REPORT
ON
THE IRON AND STEEL INDUSTRY
IN
THE REPUBLIC OF KOREA

JANUARY 1966

GOVERNMENT OF JAPAN

Errata

Page number	Line number	Incorrect	Correct
2	17	whole hearted	wholehearted
	25	requlations	regulations
6	28	moted	met
9	30	guality	quality
12	17	gaulity	quality
	21	gaulity	quality
14	11	under taken	undertaken
15	8	country	countries
21	14	superion gaulity	superior quality
27	8	kwan	Won
28	31	Second	First
36	15	inport	import
	20	branch industry	branch of industry
41	3	sustitutive	substitutive
45	14	45%	45.6%
47		(1) A missing row 'Bus'es 600 17.9' should be inserted between 'Trucks' and 'Small trucks'	
		(2) The last two words 'since then' of the last line but one should be deleted.	
56	7	gernal	general
71	12	400	400,000
73	list	(1) In the column 'Main facilities' and the row 'Cho Il and Steel Co.' 'process with by blast furnace' should be corrected as 'by blast furnace process'.	
80	10	reclained	reclaimed
86	39	miscellenous	miscellaneous
87	16	thoughout	throughout
		(1) In the list 'Coke balance' and in the column 'Sintering' 'Amount of coke needed' should be followed by '1,083,800 t/y x 0.06 = 65,000 t/y'	
91	4	Counter-measures	Countermeasures
	the last word	line	lime
100		(1) In the column 'Remarks' of 'First Stage' 'top process' should be corrected as 'top pressure process'.	
118		(1) In the column 'Contents of study' 'Operate-system and manu mantenance' should be corrected as 'Operate-system and maintenance'.	
129	14	'product' should be corrected as 'production'	

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I. INTRODUCTION

I Introduction

1. On July 28th 1965 Korean Mission in Japan made a request to the Government of Japan to dispatch a survey team to the republic in order to perform a special investigation of the overall situation of the iron and steel industry and to give recommendations concerning the feasibility of constructing an integrated iron and steel works in the country together with the concrete ways and means of realizing this project. It is needless to say that the republic considers this project as the necleus of its Second Five Year Plan (1967 - 1971) since the project constitutes an important link of the chain of its economic development. This is the reason for the above-mentioned request to the Government of Japan.

2. The Government of Japan immediately entrusted this investigation work to the Overseas Technical Cooperation Agency, which organized a survey team composed of the experts selected from six major manufacturers of iron and steel in Japan.

The Survey team arrived in the republic on September 16th 1965 and returned home on October 1st, after having investigated the overall situation of the iron and steel industry of the country and considered the feasibility of constructing an integrated iron and steel works in Ulsan area.

The team hereby expresses its deep sense of gratitude for the whole hearted welcome and kind cooperation extended to it by the authorities concerned, iron and steel manufacturers and their related enterprises, by virtue of which it could obtain such results as surpassed its expectations in spite of the extremely limited time of investigation.

The team, as stated below, consisted of ten experts, each of whom taking charge of his assigned item of investigation as the following : - economic situation of the Republic of Korea, demand and supply of iron and steel, raw materials, location of the integrated iron and steel works, labour conditions, laws and requlations concerned, etc.

3. In compliance with the request of the Government of the Republic of Korea the survey team has, in this report, examined the present demand and supply of iron and steel, estimated the demand for steel products up to 1971, which is the target year of the Second Five Year Plan, and outlined, taking into consideration the expansion projects of the existing enterprises, the idea of constructing an integrated iron and steel works. The report, however, cannot claim to be satisfactory due to the limited time of investigation and available data. Besides, we should like to add that the realization of the project of constructing an integrated iron and steel works will necessitate further special investigations.

Personnel of survey team

Title	Name	Present Post (as of Nov. 1965)
Leader of survey team	Eitaro Tomiyama	Senior Managing Director, NIPPON KOKAN K. K.
Member of survey team	Masaharu Shimizu	Acting Manager of Technical Control Dept., KAWASAKI STEEL CORPORATION, Chiba Works
	Keishiro Moro	Assistant General Manager, General Planning Dept., General Planning & Survey Division, NIPPON KOKAN K. K.
	Gennosuke Arisawa	Assistant Manager of Rolling Dept., KOBE STEEL WORKS LTD., Kobe Works.
	Sakuya Arimoto	Assistant to Manager of Controlling Dept., SUMITOMO METAL INDUSTRIES, LTD.
	Takehiko Yasuhara	Assistant Manager of Planning Dept., FUJI IRON & STEEL CO., LTD.
	Fujio Ikeda	Chief, Planning Section, Sales Dept., YAWATA IRON & STEEL CO., LTD.
	Yasuhisa Inada	Chief of Management Reseach Section, Technical & Management Research Dept., THE JAPAN IRON AND STEEL FEDRATION
	Takeyuki Inada	Director of Development Survey Div., OVERSEAS TECHNICAL COOPERATION AGENCY
Secretary to leader	Toshio Nagashima	Assistant Chief, International Affairs Dept., NIPPON KOKAN K. K.

4. The itinerary of the survey team and the places and persons it visited during its stay in the republic are as stated below (regarding the persons mentioned, prefixes have been left out from the names).

Sept. 16th (Thurs.)

in the morning : left Tokyo (Haneda).

in the afternoon : arrived at Seoul.

16:00 - 18:00 : made a formal call at the Ministry of Commerce and Industry, Ministry of Construction and Economic Planning Board and visited the following persons :

Ministry of Commerce and Industry

Lee Woo Yong, Assistant Minister for Mines, Industry and Utilities

Om, Ick-Ho, Director, 2nd Industry Bureau, "

Kim Ick Shin, Chief, Metallurgy Section, " "

Ra Chang Soo, Sub-section Chief, " , "

Nam Kye Young, Chief, Heavy Industry Section, "

Ministry of Construction

Chun Ye Yong, Minister, Ministry of Construction

Choi Chong Song, Vice-Minister, "

Baik Chin Ki, Director, Special Regional Development Bureau, "

Kim Tong Whee, Chief, Construction Section, " , "

Han Chan Woo, Staff, " , " , "

Economic Planning Board

Chang Key Young, Deputy Prime Minister and Minister, Economic

Planning Board

Kim Young Jun, Assistant Minister, "

Chang Yie Zoon, Assistant Minister for Operation

Chung Moon Doh, Director, Economic Cooperation Bureau, " "

Hwang Byung Toe, Chief, Public Loan Division , "

Kim Hyung Gook, Chief, Commercial Loan Division, "

Park Seung Kun, Project Loan Officer, Economic Cooperation Bureau

Sept. 17th (Fri.)

in the morning : general discussions with the officers in charge in the Economic Planning Bureau.

Visited the following officers : -

Assistant Minister for Operation, Director of the Economic Cooperation Bureau, Chief of the Public Loan Division, Chief of the Commercial Loan Division, Park, Economic - Finance Officer, Chi, Economic - Finance Officer, and Shu, Assigned Official for Iron-Steel Mill Project.

in the afternoon : briefing of Ulsan Development Project was made (by the Director of the Special Regional Development Bureau and other officers in charge).

Sept. 18th (Satur.)

in the morning : general discussions with the officers of the Ministry of Commerce and Industry, attendance was as the following :

Assistant Minister for mines, Industry and Utilities, Director of Bureau of Mines, Director of 2nd Industry Bureau, Chief of Metallurgy Section, Chief of Shipbuilding

Section, Chief of Machinery Section, Plant Manager of Inchon Heavy Industry Corporation, Chief of Control Division of the Corporation, Manager of 1st Division of National Research Institute of Geology.

in the afternoon : exchanged views at the National Research Institute of Geology; iron ore resources and other questions concerning the technique of iron and steel making with a few persons including the following :
Park In Kyu, Chief, National Research Institute of Geolegy Yoon Doung Sok, President, Korea Metallurgy Assoiation

Sept. 19th (Sun.)
in the morning : Tomiyama, Leader of team, paid a courtesy visit to Prime Minister Chung Il Kwon; inspected Inchon area; met the following persons:
Yoo Kyung Rin, Executive Director, Ilssin Industrial Co., Ltd.; officials of Korea Steel Co., Ltd., consisting of Vice-President Shin Kyung Sool, Executive Directors, Park Byong Oh, Lee Chon Suk, Choi Moon Su, and Song Ki Man, and Kim Sung Hyun, Chief, Business Dept.

Sept. 20th (Mon.)
in the morning: visited Head Office of Inchon Heavy Industry Corporation and met its President Ahn Chun Saen, Technical Director Park Kyun Man, Chief of General Affairs Dept. Kim Chae Rin, and Plant Manager Joo Hwi Chun; then inspected the mill.

in the afternoon : inspected Korea Machinery Industrial Co., Ltd. and met its President Chung Nak Un; inspected Kyung-Sung Industrial Co., Ltd. where met with Managing Director Cha Ha Kun and Plant Manager Cha Tong Kun.

Sept. 21st (Tues.)
in the morning : flew from Seoul to Pusan.
in the afternoon : inspected Korea Steel Works and met its Executive Director Oh Ung Hwan; inspected Tong Guk Steel Co., Ltd. and met its Directors Woo Bong Yung and Chang Sang Chol, and Chief of Business Dept. Kwak Chol Kyu; inspected Mulkeum Mines Office, Tae Hung Mineral Industrial Co., Ltd. and met its Director Kim Ko Yol and Chief of Business Dept. Lee Byung Ho.

Sept. 22nd (Wed.)
in the morning : inspected Korea Shipbuilding and Engineering Corporation and met its Executive Director Kim Chong Yul.

in the afternoon : inspected Golden Star Co., Ltd. and met its Chief of General Affairs Dept. Cho Hyung Tae.

Sept. 23nd (Thurs.)
in the morning : listened to the briefing of the development project of Ulsan area made by Suh Dong Kwan, Chief, Urban Affairs Section, Kyung-Sang Nam-Do

Provincial Government; left Pusan for Ulsan; briefing was made by Ulsan Special Construction Bureau, and met its Director and Vice-director and Mayor of Pusan; after field inspection by sea and by land of Ulsan Industrial Zone exchanged views with Special Construction Bureau (represented by the officers mentioned above).

Sept. 24th (Fri.)
in the morning : inspected Ulsan Refinery, Korea Oil Corporation, and met its Chief of General Affairs Dept. Chung Won Man and Public Information Officer Yang Hyung Chin.
in the afternoon : left for Kyung Joo.

Sept. 25th (Satur.)
in the morning : stayed in Kyung Joo.
in the afternoon : arrived at Pusan.

Sept. 26th (Sun.)
flew from Pusan to Seoul.

Sept. 27th (Mon.)
in the morning : flew from Seoul to Samchuk.
in the afternoon : inspected Samchuk Works, Sam Chuk Iron and Steel Co., Ltd. and met its President Kwon Oh Moon and Plant Manager Chu Duck Hung; after inspection left for Kang-Nung.

Sept. 28th (Tues.)
in the morning : left Kang-Nung for Yang-Yang Iron Mines.
in the afternoon : inspected Yang-Yang Iron Mines, Korea Iron Mines Development Co. and met its President Im Won Suk, Manager of Mines Office Lee Un Dae and Chief General Affairs Section Chung.

Sept. 29th (Wed.)
in the morning : flew from Kang Nung to Seoul.
in the afternoon : dicussions on practical matters with officers of Ministry of Commerce and Industry, members of Korea Metallurgy Association and moted technical experts as follows :
Ministry of Commerce and Industry : Assistant Minister for Mines, Director of 2nd Industry Bureau, Chief of Metallurgy Section, Chief of Machinery Section Chung Kong Gook, Chief of Utility Section Choi Don Chang and Sub-section Chief of Iron-Steel Section.
Inchon Heavy Industry Corporation : Technical Director
Korea Metallurgy Association : President
National Research Institute of Geology : General Manager.

Sept. 30th (Thurs.)
in the morning : attended the general meeting held by Economic Planning Board and

participated by officers in charge from M.C.I.
and M.O.C.

in the afternoon : paid a formal visit to Minister of Economic Planning Board.

Oct. 1st (Fri.)

in the afternoon : left Seoul for Tokyo.

II. SUMMARY AND CONCLUSION

II Summary and conclusion

1. Present situation of the iron and steel industry in ROK

(1) It was on the basis of the steel scrap which was brought into existence as the left-over of the Korean War that the normal production of iron and steel was commenced in ROK.

That is to say, the operation of re-rolling mills in such districts as Seoul, Inchon and Pusan was first commenced, followed by that of a 50-ton open-hearth of Inchon Hearry Industry Corporation in 1957, giving rise to the establishment of a rolling mill of medium-sized steel products by pull-over process. This is at present the sole modernized plant in the country manufacturing steel and rolled steel products. The increased demand for steel products which ensued has brought about the construction of such facilities as electric furnaces, side-blown converters and rolling mills of medium-sized products, but those facilities have been all on a small scale. However, the gradual exhaustion of the steel scrap and shortage of pig iron found in the country have inevitably caused their import since 1962, which means, the iron and steel industry of the country is now confronted with an extremely serious problem of securing the necessary raw materials. In order to overcome this difficulty of depending on steel scrap there have appeared a few projects of constructing blast furnaces planned by such manufacturers as Sam Wha Iron Works, Dong Kok Steel Mill, Co., Ltd., etc., but each of them still remains in a small scale.

(2) The presumed amount of the iron ore deposits (Fe content being more than 25 percent) comes up to approximately 45,000,000 tons as of September 1965. The greater part of such deposits consists of magnetite, and about 700,000 tons of iron ore were produced in 1964. More than half of this production comes from Yang-Yang districts, and nearly all of such iron ore is exported. Recently abundant deposits have been found in Hong Chun-jaun of Kan Won do. How to make efficient use of the iron ore resources will have to be studied in future.

As the Republic has no deposits of caking coal, which is a raw material of metallurgical coke, it will have to depend on its import as ever. On the other hand, it is rich in the deposits of anthracite of good guality in the districts centering round Samchuk. However, it is hardly possible to use untreated anthracite as such in the blast furnace, and the process of pressing anthracite culm into lumps to use instead of metallurgical coke is now being studied. Such studies should be earnestly furthered for the purpose of utilizing the anthracite in large-sized blast furnaces.

Limestone deposits are abundant in this country, and so are those of dolomite.

(3) The consumption of steel products in 1963 of the country amounted to approximately 300,000 tons, about half of which, or 150,000 tons if expressed in terms of hot rolled steel products, were local production, while the amount of

imported steel products was about 210,000 tons, and, that of exported ones, about 700,000 tons. The greatest majority of the demand for steel products comes from the field of construction work, followed by that for such products as nails, wires and metal boxes, and then by the use for general machinery, rolling-stock and shipbuilding. Consequently, various kinds of bars and sections represent a great percentage in the total steel consumption, but the relative importance of steel plates and sheets also merits attention, when we think of the prospective increase in the demand for them; at present nearly all of those flat rolled products depend on import.

2. Demand forecast for iron and steel in ROK

(1) Although it is very difficult to forecast the demand for iron and steel in ROK due to the limited data available and other various barriers, we have ventured to estimate the demand during the period up to 1971, which is the target year of the Second Five Year Plan. Before working our estimation, we have revaluated the data hitherto published concerning the demand for iron and steel in 1963, which constitutes the basic year of our estimation, converting into steel products in order to incorporate in the existing situation the utilized amount of the used iron, reproduced pig iron and iron castings, which should have been replaced by steel products under normal supply of iron and steel. As a reult, we have figured out that the demand for carbon steel products in 1963 amounted to 377,200 tons, and, by adding to these the demand for special steel products, cast steel and forged steel, the above figures would come up to 385,000 tons, which correspond, when converted, to 497,000 tons in terms of crude steel.

(2) As regards the method of estimating the prospective demand for iron and steel we have made two kinds of approach in order to consider the scale and contents of the proposed integrated steel mill project : a macro-method which has been based on the correlation between the gross national production (GNP) and the amount of crude steel; and, at the same time, a micro-method which has stacked up each amount of demand in each section of consumption of steel products classified by varieties to make up the estimate of the total amount of demand. In our forecast, we have decided to adopt, for the above-mentioned purpose, the result obtained by the micro-approach, after having checked it by the estimated result of the macro-method. Therefore, the demand for crude steel in 1971 is estimated to be 1,139,000 tons, while the estimated amount by the macro-method being 1,102,000 tons. Incidentally, in our macro-method the growth of the fixed capital formation in the gross national expenditure has been correlated with the growth of crude steel demand or production; this is a method of estimate, adopted for the first time from an international point of view because of the high degree of correlation due to the following fact. Generally speaking, there is a tendency in developing countries, contrary to that in advanced countries, to carry out a very large and extensive

amount of investment in fixed capital goods, which accounts for the above-said high degree of correlation. Although our estimate has happened to be a great deal over that of the Economic Planning Board made in May 1965 (483,000 tons in 1970), we believe that the above-mentioned demand in terms of crude steel will be actualized if the objectives in each section of the Second Five Year Plan would be wholly realized with success.

(3) As for the demand in 1971 for steel products classified by items, that for steel bars (25%) comes first, followed by steel plates (21%), and then by steel sheets (19%), if classified by fields of consumption, the relative importance in such fields as construction, metal products, general machinery and shipbuilding merits attention. The growth of the demand for flat rolled products is expected to become remarkable in future. Especially, if the plate, whose total demand depends on import at present, is made possible to be supplied locally, the greater part of the large-sized steel shapes will be replaced by the build-up of the plate, and, materials for making large diameter pipes will come to be supplied by the production of plates, thus, the demand for steel plates in 1971 is estimated to amount to 254,000 tons.

3. Expansion projects of the existing steel companies in ROK

(1) The expansion project of the iron and steel industry of ROK may be classified into the following: firstly, the project of an integrated iron and steel mill in Ulsan district by Cho Il Iron and Steel Works; secondly, the project in Inchon of an iron works to produce pig iron by Inchon Steel Co., Ltd., together with the development project of the existing facilities by Inchon Heavy Industry Corporation; thirdly, those projects planned by the existing steel companies. Although it was difficult to know all about the detailed projects of such private companies, we could feel their enthusiasm for expansion in spite of their insufficient funds for construction. Some of the noteworthy projects of such steel companies are as follows: In the section of producing pig iron : the idea of building two blast furnaces, 300t and 500t in capacity, respectively by Sam Wha Iron Works and Dong Kuk Steel Mill, Co., Ltd.; in the section of steel-making : the idea of constructing new electric furnaces by Dong Kuk Steel Co., Ltd., etc.; in the section of making rolled steel products : the idea of constructing a reversing cold strip mills by Ilssin Industrial Co., Ltd. and Union Steel Co., that of manufacturing steel plates and stainless steel sheets by Korea Steel Co., Ltd., and that of building a rolling mill of large and medium-sized steel products by Dong Kuk Steel Co., Ltd.

(2) Some of these projects have already been approved by the government and some are still under consideration, and it is desirable that they will be realized in systematic relationship with each other, at the same time, as one of the links of the integrated iron and steel mill project to develop the iron and steel industry of

ROK in future.

4. Outline of the new integrated iron and steel mill project

(1) We are convinced of the feasibility, though a number of difficulties are conceivable, of constructing a new integrated iron and steel mill in ROK, when we consider the expansion projects of the existing steel companies on the basis of the present situation of the iron and steel industry of the country as well as the estimated demand for iron and steel products in 1971.

It is needless to emphasize the importance of an integrated iron and steel mill as one of the key industries of the contemporary industrialized society. However, in view of the colossal amount of fixed capital necessary for an integrated iron and steel mill which is built on a mammoth scale due to the rapid development of technical innovation, utmost care should be taken lest the national economy should suffer from any adverse influence liable to be caused by miscalculated and ill-considered projects. Furthermore, close attention should be paid to the recent international competition of the iron and steel industry. For this purpose it is necessary to construct an integrated iron and steel mill which can stand international competition by means of supplying products of superior guality for low cost.

Thus, the objectives of the integrated steel mill lay importance on the production of flat rolled steel products as well as the products, such as billets, to be supplied as material to the existing steel companies for lower cost and with superior guality.

(2) The scale of the new integrated iron and steel mill is supposed to be of 500,000 tons on the basis of crude steel for the First Stage, and 1,000,000 tons (based on crude steel production) for the Second Stage. As for the First Stage, in order to avoid competition with the existing steel manufacturers and in consideration of the growth of demand for steel products we have adopted the facilities for a steel plate mill, laying stress on the supply of material (billet) to the existing steel companies and also on the production of various steel plates. The principal items of facilities to be built are as follows: one unit of blast furnace ($1000m^3$), two units of LD converter, one unit of sintering plant, continuous casting installations, a billet mill, a plate mill. As for the necessary iron ore, 30 percent of which is to be supplied from the domestic production, and the rest to be imported. The total amount of metallurgical coke will depend on import.

As for the Second Stage, one blast furnace and one LD converter will be newly added, together with the construction of a coke oven. The plate mill or combination mill will be made to serve a double purpose, that is, made to serve as the rougher of the hot strip mill and also as the rolling mill of the material plate. The hot strip finishing mill with its annexed installations will be constructed. Portions of the hot coil thus produced will be supplied either to the cold rolling mill, which is now

being planned by private enterprises, or to the cold rolling mill to be newly built in this integrated mill during the Second Stage. The cold rolling mill can be built within the site of the integrated iron and steel mill under separate management, in this case it may be run with less expenses than when built outside the integrated mill. The produced hoop will be supplied to the existing plants where electric welded pipes are being manufactured. Portions of the cold rolled sheets produced in the cold rolling mill will be supplied as material to the existing factories of galvanized sheets. Billets produced in the continuous casting mill will be sent to the private steel manufacturers.

Special attention should be paid to the thoroughgoing education and training of the needed operatives and technical staffs and workers by means of measures as perfect as possible. Because the projected integrated iron and steel mill, as compared with the existing facilities, will consist of such facilities of the latest type as will require the most efficient and highest degree of technique of the world today.

(3) A rough estimate of the cost of facilities is about ¥30,000 (millions) for the First Stage and about ¥30,000 (millions) for the Second Stage, amounting to ¥60,000 (millions) altogether; this estimate does not include the cost of constructing the fairways, port facilities and of purchasing the site for the proposed mill and others. The period required for the completion of construction is supposed to be as long as two and a half years respectively for the First and Second Stages, but this term may be cut short to some extent as the case may be.

(4) The above-mentioned division of the First and Second Stages has been temporarily made in consideration of the necessary funds for construction, and the above-said facilities may be either re-considered or properly selected according to such circumstances as the raising of funds, the possible growth of the demand for steel products, further examination of the expansion projects of the existing steel manufacturers, etc. As for the projects supposed to be carried out after the Third Stage, we have made up a layout plan available for the construction of such facilities as performing the surface treatment of steel sheets, rolling steel sections (large and medium-sized), bars and wire rods, and manufacturing steel pipes and tubes, etc.

(5) As for the proposed site of the integrated iron and steel mill, we have visited only Ulsan area , but we consider it desirable for the authorities concerned to come to the final conclusion after deliberate examination and comparison of several sites other than Ulsan area.

The area on the right bank of the Tae Wha River, which was originally proposed to be the site of the integrated steel mill, seems to be too small for the facilities supposed to produce more than a million tons of crude steel, even when considering

its availability apart from the concurrence of circumstances under which the area is proposed also for the site of a fertilizer plant, and, moreover, the soil condition is found to be very soft.

This has led us to the idea of locating the integrated steel mill in the reclaimed land on the left side of the confluence of the Tae Wha River and Dong Chun River together with the area to its north. This area is a vast space extending more than 3.3 million square metres, but the basin at the front of the area and the channel are in danger of being silted and shallowed by the earth and sand washed away from the Dong Chun River by the flood in summer. Another problem is that the soil condition of this site is anticipated to consist of thick layers of soft clay. Such being the case, the following should be urgently under taken :- reexamination of the dredging steps and the harbour construction plan of Port Ulsan, construction of a new port and wharves for the exclusive use of the integrated mill, overall investigation for soil conditions of the site by such means as borings and soil tests. In consideration of the above-said circumstances we have selected the site to locate the integrated iron and steel mill in the scraped land to the northeast of the above-mentioned site and in the area reclaimed with the left-over earth.

5. Recommendations to the government

(1) In order to realize the acceleration of the project of the new integrated iron and steel work as well as the development of the iron and steel industry of ROK it is necessary for the government to make utmost efforts to bring about the co-ordination of activities with the existing steel manufacturers. For this purpose it may be advisable to set up a standing committee or a steel board composed of the representatives of the authorities concerned, existing manufacturers and learned circles especially to deal with the adjustment of the projects of the existing steel companies to the new integrated iron and steel mill project to make the efficient use of funds, and to promote the overall development of the iron and steel industry in ROK.

To give concrete expression to the above-said idea so far as the field of production is concerned: the new integrated iron and steel mill should take special charge of the manufacture of flat rolled products and supply of material, such as billets, of superior quality at lower prices to the existing steel manufacturers, who should concentrate on the production of various bars and sections, and whose material (billet) is supplied from the integrated iron and steel mill, and who should refrain as far as possible from investment in new facilities, while laying stress on that in the facilities for fabricating plates and sheets and in the renewal of obsolete existing equipments, thereby making the best use of the existing installations. Thus, it follows that the expansion projects of the existing steel manufacturers will have to be reconsidered in line with the integrated iron and steel mill, and at the same time, urgent measures should be taken to materialize the integrated iron and steel mill

project, that the total energy of those persons concerned will have to be concentrated. It is also desirable to adjust each expansion project planned by each steel company and make them cooperate with each other, on the other hand, it is necessary to establish a joint organization of technical research and development consisting of all learned persons concerned for the purpose of enhancing the level of technique.

(2) It is scarcely necessary to say that the role to be played by the government in the construction of an integrated iron and steel mill is of utmost importance, for the history of progress of the iron and steel industry in advanced country clearly shows that the powerful protective and promotive measures of the government have been indispensable to the development of this industry which is a key industry of the industrial society.

In view of the above fact, the legislative action of the government is desirable to enact a "law concerning the steel industry". It is necessary by means of such a law to enable the duty-free import of machinery and other equipments required for the construction of the integrated iron and steel mill, and also the exemption from corporation taxes, local rates, other levies, etc. on the integrated iron and steel mill. Moreover, the granting of subsidies and bounties may be made necessary; if circumstances require, the enactment of a "public corporation law" may be studied as a means of promotion regarding the management of the integrated iron and steel mill.

(3) Incidentally, another important factor, which must be taken into consideration, is the correlation with the regional development project which has a great deal to do with the fairway, harbour and port, site, industrial water, electric power, transportation, development of related industries, etc.; that means, the construction of an integrated iron and steel mill requires the repletion of social and indirect capital of wide scope in the region concerned, and, conversely, the integrated iron and steel mill is required to formulate a systematic project of regional development centering round it and including the inducement of related industries to locale nearby together with their development. Therefore, it is required to secure a site wide enough, in due anticipation of its possible development, while avoiding its split into small lots for the use of such industries as have no direct relation to the integrated iron and steel works.

6. Conclusion

We have stated our outlook for the future as well as our review of the present situation regarding the iron and steel industry of ROK. Our conclusion is that the construction of an integrated iron and steel mill is feasible in ROK, although many difficulties mentioned above will have to be overcome. For the embodiment of this project, however, such detailed items as we could not investigate should be studied further by combining all the efforts of specialists together with the ways and means of raising the necessary funds, profitability of the project, balance of foreign currency, etc. On the basis of these detailed studies a final conclusion regarding the feasibility of the integrated iron and steel mill should be worked out.

III. PRESENT DEMAND AND SUPPLY OF IRON AND STEEL

III. Present demand and supply of iron and steel

1. Raw Materials

A. Iron ore

(1) Amount of deposits

The amount of the iron ore deposits in ROK has been quite limited, but, with the progress of prospecting technique, new deposits have recently been found, and the estimated amount has come up to 45,000 (thousands) tons. According to the data of the National Institute of Geological Research, the confirmed amount of iron ore deposits is: in the case of Fe content being over 40% 12,760 (thousands) tons (besides, about 4,000 (thousands) tons of magnetite containing about 15% of TiO_2); in the case of Fe content ranging from 25 to 40% 28,000 (thousands) tons. (Table 3-1 and Fig. 3-1).

Table 3-1 Amount of iron ore deposits in ROK

(As of September 1965) Geological Survey of Korea (unit: ton)

District	Do's	Name of mine	Fe content: over 40%		Fe 25~40%		Sum total	Remarks
			Confirmed amount	Possible amount	Confirmed amount	Possible amount		
Eastern district	Kang won do	Yangyang	1,000,000	1,000,000			2,000,000	M
		Kooryong	400,000	100,000			500,000	M
		Dongnam	200,000	300,000			500,000	M
		Puksam chuk	20,000	30,000			50,000	M
		Wondong	20,000	30,000			50,000	M
		Kangwon	200,000	220,000			420,000	M
		Samchuk 56 #	80,000	100,000			180,000	M
		Samhwa	50,000	50,000	100,000	100,000	300,000	M
		Susuk	50,000	50,000	150,000	150,000	400,000	M
		Sukbyongsan	20,000	30,000	30,000	50,000	130,000	H
		Jeongdong	20,000	30,000			50,000	L
		Yulgok	40,000	60,000			100,000	L
		Hongchun-jaun	1,000,000	1,500,000	9,000,000	13,500,000	25,000,000	M,H
		Total (13 iron mines)	3,100,000	3,500,000	9,280,000	13,800,000	29,680,000	
	Kyong sang Buk do	Kunggok	30,000	30,000			60,000	M
		Punggi			10,000	10,000	20,000	M
		Daenan	50,000	50,000			100,000	H,M
		Monkyong	40,000	40,000			80,000	M
		Daejang			25,000	25,000	50,000	M
		Total (5 iron mines)	120,000	120,000	35,000	35,000	310,000	
	Kyong sang nam do	Mulgum	700,000	800,000			1,500,000	M
		Ulsan	1,000,000	700,000			1,700,000	M
		Kimhae	20,000	30,000			50,000	M
		Haedong	10,000	20,000			30,000	M
		Masan	50,000	70,000			120,000	M
		Yangsung	20,000	30,000			50,000	M
		Samwoo	10,000	20,000	10,000	10,000	50,000	M
		Total (7 iron mines)	1,810,000	1,670,000	10,000	10,000	3,500,000	
Sum total of eastern district (25 iron mines)			5,030,000	5,290,000	9,325,000	13,845,000	33,490,000	

District	'Do's	Name of mine	Fe content: over 40%		Fe 25~40%		Sum total	Remarks
			Confirmed amount	Possible amount	Confirmed amount	Possible amount		
Western district	Chung chung Buk do	Chungju	300,000	200,000	100,000	100,000	700,000	H.M
		Kumgok	100,000	200,000	100,000	100,000	500,000	H.M
		Sanggum	10,000	10,000			20,000	H.M
		Yangsudong	50,000	50,000	30,000	20,000	150,000	H.M
		Samsan	10,000	20,000			30,000	H.M
		Ourae	10,000	20,000			30,000	H.M
		Changdong	30,000	20,000			50,000	M
		Chungpung	10,000	10,000			20,000	M
		Supung			20,000	10,000	30,000	M
		Ipsuk	30,000	20,000			50,000	M
		Yonpung	20,000	10,000			30,000	M
		Okchon	100,000	100,000			200,000	M
		Total (12 iron mines)	670,000	660,000	250,000	230,000	1,810,000	
	Chung chung Buk do	Susan	350,000	350,000	1,750,000	1,750,000	4,200,000	H.M
		Chungyang	10,000	10,000			20,000	M
		Kumsan	10,000	20,000			30,000	M
		Dukyu	10,000	10,000			20,000	M
		Total (4 iron mines)	130,000	140,000	2,000,000	2,000,000	4,270,000	
	Kyung ki do	Kyongin	250,000	150,000			400,000	M
		Sungdong	200,000	200,000	200,000	200,000	800,000	M
		Yonghungdo	20,000	10,000			30,000	M
		Daeya	10,000				10,000	M
		Total (4 iron mines)	480,000	360,000	200,000	200,000	1,240,000	
Sum total of western district (20 iron mines)			1,280,000	1,160,000	2,450,000	2,430,000	7,320,000	
Grand total (45 iron mines)			6,310,000	6,450,000	11,775,000	16,275,000	40,810,000	

Iron mines whose TiO_2 content is over + 15% (average: TiO_2 19% and Fe 49%) (TiO_2 6% and Fe over 60%)

Western district	Kyung Ki do	Soyonpyongdo	3,500,000	500,000			4,000,000	T.M
		Bolumdo	30,000	10,000			40,000	T.M
		Konamsan	30,000	20,000			50,000	T.M
		Total (3 iron mines)	3,560,000	530,000			4,090,000	
Total amount of iron are desposits including such iron are as containing TiO_2 (48 iron mines)			9,870,000	6,980,000	11,775,000	16,275,000	44,900,000	

(Note): M Magnetite, H Hematite, L Limonite, TM Manetite with TiO_2 content

Principal iron ore deposits are found in such iron mines as Yangyang, Susan, Mulgum Ulsan, Chungju Nyongol, and Soiyonpyon-do (Magnetite containing TiO_2).

