Chapter III Projection of Demand for Cold Rolled Flat Products

1. Methodology of Market Study

This market survey has been carried out by analyzing the data and information obtained through interviews with local companies and government authorities. Fig. III-1-1 shows a flow chart of forecasting the demand for steel products.

In the first place, we tried to grasp the demand as of today as basic information, followed by estimation of demand using a macro economic method and a micro economic method.

As a macro economic method, we estimated the demand for cold rolled flat products based on the actual records of production of cold rolled flat products by country relative to GDP per capita estimated in Chapter II, Section 1 above.

As a micro economic method, the demand for steel products has been forecast based on the prospects for production of each industry as verified under Chapter II, Section 2 above. Where there were various demand sectors and grasping of production perspectives was difficult, the demand has been estimated on the basis of the growth of industry as a whole.

The final numbers of demand for steel products have been determined following the comparative examination of the results of both above methods.

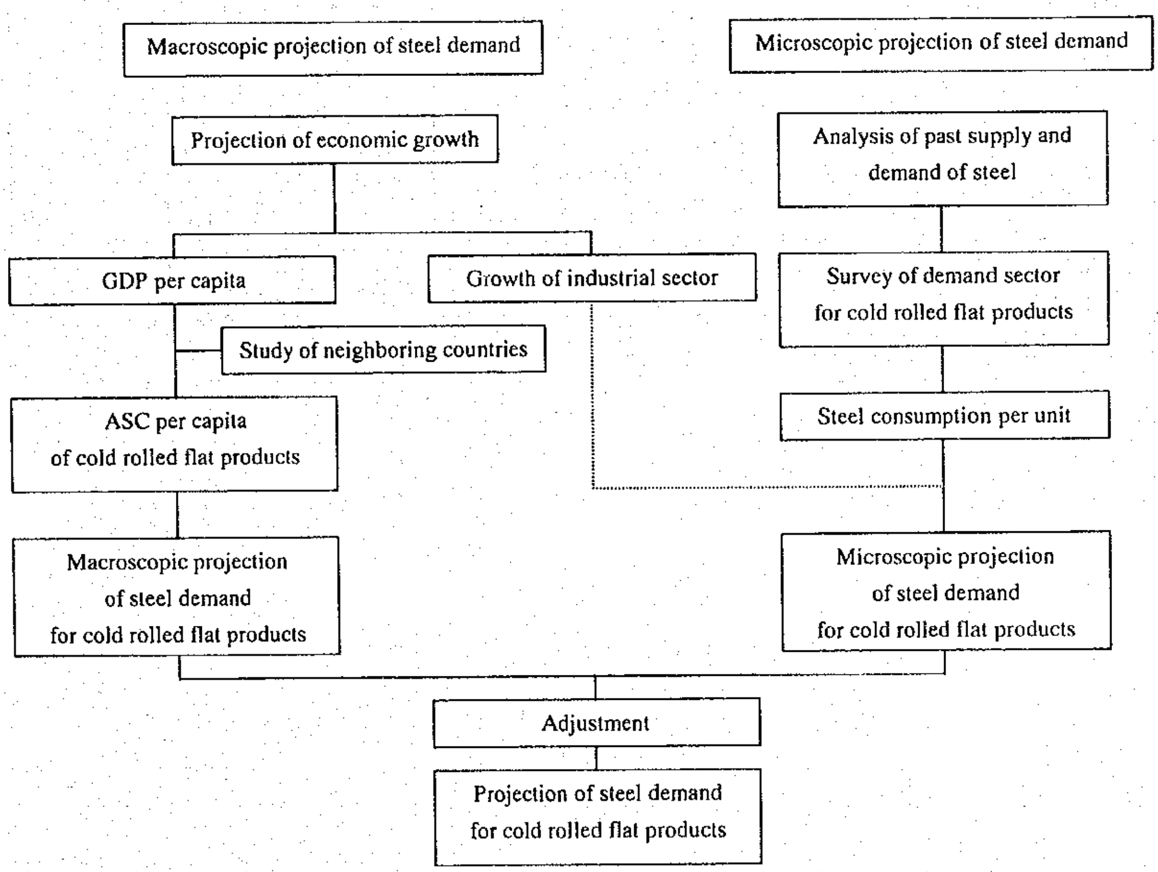


Fig. III-1-1 Steel Demand Projection Flow Chart of Cold Rolled Flat Products

2. Present Situation of Supply and Demand of Cold Rolled Flat Products

2.1 Present Situation of Supply and Demand of Steel Products

Table III-2-1 shows the trends of supply and demand of steel products. The domestic production numbers of the table represent the production of long products only in order to avoid double calculation of domestic production and import. The demand for steel products in 1999 was 2,379 thousand tons or 11.8% increase over the previous year.

Table III-2-1 Supply and Demand of Steel Products

(Unit : 1,000 tons)

		1995	1996	1997	1998	1999	2000 (estimate)
Domestic production (A) (Long products)		490	826	976	1,150	1,300	1,400
Imported steel products (B)		866	905	807	906	1,100	1,100
Inventory	at beginning (C)	0	176	269	231	159	180
	changes (D)	176	93	-38	-72	21	0
	at ending (E) = (C) +(D)	176	269	231	159	180	180
Steel consumption (F) = (A) + (B) - (D)		1,180	1,638	1,822	2,128	2,379	2,500

Source: Survey by VSC

2.2 Present Situation of Supply and Demand of Cold Rolled Flat Products

Table III-2-2 shows the import of steel products. As all of the cold rolled flat products used in Viet Nam are currently imported, the total supply volume equals the volume of import. The import of cold rolled flat products in 1999 was 291 thousand tons, occupying 25.4% of the total import of steel products.

Table III-2-2 Imported Steel Products in Viet Nam

(Unit : 1,000 tons)

	1998	1999
Steel products	846	1,144
Plate	234	292
Sheet & Coil	342	564
Hot rolled	166	273
Cold rolled	176	291
Coated steel	100	103
Tinplate	25	26
Galvanized sheet	27	16
Color	48	62
Silicon sheet	9	7
Stainless sheet	22	42
Construction	11	13
Section	53	47
Machinery steel	22	26
Spring steel	0	0
Steel wire	11	14
Others	43	36

Source: General Customs Office, VSC

Table III-2-2 shows the trends of import of steel sheet & coil.

