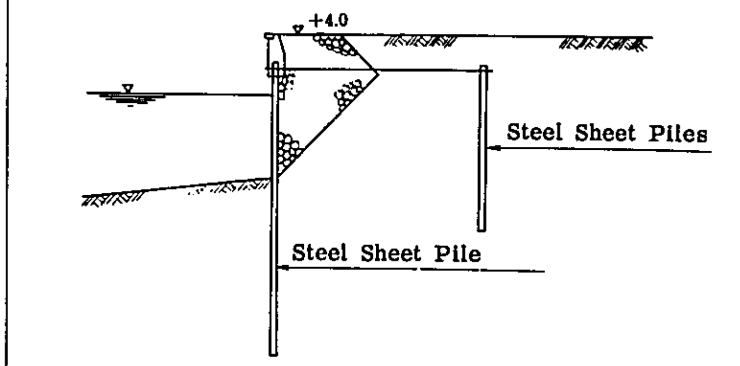


Fig. 13.2.8 Bulkhead (Type E)

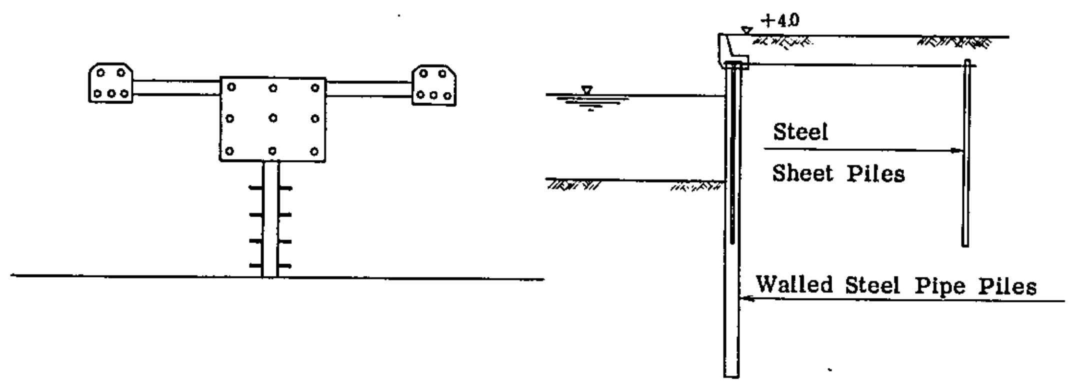


Fig. 13.2.7 Bulkhead (Type D)

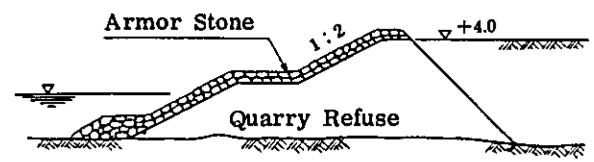


Fig. 13.2.9 Bulkhead (Type F)

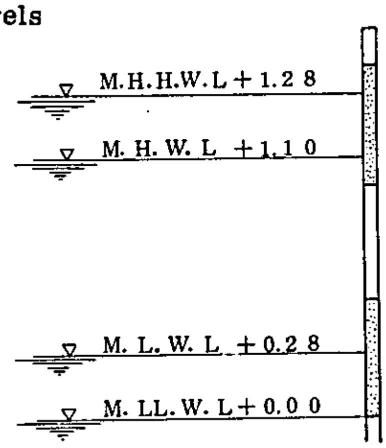
13.2.4 Technical explanation

(1) Design condition

1) Wave height and frequency

Due to the lack of observation data on the height of waves in the vicinity, the following are estimated: wave height for design purposes 2.0m and frequency 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 to come alongside the quay. Since this port will have no breakwater, a speed of about 15 cm/sec is desirable.

5) Ground condition

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

6) Load condition of cargo-handling equipment

Coal/scrap unloader

Number of wheels: 4 wheels/corner x 4 corners

	Sea side	Land side	Load condition
During operation	35t/wheel	30t/wheel	Long term

Product loader

Number of wheels: 4 wheels/corner x 4 corners

	Sea side	Land side	Load condition
During operation	34.5t/wheel	29t/wheel	Long term

7) Load on the quay

	Quay (t/m^2)	Landing bridge (t/m^2)
Coal, scrap	3.0	
Product	2.0	
Oil	1.0	0.5

Temporary storage of scrap is considered on the coal/scrap berth, and trailer running is intended for the product berth.

(2) Consideration on the mooring facilities

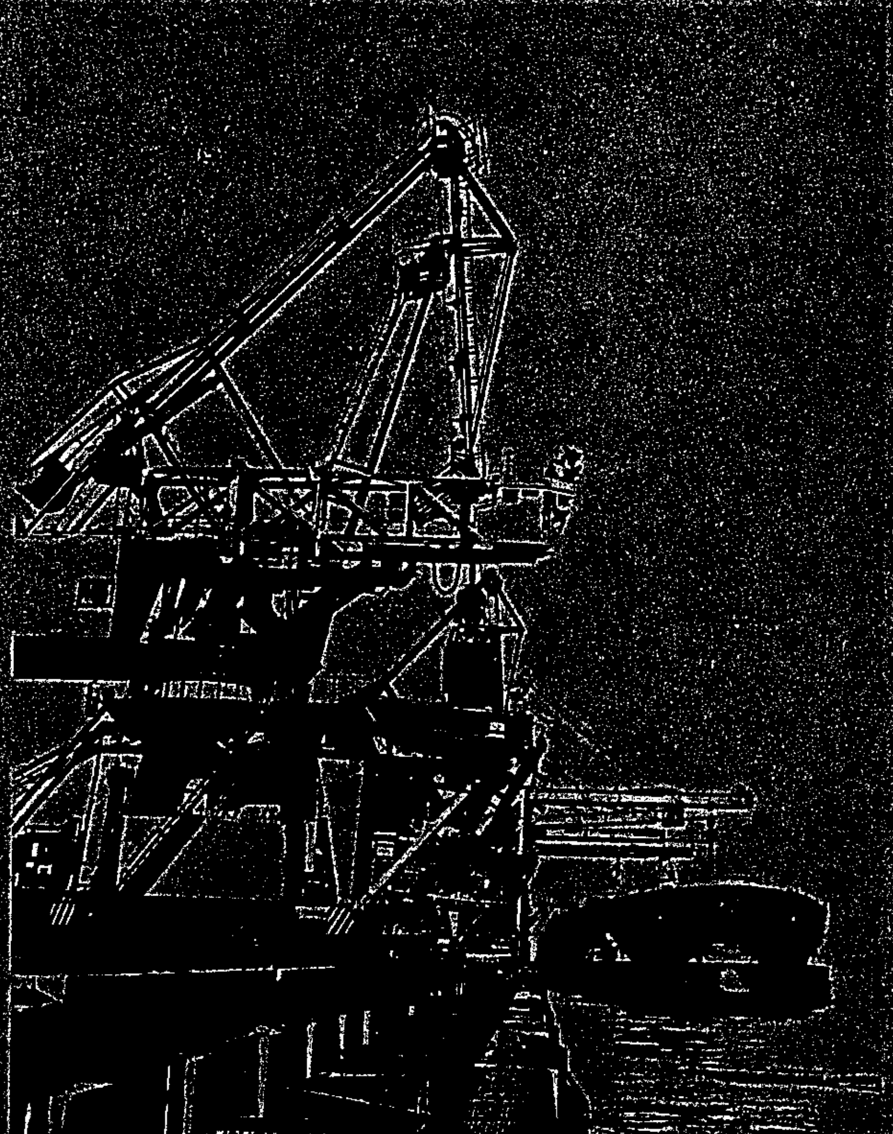
Structural types of berths can be the pier type, sheet-pile type, caisson type, etc. In view of usage conditions such as temporary storage on the quay and trailer running, site condition, ease with which work can be applied, and economy, the sheet-pile type quay is concluded to be advantageous. From the standpoint of execution and scheduling, it is advantageous to use steel piles for the basic structure.

