4. Present steel market situation in neighboring countries

4.1 Apparent steel consumption in neighboring countries

According to the recent announcement of IISI, the total steel consumption in the world is estimated to grow to 714 million tons in 2000 from the present consumption of 652 million tons(in 1995) with an average annual increase rate of 1.8%. China will grow at 5.6% p.a. and the remaining Asian countries (excluding Japan) will grow at 3.7% p.a. on average due to the deceleration of growth rates in Korea and Taiwan. The share of consumption in Asian countries (excluding Japan) will expand to 36% from the present share of 32%.

Table 1-10 summarizes the apparent steel consumption of total steel products in neighboring countries in 1995. This shows that the supply and demand in these countries as a total are well balanced at present.

Table 1-10 Apparent steel consumption of Asian countries

(Unit: 1,000t/y)

Country	Production (A) (Hot-rolled Steel Products)	Import (B)	Export (C)	Apparent Steel Consumption (A)+(B)−(C)
Indonesia	4,834	2,230	706	6,358
Malaysia	3,071	5,489	761	7,799
Philippines	2,087	1,390	78	3,399
Singapore	742	4,099	999	3,842
Thailand	3,487	6,205	635	9,057
Taiwan	17,122	6,015	2,892	20,244
Australia	6,652	1,199	1,754	6,097
Korea	37,512	7,160	8,557	36,115
Japan	95,620	6,238	21,207	80,651
Viet Nam *	418	151	-	569
Total	171,545	40,176	37,589	173,132

Source: Steel Statistical Yearbook 1995, SEAISI

* : ASC of Viet Nam in this SEAISI Steel Statistic Yearbook is not equal to the value in other tables.

4.2 GDP and ASC of ASEAN countries

Figure 1-6 shows the ASC/capita and GDP/capita of ASEAN countries in 1995. ASC/capita has a clear relation with GDP/capita among ASEAN countries. For the analysis of the development stage of the future Vietnamese steel industry, Thailand is considered to be the most suitable model to be followed because of the similarity that it started from an agricultural country aiming to become an industrialized country.

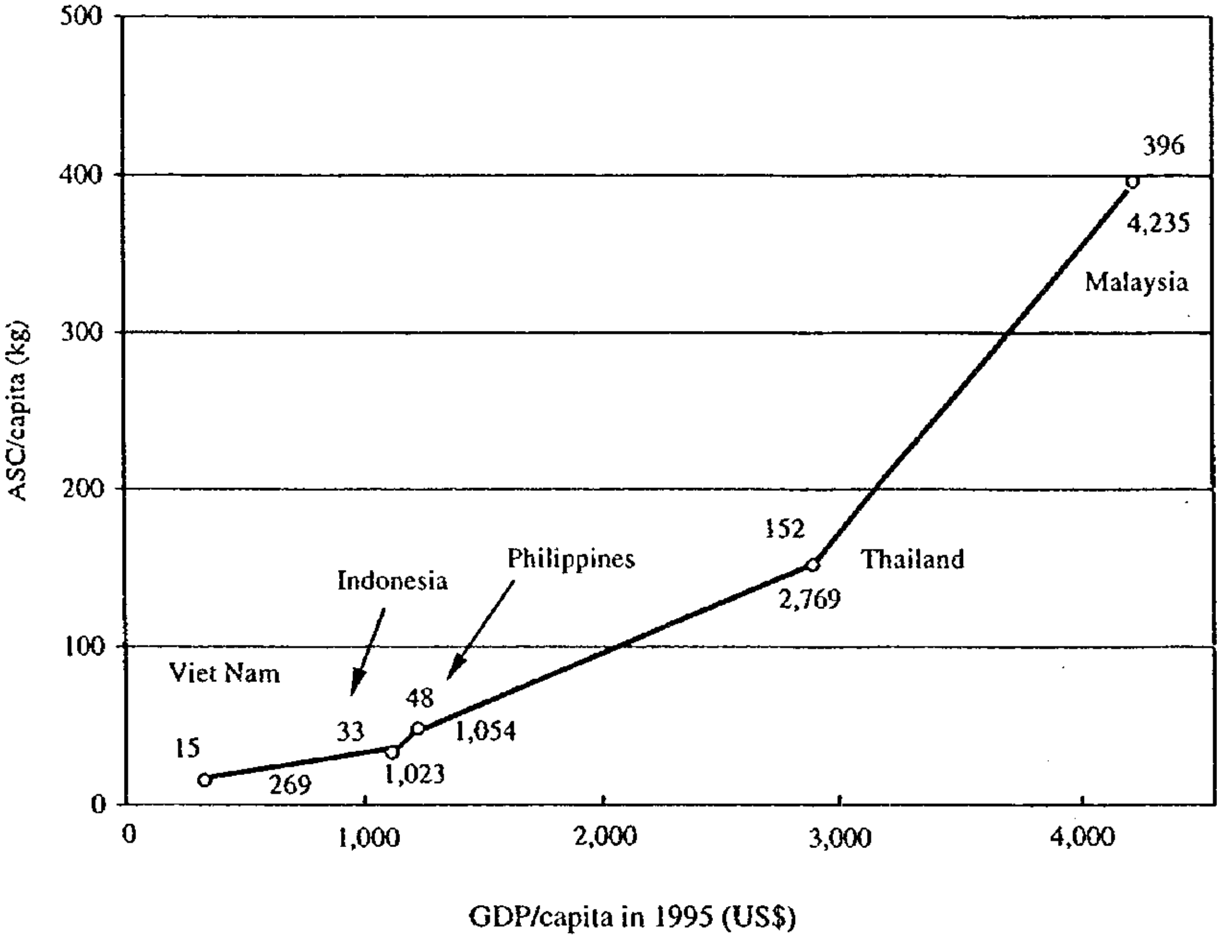


Figure 1-6 GDP/capita and ASC/capita of ASEAN countries in 1995

4.3 Case study of Thailand

4.3.1 Industrial structure of Thailand

Thailand was an agricultural country until the 1970s with a high GDP share of primary industry (agriculture, forestry, fishery) in total GDP. From the 80s, however, its industrial structure has been changing drastically with industrialized movement. As Figure 1-7 shows, Thailand is increasing its GDP share of secondary industry (manufacturing, construction, mining) and has reached nearly 37% at present. Present Viet Nam seems similar to the situation of Thailand some years ago, and is considered to follow its development stage from now.

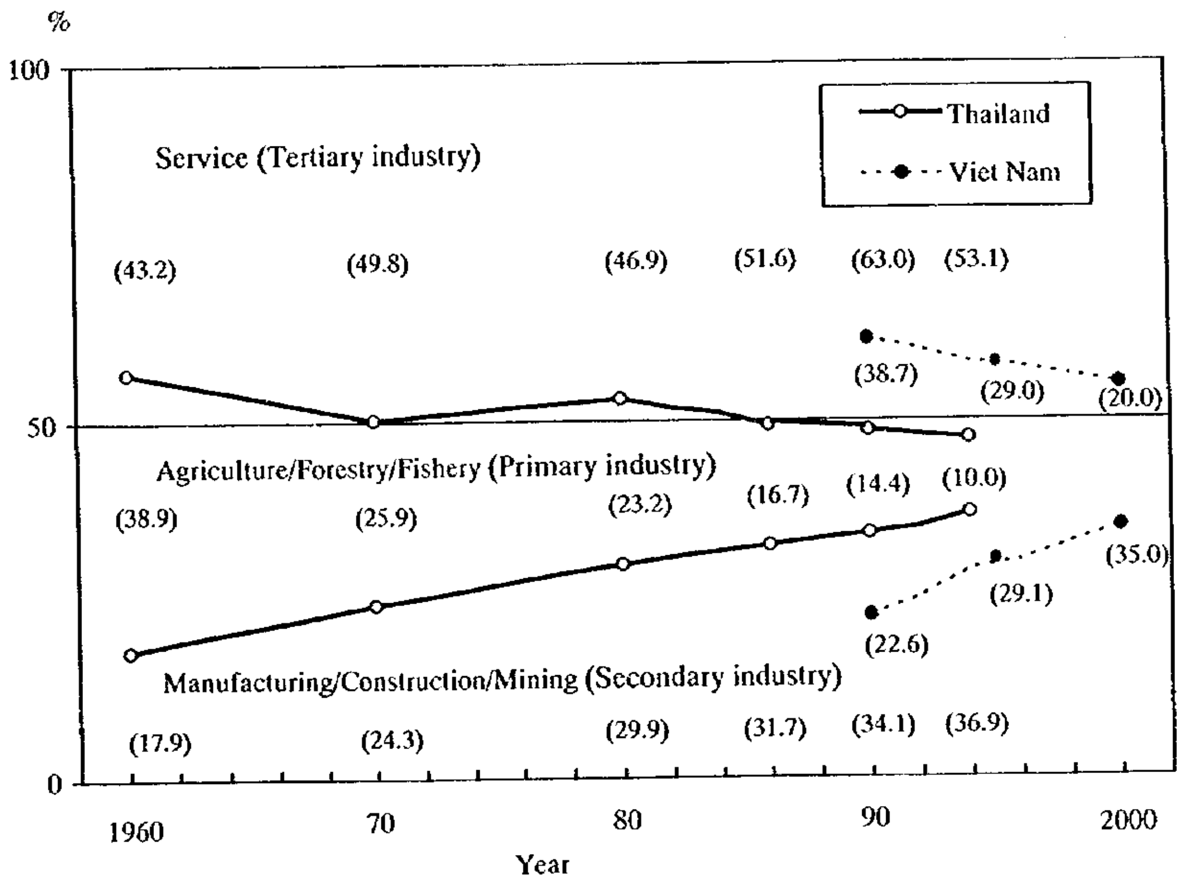


Figure 1-7 Share of GDP by sectors in Thailand and Viet Nam

4.3.2 GDP and ASC of Thailand

The GDP/capita in the early 1970s of Thailand was almost the same level as the present GDP/capita of Viet Nam (Figure 1-8). It gradually increased with the development in various fields until the middle 1980s. After that, it showed rapid growth as high as about US$ 2,800 recently. The main cause of such rapid GDP boosting was the increased investment of foreign capital in Thailand especially from Japan at that time (see Table 1-11).

Table 1-11 Foreign capital investment in Thailand

Year	Before 1969	1970s	1980-1984	1985-1989	1990s
Number of Japanese Companies invested in Thailand	25	35	15	150	60

ASC/capita also showed almost the same tendency as GDP/capita (Figure 1-9). Flat products ratio also changes corresponding to the change of ASC/capita level.

Although the Vietnamese industrial structure is different from Thailand's, the ASC level of Viet Nam is also fairly dependent on GDP. From that view point, the future investments of foreign partners to Viet Nam will significantly affect the prospects of the future steel industry. If such investment growth doesn't occur in the appropriate time in Viet Nam, the steel market situation will probably be less optimistic.

4.3.3 Steel demand content of Thailand in 1993-1995

Figure 1-10 shows the steel demand prospect of Thailand. As seen in (1) of this figure, the flat ratio is 55%, similar to other industrialized countries. Sector-wise demand contents in (2) shows that more than half is for construction, and demand for automobiles and electrical equipment is also fairly high. This is due to the fact that Thailand plays an important role as a supply center of such commodities for the Asian market.