The greater part of the iron ore deposits consists of magnetite containing much SiO_2; especially the deposits in Yang yang are said to be the largest resources. Such variety of iron ore whose Fe content is over 40% can be charged in blast furnaces after dressing, sizing and sintering treatment.

To use any iron ore whose Fe content ranges from 25 to 40% as charging material in blast furnace is regarded as a question yet to be studied. Recently great deposits of iron ore have been found in Hongchun-jaun, Guanwen-do, and are expected

Map 3-1

MAP SHOWING DISTRIBUTION OF IRON MINES IN SOUTH KOREA

(1965)

SCALE = 1: 2,000,000

20 0 40 80 120 160 200 km

126° 127° 128° 129°

38° 37° 36° 35° 34°

M Z

KANSUNG
KONAMSAN
SUNGDONG
YANGYANG
CHUVCON
JAUN
KOORYONG
JONGDONG
YANGWON
SUSUK
YULSOK
KANGNUNG
SUKBYONGSAN
BOIUMDO
SOYONPYONGDO
SEOUL
SAMHWA
SAMCHUK56
WONDONG
PUKSAMCHUK
KYOUNGIN
DAEYA
WONJU
YONSUDONG
DONGNAM
SUWON
DAEKYO
YONGHUNGDO
CHANGDONG
CHUNG
OUPYUNG
SAMSAN
CHUNGJI
SOOSAN
KUMGOK
OURAE
PUNGGI
SOOPUNG
SEOSAN
CHONAN
YONPUNG
IPSUK
MOONKONG
YONGJU
CHONGJU
DAENAM
DAEJANG
CHONGYANG
TAEJON
OKCHON
DUKYU
KUMSAN
KIMCHON
CHANGHANG
IRI
CHONJU
TAEGO
KYONGJU
ULSAN
HAEDONG
MULGUM
SAMWOO
YANGSUNG
MASAN
KIMHAE
JINJU
KWANGJU
PUSAN
SUNCHON
MOKPO
CHEJO

LEGEND

○ EAST SIDE (25)

⊗ WEST SIDE (24)

Black dots indicate deposits of over 100,000 Tons

%
37°
132°

to be a large source of ore supply pending further investigations, but their exploitation, the means of their beneficiation and the profitability of production are matters which require futher study. It is desirable to urgently perform an investigation of the ore concentration process and of the economical operation of the mine.

The Fe-grade of the above-mentioned ores ranges from 30 to 50% (some of them contain over 60% of Fe as in the case of Mulgum). That kind of iron ore now in practical use as material for the blast furnace either contains over 47% of Fe or its grade has been beneficiated to be more than that by means of pre-treatment.

(2) Production of iron ore

The amount of the iron ore production, as shown in Table 3-2, was less than 200,000 tons in 1957, but with the progress of exploitation of the mines the amount has increased, coming up to 720,000 tons in 1964.

Table 3-2 Annual reocrd of iron ore production and export

(unit: M/T)

Year	Production (A)	Export (B)	(A) - (B)	Rate of export B/A
1957	185,412	130,331	55,081	70.3
1958	261,025	188,647	72,378	72.3
1959	281,641	201,398	80,243	71.5
1960	392,129	234,085	158,044	60.1
1961	499,872	443,818	56,054	88.8
1962	470,744	(363,994) —	(106,750) 470,744	(77.3)
1963	500,752	(549,647) 500,000	(−48,895) 752	
1964	(684,828) 720,000	(586,898) 690,000	(97,930) 30,000	(85.7) 95.8

(Source): Source material of Economic Planning Board
(Note) : Figures enclosed in ( ) indicate those according to Statiscal Yearbook of ROK

As shown in Table 3-3, the quantity of SiO_2 content is remarkable in the table constituents of the iron ore.

In ROK the production of pig iron by blast furnace process counts for little and so does the domestic consumption of iron ore; therefore, 690,000 tons of iron ore, which represent 96% of the total production are exported chiefly to Japan.

Incidentally, the F.O.B. price of the iron ore is as follows:

Lump ore (Fe 56%) : $9.50

Small ore (Fe 60%) : $9.50

Table 3-3 List of constituents of iron ore in major iron mines

Dis-trict	Name of mine		SiO_2	Al_2O_3	S	P	MsO	caO	AS	Cu	Mn	Cr	V_2O_5	TiO_2	Remarks
Eastern district	Yangyang	58.37	14.53	0.60	0.047	0.033	0.20	1.23		0.004	0.04			-	Contact replacement disposits
	Ulsan	45.61	22.04						0.48						"
	Dongnam	56.2		0.67	0.566	0.04	2.03	6.46		0.04	0.54				"
	Ko Do	65.58	4.75	0.84	0.228	0.0013				0.015				0.12	"
	Mankyong	56.9	11.24	0.33	0.081	0.004			0.062	0.011					"
	Kooryong	41.6			0.3	0.04									"
	Hongchun-jaun	33.0	5.18	9.0		0.93	6.20	8.17	0.04	0.06	2.17			Nil	"
	Mulgum	60.02	11.32			0.165			0.005	0.019					Fissure filling disposits
	Samchuk 56#	46.63	35.46								0.02				Alluvial disposits
	Jeongdong	39.08				0.38								0.3	Residual disposits
Western district	Kyongin	61.99	4.88	2.22	0.3	0.023	0.052	0.57	0.015	0.026	0.049			Tr	Fissure filling disposits
	Chungju	58.37	14.53	0.60	0.047	0.033	0.20	1.23		0.004	0.04				Alluvial disposits
	Susan	36.04	47.40	2.12	Tr	0.05	Tr	Tr						Tr	"
	Okchon	55.3	20.56		0.005	0.010					0.22				Contact replacement disposits
	Soyonpyongdo	49.7			Tr	Tr					0.38	0.09	0.09	19.0	Magma differentiation disposits

B. Coke

All of the coal deposits in ROK consisit of anthracite, that means, no deposits of heavy caking coal which are the material of metallurgical coke are found there. The blast furnace is small-sized, and operated chiefely by means of anthracite, and, at the same time, this is also in conformity with the Republic's national policy. But, to employ this variety of coal in large-sized blast furnaces is a question which requires future study. Therefore, the country will have to depend on the import of necessary coke. Incidentally, the import record is: the amount in 1963 was about 18,000 tons and in value $552,000 (of which $542,000 from Japan) and in 1964 about 27,000 tons and in value $820,000 (of which $797,000 from Japan).

By the way bituminous coal is being imported from U.S.A., Australia and Japan, amounting to $1,163 (thousands) in 1963 and $1,333 (thousands) in 1964.

C. Anthracite

The Republic is comparatively rich in anthracite of superion quality. Principal coal mines are Samchuk, Chung sun etc., and their deposits are said to amount to 144 (millions) tons. The production is on the increase each year and at present amounts to ten million tons a year. As we stated above, the use of anthracite in blast furnace is a question yet to be studied. The following is a report for reference on the briquet test of Samchuk anthracite which was made available.

(Information for reference) October 10, 1965

Report on Samchok Authracite Briquets as Blast Furnace Fuel

Technical Institute,
Nippon Kokan K. K.

1. External appearance and sectional structure

The external appearance and the sectional structure of green briquets and carbonized briquets are shown in Photos 1 and 2 respectively. The sectional structure of the carbonized briquets is a little coarser than that of uncarbonized ones, but much more compact than that of ordinary metallurgical coke.

The dimensions are as listed below; the carbonized briquets show little or no shrinkage, while the briquets remained in oven show a little shrinkage probably due to the incineration of the surface.

green briquets:	48.3 x 49.5 x 31 mm
carbonized briquets:	48 x 49 x 31 mm
briquets remained in oven:	40 x 42 x 25 mm

2. Properties

(1) Chemical composition

Table 1 Proximate Analysis (%)

	Moisture	Ash	Volatile matter	Fixed carbon
Green briquets	3.0	12.0	7.5	77.5
Carbonized briquets	2.0	12.4	1.2	84.4
Briquets remained in over	0.8	17.4	1.5	80.3
NKK coke *	1	9～10	0.2～0.9	88～90

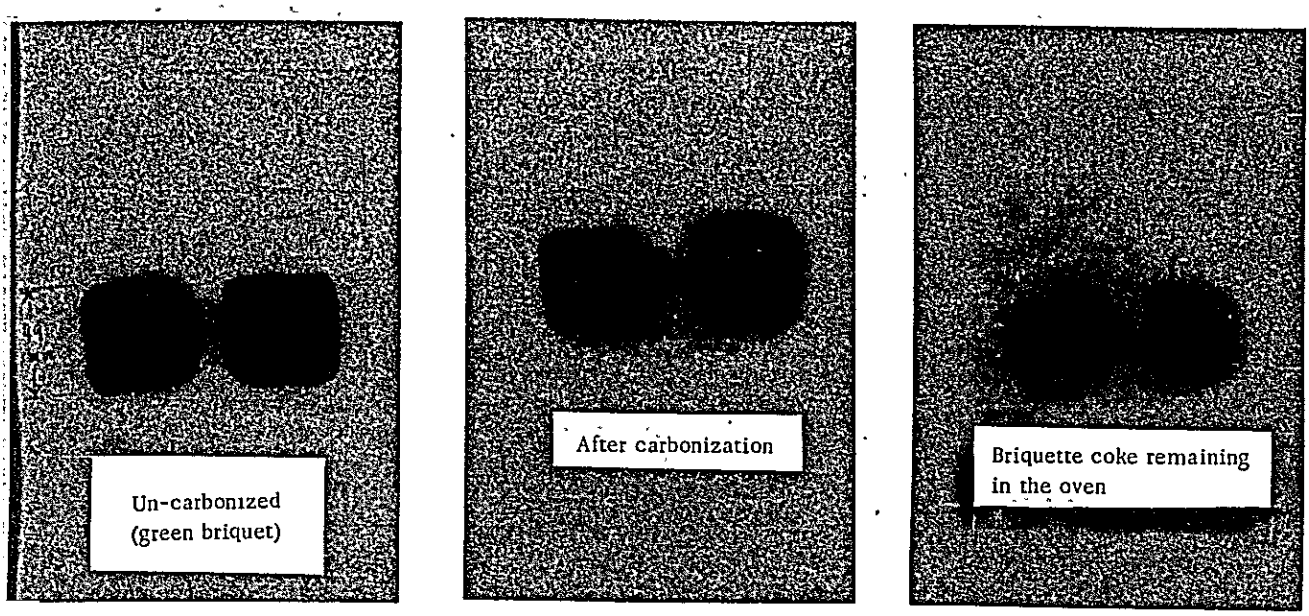
* Ordinary metallurgical coke manufactured and used in blast furnaces at plants of Nippon Kokan Kabushiki Kaisha.

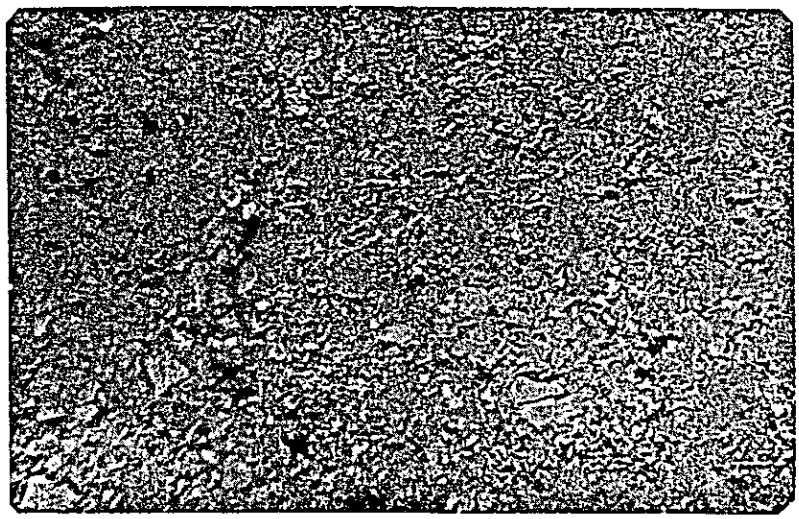
Table 2 Ultimate Analysis (% on anhydrous basis)

	C	H	N	S	O	Ash
Green briquets	85.82	0.41	0.33	0.51	0.26	12.67
Carbonized briquets	83.70	1.22	0.56	0.68	1.43	12.41
NKK coke *	87	0.3	1.1	0.5	0.2	11

* Ordinary metallurgical coke manufactured and used in blast furnace at plants of Nippon Kokan Kabushiki Kaisha.

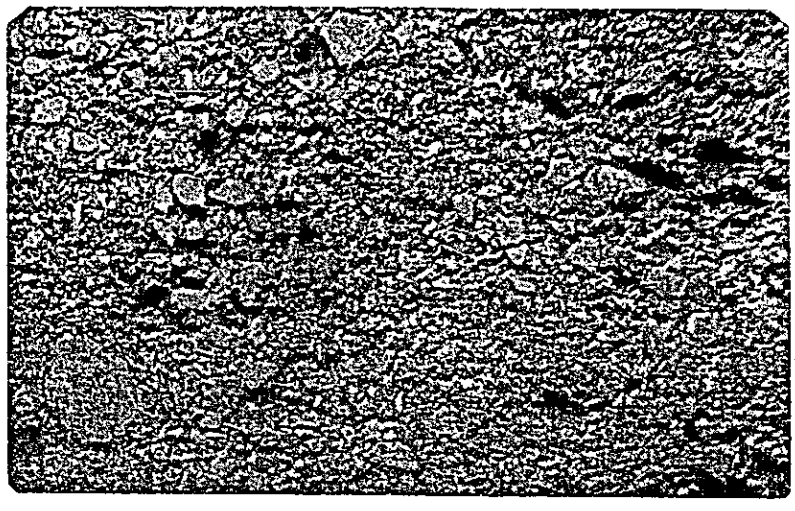
Photograph 1 External appearance





Photograph 2-1

Sectional structure of green briquet



Photograph 2-2

Sectional structure of carbonized briquet

(2) Physical properties

Table 3 Physical properties

試　料	Apparent specific gravity (g/cc)	True specific gravity (g/cc)	Porosity (%)	Compression strength (Kg/cm²)	Micro-strength		Fusing temperature of ash (C)
					14～28 mesh	28～65 mesh	
Green briquets	1.57	1.85	14.8	118.2	6.2	19.1	1256
Carbonized briquets	1.46	1.91	23.8	60.2	12.2	37.4	1262
NKK coke *	0.93	1.95	53.3	96～170	10.0	37.07	1400
Coke of West Germany	0.91	1.92	52.4	—	10.5	38.6	—

* Ordinary metallurgical coke manufactured and used in blast furnace at plants of Nippon Kokan Kabushiki Kaisha.

(3) Weight loss curves of briquets on heating under reducing atmosphere

Weight loss curves obtained by using the thermo-balance are shown in Fig. 1.

3. Discussion

Information about the furnace performance of anthracite briquets substituted for coke in the Bruceton experimental blast furnace (U.S. Bureau of Mines 1962 - 1963) is available, and the present results will be discussed in comparison with the information about the anthracite briquets.

(1) Dimensions and shape

The briquets presently tested had a shape of smoothly curved bipyramid, measuring 50 x 50 mm and 30 mm in height. As will be stated later, one of the disadvantages of the tested briquets is that they are so compact with high bulk density that they tend to reduce the voids in blast furnace; therefore, it would be advisable to make their dimensions and shape similar to those of the iron ore of average grain size in order to secure voids as much as possible when charged in blast furnace.

(2) Chemical composition

As shown in Tables 1 and 2, the chemical composition of the briquets is much the same as that of N.K.K. Coke, except for a slightly higher ash content. Hence, so far as the composition is concerned, there would be no problem for use in blast furnace. Although no chemical analysis of the ash was conducted, Ca and Mg contents are considered to be higher than those of N.K.K. coke in view of its low fusing temperature.

(3) Physical properties

a) Specific gravity

As compared with N.K.K. Coke, the carbonated briquets have much the same true specific gravity, but they have remarkably higher apparent specific gravity i.e. 1.5 times as high. The anthracite briquets used in the Bruceton furnace also had 1.5 times as high apparent specific gravity and it was reported that, when the same fuel rate as that for coke was used, the stock line dropped, the voids in the

blast furnace were reduced, and the tuyere pressure became high, resulting in 'hanging'.

Such is possibly the case with Samchok briquets.

b) Compression strength

The compression strength of the green briquets is remarkably high, but on carbonization it dropped to 60 kg/cm^2 (the structure becomes coarse due to the vaporization of the volatile matter). However, in the case of a 1,000 - ton blast furnace the static pressure is estimated to be 30 kg/cm^2 at the highest, and the above strength will be enough to serve the purpose.

c) Micro-strength

The tumbler test of briquets could not be conducted owing to the scarcity of the sample, and the micro-strength was tested instead. (the latter test showed wear proof to some extent). As shown in Table 3, the strength of the carbonized briquets was as high as or a little higher than that of N.K.K. coke. The micro-strength of the briquets was fairly low, and it is unlikely they can be used in the blast furnace.

(4) Weight loss on heating

As is illustrated in Fig. 1, in the test of carbonized briquets as well as in that of uncarbonized ones, the vapourizing of the volatile matter is completed at about 850°C, and then the weight loss due to solution loss begins. The weight loss is about 3% on heating up to 950°C, while this value for blast furnace coke amounts to about 8%.

The low reactivity of the briquets may be an advantage when used in blast furnace. The figure also shows information about Hamtae anthracite.

4. Conclusion

It might be risky to draw definite conclusions from limited information without tumbler tests, but the following can fairly safely be deduced.

(1) The carbonized briquets made from Samchok anthracite seems to be good for use in blast furnace, judging from their chemical composition and physical properties.

However, since their bulk density is 1.5 times and their porosity is less than half of those of coke, it is quite probable that the blast furnace condition is made poor due to the lack of available voids when such briquets are used as blast furnace charge under the same fuel rate as that for coke is employed.

(2) The compression strength of the green briquets is high, while its wear prool is low, so it may be impossible that the briquets as such are used in blast furnace.

The fact that the fusing temperature of their ash is over 1200°C, and that their reactivity is as high as that of Hamtae anthracite, suggests the possible use of the

briquets as a reducing agent in rotary kilns.

(annex.): Summary of the experiments by the U.S. Bureau of Mines: J.W. Eckerdetal; Report of investigation 6383

The Bruceton experimental blast furnace was operated for 4 periods, or 118 hours using 200 tons of anthracite briquets (by calcining a mixture consisting of 82 parts of anthracite, 10 parts of bituminous coal and 8 parts of coal tar pitch) at 950°C for 30 minutes.

Conclusions

(1) Anthracite metallurgical briquets can be used to replace coke as fuel in the experimental blast furnace.

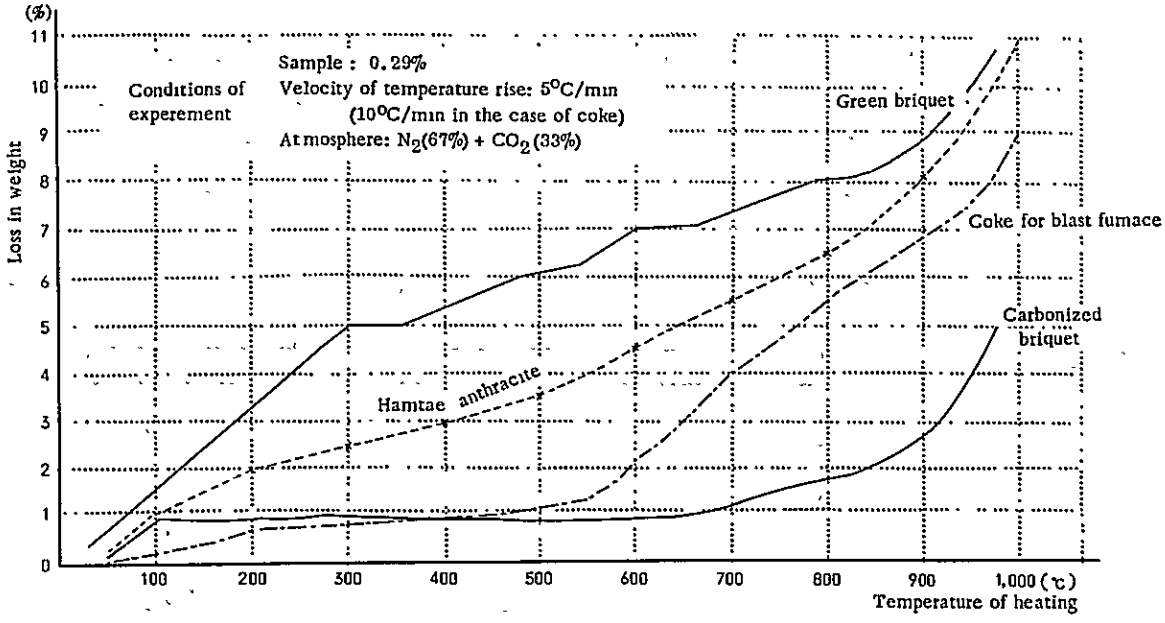
(2) The biquets were not as efficient as coke in these tests. At the same fuel rate, higher blast temperature (about 50°C) was required or, at the same blast condition, the briquet requirement was higher than that for coke.

(3) Anthracite biquets possess the strength and stability required. They will withstand transportation and handling without degradation. In the furnace they moved through the stack with little breakage or size reduction.

(4) For the same slag composition, the sulfur partition ratio appeared to be lower with briquets than with Coke.

(5) Further test work is warranted. It is recommended that a larger supply of less dense briquets be used.

Fig. 1 Curves of loss in weight on heating (reducing atmosphere)



D. Fuel oil

As ROK has no petroleum resources, it had to rely on import for the total amount of its demand for fuel oil until February 1964, when the Ulsan Refinery of the Korea Oil Corporation started its operation, by which nearly all of its demand for petroleum products has come to be met at home to the sharp decrease in their import. The production of heavy fuel oil in 1964 amounted to 420,500 kl; the capacity per day for production is 10,000 barrels (1,590 kl), and the estimated price per kl is 4,610 kwan ($17.10).

E. Limestone

Limestone is one and only of all the raw materials of iron and steel making that can be supplied in the country; it is found almost anywhere, and the amount of its deposits is estimated to be 35,000 (millions) tons, and suitable in quality for the manufacture of pig iron and steel. The production amounted to 1,363 (thousands) tons in 1963 and 2,220 (thousands) tons in 1964; it has been used chiefly as the material of cement.

F. Steel scrap

The consumption of iron and steel in ROK was not much in the past. This accounts for the small amount of the commercial iron and steel scrap which arises from the waste of iron and steel products. However, a large amount of such scrap came into existance as the result of the Korean War on the one hand, and, on the other, a considerable quantity also came to appear as the waste materials of the U.S. Forces. Under the circumstances almost all of the raw material of the present crude steel making depends upon steel scrap.

That is to say, besides using such scrap as the material of re-rolling steel products or of manufacturing steel, some portions of it are consumed in cupola's as the material of reproduced pig iron, which in molten form, constitutes the source of supply to small-sized convesters. However, such casual scrap is gradually being exhausted, and it is considered necessary to strengthen the manufacture of pig iron by ore smelting process.

Table 3-4 Amount of production and import of used iron and steel in ROK

(unit: M.T)

	Production	Import	Import of pig iron
1957	48,856	—	—
58	65,440	—	—
59	108,423	—	—
60	135,392	—	—
61	101,961	—	—
62	204,497	—	—
63	156,058	60,217	3,902
64	100,000	60,000	8,350 (estimated)

(Source) Economic Planning Boad

2. Production

Before the end of the World War II the iron and steel works in Korea were concentrated in Chongzin and Songnim except those in Sanchuk and Inchon. After the end of the war the continued depression of industry prevented an increased production of iron ore, and the demand for steel products was also not so large, that is, it could be met by manufacturing either nails by means of the wire rod in stock or re-rolled steel products by means of scrap iron. Thus, the steel production had to remain stagnant until the outbreak of the Korean War.

After the truce, with the growth of demand for steel products a slight increase in the production was shown by small-scale mills, but no operation of any regular mill was commenced.

A new phase in the development of the industry came in 1956 when Inchon Heavy Industry Corporation (now state-owned) started its operation of steel making in 1957 by means of a repaired 50-ton open-hearth.

To add to the above, Samhwa Iron and Steel Co. began the production of pig iron in 1958 by means of repairing the small-sized blast furnace (capacity: 20 tons per day) in Samchuk which had been left intact since its completion in 1944.

Thus the three sections of the industry, manufacture of pig iron, that of steel and that of rolled steel products came to be operated, though on a small scale.

The production of steel ingots, which was only 143 tons in 1955, has been on the increase since the operation of the open-hearth of Inchon Heavy Industry Corporation; for instance, 17,023 tons in 1957 and 50,051 tons in 1960.

Incidentally, the production of steel bars, which had been 6,100 tons in 1955, increased to 25,049 tons in 1958 and to 44,597 tons in 1960.

Investment in the facilities of private steel making enterprises has been also going on since some time in 1962 to produce hot rolled steel sheets and steel pipes, but all of them remain in a small way with the following production in 1963: 6,405 tons of pig iron (5,426 tons according to the Statistical Yearbook of EPB); 160,053 tons of steel ingot; 225,538 tons of steel products (including galvanized sheets of imported black sheets).

Thus, with the development of the Second Five Year Plan (1961 - 1966), the production of steel products has been on the increase, but the amount is small in comparison with the capacity of the facilities, whose operation rate being only 80% in crude steel and 28% in hot rolled steel products.

This may be due not only to the circumstances on the demand side but also to the insufficiency of necessary funds and to the difficulty of acquiring the raw material which is a great obstacle in the way of production. There seem to be some problems in the maintenance and adjustment of the facilities of production, in the matter of technical know-how together with the annexed equipments.

Table 3-5 Trend of production of iron and steel in the Republic

(unit:MT)

	1960	1961	1962	1963
Pig iron	4,829	13,827	9,106	6,405
Reproduced pig iron	870	1,072	1,336	1,318
Steel ingot	50,051	66,181	148,401	160,053
Steel shape	6,380	2,899	8,160	16,758
Steel bar	44,597	32,480	62,255	84,463
Wire rod	20,691	11,454	7,943	20,861
Steel sheet	12,310	7,948	22,832	25,364
Steel pipe and tube	4,690	5,053	9,661	13,892
Total	88,668	59,834	110,851	161,338
Cast iron pipe	—	—	4,449	6,241
Cast and forged steel	2,355	2,095	1,623	1,399

(Source) Ministry of Commerce and Industry

(Note) Figures of the steel bar, pig iron and steel ingot respectively for 1962 and 1963 are different from those of the Yearbook published by the Bank of Korea.

There are no facilities for the manufacture of such steel products as steel plates, heavy shapes (rail and sheet pile), hoop, and wide strip, which are all imported. The instalment of such facilities is a question to be taken into consideration in view of the possible increase in demand in future.

3. Facilities for production

A. Pig iron section

The existing facilities for the production of pig iron consist of eight small-sized blast furnaces, with nominal capacity of 20 tons per day for each, belonging to Samhwa Iron & Steel Co., and also a small 100-ton (nominal capacity) blast furnace, which has been recently built, belonging to Dong Kuk Steel Mill Co., Ltd.

The former were constructed during the Warld War II as wartime expedients and left intact for about ten years after the end of the War. Two units of them are now in operation, one for the production of pig iron for steel making by Inchon Heavy Industry Corporation, and the other, for that of foundry pig iron. Each blast furnace is 44 m^3 in inside measurement, and its highest record of production is said

to be 40 tons per day, which may be on the average 35 t/d, or about 10,000 tons a year. Two more units are starting their operation in near future; with four units in operation the capacity will be 40,000 tons per year, which may approximately reach its limit in view of the capacity of the annexed equipments and transport. The iron ore is domestic one produced in the mines including Yangyang; as for the fuel, the coke (representing about 40% of the total fuel) is imported from Japan together with the anthracite produced in the country; the high cost of the imported coke is a problem. Incidentally, a test operation is going to be performed in near future by means of home-made coke (a mixture of 90% anthracite and 10% coal tar pitch sintered at 900°C); which has been tentatively made by Inchon Heavy Industry corporation for the purpose of utilizing national resources.

The small-sized 100-ton blast furnace of Dong Kuk Steel Mill Co. was just constructed in August 1965. It is in operation now by means of a mixed fuel consisting of 60 - 70 % anthracite and 30 - 40 % Coke; its product, or molten pig iron, is for the company's own small converter. Although its real capacity per year is estimated to be 30,000 - 40,000 tons, it still remains in the stage of trial production; accordingly, its real capacity by means of the existing facilities alone is considered to be about 70,000 - 80,000 tons per year in future.

In addition to the above, ROK has a number of cupolas charging iron scrap as their material, the product of which is directly connected to small-sized converters to be used as steel making material.

B. Facilities for steel making

The yearly capacity for steel making by means of the existing facilities in ROK is 90,000 t by open-hearth, 116,000 t by small convertor, and 34,000 t by electric furnace, amounting to 240,000 in total.

As for the open-hearth, there are one 50-ton open-hearth of Inchon Heavy Industry Corporation and two more small-sized ones. The former, though its nominal capacity is 50t, is available for a charge of 70t, having a record of producing 70,000t a year, and the result of its performance is also good. The fuel depends exclusively on heavy oil, but no oxygen is used in its operation. (an oxygen plant is now being planned.).

As for the converter, there are small-sized ones, each with capacity of 3 - 4 t, in eight places. All of them are of side blow and acid type combined with cupolas which make molten pig iron from steel scrap; they may be called efficient facilities for utilizing the cheap iron scrap arising out of the war-damaged establishments, neglecting for a while the question of the quality of their products. In this connection we are afraid that there will be a problem concerning the cost of material when the above-said iron scrap has been exhausted and the purchase of cheap iron scrap becomes difficult.

As for the electric furnace, there are ten units in all, including the 10t electric furnace belonging to Pusan Iron Works. They are all small-sized ones with capacity ranging from 2 to 5t, except that of Pusan Iron Works and are for the manufacture of cast and forged steel.

C. Facilities for manufacturing rolled steel products

The greatest majority of the facilities for manufacturing rolled steel products are represented by those of small-sized steel bars, besides a small number of those making medium-sized bars, wire rods, steel sheets, and pipes and tubes. Generally speaking, too much stress is laid on the facilities of various steel sections, while only a little attention is paid to such flat rolled products as plates and hoops.

(1) Facilities for medium-sized products

The rolling mill for bloom and medium-sized products (commenced operation in December 1959) of Inchon Heavy Industry Corporation has a capacity of 100,000t per year, the greater part of which is appropriated for the manufacture of billets and sheet bars either for the company's own consumption or for commercial purposes, while the manufacture of such finished products as angles and channels only amounts to about 3,000t per year.

In addition to the above, there is a small-scale mill with a capacity of 10,000t per year of medium-sized products.

(2) Facilities for small-sized products and wire rod

As for the facilities for small-sized products the number of comparatively small-scale rolling mills amount to about forty, the greater part of which are concentrated in Seoul and Pusan districts. Their total capacity per year is 400,000t; over half of such mills are re-rolling mills without steel making facilities; their production per year amounts to 120 - 130 (thousands)t, nearly 40% of which are shared by such re-rolling mills.

Quite recently Dong Guk Steel Co., Ltd. has completed a mill of wire rods and medium-sized products whose capacity per year is said to be 50,000 - 60,000t; this is one of the most up-to-date facilities of ROK, but still in the stage of test operation.

(3) Facilities for steel sheets

As for the facilities for steel sheets, mills of pull-over type are being operated by Korea Steel Co. and Inchon Heavy Industry Corporation; they have capacity per year of about 50,000t, and are presumably producing about 30,000t a year altogether. Besides, Dae Dong Steel Co. is operating a two-high mill of narrow medium plates. Galvanizing equipments of cut sheet type are installed in Dong Kuk Steel Mill Co. and Ilssin Industrial Co. in addition to those in Inchon Heavy Industry Corporation and Korea Steel Co., Ltd., Tin plates are manufactured by Don Yang Tin Plate Co., Ltd.

(4) Other facilities

As for the facilities for manufacturing pipes and tubes, those of electric welded pipes, whose capacity per year is 70,000t are found in such places as Seoul, Pusan and Daegu; they are fairly superfluous as against the actual demand for the products, which amounts to about 20,000t a year.