Table III-2-3 Imported Steel Sheet & Coil in Viet Nam

(Unit : 1,000 tons)

	1995	1996	1997	1998	1999
Sheet & Coil	126	177	258	342	564
Hot rolled	48	87	122	166	273
Cold rolled	78	90	136	176	291

3. Present Situation of Cold Rolled Flat Products in Neighboring Countries

Fig. III-3-1 shows ASC per capita of cold rolled flat products in ASEAN countries in 1996 prior to surfacing of Asian economic crisis. A high correlation can be seen between the ASC per capita and GDP per capita in ASEAN countries.

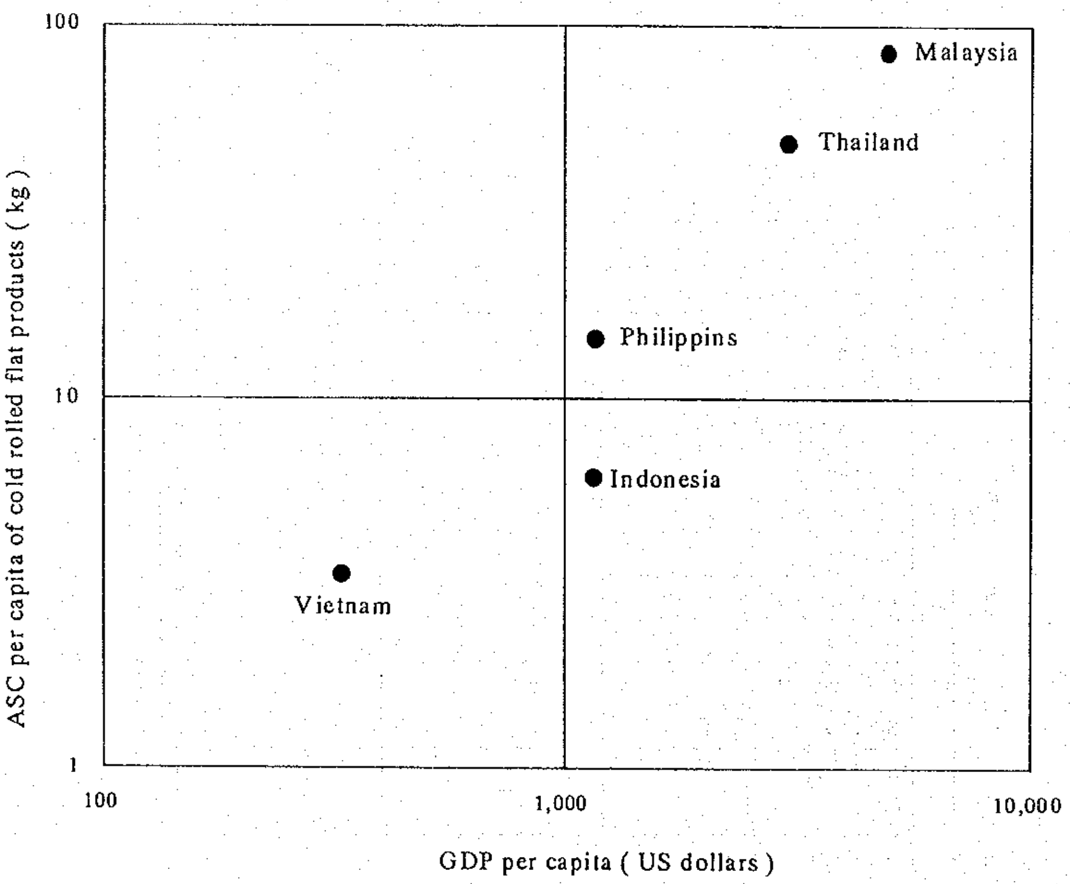


Fig. III-3-1 ASC per Capita of Cold Rolled Flat Products in 1996

Fig. III-3-2 shows the trends of ASC per capita of cold rolled flat products in ASEAN countries. GDP per capita figures shown against x-axis are quoted from Viet Nam's forecast of Table II-1-5 and the actual records of ASEAN countries of Table II-1-6. ASC of cold rolled flat products per capita in Viet Nam is estimated as 4 kg in 1999.