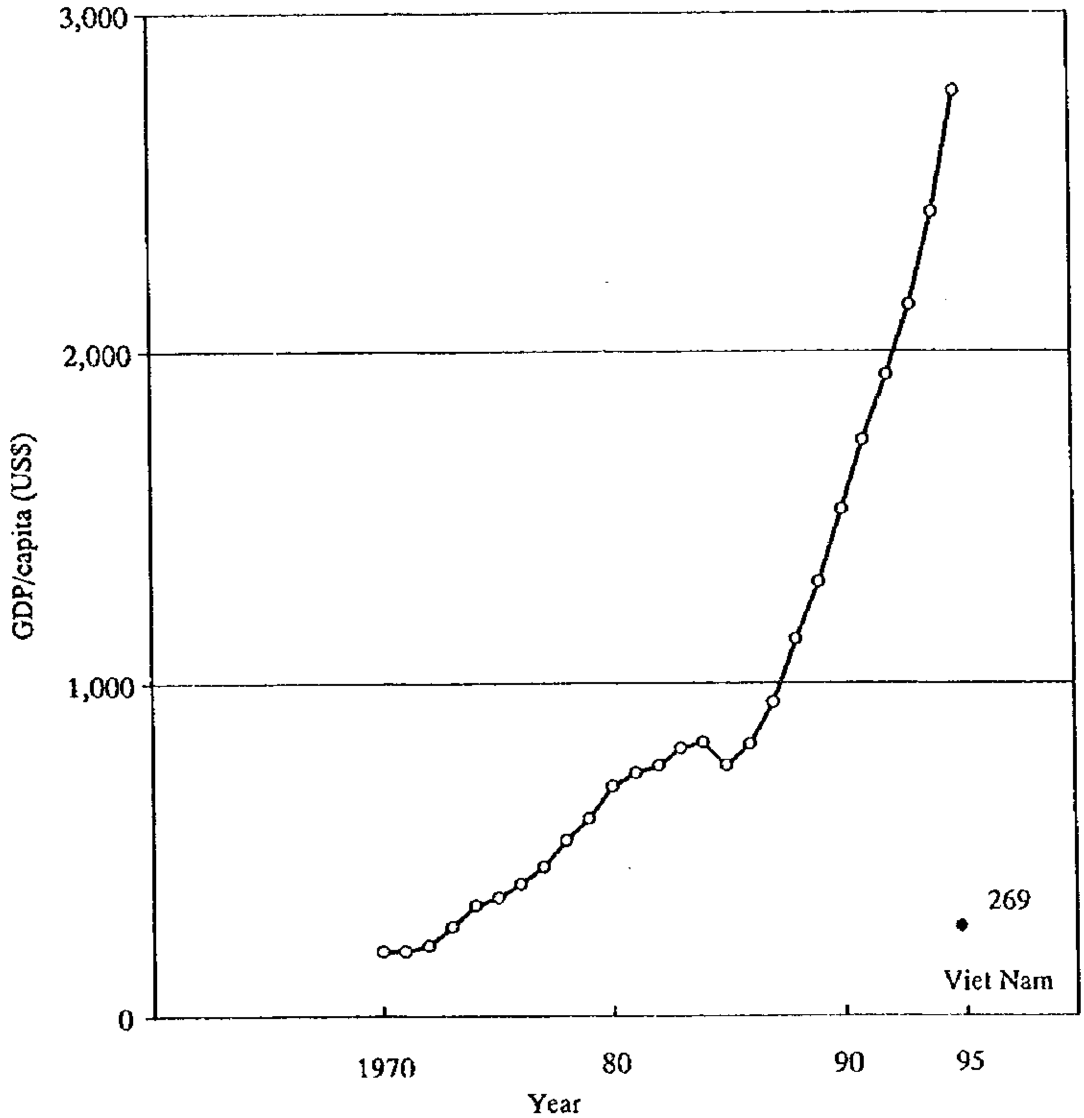


Figure 1-8 GDP/capita of Thailand

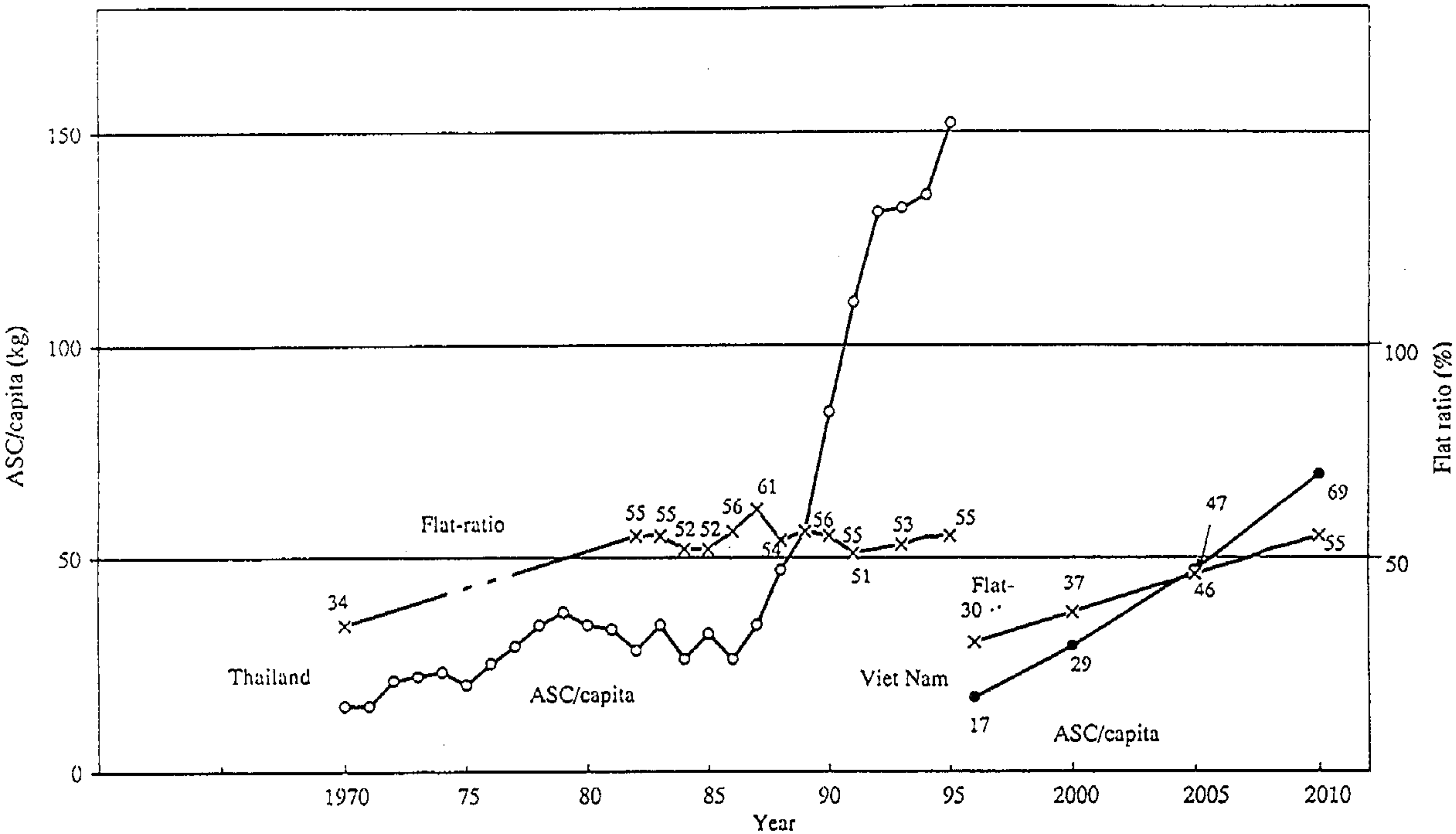
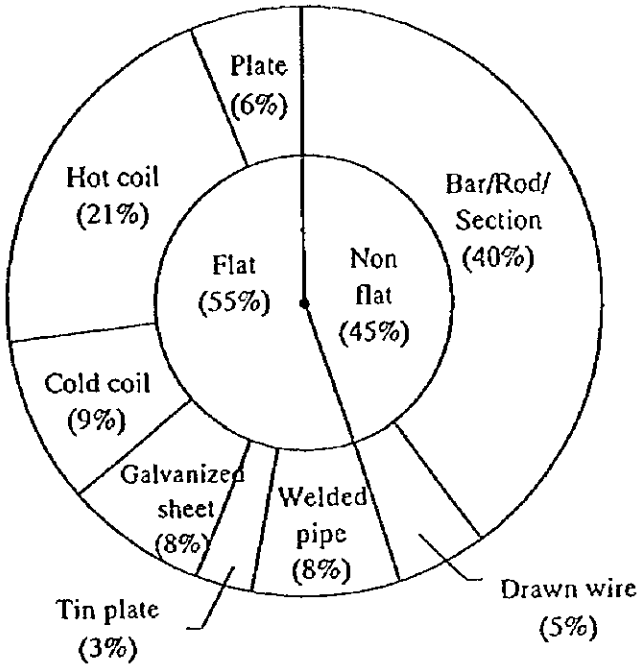


Figure 1-9 ASC/capita and flat ratio of Thailand and Viet Nam

(1) Demand by steel type



(2) Demand by sector

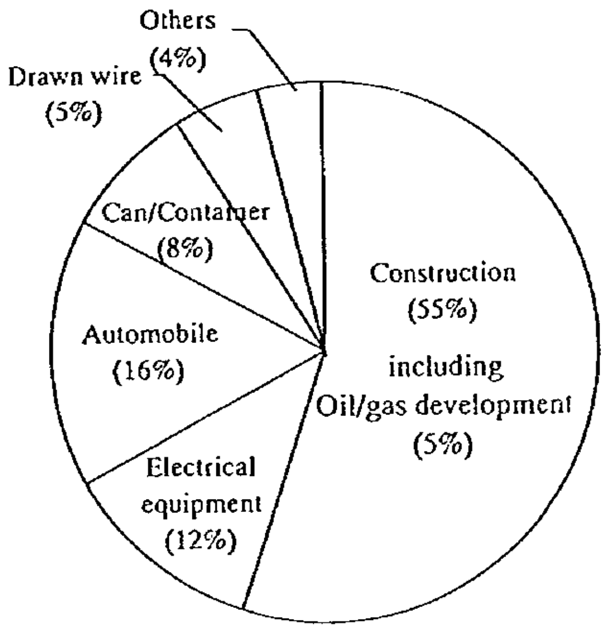


Figure 1-10 Steel demand prospect of Thailand in 1993-1995

5. Steel demand by industrial sub-sector (Microscopic projection)

Steel demand in various industrial sub-sectors are surveyed as the microscopic projection.

5.1 Building construction

5.1.1 House construction

Ministry of Construction(M.O.C.) has a plan for a housing space increase in the urban area. According to this plan, the housing space in urban areas will be as follows:

1996 : 3.8 (m^2/person)
2000 : 6.5
2010 : 8.0

Based on this, the steel demand for house construction in urban area is projected in Table 1-12.

Table 1-12 Projection of steel demand for house construction

Subject		1996	2000	2010
Average housing space	(m^2/person)	3.8	6.5	8.0
Population in urban area	(million)	15	16	19
Total housing space	(million m^2)	57	104	152
Steel use in house	(million ton)	2.28	4.16	6.08

(steel demand for urban area house: 40kg steel/m^2)

(1) Steel demand for space increase.
1996 - 2000 : (4.16 − 2.28)/4 = 470,000t/y
2001 - 2010 : (6.08 − 4.16)/10 = 190,000t/y

(2) Steel demand for new construction:
(17million × 3.8m^2 × 0.04ton)/25 = 100,000t/y
(house durability : 25years, average urban population 1996-2010 : 17million)

(3) Total steel demand
1996 - 2000 : 570,000t/y
2001 - 2010 : 290,000t/y

Source: M.O.C.

The steel type necessary for house construction is

Bar : 65%

Wire rod : 35%

The steel demand for house construction by steel type is shown in Table 1-13.

Table 1-13 Steel demand for house construction

(Unit: 1,000t/y)

Subject	1996-2000	2001-2010
Bar	370	189
Wire rod	200	101
Total	570	290

5.1.2 Surface treated sheet for house roof

From interview surveys, the demand of surface treated sheet (galvanized sheet) for house roofing is projected as follows:

(Unit: 1,000t)

1996	2000	2005	2010
85	124	200	322

Growth rate : 1996 - 2010 10%/y

5.1.3 Plant/warehouse construction

(1) PEB process

For the construction of plant/warehouses where a big span is required, the PEB process has an advantage compared to the conventional process. In the PEB process, welded shape steel is used and can reduce the total steel weight by about 30% compared to the conventional process.

Steel types and their ratio for plant/warehouse construction is shown in Table 1-14.

Table 1-14 Steel type for plant/warehouse construction

Steel type	Ratio	Remarks
Hot rolled coil Cold sheet	50% 10%	Prefabricated parts
Galvanized and Zn-Al alloy coated sheet	40%	Roof/Wall/Siding

Source: interview survey

Demand of steel for the construction of plant/warehouses by the PEB process is estimated as follows:

(Unit 1,000t)

	1996	2000	2005	2010
Steel demand for PEB	50	91	160	281

Growth rate : 1996 - 2000 16%/y
2001 - 2010 12%/y

(2) Conventional construction process
Steel types and their ratio for plant/warehouse construction is shown in Table 1-15.

Table 1-15 Steel type for plant/warehouse construction

Steel kind	Ratio	Remarks
Section	60%	
Galvanized and Zn-Al alloy coated sheet	40%	Roof/Wall/Siding

Source: interview survey

Demand of steel for the construction of plant/warehouses by the conventional process is estimated as follows:

(Unit: 1,000t)

Year	1996	2000	2005	2010
Steel demand	50	91	160	281

Growth rate : 1996 - 2000 16%/y
2001 - 2010 12%/y

5.1.4 Office building/hotel construction, etc
(1) Steel demand for office building/hotel construction, etc.
Steel demand for office building/house construction is summarized in Table 1-16.

Table 1-16 Steel demand for office building/hotel construction

(Unit: 1,000t)

Product	1996	2000	2005	2010
Bar	95	172	303	534
Wire rod	50	91	160	283
Section	15	27	48	84

Growth rate : 1996 - 2000 16%/y
2001 - 2010 12%/y

(2) Dimension of shaped steel

Steel kind	Dimension
Angle	25×25mm - 125×125mm
Channel	80 - 300mm

5.1.5 Total steel demand for building construction

Total steel demand for building construction is summarized in Table 1-17.

Table 1-17 Total steel demand for building construction

(Unit: 1,000t)

	1996				2000				2005				2010			
	House	Plant	Office/ Hotel	Total	House	Plant	Office/ Hotel	Total	House	Plant	Office/ Hotel	Total	House	Plant	Office/ Hotel	Total
Bar	370	-	95	465	370	-	172	542	189	-	303	492	189	-	534	723
Wire rod	200	-	50	250	200	-	91	291	101	-	160	261	101	-	283	384
Section	-	30	15	45	-	55	27	82	-	96	48	144	-	169	84	253
Hot/plate	-	25	-	25	-	46	-	46	-	80	-	80	-	141	-	141
Cold	-	5	-	5	-	9	-	9	-	16	-	16	-	28	-	28
Galvanized and Zn-Al alloy coated sheet	85	40	-	125	124	72	-	196	220	128	-	348	322	224	-	546
Total	655	100	160	915	694	182	290	1,166	510	320	511	1,341	612	562	901	2,075

5.2 Infrastructure

5.2.1 Bridge construction

Steel demand quantity as well as steel type used for bridge construction in Viet Nam are changing gradually. Recently the steel structure bridge is considered to be less advantageous compared to the concrete bridge due to its higher maintenance cost for corrosion. As summarized in Table 1-18, up to the middle of the 1990s steel demand for bridges was about 20,000 ton/y, and section steel was mainly used. After that, the concrete type bridge has been substituted for the steel structure bridge, and hence steel type used for the bridge construction is also changing from section steel to bar and wire rod.

Table 1-18 Projection of steel demand for bridge construction

Subject	Before middle of 1990s	After middle of 1990s			
		1996	2000	2005	2010
Steel demand (t)	20,000	20,000	25,000	35,000	50,000
Steel type	Section * 80%	Section * 80%	Bar, Wire rod 80%		
	Bar, Wire rod 20%	Bar, Wire rod 20%	Section 20%		

* Size: angle 200/200-250/250mm
beam 900-1,200mm

Source: Interview survey

5.2.2 Guard rail

The guard rail installed on road sides has been of the concrete type so far. Recently, however, production of steel guards has started in Viet Nam and now is being used. Main specification of the guard rail production equipment is as follows:

Production capacity : 2,500 ton/y
Steel dimension : 2.8×1,500mm (slit into 3)
Steel grade applied : G3106-SM520B

Steel demand is as follows:

guard rail	: 10.9 ton/km (hot rolled coil)
pole	: 3.5 ton/km (channel)
total	14.4 ton/km·(one side)

Together with the industrialization and motorization of Viet Nam, new road construction of a higher standard will become more and more important. The guard rail demand will also expand. Its demand is expected as seen in Table 1-19.

Table 1-19 Demand of guard rail

Year	1996	2000	2005	2010
Length of construction (km/y)	100	120	150	200
Steel demand (t/y)	2,900	3,500	4,300	5,800

5.2.3 Tower for electric power transmission line

Construction of steel towers for power transmission lines will increase together with the demand for electric power. Total steel demand for steel towers is about 20,000 ton/year at present. Specification and dimension of steel for the tower is seen in Table 1-20.

Table 1-20 Specification of steel for power transmission line

Steel type	Ratio (%)	Standard	Dimension (mm)
1) Angle	85	SS540	4×45×45 - 35×250×250
2) Plate (flat)	10	SS540 (50%) SS400 (50%)	Thickness: 2 - 25 (main 6-10)
3) Bolts/nuts	5		

Source: Interview survey

Future steel demand for the tower is estimated as follows:

(Unit: 1,000t)

1996	2000	2005	2010
20	27	40	59

(growth rate: 8%/y)

5.2.4 Others

Other infrastructure projects which will need to be implemented in Viet Nam in the future are:

- Water supply and drainage projects
- Irrigation projects
- Port construction
- Railway construction
- Road construction
- Others

5.2.5 Total steel demand for infrastructure

The investment in infrastructure during the 1996-2000 Five-year Plan is estimated at US$ 13 billion including communications and post infrastructure. The steel requirement is estimated at about 10% of the investment. Assuming that the steel price is US$ 310/t on average and about 80% of the steel requirement can be supplied and manufactured domestically, the steel demand will be about 670 thousand tons in 2000. The steel demand is projected to grow about 16% p.a. and 10% p.a. during 2001-2005 and 2006-2010, respectively.

The necessary adjustment between the macroscopic projection and the microscopic projection is made for the projected steel demand of the infrastructure as follows:

(Unit: 1,000t)

1996	2000	2005	2010
259	673	1,416	2,284

5.3 Capital investment

Capital investment in various fields are planned in the near future. The Main investment program until the year 2000 is summarized below:

- Steel making plant (5 plants)
- Cement plant (6 plants)
- Electric power plant (10 plants)
- Fertilizer plant(3 plants)
- Sugar production plant (10 plants)
- Refinery plant (1 plant)
- Petroleum chemistry plant (2 plants)
- Others

The capital investment during the 1996-2000 Five-year Plan is estimated at US$ 18 billion for industry. Assuming that the steel requirement is 15% of the investment and the steel price is US$ 400/t on average, the steel demand for the Five-year period is estimated at 6.75 million tons in total; the annual steel demand is estimated at 1.35 million tons on average including buildings/warehouses for plants (see 5.1.3). By subtracting 0.32 million tons from the total demand, the remainder is 1.03 million tons. If about one third of the steel products (1.03 million tons) could be manufactured domestically, the steel demand will be 340 thousand tons in 2000. A Further increase of capital investment is expected during 2001-2005, and it will then be curved during 2006-2010. In addition, domestic manufacture is estimated to increase after 2000.

The steel demand for these investments is therefore expected as follows:

(Unit: 1,000t)

1996	2000	2005	2010
50	340	1,100	1,500

5.4 Shipbuilding industry

5.4.1 Steel demand for shipbuilding industry

The future steel demand for shipbuilding is projected in Table 1-21

Table 1-21 Steel demand for shipbuilding

(Unit: 1,000t)

Year	Total steel demand	SS400 class	H-T steel
1996	10 (100%)	10 (100%)	0 (0%)
2000	50 (100%)	45 (90%)	5 (10%)
2005	100 (100%)	70 (70%)	30 (30%)
2010	200 (100%)	140 (70%)	60 (30%)

Source: VINASHIN

5.4.2 Present steel type and dimension

Present steel type and dimensions for shipbuilding are summarized in Table 1-22, of which plate/hot coil occupies 85%. As for the width of plate/hot coil, about 3/4 of the total demand is wider than 5 feet (1,550mm).

Table 1-22 Steel type and dimensions for shipbuilding

Steel type	Ratio	Dimension			
		W / T	−1,550mm	1,551mm−	Total
Plate/Hot coil	85%	Thinner than 16.0mm	68%	0%	68%
		Thicker than 16.1mm	17%	0%	17%
		Total	85%	0%	85%
Section	15%				
Total	100%				

Source: VINASHIN

5.4.3 Projected steel demand for shipbuilding by size

Projection of steel demand is summarized in Table 1-23.

Table 1-23 Steel demand for shipbuilding by size

(Unit: 1,000t)

Steel kind	1996	2000	2005	2010
Plate/Hot coil *				
Width ≦ 1,550	8 (100%)	34 (80%)	47 (55%)	51 (30%)
> 1,551	0 (0%)	9 (20%)	38 (45%)	119 (70%)
Sub total	8 (100%)	43 (100%)	85 (100%)	170 (100%)
Section steel **	2	7	15	30
Grand total	10	50	100	200

Source: VINASHIN

* Thickness distribution will be constant through to 2010

≦ 16.0 mm 80%

> 16.1 mm 20%

** Ratio of section steel in total steel demand for shipbuilding will be constantly 15% through to 2010.

5.5 Automobile industry

5.5.1 Projection of demand for automobile

Demand for automobiles in the future is estimated by TRANSINCO as shown in Table 1-24.

Table 1-24 Demand of automobiles

Year	Total	Passenger car	Commercial car
1995	39,800	5,500	34,300
2000	80,900	17,300	63,600
2005	120,000	27,300	92,700
2010	200,000	40,000	160,000

Source: TRANSINCO

5.5.2 Projection of domestic production

Quantity of domestic production is estimated by TRANSINCO is shown in Table 1-25.

Table 1-25 Quantity of domestic production

Year	Total	Passenger car	Commercial car
1995	7,000	4,500	2,500
2000	50,000	12,000	38,000
2005	100,000	20,000	80,000
2010	180,000	40,000	140,000

Source: TRANSINCO

5.5.3 Steel demand for the automobile industry

Various sorts of steel are used in the automobile industry. Domestic production ratios for such parts and body area of the car are estimated considering the quantity and technology level expected in Viet Nam. Table 1-26 shows the projection of steel demand for the automobile industry.