There is also in Pusan a unit of centrifugal casting machine of cast iron pipe whose capacity per year amounts to 15,000t.

In addition to the above and in the section of ferro-alloy, the facilities for ferromanganese with capacity per year of 2,500t are in Yongdongpo, and those for ferrosilicon with capacity per year of 5,000t in Samchuk.

Table 3-6 Existing facilities for iron and steel making in ROK

A. Facilities for production of pig iron and ferro-alloy

Classification of furnaces	Name of exterprise	Location	Facilities	Capacity per year (ton)	Products
Blast furnace	Sam Wha Iron Works	Samchuk	Small-sized blast furnace 30t x 8	72,000	Pig iron
"	Dong Kuk Steel Co., Ltd.	Pusan	" 100t x 1	36,000	"
Electric furnace	Han Kuk Electrical Metallurgy Co., Ltd.	Yong Dong Po	Electric furnace 2000KVA x 1 " 8 Con x 1	2,500	Ferromanganese
"	Samchuk Ind. Co., Ltd.	Samchuk	" 6000KVA x 2	5,000	Ferrosilicon

B. Steel making facilities

Vlassification of furnace	Name of enterprise	Location	Facilities	Capacity per year (ton)	Products
Open hearth	Inchon Heavy Industry Corporation	Inchon	Open hearth 50t x 1	75,000	Steel ingot
	Dal Han Iron Works	Yong Dong Po	" 10t x 1	10,000	"
	Inchon Iron Works	Inchon	" 6t x 1	5,000	Steel ingot Steel castings
	Total			(90,000)	
Converter	Dal Han Heavy Machine Ind. Co., Ltd.	Yong Dong Po	Converter 3t x 2	12,000	Steel ingot
	Han Kuk Steel Co.	Inchon	" 3t x 2	12,000	"
	Seoul Steel Co., Ltd.	Seoul	" 3t x 2	12,000	"
	Han Kuk Industrial Co., Ltd.	Inchon	" 3t x 2	12,000	"
	Zion Steel Co., Ltd.	Yangju	" 3t x 2	12,000	"
	Han Chang Sim Chul Co., Ltd.	Pusan	" 3t x 2	12,000	"
	Dong A Iron Works	Pusan	" 3t x 2	12,000	"
	Dong Kuk Steel Co., Ltd.	Pusan	" 4t x 4	32,000	"
	Total			(116,000)	

Vlassification of furnace	Name of enterprise	Location	Facilities	Capacity per year (ton)	Products
Electric Furnace	Dal Han Heavy Machine Ind. Co., Ltd.	Yong Dong Po	Electric furnace 3t x 1, 15t x 1	2,400	Steel Castings, Forged Steel Products
	Pupyong Steel MFG. Co., Ltd.	Inchon	" 3t x 1	1,800	Malleable Steel Products
	Korea Shipbuilding & Engineering Corp.	Pusan	" 2t x 1	1,400	Steel Castings, Forged Steel Products
	Seoul Works of Railway Bureau	Seoul	" 2t x 1	1,400	Steel Castings, Steel ingot
	Ichun Electrical Machinery Industrial Co., Ltd.	Inchon	" 2t x 1	1,400	"
	Hon Kuk Power Machinery Co., Ltd.	Oryudong	" 2t x 1	1,400	Steel Castings, Steel ingot, Forged Steel Products
	Han Kuk Machine MFG. Co.	Inchon	" 5t x 3t x 1	4,500	Steel ingot.
	Pusan Iron Works	Pusan	" 12t x 1	20,000	
	Total			(34,300)	
	Grand Total			240,000	

C. Facilities for rolling steel products

	Name of enterprise	Location	Facilities	Capacity per year (ton)	Products
Blooming mill and rolling mill of medium-sized products	Inchon Heavy Industry Corp.	Inchon	680 m/m 3 - high 1 unit 500 " 3 " 3 "	100,000	Billet, Sheet bar, Bar, Shape
Rolling mill of medium-sized products	Dal Han Iron Works	Seoul	500 " 3 " 3 "	10,000	Billet, Bar, Shape
Rolling mill of small-sized products	Seoul Steel Co., Ltd.	"	300 " 3 " 5 "	10,000	Bar
	Dal Han Iron Works	"	300 " 3 " 4 "	10,000	Bar, Shape
	Dal Han Heavy Machine Ind. Co., Ltd.	"	300 " 3 " 4 "	10,000	Bar
	Dong Kuk Steel Co., Ltd.		260 " 3 " 2 " 300 " 2 " 6 " 360 " 2 " 6 "	20,000	Bar, Wire Rod
	Sam Kang Steel Co., Ltd.		300 " 3 " 4 " 230 " 3 " 5 " 204 " 3 " 5 "	15,000	Bar, Shape, Wire rod
Rolling Mill of small-sized Products	Dong IL Steel Co., Ltd.	Seoul	320 m/m 3 - high 3 unit 240 " 3 " 5 "	9,000	Bar, Wire rod
	A. Fu Sin Chul Co.		200 " 3 " 3 " 230 " 3 " 6 "	9,000	Bar, Shape
	Yong Dong Po Sim Co.	"	300 " 3 " 2 " 250 " 3 " 4 " 200 " 3 " 4 "	9,000	Bar, Shape, Wire rod

Name of enterprise	Location	Facilities	Capacity per year (ton)	Products
Inchon Heavy Industry Corporation	Inchon	300 " 3 " 5 "	15,000	Bar
Han Kuk Steel Co.	"	500 " 3 " 2 " 300 " 3 " 7 "	20,000	Bar
Han Kuk Industrial Co., Ltd.	"	300 " 3 " 2 " 250 " 3 " 4 " 200 " 3 " 4 "	15,000	Bar
Inchon Steel Co.	"	250 " 3 " 2 " 200 " 3 " 6 "	10,000	Bar, Shape
Han Kuk Machine MFG. Co.		250 " 3 " 7 "	9,000	Bar
Dae Dong Steel Co.	"	250 " 3 " 3 " 200 " 3 " 5 "	9,000	Bar
Cho Sun Steel Co.	"	300 " 3 " 3 " 250 " 3 " 5 "	9,000	Bar, Shape, Wire rod
Inchon Steel Co.	"	350 " 3 " 2 " 300 " 3 " 5 "	9,000	Bar
Dong Bang Steel Co.	"	400 " 3 " 7 "	9,000	Bar
Choong Wang Sin Chul Co.	"	250 " 3 " 5 "	9,000	Bar, Shape
Inchon Sin Chul Co.	"	210 " 3 " 4 "	3,000	" , "
Sin Hung Steel Co.	"	210 " 3 " 4 "	3,000	Bar
Sung Nam Sin Chul Co.	"	240 " 3 " 4 "	3,000	Bar
Sin Hung Sin Chul Co.	"	205 " 3 " 3 "	3,000	Bar
Kyong il Sin Chul Co.	"	225 " 3 " 3 "	3,000	Bar
Kum OK Steel Co.	"	225 " 3 " 3 "	3,000	Bar
Kuk Dong Steel Co., Ltd.	"	360 " 3 " 3 " 250 " 3 " 4 " 250 " 3 " 4 "	20,000	Bar, Wire Rod
Dae Han Sang Sa Co.	"	260 " 3 " 3 " 250 " 3 " 4 " 250 " 3 " 4 "	15,000	" , "
Han Chang Sin Chul Co., Ltd.	"	338 " 3 " 3 " 204 " 3 " 7 "	15,000	Bar, Shape
Pusan Metallurgy Co.	"	205 " 3 " 5 " 205 " 3 " 8 "	9,000	" , "
Dong il Industrial Co.	"	305 " 3 " 3 " 230 " 3 " 7 "	9,000	" , "
Ko Ryo Steel Co.	"	200 " 3 " 5 "	9,000	Bar
	"	250 " 3 " 7 "	7,000	"
Tae Yong Sin Chul Co.	"	200 " 2 " 3 "	3,000	"
Cho Sun Sin Chul Co.	"	200 " 3 " 5 "	3,000	"
Seoul Steel Co., Ltd.	"	300 " 3 " 5 "	10,000	"
Dae Ku Sin Chul Co.	Dae Ku	200 " 3 " 4 "	3,000	"
Dong A Sin Chul Co.	Pupyong	200 " 3 " 3 "	3,000	"
Total (Rolling Mill of Small-sized products)			(490,000)	

	Name of enterprise	Location	Facilities	Capacity per year (ton)	Products
Rolling mill of Wire rod	Dong Kuk Steel Co., Ltd.	Pusan	500 m/m 3 - high 2 unit 300 " 2 " 6 " 270 " 2 " 6 "	60,000	Bar, Wire rod
	Inchon Heavy Industry Corporation	Inchon	750 " 2 " 2 "	10,000	Steel Sheet
	Korea Steel Co., Ltd.	Seoul	750 " 2 " 3 "	36,000	"
	Dae Dong Steel Co.	Inchon	500 " 2 " 2 "	6,000	Medium Plate of Narrow width

(Source): Ministry of commerce and Industry as of September 1965

4. Market

A. Demand for steel products

The total production per year of steel products of ROK is about 225 (thousands) tons, hot rolled steel products of which representing about 150 (thousands) tons, while the import amount to about 210 (thousands) tons and the export to about 70 (thousands) tons; so, when striking a balance, about 290 (thousands) tons will represent the yearly consumption of steel products (statistics for 1963).

These figures are fairly over the estimate made at the time of formulating the First Five Year Plan.

The greater part of the demand for steel products comes from the section of construction works. At such an early stage of developing heavy industry as that of ROK it is quite natural that a comparatively small quantity of steel products should be consumed as the raw material of industry as against the high ratio of their use in the construction of public utilities (roads, waterworks, bridges, etc), industrial facilities, and skycrapers.

Accordingly, nearly half the consumption is for construction works, and the rest of the consumption is often for the manufacture of such metal products as nails, wires, various containers, etc.

The principal items of the demand for steel products are as follows: -

(1) Shipbuilding: The shipbuilding industry of the country used to do chiefly the repair work of vessels, but it has recently begun to build new ships to complete yearly two cargo boats of 2,600 G. T. class, two oil tankers of 700 G. T. and more than ten ocean fishing boats of 215 G. T.

Eighty per cent of the steel products used for the above consist of

steel plates about 6 - 15 mm in thickness and those of about 20 mm in thickness represent approximately 15% of the total steel plates; their size is 5 x 20 ft. The whole of the steel products for shipbuilding use is imported. (about 10,000t a year)

(2) Automobiles:

There are matorcar factories producing passenger cars under technical cooperation with foreign countries, but the number of cars produced is very small.

The greater part of the automobile industy consists in repair shops, where, besides repairing military cars, buses and microbuses are produced by making use of the chassis of such military cars as disposed of by the government, the plate work being done by hand.

Under the circumstance, accordingly, there is no regular demand for steel products in this industry.

(3) Electrical machinery:

The inport of finished articles of this item, except in special cases, is not approved by the government, and the domestic production of motors, transformers, including electric machines for household use is now being promoted. But the amount of its production is not much yet, and, moreover, there is no production of heavy electric machinery with large capacity, besides, the frames of electric motors are made of cast iron. Such being the case the demand of this branch industry for steel products consists principally of steel sheets and silicon sheets (the total amount of the silicon sheets depends on import).

(4) General machinery:

As chemical plants, equipments and apparatuses including chemical machines are all imported, there is no demand for heavy steel products in this field.

As for the prime mover, some number of marine diesel engines and ground ones are being produced, but no motorcar engines.

The standard of boiler making is not more than that of heating boilers of low pressure, whose tubes are home-made ones which are cold drawn (electric welded carbon tubes which are cold drawn). High-grade pipes are imported.

As for the fibre machinery, looms are nearly home-made, but spinning and printing machines are imported.

Construction machines are all imported, and there are only repair shops for them.

Agricultural machines belong to that branch of industry whose increase in production is most urgently needed at the present moment; the production of straw rope twisting machines, threshers, pumps and sprayers is on the increase.

The manufacture of agricultural instruments attaches importance to those used by hand, but the relative importance of the steel products centering round sheets and plates of medium thickness is comparatively high.

(5) Bicycle:

As motorcars have not yet come into popular use, the spread of bicycles and rear-cars, as means of travel of short distance and transport of small quantity of goods in farming villages, is being encouraged also from a viewpoint of national policy. The number of bicycles produced has increased rapidly: 53,118 in 1961, 86,085 in 1962, 105,010 in 1963 and 154,620 in 1964. Although the low level of individual income is preventing the popularization of bicycles, we may place our hope on this branch of industry.

(6) Rolling-stock:

High-grade carriages, such as locomotives, are imported, but home manufacture of freight cars is advanced, which makes large the demand for steel products used for building new waggons and reparing old ones by the Repair Section of the Korean National Railway Bureau.

(7) Construction work:

As earthquakes are rare and so are large scale plants in ROK, the consumption of steel products in the construction field consists chiefly in steel bars with less relative importance of such heavy steel products as steel plates and shapes. However, this may be attributed to the fact that the dependence on import for the entire quantity needed makes it difficult to acquire them, and their high price extremely restricts their use. On the other hand, the demand for them is considered large, if we take into account the reinforced concrete in replacement for such heavy steel products and their substantial consumption in the form of factory structures attached to imported plants.

In view of the large amount of timber imported yearly because of its scarcity in the country we may anticipate latent demands of a considerable quantity for light gauge steel products.

Steel pipes of large diameter for use in the construction of water-works and sewages are being produced by means of working imported steel plates by bending roll process. It seems, however, that the present construction works often consist of those of low load, and concrete pipes are often employed.

Town gas is not widely used now because of the extensive use of anthracite briquets as heat source for both household Korean heaters and cooking stoves. This is the reason for the use of carbon steel pipes for ordinary piping mainly in the steam heating and feeding and drain work of buildings.

B. Price

Prices per ton of important steel products are as follows: -

Billet: ₩ 25,000 - 30,000 ($92.60 - $111.10 at $1.00 = ₩ 270)

Sheet bar: ₩ 27,100 ($100.40)

Concrete bar: ₩ 24,400 ($90.40)

Round bar (medium and small size) : ₩ 26,500 - 26,840 ($98.10 - $99.40)

Angle (medium and small size) : ₩ 36,500 - 28,500 ($98.10 - $105.60)

Other shapes : ₩ 31,800 ($105.60)

Sheet (0.26 - 3.2 mm) : ₩ 48,000 - 56,200 ($177.80 - $208.10)

Market prices offered by private manufactures to private customers are little higher than above: for sheet bars at ₩ 31,000 ($114.80)

C. Inport and export

According to the trade yearbook compiled by the International Trade Association of ROK the import of steel products classified by varieties is as shown in Table 3-7, most of them being imported from Japan.

As for export, 46,663 tons of galvanized sheet in 1963 and 12,827 tons in 1964 together with the secondary products of wire rod, such as nail, have been exported mainly to South Viet-Nam; this is a special export financed by the A.I.D. aid fund of South Viet-Nam.

Table 3-7 Trend of import of steel products in ROK

	1962		1963		1964	
	Amount	Value	Amount	Value	Amount	Value
	M/T	$1,000	M/T	$1,000	M/T	$1,000
Pig iron, Sponge iron	12,041	1,485	—	—		
Ferro-alloy	5,471	938	4,855	866	3,130	582
Steel ingot (semi-finished product)	1,489	199	44,421	3,714	25,611	2,485
(Bars and shapes)	19,843	2,441				
Wire rod	2,534	253	10,001	1,000	1,627	207
Bar	2,179	460	14,521	2,027	9,264	1,165
Shape over 80mm	11,888	1,448				
under 80mm	3,244	261				
Flat rolled product (plate and sheet)	64,157	8,808	149,424	12,215	42,282	4,512
Hoop	18,648	2,754	25,463	2,544	63,536	2,284
(Rail and attachments)	17,064	2,404				
Rail	9,231	1,286	1,274 17,035	273 2,381	490 3,245	118 397
Steel wire	5,664	1,330	4,561	695	2,443	519
Steel pipe, cast iron pipe and attachments	12,909	2,179	15,522	6,219	2,595	1,387
others				525		1,218
Cast and forged products	978	215				
Total		26,461		32,459		14,844

(Source): Yearbook of international trade compiled by the International Trade Association of ROK; Statistics of International Trade for 1965 published by the Bank of Korea.

IV. STEEL DEMAND FORECAST

IV. Steel Demand Forecast

1. Methodological outline

A. In the following investigation about the steel demand in the Republic of Korea, we made its forecast mainly by the method of stacking the individual demands in the classification by consuming market and by steel products. With a view to confirming the above figures, on the other hand, we have attempted a macroscopic approach, the forecast of apparent consumption of crude steel as a whole, from the correlation to the fixed capital formation in the Gross National Expenditure. Those are due to our consideration that the conclusion of our investigation will be based on hereafter for the actual construction plan of the integrated steel mills, and, for that purpose, the demand forecast by steel products will be as essential as that of crude steel total. The concluding figures are given below, and here we have adopted the result of the stacking work.

Estimate of demand by stacking method

	1963	1971	71/63
Crude steel basis	497,100 M/T	1,13900 M/T	229.1%

Estimate of demand by macroscopic method

	1963	1971	71/63
Crude steel basis	497,100 M/T	1,102,500 M/T	221.8%

Notes: Demand indicates apparent consumption, that is, production plus import, minus export, adjusting the duplication of conversion materials.

B. Characteristics of working method

(1) The peculiar points in the work by stacking method consist in the following two items:

a. In fixing the levels of consumption of steel products in basic 1963, we did not utilize the published figures, but stacked the individual data through our actual survey; and there we added the consumption of such used steel, reproduced pig iron and castings as should have been replaced by steel products under normal conditions, converting them into steel products (listed below).

Consumption pattern of steel products in ROK (1963)

(M/T)

	Ship-building	Automo-biles	Rolling-stock	Bicy-cles	General machinery	Electric machinery	Metal products	Containers	Construction	Total	%
Rails	–	–	–	–	–	–	–	–	(500) 18,800	(500) 18,800	5.0
Sheet piling	–	–	–	–	–	–	–	–	1,000	1000	0.3
Shapes	(400) 1,900	200	(100) 600	–	(600) 2,900	100	–	–	(5,400) 27,100	(6,500) 32,800	8.7
Bars	250	(600) 5,600	(200) 1,600	(200) 1,900	(1,100) 10,600	200	(1,200) 11,200	–	(6,700) 64,550	(10,000) 95,900	25.4
Wire rods	–	–	–	–	–	–	24,400	–	–	24,400	6.5
Plates	(5,600) 15,100	(1,100) 2,300	(5,000) 13,100	–	(6,600) 13,800	(100) 300	(5,000) 5,000	(700) 1,200	(6,300) 24,400	(43,100) 76,800	20.3
Sheets	(700) 3,300	(800) 4,300	(900) 5,900	(900) 1,600	(2,700) 10,800	(1,000) 7,000	(10,300) 17,500	(2,800) 7,800	(3,000) 8,000	(23,400) 67,800	18.0
Galvanized sheets	–	–	–	(1,200) 3,200	–	–	(800) 5,800	500	(2,200) 14,400	(3,000) 20,700	5.5
Tin plate	–	–	–	–	–	–	–	1,500	–	1,500	0.4
Silicon sheets	–	–	–	–	–	2,000	–	–	–	2,000	0.5
Hoop	–	–	300	1,400	2,100	300	1,200	–	–	5,300	1.4
Pipe	650	300	800	(300) 1,500	(500) 2,600	100	(500) 1500	500	(8,200) 21,750	(9,500) 29700	7.9
Tyres	–	–	500	–	–	–	–	–	–	500	0.1
Grand total	(6,700) 21,200	(2,500) 12,700	(6,200) 22,800	(2,600) 9,600	(11,500) 42,800	(1,100) 10,000	(17,800) 66,600	(3,500) 11,500	(44,100) 180,000	(96,000) 377,200	100.0

(Notes) 1. The amount of consumption classified by markets are based on the actual survey.

2. ( ) means the amount of steel products sustitutive for used steel, reproduced pig iron and iron castings, namely, a quantity supposed to be used as steel products under normal conditions, each included below.

3. The composition of products in respective market is based on the result of investigation; some parts unknown have been estimated by referring to the case of Japan.

4. As to the classification by markets, we have classified it by use of steel. For instance, in the case of shipbuilding, the steel products which were consumed in a shipyard for constructing a building or a dock are classified under a category of construction; and those for the manufacture of machinery comes under that of general machinery; therefore, the steel products to be classified under shipbuilding are limited to those used either for the purpose of shipbuilding or repairing.

b. In order to estimate the growth rate of steel demand in each steel-consuming industry, we relied, as a rule, on the result of our survey, but, in the case where the estimate got was uncertain, we had to recourse to the trend curves which were drawn by referring to the growth of the corresponding industries and products concerned in Japan during the postwar period 1948 - 1955.

Balance of demand and supply of steel in ROK (1963)

	Production (A)	Import (B)	Total supply (C)=(A)+(B)	Converting and processing material (D)	Export (E)	Domestic demand (F)=(C)-(D)-(E)
Rails	–	18,309	18,309	–	–	18,309
Sheet piling	–	1,000	1,000	–	–	1,000
Shapes	16,758	9,829	26,587	–	329	26,258
Bars	84,463	2,110	86,573	–	665	85,908
Wire rods	20,861	14,953	35,814	–	11,420	24,394
Plates	–	34,627	34,627	–	960	33,667
Sheets	25,364	82,281	107,645	+35,058 △62,800	3,537	44,366
Galvanized sheets	62,800	1,000	63,800	–	46,100	17,700
Tin plates	1,400	100	1,500	–	–	1,500
Silicon sheets	–	2,000	2,000	–	–	2,000
Hoop	–	25,447	25,447	* △35,058 △14000	3,071	5,318
Pipe	13,892	8,851	22,743	–	2,534	20,209
Tyres	–	500	500	–	–	500
Carbon steel products	225,538	201,007	426,545	△76,800	68,616	281,129
Special steel products	–	5,545	5,545	–	–	5,545
Total	225,538	206,552	432,090	△76,800	68,616	286,674
Ingot and semi-finished products	160,053	54410	214,463	195,994	13,722	4,747
Cast and forged steel	3,707	34	3,741	–	845	2,896
Amount converted into crude steel (the same per capita)						372,100 13.7Kg
Cast iron pipe	6,241	5,179	11,420	–	70	(6,400) 11,350
Iron castings	52,000	49	52,049	–	25	(24,000) 52,024
Used steel, (Waste utilized)						74,700
Amount converted into crude steel (including demands) (the same per capita)						497,100 18.2Kg

* Appropriated for sheets

(Notes) 1. The amounts of production, import and export are respectively based in principle on the "Inclusive plan for developing iron and steel industry" by the Economic planning Board of ROK: some figures have been made out by referring to "Statistics of World Trade in Steel" published by the Japan Iron and Steel Federation", and parts have been estimated.

2. In the column 'Deduction for converting and processing material' ' sheets' represent the material for galvanized sheets and 'hoop', the material for pipes and sheets; their amounts are all estimated.

3. Figures enclosed in ( ) at 'Cast iron pipes; Iron castings' represent the amount of substitutive steel products and included below; the loss of weight by conversion is allowed at about 30%. (Thus, the amount of conversion including that of the used steel comes up to 96,000 tons of steel products, and it is estimated to be 125,000 tons in terms of crude steel).

(2) Macroscopic method

It is regarded as an international method to estimate a future scale of apparent consumption of steel from the macroscopic correlation to GNP. But in this case, we have made its forecast from the connection with the fixed capital formation in GNE. This is quite a new approach from international comparison by countries through the coefficient of apparent steel consumption per unit fixed capital formation. This is due to the fact that steel demand has a direct influence on the sum of direct investment in fixed capital goods, and the density of steel consumption in fixed capital formation gets larger as a country advances.

2. Outline of the result of steel demand forecast

A. Summary

	1963	1971	71/63
Carbon steel products	377,200 M/T	877,900 M/T	232.7
Special steel products	5,500	15,000	272.3
Cast and forged steel	2,900	10,000	344.8
Total products	385,600	902,900	234.2
Crude steel	497,100	1,139,000	229.1
Iron castings	33,000	76,200	230.9

(Notes) The estimate of special steel products and cast and forged steel has been formed, reflecting upon the special conditions of ROK and also referring to their proportion in total crude steel in Japan in its postwar period.

On iron castings we have reckoned with 7% of crude steel total.

On plates: If the plates will come to be self-supplied in ROK, the greater part of the large-sized shapes which depends on import now will be replaced by the build-up of the plate, and also material for pipe will be supplied as plate.

Accordingly, the demand for plates in 1971 is estimated at 254,200 M/T.

Plates	186,200 M/T	
For shapes	24,500	35% of shapes supposed to be of large size.
For pipe	43,500	
Total	254,000	

B. Items classified by products

	1963	%	1971	%	71/63
Rails	18,800	5.0	37,600	4.3	200.0
Sheet piling	1000	0.3	2,000	0.2	200.0
Shapes	32,800	8.7	70.000	8.0	213.4
Bars	95,900	25.4	220.000	25.0	229.4
Wire rods	24,400	6 5	56,800	6.5	232.8
Plates	76,800	20.3	186,200	21 2	242.4
Sheets	67,800	18.0	163.200	18.6	240.7
Galvanized sheets	20,700	5.5	43,800	5.0	211.6
Tin plate	1,500	0.4	11,500	1.3	766.7
Silicon sheets	2,000	0.5	5,100	0.6	255.0
Hoop	5,300	1.4	16,400	1.9	309.4
Pipe	29,700	7.9	63,700	7.2	214.5
Tyres	500	0.1	1,600	0.2	320.0
Total	377,200	100.0	877,900	100.0	232.7
Bars and sections	172,900	45.8	386,400	44.0	223.5
Flat products	174,100	46.2	426,200	48.5	244.8
Others	30,200	8.0	65,300	7.5	216.2

(Note) 'Others' mean pipe and tyres only.

C. Items classified by markets

	1963	%	1971	%	71/63
Shipbuilding	21,200	5.6	86,700	9.9	409.0
Automobiles	12,700	3.4	41,600	4.7	327.6
Rolling-stock	22,800	6.0	53,400	6.1	234.2
Bicycles	9,600	2.5	32,200	3.7	335.4
General machinery	42,800	11.3	91,000	10.4	212.6
Electric machinery	10,000	2.7	27,800	3.2	278.0
Metal products	66,600	17.7	155,000	17.6	232.7
Containers	11,500	3.1	30,200	3.4	262.6
Construction	180.000	47.7	360,000	410	200.0
Total	377,200	100.0	877,900	100.0	232.7

According to the forecast, the growth of the construction-field ranks lowest of all, so the increase in section steel is generally low, while the plates and sheets are supposed to show a steady growth, owing to the expansison of such transport means as ships, bicycles and automobiles.

D. Summarization

The demand estimate for ordinary steel by products and market classifications in ROK in 1971 is tabulated as follows:

Demand estimate for steel products in ROK (1971)

	Ship-building	Automobiles	Rolling-stock	Bicycles	General machinery	Electric machinery	Metal Products	Containers	Construction	Total	%
Rails	–	–	–	–	–	–	–	–	37,600	37,600	4.3
Sheets piling	–	–	–	–	–	–	–	–	2,000	2,000	0.2
Shapes	9,000	900	1,500	–	4,000	400	–	–	54,200	70,000	8.0
Bars	1,300	20,300	3,700	6,200	32,700	600	26,100	–	129,100	220,000	25.0
Wire rods	–	–	–	–	–	–	56,800	–	–	56,800	6.5
Plates	68,400	7,900	30,100	5,600	9,300	900	11,600	3,600	48,800	186,200	21.2
Sheets	5400	11,500	13,500	10,700	34000	19,300	40,700	12,100	16,000	163,200	18.6
Galvanized sheets	–	–	–	–	–	–	13,500	1,500	28,800	43,800	5.0
Tin plate	–	–	–	–	–	–	–	11,500	–	11,500	1.3
Silicon sheets	–	–	–	–	–	5,100	–	–	–	5,100	0.6
Hoop	–	–	1,200	4,600	4,700	1,100	2,800	–	–	14,400	1.9
Pipe	2,600	1,000	1,800	5,100	4,300	400	3,500	1,500	43,500	63,700	7.2
Tyres	–	–	1,600	–	–	–	–	–	–	1,600	0.2
Total sum	86,700	41,600	53,400	32,200	91,000	27,800	155,000	30,200	360,000	877,900	100.0

3. Estimate of future level of activity and demand for steel products in steel-using industires

A. Shipbuilding

(1) Present situation of the industry

The total shipping held by ROK as of 1963 amounts to 294,000 GK, of which 134,000 G/T, or 45%, occupies steel ships; so the wooden ships such as fishing boats or lighters are relatively important. The latest record of shipbuilding is as follows (1964 - "65):

a. Cargo boats: 2,600 G/T x 2
Oil tankers: 700 G/T x 2
500 G/T x a few

b. Ocean fishing boats: 215 t x 10 in 1964
215 t x 22 in 1965

So, as for steel demand, the weight of repairs of fishing boat has been fairly high:

The shipyards are:

Korea Shipbuilding & Engineering corporation: the largest shipyard in ROK, equipped with a 4,000 G/T dock and has a share of ~~40%~~ 60%

Dae Sun Shipbuilding Co.: the second, with a 3,000 G/T dock, having a share of 15%

(2) Estimate of shipbuilding amount in 1971

In order to settle the existing shortage of shipping, the Second Five Year Plan for Shipbuilding will be carried in force in 1967. For five years before 1971, vessels amounting to 200,000 - 300,000 G/T will be built chiefly by Korea Shipbuilding & Engineering Corporation, which is planning to reconstruct its 4,000 G/T dock as a 20,000 G/T dock, and to build four or five new shipyards of Dae Sun Sun Shipbuilding Co. class with a source of revenue by the claim on Japan. (The latter will be operated exclusively for the building of fishing boats of 215t class.)

	Present	Future	Amount of shipbuilding in 1971
Korea Shipbuilding & Engineering Corporation	60%	55%	60,000 G/T
Dae San Shipbuilding Co.	15	35	38,000
Others	25	10	10,900

Above are the estimated figures of shipbuilding in 1971, supposing the share of Korea Shipbuilding & Engineering Corporation to be 55% and that of Dae Sun Shipbuilding Co. to be 35%.

(3) Estimated amount of steel products demanded in 1971

	Specific consumtion of steel products	accordingly, amount of steel products demanded.
Korea Shipbuilding & Engineering Corporation	600 kg/G/T	60,000 x 0.6 - 36,000 T
Shipyards of Dae San Ship Bldg., Co. Class	650 kg/G/T	38,000 x 0.65 - 24,700 T

In addition to above 60,000 M/T for shipbuilding, 30% of the total amount will be included as material for repairs; therefore, the estimated amount of the steel products needed in 1971 is listed as follows:

M/T

	Corporation	Shipyards of Dae Sun Co. Class	Total	Repairs	Total sum
Shapes	4,100	2,200	6,300	2,700	9,000
Bars	600	300	900	400	1,300
Plates	30,300	17,600	47,900	20,500	68,400
Sheets	-	3,800	3,800	1,600	5,400
Pipe	1,000	800	1,800	800	2,600
Total	36,000	24,700	60,700	26,000	86,700

B. Automobiles

(1) Present situation of the industry

The automotive industry in ROK has been restrained of its development for such a long time that the popularization of cars remains quite low as compared with that in advanced countries (as of 1964, total number of motor vehicles in use by the nation amounts to 37,815; and the same per 1,000 persons is 1.35). As for the automotive industry, the majority of its production is concerned with parts-making, so the through process of cars is performed on a very small scale. There are about 30 assembly shops of automobile, most of which are of small-scale and manual work, and their capacity as a whole seems to be 3,000 - 4,000 cars a year.

Estimated number of automobiles produced in 1963

Passenger cars	1,600	47.8%
Trucks	850	25.4
Small trucks	300	8.9
Total	3,350	100

* The chassis (including engine section) are recomposed chiefly from those which are disposed of by the U.S. Forces; there are no domestic production of completed cars.

(2) Estimate of the number of automobile production in 1971

a. Estimate based on productive capacity

It is known to us that there is a programme of establishing an automotive plant (equipped with presses) which is specialized in the assembly with a fund of 3 - 5 million dollars. The construction cost of an assembly plant with a productive capacity of monthly 10,000 cars would amount to ¥60,000 (millions) in Japan, but in that case it must be taken into consideration that the plant is equipped with modern conveniences and that a fairly large portion of the construction cost is for the purchase of plant lot. In the case of ROK reasonable productive capacity of a plant that would be constructed with the above-said fund would be the assembly of monthly 500 cars. Besides, with the expansion of the existing plants, the estimate of the number of automobiles to be produced in 1971 will amount to about 1,500.

b. Estimate from the number of automobiles in use

The present ratio of automobiles in use in ROK is 1.35 cars per thousand persons which is as high as that of Japan in 1930. On looking at the rate of increase in the number of cars in use by Japanese people, it had, as graphically shown elsewhere, remained at the low level of 1-3 cars per 1,000 persons for the long wartime until 1950, when it barely increased to 4.04; since then it since then has shown an upward tendency, though it is slow.