(3) Dredging and reclamation

The amount of soil necessary for reclamation is 840,000 m^3, and the amount of soil for dredging is 680,000 m^3. The amount of soil in shortage will be replenished by mountain soil outside the site, which is also necessary for quay construction. For dredging, the cutter suction dredger is to be used. Soil dredged is blown into the reclamation area for land development. The sea area directly before the quay will be dredged by the grab dredger, and this soil thus dredged will be disposed of in the ocean.

CHAPTER 13-3

LOADING AND UNLOADING FACILITIES



13.3 Loading and unlosing facilities

13.3.1 Outline

These facilities unload coal, scrap, submaterials, etc., which are necessary for iron-making, and transport these raw materials from the Raw Materials or Product Berth respectively to the prescribed places. Also, they carry manufactured ingots, slabs and billets from respective mill yards to the product stock yard by T.T. (tractor trailer) and load them for shipment. This facilities consist of the unloaders and loaders on the Raw Materials and Product Berth respectively transport equipment and stock yard. The sufficient space will be secured in the area behind the Product Berth for improvement of shipping efficiency and for future expansion.

13.3.2 Conditions

(1) Amount of handling on the Raw Materials and Product Berth respec tively.

Table 13.3.1 Amount of handling on the raw materials berth

(Unit: 1,000 t/year)

	Type	Quantity	Remarks
Unloading	Coal	867	From Australia and the U.S.A.
	Scrap	87	
	"	28	From NASCO
	Fluorspar, soda ash, etc.	5	
Total		987	

Table 13.3.2 Amount of handling on the product berth

(Unit: 1,000 t/year)

	Destination	Type	Unit weight	Quantity
Loading	NASCO	Ingot	15.07 t	152
		Slab (for hot strip)	8.8	76
		" (")	11.7	245
		" (")	17.7	157
		" (for plates)	14.6	40
		" (")	17.7	40
	(Subtotal)			710
	Manila	Slab (for plates)	14.6	40
		" (")	17.7	40
	(Subtotal)			80
	Manila & others	Billet	5.0	199
	Total			989
Unloading		Ferro-alloy		9
		Moulds, refractories, etc.		23
	Total			32
Grand Total				1,021

(2) Working conditions

1) Working time: The working time of berth handling is consecutive 24-hours for 3 teams in 3 shifts.

2) Rate of operation (average)

(Unit: %)

Equipment name	Rate of operation	Remarks
Loader	58	Loading 40, temporary storage 15, unloading 3
Unloader	37	coal unloading 22, scrap unloading, loading 15
Tractor	53	

3) Product inventory: Product inventory is an average of 10 to 12 days.

13.3.3 Equipment specifications

The equipment specifications are shown in Table 13.3.3.

Table 13.3.3 Equipment specifications

Equipment name	Quantity	Specifications
(1) Berth		
1) Unloader	2	Capacity: 500 t/hr, Hoisint load { Lifting load: 16t; Rated load: 8t (coal, apparent specific gravity 0.8) 3.6t (scrap, apparent specific gravity 1.2) Type: Level luffing crane Dimensions: Travelling rail span 20m Lift 28m (Travelling rail, both top and bottom 14m) Outreach 28m (From sea side rail center) (24.5m from the coast normal line to the sea side) Bucket (one grab) $10m^3$ (for coal) $3m^3$ (for scrap) Lifting magnet (for scrap)
2) Loader	2	Capacity; 20t Type; Rope trolley type crane with elevated girder Dimensions: Travelling rail span 20m Lift 22m (8m above travelling rail, 14m below) Outreach 15m (from sea side rail center) Backreach 10m(from land side rail center) Effective opening of legs 13.5m (Both sea and land sides)
(2) Transport equipment		
1) Tractor	3	
2) Trailer	7	35t 2.5m wide x 7m long
3) Forklift	1	25t
4) Bulldozer	3	14t
5) Paw crane	2	0.4 m^3
6) Dump truck	3	18t with a $20m^3$ frame
7) Truck	1	2t
(3) Yard		
1) Product stock yard	1	Effective area: 12,170m^2 Yard capacity: max. 79,000t
2) Scrap temporary storage	1	Effective area: 2,520m^2 Yard capacity: max. 6,000t
(4) Buildings		
1) Site office	1	600m^2, 20m x 15m, two-stories
2) Garage/spare parts storage	1	360m^2, 24m x 15m
3) Electric room (for berth crane)	1	65m^2, 10m x 6.5m
4) Transformer station (for berth crane)	1	45m^2, 10m x 4.5m

13.3.4 Technical explanation

(1) Unloader

1) Selection of functiohs

Needless to say, carriers of raw materials such as coal and scrap tend to become larger and larger in order to reduce the distribution cost. In keeping with this trend, the berth, unloaders and facilities behind are all becoming larger, more labor-saving or offering higher speed.

As for the coal carrier, the 20,000 - 30,000 DWT class is considered normal. However, the proposed equipment will be a 500 t/hr level luffing crane in preparation for large carriers of the 50,000 DWT class. (See Fig. 13.3.1.) This is a crane exclusively for unloading coal and other bulk materials, from the ship by means of a grab bucket. Equipped with the hopper, feeder and conveyor inside the crane and connected directly to the coal stock yard by the belt conveyor on the ground, it is very well suited for bulk unloading. In the case of scrap, its function should be such that it can be unloaded by the polyp bucket and lifting magnet, swinging for direct loading on the dump truck or for temporary storage on the berth.

As vessels become large-sized, a portion of the cargo to be scrapped out of the ship tends to increase, thereby making it possible for the crane capacity to decrease. Key to raising the efficiency is completing unloading in a short period of time to curb generation of demurrage; this is accomplished by keeping the grabbing quantity of the bucket unchanged at all times and by raking coal, scrap, etc. out of the ship. Therefore, labor saving is introduced by replacing the manual rake-out work in the ship with mechanized methods using a bulldozer or paw crane.