Table 1-26 Projection of steel demand for the automobile industry

Year	2000			2005			2010		
	P	C	Total	P	C	Total	P	C	Total
Projected domestic production car number	12,000	38,000	50,000	20,000	80,000	100,000	40,000	140,000	180,000
Hot rolled sheet									
Steel weight/car (kg)	177	197		177	197		177	197	
Domestic production ratio (%)	30	30		50	50		80	80	
Total steel demand (1,000t)	0.6	2.2	2.8	1.8	7.9	9.7	5.7	22.0	27.7
Cold rolled sheet									
Steel weight/car	167	186		167	186		167	186	
Domestic production ratio	5	10		10	30		10	50	
Total steel demand (1,000t)	0.1	0.7	0.8	0.3	4.4	4.7	0.7	13.0	13.7
Surface treated sheet									
Steel weight/car	224	249		224	249		224	249	
Domestic production ratio	10	10		30	30		50	50	
Total steel demand (1,000t)	0.3	0.9	1.2	1.3	6.0	7.3	4.5	17.4	21.9
Bar/Rod/Pipe/Others									
Steel weight/car	192	213		192	213		192	213	
Domestic production ratio	10	10		20	20		40	40	
Total steel demand (1,000t)	0.2	0.8	1.0	0.8	3.4	4.2	3.0	11.9	14.9
Grand total (1,000t)	1.2.	4.6	5.8	4.2	21.7	25.9	13.9	64.3	78.2

P: Passenger car, (displacement 1,000-1,300cc)

C: Commercial car (loading capacity 1-1.5ton)

Source: Unit consumption by Japan Automobile Manufacturers Association

5.6 Household appliances

With the rapid modernization in Viet Nam, household appliances have spread widely. The manufacturers are expecting an increase in export quantity as well as domestic demand.

5.6.1 Expected production of household appliances

Projected production of household appliances is summarized in Table 1-27.

Table 1-27 Production of household appliance

(Unit: 1,000unit)

Machine	1995	2000	2005	2010	Japan in 1996 (export ratio)
Washing machine	70	400	600	800	4,806 (10%)
Refrigerator	50	300	400	500	5,039 (4%)
Air conditioner	70	400	600	800	9,570 (18%)

Source: interview survey

5.6.2 Unit steel consumption by steel type for household appliances

Unit steel consumption by steel type for household appliances is summarized in Table 1-28.

Table 1-28 Steel unit consumption

(Unit: kg/unit)

Machine	Cold rolled sheet	H-D galv.		E galv.	Total
		Galvanized and Zn-Al alloy coated sheet	Galvannealed		
Washing machine	-	9.4	-	1.6	11
Refrigerator	5.2	9.4	0.2	5.2	20
Air conditioner	-	11.9	0.4	2.7	15

Source: interview survey

5.6.3 Steel demand for household appliances in future

Based on the above data, future steel demand for household appliances is summarized in Table 1-29. H-D galv sheet is about 3/4 of the total steel demand.

Table 1-29 Steel demand for household appliance

(Unit: 1,000t)

Year	Cold rolled sheet	H-D galv.			E galv.	Total
		Galvanized and Zn-Al alloy coated sheet	Galvannealed	Total		
1995	-	2.9	0.1	3.0	1.0	4.0
2000	2.0	10.8	0.2	11.0	3.0	16.0
2005	2.0	14.7	0.3	17.0	5.0	24.0
2010	3.0	20.6	0.4	23.0	6.0	32.0

5.7 Can

Tin plate (as well as tin free plate) is a raw material for steel can. The steel can consists of two types. They are the food can and the oil can.

5.7.1 Food can

Food can application is mainly for fruit, vegetable and condensed milk.

(1) Tin plate specifications for food can
- Thickness: 0.20-0.23mm
- Coating weight (see Table 1-30)
-

Table 1-30 Coating weight

(Unit: g/m^2)

Application	inside	outside
Fruits	11.2	2.8, 5.6
Vegetable	5.6	-
Condensed milk	5.6	5.6

Source: interview survey

(2) Projection of steel demand
The steel demand for food cans are projected as shown below.

(Unit: 1,000t)

1996	2000	2005	2010
38	61	81	110

Source: interview survey

5.7.2 Oil can (pail can)
An oil can is used mainly for petroleum products.

(1) Steel thickness : 0.32mm

(2) Projection of steel demand
The steel demand for oil cans are projected as shown below.

(Unit: 1,000t)

1996	2000	2005	2010
2	4	7	15

Source: interview survey

5.8 Containers

The following kinds of container are considered:

- Drum
- Gas cylinder
- Freight container

5.8.1 Drum
Drums are used for the storage and transportation of oil lubricants and vegetable oil.

(1) Steel specification
- Steel grade : Cold rolled sheet (G3141-SPCC/SPCD)
- Thickness : 0.9mm

(2) Projection of steel demand for drums
The steel demand for drums is projected as shown below.

(Unit: 1,000t)

1996	2000	2005	2010
8	12	18	28

Source: interview survey

5.8.2 Gas cylinder

The LPG cylinder is used as a LPG container for family use. These cylinders are imported from France, Malaysia and other countries. At the same time, some amount of semi-finished cylinders are imported to be assembled by welding two halves domestically. At present some 1.7 million cylinders are used by families, which corresponds to 22,000 tons of steel.

The following calculation shows the total gas cylinder demand expected in 2010:

92.2 million × 1/5 × (0.4 + 0.4) × 13kg × 1/1000 = 192,000 ton-steel

where

- estimated population in 2010 : 92.2 million
- average family members : 5 people/family
- ownership rate of LPG system : 40% of total families
- cylinders necessary for distribution stage : 40% of total families
- cylinders weight/per unit : 13kg

If complete cylinder production is carried out in Viet Nam, some 170,000 tons of steel demand (hot rolled sheet, thickness 2.5mm) for new cylinder production is expected from 1996 to 2010, which corresponds to 12,000 ton/year. The same amount for replacement due to the cylinder life time should be added to it.

Steel demand for LPG cylinder is therefore projected as follows:

(Unit: 1,000t)

2005	2010
6	12

5.8.3 Freight container

In 1997 20-feet container production was started in Viet Nam. Steel specifications and its quantity are as follows:

(1) Thickness : 2.5-4.6mm

(2) Steel demand : 2000 2,000t/y
: 2005 3,000t/y
: 2010 4,000t/y

5.9 Machine tool

Machine tools are basic machinery equipment used for the metal industry, consisting of lathes, shapers, drilling machines, etc.

5.9.1 Steel specifications for machine tool

Steel specification for machine tool is summarized in Table 1-31.

Table 1-31 Steel specification for machine tool

Steel type	Ratio
1) Carbon steel-S45C	70%
2) Tool steel/bearing steel	30%

Source: interview survey

5.9.2 Steel demand for machine tool

(Unit: 1,000t)

1996	2000	2005	2010
20	28	40	60

6. Projection of steel demand

6.1 Projection of steel demand by steel type

Based on the macroscopic and microscopic survey of the present and future industrial structure in Viet Nam, as well as the case of neighboring countries, future demand by steel product in Viet Nam is projected as shown in Table 1-32 as the Base case.

Table 1-32 Demand projection for Base case

(Unit: 1,000t)

Product		1996	2000	2005	2010
Non-flat products	Bar	470	770	1,190	1,520
	Wire rod	300	440	600	770
	Section	140	270	450	580
	Sub total (% of non-flat steel)	910 (70%) (1,010)	1,480 (63%) (1,640)	2,240 (54%) (2,490)	2,870 (45%) (3,180)
Flat products	Plate *	58	93	239	473
	Hot coil/sheet **	48	195	501	994
	Cold coil/sheet	65	177	454	899
	Galvanized sheet	139	228	388	659
	Tin plate	40	65	88	125
	Welded pipe	40	112	240	360
	Sub total (% of flat steel)	390 (30%) (430)	870 (37%) (970)	1,910 (46%) (2,120)	3,510 (55%) (3,900)
Grand total ***		1,300 (1,440)	2,350 (2,610)	4,150 (4,610)	6,380 (7,080)

* : Plate : thickness ≧ 6.0mm

** : Hot coil/sheet : thickness < 6.0mm

*** : Figures in parenthesis show "crude steel base" quantity calculated by the following IISI formula.
Crude steel quantity = 1.11 × final steel products (assuming C.C. ratio 100%)

6.2 Present area wise demand

Present area wise steel demand ratio is as follows, and is assumed to be unchanged in 2010.

North area	Central area	South area	Total
30%	5%	65%	100%

Source: VSC

6.3 Summary of typical steel grades and sizes in 2010

Projection of typical steel grades and sizes in 2010 is summarized in Table 1-33.

Table 1-33 Typical steel grades and sizes in 2010

Steel type	Typical steel grades(JIS)	Typical sizes
(1) Plate (for local ship building)	SM 400, SM 500	T : ≦ 16mm 80% W : ≦ 1,600mm 30 - 40%
(2) Hot rolled coil/sheet	SS 400, SPHC	T : 1.2 - 14mm W : ≦ 1,600mm 92%
(3) Cold rolled coil/sheet	SPCC, SPCD, SPCE	T : 0.9mm W : 1,000mm
(4) Galvanized steel	SGCC, SGCH	T : 0.4mm W : 1,000mm
(5) Tin Plate	SPTE	T : 0.22mm W : 820mm
(6) Bar	re-bar SD 295 round bar SS 400	ϕ10 - 40mm ϕ13 - 50mm
(7) Wire rod & bar in coil	SS 400	ϕ5.5 - 18mm
(8) Section	angle SS400 channel SS400	25×25 - 100×100mm 65 - 120 mm

T: thickness, W: width

7. List of organizations for interview survey

Table 1-34 shows the list of organizations contacted for the interview survey of the market study.

Table 1-34 List of organizations for the interview survey

Steel customers

Name of company	Subject for survey
1) VINASTAR	Automobile market and steel demand
2) VISUCO	Automobile market and steel demand
3) Bach Dang Shipyard	Shipbuilding market and future prospects
4) SHIPPLACOM	Shipbuilding market and future prospects
5) BASON SHIPYARD	Shipbuilding market and future prospects
6) TOVE CAN	Tin plate market
7) CANSALIPACK	Can production
8) VEGETEXCO	Foods can market
9) VINA MILK	Can market for dairy products
10) PETROLIMEX	Steel market for petroleum
11) Petrol Mechanical	Drum/Pail can for petroleum
12) NIPPOVINA	Galvanized sheet production and its market
13) POSVINA	Galvanized sheet production and its market
14) MARUVIENA	Galvanized sheet production and its market
15) SSSC	Galvanized sheet production and its market
16) Taisei Corp.	Construction market and steel demand
17) Mitsui Construction	Construction market and steel demand
18) Hazama Corp.	Infrastructure development
19) ZAMIL STEEL	Pre-fabricated engineering building
20) BUTLER	Pre-fabricated engineering building
21) THANG LONG BRIDGE	Bridge construction
22) HYUNDAI DONGANH	Tower for electric transmission line
23) Da Nang Container	Container manufacturing
24) HAMECO	Machine tool, Heavy machine
25) BRC	Weldmesh market
26) QUI CHE 2	Fastener (Bolts/nuts) market
27) Sanyo Home Appliances	Steel demand for home appliances
28) SONY Vietnam	Steel demand for home appliances
29) VIETSOVPETRO	Steel demand for petroleum production

Steel suppliers

Name of company	Subject for survey
1) TISCO	Production and equipment
2) SSC	Production, environmental problem, plant shut down
3) VPS	Management of J/V company
4) Da Nang Steel mill	Steel production in central area
5) VINA KYOEI	Construction of steel mill and its operation

Governmental agencies

Name of agencies	Subject for survey
1) VSC	Steel making industry as a whole
2) MPI	Policy for investment and 5 Year Plan
3) MOI	Policy for economic and industrial development
4) MOT	Policy for transportation (automobile, ship, etc.)
5) MOC	Policy for construction (house, building, infrastructure)

Other organizations

Name of organization	Subject for survey
1) Chamber of Commerce	Economics and industries in central area
2) People's Committee	General affair and policy for development
3) VINASHIN	Future prospect of shipbuilding
4) TRANSINCO	Automobile industry

Section 2 Production Plan

Contents

1. Production plan

1.1 Basic conditions for production planning

The construction of the integrated steelworks will be divided into three phase.

The amount of the production for each phase will be set up to mach the steel demand in Viet Nam based on the market research described in Section1, Part 2, Chapter Ⅳ.

1.1.1 Basic steel demand and production scale of the integrated steelworks

The relation between the amount of production in each step and steel demand is shown in Figure.2-1.

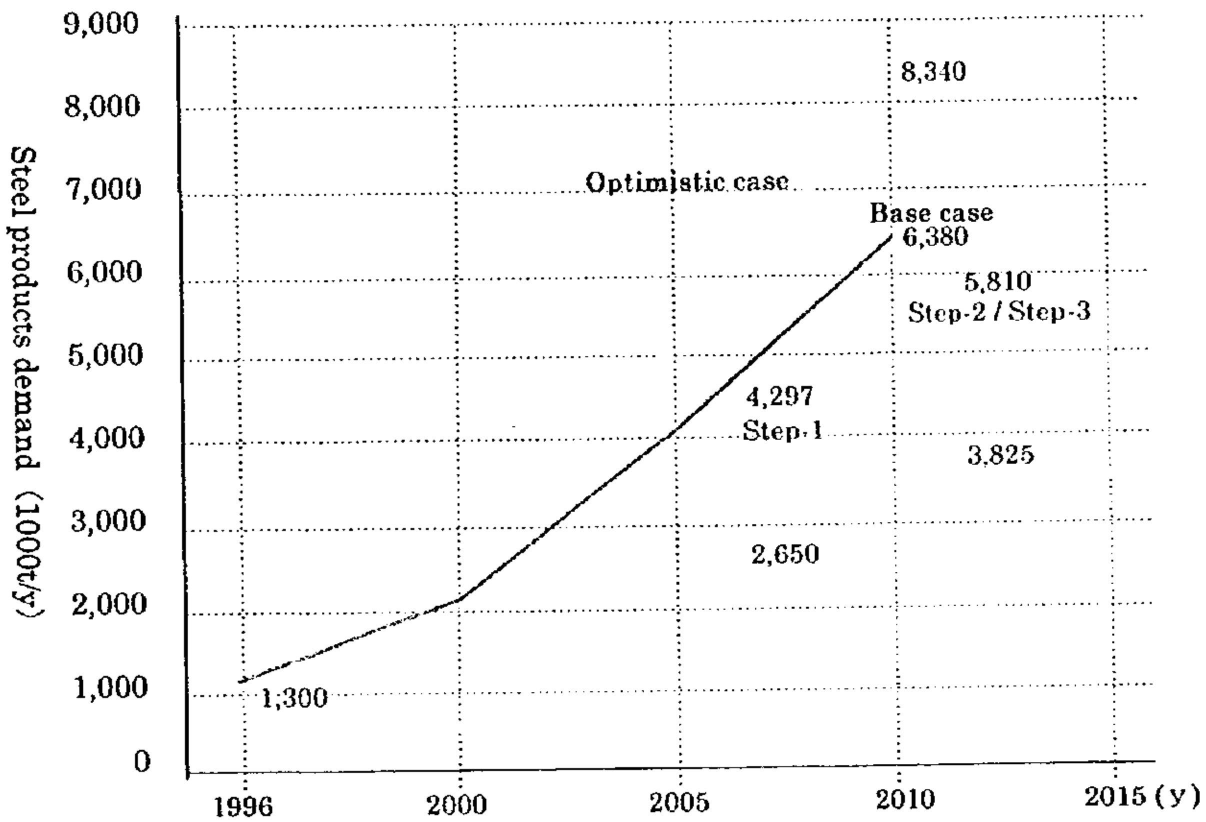


Figure 2-1 Steel demand projection and steel product supply capacity of the integrated steelworks

1.1.2 Consideration for production planning by product for each step

(1) First step

- A production structure for manufacturing hot rolled and cold rolled products which are advantageous from the viewpoint of the return on investment is set up.
- An annual production of 1.55 million tons of hot rolled sheet and coils, cold rolled sheet and coils, and galvanized sheets and coils is planned.
- A prerequisite to the annual production of 1.55 million tons of hot rolled and cold rolled products is to ensure the purchase of 1.68 million tons/year of good quality slabs on a consistent basis.

(2) Second step

- A production structure with one blast furnace will be built.
- Crude steel production of 2.342 million tons/year by means of iron and steel making equipment is planned.
- Hot and cold strip mill plants will be expanded to their final production capacity, i.e., 3.0 million and 1.0 million tons respectively from view point of improving the return on investment.
- 2.342 million tons of crude steel will entirely be assigned to produce 2.224 million tons of slabs.
- In addition, 1.0 million tons of slabs will have to be imported at this step.

(3) Third step

- A production structure with two blast furnaces will be built.
- Crude steel volume which matches the planned production quantity of hot rolled and cold rolled products will be assigned to the production of slabs, and the remaining volume of crude steel the production of billets.

1.2 Production balance and material flow

The production balance and the material flow in each phase are shown in Figure.2-2, Figure.2-3 and Figure.2-4, respectively.