Taking into consideration the present situation of ROK and the tempo of popularization of cars in Japan for reperence, we estimate the ratio of cars in use in ROK to be 4.00 in 1971; that means, the total number of the cars in use will be 129,700. Assuming that the above ratio increases in an arithmetical progression, namely, by equal difference, the number at the end of 1970 will be 116,600; that is, the net increase in 1971 will be 13,000. Besides, the demand for the renewal of cars (assumed to be durable for ten years) is estimated at 2,000 - 3,000 in number. Therefore, the number of cars which will have to be produced is expected to be 15,000 - 16,000, and, now, in consideration of the above-mentioned estimate of productive capacity, that is assumed to be 15,000.

	Number of automobiles in use					Population	Popularization*
		Passnger cars	Trucks	Buses	Small-sized car and others	1,000 persons	Number
1955	18,356	6,556	8,103	2,953	744	21,502	0.85
56	25,328	8,428	12,740	3,312	848	22,307	1.14
57	28,086	9,743	13,679	3,847	817	22,949	1.22
58	28,933	10,766	13,366	3,954	847	23,611	1.23
59	30,392	12,133	13,196	4,140	923	24,291	1.25
60	31,339	12,776	13,426	4,195	942	24,989	1.25
61	29,324	9,171	12,613	4,266	3,184	25,700	1.14
62	30,814	11,074	13,093	4,406	2,241	26,432	1.17
63	34,228	12,679	13,929	5,022	2,598	27,184	1.26
64	37,815	14,586	14,951	5,440	2,838	27,958	1.35
71	129,700					32,427	4.00
71/63	378.9					119.3	

* Popularization indicates the number of automobiles in use per thousand persons.

Source: Yearbook of Statistics of ROK (Economic Planning Board)

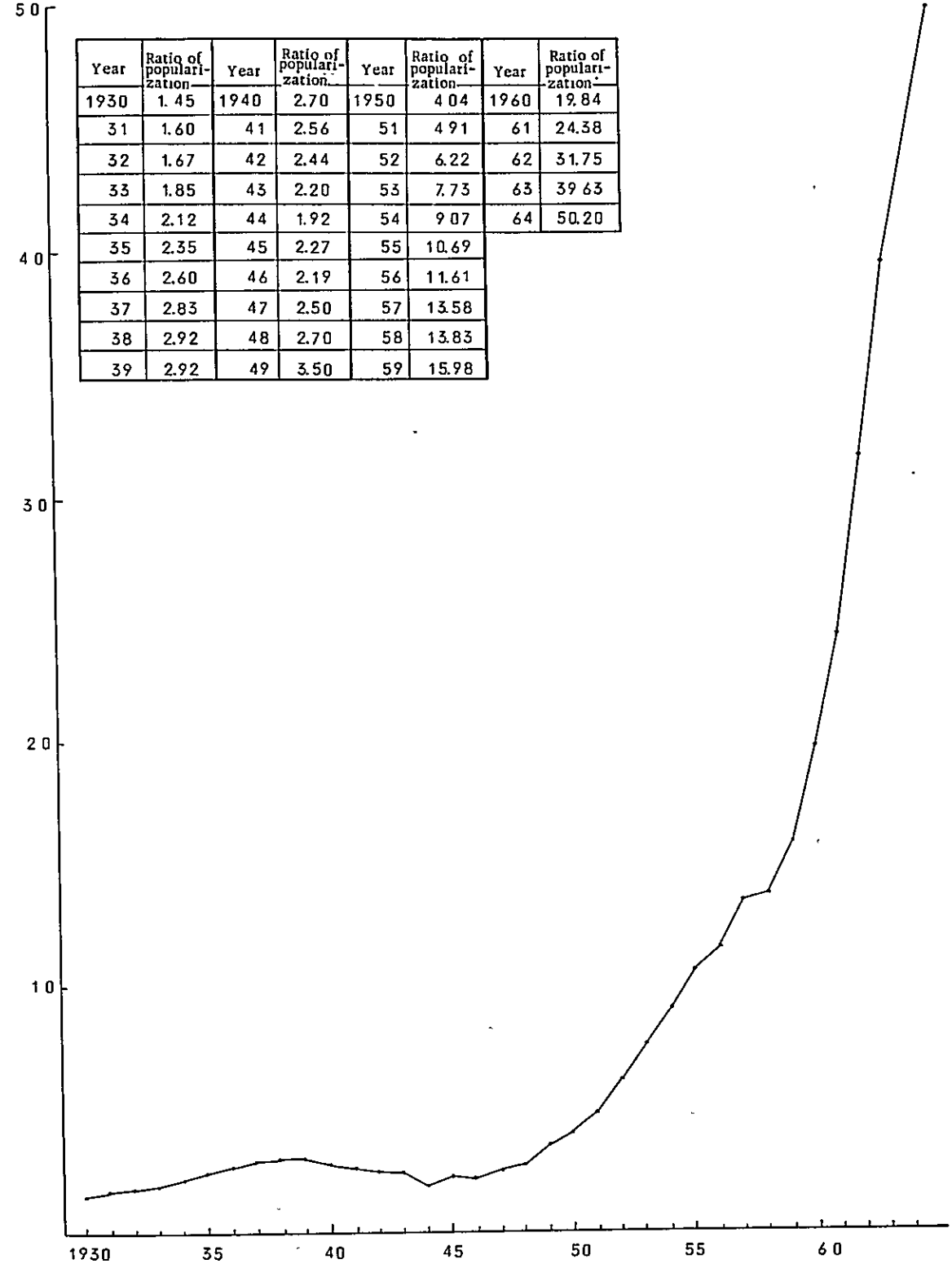
c. Estimate of items by car classifications

When the progress in the means of transport is accelerated by the expansion of industrial activity, the demand for trucks and buses is expected to increase as the leading means in future so long as we consider the fact that the capacity of the railway transport is not enough in ROK. Above all, the demand for medium and small-sized trucks is prospected to show a rapid increase especially in appreciation of their handiness and lower price, as the level of national income goes up.

Trend and prospect of popularization of automobiles in Japan

Number of automobiles

Year	Ratio of popularization	Year	Ratio of popularization	Year	Ratio of popularization	Year	Ratio of popularization
1930	1.45	1940	2.70	1950	4.04	1960	19.84
31	1.60	41	2.56	51	4.91	61	24.38
32	1.67	42	2.44	52	6.22	62	31.75
33	1.85	43	2.20	53	7.73	63	39.63
34	2.12	44	1.92	54	9.07	64	50.20
35	2.35	45	2.27	55	10.69		
36	2.60	46	2.19	56	11.61		
37	2.83	47	2.50	57	13.58		
38	2.92	48	2.70	58	13.83		
39	2.92	49	3.50	59	15.98		



	1963 Number	%	1971 Number	%	71/63
Passenger cars	1,600	47.8	3,000	20	187.5
Trucks	850	25.4	4,500	30	529.4
Buses	600	17.9	2,000	13	333.3
Small trucks	300	8.9	5,500	37	1,833.3
Total	3,350	100	15,000	100	447.8

Reference (case of Japan)

	1950 Number	%	1964 Number	%
Passenger cars	1,593	2.4	579,660	32.5
Trucks	17,576	26.2	115,726	6.5
Buses	3,502	5.2	13,675	0.8
Small trucks	44,519	66.2	1,073,464	60.2
Total	67,190	100	1,782,523	100

(3) Estimated amount of steel products demanded in 1971

The estimated amount of steel needed in 1971 is calculated by multiplying the number of production by the specific consumtion of steel products classified by car types; in addition, 10% of the total amount is estimated to be consumed as material for repairing.

(unit: M/T)

	Passenger cars	Trucks	Buses	Small-sized trucks	Total	For repairs	Total sum
Shapes	–	480	130	180	790	90	880
Bars	1,520	7,680	4,700	4,400	18,300	2,030	20,330
Plates	390	3,440	2,330	920	7,080	790	7,870
Sheets	2,780	2,280	3,300	2,020	10,380	1,150	11,530
Pipe	60	160	470	180	870	100	970
Total	4,750	14,040	10,930	7,700	37,420	4,160	41,580

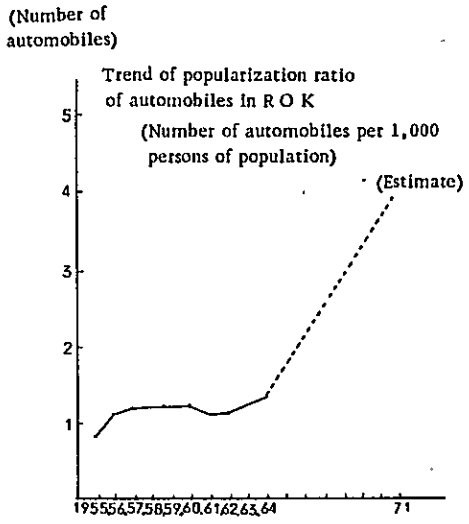
C. Rolling-stock

(1) Present situation of the industry

The total number of rolling-stock consists, as of 1964, of 10,764 freight cars, 1,340 passenger cars and 377 locomotives. As well as the other means of transport, there is a shortage of fairly large number of cars; especially, the number of freight cars, which was 11,964 in 1955, has been rather decreasing recently.

On the contrary, both ton-kilometre and passenger-kilometre are steadily increasing, and the rate of railway use is rising.

(In this connection, the number of rolling-stock in use in Japan as of 1963 consists of 5,508 locomotives and 147,422 freight cars.)



	GNP	Freight cars		Passenger cars	
	(value of 1964)	Number in use	Total ton-kilometres	Number in use	Total Passenger-kilometres
	million ₩				1,000-person-kilometres
1955	352,35	11,967	2,060,363	985	5,969,362
56	357,01	...	2,274,443	...	...
57	382,56	10,593	2,569,724	1,172	3,434,862
58	405,90	9,913	2,658,442	1,167	4,172,405
59	424,65	9,799	3,070,709	1,274	4,539,696
60	452,32	9,541	3,282,824	1,523	4,935,309
61	453,11	9,455	3,485,563	1,326	5,371,537
62	469,06	9,659	3,977,132	1,476	5,869,360
63	500,89	10,479	4,358,480	1,690	6,675,749
64	535,55	10,764	4,522,317	1,340	7,353,295
71	940,14	25,400	10,560,000	2,850	11,250,000
71/63	187,7	242,3	242,3	168,5	168,5

Source: Statistical Yearbook (*Economic* Planning Board)

(2) Number of rolling-stock in use in 1971
(Freight cars)

The close correlation of GNP to the amount of freight transport is observed in a fairly high degree, as graphically shown elsewhere. By means of this line graph, the amount of goods transport is estimated at 10,560 thousand ton-kilometers, and by multiplying the number of freight cars by 2.42 x 3, that is, the growth rate of the above-mentioned goods transport as for 71/63, we obtain the number of freight cars in use in 1971 as 25,400.

(Passenger cars)

Through the cross section analysis of GNP and passenger-kilometres, we obtain an extremely large value which does not seem to fit in the reality; therefore, estimating by means of time series analysis, we calculate the passenger-kilometres in 1971 to be 11,250 millions. By multiplying the number of passenger cars in 1963 by that growth rate of passenger-kilometres, 1,685, we reckon the number of passenger cars in use in 1971 as 2,850.

(3) Estimate of the number of rolling-stock to be produced in 1971
(Freight cars)

Assuming that the number of freight cars increases in an arithmetical progression, the number of the freight cars in 1970 would be 23,300, and accordingly, the net increase in the number in 1970 would be 2,100. Adding to this, if yearly 500 freight cars are supposed to be disused (assuming the freight car to be durable for 10 years), the number of freight cars to be produced is:

$$2,100 + 500 = 2,600$$

which are considered to be made all at home.

(Passenger cars)

Assuming that the number of passenger cars increases in an arithmetical progression, as in the case of freight cars, the number of passenger cars in 1970 would be 2,635, and accordingly, the net increase in 1971 would be 215.

Again assuming 50 passenger cars fall into disuse every year (the car is supposed to be durable for 30 years), the estimated number of passenger cars needed in 1971 is:

$$215 + 50 = 265$$

half of which is considered to be made at home.

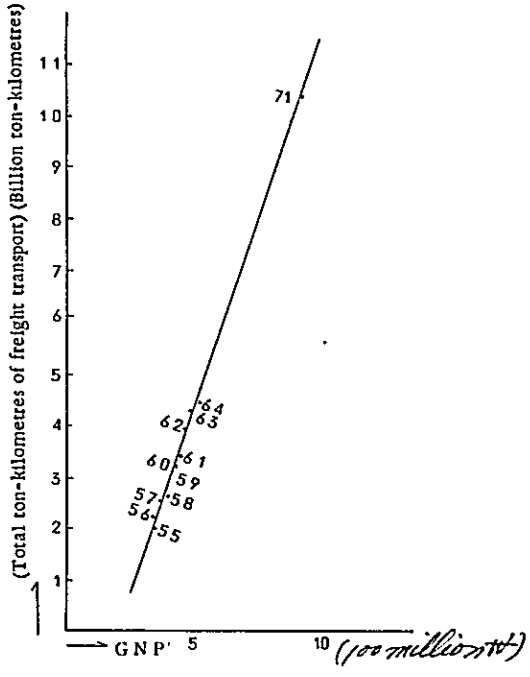
(4) Estimated amount of steel products demanded in 1971

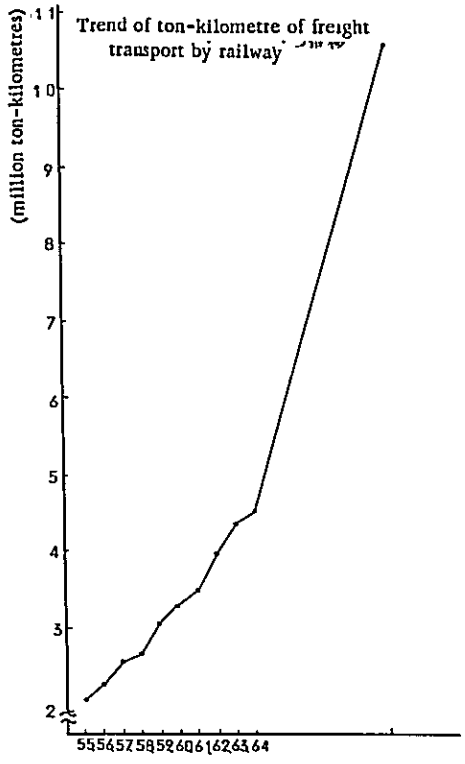
The amount of demand for steel products is calculated by multiplying the number of rolling-stock needed to be produced by the specific consumption of steel products; and, 10% of the total amount is considered to be used for repairing and for industrial cars.

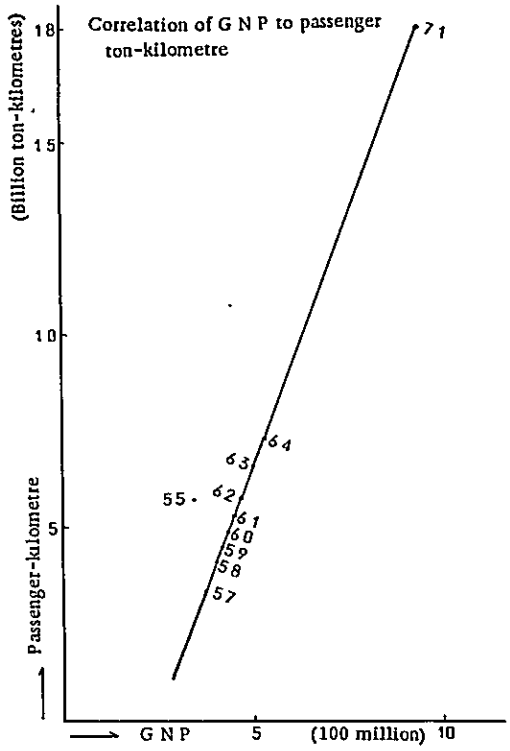
(unit :M/T)

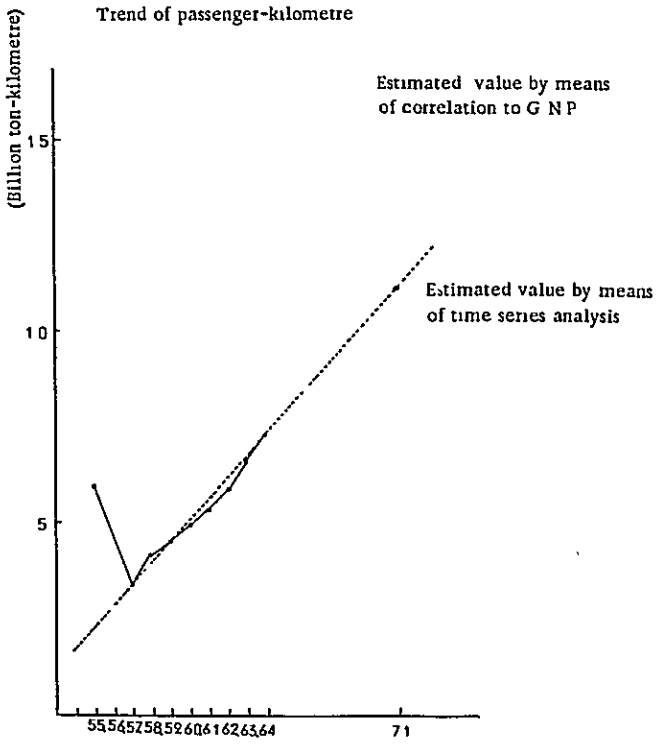
	Freight cars	Passenger cars	Total	Industrial cars and repairing	Total sum
Shapes	1,100	220	1,320	150	1,470
Bars	3,060	300	3,360	370	3,730
Plates	25,340	1,770	27,110	3,010	30,120
Sheets	11,380	730	12,110	1,350	13,460
Hoop	870	250	1,120	120	1,240
Pipe	1,530	80	1,610	180	1,790
Tyres	1,360	90	1450	160	1,610
Total	44,640	3,440	48080	5,340	53,420

Correlation of GNP to total ton-kilometres of freight transport by railway




Trend of ton-kilometre of freight transport by railway
(million ton-kilometres)
11
10
9
8
7
6
5
4
3
2
55 56 57 58 59 60 61 62 63 64


Correlation of G N P to passenger ton-kilometre
(Billion ton-kilometres)
18
15
10
5
Passenger-kilometre
71
64
63
62
61
60
59
58
57
55
G N P
5
(100 million)
10


Trend of passenger-kilometre
(Billion ton-kilometre)
Estimated value by means of correlation to G N P
Estimated value by means of time series analysis
15
10
5
55 56 57 58 59 60 61 62 63 64
71

D. Bicycles

(1) Present situation of the industry

From an extreme shortage of automobiles in the country, bicycles are serving as important means of traffic both in towns and farming villages. The government is encouraging to use bicycles, and authorizes its sale by monthly payment system, furnishing necessary funds.

The amount of bicycle production has come to 154,000 in 1964, and all the demand has been self-supported at present.

The rate of popularization of bicycle is rapidly improving recently; it was 64 persons per bicycle in 1964. But comparing with that of Japan, i.e. 5.1 persons in 1956 and presumed 3.6 in 1965, or with that of advanced countries in Europe - 3 persons, -, that of ROK may be said fairly low.

	Amount of production	Presumed number in use	Population	Rate of popularization
			thousands	Persons per bicycle
1955	39,650	...	21,502	...
56	42,780	...	22,307	...
57	36,065	...	22,949	...
58	24,678	...	23,611	...
59	23,463	167,000	24,291	145.5
60	38,030	165,000	24,989	151.4
61	53,118	176,000	25,700	146.0
62	86,085	226,000	26,432	116.9
63	105,010	306,000	27,184	88.8
64	154,620	437,000	27,958	64.0
71	391,000	1,621,000	32,429	20.0
71/63	372.3	529.7		

(Source): Statistical Yearbook of ROK (Economic Planning Board)

(Notes): 1) The presumed number in use was calculated by assuming the durable year to be 10.

2) Rate of popularization means the number of persons per bricycle.

(2) Estimated number of bicycles to be produced in 1971

a. Estimate of number of bicycles in use in 1971

By referring to the tempo of the past popularization in ROK or to the rate of diffusion in Japan and other countries the rate in 1971 has been estimated at 20 persons per bicycle, on the basis of which the number of bicycles in use in 1971 has been calculated to be 1,621,000.

b. Estimated number of bicycles to be produced in 1971

Assuming that the number of bicycles increases in an arithmetical progression, it would be 1,452,000 in 1970, and its net increase in 1971, 169,000.

In addition to the above, a renewal demand which represents 222,000 bicycles (corresponding to the number of production in 1966) should be taken into consideration; thus the number of production in 1971 is:

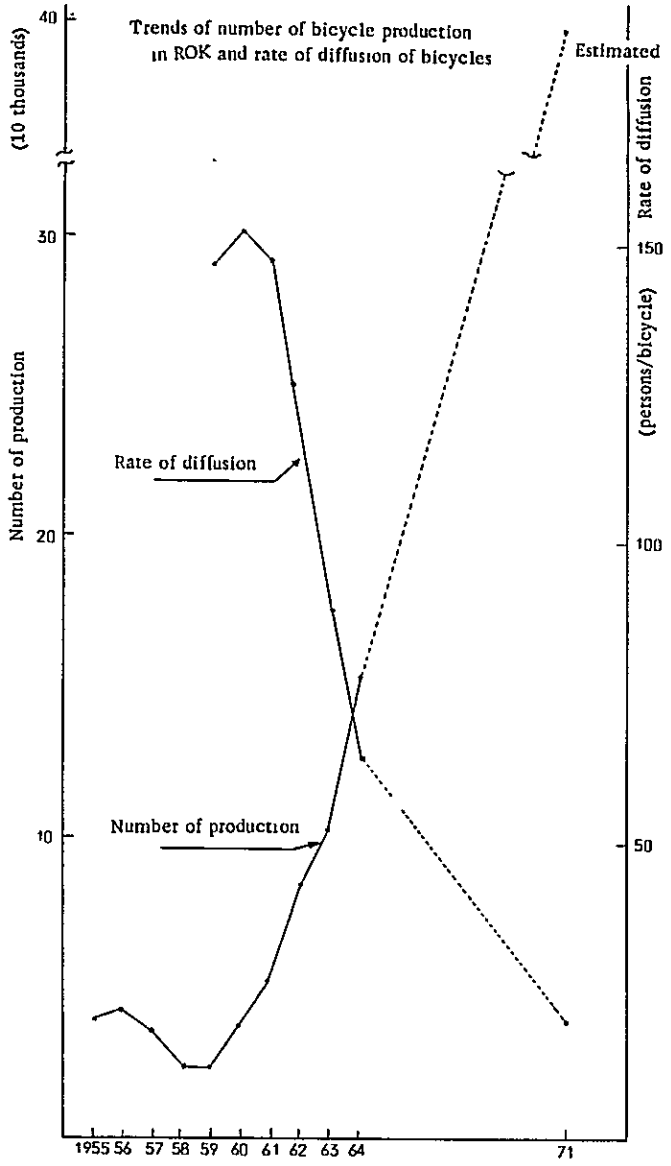
$$169,000 + 222,000 = 391,000$$

(3) Estimated amount of steel products demanded in 1971

The number of bicycles to be produced has been multiplied by the estimated specific consumption of steel to obtain the amount of steel products needed; 20% of the total demand has been estimated to be used for rear-cars.

(unit : M/T)

	Bicycles	Rear-cars	Total
Bars	4,920	1,230	6,150
Plates	4,500	1,130	5,630
Sheets	8,570	2,140	10,710
Hoop	3,650	910	4,560
Pipe	4,090	1,020	5,110
Total	25,730	6,430	32,160



E. General machinery

(1) Present situation of general machinery production

The principal items of the general machinery in ROK consists of such agricultural machines as pumps, automatic sprayers of agricultural medicines, etc., and, considering the fact that the government, for the purpose of encouraging to use them by means of granting subsidies, those agricultural machines and instruments will continue as ever to be the central item of the gernal machinery.

In addition to the above, some fibre machines, prime movers and boilers are being produced, but construction and chemical machines, etc., will have to depend as ever either on import or on sale by the U.S. Forces.

The production of principal items of machines in 1963 consists of 7,266 internal combustion engines, 43,020 threshers, 20,993, pumps, 91,744 sewing - machines and 50,501 blowers.

Production of principal items of machines

	Production index of mining and industry	Boilers	Internal combustion engines	Threshers	Pumps	Sewing-machies	Looms	Blowers	Lathes
1955	514	...	...	...	4,000	50,600	1,400	...	..
56	629	...	...	...	5,000	23,338	1,200	...	...
57	726	...	...	...	4,545	23,222	1,125	...	...
58	800	...	...	...	3,171	42,977	908	..	...
59	918	...	...	...	4,474	28,779	927	...	...
60	1000	...	...	...	247	22,888	746	...	...
61	1057	...	...	...	837	51,494	558	...	...
62	1235	453	8,817	48,842	17,754	123,345	688	77,273	555
63	1398	596	7,266	43,020	20,993	91,744	1,749	50,501	960
64	1510	713	8,186	36,180	14,301	86,489	1,732	18,532	601

Source: Statistical Yearbook (Economic Planning Board);
Monthly Bulletin (Bank of Korea)

(2) Estimate of the level of activity in 1971

1. The following two plants are prearranged to be constructed: a universal prime mover plant whose scale of investment is over 10 million dollars and a fibre machine plant with an investment of a million dollars.

2. The growth of the production index of mining and industry in 1971 to that in 1963 is calculated to be 264.7% from its correlation to GNP.

3. The magification in the domestic fixed capital formation in 1971 to that in 1963 is 228.0%.

4. In this connection, the trend of the production index of general machinery in post-war Japan is illustrated in the list below, in which the growth is shown as follows:- letting index of 1948 = 100, that of 1953 = 270.00 and that of 1954=289.1.

From the above data, (1-4), the growth of general machinery in 1971 to that in 1963 is expected to be 300%.

	Mining and industry	General machinery	
1947	10.6	8.0	
1948	14.0	12.8	100
1949	18.2	17.3	
1950	22.3	15.5	
1951	30.8	29.7	232.0
1952	33.0	27.0	210.9
1953	40.3	34.6	270.3
1954	43.7	37.0	289.1
1955	47.0	35.1	274.2
1956	57.5	46.3	361.7
1957	67.9	58.7	458.6

Source: Handbook on Economy
Note: Index of 1960 = 100

(3) Estimated amount of steel products demanded in 1971

The consumed amount of steel products for general machinery in 1971 except that for repairing purposes is obtained by multiplying the amount of steel products consumption in 1963 by the growth rate of 71/63, 300%; 10% of the total amount is estimated to be appropriated for repairing purposes.

	For finished products	For repairs	Total
Shapes	3,600	400	4,000
Bars	29,400	3,300	32,000
Plates	8,400	900	9,300
Sheets	30,600	3,400	34,000
Hoop	6,000	700	6,700
Pipe	3,900	400	4,300
Total	81,900	9,100	91,000

F. Electric machinery

(1) Present situation of electric machinery production: As for heavy electric machines, Ichun Electrical Machinery Industrial Co., Ltd. and Kuk Jae Electrical Mfg., Co. are two major makers and they produce small-sized electric motors of

30 - 50 HP class and transformers; as for household electric appliances, there are several makers, such as, Golden Star Co., Ltd., Sun Yong Electrical Mfg. Co., etc., and they produce radio sets, electric fans, telephone sets, etc.

The production of principal items in 1963 consisted of 27, 436 transformers, 11,451 motors, 8,482 electric fans, 98,484 electric irons, 158,330 radio sets, etc.; among them irons and radio sets seem to be fairly popularized. Electric refrigirators are partly produced at home, while televison sets have not yet been produced (though a fund of $150,000 has been already invested.)

Production of principal items of electric machines

	Trans-formers	motors	Electric fans	Electric irons	Fluorescent lamps	Radio sets
year	unit	unit	unit	pc	pc	unit
1955	841	4	...	...	...	...
56	1,319	17		...	...	...
57	709	43	...	...	...	...
58	1,918	885	..	...	...	...
59	4,405	1,409	...	...	...	...
60	3,066	1,224	...	...	...	...
61	4,634	1,741	...	...	...	...
62	8,184	2,350	31,504	38,991	429,353	153,504
63	27,436	11,451	8,482	98,484	453,762	158,330
64	24,152	21,256	40,902	89,333	668,439	202,863

Source: Statistical Yearbook of ROK (Economic Planning Board); Monthly Bulletin (Bank of Korea)

(2) Estimate of the level of activity in 1971

a. Heavy electric machinery

(1) An inclusive plant of electric machines of Ichun Electrical Machine Industrial Co., Ltd. class will be constructed with a fund of one million U.S. dollars; the range of its capacity is supposed to be limited to medium-sized electric machines.

(2) The supply of electric power is expected to increase rapidly by the execution of the long-term energy generation plan; mainly in steam power electric generation.

The growth of electric power in correlation to GNP is estimated at 273.7% as for 71/63.

③ The growth of the total fixed capital formation is expected to be 228.0% as for 71/63.

as for 71/63.

④ The increase in the production index in post-war Japan was 260.3% as for 1954/1948, and 289.8% as for 1955/1948.

By means of the above data the growth of production of heavy electric machines as for 71/63 is estimated to be 270.0%.

b. Household electric appliances

① Golden Star Company Ltd. has succeeded in raising a fund of U.S. $1,500,000 from West Germany; the new plant is expected to be set in motion in 1966.

② Owing to the rise of income level the demand for such electric appliances as electric irons, radio sets, electric fans, electric washers, television sets, etc. will increase.

③ The growth of demand for household electric appliances in post-war Japan was extremely rapid for each item, the produced amount of which had been increasing by turns as follows: - electric iron - electric fan - electric washer tlevision set - electric refrigirator.

On the basis of the above data the growth of household electric appliances as for 71/63 is estimated at 350.0%.

(3) Estimated amount of steel products demanded in 1971

The amount of steel products consumed for heavy and domestic electric machines (except that for repairs) in 1963 has been multiplied respectively by the estimated growth rate as for 71/63 to obtain the estimated amount of steel products demanded in 1971, the amount for repairs is considered nil.

Trend of production of principal items of electric machinery in Japan

(unit: number)

	Production index of electric machinery	Electric irons	Electric fans	Electric washers	Electric refrigirators	Standard electric motors	Standard electric transformers for electric pole
1948	5.8						
1949	6.2	195,566	95,703	364	5,312	...	..
1950	6.6	253,205	118,804	2,328	4,996	276,739	86,142
1951	9.1	540,117	173,903	3,388	1,998	268,109	107,208
1952	9.9	776,067	290,879	15,117	5,587	222,541	53,866
1953	13.3	919,064	434,585	104,679	7,470	410,952	107,645
1954	15.1	1,082,255	561,972	265,552	16,990	498,265	125,403
1955	16.8	1,223,216	515,305	461,267	30,571	528,925	134,080
1956	25.6	1,626,588	797,290	754,458	81,202	856,849	233,690
1957	36.7	2,021,082	1,320,072	854,564	251,241	952,079	248,571

(Source): Annual of Statistics of Machinery; Handbook on Economy;
Production index of electric machinery in 1955 is equated to 100.

Estimated amount of steel products needed' 1971

(unit: M/T)

	Heavy electric machinery	Household electric appliance	Total
Shapes	-	350	350
Bars	350	250	600
Plates	540	350	890
Sheets	9,450	9,800	19,250
Hoop	-	1,050	1,050
Silicon sheets	4,100	980	5,080
Pipe	-	350	350
Total	14,440	13,130	27,570

G. Containers

(1) Cans for provisions

The expected amount of canned foods for export in 1971 is 2 million c/s, which are three times 700 (thousands) c/s in 1967 (planned figures by the Economic Planning Board).

As the amount for domestic consumption, it is supposed to represent 30% of the total production, considering that it is about 10% at present.

The specific consumption of tin plate for can-making is presumed to be 4t/1,000 c/s, so the amount of tin plate demanded is 11,500 M/T.

Thus the estimated figures for 1971 are:

domestic consumption	860	thousand	c/s
export	2,000	"	"
Total	2,860	"	"

(2) Drums

In 1965 the capacity for producing drums is 200,000 a year, and, supposing the operation rate to be 40%, the production amount is 800,000 a year, that means, the amount of steel sheets needed is 2,000 M/T.

The estimated production of drums in 1973 amounts to 250,000 a year, which are three times the production in 1965; thus the amount of steel sheets needed is estimated to be 6,300 M/T.