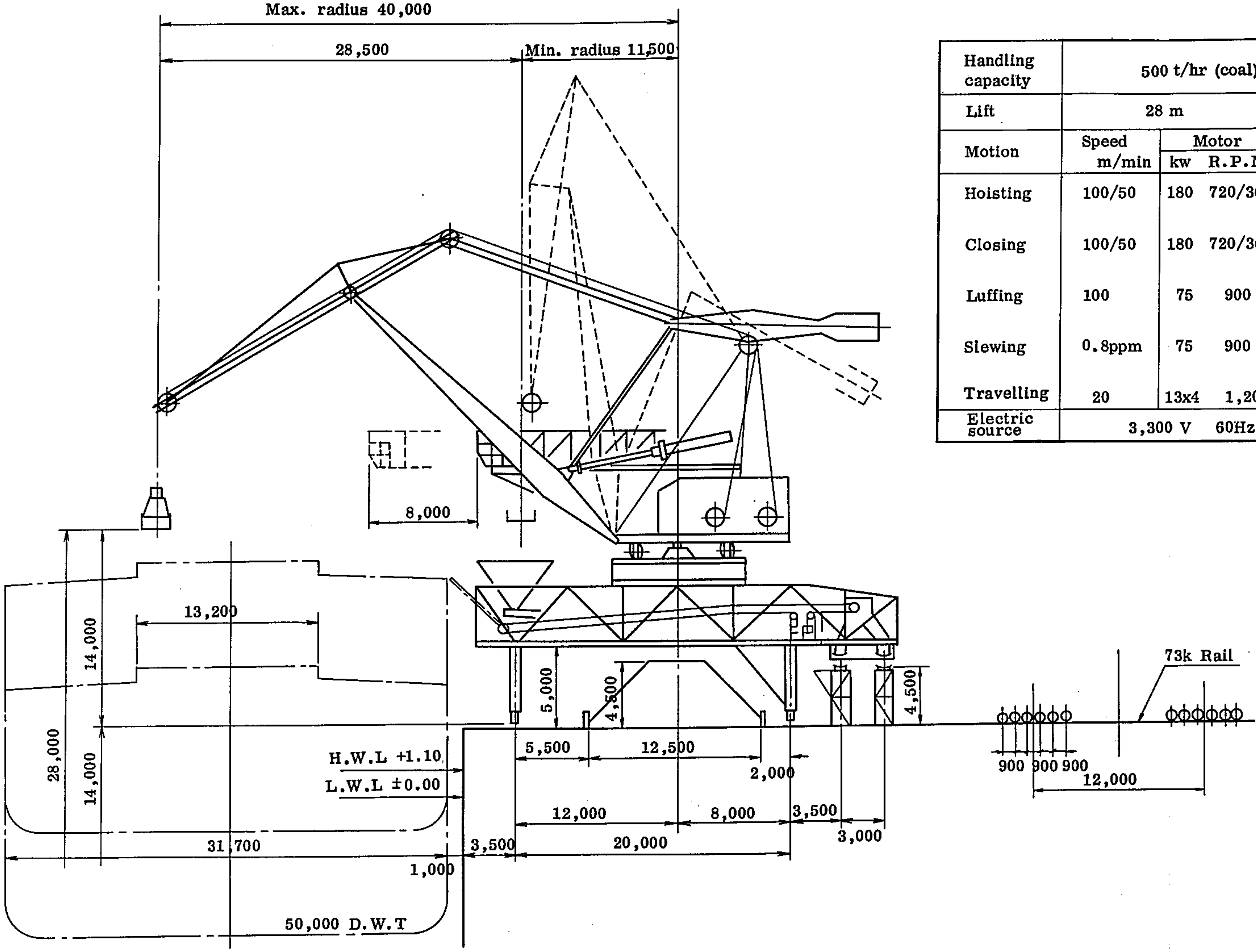
2) Capacity calculation

	Coal	Scrap	Scrap* (temporary storage)	Total
Applicable vessels	50,000 DWT	20,000 DWT	-	-
Quantity loaded or unloaded	72,000 t/month	10,000 t/month	2,000 t/month	84,000 t/month
Crane capacity	550 t/hr. 2 units	120 t/hr. 2 units	120 t/hr. 2 units	-
Days required	6.5 days	4 days	0.5 day	11 days
Rate of operation	22%	13%	2%	37%

*Scrap (temporary storage) indicates the one loaded on dump trucks.

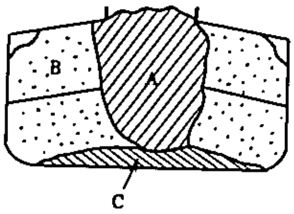
3) Loading of the scrap temporarily stored on the berth to dump trucks

As a rule, scrap is directly loaded on dump trucks by the unloader and transported to the scrap stock yard. It is noted, however, that unloading at Section A as shown in Fig. 13.3.2 is the most efficient and do not lower the loading efficiency. This method makes it necessary to store scrap on the berth temporarily. At some appropriate time, the temporarily-stored scrap is loaded by the unloader on the dump truck and carried to the scrap stock yard. The minimum number of dump trucks will be used -- 3 trucks.



Handling capacity	500 t/hr (coal)				
Lift	28 m				
Motion	Speed m/min	Motor			Brake
		kw	R.P.M.	%ED	
Hoisting	100/50	180	720/360	60	Magnet eddycurrent
Closing	100/50	180	720/360	60	Magnet eddycurrent
Luffing	100	75	900	100	Magnet eddycurrent
Slewing	0.8ppm	75	900	100	Hydraulic (foot operated)
Travelling	20	13x4	1,200	25	Electrohydralic
Electric source	3,300 V 60Hz 3Ph				

Fig. 13-3-1 Unloarder



A: 35%, 104 t/hr.unit (location, where scrap can be grabbed by the polyp bucket

B: 55%, 52 t/hr.unit --- 1/2 of A (location, where rake-out work by machine is required)

C: 10%, 26 t/hr.unit --- 1/4 of A (location, where bottom-scrapping by human power or lifting magnet is required.)

Average: about 60 t/hr.unit

Fig. 13-3-2 Scrap shipment

(2) Loader

1) Selection of functions

The manufactured products are to be transported by sea mainly to NASCO and Manila and to other parts of the Philippines, and it is anticipated that applicable vessels will be of various types ranging from 300 to 5,000 DWT. To cope with such a situation, the rope trolley type crane with an elevated girder is to be used, which travels in parallel to the berth, and which makes it easier to work by keeping out of ship's mast as long as a cantilever is set up. (See Fig. 13.3.3.)

The operator's cab is attached to the main trolley of this crane so that the operator conducts all operations from the trolley in good view and the hoisting mechanism is of the double hook type to insure safe and speedy work. Furthermore, in order to enlarge the working range below the crane, a 10 m backreach is set up to make the crane useful not only for loading for shipment but also as the product yard crane.