Unit : 1000t/y

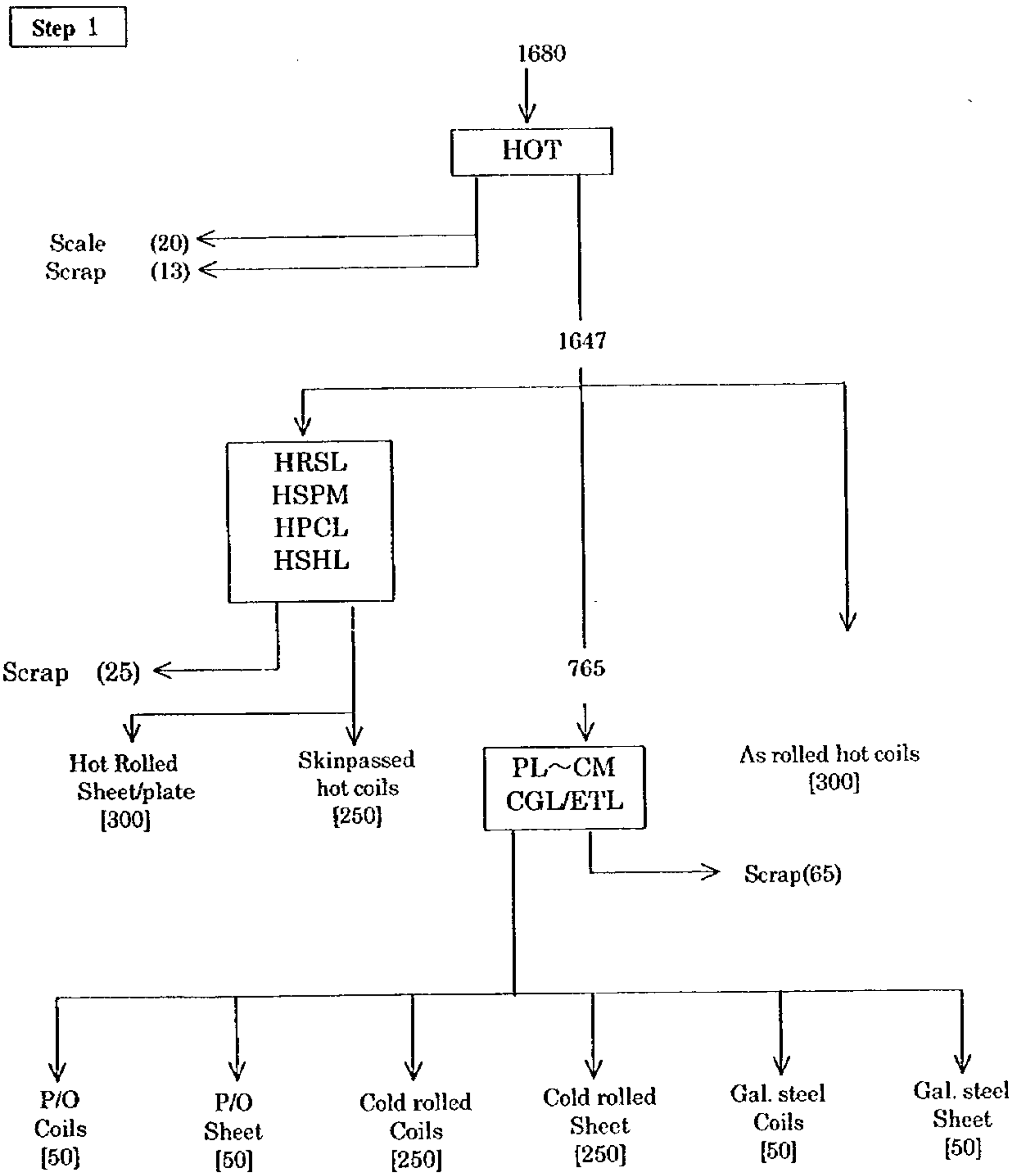


Figure 2-2 Material flow and material balance

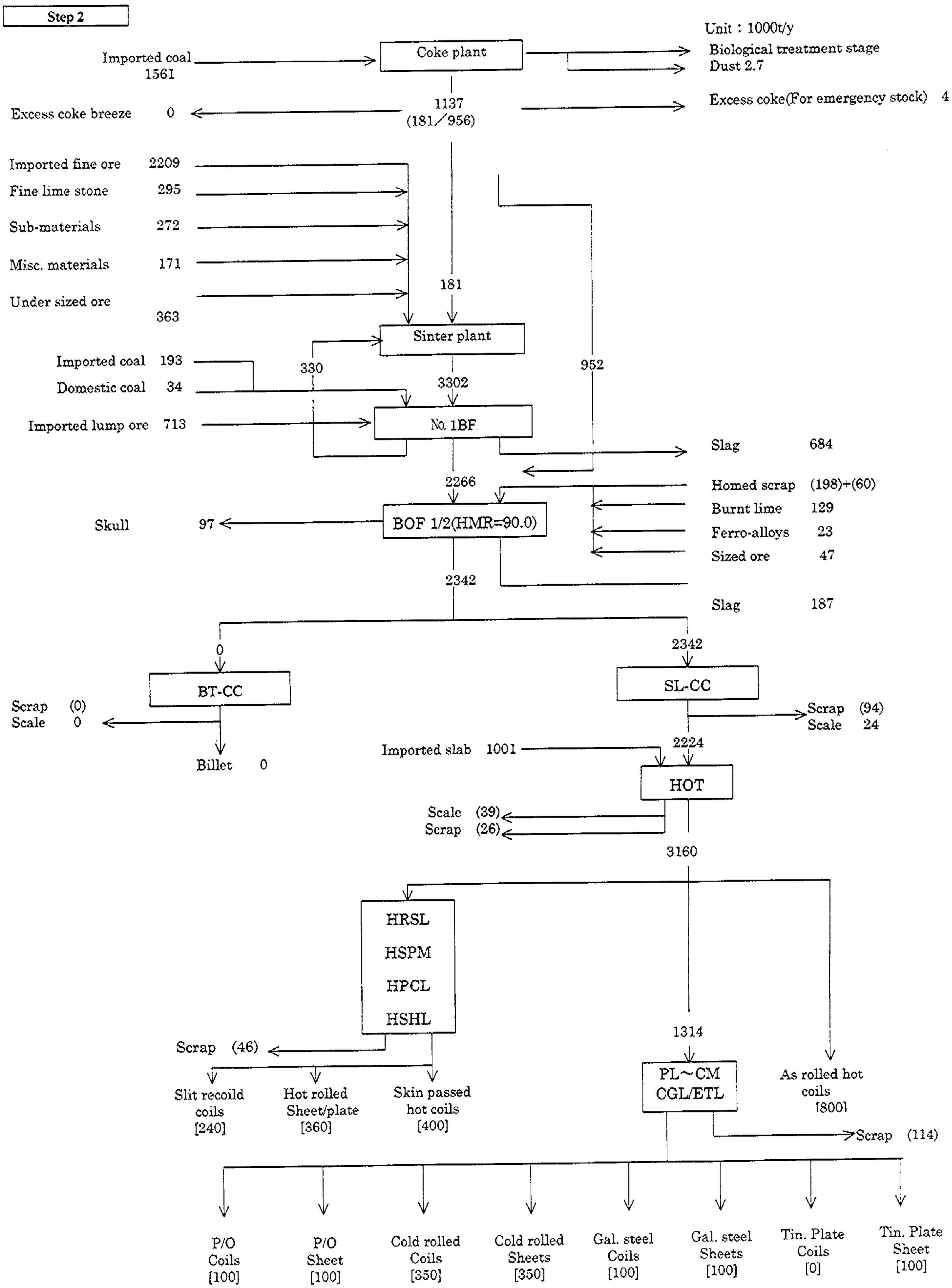


Figure 2-3 Material flow and material balance

Step 3

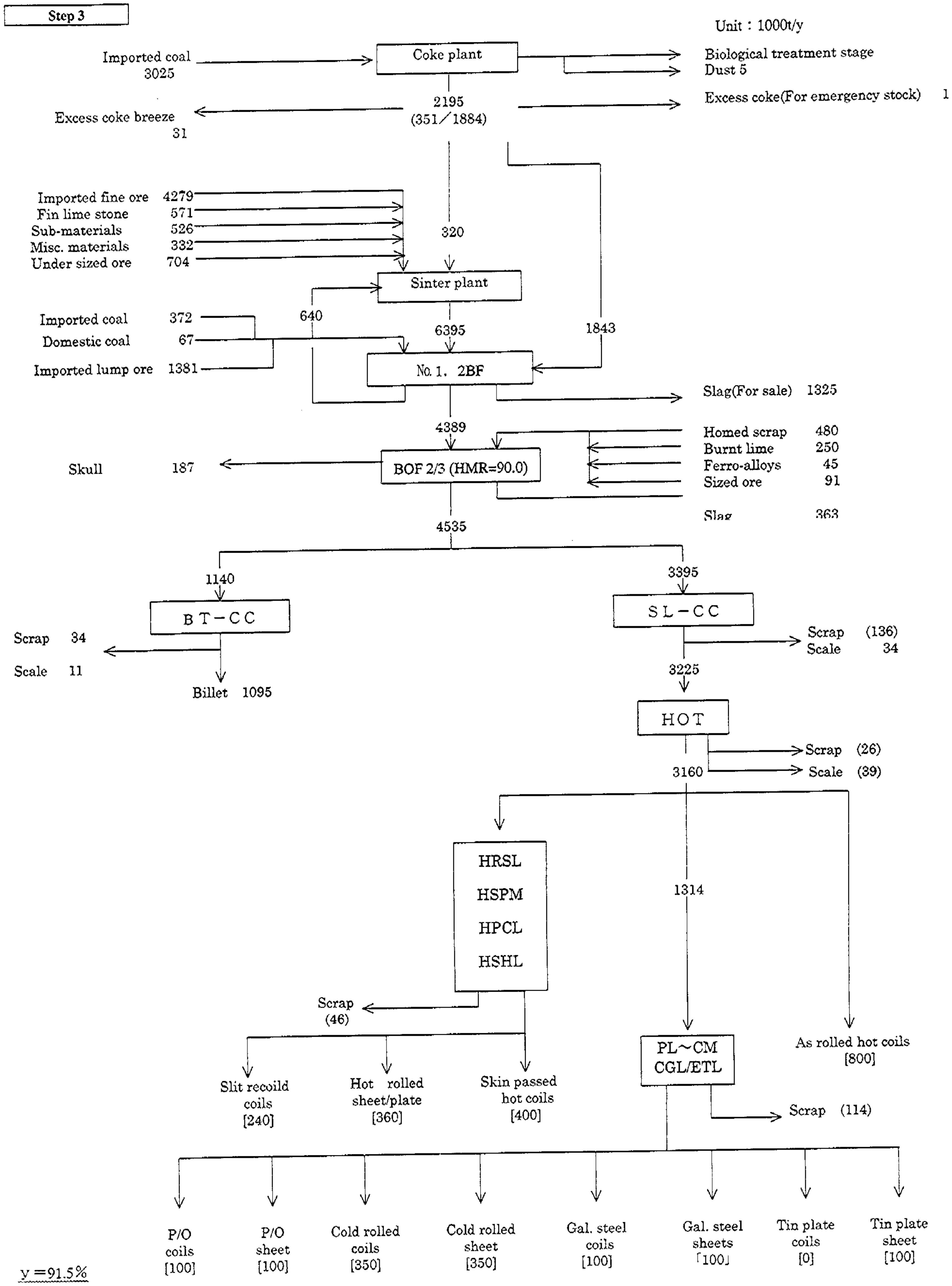


Figure 2-4 Material flow and material balance

Part 4 Site Description

Section 1 Soil, Weather, Marine and Transportation Conditions

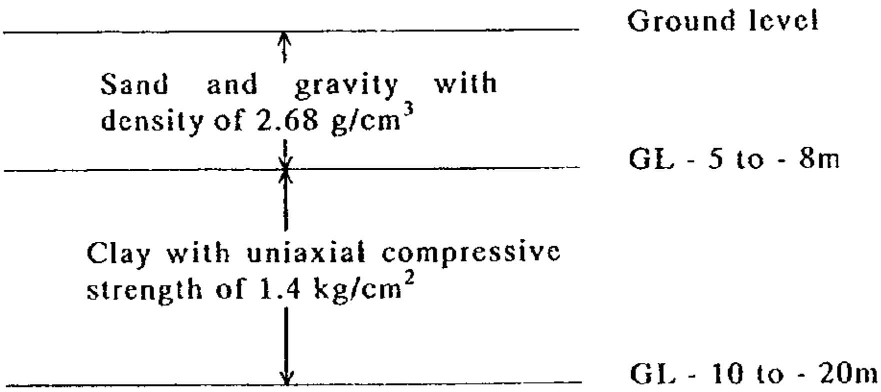
Contents

1. General

Some site conditions were confirmed on 22nd August,1997 based on the questionnaire which was prepared by JICA Master Plan Team and handed to Ha Thinh Peoples' Committee through VSC.
Such questionnaire was based on the site information including a map around the site which was given to MP Team by VSC in March,1997.

2. Soil properties

Soil properties based on boring up to the ground level of 20m near the site are as shown in Figure 1-1. Some kinds of soil test was conducted at the same time, but SPT(Standard Penetration Test) which gives the most important information for soil properties has not been done yet.



Source: Ha Thinh Peoples' Committee

Figure 1-1 Soil properties of the site

3. Weather conditions

3.1 Temperature

Temperature recorded in Ky Anh district during the past 36 years is as follows.

- Yearly average 23 ~ 27°C
- Maximum 40.5°C
- Minimum 8.0 °C

Source: Ha Thinh Peoples' Committee

3.2 Rainfall

- Yearly average 2,000 mm/year (at Ha Tinh city)
- Maximum 3,200 mm/year ~ 3,400 mm/year
- Minimum 1,600 mm/year ~ 1,800 mm/year
- Maximum in 24hour 150 mm/hour ~ 200 mm/hour

Table 1-1 Rainfall volume comparison by month

May	Jun	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
0%	6%	13%	18%	43%	20%	0%	0%	100%

Source; Ha Tinh Peoples' Committee

3.3 Wind

(a) Direction

Direction of wind in Ha Tinh province is shown in Table 1-2.

Table 1-2 Direction of wind

Month	Direction
Apr. to Nov.	West - South
Nov. to Apr.	East - North

Source: Ha Tinh Peoples' Committee

(b) Typhoon

The number of typhoon hitting directly the site area in a year is 0.47 times on average according to the statistical data during the past 36 years(17 times/36years). However, since typhoons normally give influence on a large area of hundreds square km, other typhoon hitting neighboring area should be considered. Accordingly the average number of typhoon to influence to the site in a year is around 2 to 3 times.

3.4 Humidity

Humidity in Ha Tinh province is shown in Table 1-3.

Table 1-3 Humidity

Average	83 -87 %
Minimum	45 - 55%
Maximum	90 - 94%

Source: Ha Tinh Peoples' Committee

4. Marine condition

4.1 Wave

The direction of open-sea wave near the site is divided into 2 seasons. Its detail is shown in Table 1-4.

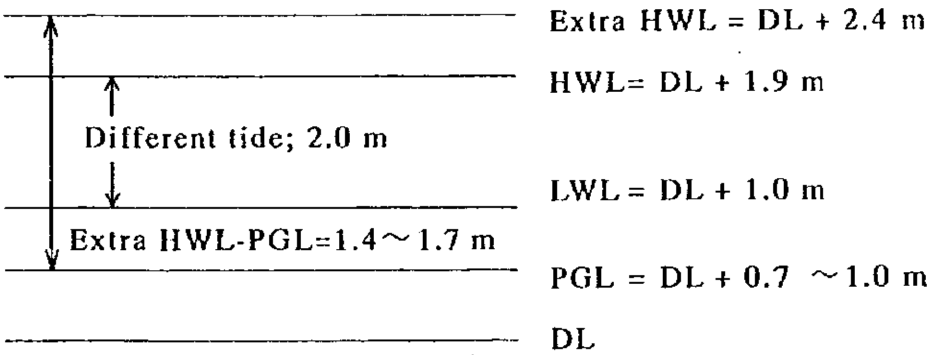
Table 1-4 Wave record in open-sea near the site

Season	Direction	Average height	Maximum height
Summer	SE and WE	0.7 to 1.2 m	6.0m *1
Winter	N and NE	0.7 to 1.0 m	3.5m

*1 Recorded in the typhoon NANCY on Oct. 18, 1982
Source: Viet Nam Steel Corporation

4.2 Tide

Tide figure near the site is shown in Figure 1-2.



Source: Viet Nam Steel Corporation

Figure 1-2 Tide figure near the site

5. Transportation

First of all, road situation in the neighborhood of the site is described. Route 1 is located about 6km away from the candidate site, but the present situation of road connecting with route 1 and the site has not paved and its width is not sufficient for new integrated steelworks transportation. Therefore it needs to be tidied up. Present situation and upgrade plan of route 1 is described in Chapter II Part3.
In surroundings of the proposed site, port and port facility being utilized now is none at all. Recently, the feasibility study is under way by the Ministry of Transportation for the exporting port of woods at Vung Ang where is near the site. Therefore, it is necessary to construct new berths exclusively for the integrated steelworks.
The main railway in Viet Nam is located several km far from the site, but effective maintenance and upgrade has not been carried out for long time. Under the present situation, the railway is not considered as transportation means of the new integrated steelworks.

Section 2 Environment

Contents

1. Meteorological conditions

1.1 Atmospheric temperature

(1) The atmospheric temperatures in Ha Tinh Prov. and Mui Ron are shown in Table 2-1 and 2-2, respectively.
(2) The annual average atmospheric temperature is about 24°C, with the maximum atmospheric temperature being about 40°C and the minimum atmospheric temperature being about 8°C.
(3) It is in the months from May to September that the monthly average atmospheric temperature exceeds 25°C.

Table 2-1 Atmospheric temperature (Ha Tinh Prov.)