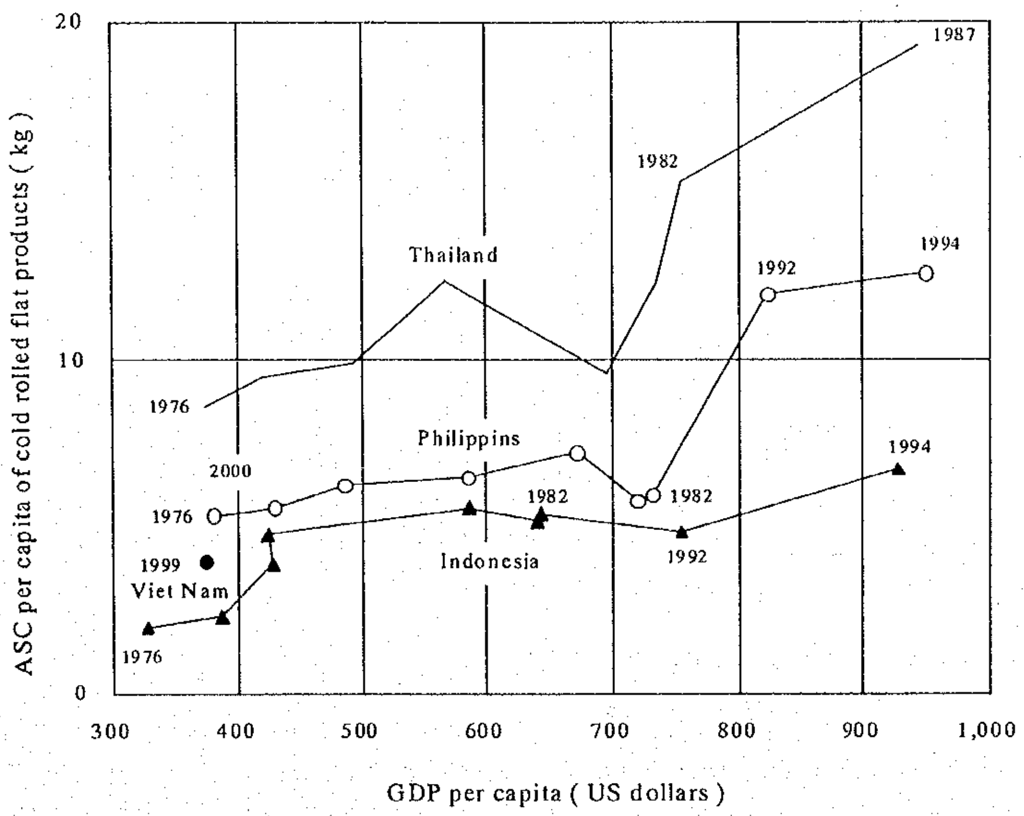


Fig. III-3-2 ASC per Capita of Cold Rolled Flat Products in ASEAN Countries

4. Projection of Demand of Cold Rolled Flat Products in Viet Nam

4.1 Steel Demand for GI Manufacturers

Table III-4-1 shows the steel demand for GI manufacturers. Production of GI sheets has been quoted from Table II-2-2. The ratio of GI substrates as a raw material of GI sheets is estimated as approximately 85%, the steel demand for GI manufacturers is estimated to reach 213 thousand tons for 2005, and 425 thousand tons for 2010.

Table III-4-1 Steel Demand for GI Manufacturers

(Unit : 1,000 tons)

	1999	2000	2003	2004	2005	2010
Production of GI sheets (a)	120	140	210	230	250	500
GI substrate (b) = (a) × 0.85	102	119	179	196	213	425

4.2 Steel Demand for the Motorbike Industry

Table III-4-2 shows the steel demand for the motorbike industry. The number of motorbikes assembled in the country is quoted from Table II-2-3. The demand for steel products has been calculated as the number of motorbikes multiplied by the steel consumption per unit and the localization rate.

The steel consumption per unit has been estimated on the basis of motorbikes with 100 cc displacement which represent the largest portion of the motorbikes assembled in Viet Nam. The localization rate has been estimated as follows. The motorbike manufacturers are requested to increase the ratio of local contents to 64% by the sixth year of operation and the ratio of local contents as of the time of this survey of foreign capital motorbike manufacturers was in the range of 40 to 50%. However, as components procured from factories in Viet Nam are treated as entirely local content, the real ratio of local contents in the finished products is not considered as high as it seems and the ratio of local contents of the majority of domestic manufacturers is said to be just about 10% according to our interview survey. As a result, we assumed that the localization rate of the entire motorbike industry to be 25% as of 1999. In consideration of future plans of foreign capital motorbike manufacturers and potentials of development of components industry, it has been forecast to reach 55% by 2005, and 64% by 2010.

Based on the above assumptions, the steel demand for the motorbike industry has been estimated as 8,000 tons for 2005, and 14,000 tons for 2010.

Table III-4-2 Steel Demand for Motorbike Industry

		1999	2000	2003	2004	2005	2010
Assembly of motorbikes (a)	1,000 pieces	437	450	500	550	600	900
Steel consumption per unit Cold rolled sheet & coil (b1) Galvanized sheet (b2)	kg / piece	18 7	18 7	18 7	18 7	18 7	18 7
Localization rate (c)	%	25.0	25.0	45.0	50.0	55.0	64.0
Cold rolled sheet & coil (d) = (a) × (b1) × (c)	1,000 tons	2	2	4	5	6	10
Galvanized sheet (e) = (a) × (b2) × (c)	1,000 tons	1	1	2	2	2	4
Total demand (f) = (d) + (e)	1,000 tons	3	3	6	7	8	14

4.3 Steel Demand for the Automobile Industry

Table III-4-3 shows the steel demand for the automobile manufacturing industry. The number of automobiles assembled in Viet Nam is given in Table II-2-4. The steel demand has been calculated as the said number of automobiles multiplied by the steel consumption per unit and the localization rate.

The steel consumption per unit has been estimated on the basis of passenger cars of 1,000 cc to 2,000 cc displacement and commercial vehicles of loading capacity 1.0 to 1.5 tons, The localization rate has been determined in accordance with our interview survey.

Based on the above assumptions, the steel demand for the automobile industry has been estimated as 3,000 tons for 2005, and 8,000 tons for 2010.

However, the production level of most automobile manufacturers remains at Completely-Knocked-Down-2 (CKD2) meaning that the automobile industry of Viet Nam is performing the assembling of automobiles starting from welding and painting of imported components to the assembling process, without the pressing process. It would not be realistic, therefore, to include the steel demand for the automobile industry in the steel demand to be met by the new CRM, at least until 2005.

Table III-4-3 Steel Demand for Automobile Industry

		1999	2000	2003	2004	2005	2010
Assembly of automobiles							
Passenger cars (a1)	1,000 pieces	4.4	5.5	7.0	10.0	11.0	18.0
Commercial vehicles (a2)		4.1	6.5	8.0	10.0	13.0	12.0
Steel consumption per unit							
Passenger cars							
Cold rolled sheet & coil (b1)		173	173	173	173	173	173
Surface treated sheet (b2)	kg / piece	186	186	186	186	186	186
Commercial vehicles							
Cold rolled sheet & coil (b3)		247	247	247	247	247	247
Surface treated sheet (b4)		249	249	249	249	249	249
Localization rate							
Passenger cars (c1)	%	5.0	5.0	10.0	20.0	20.0	60.0
Commercial vehicles (c2)		10.0	10.0	20.0	30.0	30.0	60.0
Cold rolled sheet & coil (d) = (a1) × (b1) × (c1) + (a2) × (b3) × (c2)	1,000 tons	0	0	0	1	1	3
Surface treated sheet (e) = (a1) × (b2) × (c1) + (a2) × (b4) × (c2)	1,000 tons	0	0	0	1	2	5
Total demand (f) = (d) + (e)	1,000 tons	0	0	0	2	3	8

4.4 Steel Demand for the Home Appliance Industry

Table III-4-4 shows the steel demand for the home appliance industry. The number of home appliances assembled in Viet Nam is the same with that given in Table II-2-5. The demand for steel products has been calculated as the number of units assembled multiplied by the steel consumption per unit and the localization rate.