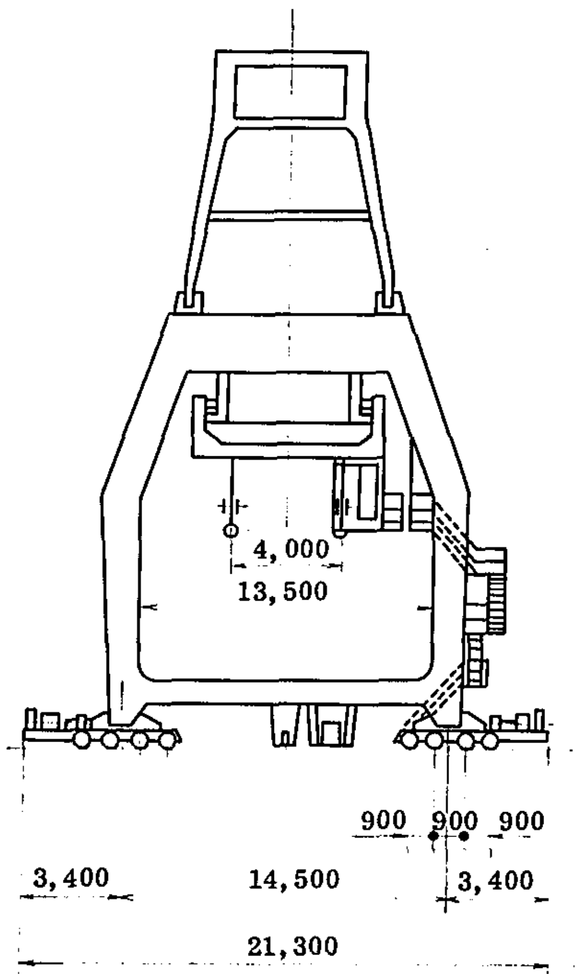
2) Capacity calculation

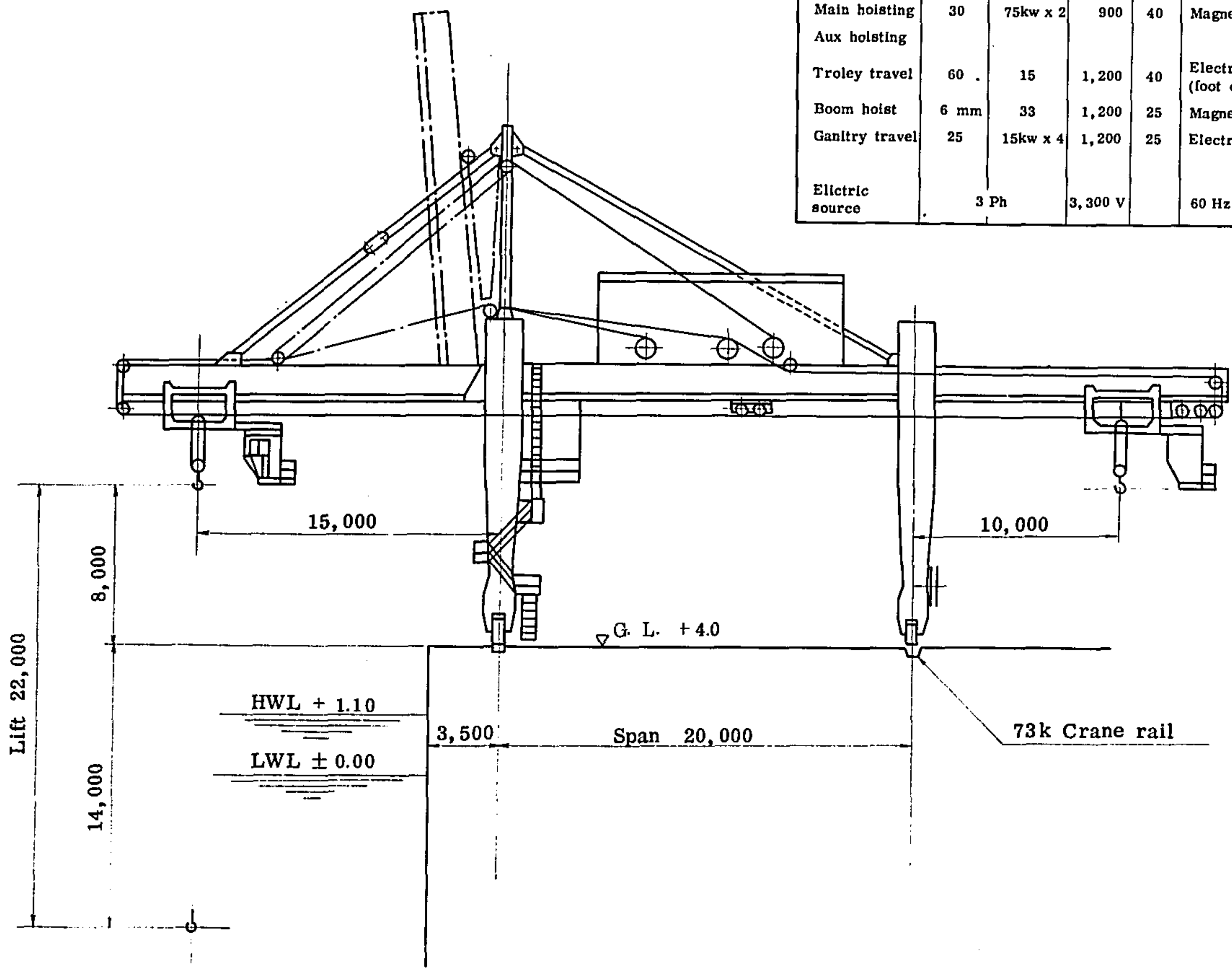
a) Necessary number of units

As shown in Fig. 13.3.4, the 30 t crane (3 min/cycle, 341 t/hr, 73%, Ⓖ) provides the best rate of crane operation, and one unit is sufficient. However, if there is only one unit, and if it should break down, there will be a complete halt of the operation.

Normally, the rate of crane operation at the steel works is 55 to 65%. Now, 3 min/cycle for loading is possible when the product yard and the work for getting the products be ready for crane operation are in the best condition, and an average is 4 to 5 min/cycle. The rate of crane operation at the time of 4 - 5 min/cycle loading is 98 - 116% (Ⓔ, Ⓓ) as clearly shown in this chart.

Consequently, the rate of operation per crane is 49 - 58% (98 - 116%/2 cranes) in the case of 2 cranes, and 33 - 39% (98 - 116%/3 cranes) in the case of 3 cranes. The necessary number of cranes is, therefore, 2 cranes.





Specifications					
Main hoisting load 2 x 10 t					
Aux hoisting load					
Lift main 22M aux				Span	20 m
Motion	Speed m/min	Motor			Brake
		KW	RPM	%ED	
Main hoisting	30	75kw x 2	900	40	Magnet eddy current
Aux hoisting					
Troley travel	60 .	15	1,200	40	Electro hydraulic hydraulic (foot operated)
Boom hoist	6 mm	33	1,200	25	Magnet eddy current
Ganitry travel	25	15kw x 4	1,200	25	Electro hydraulic
Elictric source	3 Ph		3,300 V		60 Hz

Fig. 13-3-3 Loader

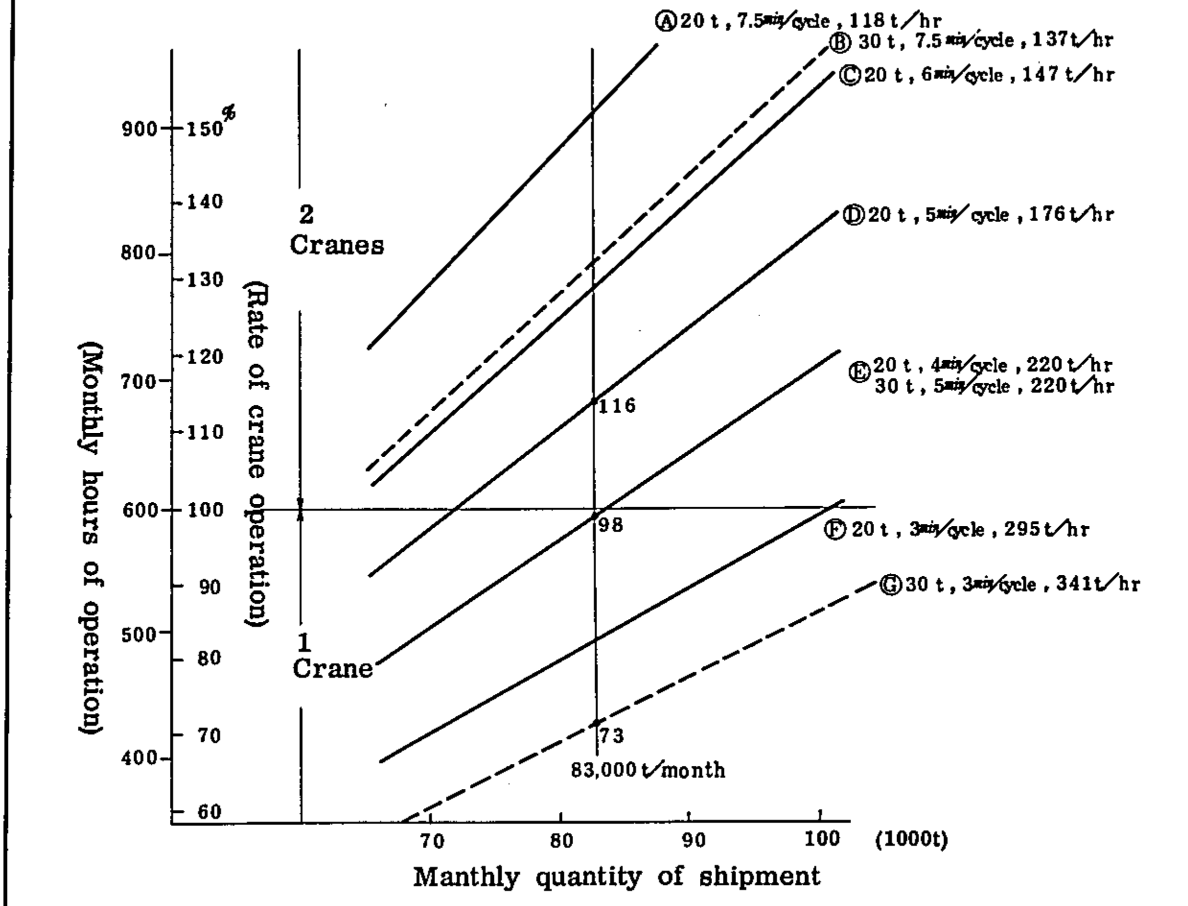


Fig. 13-3-4 Necessary number of Cranes

b) Rated load:

The maximum unit weight of the planned product is 17.7 t. When 0.1 t of the wire/rope is added, the total is 17.8 t. Hence, as shown in Fig. 13.3.4, 2 types of 20 t and 30 t are reviewed. As far as the work efficiency is concerned, there is no appreciable difference between the 20 t and 30 t cranes. The low-construction-cost 20 t crane is selected.

For a hoisting equipment, a lifting magnet can be considered. But this will require remodelling of the loading facilities at the port and the compass of vessels. Wire/rope is thus adopted.

c) Rate of loader operation

(Unit: %)

Loading	Temporary storage	Unloading	Total
40	15	3	58

(3) T.T. (tractor trailer) transport of products at the works

1) Selection of functions

In product transport at the steel works, there are two types -- railway and truck. Although the railway type is suited for conveying massive quantities of products at a time, its initial equipment investment is very high and its ease of operation below the berth crane is poor. The truck type is, therefore, selected.

Of the many modes of truck transport, the T.T. (tractor trailer) transport is adopted. Composed of 3 trailers to one tractor, this method is flexible enough to let the tractor carry other trailers while unloading cargo. Since operator's waiting time is thus eliminated and this contributes to getting good efficiency. It is expected that better results may be obtained by devising methods of communications or instructions such as adopting radiotelephone, and etc.