	Ha Tinh Prov.
Average	23～24℃
Max	40.5 ℃
Min	8 ℃

Table 2-2 Atmospheric temperature (Mui Ron)

Month	Atmospheric temperature ('1962～'1992)
January	17.6℃
February	18.4℃
March	21.2℃
April	24.4℃
May	28.0℃
June	29.6℃
July	29.8℃
August	28.8℃
September	26.9℃
October	24.3℃
November	21.7℃
December	18.7℃
Average	24.1℃

1.2 Amount of rainfall

(1) The amounts of rainfall in Ha Tinh Prov. and Mui Ron are shown in Tables 2-3 and Table 2-4, respectively.
(2) Although the annual average amount of rainfall in Ha Tinh Prov. is about 2,000mm, it is about 3,000 mm in Mui Ron, the planned construction site of the steel plant.
(3) It is in the months from September to November that the monthly average amount of rainfall is large in Mui Ron, the planned construction site of the steel plant.
This amount is more than 400 mm.
The daily maximum amount of rainfall is 400 mm.

Table 2-3 Rainfall (Ha Tinh Prov.)

	Ha Tinh Prov.
Average	2,000mm
Max	3,200~3,400mm
Min	1,600~1,800mm
Rainfall Day	155~180day

Table 2-4 Rainfall (Mui Ron)

Month	Rainfall
January	123.4mm
February	72.4mm
March	59.7mm
April	77.8mm
May	135.5mm
June	129.0mm
July	134.2mm
August	217.0mm
September	603.7mm
October	810.8mm
November	421.1mm
December	184.2mm
Average	3,019.7mm/year
Max.	400mm/day

1.3 Humidity

1) The humidity in Ha Tinh Prov. is shown in Table 2-5.
2) The annual average humidity is 83% to 87% and high.

Table 2-5 Humidity

	Ha Tinh Prov.
Average	83～87%
Maximum	90～94%
Minimum	45～55%

1.4 Flux of insolation

In terms of annual flux of insolation, this district has about 1500-2000 sunny hours/year.

1.5 Wind

(1) There are two main directions of wind in Mui Ron:
- Nov.-Apr. East-North
- Apr.-Aug. West-South

(2) Especially in the months from July to September, the humidity is high and high-temperature west-south winds blow. They are called Laotian winds and for about 40 days winds blow at a wind velocity of 7 m/s.

1.6 Typhoon

(1) As shown in Table 2-6, typhoons hit Ha Tinh Prov. twice a year on average.
(2) The proportions of the months in which typhoons hit Ha Tinh Prov. for the past 100 years are shown in Table 2-7.
(3) Typhoons come in the months from June to October and about 40% of typhoons come especially in September.

Table 2-6 Latitude and hit of typhoons (results for the past 36 years)

Latitude	17º～18º	18º～19º	19º～20º	Total
Total times	31	17	26	74 times
Average times	0.86	0.47	0.72	2.05 times/year

Table 2-7 Proportions of hit of typhoons by months (results for the past 100 years)

Month	May	June	July	August	September	October	November
Ratio	0%	6%	13%	18%	43%	20%	0%

2. Investigation of environment of planned construction site

2.1 Investigation item

A water quality investigation and a noise investigation were conducted as the environmental investigations of the planned construction site.

2.2 Water quality

(1) Sampled water was analyzed twice as a water quality analysis. The average analytical values are shown in Table 2-8. The water quality of seawater, river water and the water on the reservoir to be used as industrial water were analyzed.

(2) Any of the seawater, river water and reservoir water was not in an especially dirty or contaminated condition and there is no problem.

(3) The problem was that the pH value of sampled river water was about 5 and low. Because the mixing-in of some acid can be considered, an acid ion analysis of the river water was conducted and an acid ion analysis of the reservoir water was also conducted for comparison. The results of these analyses are shown in Table 2-9.

(4) There is no special problem in the pH and acid ions of the reservoir water sampled above the river. Therefore, some acid ions must have mixed in while the river water went downstream, resulting in a decrease in the pH of river water.

The following items may be the causes of the low pH of river water:

- Because the concentration of chlorine ions (Cl^-) is high, the mixing-in of sea water, mixing-in of the salt of sea water, etc., is conceivable.
- Because the concentration of sulfuric acid ions (SO_4^{2-}) is high, the mixing-in of agricultural chemicals is conceivable.
  There are regions of acid soil in Southeast Asia and the effect of acid soil is conceivable.
- In a venture business in the south where underground water is used as industrial water, the pH of underground water is about 5.5 and low and, therefore, underground water is neutralized before use for corrosion protection and rust prevention.

(5) In view of the foregoing, it is necessary to conduct another water quality investigation and a soil investigation in the surrounding area in constructing the steel plant.

Table 2-8 Water quality

No	Parameters and substances	Unit	Mui Ron		
			A	B	C
1	pH value	—	8.3	4.8	6.4
2	BOD	mg/l	—	—	—
3	COD	mg/l	2.2	4.0	2.8
4	Suspended solids	mg/l	5	5	14
5	Mineral oil and fat	mg/l	—	—	—
6	Animal-vegetable fat and oil	mg/l	—	—	—
7	Phenol	mg/l	< 0.01	< 0.01	< 0.01
8	Copper	mg/l	< 0.05	< 0.05	< 0.05
9	Zinc	mg/l	< 0.05	< 0.05	< 0.05
10	Iron	mg/l	< 0.05	< 0.05	0.08
11	Manganese	mg/l	< 0.05	0.15	< 0.05
12	Chromium	mg/l			
13	Fluoride	mg/l	0.92	0.19	0.27
14	Coliform	MPN/ml	—	—	—
15	Total nitrogen	mg/l	0.22	1.32	0.51
16	Total phosphorous	mg/l	0.27	0.04	0.06
17	Cadmium	mg/l	< 0.01	< 0.01	
18	Cyanide	mg/l	< 0.1	< 0.1	
19	Organic phosphorous	mg/l	< 0.1	< 0.1	
20	Lead	mg/l	< 0.01	< 0.01	
21	Chromium (VI)	mg/l	< 0.05	< 0.05	
22	Arsenic	mg/l	< 0.01	< 0.01	
23	Mercury	mg/l	< 0.0005	< 0.0005	—
24	Alkylmercury	mg/l	< 0.0005	< 0.0005	
25	Polychlorinated biphenyl	mg/l	< 0.0005	< 0.0005	—
26	Trichlorethylene	mg/l	—	—	—
27	Tetrachlorethylene	mg/l	—	—	—
28	Dichloromethane	mg/l	—	—	—
29	Carbon tetrachloride	mg/l	—	—	—
30	1,2-Dichloroethane	mg/l	—	—	—
31	1,1-Dichloroethylene	mg/l	—	—	—
32	Sys1,2-Dichloroethlene	mg/l	—	—	—
33	1,1,1-Trichloroethane	mg/l	—	—	—

No	Parameters and substances	Unit	Mui Ron		
			A	B	C
34	1,1,2-Trichloroethane	mg/l	—	—	—
35	1,3-Dichloropropene	mg/l	—	—	—
36	Tetramethylthiuram disulfide	mg/l	—	—	—
37	2-chloro-4,6-bis(ethylamino) -1,3,5-triazine	mg/l mg/l	—	—	—
38	S-4-chlorobenzyl diethythiocarbamate	mg/l mg/l	—	—	—
39	Benzene	mg/l	—	—	—
40	Selenium	mg/l	< 0.01	< 0.01	—

A : Water on the sea — Son Duong Bay / Mui Ron
B : Water on the river — Ong River (at Tay Yen Bridge) / Mui Ron
C : Water on the Reservoir — Song rac

Table 2-9 Results of ion analysis of water

	Cl^-	NO_3^-	PO_4^{2-}	SO_4^{2-}
Water on the Reservoir	3.7 mg/l	3.9 mg/l	1.4 mg/l	2.3 mg/l
Water on the river	706 mg/l	4.1 mg/l	2.0 mg/l	86.9 mg/l
Balance	702 mg/l	0.2 mg/l	0.6 mg/l	84.6 mg/l

2.3 Noise

(1) The results of a noise investigation are shown in Table 2-10. Noise was measured at two places in the planned construction site. The results of records by a noise meter are shown in Figure 2-1.

(2) At both of the two places, the average values of noise level are about 40 dB. There is no factory, house, etc. around and the noise is natural sound and there is no problem in the sound level. When the steel plant is constructed, the noise of the steel plant will become the principal noise.

Table 2-10 Noise measurement result

Noise level	Site A	Site B
L eq	39.5 dB	40.2 dB
L 5	41.8 dB	43.6 dB
L10	39.9 dB	42.5 dB
L50	36.5 dB	38.8 dB
L90	34.9 dB	36.1 dB
L95	34.2 dB	35.3 dB

Site A The coastline
Site B In the woods

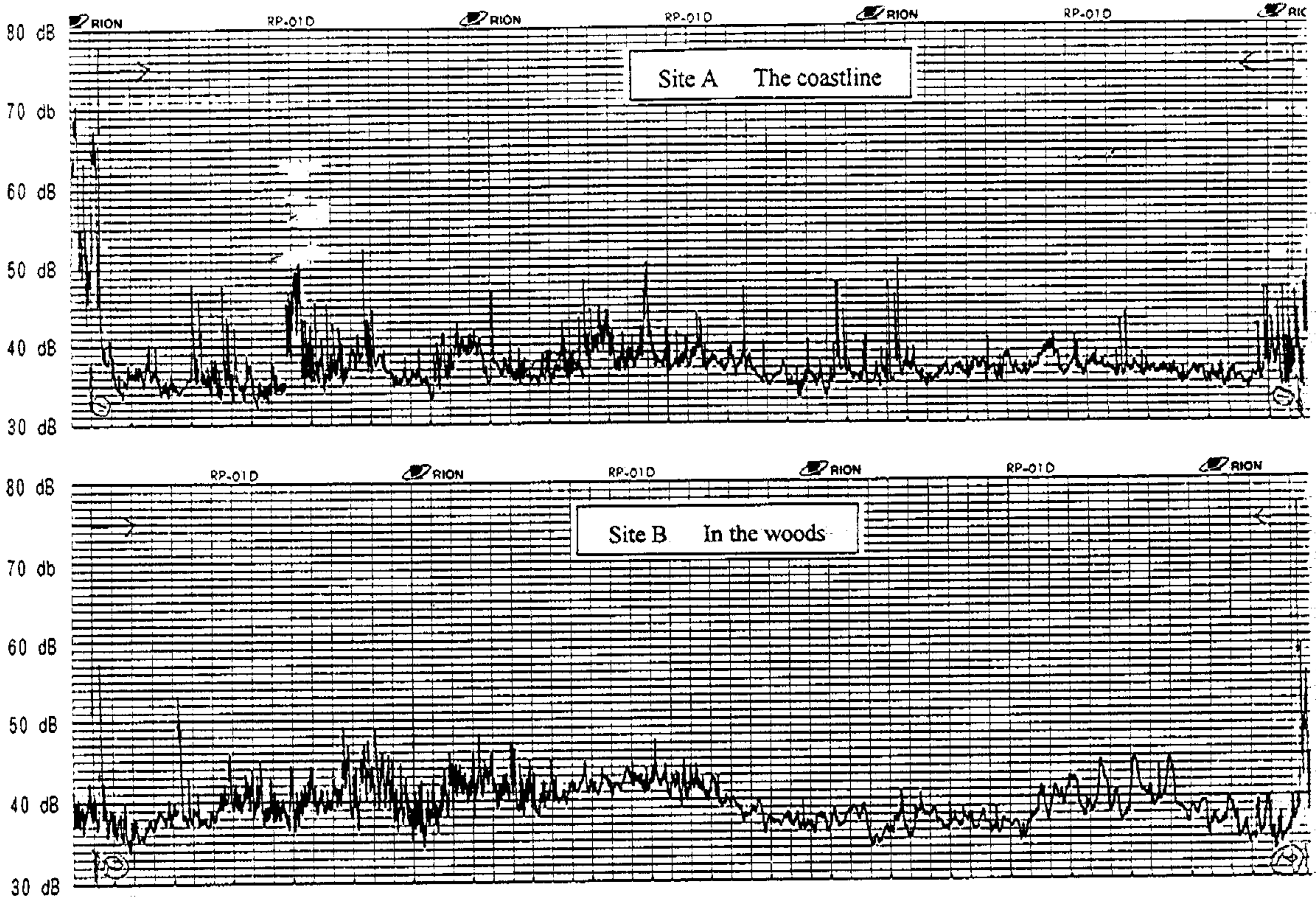


Figure 2-1 Noise measurement result

Section 3 Utilities

Contents

1. Water supply

1.1 Actual and future plan of the reservoirs near the site area

Actual and future plan of the reservoirs near the site area are shown in Table 3-1.

Table 3-1 Actual and future plan of reservoirs near the site area

	Name	Capacity	Present reserved volume	Distance to site	Purpose	Investment cost
Actual	Da Cat	3 million m^3	3 million m^3	19 km	Flood (No use)	-
	Kim Son	28 million m^3	28 million m^3	12 km	Flood (No use)	-
	Moc huong	3 million m^3	3 million m^3	7 km	Flood (No use)	-
	Tau Voi	3 million m^3	3 million m^3	4 km	Flood (No use)	-
	Song Rac	150 million m^3	150 million m^3	20 km	- Irrigation 40 million m^3 - Industry 110 million m^3	-
Future plan	Tau Voi	+ 7 million m^3	-	4 km	Industry	Not informed
	Kim Son	+22 million m^3	-	12 km	Industry	Not informed
	Song tri (New)	54 million m^3	-	10 km	Industry	Not informed
	Tao Tro (New)	294 million m^3	-	-	Industry	Not informed

1.2 The plan of water supply for the new integrated steelworks

According to Ha Tinh Province People's Committee, industrial water for the new integrated steelworks is supplied from the existing Song Rac reservoir without new investment except installation of water pipeline. The volume is enough for necessary ones shown in the criteria of site selection of new integrated steelworks. There are two schemes of installing water pipeline. One is the user itself installs, and the other is to be installed by Viet Nam's government. In the latter case, construction cost is added to water supply charge, resulting that the total water cost is estimated to be 1,000VND / m^3. In this case, there is no need to pay connection charge etc. except water supply charge.

The construction cost of water pipeline is reported to be 5US$/$m^2$/m-length.

2. Power supply

2.1 The plan of power supply for the new integrated steelworks

(1) Existing 500kV substation, Tachidien substation, with a plan to expand one set of 450MVA transformer in 2000 will be able to supply electric power to the new integrated steelworks. This expansion was originally planned to supply electric power for iron ore exploitation at Thach Khe mine.

(2) Distance between existing 500kV substation and Mui Ron site is approximately 40 km.

2.2 Erection power supply

The Ky Anh substation with a capacity of 25 MVA which is planned to be operated in 2000 to supply electric power for Vung Ang industrial area will be able to supply erection power for the new integrated steelworks before completion of 220kV power receiving.

2.3 Unit price of electricity

The following unit price of electricity was applied to domestic manufacturer with power receiving of 110kV or higher as of 15th May, 1997.

Energy charge

- Normal time (4 to 17 O'clock) 700 VD/kWh
- Peak time (17 to 22 O'clock) 1,150 VD/kWh
- Off peak time (22 to 4 O'clock) 400 VD/kWh

Demand charge

This system is not adopted in Viet Nam.

2.4 Unit price of other energy

As of 1997, unit price of LPG, diesel oil, heavy oil (C class) are as follows.

- LPG : 6,900 VD/kg
- Diesel oil : 3,300 VD/l
- Heavy oil (C class) : 1,700 VD/l

Part 5 Raw Materials and Semi-products

Section 1 Raw Materials

Contents

1. Iron ore

1.1 Import of iron ore

The basic assumption is that all iron ore will be imported into Viet Nam. In preparing an actual iron ore purchasing strategy many factors have to be taken into account including the economical and political situation in Viet Nam at the time.

1.2 Import strategy and plan

As described in Section 5, Part 2, Chapter IV, it is advisable to select several sources. It is recommended to import iron ore from nearest sources of India and Australia as much as possible with broadly the same proportions as at present exported from these countries. And adjustments of the import ratios may have to be made to keep the slag ratio for blast furnaces at about the level as it is in the case for big volume blast furnace, i.e., a level that has been found by experience suitable by importing ore from Brazil. And small adjustments have to be made to keep the sinter ore ratio around 80% by importing lump ore from South Africa. The proportion of import is set to be the same in Step 2 and Step 3 of the construction schedule. The ratio of imports becomes as shown in Table 1-1.

Table 1-1 Import plan of iron ore

(unit:%)

	Australia	India	South Africa	Brazil & others	Sub total
Lump	20.4	7.2	5.2	0.0	32.8
Fines	41.7	6.0	0.7	18.8	67.2
others	0.0	0.0	0.0	0.0	0.0
Sub total	62.1	13.2	5.9	18.8	100.0

Representative properties and prices of iron ores in area-wise are shown in Table 1-2. The rates for ocean freight have been based on the spot unit prices paid by steel mills in 1996 in Asia. FOB prices of ore have been based on 1996 price to Asia decided under the long term contract. The gate price is the price just after the ore has been unloaded from the ship at the unloading port. In the case of Australian fine ore limonitic ores are excluded from the average calculation for the purpose of comparison of hematitic ores.

Table 1-2 Properties of iron ore

Source and type of ore	T.Fe	SiO_2	Al_2O_3	Unit Price	FOB	Gate price
	%	%	%	¢ per ton per %Fe	US$per Dry metric ton	US$per Dry metric ton
Australia Fine	63.0	4.2	2.3	28.5	17.7	26.4
Australia Lump	65.1	3.2	1.4	37.7	24.1	32.8
Indian Fine	65.1	3.0	1.4	20.8	13.4	24.1
Indian Lump	65.7	1.9	1.7	33.0	21.4	29.9
South Africa Lump	66.4	3.2	1.4	30.4	19.9	34.4
South America Fine	67.3	0.7	0.9	26.3	17.4	29.8

1.3 Usage of iron ore

Iron ores are processed in the plant.
Fines and under size lump after screening lump are to be used in sintering plant.
Sized lump ore after screen is used in blast furnace and in steel making process.
A summary of these usage of ores are shown in Table 1-3.