It will be possible for the home appliance makers to enhance the ratio of local content to 60% through the use of plastic parts and packaging materials to be manufactured in Viet Nam and printing of instructions for domestic use. Also, the lack of painting facilities at factories forces the manufacturers to use imported pre-coated steel sheets, thus no cold rolled flat products are used at the moment. It is said that installation of painting facilities will only reasonably pay when the production reaches a level of 1,000,000 pieces of home appliances. Accordingly, it would not be realistic to include the steel demand for the home appliance industry in the steel demand to be met by the new CRM, at least till 2005.

Table III-4-4 Steel Demand for Home Appliance Industry

		1999	2000	2003	2004	2005	2010
Assembly of home appliances Air-conditioners (a1) Refrigerators (a2) Washing machines (a3)	1,000 pieces	32 130 200	80 195 250	100 231 300	120 260 350	140 300 400	200 450 600
Steel consumption per unit PCM Air-conditioners (b1) Refrigerators (b2) Washing machines (b3)	kg / piece	15 20 11	15 20 11	15 20 11	15 20 11	15 20 11	15 20 11
Localization rate Air-conditioners (c1) Refrigerators (c2) Washing machines (c3)	%	40.0 40.0 40.0	40.0 40.0 40.0	40.0 40.0 40.0	40.0 40.0 40.0	50.0 50.0 50.0	70.0 70.0 70.0
Total demand (PCM) (d) = (a1) × (b1) × (c1) + (a2) × (b2) × (c2) + (a3) × (b3) × (c3)	1,000 tons	2	3	4	5	6	13

4.5 Forecast of Steel Demand for the Total Cold Rolled Flat Products by all the Sectors

The demand for cold rolled flat products in 1999 is shown in Table III-4-5. The total demand for 1999 is considered to be 291 thousand tons as quoted in Table III-2-2, of which the demand of 102 thousand tons for GI substrates has been put aside and the remaining 189 thousand tons have been estimated as demand for cold rolled sheets & coils. Further, considering the result of our interview survey, a portion corresponding to 9% or 17 thousand tons of the demand for cold rolled sheets & coils has been determined as a demand for high classed cold rolled sheets & coils, with the remaining 172 thousand tons considered as cold rolled sheets & coils for conventional use.

Table III-4-5 Distribution of Demand for Cold Rolled Flat Products in 1999

(Unit : 1,000 tons)

	1999
Total demand	291
GI substrate	102
Cold rolled sheet & coil	189
High class	17
Conventional use	172

Table III-4-6 shows a forecast of demand for cold rolled sheets & coils. As the users of cold rolled sheets & coils are diverse, the demand for the same has been estimated based on the growth rates of the related industries in GDP. According to an example in Thailand of Fig. II-1-1, as the growth rate of cold rolled flat products in Thailand exceeded the growth of the industry in GDP, the demand for cold rolled sheets & coils was calculated as the volume of demand for those of the previous year multiplied by the ratio of growth of the industry sector in GDP plus an adjustment factor comprising a ratio representing an average deviation between the growth of demand for cold rolled flat products in Thailand and the growth rate of the industry sector.

Also, the distribution of cold rolled sheets & coils of high class and for conventional use was estimated on the basis of composition of demand of 1999.

Table III-4-6 Demand Forecast of Cold Rolled Sheet & Coil

(Unit : 1,000 tons)

	1999	2000	2003	2004	2005	2010
Revised growth rate		8.8	11.2	11.2	11.1	11.4
Cold rolled sheet & coil	189	206	283	315	350	600
High class	17	19	26	29	32	55
Conventional use	172	187	257	286	318	545

Table III-4-7 shows the steel demand for new CRM by the total of demand sectors. The demand for cold rolled sheets & coils of high class has been determined as the balance of the figure calculated in Table III-4-6 less the steel demand for the motorbike industry of Table III-4-2. The steel demand for the automobile industry and the home appliance industry which are non-existent yet as of 1999 has been counted as the demand for high classed cold rolled sheets & coils first in 2010. The demand for GI substrates has been quoted from Table III-4-1.

Based on the above assumptions, the steel demand for new CRM has been estimated as 563 thousand tons by 2005, and 1,046 thousand tons by 2010.

Table III-4-7 Forecast of Steel Demand for New CRM by Total of Demand Sectors

(Unit : 1,000 tons)

	1999	2000	2003	2004	2005	2010
Cold rolled sheet & coil	189	206	283	315	350	621
Conventional use	172	187	257	286	318	545
High class	17	19	26	29	32	76
Motorbikes	3	3	6	7	8	14
Automobiles	-	-	-	-	-	8
Home appliances	-	-	-	-	-	13
Others	14	16	20	22	24	41
GI substrate	102	119	179	196	213	425
Maximum demand for new CRM	291	325	462	511	563	1,046

4.6 Forecast of Steel Demand Derived from GDP per Capita

Fig. III-4-1 presents a forecast of steel demand based on GDP per capita. The curve in the figure was created by an regression equation method using the least square equator applied to the ASC per capita of cold rolled flat products in ASEAN countries of Fig. III-3-1 and GDP per capita, with Indonesia excluded due to large deviation from other samples. The curve gives an ASC per capita of cold rolled flat products of 6 kg and 12 kg when GDP per capita reaches U.S. dollars of 600 and U.S. dollars of 900 respectively.

Assuming that GDP per capita in Viet Nam would reach 600 U.S. dollars in 2005 and 900 U.S. dollars in 2010 as was assumed in Table II-1-5, the ASC of cold rolled flat products would be approximately 530 thousand tons in 2005 and 1,080 thousand tons in 2010.