2) Capacity calculation

a) Load capacity

It is generally considered that the higher the load capacity is, the more efficiency may be obtained. While this is true, the load is limited by product type, shape, dimensions, unit weight and other factors. And so, after examining 20 - 65 t trailers, 35 t trailers, which being proved to have been the highest loading efficiency on an average of all product types, are to be employed.

b) Necessary number of vehicles

As shown in Table 13.3.4, the rate of operation with loads 35 t and 65 t is 106% and 78%, respectively. The rate of operation with a 65 t load is 78%, and theoretically, 1 tractor will do. But in consideration of Philippines' climate, a relief operator may be needed. This means two 35 t tractors and 6 trailers with the rate of operation 53% (106%/2 units). In the case of breakdown, 1 tractor and 1 trailer will be spares.

Table 13.3.4 Working time for T.T. transport, rate of operation

Load	Slab					Ingot	Billet	Total (hr/month)	Rate of Operation (%)
	Width mm 1,838	1,520	1,215	910	Sub-total				
30t	190	78	198	82	548	118	104	770	128
35	190	52	149	82	473	79	81	633	106
45	127	39	149	82	397	59	81	537	90
55	95	31	149	82	357	59	81	497	83
65	76	31	149	82	338	47	81	466	78

(4) Product stock yard

Most of the products being planned are for marine transport. Improving the loading work efficiency without having useless waiting time on the part of transportation equipment and workers will lead to increasing all of the product shipping efficiency. Products are to be placed by destination at locations close to the berth so that a discontinuance of cargo can be avoided during loading. A little more than 70% of all destinations of products for shipment are NASCO, the remainder being mainly Manila. NASCO's product yard is narrow. Unless the Manila habor warehousing facilities are re-arranged at an early opportunity, this facility will be used until the aforementioned will be completed.

As Fig. 13.3.5 illustrates, about 25,000 t, 10 days' stock can be stored below the berth crane. The stock is determined by such factors as period of working scheduled, transportation lot, production schedule, status of ships waiting at the place of unloading, and business fluctuation, and it is normally for 10 to 12 days.

In this plan, an extra yard of 8,000 m^2 for 54,000 t, about 20 days will be prepared in an area behind the berth in addition to the area below the berth crane; this is just in case of fluctuations. Moreover, on the land side, a product yard will be secured for future expansion.

It would be premature to think that use of high-performance, labor-saving equipment for transportation will immediately bring in an improvement of the transport efficiency. Efficient operation of the equipment as well as orderly management of workers are possible only when an integrated transport information control system is established, thereby centrally gathering information on movements of ships, transportation, cargo work and stock and operating from a comprehensive standpoint in order to cope with daily changing conditions of production and to get ready for the future increase in production.

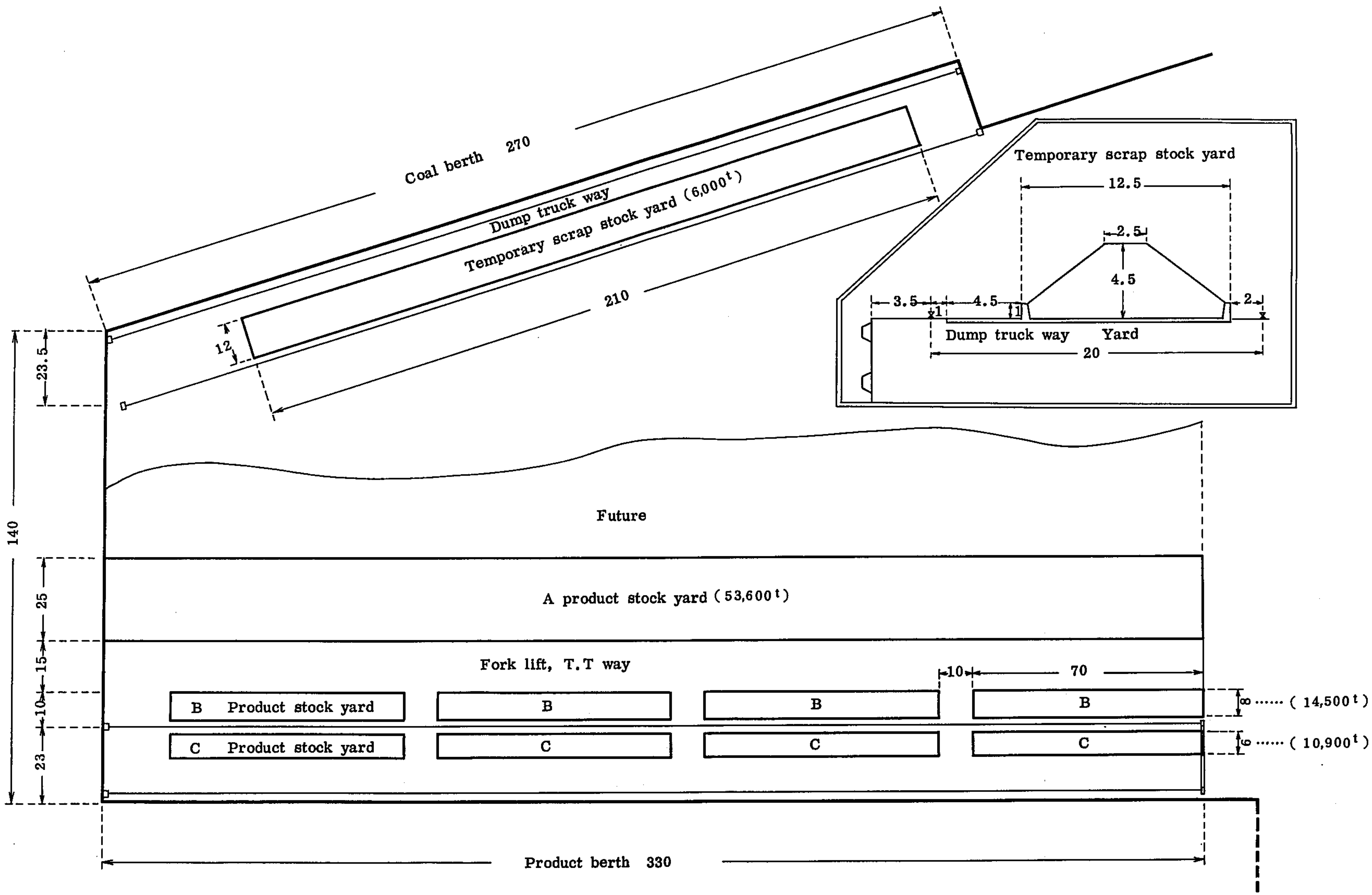


Fig. 13-3-5 Yard lay out

CHAPTER 13-4

RAW MATERIAL HANDLING FACILITIES

13.4 Raw materials handling facilities

13.4.1 Outline

These facilities receive, store, size, blend and supply necessary raw materials to the blast furnace, coke oven, sinter plant, steelmaking plant and lime plant, and they consist of the ore yard, sizing plant, sinter and miscellaneous materials yard, blending yard, coal yard and receiving/releasing belt conveyors.

Iron ore unloading and production of sinter are entrusted to P.S.C. Hence, the capacity of various equipment connected to the P.S.C. equipment is planned together with the P.S.C. equipment capacity. The capacity of other equipment is planned in consideration of the future expansion so that it can cope with the second stage.

13.4.2 Preconditions

(1) Raw materials consumption plan

The quantity of raw material consumption at each plant, to which the raw material is supplied from the raw materials yard, is shown in Tables 13.4.1 - 13.4.6.