(3) Other steel containers

The demand for other steel containers in 1971 is estimated three times that in 1963. The amount of steel products needed is listed below.

Plates	3,600 M/T
Sheets	5,800
Galvanized sheets	1,500
Pipe	1,500
Total	12,400

(4) Total of steel products needed for containers

Plates	3,600 M/T
Sheets	12,100
Galvanized sheets	1,500
Tin plate	11,500
Pipe	1,500
Total	30,200

H. Construction

The growth of investment in construction work is considered to be 200. 0% in consideration of the value 228. 0% which indicate the growth of the domestic fixed capital formation investigated by our survey team (considering the growth of 300% in the field of machinery).

Fundamentally speaking, the increase of the specific consumption (due to the substitution of steel products for other materials) should be added to the above figures.

However, a considerable amount of cement is being consumed in the construction field now in ROK, and this tendency of laying stress on cement seems to continue for some time. For this reason we have not incorporated the increase of the specific consumption into the above-said percentage.

The estimated amount of products needed for construction work in 1971 is listed below.

	1963	1971	1971/63
Rails	18,800	37,600	
Sheet piling	1,000	2,000	
Shapes	27,100	54,200	
Bars	64,550	129,100	
Plates	24,400	48,800	
Sheets	8,000	16,000	
Galvanized sheets	14,400	28,800	
Pipe	21,750	43,500	
Total	180,000	360,000	200. 0

I. Metal products

The estimated amount of steel products demanded for metal products has been worked out by adopting the average rate of growth in all items of steel products.

	1963	1971	1971/63
Bars	11,200	26,100	
Wire rods	24,400	56,800	
Plates	5,000	11,600	
Sheets	17,500	40,700	
Galvanized sheets	5,800	13,500	
Hoop	1,200	2,800	
Pipe	1,500	3,500	
Total	66,600	155,000	232.7

4. Macroscopic forecast based on international comparison

A. How to view and forecast the steel demand

(1) Point of view on the steel consumption level in relation to the level of national economy.

In looking at the steel demand in a country from the aspect of its level, a generally used index is the apparent consumption of crude steel per capita. While, as the index which indicates the level of national economy, the national income per capita (uniformly represented in U.S. dollars) is used. When we plot some curves from the data belonging to these two kinds of indices by countries and in time series, we can trace, though roughly, a relation of the amount of steel consumption to the variable level of national economy. That can be said to be an upward convex curve from the point of growth. (Fig. 4-1).

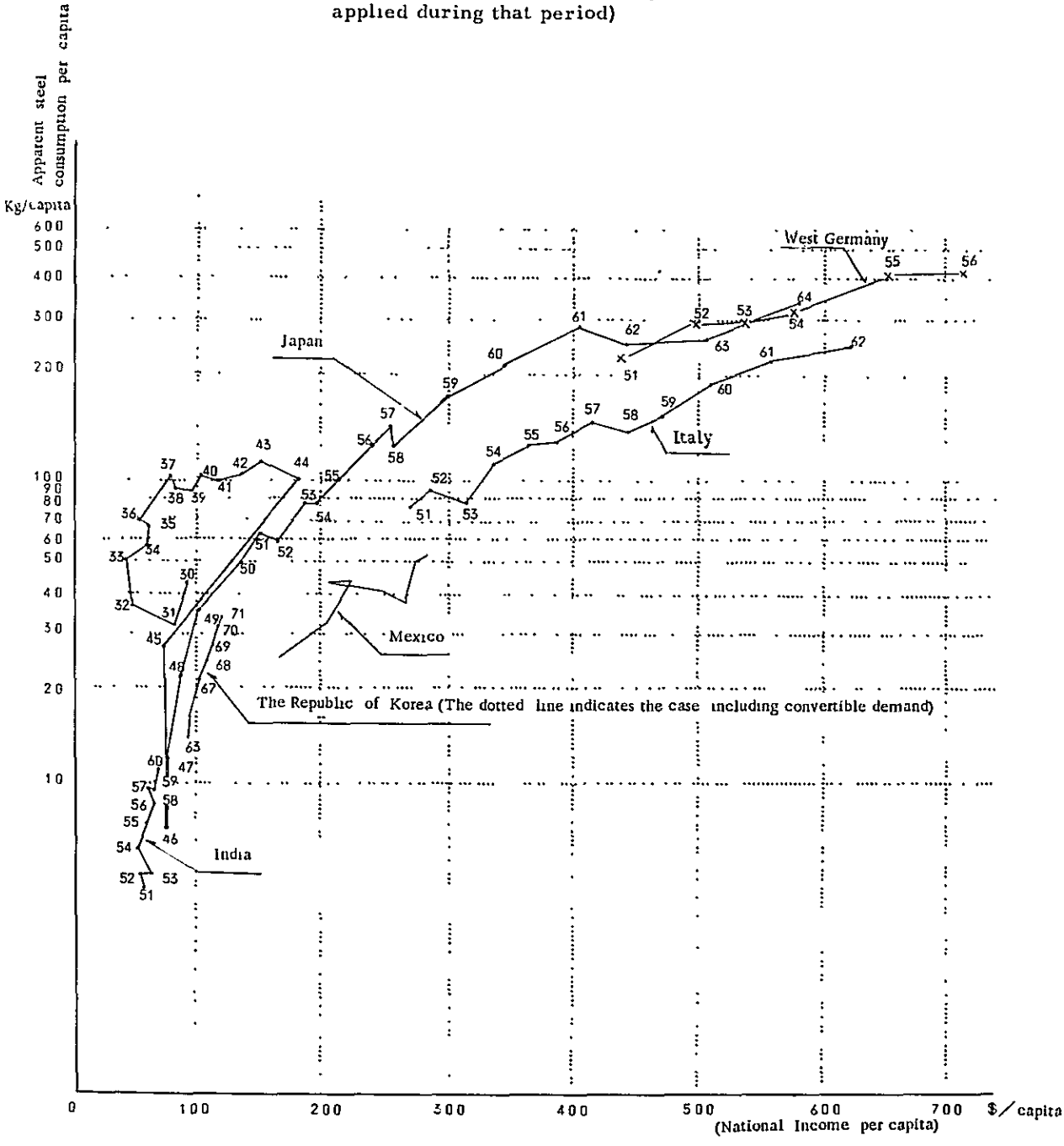
However, even at the equal stage of income, the steel consumption disperses upwards or downwards to a considerable extent in accordance with each country. That makes it necessary, when we utilize the above relation in a steel demand forecast of a specific country (the Republic of Korea), to clarify to some extent the characteristics of the country in relation to the various factors which exert influence upon the steel consumption.

As the factors which give rise to such relation:

① From the viewpoint of the characteristics as goods, steel products are mostly consumed as those for investment. The relative importance of such investment goods in the total steel demand becomes higher in proportion to the degree of industrialization or to the rate of economic growth in rapidly developing countries where the ratio of the fixed capital formation in GNE gets larger, too.

(Fig. 4-1) Apparent steel consumption per capita in relation to National Income per capita in various countries

(Note): The figures of National Income per capita in Japan during '45 - '49 are estimated from the value in '50 and its growth in real terms until then (doubtful in exchange rate to be applied during that period)



In opposition, in those advanced countries which are already either half or highly industrialized, the consumption of durable consumer goods, processed exports, etc. are added, while that of investment goods stagnates, decreasing its ratio in GNE with slower economic growth. Among the factors in GNE the deposit of steel consumption per unit value in money is overwhelmingly high in the case of the fixed capital formation, but not so high in the case of private consumption, though it sometimes differs by the spread of durable consumer goods, and in the case of export and import it depends on the heavy industrialization. Accordingly, the steel consumption as a whole is now evaluated roughly from the relation to the fixed capital formation. Upon the assumption of such a viewpoint:

② In the case of a country which is typical of a greater deal of steel consumption (Japan, West Germany, etc.) it shows rapid growth of economy, and there it has the connection with the relative importance of the fixed capital formation (private investment in facilities + private housing + public investment) in GNE or to the large absolute amount of the same per capita.

③ The level of steel consumption goes up or down according to the character of the country - whether it imports or exports steel-processed goods such as machines.

④ It is related to the particular conditions in each country - such as the earthquake-proof materials in the case of Japan, availability of competitive materials (timber, cement, etc.), and the relative gains and losses of steel, etc. (As a country advances, steel turns into articles of consumption from valuables.)

⑤ As for the ratio (coefficient) of the total steel consumption per capita to the fixed capital formation per capita, it tends to increase even in the same country for such reasons as 1, 3, and 4 as it grows in economy.

(2) Methodology in the case of ROK

① To calculate the national income per capita in the forecast year basing on the future plan of national economy.

② To find the amount of fixed capital formation per capita in GNP (=GNE) which corresponds to the value of 1.

③ To estimate, while considering the particular conditions of ROK, the coefficient (ratio) of the quantity of steel consumption to the fixed capital formation.

④ To estimate the steel consumption per capita in future by the amount of the fixed capital formation X the coefficient obtained in 3.

⑤ The apparent crude steel consumption is calculated by multiplying the value obtained in 4 by the population in the forecast year.

⑥ To forecast the demand and supply (production, export and import) by converting the amount of demand on crude steel basis into steel products classified by items.

⑦ If the forecast is concerned with a period longer than the planned

term, a demand curve is conceivable in modified exponential curve (Grompertz curve) basing on the data up to that time.

B. Assumption in calculation and result of forecast

(1) Forecast of national economy of ROK

a. The First Five Year Plan (1962 - 66) was formulated by assuming the yearly average rate of economic growth to be 7.1 %; this rate was supposed to rise every year starting from 5.7 % in the first year to reach 8.3 % at last through the expansion of government investment and loan or by means of political inducement, intending to bring about the overcome of the economic bakcwardness together with the attainment of economic self-support.

The rate of real growth of GNP has shown a record of 3.5 % in 1962, 6.8 % in 1963 and 6.9 % in 1964, and at present, though a little lower than that in original programme, it is getting at nearly 7.0 %.

As for the production activity of mining and industry, coal, cement, refined oil, etc. have been favourable, and are expected to reach its desired amount of production in the last year of the Plan; concerning the steel ingot, the production was already a great deal over the desired amount in 1962.

b. In the train of the First Five Year Plan, the government is supposed to formulate the Second Five Year Plan (1967 - 71) in order to continue the industrial consolidation as well as the economic independence and growth. As the government is also expected to extend positive guidance through its continued financial investment and loan or by the use of foreign currency, so, at least the present rate of economic growth may be possible to be maintained, and it is presumable that the growth at the rate of more than 7.% can be realized, when the economic development gets on the right track.

Incidentally, the percentage of the fixed capital formation in GPE represents 12.9% in 1962, 15.3% in 1963 and 13.8% in 1964 respectively (compared in real terms). Powerful policies, however, will be executed in future for the repletion of social capital stock and the establishment of the key industries, and, besides, the economic guidance by the government in the light of the above is expected to play a leading role in the Second Five Year Plan. Thus, it is considered that the percentage of gross capital formation will successively increase to be 18 - 19% in the last year of the Second Five Year Plan. On the other hand, the rate of rise of the production index of manufacturing industries is 12.7% in 1962, 13.1% in 1963 and 6.8% in 1964 respectively, and the production in 1965 is expected to increase a great deal, and more so afterward, as the industrial facilities are modernized as well as expanded with the progress of the Second Five Year Plan; therefore, the yearly rate of increase is presumed to be kept going at 12 - 14%.

(2) Assumptions in calculation

a. The figures on national income, population, GNP, fixed capital formation, etc. are based on the investigation performed by our survey team.

b. Way of thinking on the coefficient of steel consumption to fixed capital formation.

1. Under the existing circumstances, the consumption of steel products has been surpassed by that of such competitive materials as cement, etc. owing to the shortage of funds for purchasing steel or to the difficulties to fully appreciate the economic gains of using steel.

2. A large quantity of used steel (drums, etc.), which has been treated as an outer number in our calculation of the steel demand, has the possibility of being converted into new steel products; the conversion is under way now.

3. A considerable amount of finished articles such as machines, arms, etc. are being imported now; that means an indirect import of steel products. If their supply is enabled at home in future, a certain sum will be added to the demand for steel products, and, further, there will be a possibility of exporting steel as finished products, such as machines.

4. In near future we can expect the spread of durable consumer goods, and this will give a factor of enlarging the coefficient.

We can fairly look forward to the actualization of such convertible latent demand as above-mentioned by the efforts of private enterprises as well as the backing-up of the government policies. On the other hand, the price reduction of steel products enabled by means of self-support and mass production will bring about the improvement of the economic gains in using steel; thus, it would not be a dream to imagine that the steel products will be used in a manner like that in present Japan.

Here, we consider that the existing coefficient (0.85 as of 1963 and 1.130 when adding the convertible demand) will rise approximately to 1.35 in 1971 (Fig. 4-2).

C. Direct import and export

As the total net amount of the import and export of steel products, there will be neither deficiency nor surplus from a viewpoint of the international balance of payment. Thus, as the total, the amount of apparent consumption = the amount of production needed.

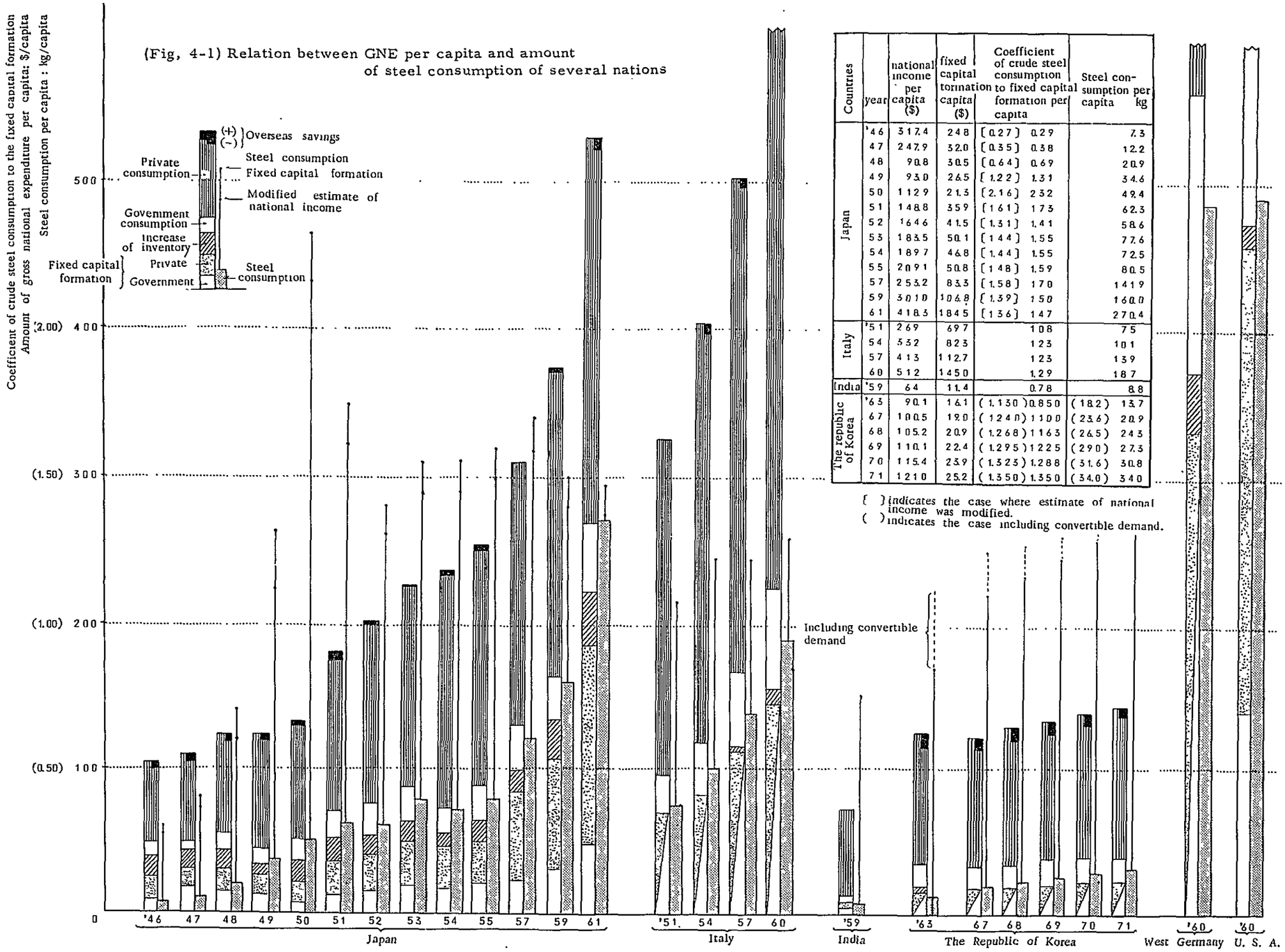
(3) Result of the forecast

The trial calculation, based on the above assumptions, of the quantity of apparent consumption of crude steel is as listed below; that is, the apparent consumption of crude steel in 1971 is 1,102,500 M/T.

	National Income per capita	Fixed capital formation per capita	Coefficient of steel consumption per amount of fixed capital formation per capita	Steel consumption per capita	Population	Total of steel consumption
'63 (Basic year)	$ 901	$ 161	(1150) 0850	Kg (182) 137	1,000 persons 27,239	t (497,100) 373,174
67	1005	190	(1240) 1100	(236) 209	29,784	(702,902) 622,500
68	1052	209	(1268) 1163	(265) 243	30,469	(807,429) 740,400
69	1101	224	(1295) 1225	(290) 274	31,139	(903,031) 853,200
70	1154	239	(1523) 1288	(316) 308	31,793	(1,004,659) 979,200
71	1210	252	(1550) 1350	(340) 340	32,427	(1,102,500) 1,102,500

Note: ( ) indicates the case including convertible demand.

(Fig, 4-1) Relation between GNE per capita and amount of steel consumption of several nations



Countries	year	national income per capita ($)	fixed capital formation capita ($)	Coefficient of crude steel consumption to fixed capital formation per capita	Steel consumption per capita kg
Japan	'46	317.4	24.8	[0.27] 0.29	7.3
	47	247.9	32.0	[0.35] 0.38	12.2
	48	90.8	30.5	[0.64] 0.69	20.9
	49	93.0	26.5	[1.22] 1.31	34.6
	50	112.9	21.3	[2.16] 2.32	49.4
	51	148.8	35.9	[1.61] 1.73	62.3
	52	164.6	41.5	[1.31] 1.41	58.6
	53	183.5	50.1	[1.44] 1.55	77.6
	54	189.7	46.8	[1.44] 1.55	72.5
	55	209.1	50.8	[1.48] 1.59	80.5
	57	253.2	83.3	[1.58] 1.70	141.9
	59	301.0	104.8	[1.39] 1.50	160.0
	61	418.3	184.5	[1.36] 1.47	270.4
Italy	'51	269	69.7	1.08	75
	54	332	82.3	1.23	101
	57	413	112.7	1.23	139
	60	512	145.0	1.29	187
India	'59	64	11.4	0.78	8.8
The republic of Korea	'63	90.1	16.1	(1.130) 0.850	(18.2) 13.7
	67	100.5	19.0	(1.240) 1.100	(23.6) 20.9
	68	105.2	20.9	(1.268) 1.163	(26.5) 24.3
	69	110.1	22.4	(1.295) 1.225	(29.0) 27.3
	70	115.4	23.9	(1.325) 1.288	(31.6) 30.8
	71	121.0	25.2	(1.350) 1.350	(34.0) 34.0

[ ] indicates the case where estimate of national income was modified.
( ) indicates the case including convertible demand.

V. EXPANSION PROJECTS OF EXISTING ENTERPRISES

V. Expansion projects of existing enterprises

The expansion project of the iron and steel industry in ROK may be classified into three main divisions; the construction of a new integrated iron and steel works in Ulsan district, the construction of a new electric furnace to produce pig iron for the supplement of the existing facilities of Inchon Heavy Industry Corporation, and the expansion projects of the other existing private enterprises.

1. Project of a new integrated iron and steel works.

This project in Ulsan district constitutes the object of the investigation of our survey team, but there is another project conceived of by Cho Il Iron and Steel Co., Ltd. prior to our investigation work.

According to the latter, it would be an integrated iron and steel works with the capacity of 300,000 - 400, tons of crude steel per year, the finished products consisting of 200,000t of flat rolled products, and 50,000t of large section steel per year. Out of the necessary foreign loan, that of non-governmental source of Japan amounting to $27,231,000 (principal being $22,000,000 and interest, $5,231,000) was approved by the Seventh Plenary session of the 50th Extraordinary session of the National Assembly (June 10, 1965) following the resolution passed by the 18th cabinet meeting (February 27, 1965) and the Presidential approval of ROK (March 3, 1965).

2. Plan for construction of new pig iron plant in Inchon area

A loan from West Germany to Inchon Iron Works Co., Ltd. having been approved, a plan is under way for producing 125,000t of electric pig iron per year by the combination of a RN/SL type preliminary reducing furnace and an electric furnace of 25,000 KW, and the open-hearth of Inchon Heavy Industry Corporation will be converted from cold pig iron process to molten pig iron process; and together with the introduction of oxygen-steel-making process, the existing capacity of 80,000t per year will be increased to 140,000t per year, and, further, this will raise the operation rate of the medium section mill, and an increased production of medium sections, commercial billets and sheet bars are being planned.

3. Expansion projects of private enterprises

It was difficult for the survey team to know all the expansion projects of private enterprises, as it could visit only a part of the steel works because of its limited time of survey work. However, judging from our observation of the limited number of makers we visited, we felt that the private sectors have active plans of expansion in spite of their insufficient availability of funds.

First of all, in the section of producing pig iron, there are projects of building two blast furnaces, 300t and 500t in capacity, respectively by Samhwa Iron-Steel Co., Ltd. and Tong-Guk Steel Co., Ltd.; this will, however, have to encounter-

many difficulties in connection with the locations and shortage of funds before its realization.

In the field of steel making there are plans of constructing 15-ton electric furnaces in at least two plants, but the problem seems to consist in the availability of steel scrap.

In the section of rolling mills, two projects of constructing reversing cold strip mills respectively by Il ssin Industrial Co., Ltd. and Union Steel MFG. Co, Ltd. are noteworthy. These mills will be completed by the end of 1966, by which over 100,000t of cold rolled sheet per year will be supplied. Other projects are as follows: a stainless steel sheet mill and a new three-high plate mill of Lauth type by Korea Steel Co., Ltd., a large and medium section mill by Tong-Guk Steel Co., Ltd., etc.

List of expansion projects of facilities for production of iron and steel in ROK

Name of enterprise	Funds for construction	Scale of production	Main facilities	Others
CHO IL Iron and steel Co.	Foreign fund : $22,000,000 National fund : ₩1,274,500,000	Crude steel : 300,000 - 400,000 ton/year Plates and sheets : 200,000 " Larger sections : 50,000 "	Integrated iron and steel making process with by blast furnace	Location : Ulsan Time of construction : 2 years
Inchon Iron Works Co., Ltd.	Foreign fund : $9,200,000 (Approved amount of loan from West Germany) National fund : ₩459,000,000	Pig iron : 125,000 ton/year Production Programme of Inchon Heavy Industry Corporation Steel ingot : 140,000 ton/year Sheet bar : 50,000 " Billet : 53,000 " Medium Section : 20,000 " Black sheet : 24,000 " Galvanized sheet : 6,000 "	Construction of a new preliminary reducing furnace of RN/SL type and a new electric pig iron furnace of 25,000 KW	Location : Inchon Time of construction : 3 years after effectuation of loan constract
Samha Iron Steel Co., Ltd.			Construction (under consideration) of a 300 - ton per day blast furnace	Location : undecided Besides, a programme is being developed of restoring two of the six blast furnace now out of operation (two 30-ton blast furnaces are in operation).
Tong - Guk Steel Co., Ltd.			Construction (under consideration) of a 15-ton electric furnace Construction (under way) of a large and medium section mill Construction (under consideration) of 500-ton per day blast furnace.	Location : Pusan, consisting of 693,000m^2 in area proposed to be reclaimed (reclamation of 198,000m^2 has been completed)
Korea Steel Co., Ltd.		Stainless steel sheet : 12,000 ton/year	Unit of facilities for making stainless steel sheet (under construction) : 2-high mill x 3, and 4-high mill x 1	Location : Yongdungpo Schedule of operation : To be started within 1965
		Steel ingot : 95,000 ton/year Plates : 35,000 " Sheet bar : 30,000 " Stainless sheet bar : 15,000 "	Construction of two new 15-ton electric furnaces Construction of a new 3-high plate mill	Location: Masan Schedule of operation: 1966

Ill-Shin Industrial Co., Ltd.		Cold Rolled Steel sheet: 40,000 ton/year	Construction of a new reversing cold strip mill	Location : undecided (Inchon district) Schedule of operation: 1966
Union Steel MFG. CO., LTD.	Foreign funds : $4,190,000 (non-governmental loan from Japan)	Cold rolled steel sheet : 60,000 ton/year	Construction of a new reversing Cold strip mill	Location : Pusan Schedule of operation : 1966

VI. IDEA OF A NEW INTEGRATED IRON AND STEEL WORKS

VI. Idea of a new integrated iron and steel works

1. Fundamental principle

(1) We are convinced of the feasibility, though a number of difficulties are conceivable, of constructing a new integrated iron and steel works in the Republic of Korea, when we consider the expansion projects of the existing enterprises on the basis of the estimated demand for steel products in 1971 as well as the present situation of the steel industry of the country. It is needless to mention that an integrated iron and steel works is, as a basic industry, very important to the modern industrialized nation. However, in view of the fact that enormus capital expenditure and huge equipment are needed for the construction of an integrated iron and steel works because of the recent innovation of technical know-how, utmost care should be taken lest the national economy should suffer any adverse influence liable to be caused by miscalculated and ill-considered schemes. Furthermore, close attention should be paid to the recent trend of the iron and steel industry of the world. For this purpose it is necessary to build an integrated works which can stand international competition by means of supplying products of superior quality at low cost. Our idea of such a works lays importance on the production of steel plates as well as on the products to be supplied as material to the existing enterprises.

(2) The scope of the new integrated iron and steel works will be 500,000 ton/year in terms of crude steel in the first stage of conetruction and 1,000,000 tons/year in the second stage. In the First Stage, in order to avoid competition with the existing enterprises and in consideration of the growth of demand for steel products, we have adopted the facilities for producing steel plates, placing stress on the supply of material (billet) to the existing manufacturers and also on the production of various steel plates. The principal facilities to be built are as follows: - a blast fournace (100 m^3); two LD oxygen converters (50 t each); a unit of sintering plant; a unit of continuous casting; a billet mill; a plate mill. As for the necessary iron ore, 30% of which is to be supplied from the domestic production, and the rest, imported: The total amount of the metallurgical coke will depend on import.

As for the Second Stage, one blast furnace and one converter will be added and one unit of coke oven and finishing stand of hot strip mill with its auxiliary equipment will be constructed (the plate mill already installed will be used as the roughing stand for the hot strip mill.) Portions of the hot coil thus produced will be supplied either to the cold rolling mill, which is now being planned by private enterprises, or to the cold rolling mill to be newly built in the proposed iron and steel works in the Second Stage. The cold rolling mill can be built within the site of the integrated iron and steel works under separate management; in this case it may be run more economically than when building it outside the iron works. The hot strip

produced will also be supplied to the existing electric welded pipe mills. Portions of the cold rolled sheets produced in the cold rolling mill will be supplied as material to the galvanizing iron sheet mill now existing in Korea. Billets produced in the continuous casting unit and billet mill will be supplied to the existing manufacturers of sections. A rough estimate of the cost of facilities is about ¥30,000 (millions) for the First Stage and about ¥30,000 (millions) for the Second Stage, amounting to about ¥60,000 (millions) in total. This estimate does not include the cost of constructing the fairways, harbour and port facilities, and of purchasing the site of the iron works. Time required for the construction projects would be two years and a half for each Stage, but this term of construction can be shortened to some extent as the case may be.

(3) The division of the First and Second Stages has been temporarily made in consideration of the necessary funds for construction. Facilities mentioned above may be either restudied or properly selected in accordance with such circumstances as the preparation of necessary funds, the possible growth of the demand for steel products and expansion programme of the existing enterprises. The layout of the iron works is arranged so that the construction of a surface-treated sheet mill, a structural steel mill (large and medium sections and wire rods) and a pipe mill could be made in the third stage of construction.

(4) As for the proposed site of the integrated iron and steel works, we have inspected only the lot in Ulsan area, but we consider it desirable to select the most appropriate site after deliberate examination and comparison of several lots other then the Ulsan lot.

The area of the right bank of the Tae Wha River which was originally proposed to be the site of the iron works, seems to be insufficient for the production of more than a million tons of crude steel, apart from the circumstances under which the lot is proposed also for the site of a fertilizer plant; and moreover, the soil of the proposed site is found to be soft.

As a result, the reclaimed land on the left bank at the confluence of the Tae Wha River and the Dong Chun River including the area extending to its north has been studied as the site for construction of the proposed iron works. This lot, possible as it is to secure here a vast area extending more than 3,300 (thousands) square metres, is in danger of being attacked by the silt and sand, discharged from the Dong Chun River by flood in summer, which would be deposited at the bottom of the waterways in front of the reclaimed land, rendering the water depth shallow in the fairway and port. Another problem is that the soil of this lot is supposed to consist of thick layers of soft clay.

Such being the case, the following measures should be urgently taken: - re-examination of the dredging and of the harbour construction plan of Port Ulsan; construction of a new port and wharf for the exclusive use of the iron works; overall investigation of the lot by means of boring tests. In consideration of the above-said

circumstances, the firm land located in the northem part of the proposed site together with the area to be reclaimed with the earth scraped from the hill will be used for the construction in the first stage.

2. Location

A. General requirements for location of an intergrated iron and steel works

In determining the location of an iron works it is desirable to select a site which can meet the following requirements: -

(1) As there is a need for receiving raw materials and shipping finished products in a large quantity, the iron works must, first of all, be equipped with fairways and a harbour which can accomodate steamers up to 40,000 - 50,000 D. W. T. class; that is, the most important requisite is to construct an iron works on the sea side.

(2) Next important is that the construction of an iron works requires a large area, although it varies with the scale of the iron works, for larger its facilities tend to become because of the necessity for enhancing the productivity high enough to meet the keen competition in world markets to-day; this in turn makes it necessary to provide a large storage space for raw materials, semi-finished and finished products. A still larger area will be needed, when taking into consideration the finishing and processing of the products of the iron works.

(3) It would be best, if principal raw materials such as iron ore, limestone, coke, heavy caking coal, semi-caking coal, scrap steel, and heavy oil, etc. could. be obtained in the neighbourhood. However, the number of the iron works where the above-said requirements are met is gradually decreasing in the world, and the rate of dependence on the source abroad for those materials is on the increase.

(4) It is desirable that such steel-consuming industries as machine manufacturing, shipbuilding, automobile manufacturing, electric machine manufacturing enterprises exist in the vicinity of the iron works as customers of steel products it produces. Such industries are also helpful for the construction and repair works of the iron works.

(5) Existence of market close to iron works

It is also most desirable that either steel-consuming incustries as stated in (4) or large cities, where a large amount of steel products is consumed for the construction of buildings, transportation facilities and manufacturers of consumer durable goods, etc, exist close to the iron works. However, market can be developed throughout the world, if sufficient cost reduction is realized by the rationalized and efficient operation of the iron works itself.

(6) A huge amount of sea and fresh water is consumed by the iron works.

For the purpose of obtaining sea water, a tidewater plant is most preferable. Also water source nearby is necessary for obtaining fresh water.

(7) Because of the huge amount of electric power needed by the iron works, the supply source of ample electric power must be found in its vicinity.

In addition to the above-said requirements the iron works must be located in a district where sufficient labour can be secured. If there is an iron works which is provided with all the requirements mentioned above, it can be called the most favoured one.

However, such conditions are seldom met and, therefore, in constructing an iron works, it is necessary to make most of every possible scientific measure so that the existing conditions can be utilized to the fullest extent in order to supply products of superior quality at low prices.

B. On Ulsan area

The survey team inspected no other place than Ulsan as the proposed site of locating the iron works, and our view on the place in the light of the above-said general requirements for the location of an iron works are as roughly stated below. We hope that any ~~other~~ suitable places other than Ulsan will be examined and compared with each other with reference to the above-mentioned general requirements in order to come to the final decision.