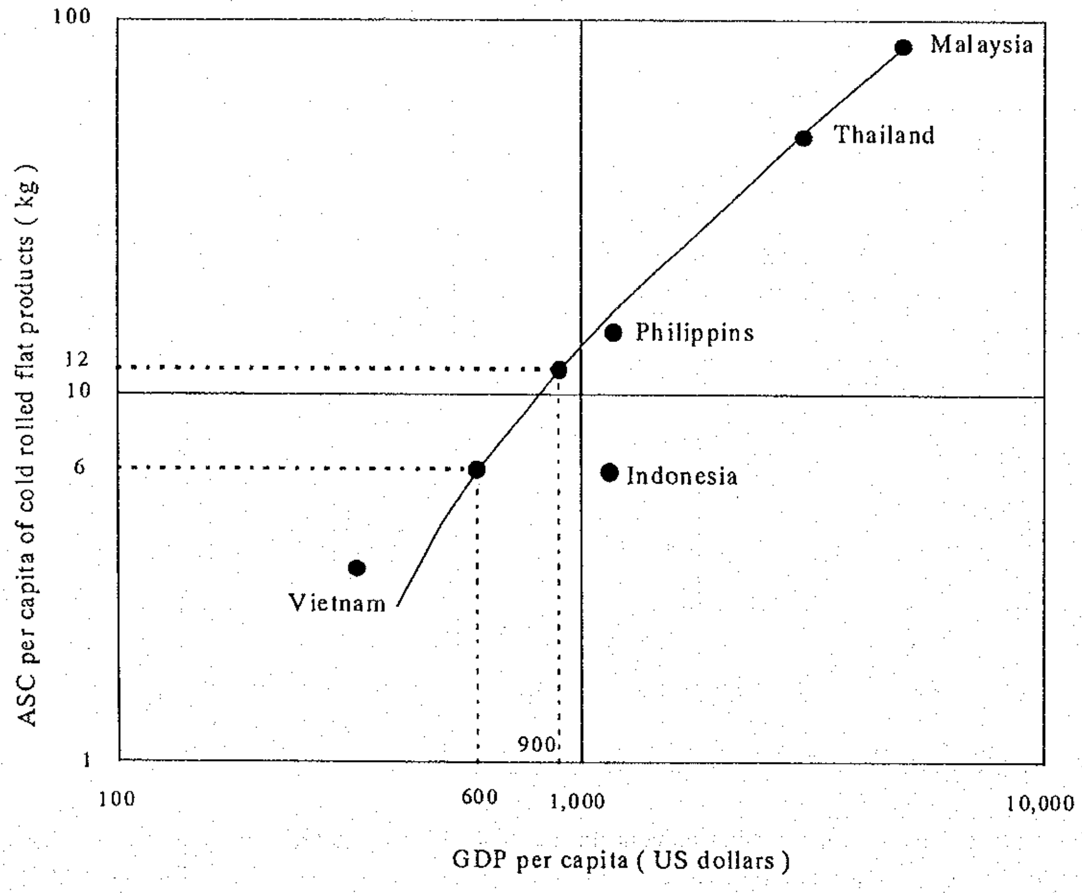


Fig. III-4-1 Forecast of Steel Demand based on GDP per Capita (A)

Fig. III-4-2 presents a result of the estimation of steel demand based on another method using GDP per capita. As is seen in Fig. III-3-2, the ASC per capita of cold rolled flat products increases as GDP per capita grows. The consumption per capita is estimated to reach 7 kg and 9 kg when GDP per capita reaches U.S. dollars of 600 and 900 respectively as indicated as the average of the results of the neighboring countries. If assumed Viet Nam will grow to the same level of GDP per capita, the ASC per capita of cold rolled flat products will be approximately 590 thousand tons in 2005, and 1,110 thousand tons in 2010.

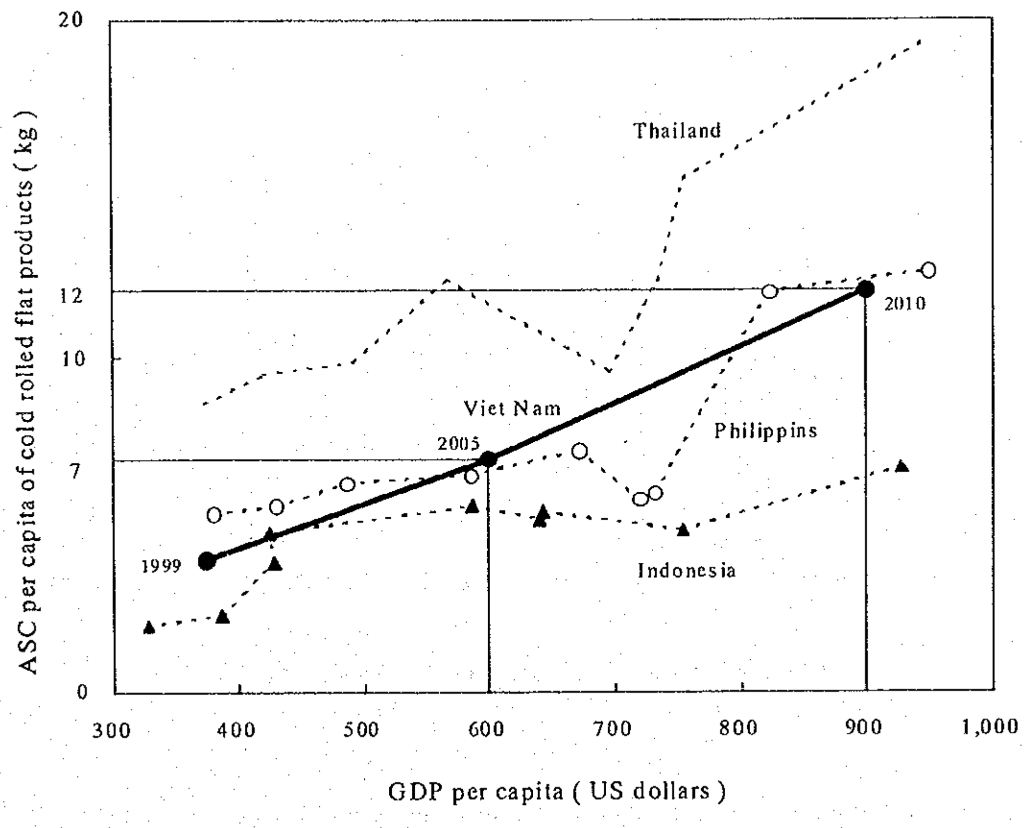


Fig. III-4-2 Forecast of Steel Demand based on GDP per Capita (B)

4.7 Conclusion

Fig. III-4-3 presents a forecast of steel demand for new CRM. The Figure shows the steel demand for new CRM by the total sectors of Table III-4-7 and the steel demand estimated on the basis of GDP per capita of Fig. III-4-1 and Fig. III-4-2. The three methods employed produced similar numbers, indicating the forecast numbers are reasonable.

For the purpose of this paper, we would like to use the result obtained by the total of demand sectors quoted afresh in Table III-4-8 as a forecast of steel demand for new CRM considering the the breakdown of demand by usage.