Table 13.4.1 For blast furnace

Item	Unit of consumption kg/t-pig iron	Quantity t/d	Remarks
Pig iron tapped		2,644	
Amount of ore charged (breakdown)	1,620	4,283	
Sinter		2,521	2,740 with fines incl.
Pellet		904	
Sized ore		858	
Manganese ore	9	25	
Lump limestone	40	107	
Subtotal		4,415	4,634 Amount charged in ore storage bin.
(Coke)	(520)	(1,375)	

Table 13.4.2 For coke oven

Item	Yield	Quantity dry t/d	Remarks
Blast furnace charging coke		1,375	
Coke production	Lump yield 850 kg/t-coke	1,616	
Amount of coal charged	Coke yield 740 kg/t-coal	2,186	

Table 13.4.3 For sinter plant

Item	Unit of consumption kg/t-sinter	Quantity t/d	Remarks
Sinter production		15,220	
Fine ore	675	10,274	
Sinter fines	80	1,218	
Iron sand	48	731	
Mn ore	9	137	
Dolomite	46	700	
Quartzite	30	457	
Mill scale	20	304	
Flue dust	19	289	
Total raw materials supplied	927	14,110	

Table 13.4.4 For steelmaking plant

Item	Unit of consumption kg/t-steel	Quantity t/d	Remarks
Tapped steel		2,877	
Sized ore	20	58	
Lump limestone	6	17	
(Burnt lime)	(60)	(173)	

Table 13.4.5 For lime plant

Item	Unit of consumption kg/t-lime	Quantity t/d	Remarks
Burnt lime production		173	
Lump limestone consumption	2,330	403	

Table 13.4.6 For sizing plant

Raw material	Blast furnace consumption t/d	Fine ratio %	Sizing quantity t/d	Fines produced t/d	Remarks
Pellet	904	5	952	48	
Lump ore	858	45	1,560	702	
Mn ore	25	50	50	25	
Total	1,787		2,562	775	

(2) Data on raw materials received

The data on the raw materials received at the yards are shown in Table 13.4.7. Quantities of iron ore, limestone and other raw materials to be received at the ore yard reach some 2.7 million tons per year including sinter, mill scale and flue dust. The amount received at the coal yard is about 800,000 tons per year.

Since large carriers are used for transport of imported raw materials, a sufficiently large yard area will be required for receiving them. A flow of raw materials among the quay, yard and between each plant is shown in Fig. 13.4.1.

Table 13.4.7 Raw materials data

Raw materials	Annual consumption dry m.t.	No. of brands	Domestic or import	Type of ship DWT	Particle size mm	Ratio of fine %	Remarks
Pellet	347,000	1	Import	100,000	5 -16	5	
Lump ore	609,000	3	"	20,000 ~ 150,000	-20	45	
Fine ore	400,000	3	"	20,000 ~ 100,000	-10	100	
Mn ore	18,000	1	"	20,000	-200	50	
Iron sand	48,000	1	Domestic	6,000	-3	100	
Dolomite	46,000	1	"	6,000	-3	100	
Quartzite	30,000	1	"	6,000	-3	100	
Lump limestone	192,000	1	"	6,000	10 ~ 30	0	Water content 7 ~ 9%
Quantity loaded at quay	1,690,000						
Sinter	1,000,000	1	(P.S.C.)		-50	8	
Mill scale	20,000	1			-10	100	
Flue dust	19,000	1			-3	100	
Received from steel works	1,039,000						
Total quantity received at ore yard	2,729,000						
Coal	798,000	5	Import	50,000 ~ 60,000	-50	---	Water content 8%

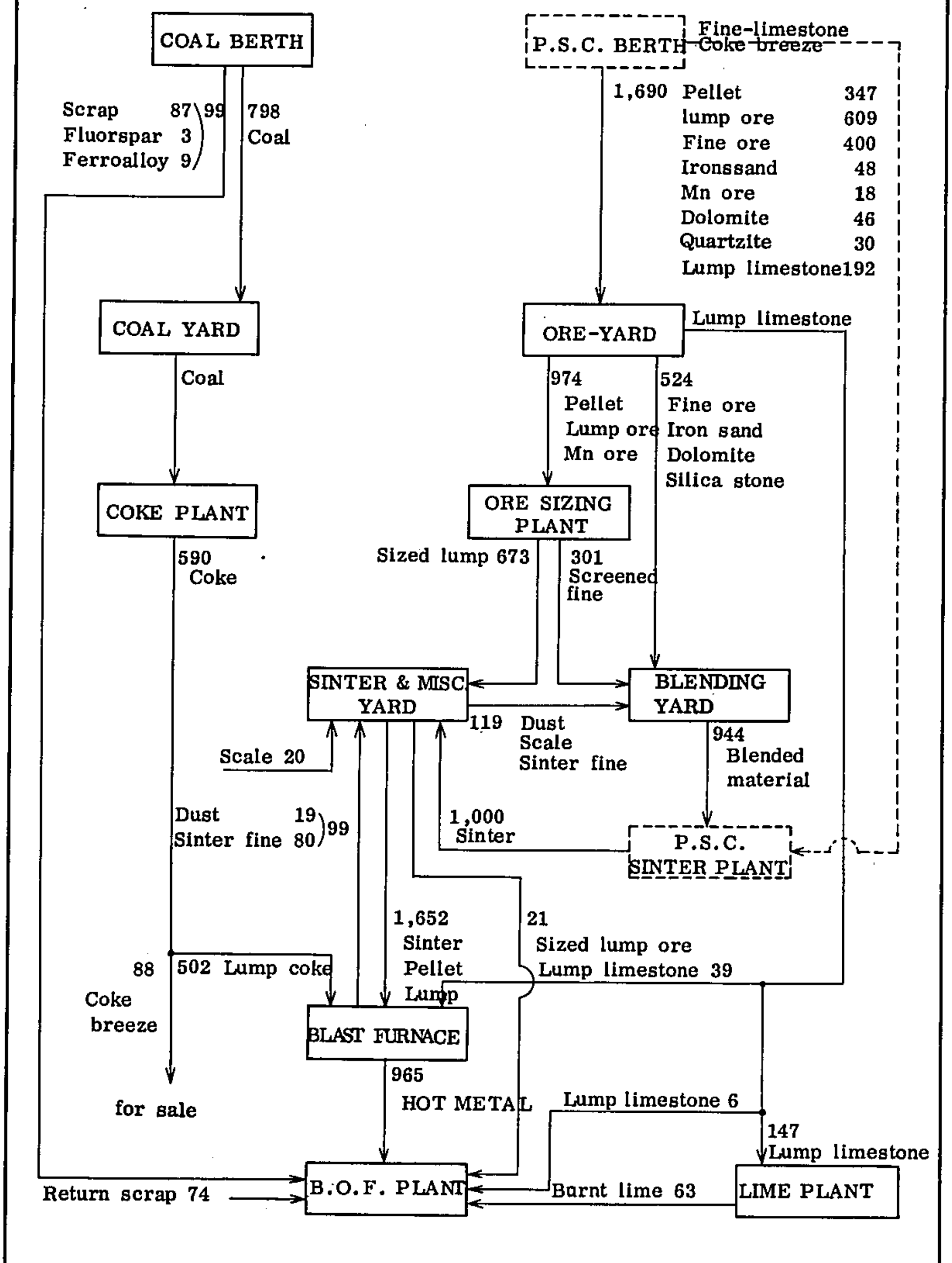


Fig. 13.4.1 Raw material flow & balance

(3) Operating condition

1) Working hours

Raw materials preparation work will be continuous operations for 24 hours in 3 shifts.

2) Capacity of the allied equipment

The capacity of the equipment directly connected to raw materials preparation work is shown in Table 13.4.8.

Table 13.4.8 Allied equipment capacity

Equipment	Capacity	Allied raw materials preparation equipment
PSC unloader	1800 t/h x 2 (max. 2500 t/h)	Ore yard receiving belt conveyor, stacker
Coal unloader	500 t/h x 2 (max. 700 t/h)	Coal yard receiving belt conveyor, stacker
PSC sinter products release	635 t/h (max. 800 t/h)	Sinter and miscellaneous materials yard receiving belt conveyor, stacker
PSC sinter raw materials receiving	1500 t/h	Blending yard reclaimer, releasing belt conveyor

3) Sinter production

The sintered ore manufactured by PSC for export is slightly different from the sintered ore generally used at steel mills. Consequently, it is difficult to use the sintered ore for export as it is at the new steel works.

For use of the new steel works, production of sintered ore, whose composition is adjusted to fit blast furnace operation through addition of iron sand, dolomite, quartzite and other necessary raw materials, is desirable.