Table 1-3 Usage plan of iron ore

(unit: kilo t/y)

	Step 2		Step 3	
	Procure	Usage	Procure	Usage
Lump	1,123		2,167	
sized lump for steel making		47		91
sized lump for blast furnace		713		1,381
under size at sinter		363		704
Fines at sinter	2,209	2,209	4,279	4,279

1.4 Burden for blast furnace

Table 1-4 shows the burden of the blast furnace based on the above iron ore import and usage plan.

Table 1-4 Ferrous burden for blast furnace

	Blend	T.Fe	SiO_2	CaO	Al_2O_3	MgO
Sinter	80.6	56.7	4.6	9.6	1.7	1.9
LL	19.4	65.8	2.8	0.1	1.2	0.04

LL: Lump ore after sizing through crushing and screening in the plant

2. Coal

2.1 Import of coal

The basic assumption is that all coking coal will be imported into Viet Nam. In preparing an actual coal purchasing strategy, many factors have to be taken into account including economical and political situation in Viet Nam at the time.

2.2 Import strategy and plan

It is advisable to import coking coal from suppliers mainly in China, CIS and Australia. The proportions of coking coal to be imported from these countries is to be decided using the same philosophy as set out for the iron ore. To keep the property of coke and ash at an optimum level from the requirement of blast furnace operation, the proportions of hard coking coal to soft and weak coking coal would be as shown in Table 1-5 below.
It is assumed that 98% of the required coal is to be imported and the remaining 2% would be Hongai coal in the form of Pulverized Coal Injection (PCI) coal for the blast furnace. Hongai coal is to be used with fraction of 15% in PCI coal. The actual properties of the Hongai coal for PCI still has to be studied in detail. It is assumed that PCI will be used in a ratio of 100 kilograms per ton of pig iron. The proportion of coking coal import is set to be same in Step-2 and Step-3.

Table 1-5 Import plan of coking coal

(unit:%)

	Australia	CIS	China	U.S.A	Sub-total
Hard coking coal	25	12	3		40
High fluidity				10	10
Semi coking coal.	10		2		12
Soft and weak coking coal	33		3		36
Total	68	12	8	10	98

The rate for ocean freight is assumed to be the spot contract freight rate experienced in 1996 by steel mills in Asia. The gate price is that just after being unloaded from the ship at the unloading port. The average properties of coal are calculated as shown in Table 1-6.

Table 1-6 Properties of coal for coking

Coal category	Ash	VM	MFD	Ro*1	Ctr*2	Ash composition			FOB	Gate price
	(%)	(%)	(%)		(%)	SiO_2	CaO	Al_2O_3	US$/DMT	US$/DMT
Hard coking	8.9	22.2	2.3	1.2	5.0	47.0	2.6	25.9	59.6	67.2
High fluidity	7.7	34.4	4.2	0.9	15.4	51.0	0.8	26.0	53.0	66.5
Semi coking	9.0	30.1	3.2	0.9	18.6	54.6	0.8	29.4	54.1	62.7
Soft and weak	8.9	32.0	1.9	0.9	16.0	54.6	2.5	24.8	49.3	58.5
Total	8.8	27.5	2.5	1.0	11.2	50.7	2.1	26.1	55.1	64.1

*1 Reflection ratio, *2 Contraction

2.3 Usage of coal

The usage of coal is shown in Table 1-7

Table 1-7 Usage plan of coal

(unit: dry kilo t/y)

	Step-2	Step-3
Hard coking	721	1,396
High fluidity	178	346
Semi coking	217	422
Soft and weak	445	861
PCI imported	192	372
PCI(Hongai)	35	67
Total	1,788	3,464

3. Miscellaneous materials

3.1 Limestone, dolomite and quartzite

These materials can be sourced from Viet Nam.

3.2 Serpentine

Serpentine is useful for the adjustment of the chemical composition of slag, but it has not been taken into consideration because there is no mine in Viet Nam and it is ossible to substitute it for domestically produced dolomite and quartzite.

3.3 Recycled waste

All waste products from the plant, which is possible to be used such as flux, fuel and source of iron, are to be recycled as far as possible with the exception of blast furnace slag.

3.4 Manganese ore and ferruginous iron ore

These materials are not to be used in iron and steel making process.

3.5 Fluorspar

This is to be imported from China.

3.6 Scrap

Only return scrap, that is generated within the plant, is to be used.

3.7 Ferroalloys

All ferroalloys are to be imported from all over the world.

Section 2 Slab

Contents

1. Demand of the semis

Worldwide Statistics of the semi-products do not seem to be very apparent. World Steel Exports in 1995, however, by ISSB (International Steel Statistics Bureau), for instance, reported that grand total of semis amounted to approximately 22.7 million tons per annum which included ingot and semis of blooms, billets, and slabs.

Other information sources reportedly informed that worldwide demand in 1996 for slabs were 18 million tons.(Steel Survival Strategies XII, America Metal Market June, 1997 by Mr. B. M. Baptista Filho)
The details in the report of the destinations supplied are shown in Figure 2-1. Most of slabs exported were consumed in Far East (47%) and North America (39%).

Slabs demand, according to the report, recently tends to increase rapidly, on the contrary capacity of slabs supply seems to maintain its capacity or decrease.

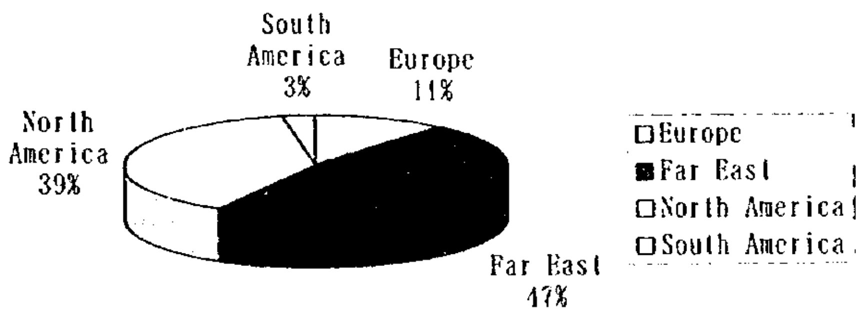


Figure 2-1 Worldwide demand of slabs in 1996
(Steel Survival Strategies, 1997)

2. Trend of demand of slab

The report also suggested the trend of slabs demand including the past data and estimation for the year of 1998 based on the installation of re-rolling mills in Korea (1.5 million tons) and Taiwan (1 million tons) as well as reduction of supply capacity after installation of hot rolling mill in Brazil.

Demand of slabs seems to have reached to approximately half of the demand of grand total of semis, though it was one third in 1984. The remaining is obviously the demand for blooms, billets, and ingots, etc. Trend of the demand is shown in Figure 2-2.

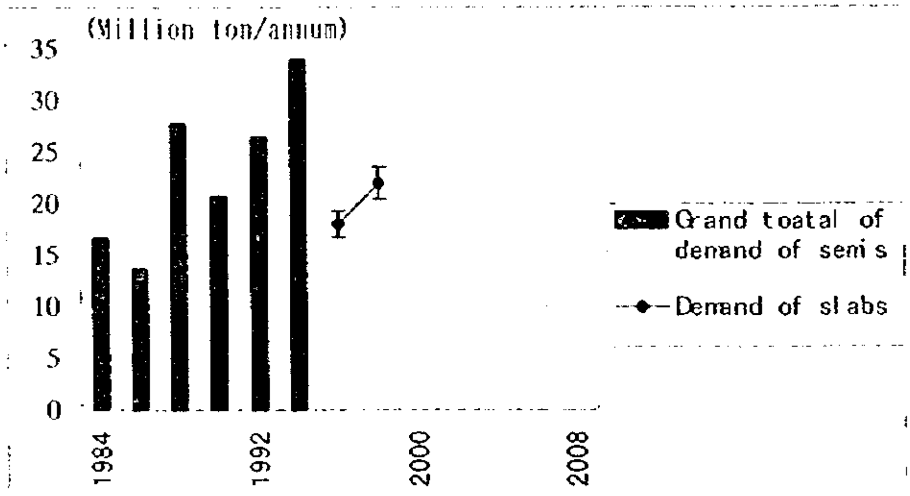


Figure 2-2 Trend of demand for semis

The value for the year of 1998 includes the estimation of increase of demand by new installation of hot rolling mills in the two countries mentioned above.

3. Supply of the slab

Capacity of supply of slabs, as indicated previously, does not seem to be harmonized with the trend of demand of slabs or rather seems to decrease due to the market conditions, since hot rolled coils sales are more profitable than the those of slabs and therefore suppliers tend to diversify to hot coil suppliers.

Figure 2-3 shows the current map of slabs suppliers worldwide in 1996, which indicates that Latin America, CIS, and Ukraine are the main sources
of slabs supply which cover approximately 70 % of the total.

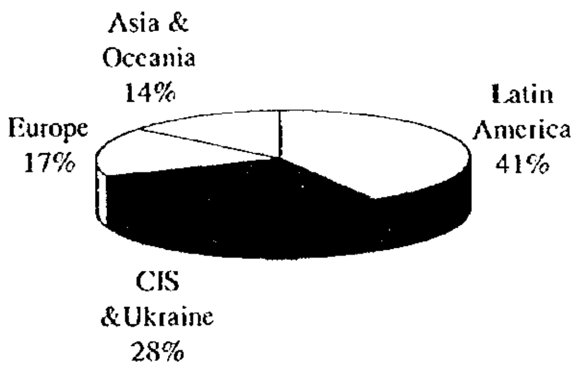


Figure 2-3 Main slabs suppliers in1996

Two figures also indicate that there exist large material flows from Latin America and Ukraine & CIS to the Far East and North America which amounts to 18 million tons equivalent to that of the demand.

The report also suggested that half of them are consumed by re-rollers and remaining half by integrated mills.

North American integrated mills decline to re-enforce their up-stream processes such as Coke Ovens, Blast Furnaces as well as Basic Oxygen Furnaces due to financial and environmental constraints.

4. Market price of slab

There will be two alternatives to purchase slabs in the market, namely to obtain spot basis and to contract in long term business.

Purchasing large amount of semis will stably be attained by contracting in long term relationship, though the price should be negotiable.

Following data (Figure 2-4) shows some trends of spot market slabs price worldwide.

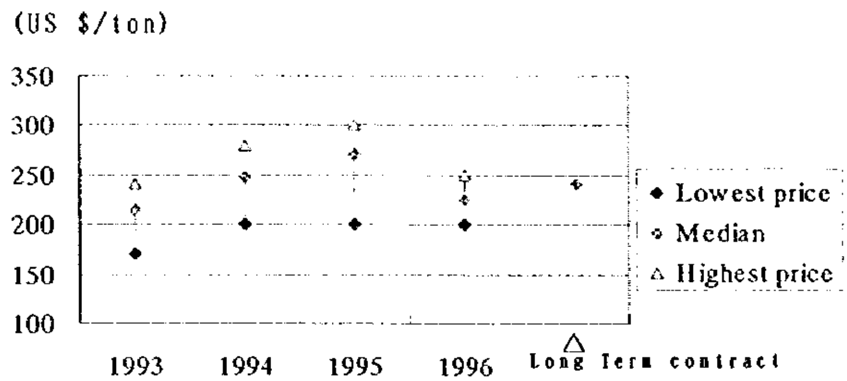


Figure 2-4 Trend of slab spot price

Long term basis price, for instance, indicated by the reporter at Steel Survival Strategies XII was approximately 240 US $/ton fob in 1996.
Spot market prices shown above, on the other hand, deviated from 220 to 250 US $/ton in the year.
Freight will be 30 US $/ton between Far East and the large suppliers of slab.

Slabs prices obtained at the site may cost approximately 270 US $/ton.
Spot prices, in the near future, may raise sharply unless more participation of suppliers is expected in the worldwide market.
A certain Japanese trader observed that slab price in long term relationship contract could be 230 US $/ton, fob and 260-270 US $/ton, CIF.

Part 6 General Plant Description

Section 1 General Design Concept

Contents

1. General design concept

The following basic design concepts were adopted as the base for the integrated steelworks.

1.1 Plant design

- Production lines are designed with a view to ensuring stable production by adoption of the most appropriate and reliable, established mass-production process.
  While a combination of blast furnace and basic oxygen processes is employed for the iron and steel making, conventional hot rolling process is adopted for the flat product production.
- In designing production equipment, priority is given to reduction in equipment cost.
- Use of labor and energy saving equipment is confined to processes that have limitations in attainment of desired product quality and operation by human labor.
- Grades of products and by-products are decided by considering their marketability and the amount of capital investment required for their production equipment.
  In deciding steel production capacity, priority is given to slabs, with surplus capacity allocated to billets.
  By-products of coke are planned to be marketed as tar, crude light oil, ammonia and other intermediate product.
- Environmental system are designed to meet the environmental regulations of viet Nam, with recent international environmental situations in mind.
- Intraworks transport system are designed based on inexpensive and highly mobile tractors, trailer, dump and ordinary trucks, and other trackless vehicles, except those for pig iron and molten slag that must be transported by rail.
- Although by-product gases generated in the steelworks can be used as in-plant energy sources, large quantities of fuel gases remain as surplus.
  To make use of such surplus by-product gases, an intraworks power plant is planned.
- As energy control center will not be installed in this steelworks.
  Adjustment for supply and demand of by-product gas and supervision of fuel distribution will be made at power plant control room.

Section 2 Level of Process Automation and Energy Conservation

Contents

1. Levels of process automation and energy saving

The design concept of the projected integrated steelworks gives priority to the minimization of capital investment on equipment and attainment of maximum return on investment.
Therefore, all equipment is not designed with the highest level of automation and energy saving in mind, as in advanced steelmaking countries.
The design concept and concrete plans of automation and energy saving for the individual processes of the steelworks are described blow.

2. Process automation

Process automation can generally be classified into the levels shown in Figure 2-1.
Levels one, two, and three of automation will be employed by the individual processes of the steelworks.
VSC must consider and carry out on its overall automation of the steelworks including production control to further enhance its operating efficiency after its production system has stabilized and its management has come on stream.

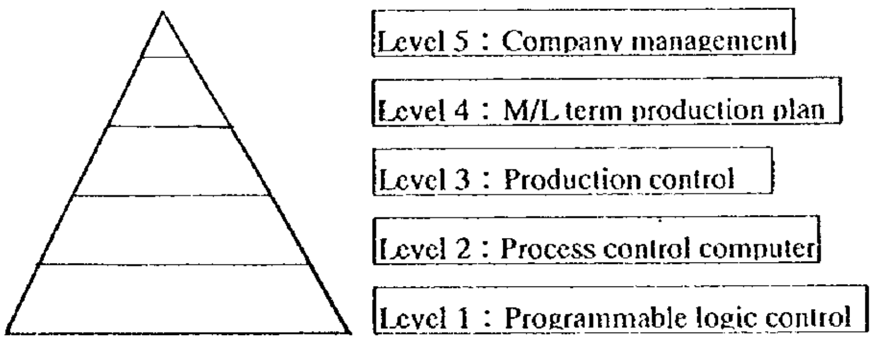


Figure 2-1 Classification of automation

2.1 Concepts of each control level

(1) Equipment with level 3 automation
The level 3 equipment is limited to the type of equipment which will be necessary for production control between the steelmaking plant and the hot strip mills.

(2) Equipment with level 2 automation
The equipment with level 2 automation is confined to those which necessitate such automation and process computer control for assurance of desired equipment performance and product quality.

(3) Equipment with level 1 automation
Most of the production equipment are with level 1 automation.
Level 1 automation is achieved by programmable logic controllers(PLC), and micro-computers.
Level 1 automation is mainly bloc automation, with manned equipment operation in view.
Adopted automation levels 1,2 and 3 are shown in Table 2-1.