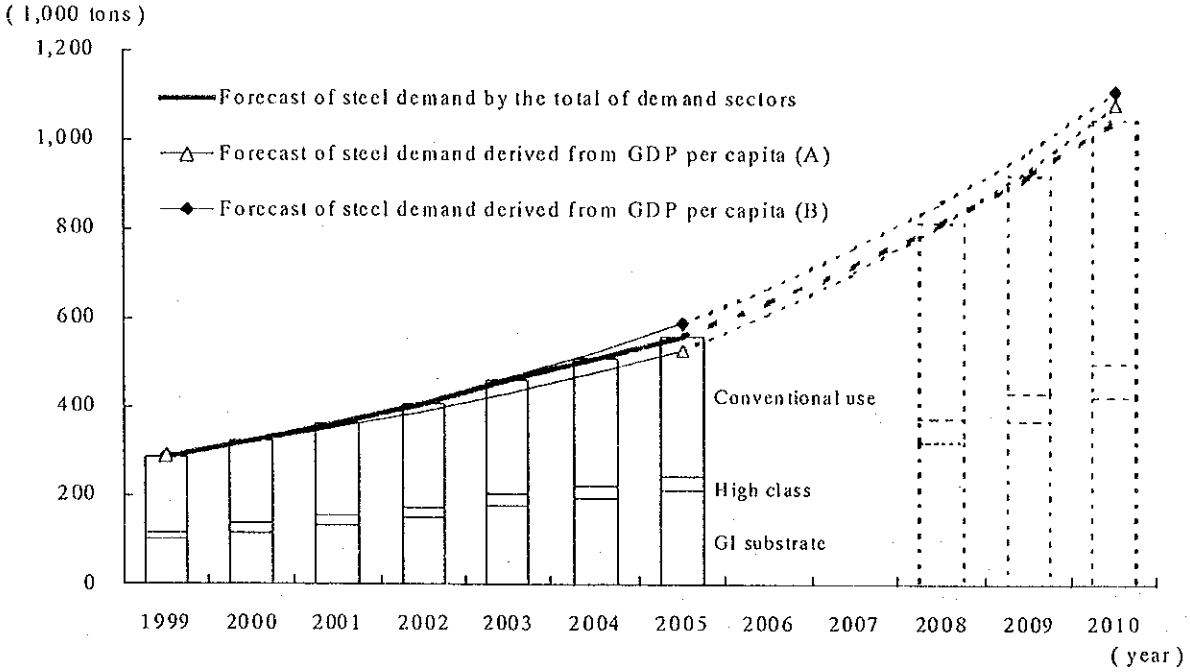


Fig. III-4-3 Forecast of Steel Demand for New CRM

Table III-4-8 Forecast of Steel Demand for New CRM

(Unit : 1,000 tons)

	1999	2000	2003	2004	2005	2010
Cold rolled sheet & coil	189	206	283	315	350	621
Conventional use	172	187	257	286	318	545
High class	17	19	26	29	32	76
GI substrate	102	119	179	196	213	425
Maximum demand for new CRM	291	325	462	511	563	1,046

Chapter IV Product Mix and Production Capacity for New Cold Rolling Mill

1. Result of Investigation on Size Mix and Grade Mix of Cold Rolled Steel Sheets and Galvanized Iron Substrates in Vietnamese Market

In general, production capacity of cold rolling mill complex varies depending upon strip thickness, width and grades. This necessitates the work of defining the thickness, width and grades of the products for designing the cold rolling mill complex. Accordingly, an investigation on the thickness, width and grades of Vietnamese market was made and the necessary information was collected.

(1) Cold rolled steel sheets for manufacturing (CRS)

Through the market study, CRS market is found to be classified in two groups, namely conventional use and high class use. Under the present condition CRS for conventional use is imported mainly from CIS countries such as Russia and so on, while that for high class use mainly from Japan, Korea and Taiwan. Accordingly, the size mix of both conventional use and high class use has to be investigated in order to clarify the size mix of CRS as a whole in Viet Nam.

Size mix of CRS for conventional use is shown in Table IV-1-1.

Characteristics of CRS for conventional use can be summarized as follows;

a) Thickness is more than 0.4 mm.
b) Width is basically 1,000 mm and 1,250 mm.
c) Grade is all Commercial Quality (CQ).
d) Total amount consumed in Viet Nam is estimated to be about 145,000 tons/year. (Source: Customs data and Discussion with VSC)
e) Customers of the coil centers and trading companies surveyed are local traders, pipe manufacturers, furniture manufacturers for domestic use, bicycle manufacturers, repairers of motorcycles and so on.

Table IV-1-1 Size Mix Table of CRS for Conventional Use

CQ	Width (mm)		- 649	650 - 849	850 - 1,049	1,050 - 1,249	1,250 -	Total
	Thickness (mm)		-	750	1,000	1,150	1,250	(%)
	T<0.30	-						
	0.30≦T<0.35	0.32						
	0.35≦T<0.40	0.37						
	0.40≦T<0.50	0.45			2.5			2.5
	0.50≦T<0.60	0.55			16.2		4.4	20.6
	0.60≦T<0.70	0.65			3.0		4.2	7.2
	0.70≦T<0.85	0.77			7.6		10.5	18.1
	0.85≦T<1.00	0.92			5.4		10.7	16.1
	1.00≦T<1.25	1.12			4.9		18.8	23.7
	1.25≦T<1.50	1.37					6.2	6.2
	1.50≦T<1.60	1.55				0.3	4.8	5.1
	1.60≦T	-					0.5	0.5
Total (%)					39.6	0.3	60.1	100.0

(Source of Information : VINANIC, VINAMETAL (Hanoi, HCMC), Saigon Steel Service 1999)

Size mix of CRS for high class use is shown in Table IV-1-2.
Characteristics of CRS for high class use can be summarized as follows;

a) Width is under 1,250 mm.
b) Grade is all Commercial Quality (CQ).
c) Total amount consumed in Viet Nam is estimated to be about 17,000 tons/year.
(Source: Customs data and Discussion with VSC)
d) Customers of the coil center surveyed are furniture manufacturers for export, motorcycle manufacturers, switch panel manufacturers and so on.