To manufacture one month supply of sinter to be used at the new steel works, it will take about 6 days for PSC. At the current calculation, it is assumed to manufacture one month supply of sinter once a month. It is further assumed that a blending yard sufficient for supplying blended raw materials required for sintering and a storage space for one month supply of sinter will be prepared.

13.4.3 Outline of the equipment

The equipment is outlined in Table 13.4.9.

Table 13.4.9 Equipment outline

Equipment name	Specifications
(1) Ore yard	
1) Yard	50m x 900m x 1 yard Ore storage capacity 360,000 t
2) Receiving belt conveyor	3600 t/h x 2000mmW x 3 belts x about 1400m
3) Stacker	3600 t/h x 1 unit
4) Reclaimer	800 t/h x 1 unit
5) Releasing belt conveyor	800 t/h x 1050mmW x 4 belts x about 1300m
(2) Sizing equipment	
1) Surge bunker	2 bunkers
2) Crushing/screening equipment	400 t/h
3) Belt conveyor	400 t/h x 1050 - 2000mmW x about 30 belts x about 1300m
4) Lump/fine bunker	9 bunkers
(3) Sinter and miscellaneous materials yard	
1) Yard	50m x 900m x 1 yard Storage capacity 360,000t
2) Receiving belt conveyor	800 t/h x 1050 - 1400mmW x 8 belts x about 2700m

3) Stacker	800 t/h x 1 unit
4) Reclaimer	800 t/h x 1 unit
5) Releasing belt conveyor.	800 t/h x 1050 - 1400mmW x 8 belts x about 2300m
(4) Blending yard	
1) Yard	30m x 400m x 1 yard Storage capacity 90,000t
2) Receiving belt conveyor	1500 t/h x 1200mmW x 6 belts x about 700m
3) Stacker	1500 t/h x 1 unit
4) Reclaimer	1500 t/h x 1 unit
5) Releasing belt conveyor	1500 t/h x 1200mmW x 3 belts x about 1400m
(5) Coal yard	
1) Yard	50m x 900m x 1 yard Storage capacity 270,000 t
2) Receiving belt conveyor	1000 t/h x 1200mmW x 6 belts x about 1700m
3) Stacker	1000 t/h x 1 unit
4) Reclaimer	300 t/h x 1 unit
5) Releasing belt conveyor	300 t/h x 900mmW x 3 belts x about 1300m

13.4.4 Flowchart and layout

The equipment flowchart is shown in Fig. 13.4.2. Also, the layout is shown in Fig. 13.4.3. What are handled by this equipment are ore, coal, limestone, etc. carried by the belt conveyors. Scrap, ferroalloy, soda ash, etc. are truck-transported from the quay to the steelmaking plant.

13.4.5 Technical explanation

(1) Yard capacity

Area required for the raw materials yard is determined by the number of brands of raw materials, amount of consumption per brand, size of the received lot, and fluctuation of the arrival time, etc.

The yard planned at this time will be adequate up to the second Stage, provided that there is no major change in such conditions as the number of brands and size of the received lot. If the preparation quantity at the second Stage should exceed double the first Stage amount, it will probably be necessary to consider adding more reclaimer and releasing belt conveyor.

(2) Sizing capacity

In order to effect a smooth flow of raw materials from the ore yard to the miscellaneous materials yard, it is desirable that the sizing capacity has something in reserve. It is possible to add more equipment in the future to the currently planned plant to increase its capacity by 50 to 100%. Moreover, a space for the second plant is taken into account.