Table 2-1 Automation level for each plant

plant	Level 3	Level 2	Level 1	Items controlled
Port facilities			●	
Raw materials handling facilities			●	
Sintering plant			●	
Coke plant			●	
BF plant		●	●	
BF auxiliaries			●	
Lime calcining			●	
BOF plant	●	●	●	Production control. Turndown time/chemical composition.
CC plant	●	●	●	Production control. Casting speed & cooling rate & tracking
Hot strip mill	●	●	●	Production control. Plate temperature/profile.
Hot strip mill auxiliaries			●	
Cold strip mill		●	●	Plate profile, & tracking
Cold strip mill auxiliaries			●	
Metal finishing			●	
Metal finishing auxiliaries			●	

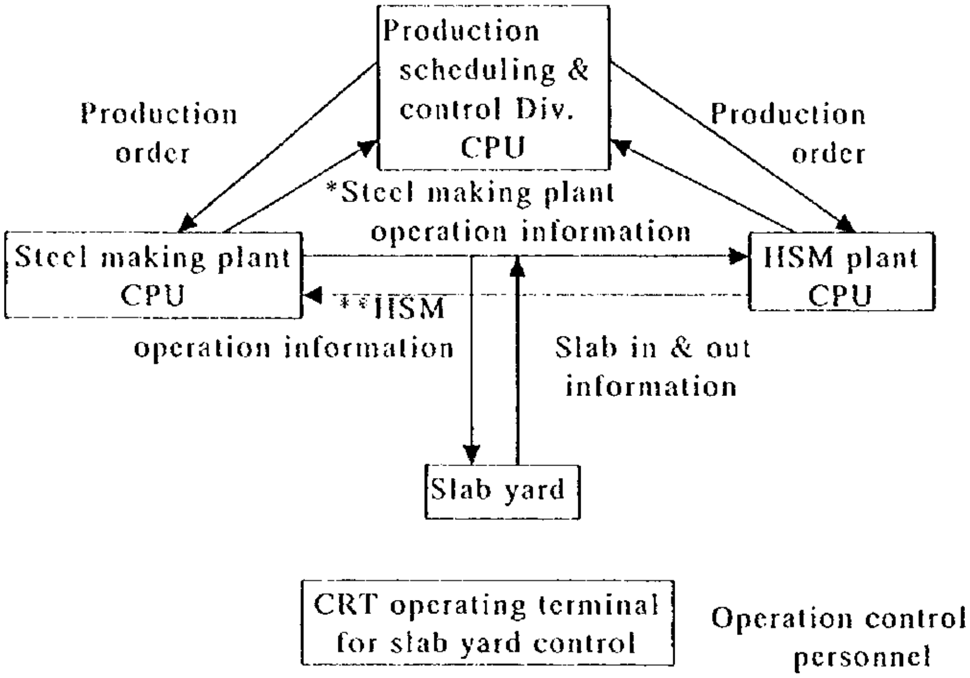
2.2 Energy saving facilities

Energy saving equipment is important for steel industry that consumes large amounts of energy.
Its importance has been increasing recently because of the global environmental need to reduce carbon dioxide emission.
On the other hand, energy saving equipment require huge amount of capital investment and high level of control and maintenance.
For Viet Nam that constructs and operates a full-fledged integrated steelworks for the first time, installing energy-saving facilities like those of advanced steel making countries involves many problems.
Therefore more sophisticated energy-saving facilities are described on a provisional basis in the future.

Table 2-2 Energy-saving facilities

Energy-saving facilities	Adoption	Provision
Dust collector motor rotation controllers	●	x
Heating furnace recuperators	●	x
Sintering machine waste heat recover system	x	●
Coke dry quenching equipment	x	●
Coke oven waste heat recover system	x	●
Blast furnace top-pressure recovery turbine	x	●
BOF gas recovery system	●	x
Direct hot charging for HRM	●	x

Note: ● : Adopted
x : Not adopted



* BOF plant operation information

1) Steel grade in production
2) Size(weight)
3) Slab temperature
4) Slab tracking
5) Production order/production data i/o

** HSM plant operation information

1) Slab acceptance/rejection
2) Rolling schedule
3) Rolling conditions(size & weight)
4) Production order/production data i/o

Figure 2-2 Concept of production control system

Part 7 Execution Plan

Section 1 Construction Schedule

Contents

1. Construction schedule

1.1 Basic concept for construction schedule

The construction schedule described in this section covers the period from the start of basic design by the successful plant supplier to the start of operation.
The construction period for each unit of production equipment is generally determined by the feature of equipment itself, its scale of complexity, etc.
The basic concept of the construction schedule are described below.

- Preliminary work necessary for determining the supplier of each plant equipment unit before the construction schedule is not stated.

- In consideration of the transport situation in Viet Nam, unloading and transport of equipment and materials to the site for the construction of the integrated steelworks will be carried out from the product berth. From this purpose, the work for land preparation and product berth facility will precede other work.
- The construction process consists of three steps to the completion of the construction of an integrated steelworks.
- These three steps are first, the construction of hot strip mill and cold mill plant, second, the construction of one blast furnace and its related facilities, and, third, the construction of another blast furnace to establish a 2-blast furnace production structure.
- The timing of construction commencement for auxiliary plant will necessarily be determined by the date planned for its production plant start up.

(1) First step

- Land preparation and product berth facilities construction will precede all other equipment construction work.
- Land preparation schedule should be completed before the start of foundation work of the tandem cold mill.
- The power receiving equipment for construction should be completed before the start of foundation work for the tandem cold mill etc.
  The product berth should also be completed before the start of erection work for the hot strip mill, the tandem cold mill equipment, etc.

- Berth product loader and intraworks transport equipment should start operating in conjunction with the cold-run test on the tandem cold mill equipment.
- The intraworks communication systems should start operating in conjunction with the start of production equipment such as the hot strip mill, tandem cold mill, etc.
- The central administration office and administrative equipment should take their final shapes during the first step.

(2) Second step

- For equipment such as coke plant and blast furnace which require a long construction period, the determination of the plant suppliers should precede other work.
- The coke plant should start operating two months prior to the start of the blast furnace plant for purposes of the production of blast furnace coke and the production of COG in preparation for the start of other production plant.
  The sintering plant should also start operating one month prior to the start of the blast furnace plant.
- The berth facilities and the raw materials handling facilities should start operating one month prior to the start of the coke plant which precedes the start of blast furnace plant.
- The power generation and other utility plant should start operating in conjunction with the start of the coke plant.
- Expansion will be made to the hot strip mill and tandem cold mill plant built during the first step, and such expansion work should be made during scheduled maintenance of each plant at several times.
- Reinforcement to the intraworks transport equipment should be made in conjunction with the tandem cold mill plant.
- Reinforcement to the central maintenance shop should be completed before the start of the commissioning of the iron and steelmaking equipment.
  Further, the central maintenance shop should be completed in its final array at the second step.
- Reinforcement to the test and analysis facilities should be completed in conjunction with the start of the raw materials handling facilities. Further, the test and analysis facilities should, like the central maintenance shop above, be complete in its final array at the second step.

- Additions to the power receiving plant to be made at the second step should be completed before the commissioning of the coke plant.

(3) Third step
- The coke plant together with the sintering plant and raw material handling facilities should start operating in conjunction with the start of the blast furnace and the steelmaking plant in the third step.
- Expansion work of the berth facilities should be made started in conjunction with the start of the raw material handling plant.
- Expansion work of the power generation plant and the oxygen plant should be made in conjunction with the start of the coke plant.

1.2 Construction schedule

For the general construction schedule refer to Table 1-1, and in each of the three steps, refer to Table 1-2, Table 1-3, Table 1-4.

Table 1-1 Construction schedule

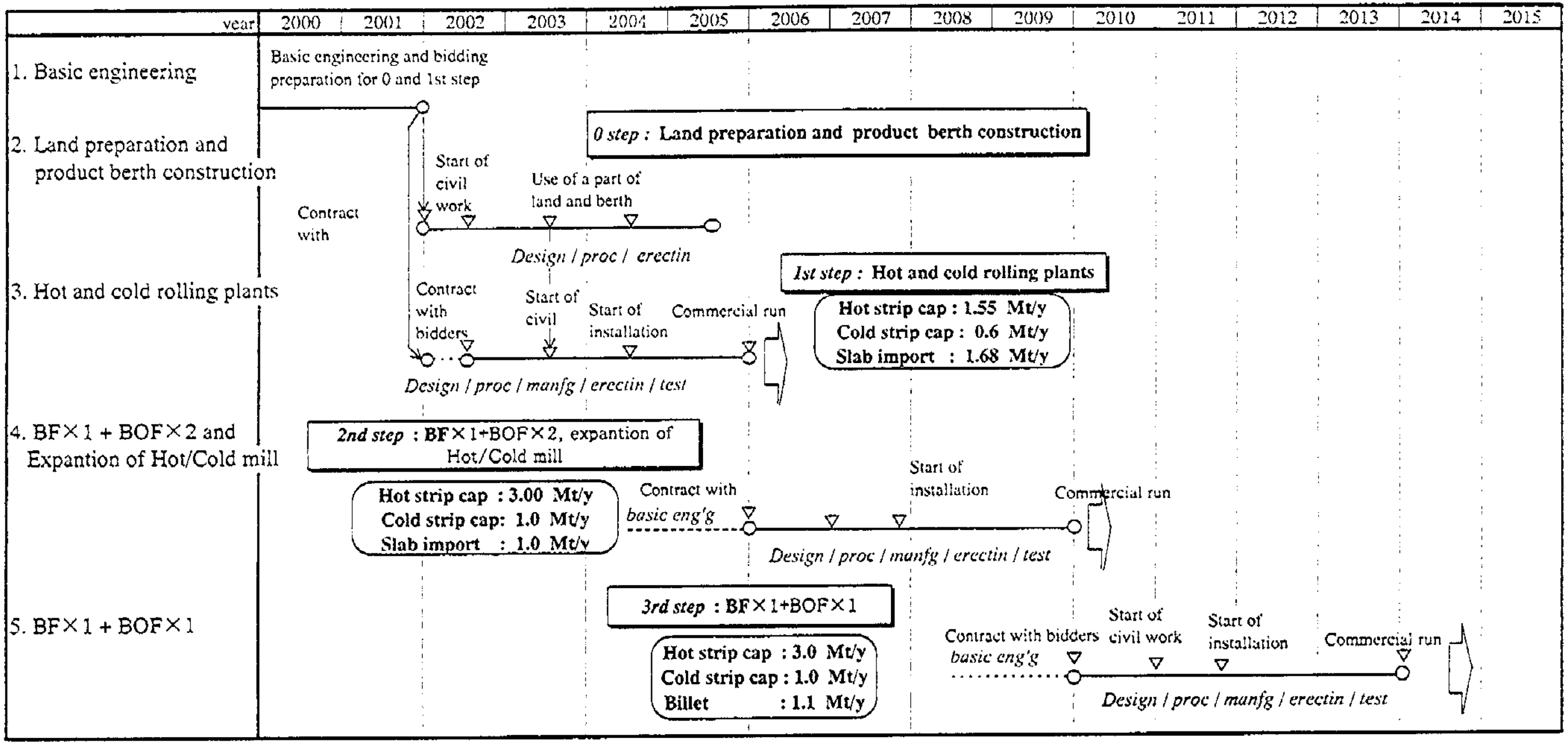


Table 1-2 Construction schedule (Step 0.1)

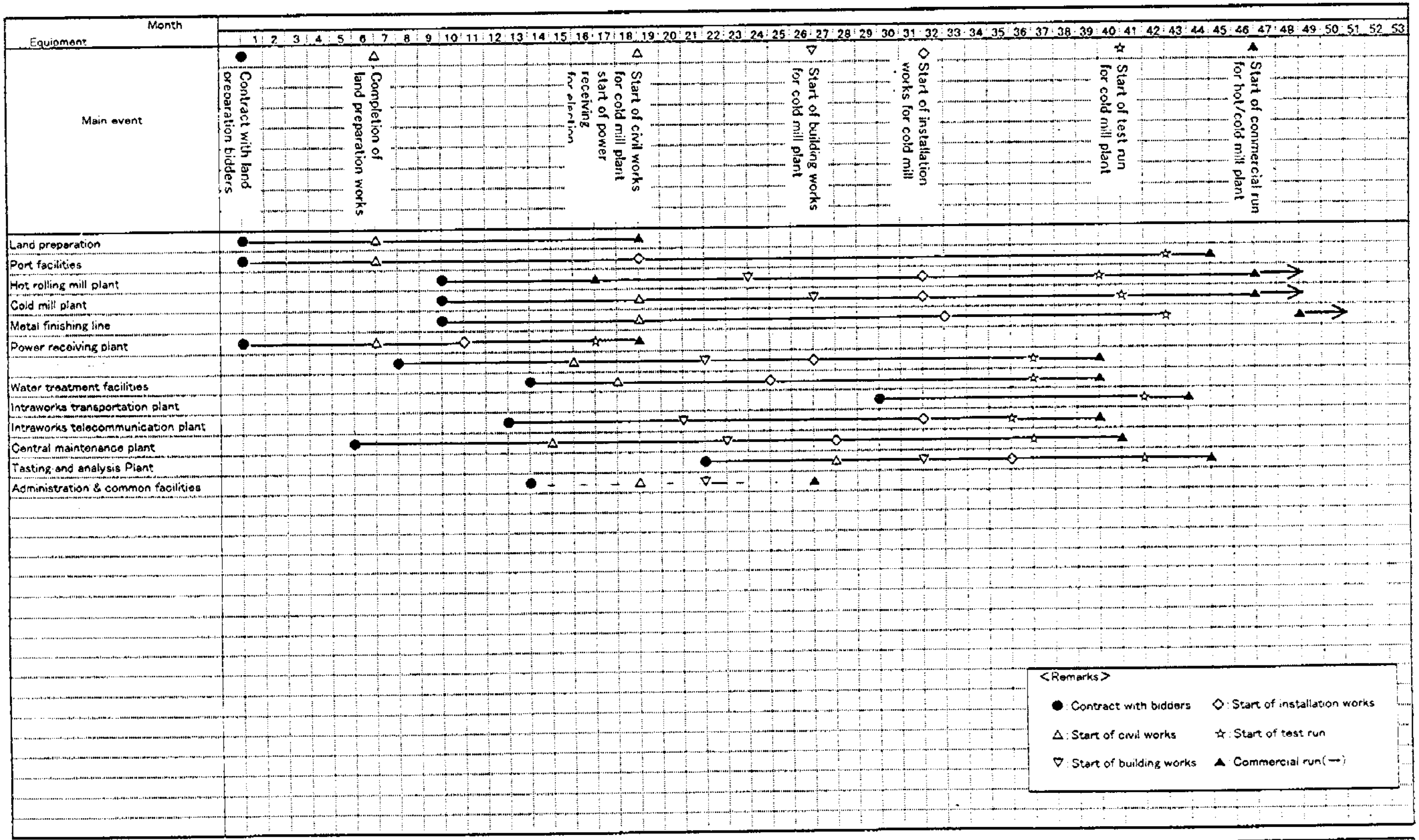


Table 1-3 Construction schedule (Step 2)