(1) Site

The area on the right bank of the Tae Wha River, which was originally proposed for the site for the iron works, involves the following problems:

a. Since this area is proposed also for the location of the 5th fertilizer plant, this will make ~~is~~ it possible for the iron works to secure only 1,320 (thousands) square metres, which would be insufficient to future expansion of production up to a million or a million and a half tons, to say nothing of inducing related industries there nor their development.

b. The results of boring test shows that the existence of a layer of soft clay 20 - 30 m thick~~er~~, and the thickness varies with the spots of boring; the depth of the rock bed is also irregular; these will make it difficult to construct a harbour and industrial facilities here. There is neither silt nor sand on the neighbouring sea-bottom good enough for reclamation use, and the mountain at the back consists of hard rock; these factors will require a large amount of expenses and a considerable length of time for the completion of good reclaimed land. Thus, we consider the reclaimed ground on the left bank of the confluence of the Rivers Tae Wha and Dong chun together with the area on its north as proposed site for locating the iron works.

However, this lot cannot be said satisfactory for the following reasons: -

a. The silt and sand which are washed away from the Dong Chun River by the flood in summer would be deposited on the bottom of waterways in front of the

reclaimed ground, rendering water depth of the fairway and harbour shallow.

This makes it absolutely necessary to dig pockets in the water area in front of the reclaimed ground as means of preventing the deposition of silt and sand, and to equip a dredger to do constant dredging. It will be also an effective preventive measure against deposition of sand and silt in the fairway and berth in the harbour of Ulsan which is now under construction. Therefore, it is necessary to re-examine the harbour project of Ulsan and to commence study of the feasibility of constructing a new harbour and wharf for the exclusive use of the iron works together with that of dredging in the above-said area.

b. Although the soil condition of the existing reclained ground has not been made clear, the boring tests conducted at two spots also presage the existence of a fairly thick layer of soft clay; therefore, this lot also has to be filled up with the earth excavated from the farm land on its north and with that from the hill. For this purpose an overall boring tests over the whole area must be conducted.

However, if these difficulties mentioned above are solved, this lot will be very attractive, because it can provide a wide space over 3,300 (thousands) square meters which is enough not only for the future expansion of iron works but also for the development of related industries induced there.

Accordingly, in constructing the iron works here, the harbour should be built inside the site to be free from the deposition of silt and sand, and the farm land on the north of the existing reclaimed lot should be graded in consideration of the subsidence of the ground.

Out of the reclaimed ground the portion to be used in the initial stage of construction is the leveled farm field on the north and also the lot made up of the left-over earth obtained from the leveling of the said farm land.

After the commencement of blast furnace operation reclamation with blast furnace slag is conceivable; also, reclamation with the earth (appears to be consisting of soft clay) which is obtained from the dredging of the fairway and berth will be possible if the land so made is left as it is for a long time or protected with some proper means for soft ground.

The reclaimed land thus made would be utilized as the appropriate site for plant construction or its future expansion.

(2) Harbour

The harbour for raw materials should be so designed as to have the water depth of 11 - 12 m in the beginning to enable steamers of 20,000 - 30,000 D.W.T. class to come alongside the quay, and also so designed as to enable the construction of the fairway with water depth of more than 13m, the berth and the quay for the use in future of steamers of over 40,000 D.W.T. Besides, for the shipment of products a quay is needed which can bring alongside it steamers of 1,000 - 3,000 D.W.T. class at the largest.

(3) Industrial water

As for the industrial water of the iron works, both sea water and fresh water are necessary; the former is easily pumped up from the sea. Fresh water including the loss to be made-up will amount to 38,000 m^3/day at the production level of 500,000t, and 80,000 m^3/day at that of 1,000,000t. These amounts are calculated on the basis of recirculating 85% of fresh water used in the works.

Fresh water can be supplied from the existing dam.

(4) Electric power

The amount of electric power needed by the iron works is estimated to be 145 (millions) KWH/year at the production level of 500 (thousands) t of crude steel, and 339 (millions) KWH/year at that of a million t of the same. At the stage of operating one blast furnace, facilities for power generation by means of the blast furnace gas and heavy oil should be installed, which can supply 70% of the necessary electric power.

The rest, or 30%, should be purchased, and this can be supplied by Pusan Power Plant.

At the production level of a million tons another blast furnace will be constructed, when a power plant generating 15,000 KW will be built to supply 62% of the necessary electric power; the rest will be purchased; the maximum load on the rolling mill will require, as back-up power, the construction of Pusan Power Plant with a capacity of generating at least 100,000 KW.

(5) Transportation

The railway between Ulsan and Kyung-In areas, Pusan and those in the east is expected to be improved and strengthened; it will be also extended from Pusan to the zone of the iron works to enable the transport of raw materials, other materials, and products.

(6) Labour

There is no problem in obtaining the necessary labour, but it is necessary to give the workers and engineers technical education and training

(7) Market

At the present moment there is no industries in Ulsan area as correlated with steel industry, but there are some in Pusan area It is to the advantage of the iron works to have Pusan area as the so-called hinterland. Moreover, the closer ties with Kyang-In areas will be also strengthened, with the improvement of transportation and harbour facilities, and the inducement of correlated industries to Ulsan area itself and their development can be expected in future.

3. Programme of production

A. Programme of production for the First Stage

(1) The annual crude steel production will be 500,000 t, out of which 150,000 t are appropriated for the continuous casting process, and 350,000 t for the production of flat rolled products.

(2) 138,000 t of billet are supplied as material to the existing mills of section steel and re-rolling.

(3) 225,000 tons of plate will be produced as finished products, portion of which is employed as material for large section mill and for pipe, and the rest is supplied to the correlated industries, such as shipbuilding, etc.

B. Programme of production for the Second Stage

(1) The amount of crude steel to be produced is 1,000,000 tons per year, out of which 150,000 t/year appropriated for the continuous casting process, and 850,000 t for the production of plates and sheets.

(2) 138,000 t of billet, as in the First Stage, are supplied as material to the existing structural mills re-rolling mills.

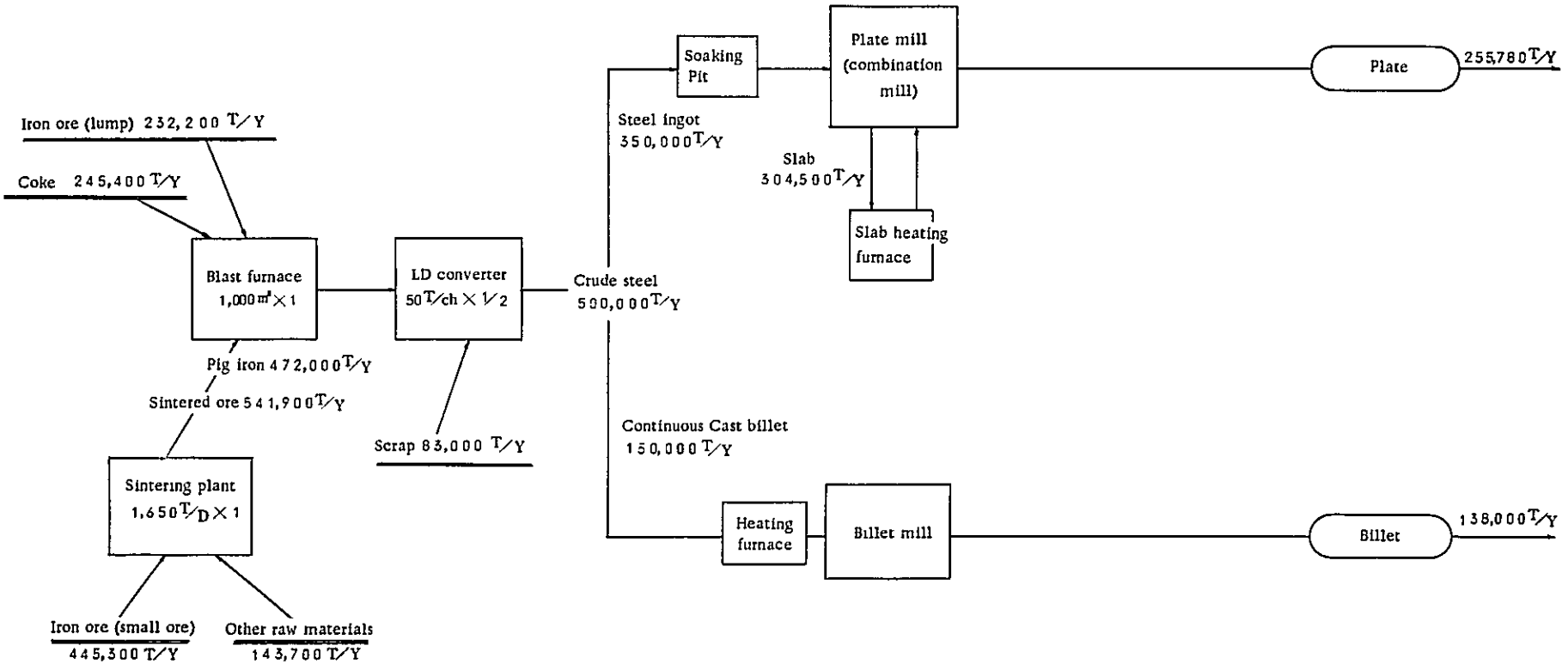
(3) Out of 850,000 tons of crude steel to be used for production of plates and sheets, 255,000 t are employed for manufacturing plates, and the rest for the hot strip mill, of which 120,000 t are supplied as material to the private cold strip mill now being planned. 60,000 t of hoop are supplied to the existing electric welded pipe manufactures; the production of hot rolled sheet is 126,000 tons per year, and the rest is made into coils for cold strip mill. Out of the cold rolled sheets 60,000 t/year supplied as material to the existing manufacturers of galvanized sheets, and 29,000 t/year sold as cold rolled hoop.

The summary of the production programme and the flow chart of production are as follows: -

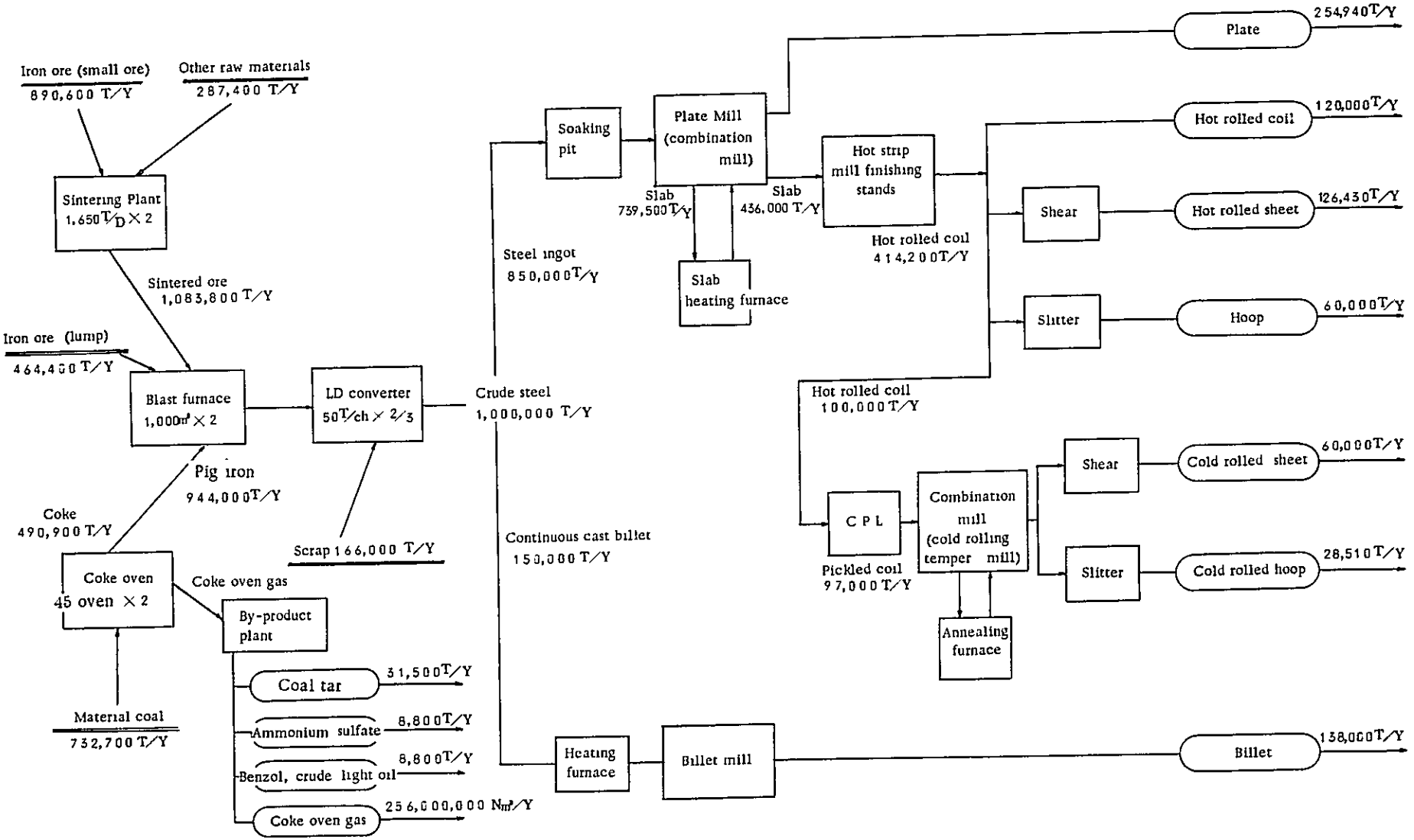
Summary of production programme

	Programme for First Stage		Programme for Second Stage	
1. Pig iron	472, 000 t/y (1, 310 t/d)	Blast furnace (1, 000 m^3) Sintering " (1, 650 t/d)	944, 000 t/y	Blast furnace, Sintering plant, Coke oven plant (90 ovens), etc.
2. Crude steel	500, 000 t/y	50t LD Converter x 2 Oxygen generator x 3 (4, 000 m^3/hr x 2)	1, 000, 000 t/y	50t LD Converters x 3 Oxygen generator x 3 (4, 000 m^3/hr x 3)
3 Conventional teeming and Continuous casting				
A) Continuous casting	150, 000 t/y	150 ϕ, 4 Strands (for billet)	150, 000 t/y	(for billet)
B) Ingot	350, 000 t/y	(for plate)	850, 000 t/y	(for plate)
C) Total	500, 000 t/y		1, 000, 000 t/y	
4. Billet	138, 000 t/y	3-high rolling mill x 1 60 - 70 ϕ	138, 000 t/y	
5 Plate		2-high rolling mill, 4-high finishing mill		
A) Plate	255, 000 t/y		255, 000 t/y	
B) Slab			436, 000 t/y	(for hot strip mill)
C) Total			691, 000 t/y	
6 Hot strip			Hot strip mill	
A) Commercial coil			120, 000 t/y	Hot shearing line
B) Cold rolled sheet cut to length			126, 000 t/y	
C) Hoop			60, 000 t/y	Slitting line
D) Coil for cold rolling			100, 000 t/y	
E) Total			406, 000 t/y	
7. Cold rolled sheet			C.P.L. Reversing mill, Bell-type annealing furnace	
A) Cold rolled sheet cut to length			60, 000 t/y	Shearing line
B) Cold rolled hoop			29, 000 t/y	Slitting line
C) Total			89, 000 t/y	

Flow chart of production programme for First Stage



Flow chart of production programme for Second Stage



4. Raw materials

A. Planning of raw materials per year for First Stage

(1) The amount of pig iron to be produced is 472,000 t. Let the basic unit of iron ore per ton of Pig iron be 1.64t, the blending ratio of sintered ore be 70%, and the yield of sintering be 92%, then the amounts of iron ore required for both blast furnace and sintering furmace are 232,200 t and 445,000t respectively, coming to 687,500t altogether.

(2) Most of the iron ore found in the Republic are magnetite, which contains extremely high SiO_2 and high S, and as a result its reducing character is poor when compared to that of other kinds of iron ore; while its disintegration involves no problem. If a large quantity of such an ore is charged into the blast furnace, its operation will become difficult, for such a burden is considered to deteriorate the productivity of the furnace because of the poor reducing character of the ore as well as ~~of~~ the increase in slag. If economical beneficiation such as crushing, screening, and magnetic separation, etc. is possible, a fairly large amount of magnetite ore can be used in the form of sintered fine ore with high Fe content brough about by magnetic concentration.

The reason for the export to Japan of the greater part of such iron ore is as follows: -

Japan depends on import for the most part of her iron ore requirement. The imported ore, being rich in Fe content, is poor in silica content, and, in the case of the ores from Goa and Dungun, their Al_2O_3 content is high and they tend cause poor fluidity and deteriorated desulferizing rate of slag, making the smooth operation of blact furnace difficult. Therefore, imported ores are blended with Korean ores containing high Silica in order to increase the ratio of SiO_2 to Al_2O_3 and reduce the percentage of Al_2O_3 remaining in the slag.

It is not advisable to employ a large amount of the domestic iron ore in the blast furnace operation in view of the advantage of its export as a means of obtaining foreign currency, its low reducing character and high percentage of SiO_2 content, the present situation of the exploitation of iron ore mines, etc. It would be advisable to export it to Japan where its special merit is appreciated, while trying to develop the economical methods of beneficiation such as crushing, magnetic concentration, etc.

For the reasons stated above we have concluded that at the initial stage of operation, 30% of the total iron ore requirements should be supplied from domestic sources and the rest, ~~to~~ depend on import. Accordingly, the amount of the imported iron ore will be 477,500t and that of the domestic one, 210,000t.

(3) The details of supplementary materials such as manganese ore, converter slag, limestone, blast furnace slag, scale and miscellenous materials are shown in the list attached herein.

(4) The annual requirements of coke for the blast furnace in the First Stage will be 245,000 tons (dry measure) with coke ratio of 520 Kg/ton, and that for sintering, 32,500t. Although due consideration should be given in future to the utilization of anthracite coal of the country, we have decided to import all of the coke needed for use in blast furnace and that only limited amount of anthracite coal is to be used for production of coke for sintering; the amount of coke to be purchased is 261,000 t per annum, taking into consideration 6% of weight loss.

B. Annual Requirements of Raw Materials in the Second Stage

(1) The annual requirements of the iron ore and supplementary materials will be twice that of the First Stage.

(2) As for the coke, a coke oven will be constructed during the Second stage. The annual consumption of coke in the Second stage is 490,900 tons and all of the 747,600 tons of coking coal, which is required to produce the said amount of coke, will be imported. The details are shown in the following list.

It is necessary to secure reliable sources of import who can supply raw materials such as iron ore, coal and coke, etc. on a long term basis thoughout the first and second stages.

Coke balance

	Blast furnace	Sintering
First Stage		
Coke	Coke ratio 520 Kg/t Heavy oil ratio 49 Kg/t Amount of Coke needed (dry) 472,000 t/y x 0.52 = 245,400 t/y Purchase amount of coke (dry) Rate of loss in weight : 2% Rate of production of screenings: 4% 245,400 t/y ÷ 0.94 = 261,000 t/y	Amount of coke needed 511,900 t/y x 0.06 = 32,500 t/y Supply Screenings from blast furnace (4%) 10,400 t/y Anthracite (amount to cover shortage) 22,100 t/y
Second Stage		
Coke (homemade)	Amount of coke needed 944,000 t/y x 0.52 490,900 t/y Amount of Coke produced 944,000 t/y x 0.52 = 490,900 t/y	Amount of coke needed Supply Screening from blast furnace 732,700 t/y x 0.04 = 29,300 t/y Fine coke produced at coke oven 732,700 t/y x 0.04 = 29,300 t/y Anthracite (amount to cover shortage) 6,400 t/y
Material coal (imported)	Amount of charge in coke oven (yield rate of lump coke: 67%) 490,900 t/y ÷ 0.67 = 732,700 t/y Import amount of coal (rate of loss in weight: 2%) 732,700 t/y ÷ 0.98 = 747,600 t/y Ceperation rate of coke oven 732,700 ÷ 365 ÷ (15.5 x 90) = 144%	

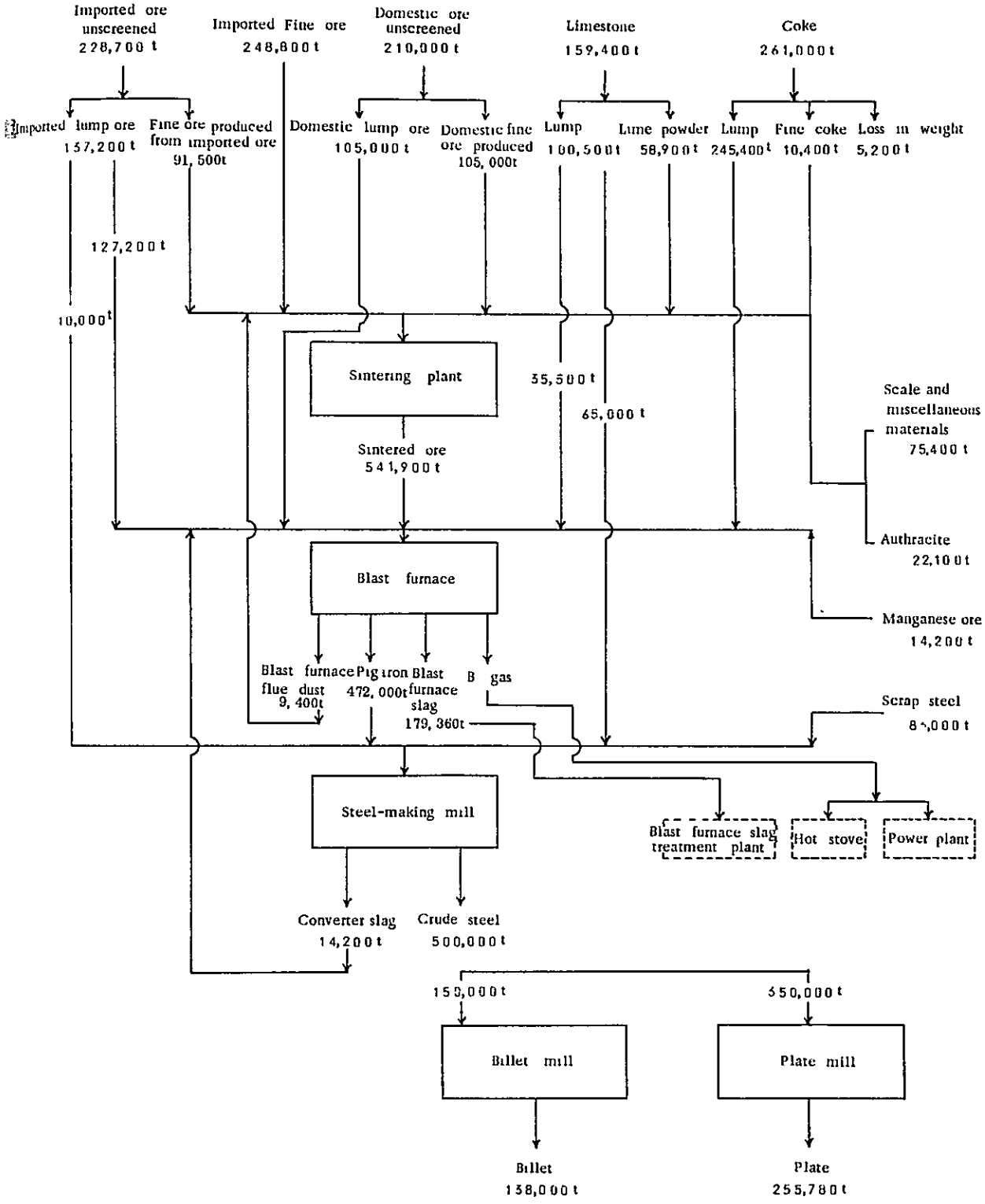
Balance of iron ore and other principal supplementary materials
(First Stage)

	Total	Blast furnace	Sintering	Converter	Remarks
Iron ore	t/y	t/y	t/y (Fine ore produced)	t/y	. Ore ratio of charge in blast furnace: 1.64 t/t, Blending ratio of sintered ore: 70%. Amount of ore needed: 472,000 t/y x 1.64 = 774,100 t/y Sintered ore 774,000 " x 0.70 = 541,900 " Lump ore 774,000 " x 0.30 = 232,200 "
Imported iron ore unscreened (ratio of fine ore : 40%)	228,700	127,200	91,500	10,000	
Imported fine ore	248,800		248,800		
	0				
Total of imported ore	477,500	127,200	340,300	10,000	Iron ore for sintering (yield rate: 92%) 541,900 t/y ÷ 0.92 = 589,000 t/y
Domestic ore (ratio of fine ore : 50%)	210,000	(Lump) 105,000	(Fine ore produced) 105,000		. Iron ore to be charged into convertor 20 Kg/t
Total	687,500	232,200	445,300	10,000	
Raw-material					
Manganese ore	14,200	14,200			30 Kg/t
Converter slag	14,200	14,200			30 Kg/t
Limestone	159,100	(Lump) 35,500	(Fine ore produced) 58,900	(Lump) 65,000	For blast furnace 200 Kg/t For sintering : 10% of material needed Calcined lime for converter: 65 Kg/t Calcination loss : 50%
Blast furnace blue dust	9,100		9,100		20 Kg/t
Scale and miscellaneous materials	75,100		75,400		
Total	272,600	63,900	143,700	65,000	
Grand Total	960,100	296,100	589,000	75,000	

(Note) The amount for the Second Stage is twice that for the First Stage.

Balance of principal raw materials

First Stage (crude steel: 500, 000 t/y)



5. Plan for Production Facilities

A. Outline

(1) Plant Layout

As detailed in the attached exhibit, the plant loyout has been arranged on the basis of using an area of approximately 2,640 (thousands) sq. meters located in the proposed site for the iron works in Ulsan area. It is also arranged to provide space required to accomodate all necessary mills and equipments at the time when three blast furnaces are in operation.

(2) Construction Site

The site located on the left bank of the Tae Wha River and occupying about 2,640 (thousands) square metres in area consisting of the graded land and reclaimed ground was selected.

Because the soil condition of the reclaimed land is soft, the land up to 15 to 20 meters above sea-level is to be graded so that a greater part of the facilities planned in the first stage may be installed in the existing land area.

The proper edge height of the site appears to be +3.0 to +4.0 meters above L.W.L.

With the progress of construction of the site, expropriation of the villages, rebuilding of roads, rechanneling of irrigation and brooks, etc. will become necessary.

(3) Port and Harbour

The harbour is designed to be constructed on the southeast of the proposed site; the outline is as follows: -

a. Fairway

In order to enable boats to reach the port, fairway must be provided to the right of the existing faireway which leads to No. 3 fertilizer plant. Necessary water depth is 11-12m for the First Stage and ultimately it must be 12-13m. Besides, it will be necessary to remove small shoals now existing at the entrance of the harbour and to construct sea walls.

b. Anchoring Berth

It is possible to provide an anchoring berth with an area of over 1,200 x 450 m. In order to maintain the same depth as that of fairway, water around the anchoring berth must be dredged.

The construction of sea walls and some facilities for small fishing boats will be necessary near by the existing villages.

c. Training Dike

Training dikes of 800 - 900 meters long should be built to prevent the silt discharged from the River Tae Wha from flowing into the harbor and port.

d. Quay

Four berths extending about 900 meters in length can be built at the

quay for the exclusive use of unloading raw materials, but a berth or two would be sufficient for the operation in the first stage. The quay can also afford to arrange a berth, more then 450 m in length, for the shipment of products.

e. Counter-measures for Silting

As the fairway and the vicinity of the harbour mouth are liable to be deposited with silt discharged from the Tae Wha River, effective measures to counter the deposition of silt would be to dig pockets a little upstream and perform constant maintenance dredging.

This will be effective also for the fairway of the fertilizer plant.

(4) Facilities for production of pig iron

One blast furnace (1,000 m^3) will be built corresponding to the scale of crude steel production for each stage of construction. Blast furnace is designed so that high top pressure operation devices can be equipped with it in future.

Raw materials requirements will be as follows,

The iron ore will consist, throughout the First and Second Stages, of 30% sized lump ore and 70% sintered ore. The coke will depend on import for the entire requirements during the First Stage, and it will be self-supplied in the Second Stage with the construction of a coke plant (2 batteries, 40 ovens each). One sintering plant of Dwight Lloyd type with capacity of 1,650 ton/day will be built for each stage. Coal chemicals such as ammonium sulphate, naphthalene, crude benzol, tar and light oil, etc. will be produced in a chemical by-product plant. Pig iron production plant will be provided with storage yards capable of storing 2 months' raw materials requirements.

(5) Facilities for steel making

Molten iron is carried by ladle cars and stored in the mixer. The mixer is designed to hold and keep 1,000 tons of molten metal brought to it from blast furnaces even on the reparing day of the convertor (for 12 hours once a week).

Steel-making is performed by converters of the L.D. oxygen steel making process. Two converters, each with capacity of 50 tons per charge will be built for the First Stage, operating one of them at the rate of 37 charges per day; for the Second Stage three converters will be installed, two of which operating at the rate of 67 charges per day.

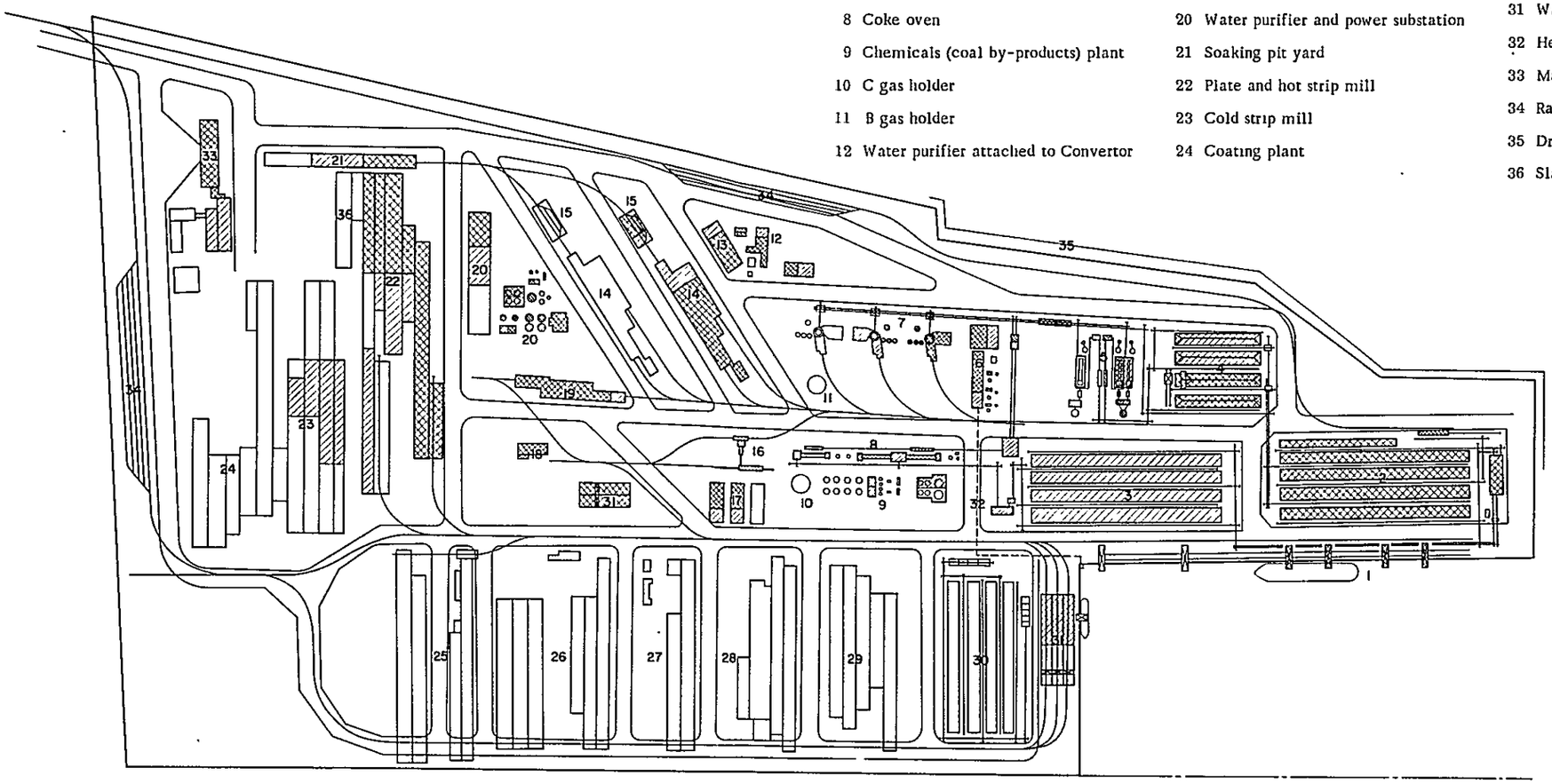
Scrap will be brought by truck in the iron works, where it will be charged into scrap bags.

The continuous casting machines will produce the material of billet of 150 ϕ,to be sold to outside manufacturers and the steel ingot for plate and hot strip will be molded by conventional teeming process.