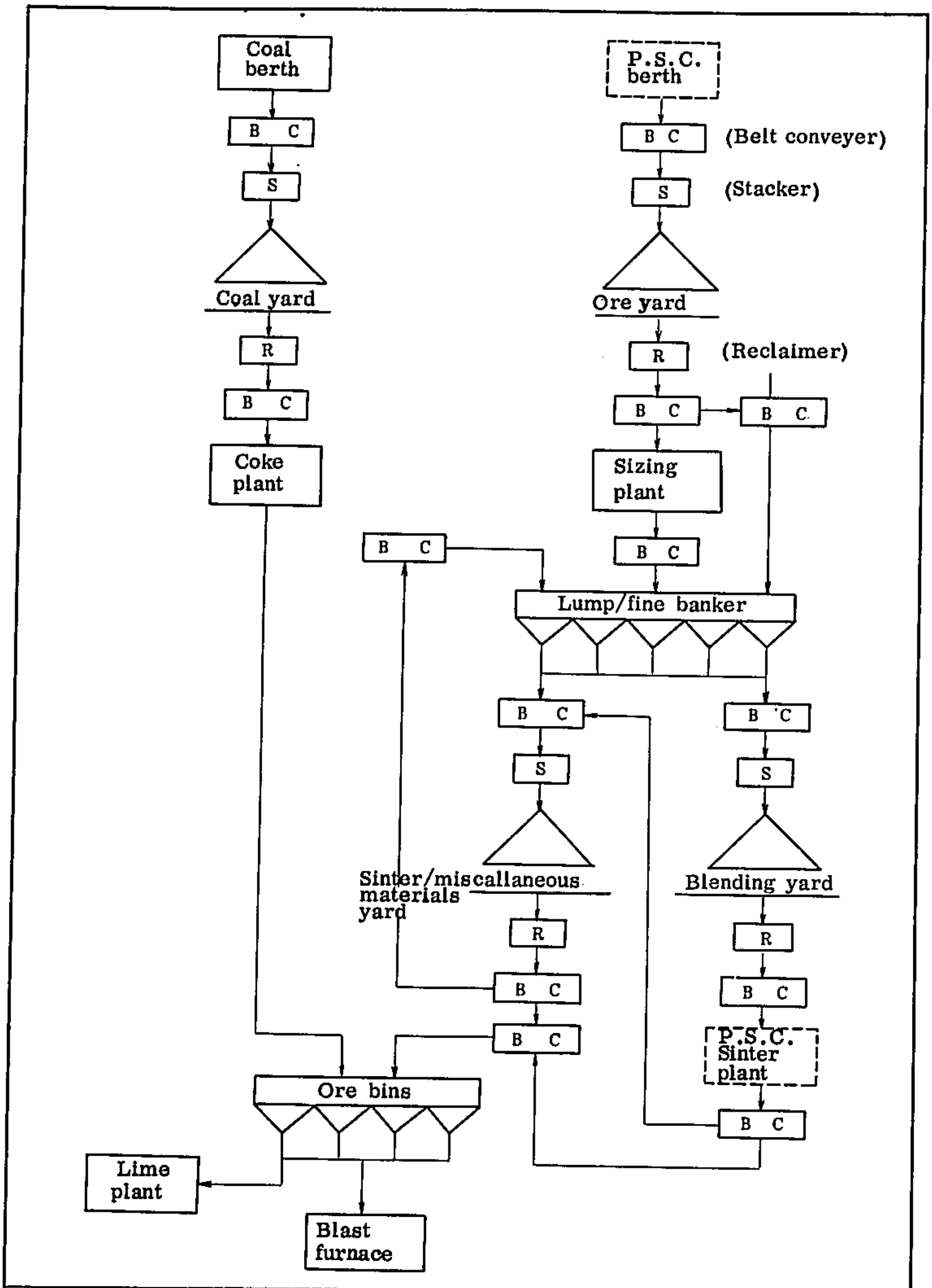


Fig. 13-4-2 Raw materials preparation flowchart

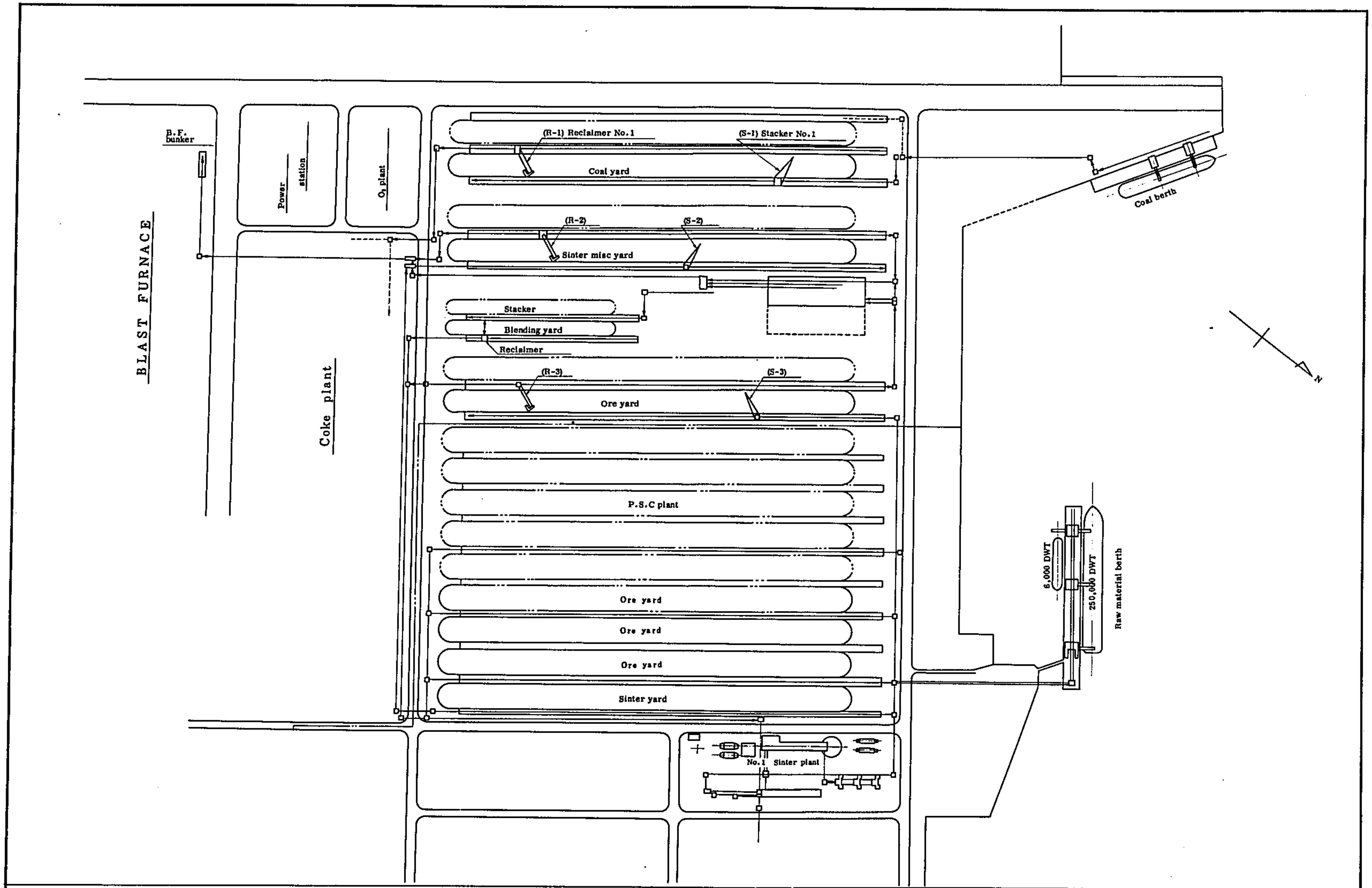
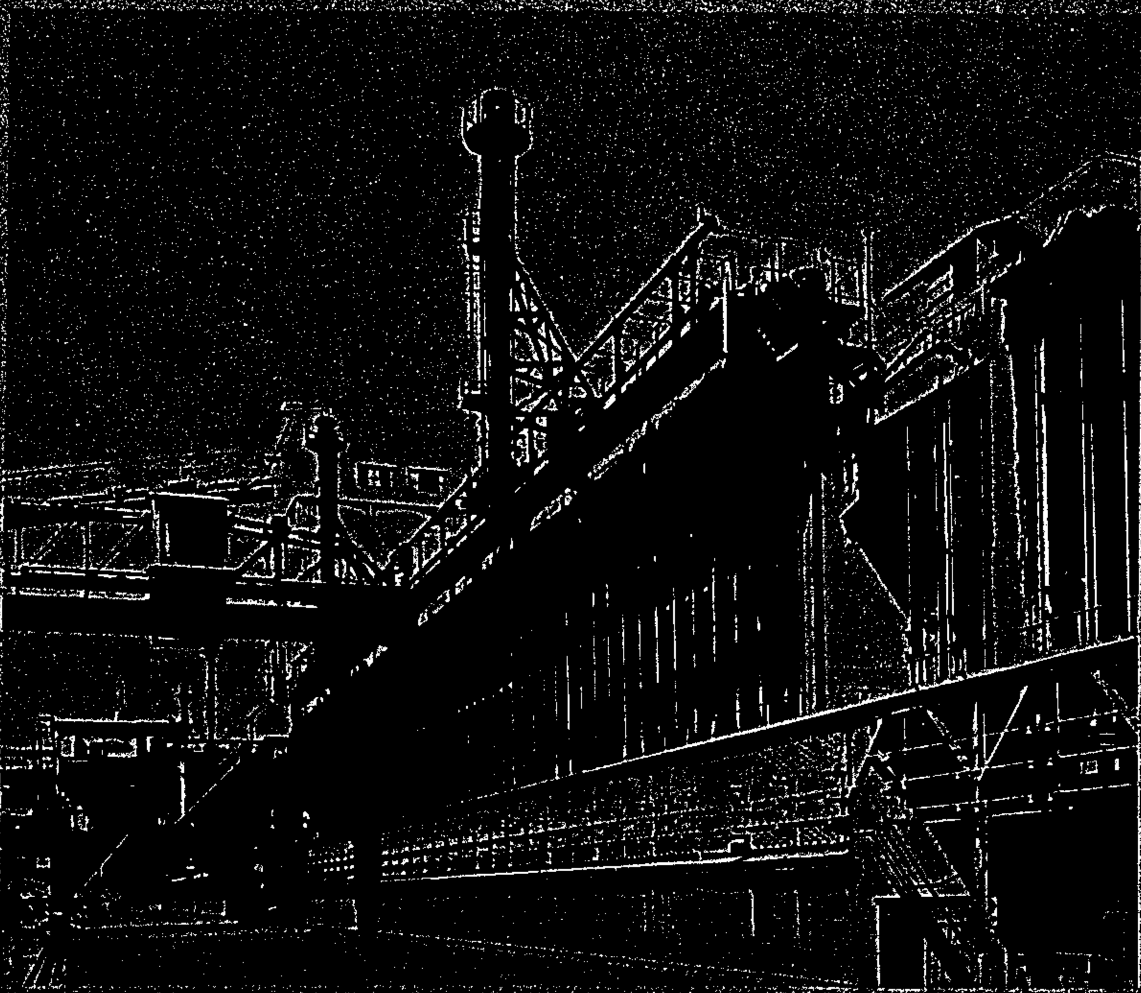


Fig. 13.4.3 Layout of rew material handling fascilities

CHAPTER 13-5

COKE OVEN PLANT AND BY-PRODUCT PLANT



13.5 Coke oven plant and by-product plant

13.5.1 Outline

The coke plant will be capable of producing all the quantity of coke to be used at the blast furnace -- with a battery of coke ovens. In consideration of working environments, reliability, safety and operational capability of the equipment, 76 ovens, each 5m high, will be built. The coal preparation equipment and the coke transport equipment will be such as to match the requirements at the first Stage.

The chemical by-product equipment, consisting of gas collecting system, ammonia decomposition facility, light oil collecting system and biological treatment facility, collects C.O.G., tar and light oil by-products and disposes ammonia gas, ammonia liquor, etc.

For the environmental-control equipment are planned the biological treatment facility that treats sludge generated from the coke ovens and chemical by-product equipment, charging car dust collector for reducing operator's load and for dust prevention, smokeless charging device, crusher, coke cutter, and dust collector for coke screen. Sulphur and ammonia compounds are contained in the coke oven gas. Ammonia compounds can be eliminated by the ammonia decomposition facility, while no desulphurization equipment will be set up.

13.5.2 Preconditions

(1) Coal blending condition

Coal blending must be in such a blending ratio as to meet all the quality requirements (strength, ash content, sulphur content) set up by the blast furnace. In this plan, the equipment is planned according to the following blending ratios shown in Table 13.5.1 using 5 kinds of coal.