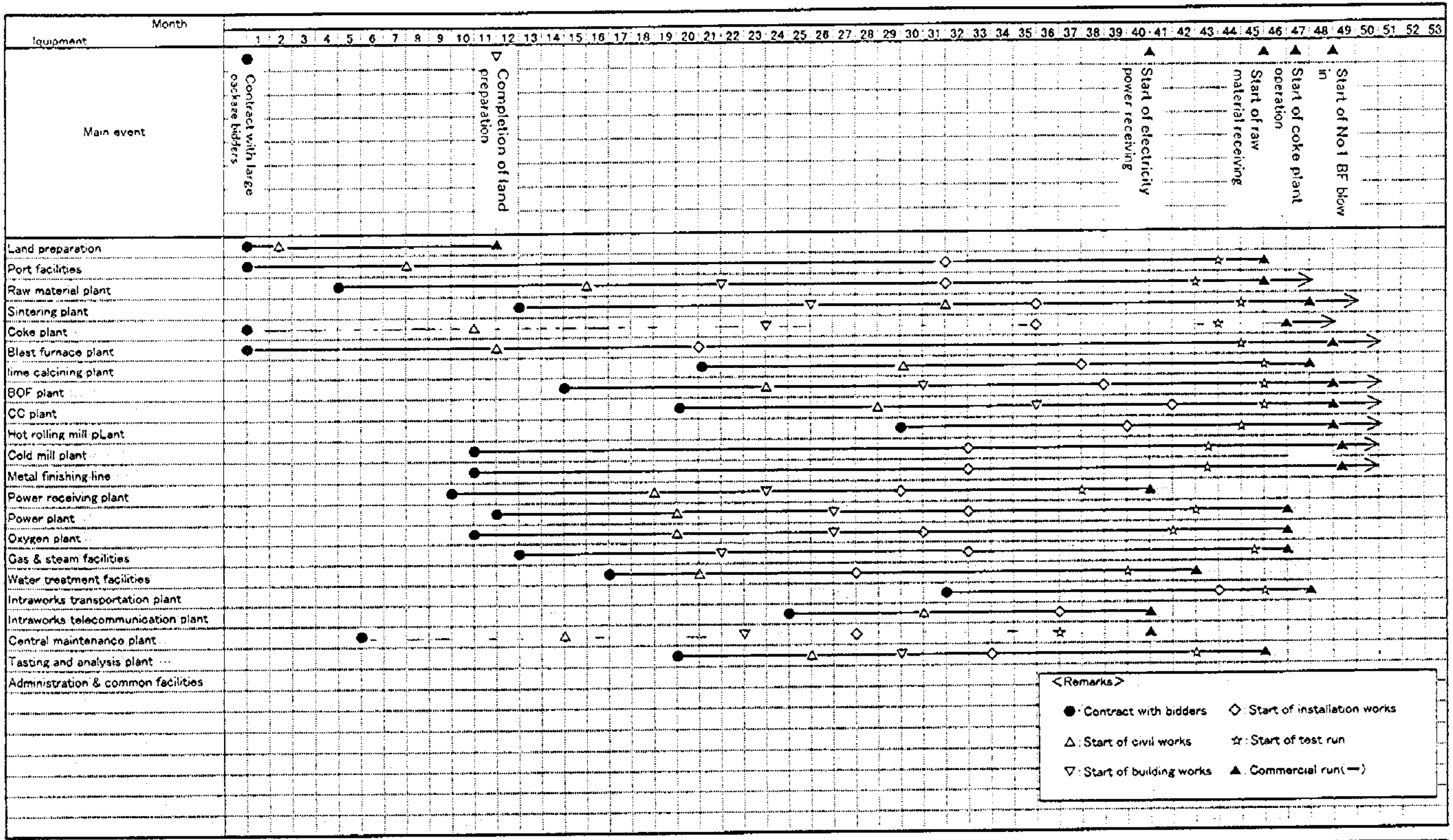
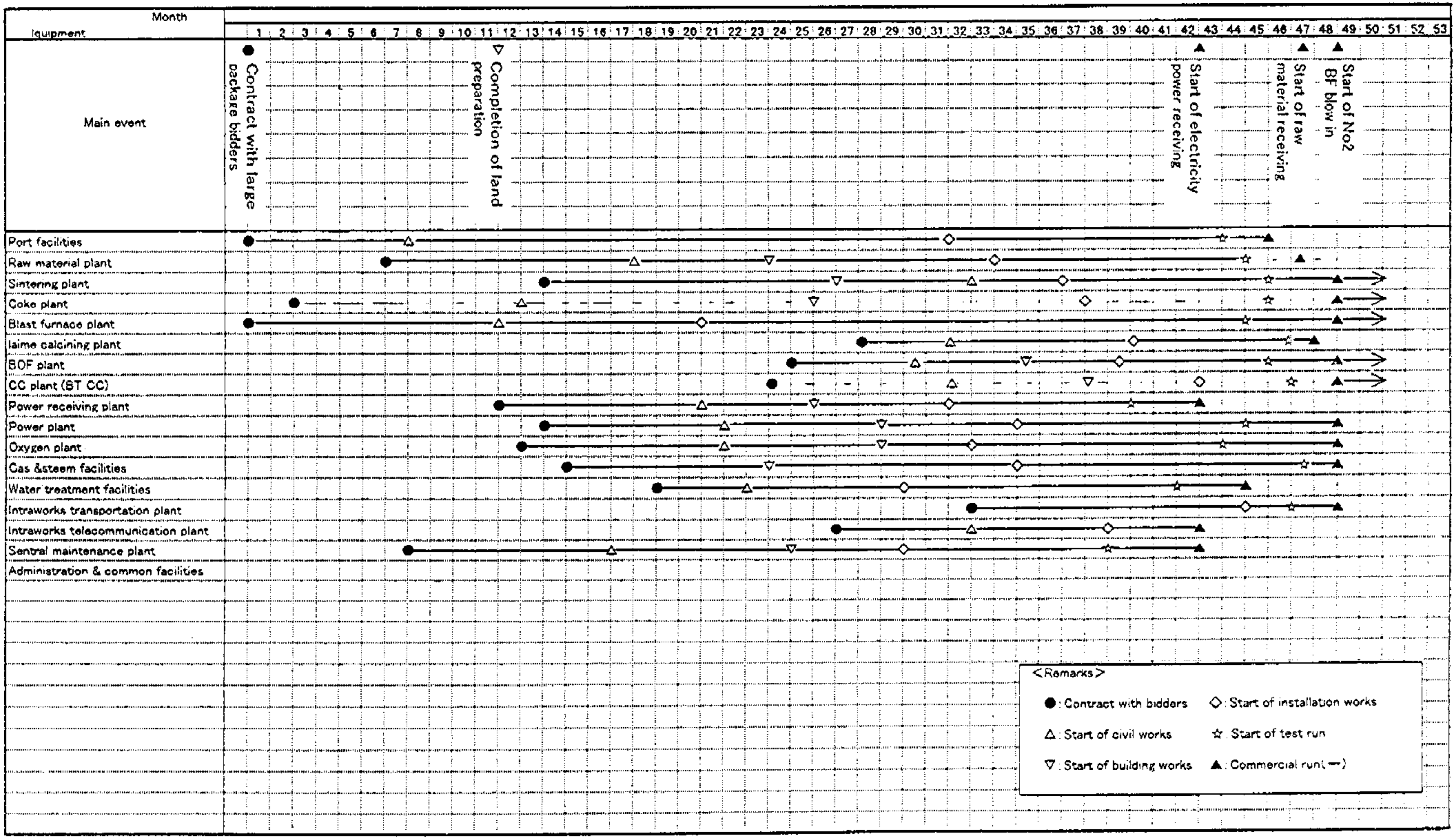


Table 1-4 Construction schedule (Step 3)



Section 2 Management Organization and Manning Plan

Contents

1. Management organization

1.1 Consideration for management organization

(1) The management organization will basically be that of the line and staff system.
(2) The management organization should be formed on the premise that it will shift toward a market economy-oriented management system.
(3) Simplification and flattening of organization should be sought for the management organization by grouping its functions.
(4) The area maintenance and line test and analysis function should be allocated to each production plant to improve the mobility of the management organization.

1.2 Management organization

(1) For the management organization, refer to Figure 2-1.
(2) For the management organization and its job items, refer to Figure 2-2.

2. Manning plan

2.1 Consideration for manning plan

(1) The manning plan is based on the management organization shown in Figure 2-1
(2) The level of automation and labor-saving for each equipment unit which constitute the basis of manning plan should, in principle, conform to those described Section 2, Part 6.
(3) All people who will work in the steelworks are counted as direct employees.
(4) The number of employees required are calculated on the basis of three shifts by four crews.
(5) The central maintenance shop personnel is allocated in departments which will be engaged in major plant equipment repairs, manufacture of spare part for production plant, etc. in the manning plan.
(6) The personnel for transport in the steelworks, product & semi-product warehouse, materials control, etc. is included in the production scheduling division in the manning plan.

2.2 Manning allocation

(1) Management section (final stage)

Table 2-1 Manning allocation of management section

Division	General manager	Section manager	Staff	Foreman	Skilled worker	Unskilled worker	Total
Personnel & labor	1	8	44	5	40	0	98
Accounting & finance	1	3	20	0	0	0	24
Purchasing	1	4	20	0	0	0	25
Sales	1	5	32	0	0	0	38
Technical	1	7	33	8	138	66	253
Production scheduling	1	3	37	24	280	150	495
Maintenance	1	12	73	59	844	318	1307
Total	7	42	259	96	1302	534	2240

(2) Production section (final stage)

Table 2-2 Manning allocation of production section

Division	General manager	Section manager	Staff	Forman	Skilled worker	Unskilled worker	Total
Ironmaking	1	5	79	82	739	397	1303
Steelmaking	1	8	54	62	760	326	1211
Rolling mill	1	8	78	107	1296	271	1761
Total	3	21	211	251	2795	994	4275

Each Step manning allocation is shown in Table 2-5.

2.3 Evaluation for manning plan

Personnel requirement is generally evaluated on the basis of labor productivity (annual production divided by total number of workers). The labor productivity planned for the projected integrated steelworks is shown in Table 2-3.
The actual labor productivity of Japanese integrated steelworks is shown in Table 2-4 for the purpose of comparison.

Table 2-3 Labor productivity for each step

	Step 1	Step 2	Step 3
Annual production	1,550,000 t/y	2,100,000t/y	4,535,000 t/y
Total number of workers	2,056	5,405	6,515
Labor productivity	754 t/y/worker	389 t/y/worker	696 t/y/worker

Table 2-4 Labor productivity of Japanese integrated steelworks

	Average of BF-based steelworks in Japan*	Oita steelworks of Nippon steel**
Annual production	69,380,000 t/y	7,420,000t/y
Total number of workers	98,800	7,200
Labor productivity	702.2 t/y/worker	1,030t/y/worker

Source : * JISF 1997 (average of 1991 to 1995)
** Nippon Steel Guide 1997 (actual figure of FY 1995)

The average figure of Japanese mill, 702.2 t/y/worker, represents the total average of labor productivity of BF-based steelworks in Japan during 1991 to 1995 and this reflects strict market situation of Japan. Workers to satisfy strict quality requirement of Japanese steel market are one of the factors to increase number of workers; on the other hand Japanese BF-based steelworks are producing almost all kind of steel products such as seamless and /or welded pipe/tube, wire rod, bar, shape, special steel product, etc. in addition to the various kind of high grade flat products, causing the increase of number of workers.

On the other hand, Oita steelworks of Nippon Steel possesses only hot strip mill and heavy plate mill as the product producing lines, producing only hot rolled flat products.
Therefore, the labor productivity of Oita is as high as 1,030t/y/worker.

In comparison with the figures indicated in Table 2-4, the labor productivity of the projected integrated steelworks shown in Table 2-3 should be evaluated as internationally competitive one.
Productivity drops temporarily when auxiliary facilities come on stream at Step 2 with only one blast furnace.
In the third step in which the final production system is completed, the productivity will become as high as that in industrialized steelmaking countries.

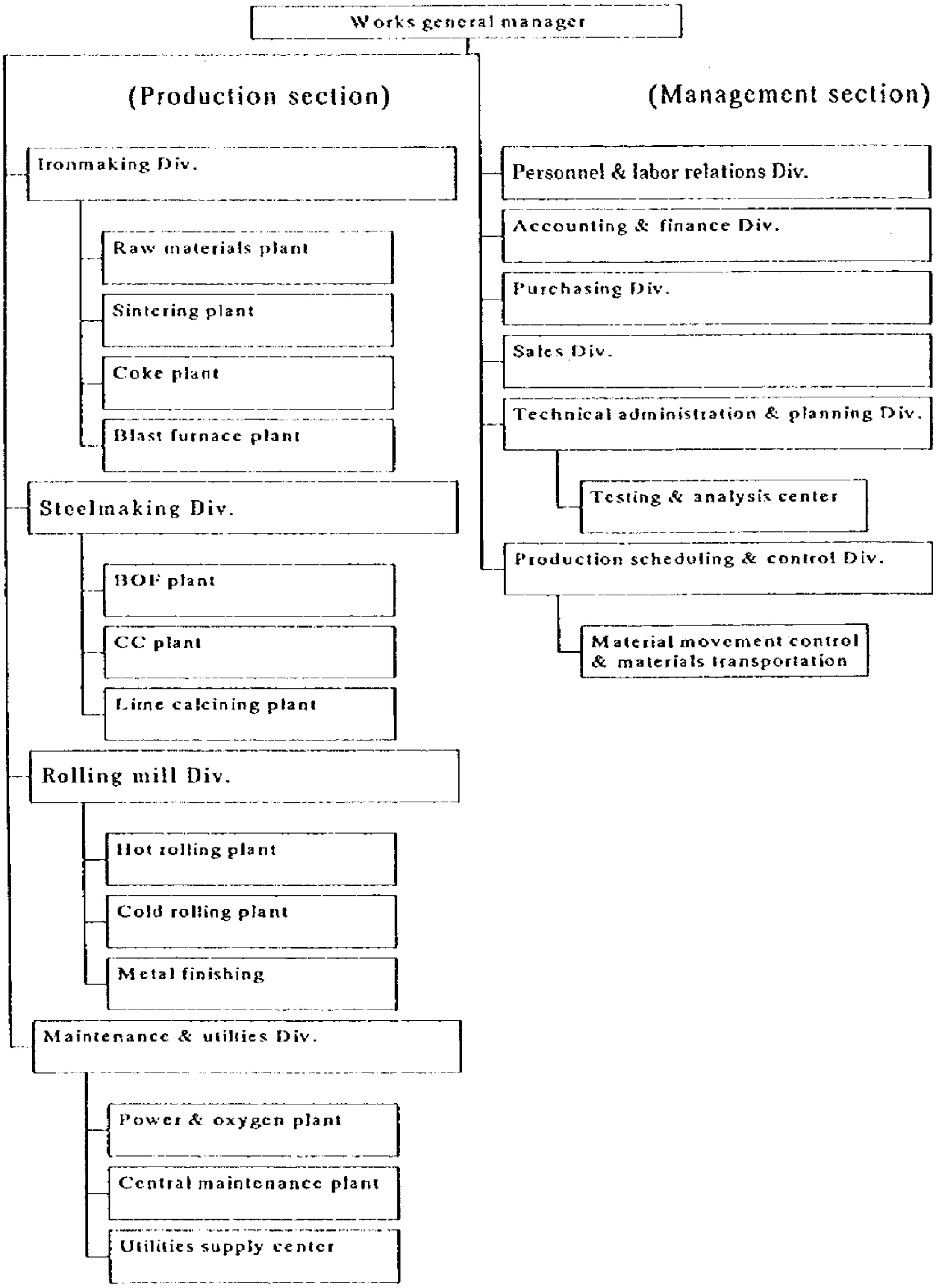


Figure 2-1 Management organization

Division	Functions
Personnel & labor relations Div.	1)Secretariat for executives 2)Corporate policy, organization and legal matters 3)Recruitment and personnel management 4)Salaries, wages, welfare, & safety 5)Environmental management 6)Systems management
Accounting & finance Div.	1)Financial accounting & funds management 2)Financial planning & control 3)Cost control
Purchasing Div.	1)Equipment & material purchasing & control 2)Construction contracting & control 3)Coal & iron ore supply/demand control 4)Contracting of other raw materials & sub-materials
Sales Div.	1)Sales planning of finished & semi-finished products 2)Sales contract of finished & semi-finished products
Technical administration &planning Div.	1)Production planning, planned value & cost control 2)Technical control, patents & intellectual properties 3)Quality control 4)Energy control 5)Testing & analysis
Production scheduling & control Div.	1)Production control 2)Product inventory & shipment control 3)Materials movement planning & control 4)Intraworks transport
Maintenance & utilities Div.	1)Major projects repairs 2)Equipment parts & spares & manufacture & purchasing 3)Power, oxygen 4)Utilities supply
Ironmaking Div.	1)Raw materials handling & sinter ore production 2)Coke production 3)Pig iron production
Steelmaking Div.	1)Steel production 2)Slab, billet production 3)Burned lime (CaO) Production
Rolling mill Div.	1)Hot rolled coil/sheet production 2)Cold rolled coil/sheet production 3)Finished plate production

Figure 2-2 Administrative organization & its functions

Table 2-5 Manning plan for each step

Division	Step 1 General M	Step 1 Section M	Step 1 Staff	Step 1 Foreman	Step 1 Skilled w	Step 1 Unskilled w	Step 1 Total
Personnel & labor	1	8	20	5	20	0	54
Accounting & finace	1	3	10	0	0	0	14
Purchasing	1	2	10	0	0	0	13
Sales	1	3	22	0	0	0	26
Technical administration	1	6	20	4	55	26	112
Production scheduling	1	3	15	10	84	46	159
Maintenance & utilities	1						369
Central maintenance	0	7	16	15	176	55	269
Utility supply	0	1	10	15	49	24	99
Power & oxigen	0	0	0	0	0	0	0
Iron making	0						0
Raw materials plant	0	0	0	0	0	0	0
Sintering plant	0	0	0	0	0	0	0
Coke plant	0	0	0	0	0	0	0
Blast furnace plant	0	0	0	0	0	0	0
Steel making	0	0	0	0	0	0	0
Lime calcining plant	0	0	0	0	0	0	0
BOF plant	0	0	0	0	0	0	0
CC plant	0	0	0	0	0	0	0
Rolling mill	1						1309
Hot rolling mill plant	0	3	27	24	234	59	347
Cold rolling mill plant	0	4	33	54	592	120	803
Metal coating plant	0	1	7	12	116	23	159
Total	8	41	190	139	1326	353	2056

Division	Step 2 General M	Step 2 Section M	Step 2 Staff	Step 2 Foreman	Step 2 Skilled w	Step 2 Unskilled w	Step 2 Total
Personnel & labor	1	8	44	5	40	0	98
Accounting & finace	1	3	20	0	0	0	24
Purchasing	1	4	20	0	0	0	25
Sales	1	5	32	0	0	0	38
Technical administration	1	7	33	8	138	66	253
Production scheduling	1	3	29	20	184	100	337
Maintenance & utilities	1						1136
Central maintenance	0	9	48	21	626	169	873
Utility supply	0	1	13	21	81	58	174
Power & oxigen	0	1	8	14	39	26	88
Iron making	1						986
Raw materials plant	0	2	16	14	135	73	240
Sintering plant	0	1	11	9	75	41	137
Coke plant	0	1	34	23	233	125	416
Blast furnace plant	0	1	9	20	106	57	193
Steel making	1						748
Lime calcining plant	0	1	9	6	19	8	43
BOF plant	0	5	20	32	203	87	347
CC plant	0	1	14	19	226	97	357
Rolling mill	1						1760
Hot rolling mill plant	0	3	30	28	318	76	455
Cold rolling mill plant	0	4	34	55	700	140	933
Metal coating plant	0	1	14	24	278	55	372
Total	10	61	438	319	3401	1178	5405

Division	Step 3 General M	Step 3 Section M	Step 3 Staff	Step 3 Foreman	Step 3 Skilled w	Step 3 Unskilled w	Step 3 Total
Personnel & labor	1	8	44	5	40	0	98
Accounting & finace	1	3	20	0	0	0	24
Purchasing	1	4	20	0	0	0	25
Sales	1	5	32	0	0	0	38
Technical administration	1	7	33	8	138	66	253
Production scheduling	1	3	37	24	280	150	495
Maintenance & utilities	1						1307
Central maintenance	0	10	52	24	691	199	976
Utility supply	0	1	13	21	88	72	195
Power & oxigen	0	1	8	14	65	47	135
Iron making							1303
Raw materials plant	1	2	19	14	155	84	275
Sintering plant	0	1	14	9	111	60	195
Coke plant	0	1	34	27	301	161	524
Blast furnace plant	0	1	12	32	172	92	309
Steel making	1						1211
Lime calcining plant	0	1	9	6	25	11	52
BOF plant	0	5	21	32	322	138	518
CC plant	0	2	24	24	413	177	640
Rolling mill							1761
Hot rolling mill plant	1	3	30	28	318	76	456
Cold rolling mill plant	0	4	34	55	700	140	933
Metal coating plant	0	1	14	24	278	55	372
Total	10	63	470	347	4097	1528	6515