Oxygen generating equipment and lime-calcination plant will be built in the works to produce oxygen and calcined line.

1 Berth
2 Ore yard (including coke yard)
3 Coal yard
4 Ore-bedding yard
5 Sintering plant
6 Power generation plant
7 Blast furnace
8 Coke oven
9 Chemicals (coal by-products) plant
10 C gas holder
11 B gas holder
12 Water purifier attached to Convertor
13 Oxygen generator
14 Convertor and continuous casting mill
15 Stripping yard
16 Pig casting machine
17 Repair shop
18 Repair shop of ladles
19 Billet mill
20 Water purifier and power substation
21 Soaking pit yard
22 Plate and hot strip mill
23 Cold strip mill
24 Coating plant
25 Electric welded pipe mill of medium diameter and butt welded pipe mill
26 Structural mill
27 Wire rod mill
28 Round bar mill
29 Large diameter electric welded pipe mill
30 Stockpiling yard of raw materials
31 Warehouse of products
32 Headrace (Channel) of sea water
33 Main office
34 Railway yard
35 Drainage channel
36 Slabbing mill

1st Stage of construction
2nd "
3rd "



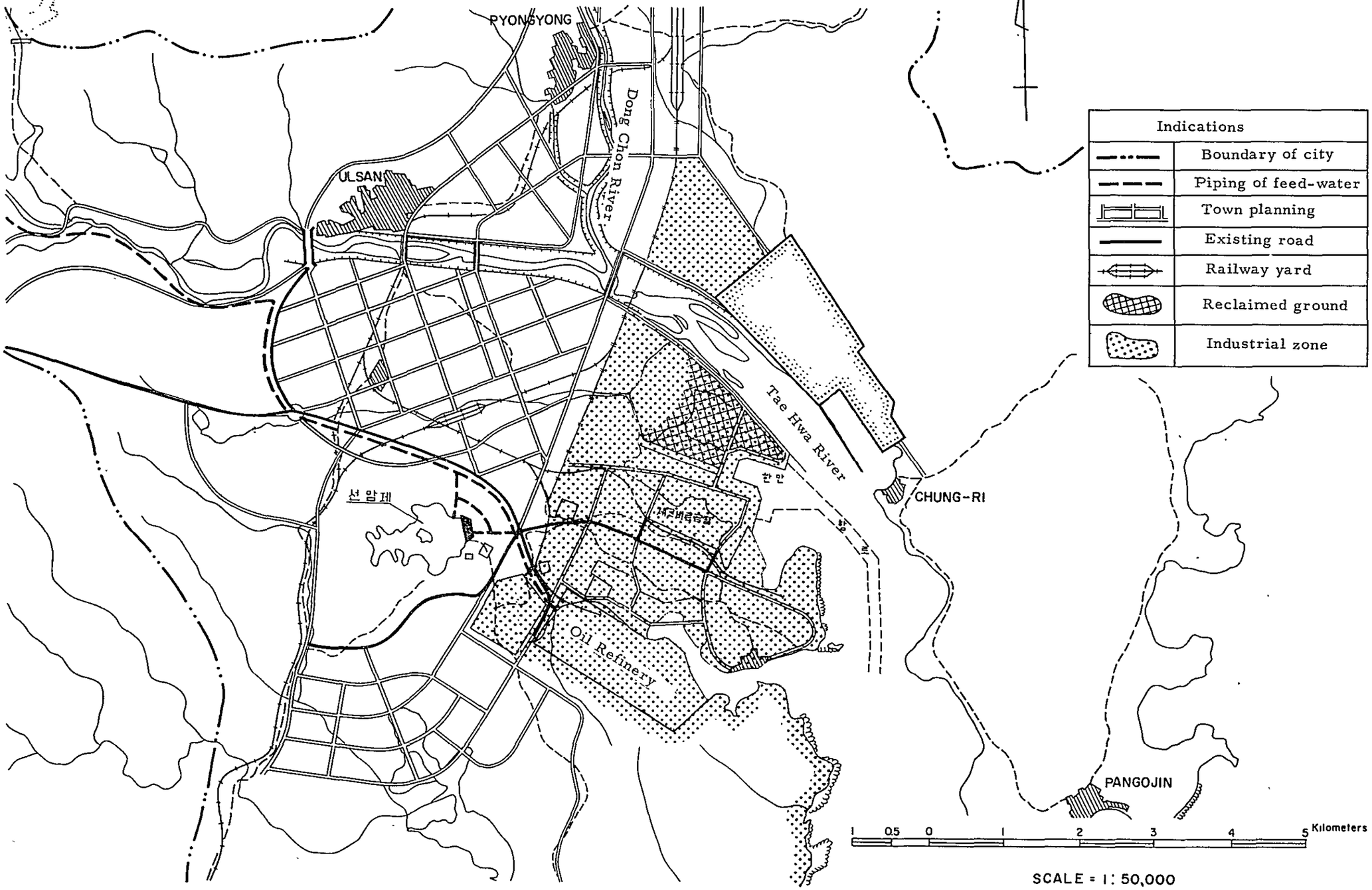
Construction plan of 1st Stage
Construction plan of 2nd Stage
After construction of 3rd Stage

0 100 200 300 400 500m

N

COMPLETE LAYOUT OF THE ULSAN IRON AND STEEL WORKS

ULSAN INDUSTRIAL AREA



(6) Billet Mill Facilities

The billeting mill will roll ingots of 150,000 tons per year, produced by continuous casting unit, into commercial billets of 60 - 75 m/m ϕ to be sold to the outside manufacturers. The billet mill consists of only one stand of three-high mill, but it is possible to remodel it so that the operation efficiency of the mill can be improved, and, at the same time, it can roll billets of 180 - 200 ϕ, if demands for high carbon and high alloy steels arise in future.

(7) Rolling mill facilities

a. Plate mill

The plate mill will roll the ingots, of which 350,000 tons/year are for the plate throughout the First and Second Stages, and 500,000 tons are for the slab for making hot strip during the Second Stage. As measured by the tonnage it rolls in a year, this much slabbing of ingot can be done by the plate mill without a slabbing mill. Therefore, a soaking pit only will be installed and the plate rolling mill will be used both for slabbing of ingots and roughing stand for hot strip mill. The slabs, which are sent to the plate rolling mill through continuous slab reheating furnace, are rolled into plate or delivered to the finishing stands of hot strip mill.

The layout of the plate mill has been so arranged as to allow the construction of a slabbing mill in case of its need in future.

b. Hot strip mill facilities

The slab which has had its cross section reduced by the plate mill will be rolled into hot strip coils by the continuous finishing stands of hot strip mill.

In additon, as the necessary equipment for further processing of the steel, a continuous shearing line and a slitting line have been designed.

c. Cold rolling facilities

In consideration of the scale of production, the cold strip mill has been designed to be of reversible type. It is a combination mill which can also do the work of skin passing. As the necessary equipment for processing the products, a continuous shearing line, a slitting and a recoiling line have been designed to be installed.

(8) Power facilities

a. The blast furnace gas is collected in a gas holder of wet type with capacity of 30,000 m^3 and supplied to the hot stove and boilers at an internal pressure of 300 mm Aq.

The coke gas to be produced by the coke ovens, which will be built in the Second Stage, is collected in a gas holder of wet type with capacity of 20,000 m^3 and supplied to the rolling mills by blower at a pressure of 1,000 mm Aq and to the boiler at an internal pressure of 300 mm Aq.

In order to supply the steam to the power plant, to be built in the plant, the turbine of the blower and the mills, two boilers, each with capacity of 55 ton per hour, for the First Stage and another boiler with capacity of

110 tons per hour for the Second Stage will be installed in accordance with the programs of construction and operation.

b. The independent power plant consisting of two generators, each with capacity of 15,000 KW, will be installed in each Stage. They are chiefly used for operation and emergency purposes. The electric power to be purchased will be received at 66 KV and supplied to the facilities at 20 KV or 6 KV.

The transformer of the central substation is designed to be of 25 MVA and that of each substation located in such plants as the blast furnace, steel making mill and rolling mill etc. will be 10 MVA.

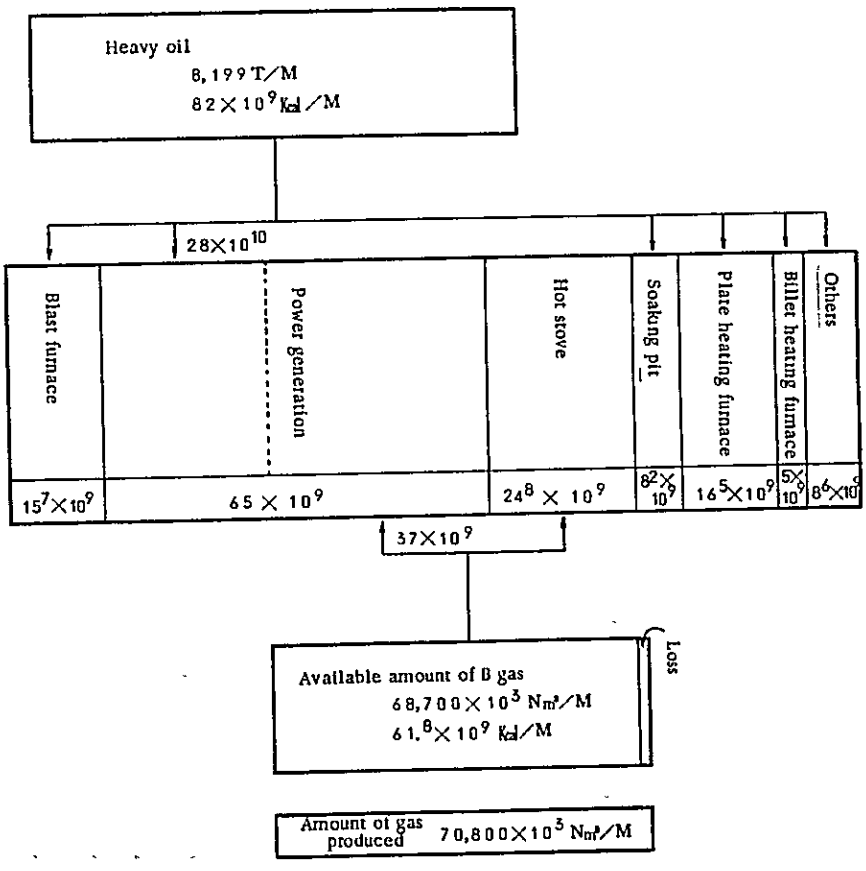
(9) Water System

Water system within the plant site is arranged so that water can be circulated and re-used, taking into consideration in principle the volume to be consumed and cost of water. Water system will be classified into two: i.e., contaminated water which can not be re-used; recirculated water whose temperature only rises while in use as cooling agents. The former is discharged after purification, and the latter is circulated by pump for re-use after cooling or after removing the mill scale in it by sedimentation.

Requirements of such items as gas, electric power, industrial water, oxygen and steam are shown, in the accompanying sheets for reference.

First Stage Balance of B gas and heavy oil

(unit: Kcal/M)



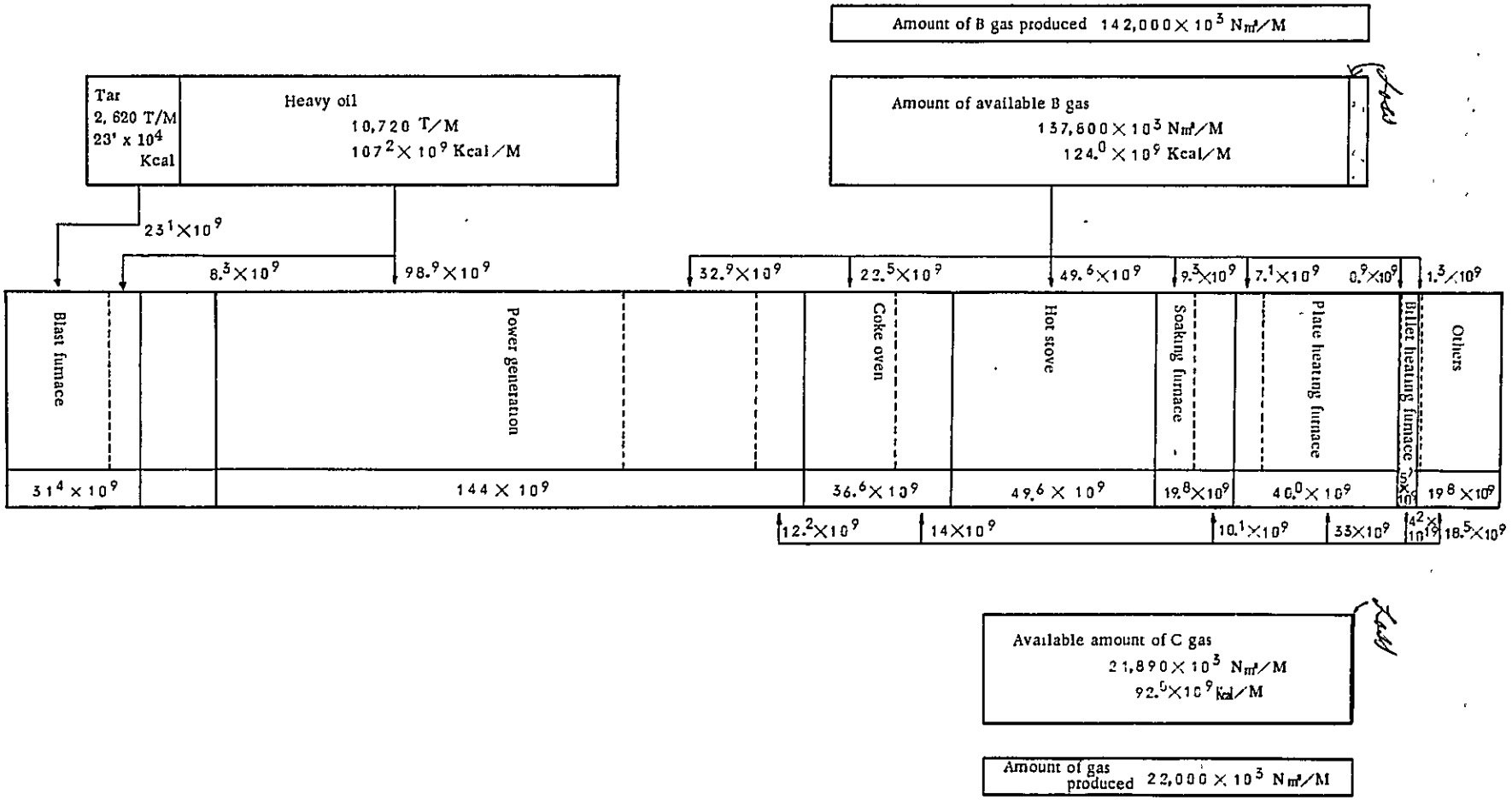
Balance of gas, heavy oil and coal tar

(unit of B and C gas: Nm^3/M; unit of heavy oil)

		Standard	Basic unit	First Stage				Second Stage				Remarks
				Amount of production T/M	Amount of gas $\times 10^3 Nm^3/M$		Heavy oil T/M	Amount of production T/M	Amount of gas $\times 10^3 Nm^3/M$		Heavy oil T/M	
					B gas	C gas			B gas	C gas		
Amount of generation	B gas	Pig iron	1,800 Nm^3/PT	39,300	70,800			78,600	142,000			1. Amount of gas loss B gas 3% C gas 0.5%
	C gas	Coal charged	360 Nm^3/T					61,000		22,000		
	Gas loss				△2,100				△ 4,200	△ 110		2. Quantity of heat B gas 900 kcal/Nm^3 C gas 4,220 " Heavy oil 100,000 kcal/kg Tar 8,820 "
	Available amount of gas				68,700				137,800	21,890		
	Coal tar	Coal charged	4.3 %					61,000			※ 2,620	
Amount of consumption	Blast furnace	Pig iron	40Kg/T	39,300			1,570	78,600			※ 2,620 830	3. Rate of mixing (B and C gas) Coke oven: B/C = 7.5 Soaking pit: B/c=4.5 Heating furnace: B/C=1 Plate heating furnance: B/C=1
	Hot stove	"	630 × 10^3 Kcal/T	39,300	27,600			78,600	55,200			
	Coke oven	Coal charged	600 × 10^3 "	—				61,000	25,000	3,330		
	Soaking pit	Ingo	280 × 10^3 "	29,200			816	71,000	10,800	2,410		
	Heating furnace	Bloom	400 × 10^3 "	12,500			500	12,500	980	980		* indicates coal tar
	Plate heating furnace	Slab	650 × 10^3 "	25,400			1,650	61,600	7,850	7,850		
	Sintering furnace	Sintered ore	25 × 10^3 "	45,000			112	90,000		536		
	Converter	Ingot	42 × 10^3 "	41,700			175	83,400		834		
	Ammonium sulfate	Ammonium sulfate	100 × 10^3 "	—				800		19		
	Cold rolling	Cold rolling amount	300 × 10^3 "	—				8,350		595		
	Boiler				41,100		2,800		36,570	2,906	9,890	
	Lime kiln	Calcined lime	1,800 × 10^3 "	2,700			486	5,400		2,320		
	Others						90		1,400	110		
	Total				68,700		8,199		137,800	21,890	※ 2,620 10,720	

Second Stage Balance of B gas, C gas, heavy oil and coal tar

(unit: Kcal/M)



Balance of electric power

		First Stage			Second Stage			Remarks
		KWH/M	KWH/H	Maximum load (15M)	KWH/M	KWH/H	Maximum load (15M)	
Amount of generation	Generation	$8,640\times10^3$	12,000		$17,280\times10^3$	24000		
	Power received	3,760	5,200		10,970	15200		
	Total	$12,400\times10^3$	17,200	24000	$28,250\times10^3$	29200	55,000	Load factor: 0.7

		Standard	Basic unit	First Stage		Second Stage		Remarks
				Amount of production (t/M)	KWH/M	Amount of production (t/M)	KWH/M	
			KWH/T					
Amount of consumption	Blast furnace	Pig iron	22	39,300	870×10^3	78,600	$1,730\times10^3$	
	Sintering plant	Sintered ore	30	45,200	1,350	90,400	2,700	
	Converter	Ingot	12	41,700	500	83,400	1,000	
	Slabbing mill	Ingot	30	41,700	1,250	83,400	2,500	
	Plate	Slab	90	25,400	2,290	25,400	2,290	
	Hot strip	Slab	100	—		36,300	3,630	
	Cold rolling	Pickling	110	—		10,000	1,100	
	Coke	Coal charged	13	—		61,100	790	
	Chemicals	Coal charged	2	—		61,100	120	
	Lime kiln	Calcined lime	20	5,400	120	10,800	220	
	Total				6,380		16,080	
	Power substation				860		1,730	
	Industrial water				830		1,670	
	Oxygen				2,260		4,520	
	Air, Gas, Lighting, Others				1,720		3,440	
	Total				5,670		11,360	
	Loss				350		810	
	Grand total				$12,400\times10^3$		$28,250\times10^3$	

Consumed amount of fresh water (make-up feed) and sea water

		First Stage T/H	Second Stage T/M
Fresh water	Supply pipe of pig iron making plant	560	1,120
	Supply pipe of steel making plant	730	1,235
	Supply pipe of rolling mill	280	968
	Total	1,570	3,324
Sea water	Power generation plant	8,000	16,000
	Other mill	4,450	10,000
	Total	12,450	26,000

Balance of oxygen

		Standard	Basic unit	First Stage		Second Stage		Remarks
				Amount of production (t/M)	O_2	Amount of production (t/M)	O_2	
Amount of production					3,700 m^3/H		7,400 m^3/H	
Amount of Consumption	Converter	Ingot	52 m^3/H	41,700	3,350	83,400	6,700	Finishing of billets only
	Billet	Billet		36,300		72,500		
	Muscellaneous uses				350		700	
	Loss							
	Total				3,700		7,400	

Balance of steam

(unit: T/H)

		Stage of construction	
		First Stage	Second Stage
Supply	Boiler of power station	100	220
Consumption	Blast furnace	3.0	6.0
	Chemicals	0	1.6
	Sintering	0.06	0.12
	Converter	1.0	2.0
	Slabling mill	1.4	3.0
	Plate, Billet, Hot Strip mill	5	15.0
	Cold strip mill	0	6.6
	Other muscellaneous uses	10	20.0
	Total	20.46	59.72
	Power generator	55.3	110.6
	Blower	15.5	31
	Power station	7	15
	Total	77.8	156.6
	Evaporation loss	1.8	3.7
	Grand total	100 T/H 72,000 T/M	220 T/H 159,000 T/M

B. Items of principal facilities

For the First and Second Stages the principal items of the facilities are as listed in the accompanying sheets. They are the facilities for: the production of pig iron, steel making, billeting, plate rolling (combination mill of rolling slabs, plates and roughing hot strip), hot strip mill, cold strip mill, oxygen generation, electric power generation, power receiving and distributing, etc.

1. Facilities for production of pig iron

	First Stage			Second Stage		
Name	Number	Capacity	Remarks	Number	Capacity	Remarks
Blast furnace and auxiliary installation	1 set	1,300 T/D	A blast furnace of 1,000 m^3 (designed in anticipation of attaching installations for high top process in future) 3 hot stoves, material winding apparatus of belt conveyer type, gas purifier, pig casting machines and other auxiliary equipments	1 set	Addition: Capacity and specifications are the same as those of First Stage	
Sintering machine	1	1,650 T/D	Dwight Lloyd type with hearth area of 55 m^2 consisting of sintering machines and auxiliary apparatuses	1	"	"
Coke oven				1	1,450 T/D	Coke oven consisting of 90 oven (45x2) with auxiliary apparatuses
By-product plant				1 set		Ammonium sulfate collector, naphthalene cleaner, crude benzol collector, tanks of coal tar and light oil
Raw material handling facilit	1 set		300 T/Hr UCx2, 200T/Hr UCx2, stacker, jib loader, crushing and screening equipment, 1 set of belt conveyor, a yard of 45,000 m^2 for iron ore, coke, etc., and an ore-bedding yard of 9,000m^2	1 set	Addition	Stacker, jib loader, crushing and screening equipment, 1 set of belt conveyors, addition of 45,000 m^2 area to yards of iron ore and coal, and addition of 9,000 m^2 to ore-blending yard

2. Steel making facilities

	First Stage			Second Stage		
Name	Number	Capacity	Remarks	Number	Capacity	Remarks
Mixer	1	1,000 T	Mixer and auxiliary equipment	1	Addition: Capacity and specifications are same as those of First Stage	
Converter	2	500,000 T/Y	Converter of 50 T/ch x 2, tilting apparatus, dust collector, oxygen blowing apparatus, ingot molding equipments, and other auxiliary equipments	1	" (1,000,000 T/Y)	"
Auxiliary equipments	1 set		Scale, ladle, scrap bag, pit of subsidiary material, 8 cranes, trucks, etc.	1 set		5 cranes; Others are same as foregoing
Continuous casting machine	1 set	150,000 T/Y	Casting facilities of 150 x 150mm ϕ, 4 strands with auxiliary equipments			
Dolomite kiln	1 set	500 T/M	1 crushing, 1 pressing, and 1 scale for kiln material			
Line kiln	1 set	100 T/D	Roasting apparatus of lime			
Building	1 set		Floor space: 8,984 m^2	1 set		Added floor space: 3,240 m^2

3. Facilities for billet mill

	First Stage			Second Stage		
Name	Number	Capacity	Remarks	Number	Capacity	Remarks
Heating furnace	1	50 T/Hr	Continuous reheating furnace of 3-zone type, 6,000 x 20,000 mm			
Rolling mill	1 set	150,000 T/Y	3-high rolling mill x 1; roll size: 680 m/m x 1,600 mm; main motor: AC 1,500HP; auxiliary motor: AC 540 HP; material: 150 ϕ x 2,500 mm; products: 60 - 70 ϕ x 1,500 - 2,000 mm Tilting table, turning apparatus, billet shear and other auxiliary equipments			
Auxiliary equipments	1 set		Roll lathe, shaper, 5 cranes, scarfing and inspecting apparatus of products, feed water and drainage equipments, etc.			
Building and foundation	1 set		Building: 4,000 m^2, foundation: 8,000 m^3			

4. Facilities for plate mill

(combination mill of rolling slabs, plates and roughing hot strip)

First Stage				Second Stage		
Name	Number	Capacity	Remarks	Number	Capacity	Remarks
Soaking pit	3	(350,000 T/Y)	Recuperator type, 1 battery two pits; amount of charge per pit: 80 - 50 T/time	4	Addition (850,000 T/Y)	Specifications: Same as foregoing
Reheating furnace	1	100 T/Hr	Continuous reheating furnace of 3-zone type	2	Addition: Capacity and specifications, same as foregoing	
Rolling mill	1 set		Maximum unit weight: ingot: 12T; slab: 10.8T Maximum breadth of product: 2,850 mm; minimum thickness: 4.5 m/m; maximum length: 20m 2-high reversing roughing mill x 1; main motor: 6,000 HP; roll size: 46" x 120" Edger; motor: 1,500 HP, roll: 42" ϕ 4-high reversing finishing mill x 1; main motor: 7,000 HP; roll size: 36" & 60" x 120"; table and other auxiliary equipment			
Slab mending equipment	1 set		Slab carrier table, frame cutter, hand scarfing apparatus			
Finishing equipment	1 set		Light leveller, dividing shear, cooling bed, heavy leveller, plate inspector, trimming shear (with scrap chopper), piler, frame planer, etc.			
Annexed equipment	1 set		1 roll grinder, 13 cranes, feed water and drainage apparatuses			
Building	1 set		Building: 33,230 m^2			

5. Hot strip mill

First Stage				Second Stage		
Name	Number	Capacity	Remarks	Number	Capacity	Remarks
Hot strip mill				1 set		Flying crop shear maximum shearing thickness: 2.5 m/m Finishing scale breaker 1 set Continuous finishing mill: 4-high mill x 5, Roll size: 27" & 56" x 56", main motor: 4,000 HP x 43,500 HP x 1, maximum unit weight of material slab: 7.5 T, maximum breadth of product: 1,270 mm (50"); Thickness of product: minimum 1.6 m/m-maximum 8 m/m Runout table: 111 m in length Down coiler x 2 Descaling apparatus, coil conveyor, etc.
Plate finishing apparatus				1 set		50" hot shearing line, maximum shearing thickness: up-cut shear 8 m/m; flying shear 3.2 m/m Slitter, Slitting thickness: maximum 6 m/m
Auxiliary equipment				1 set		2 roll grinders, 1 knife grinder, 7 cranes, feed water and drainage apparatus, etc.
Building				1 set		Building: 16,760 m^2

6. Cold strip mill

First Stage				Second Stage		
Name	Number	Capacity	Remarks	Number	Capacity	Remarks
Continuous pickling line				1	15,000 T/M	Breadth: 56"; maximum thickness: 6 m/m Weight of coil: inlet: 7.5T; outlet: 10 - 20T
Combination mill				1	10,000 T/M	Material, thickness: 1.6-4.5 m/m, Weight of coil: maximum 20T, breadth: maximum 50" Product, thickness 0.2-2.3 m/m, breadth: maximum 50" 4-high reversing mill, roll size: 16"-14" & 56" x 56", main motor: 1,300 KW x 2 with tension rolls at inlet and outlet
Annealing furnace				8		Direct fired bell type, single stack x 8.24 per base Set of protective gas (D x gas) producer, etc.
50" sheaving line				1		Shearing thickness: 0.2-2.3 m/m, line speed: 350 f PM, Weight of coil: 10 - 20T
Annexed equipments				1 set		Slitting thickness: 0.2 - 2.3 m/m
Building				1 set		Building: 16,300 m^2 in floor space

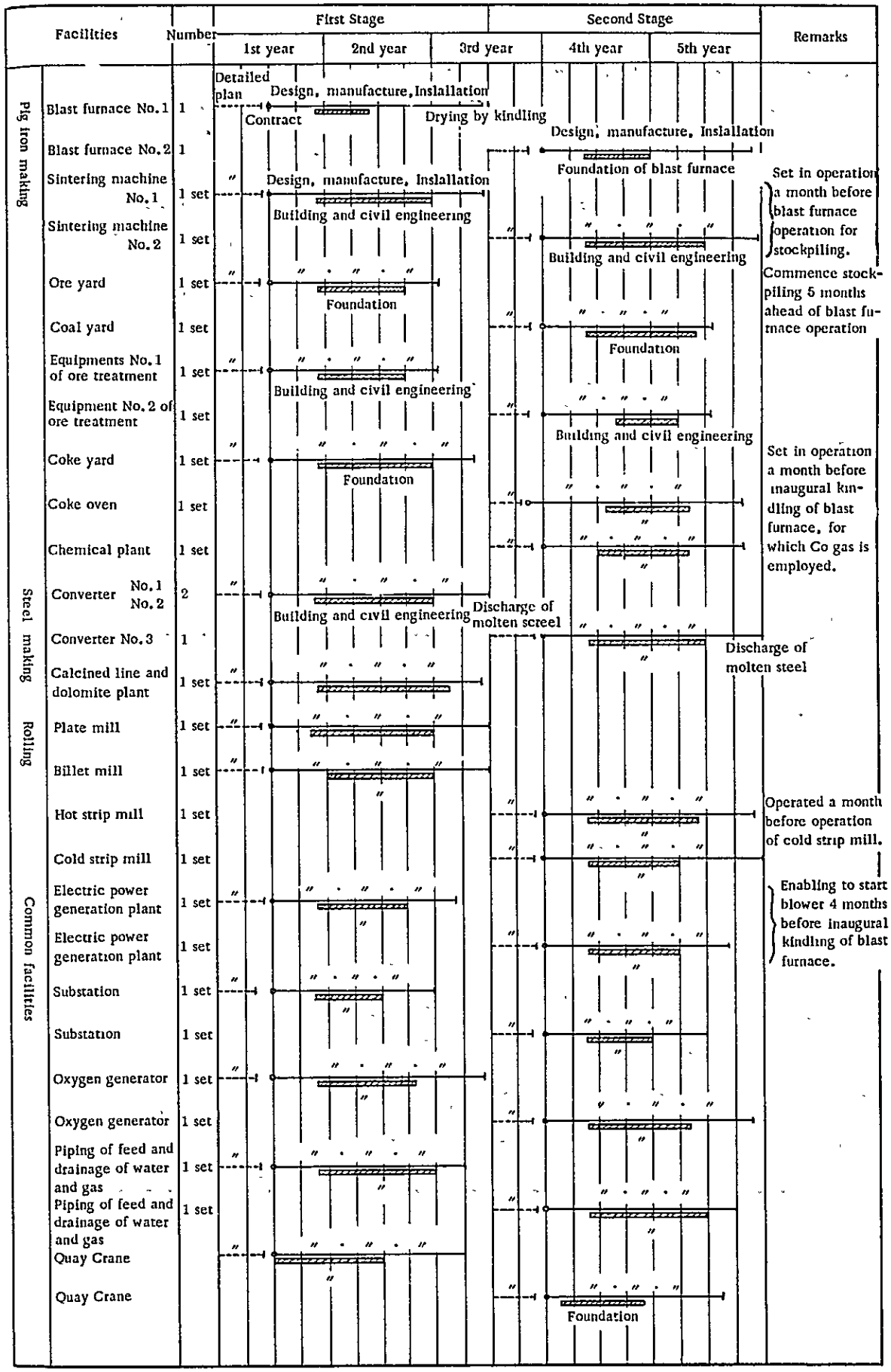
7. Facilities for oxygen generation, electric power generation, and power receiving and transforming

First Stage				Second Stage		
Name	Number	Capacity	Remarks	Number	Capacity	Remarks
Oxygen generator	2	4,000 Nm^3/Hr	Operation rate of generators: 1/2 (one kept in reserve in case another placed under repairs), Oxygen holder of 440 m^3 x 1 attached, Internal pressure of holder: 30 kg/cm^2	1	4,000 Nm^3/Hr	Another generator added, operation rate: 2/3 Including another holder of 440 m^3 added
Equipment for boiler, electric power generation and blower of blast furnace	1 set		55 t/H boiler x 2, 1,500 KW generator x 1, 5,500 KW axial blower x 2	1 set		110 T/Hr boiler x 1, 1,500 KW generator x 1, 5,500 KW axial blower x 1
Feed water equipments	1 set		Respective equipment for treating, rapid-filtering and pumping return water and a cooling tower in each site of rolling, steel making and pig iron making mills.	1 set		Addition of foregoing
Waterworks of service water	1 set		Reservoir of service water: pumping equipment	1 set		Addition of foregoing
Sea water equipments	1 set		Pumping-up plant of sea water; capacity:10,000 T/Hr			
Air compressor	1 set		Air compressor (42 Nm^3/Hr, 8 kg/cm^2) x 3	1 set		Compressor x 2
Gas equipments	1 set		B gas holder of wet type x 1: 30,000 m^3	1 set		C gas holder of wet type: 20,000 m^3,
Piping	1 set		Piping of gas, industrial water and compressed air	1 set		Pressure pump of C gas x 1 Addition of foregoing
			Chemical motor fire engine x 1, motor fire engine x 1			
Substation	1 set		Central substation and respective substation for steel making, sintering material and rolling mill. Distribution lines, communication equipment, etc.	1 set		Addition of foregoing

8. Others

First Stage				Second Stage		
Name	Number	Capacity	Remarsk	Number	Capacity	Remarks
Transport facilities	1 set		25 T DL locomotive x 10;	1 set		25T DL locomotive x 5; 25 cars; railway lines; crane for shipment of products x 1
Workshop	1 set		Machine shop, plate working shop and car repairshop	1 set		Addition of foregoing
Office	1 set		Main office, field office, dressing room. Equipments for analysis and inspection and building	1 set		Addition of foregoing

Progress schedule of construction



C. Progress schedule of construction

The progress schedule of construction of principal facilities, as shown in the lists below, will take 2.5 years for each Stage, but this term of construction may be cut short as the case may be. Besides, the division of the First and Second Stages has been made in consideration of the necessary funds, trend of the demand for steel products and expansion projects of the existing enterprises; therefore, the facilities may be reconsidered, and the term, shortened, if necessary.