Table IV-1-2 Size Mix Table of CRS for High Class Use

CQ	Width (mm)		- 649	650 - 849	850 - 1,049	1,050 - 1,249	1,250 -	Total
	Thickness(mm)		-	750	950	1,150	1,250	(%)
	T＜0.30	-						
	0.30≦T＜0.35	0.32						
	0.35≦T＜0.40	0.37		0.6	1.2		1.8	3.6
	0.40≦T＜0.50	0.45						
	0.50≦T＜0.60	0.55			6.9	9.5	16.4	32.8
	0.60≦T＜0.70	0.65				13.6		13.6
	0.70≦T＜0.85	0.77			5.4	4.8		10.2
	0.85≦T＜1.00	0.92		3.2	0.6			3.8
	1.00≦T＜1.25	1.12		1.6	3.5	9.4		14.5
	1.25≦T＜1.50	1.37				2.7		2.7
	1.50≦T＜1.60	1.55						
	1.60≦T	-			6.8	12.0		18.8
	Total (%)			5.4	24.4	52.0	18.2	100.0

(Source of Information : Saigon Steel Service 1999)

(2) Galvanized iron substrate (GIS)

Under the present condition, GIS is mainly imported from Japan, Korea, Taiwan and Thailand. The import of GIS from CIS countries such as Russia is rather limited due to the thin thickness of GIS.. GIS can be classified in two groups, namely "annealed (CQ)" and "not-annealed (Full Hard)". Accordingly, the size mix of both CQ and Full Hard has to be investigated in order to clarify the size mix of GIS as a whole in Viet Nam.

Size mix of GIS for "annealed" and "full hard" is shown in Tables IV-1-3 and IV-1-4 respectively. Characteristics of GIS can be summarized as follows;

a) Thickness of GIS is more than 0.15mm .
b) Width of GIS is under 4 feet.
c) Grades are Full Hard and Commercial Quality (CQ).
d) Total amount consumed in Viet Nam is estimated to be about 102,000 tons/year. (GIS base) (Source: Customs data and Discussion with VSC)

Table IV-1-3 Size Mix Table of GIS (Full Hard)

Full Hard	Width (mm)		- 649	650 - 849	850 - 1,049	1,050 - 1,249	1,250 -	Total
	Thickness (mm)		-	750	950	1,150	-	(%)
	T<0.15	-						
	0.15≦T<0.17	0.16		0.3	2.8			3.1
	0.17≦T<0.20	0.18		0.3	11.4			11.7
	0.20≦T<0.25	0.22			13.6	1.1		14.7
	0.25≦T<0.30	0.27			11.0	6.4		17.4
	0.30≦T<0.35	0.32			3.1	2.7		5.8
	0.35≦T<0.40	0.37			2.2	3.7		5.9
	0.40≦T<0.50	0.45			2.2	4.1		6.3
	0.50≦T	-						
	Total (%)			0.6	46.3	18.0		64.9

(Source of Information : POSVINA, SSSC 1999)

Table IV-1-4 Size Mix Table of GIS (CQ)

CQ	Width (mm)		- 649	650 - 849	850 - 1,049	1,050 - 1,249	1,250 -	Total
	Thickness (mm)		-	750	950	1,150	-	(%)
	T<0.15	-						
	0.15≦T<0.17	0.16						
	0.17≦T<0.20	0.18						
	0.20≦T<0.25	0.22			0.3			0.3
	0.25≦T<0.30	0.27			0.8			0.8
	0.30≦T<0.35	0.32			3.5	4.2		7.7
	0.35≦T<0.40	0.37			2.6	2.2		4.8
	0.40≦T<0.50	0.45			1.7	8.2		9.9
	0.50≦T	-			5.9	5.7		11.6
	Total (%)				14.8	20.3		35.1

(Source of Information : POSVINA, SSSC 1999)

(3) Pickled and Oiled sheet (P/O)

Under the present condition P/O is not imported regularly, which indicates the existence of only a limited market for this product in Viet Nam.

2. Basic Idea for Defining Product Mix and Production Capacity

It is quite important to define the product mix and production capacity in planning or designing the new cold rolling mill complex. The following preconditions for the work of defining the product mix and production capacity are set based on the result of market survey, the detail of which is described in IV-1.

(1) CRS for both conventional use and high class use and GIS of both CQ and Full Hard are selected as the possible products for the new cold rolling mill complex.

(2) The demand for cold rolled steel sheets in Viet Nam is estimated to be around 500,000 tons/year in 2004, when the new cold rolling mill complex is expected to start its operation. To be least affected by the variation in demand and also to minimize the initial investment cost the new cold rolling mill complex with a production capacity of 250,000 tons/year is to be studied in this FS. This capacity of 250,000 tons/year coincides with the idea of the Vietnamese side at the time of this FS.

(3) Judging from the prediction of demand increase of major customers for the cold rolled steel sheets, it is unlikely that a considerable change in the demand for the size mix for CRS and GIS occurs at the time of the start-up of the new cold rolling mill complex. Accordingly, the size mix described in IV-1 is adopted for this FS.

(4) With regard to grade mix the following preconditions are set ;
  1) For GIS, the proportion of Full Hard and CQ of the the present market is adopted for this FS. Namely, 64.9 % of GIS is considered to be Full Hard and 35.1 % CQ.
  2) At the moment the grade of CRS is all CQ. Considering the upper allowance of the BAF capacity, however, the proportion of CQ, DQ and DDQ in the new cold rolling mill complex is assumed to be 85%, 10% and 5% respectively.

In general, the production capacity of cold rolling mill complex is dominated by that of the cold rolling mill, which is the main equipment of the complex. The relationship between the production capacity and the mill type is shown in Table IV-2-1.

One (1) stand reversing cold rolling mill of combination type, which is used both for rolling and skin pass, is widely adopted for the cold rolling mill complex with a production capacity level of 250,000 tons/year. The said mill type, namely one (1) stand reversing cold rolling mill of combination type is adopted in this FS.