D. Rough estimate of production cost

As listed below, a rough estimate of the construction cost is about ¥30,000 (millions) for the First Stage and about ¥30,000 (millions) for the Second Stage, amounting to about ¥60,000 (millions) altogether. It is necessary to note that this estimate does not include the cost of such matters as the site, harbour and dredging, etc.

List of rough estimate of construction cost

(unit:million yen)

Items of facilities	First Stage			Second Stage			Grand Total		
	Works	Purchase	Total	Works	Purchase	Total	Works	Purchase	Total
Blast furnace	869	4,729	5,598	678	4,045	4,723	1,547	8,774	10,321
Coke oven	–	–	–	420	2,624	3,044	420	2,624	3,044
Sintering	140	897	1,037	140	897	1,037	280	1,794	2,074
Converter	606	3,101	3,707	199	1,564	1,763	805	4,665	5,470
Continuous casting	70	690	760	–	–	–	70	690	760
Billet mill	95	897	992	–	–	–	95	897	992
Plate mill	1,311	6,548	7,859	–	–	–	1,311	6,548	7,859
Hot strip mill	–	–	–	955	6,344	7,299	955	6,344	7,299
Cold strip mill	–	–	–	378	3,462	3,840	378	3,462	3,840
Oxygen	252	1,082	1,334	126	541	667	378	1,623	2,001
Power generation	489	3,746	4,235	462	2,958	3,420	951	6,704	7,655
Others	610	2,042	2,652	260	1,463	1,723	870	3,505	4,375
Total	4,442	23,732	28,174	3,618	23,898	27,516	8,860	47,630	55,690
Project Engineering fee	222	1,187	1,409	181	1,195	1,376	403	2,382	2,785
Grand total	4,664	24,919	29,583	3,799	25,093	28,892	8,463	50,012	58,475

Standards of estimating construction cost:

1. 'Works' means the cost of construction to be executed in the location; 'Purchase' means the cost of machinery and construction materials to be imported.
2. The construction cost has been estimated at 70% of the supply price in Japan, taking into consideration the level of wages and productivity of labour in the Republic.
3. The cost of machinery and instruments to be purchased has been estimated by adding such necessary expenses as freight, etc. to their procurement prices in Japan; this cost does not include the import duties and other taxes.
4. The item 'Others' includes reserve funds.
5. 'Project engineering fee' represents 5% of the total cost of 'Works' and 'Purchase'.
6. Such costs as stated below have been excluded.
   (1) Cost of site and land adjustment.
   (2) Cost of harbour construction and dredging
   (3) Cost of dispatching engineers for guidance of construction and operation.
   (4) Cost of facilities outside the mill for electric power, waterworks, railways, etc.

6. Training programme of personnel

A. Necessary personnel list

The personnel needed for the iron works consists, as listed below, of about 1,500 for the First Stage and about 1,500 for the Second. This number has been estimated by referring to that of principal iron works in Japan, and does not include such personnel as needed for contract work or repair work given to other enterprises, etc. It is required to secure such personnel and give them necessary education and training.

In addition to such personnel, technical and common enployees must be secured as well.

List of personnel

	First Stage	Second Stage
Blast furnace	200	290
Sintering	110	200
Coke oven	-	145
LD converter	250	420
Continuous casting	40	40
Billet	80	80
Plate	340	490
Hot strip	-	280
Cold strip	-	270
Power generation	100	150
Transport	100	160
Heat control	90	30
Inspection and Analysis	90	165
Maintenance	150	230
Total	1,480	2,950

(Notes): 1) Estimated on the basis of the personnel of principal iron works in Japan. These figures contain only such operatives (including group leaders) as directly engaged in operation, excluding the technical and common employees.

2) The shift system is: three shifts in such sections as blast furnace, sintering, coke oven, LD convertor, and continuous casting; two shifts in the other sections.

3) Besides, persons engaged in repair work, contract work, etc. which are ordered from outside enterprises, are not included.

4) These figures include 10% of the total personnel as non-attendace members.

B. Training programme of operatives

It requires, prior to the operation of the integrated iron works, to give necessary knowledge and training to the personnel. The details about the needed trainees are listed as follows:

List of trainees

Facilities		Leader	Assistant leader	Common operative	Total	Remarks
Blast furnace	Blast furnace and its related operation	1	9	30	40	
	Raw material handling	2	9	43	54	
LD converter	Converter operation	5	29	98	132	including continuous casting
Rolling	Billet mill	2	6	24	32	
	Plate mill	3	24	72	99	
	Hot strip mill	3	15	51	69	
	Cold strip mill	3	15	54	72	
Power generation	Power generator Blower	2	6	22	30	
	Gas	1	3	6	10	
	Oxygen	1	3	10	14	
Maintenance	Electricity	6	22	24	52	including meters and gauges
	Machinery	4	12	24	40	
	Crane	1	15	57	73	
Sum total		34	168	515	717	

Notes: (1) The figures of the hot strip and cold strip mills and maintenance contain the number of trainees needed for the First and Second Stages; the other figures contain that of the First Stage only.

(2) The programme does not indicate the number of operatives needed for the iron works in actual operation, but the minimum number of those who are required to be trained to get experience prior to the commencement of operation in the iron works.

(3) The definite number of operatives at the commencement of operation should consist of those who have been trained as beginners and those who come from outside the iron works as experienced operatives to assist the beginners.

(4) This programme is concerned with the specialists fitted for the iron works: specialists in other fields are left out of consideration.

Detailed list of trainees classified by sections of operation

(1) Blast furnace

Division		Rank	Number of years of experience	Number of operatives	Remarks
Blast furnace and its related operation	Operative of pig iron making	Leader	5	1	
		Assistant leader	3	3	
		Common operative	1	15	
	Operative of measuring work at hot stove	Assistant leader	3	3	
		Common operative	1	3	
	Operative of machine operation	Assistant leader	3	3	including operatives of maintenance work
		Common operative	1	12	
Raw material handling and its related operation	Operative of raw material handling work	Leader	5	1	
		Assistant leader	3	3	
		Common operative	1	6	
	Operative of maintenance work	Assistant leader	3	3	
		Common operative	1	24	
	Operative of sintering work	Leader	5	1	
		Assistant leader	1	3	
		Common operative	0.5	13	

(2) LD convertor

Division	Rank	Number of years of experience	Number of operatives	Remarks
Operative of furnace mouth work	Leader	5	1	Operative of blowing-in-and-out work
	Assistant leader	3	3	
	Common operative	1	12	
Operative of raw material handling	Leader	3	1	Operative of compounding subsidiary material work in mixer
	Assistant Leader	3	3	
	Common operative	1	20	
Operative of ingot molding	Leader	over 5	2	including continuous casting
	Assistant leader	5	6	
	Assistant leader	3	14	Operative of arranging molding and handling ladles
	Common operative	1	42	
Crane operator	Leader	5	1	including operatives of maintenance work
	Assistant leader	3	3	
	Common operative	1	24	

(3) Rolling mill

Division		Rank	Number of years of experience	Number of operatives	Remarks
Operative of heating work	Billeting mill	Leader	4	1	
		Assistant leader	1	3	
		Common operative	0.5	3	
	Plate mill	Leader	4	1	Operatives assigned to soaking pit and 3-zone heating furnace
		Assistant leader	1	6	
		Common operative	0.5	9	
	Hot strip mill	Leader	4	1	
		Assistant leader	1	3	
		Common operative	0.5	6	
	Cold strip mill	Leader	4	1	
		Assistant leader	1	3	
		Common operative	0.5	3	
Operative of rolling work	Billeting mill	Leader	over 5	1	
		Assistant leader	over 3	6	
		Common operative	1	18	
	Plate mill	Leader	over 5	2	
		Assistant leader	over 3	9	
		Assistant leader	over 1.5	9	
		Common operative	1	63	
	Hot strip mill	Leader	over 5	2	
		Assistant leader	over 3	6	
		Assistant leader	over 1.5	6	
		Common operative	1	45	
	Cold strip mill	Leader	over 5	2	
		Assistant leader	over 3	6	
		Assistant leader	over 1.5	6	
		Common operative	1	51	

(4) Power generation and its related operation

Division	Rank	Number of years of experience	Number of operative	Remarks
Operative of oxygen generation	Leader	5	1	
	Assistant leader	2	3	
	Common operative	0.5	10	including maintenance work
Operative of gas work	Leader	5	1	
	Assistant leader	3	3	
	Common operative	0.5	6	including maintenance work
Operative of boiler work	Leader	5	1	
	Assistant leader	3	3	
	Common operative	1	10	including maintenance work
Operative of steam turbine engine	Leader	5	1	
	Assistant leader	3	3	
	Common operative	1	12	including maintenance work

(5) Maintenance and its related work

Division	Rank	Number of years of experience	Number of operative	Remarks
Operative of maintenance work of electric machines	Leader	8	1	
		5	4	
	Assistant leader	3	12	
	Common operative	0.5	24	
Operative of handling meters and gauges	Leader	5	1	
	Assistant leader	2	10	
Operative of adjustment work	Leader	5	4	Operatives mainly engeged in maintenance of rolling mill and oilers
	Assistant leader	3	12	
	Common operative	0.5	24	
Operative of crane operation	Leader	8	1	
	Assistant leader	5 - 3	15	
	Common operative	1	57	including maintenance work

In addition, detailed programmes of education and training are as listed, for your information, in the accompaning sheet.

(1) Items of work to be trained in:

Blast furnance and its related operation

LD converter " "

Rolling mill " "

Power Plant " "

Necessary operatives for crane and its related matters

(2) Education and its related matters: Contents and term of education We have outlined this matter, but, to prepare the textbooks is considered as another question.

(3) Qualifications: We have suggested the minimum school education required for the trainees. Aptitude test must be studied as another question.

(4) Remarsk: The 'Organization' shown in the 'Remarks' column of the accompanying lists means the minimum condition of organization at the commencement of operation.

( ) indicates the number of years of experience.

C. Training programme of technical employees

Keeping pace with the training of operatives, this programme will have to be carried out:

(1) Prior to the construction of the iron works a practice course for about 6-12 months will be given as to the structure, function and operation method of the facilities which such technical employees are expected to take charge of.

(2) Let them assist in the construction of the above-said facilities.

(3) Let them experience the initial operation of the facilities in company with skilled persons, just as the operatives do, until they attain the technical level of performing standard operation, thereby establishing the standards of operation.

(4) Qualifications: College graduates or graduates of high school (having experience of 2-3 years).

Outline of training programme of operatives

(For information)

(1) General

Division	Subject of study	Contents of study	Method	Term	Qualification	Remarks	
						Organization	
Education before assigment	Outline of iron works	Informations about safety at workshop	Lecture	4 Hr	Graduate of junior high school		
	Shop regulations	Compensation, welfare, shop regulations	"	6 Hr	"		
	Safety	Organization, regulations, instruments of safety, informations about safety	"	4 Hr	"		
	Sanitation		"	2 Hr	"		
	Inspection of iron works		-		"		
	Rules of conduct as an industrial operative		"	3 Hr	"		
Education after assigment	Informations about safety at workshop	Safety of workshop	Lecture	10 Hr	Graduate of junior high school		
	Informations about handling dangerous matters	On gas, oxygen and fats and oils	"	2 Hr	"		
	Primary knowledge of operation	Contents and nature of operation at one's post	"	7 Hr	"		
	Basic behaviour of operation	Purpose and understanding of books on safety and standard behaviour	"	7 Hr	"		
	Maintenance of health	Characteristics of workshop, first aid accessories and protecive instruments	"	2 Hr	"		

(2) Blast furnace

Division	Subject of study	Contents of study	Method	Term	Qualification	Remarks: Organization	Remarks:
Operative of pig iron making	1. Basic eduction	Process of pig iron making; Outline of major facilities; Outline of transport means	Lecture	20 Hr. in 3 month	Standard of junior high school graduate	Leader (5 year's experience): 1 Head of group (3 year's experience): 1 x 3 Common operative (1 year's experience)	
	2. Education at furnace mouth	Tapping operation; Repairing operation of runners; Blowing-out operation; Mud gun operation	Practice	4 months	"		
	3. Others	Education on hooking method and gas operation (10 Hr of gas education)	"	2 months	"		
	Total			6 months			
Operative of measuring works at hot stove	1. Basic education	Same as operative of pig iron making	Lecture	20 Hr	"	Leader (3 year's experience) : 1 x 3 Common operative (1 year's experience)	
	2. Practice of operation	Operation of hot stove; Checking-up of each valve; etc. Blowing-out operation	Practice	5 months			
	3. Others	Handling of measuring instruments; Power generation facilities; Outline of related sections and departments; Education on gas, etc.	Practice and lecture	20 Hr. in 3 months			
	Total			8 months			
Operative of machine operation	Basic learning	1. Structure, function, mechanics	Lecture	30 H	Graduate of junior high school	Leader (3 year's experience): 1 Common operative (1 year's experience)	
		2. Prime mover		30 H			
		3. Pig iron making process		10 H			
	Practice at workshop	1. Outline of operation	Practice	6 months			
		2. Controling method					
		3. Checking-up, adjustment					
	Others	1. Education on safety	Lecture	10 H			

Division	Subject of study	Contents of study	Method	Term	Qualification	Remarks	
						Organization	
Education on subjects common to raw materials and related matter	Basic learning	1. Outline of treatment of raw materials	Lecture	30 H		Including keeper of maintenance yard	
		2. Outline and function of facilities		20 H		Leader (5 year's experience): 1	
		3. Basic knowledge of electric belt conveyor		40 H		Common operative (1 year's experience)	
	Practice	1. Operation of principal machines		20 H			
		2. Operation of belt conveyor		10 H			
		3. Education on safety		10 H			
	Total			130 H			
Operation of maintenance	Practice at workshop	1. Checking-up and reparing of each item of facilities 2. How to read wiring diagrams 3. Structure and function of each item of facilities	Lecture and Practice	150 Hr in 5 months			Necessary for operatives engaged in checking cranes and machines
Operative of yeard keeping	Practice at workshop	1. Receiving operation of ore at yard, Structure and handling of transport means; Structure and handling of sizing facilities	Practice	6 months			
		2. Charging operation of ore into ore bin; Structure, function, etc. of transport means	Practice	6 months			
		3. Emergency measures	Practice	included in 1 and 2			

Division	Subject of study	Contents of study	Method	Term	Qualification	Remarks	
						Organization	
Operative of sintering	1. Basic education	○ Treatment of raw materials (first steps in the theory of sintering) ○ Outline of sintering facilities ○ Method of operating sintering facilities ○ On raw materials (kinds; blending) ○ Testing method of grain size and strength of sintered products	Lecture	15 Hr 20 Hr	Standard of junior high school graduate	Persons of high school graduate standard are preferable in control room Leader (over 5 year's experience): 1 Control room (over 3 month's experience): 1	
	2. Practice of operation of machines	○ Operation method of controlling apparatus of sintering machine Method of checking-up, oilering and adjuisting Method of gas handling	Practice	3 months		Common operative (1 month's experience)	

(3) LD converter

Division	Subject of study	Contents of study	Method	Term	Qualification	Remarks	
						Organization	
Operative of furnace	Basic education	○ Outline of LD converter facilities ○ Outline of mechanical engineering (first steps) ○ Outline of electrical engineering (first step) ○ Outline of steel making by converter process (operation of converter) Outline of blending raw materials (main material, subsidiary material, flux and reducing material) Outline of kinds of steel First steps in thermodynamics materials	Leeture	60 Hr 30 Hr 60 Hr	Above graduation of junior high school	Leader (5 year's experience):1 Operative of blowing-out-and-in (3 year's experience):2 Common operative (1 year's experience)	

Division	Subject of study	Contents of study	Method	Term	Qualification	Remarks	
						Organization	
Operative of new material	Practice at furnace front	○ Operation of control device; ○ Tilting operation of converter body ○ Determination of components of sample (by eye-estimation) ○ Maintenance and checking-up of converter body ○ On-the-job education of standards of operation	Practice	6 M			
	Education on computer	○ Operate-system and manu mantenance	Lecture Practice	2 W 6M - 12 M			
	Education on safety	○ Handling of gas, oxygen	"				
	1. Basic education	○ Outline of converter facilities (in relation to raw material) ○ Outline of steel making by converter process (principles of steel making by converter) ○ Outline of raw materials Basic knowledge of the kinds, function, constituents of main material, subsidiary material, flux, reducing material, etc. Relation between kinds of steel and reducing agent ○ Outline of blending raw materials	Lecture	21 Hr. in 3 months	Standard of junior high school graduate	Leader (5 year's experience): 1 Leader (3 year's experience):2 (assigned to bledning work and mixer) Common operative (1 year's experience): other posts	
	2. Education on transport	○ Transport of molten pig iron; transport of cold pig iron; signal for wire rope sling					
	3. Practice of raw material handling	○ Operation of mixer ○ Theoretical exercise of new material blending (desk work)					
	4. Education on safety						

Division	Subject of study	Contents of study	Method	Term	Qualification	Remarks	
						Organization	
Operative of ingot molding	1. Basic education	○ Outline of ingot molding apparatuses (ladle, ingot case, stool, truck, etc.) ○ Outline of kinds of steel ○ Method of ingot molding (tteming, relation between ingot case and kind of steel, stripping, arrangement of ingot cases, etc.) ○ Emergency measures (running of ladle stopper, shut of nozzle, etc.) ○ Function of heat insulator	Lecture	21 Hr		Leader (over 5 year's experience): 1 Leader (5 year's experience): 1 per teeming deck Leader (3 year's experience): 1 1 in charge of arranging ingot cases Leader (3 year's experience): 1 in charge of ladles Common operative (3 year's experience): 1 engaged in stripping operation	
	2. Practice of ingot molding	○ Operations of teeming, arranging ingot cases, stripping ingots, arranging ladles, dispatching trucks, etc.)	Practice	3 year's			
	3. Education on safety	○ Methods of wire rope sling, dispatching trucks, gas handling, etc.	Lecture	4 Hr			
Operator of ladle crane	1. Basic education	○ Structure and function of ladle crane ○ First steps in mechanics ○ First steps in electrical engineering ○ Emergency measures ○ Laws and regulations concerning crane handling	Lecture	40 Hr-50Hr		Leader (5 year's experience): 1 Common operative (3 year's experience): 1/per ladle crane	
	2. Practice of operation	○ Handling of crane ○ Strength of wire rope, purpose of weight	Practice	2 - 3 years			

Division	Subject of study	Contents of study	Method	Term	Qualification	Remarks	
						Organization	
	3. State examination	○ Intellectual examination (electricity, mechanics, laws and regulations)					
		○ Skill measurement					
	4. Education on safety	○ How to handle electricity	Lecture				
Operative of oxygen generation	1. Basic education	○ Outline of mechanical engineering (first steps)	Lecture	10 Hr	Standard of high school graduate	Leader (5 year's experience): 1	
		○ Outline of thermodynamics (first steps) (concentrating on method of separating air)		10 Hr		Common operative (1.5 months experience)	
		○ Outline of facilities for oxygen generation		5 Hr			
		○ Handling method of high pressure gas		20 Hr			
	2. Practice of machine operation	○ Driving, halting and handling of oxygen generator	Practice	4 - 5 weeks		Education should be given preferably by advisors dispatched by the manufacturers of facilities.	
		○ Maintenance, checking-up and adjusting operation					
		○ Dehydration of air separator					
	3. Education on safety	○ Regulations concerning prevention of danger		20 Hr			
		○ General rules of safety					

(4) Rolling operation

Division	Subject of study	Contents of study	Method	Term	Qualification	Remarks: Organization	Remarks
Operative of heating furnace	Basic learning	1. Fuel and combustion	Lecture	30 Hr	Graduate of junior high school	Leader (4 year's experience): 1	
		2. Facilities, structure, function				Common operative (6 months' experience)	
		3. Technical standards of process		30 Hr			
		4. Measurement of standards of operation					
	Practice at workshop	1. Practice according to standards of operation	Practice	6 months			
Operative of rolling shop	Basic learing	1. Common sense of electricity and machinery	Lecture	30 Hr		Leader (5 year's experience):1	
		2. Facilities, structure, function		30 Hr		Operative in charge of mill (3 year's experience): 2	
		3. Operator system				Common operative (1 year's experience)	
	Practice at workshop	1. Operation of auxiliary machines of rolling	Practic	1 year		Operator in charge of shearing machine (1.5 year's experience): 1	
		2. Screw-down operation of rolls		3 year		experience): 1	
		3. Operation of shearing machine		1.5 year		Common operative (1 year's experience)	
Subjects of study common to rolling operation	Education on safety	Rules of safety at wrokshop	Lecture	7 Hr			

(5) Power generation

Division	Subject of study	Contents of study	Method	Term	Qualification	Remarks	
						Organization	
Operative of gas	1. Basic learning	1. Knowlage of gas	Lecture	10 Hr	Graduate of junior high school	General leader (5 year's experience): 1 Sectional leader (3 year's experience): 1 per section Common operative (1 year's experience)	
		2. Structure and function of facilities, gas purifier, blower, holder, etc.		30 Hr			
		3. Explanation of piping system		5 Hr			
	2. Practice at workshop	1. Standard operation for each item of facilities	Practice	at each workshop			
		2. Measures against accidents		3 months			
		3. Checking-up and patrol					
		4. Measures against blow-out and interruption of service					
	3. Others	1. Education on safety measures against poisoning and explosion of gas	Lecture	10 Hr			
Operative of measuring instruments	1. Basic learning	1. Measurement of pressure and flow	Lecture	40 Hr	Graduate of technical high school	General leader (5 year's experience): 1 Common operative (1 year's experience)	
		2. Measurement of temperature					
		3. Standard meter for amplifier					
		4. Automatic regulator of converter					
		5. Testing methods					
	2. Practice at workshop	1. System of each item of facilities for production	Practice	2 year			
		2. Checking-up of meters on each item of facilities					
		3. Detection and repair of failure of meters					
	3. Others	1. Education on safety Knowledge of electricity, gas and steam	Lecture	15 Hr			

Division	Subject of study	Contents of study	Method	Term	Qualification	Remarks
						Organization
Boiler man	Basic learning	1. Structure and handling of boiler 2. Combustion and fuel 3. Law and regulations	Lecture	50 Hr	Grduate of junior high school	Leader (5 year's experience): 1 Common operative (1 year's experience)
	Practice at workshop	1. Handling of boiler 2. Emergexcy measures	Practice	6 months		
Operative of turbine engine		1. Mechanical engineering 2. Knowledge of steam turbine 3. Knowledge of blower	Lecture	60 Hr		Leader (5 year's experience): 1 Common operative (1 year's experience)
	Practice at workshop	1. Starting and stopping of facilities 2. Checking-up and adjustment of facilities while in operation 3. Emergency measures	Practice	6 months		
Common subjects of study	Others	1. Education on safety 2. Handling of dangerous matters	Lecture	10 Hr 10 Hr		

(6) Maintenance

Division	Subject of study	Contents of study	Method	Term	Qualification	Remarks
						Organization
Operative of electrical maintenance	Basic learning	1. Principles of electromagnetism 2. Principles of alternating current 3. Electrical machinery 4. Method of measurement 5. Function and structure of facilities	Lecture	60 Hr	Graduate of junior high school	Leader (8 year's experience): 1 Assistant leader (3 year's experience): 1 x 3 Common operative (6 months)

Division	Subject of study	Contents of study	Method	Term	Qualification	Remarks	
						Organization	
	Practice at workshop (for each item of facilities)	1. Starting and stopping of machines 2. Checking-up and adjusting of machines while in operation 3. Control of lubricants 4. Emergency measures	Practice	6 months for each item		(For graduates of technical high school term of practice is 3 months)	
	Others	1. Education on safety Regulations concerning handling electricity		30 Hr			
Oiler of maintenance section	Basic learning	1. System of lubricants Morgoil bearing, roll balance, oil pressure of auxiliary machines, roll coolant, etc.	Lecture	30 Hr		Leader (5 year's experience): 1 Common operative (workers of construction work): 50% Common operative (1 months experience): 50%	
		1. Starting and stopping of facilities 2. Checking-up and adjustment 3. Emergency measures First term: Observation-study at operation standard Second term: Practice of operation Assistance in construction work		1 week for each item			
	Others	1. Education on safety	Lecture	15 Hr			

(7) Crane

Division	Subject of study	Contents of study	Method	Term	Qualification	Remarks	
						Organization	
Crane operator	Basic learning	1. Structure, function, mechanics 2. Electric motor, internal combustion engine	Lecture	60 Hr	Graduate of junior high school	General leader (8 year's experience): 1 Common operative (who has finished the above-mentioned training course)	
		3. Laws and regulations		30 Hr			
(A) Overhead travelling crane	Practice	1. Structure 2. Control method	Lecture	50 Hr 3 months	After finishing basic study		
(B) Jib crane	Practice	1. Structure 2. Control method	Lecture	30 Hr 2 months	Operative who has learned the operation of overhead travelling crane		
(C) Level luffing crane	Practice	1. Structure 2. Control method	Lecture	60 Hr 6 months	Operative who has learned the operation of B crane		
(D) Unloader	Practice	1. Structure 2. Control method	Lecture	60 Hr 6 months	Operative who has learned the operation of C crane		
	Others						

7. Examination of profitability

(1) It is indeed important to examine the advisability of constructing an integrated iron and steel mill in the Republic of Korea in the light of the possible increase in the demand for steel products and the expansion projects of the existing steel companies, but it is extremely important to consider the profitatility of such an integrated steel mill. That is to say, whether the projected integrated mill will be able to supply steel materials and products of superior quality at lower prices is an important matter to be examined relative to the level of domestic sales prices of such steel products. Besides, consideration will have to be given to the loss of foreign currency which will be caused by the import of raw materials attendant on the operation of the integrated mill. In order to maintain the balance of foreign currency, it will be necessary not only to prevent its loss, which has been caused by the import of steel products, by means of supplying to the correlated industries steel products of superior quality at lower prices but also positively try to obtain foreign currency by an increased export of such industries. It is also desirable to obtain it by direct export of steel products as far as possible. Accordingly, the integrated iron and steel ~~will~~ had better be so projected that it may have a competitive power in international market. In other words, it is not enough that its cost can be be lower than the level of domestic sales prices, but it will have to stand the competition of the export price of steel products of major steel making countries.

In addition to the above conditions, the profitability of the integrated iron and steel mill itself will have to be realized. However, it is extremely difficult, at this moment, to formulate a plan of production cost, to estimate profit and loss, and to make a cash flow due to many undetermined factors and a number of problems which the survey mission alone cannot decide. Therefore, we have had to refrain, in this report, from examining the concrete question of the profitability of the integrated steel mill.

(2) In examining profitability, the determination of the prerequites is indispensable; that is, such items as the scale of the mill enterprise system, selection of facilities, production planning, purchase of raw materials, sales of products, method of management, and the amount of capital must be determined; and also the plan of raising necessary funds has to be examined. Prerequisites to the production cost accounting consist naturally in the clarification of the production programme, basic unit of materials, yield of products, labour cost, depreciation cost, management expenses of mills, and especially in the actual methods of purchase and prices of raw materials and others. Prerequisites to the estimate of profit and loss lie in the determination of sales price, sales cost, interest on funds, expenses of general management, etc. Particularly, the relative importance of interest on funds is estimated to be considerably high, which makes it necessary to formulate a comprehensive plan of raising and using the funds, including both domestic and foreign

ones, and this plan constitutes the prerequisite to the estimate of interest.

If the above-mentioned prerequisites are determined by the government of the Republic, the examination of the profitability will be made possible, by which the project will be enabled to be reconsidered and reorganized more efficiently.

VII. RECOMMENDATIONS TO THE GOVERNMENT

VII. Recommendations to the government

1. Setting up a steel committee

(1) In order to realize the project of an integrated iron and steel mill as well as the systematic development of the iron and steel industry of ROK, it is necessary, first of all, to bring about the co-ordination with the existing steel manufacturers. It is advisable, for this purpose, to set up a standing steel committee or a steel board, consisting of the specialists from the Government, private industries and learned circles, aiming at the co-ordination of the expansion projects of the existing enterprises with the integrated iron and steel mill project, clarifying the work field to be assigned to each of them, refraining from dividing the equipment investment into small sums and, at the same time, making an efficient use of the limited funds, and thus realizing the systematic development of the iron and steel industry of the country. That is to say, so far as the field of production is concerned. the new integrated iron and steel mill should specialize in the product of flat rolled products and materials for the existing mills of superior quality at low prices ~~to the existing enterprises~~; the latter should concentrate on the production of bars and sections, the material(billet) of which is to be supplied by the former, refraining as far as possible from investment in new facilities, attaching, instead, importance to the processing facilities of flat rolled products and renewal of the obsolete equipments of bars and sections, and thus making the best of the existing facilities. This will necessitate the re-examination of the expansion projects of the existing enterprises as well as the early materialization of the integrated iron and steel mill project whole energy of those concerned should be concentrated by means of establishing such an organization as will bring about the cooperation of each enterprise, the joint research and development by those learned people concerned with iron and steel in order to improve the technical level.

(2) The steel committee or steel board should not only deal with the co-ordination with the existing enterprises but also immediately start various investigations in order to materialize the project of the integrated iron and steel mill. The items of the investigation are important as well as numerous the studies of the location, including Ulsan, of the new integrated mill, the geological study of the left bank of the Jae Wha River; measures for securing the necessary site; re-examination and feasibility study of the harbour project of Ulsan such as the construction of a special harbour for the exclusive use of the integrated mill, dredging of the fairway, etc; dredging work of the Tae Wha River; and in addition, the determination of the scale, facilities and their specifications of the mill; measures for securing raw materials; establishment of the ways and means of raising the necessary funds.

2. Enactment of special laws

In the construction of an integrated iron and steel mills, the role to be played by the Government is extremely important as well as immeasurably great. As is cleary shown by the history of the iron and steel industry in advanced countries, powerful protective and promotive measures of the government have been indispensable to the development of this key industry of the industrial society.

For this reason it is advisable to enact a "law concerning the steel industry", by means of which the integrated iron and steel mill will be exempted from the import duties on the facilities necessary for the construction and on the raw materials, and from the corporation tax, local rates and other levies, etc.; sometimes granting of subsidies and bounties may be made necessary. As to the type of managing the integrated steel mill, the idea of studying the enactment of a "public corporation law" may be useful.

3. Study of regional development project

When constructing an integrated iron and steel mill, full consideration should be given to the correlation with the regional development project. The construction of such an integrated mill requires the replenishment and fulfilment of social and indirect capital which ranges the whole field of the fairway, harbour, site, industrial water, electric power, related industries in the district concerned; and, conversely, a systematic regional development project is needed, including the inducement plan of related industries to locate centering round the integrated mill together with their own development plan. For this reason a site wide enough to locate such an integrated mill should be secured in view of its future development, and, at the same time, the breaking-down of the site into small parts for the industries not directly related to the integrated mill should be prevented as far as possible.

4. Conclusion

In view of the present situation and outlook for the future of the iron and steel industry of ROK and also in the light of our studies principally on the demand for steel products and facilities, we consider that the construction of an integrated iron and steel mill is feasible, although many problems will have to be overcome. However, the materialization of this project requires a full and special investigation of the detailed matters which the survey mission has not been able to perform this time, this will require the total strength of those concerned with this project; and, furthermore, final decision should be made when the plan of raising funds, profitability, the balance of foreign currency, etc. have been deliberately considered.