Table IV-2-1 Relationship between Production Capacity and Mill Type

<table>
<tr><th>Production
Capacity*
(tons/year)</th><th colspan="3">Mill Type</th></tr>
<tr><td rowspan="4">850,000
750,000
650,000
550,000
450,000
350,000
250,000
150,000</td><td colspan="3">TCM× 1
+ SPM× 1</td></tr>
<tr><td>Comb.1std.RCM× 1
+ 1std.RCM× 1</td><td>1std.RCM×2
+ SPM× 1</td><td>2std.RCM× 1
+ SPM× 1</td></tr>
<tr><td colspan="3">1std.RCM× 1
+ SPM× 1</td></tr>
<tr><td colspan="3">Comb.1std.RCM× 1</td></tr>
</table>

Comb.1std.CRM : 1 stand reversing cold rolling mill of combination type (cold rolling and skin pass)

1std.RCM : 1 stand reversing cold rolling mill (cold rolling only)

2std.RCM : 2 stand reversing cold rolling mill (cold rolling only)

TCM : Tandem cold rolling mill (cold rolling only)

SPM : Skin pass mill

*Note; The capacity is only for reference.
(The capacity varies with product mix)

3. Recommend Product Mix and Production Capacity of New Cold Rolling Mill Complex

(1) Basic ideas for cases to be considered

To decide the product mix and production capacity of the new cold rolling mill complex the following four cases are studied. The result of the study is shown in Table IV-3-1.

1) Case 1

An emphasis is laid on the expected profit.

CRS for high class use (hereinafter described as CH), GIS of Full Hard (hereinafter described as GH) and GIS of CQ (hereinafter described as GS) are to be produced.

2) Case 1-1

All of four grades of cold rolled steel sheets are to be produced in this case. This case is studied responding to the request from Vietnamese side.

CRS for conventional use (hereinafter described as CC), CH, GH and GS are to be produced.

3) Case 2

An emphasis is laid on the production quantity.

Only CRS, namely CH and CC are to be produced.

4) Case 3

An emphasis is laid on the reduction of the initial investment.

Only GH is to be produced.

(2) Calculation of production capacity for each case

For the above-mentioned four cases, production capacity was calculated in the following manner ;

1) Case 1

a) Firstly, considering the demand predicted, together with some safety allowance, for the year 2004 when the new cold rolling mill complex is to start its operation, the production amount of CH is assumed to be 21,000 tons/year. The time required for the production of CH at each process is calculated based on the real operating indices.(refer to V.2.2 (5))

b) For all the time excluding that required for the production of CH, GIS is to be produced. The proportion of GH and GS is assumed to be those obtained at the market survey.

The production amount for each grade and the time required for the production of each grade are as follows;

CH: 21,000tons/year (RCM 334hr/year, SPM 169hr/year), GH: 120,000tons/year (RCM 4,312hr/year), GS: 64,000tons/year (RCM 1,528hr/year, SPM 683hr/year)

2) Case 1-1

a) Firstly, the production amounts of CH and CC are assumed to be 20,000 tons/year and 50,000 tons/yesr respectively. The time required for the production of CH and CC at each process is calculated based on the real operating indices.

b) For all the time excluding that required for the production of CH and CC, GIS is to be produced. The proportion of GH and GS is assumed to be those obtained at the market survey.
The production amount for each grade and the time required for the production of each grade are as follows;
CH: 20,000tons/year (RCM 318hr/year, SPM 161hr/year), CC: 50,000tons/year (RCM 709hr/year, SPM 376hr/year), GH: 100,000tons/year (RCM 3,609hr/year), GS: 50,000tons/year (RCM 1,193hr/year, SPM 533hr/year)

3) Case 2

a) Firstly, considering the demand predicted, together with some safety allowance, for the year 2004 when the new cold rolling mill complex is to start its operation, the production amount of CH is assumed to be 21,000 tons/year. The time required for the production of CH at each process is calculated based on the real operating indices.

b) For all the time excluding that required for the production of CH, CC is to be produced.
The production amount for each grade and the time required for the production of each grade are as follows;
CH: 21,000tons/year (RCM 334hr/year, SPM 169hr/year), CC: 260,000tons/year (RCM 3,684hr/year, SPM 1,954hr/year)

4) Case 3

a) For all the time available GH is to be produced. The production amount is calculated based on the real operating indices.
The production amount for each grade and the time required for the production of each grade are as follows;
GH: 211,000tons/year (RCM 7,618hr/year)

The production amount calculated and the required equipment for each case is shown in Table.IV-3-1.
The production flows for CASE 1 to CASE 3 are shown in Fig. IV-3-1 through IV-3-4 respectively. The yield for each process is assumed based on the operational result of the similar process being in operation in Japan.

(3) Evaluation of each case

The evaluation of each case is made from the viewpoints of production capacity, required initial investment cost, number of grades to be produced and profitability. The result of the evaluation is also shown in Table.IV-3-1.
For Case 1 a relatively high initial investment cost is expected as this case covers three grades of GH, GS and CH. The production capacity reaches 205,000 tons/year, a little less than the planned value. However, higher profitability is expected as all the grades to be produced in this case have good profit.
For Case 1-1 an additional investment cost is required compared to Case 1. This is because the

amount of products which require annealing increases due to the production of CC, thus necessitating an additional BAF equipment. The production capacity increases up to 220,000 tons/year, still a little less than the planned value. The profitability is lower compared to Case 1 as only a small profit is expected for CC.
For Case 2 the production capacity reaches 281,000 tons/year, more than the planned value. However, this case has a disadvantage of producing only CRS.
For Case 3 the production capacity reaches 211,000 tons/year. This case also has a disadvantage of producing only GH although the investment cost is rather small. According to the demand prediction of GH, the market of only around 200,000 tons/year is expected for GH at the time of the start-up of the new cold rolling mill complex, indicating an unstable operation of Case 3 which depends totally on GH.

Considering the following two points, Case 1 is adopted for this FS although it falls short of the production capacity of 250,000 tons/year originally planned.

1) Any single grade market is not large enough to satisfy the mill capacity of the new cold rolling mill complex. In other words, the new cold rolling mill complex has to produce both GIS and CRS.

2) Emphasis of production is to be laid on GH, GS and CH which can lead to a high profitability.

Table IV-3-1 Case Study of Product Mix

Case	Production Capacity (Products base)	Required Equipment	Initial Investment	Number of Grades	Profitability	Evaluation
1	GH: 120 ktons/year GS: 64 ktons/year CH: 21 ktons/year CC: 0 ktons/year (Total:205 ktons/year)	PL RCM ECL BAF SPM RCL	(○) (base)	○	○	○
1-1	GH: 100 ktons/year GS: 50 ktons/year CH: 20 ktons/year CC: 50 ktons/year (Total:220 ktons/year)	PL RCM ECL BAF SPM RCL	(△) (+2 M US$) compared to Case 1	○	△ compared to Case 1	△
2	GH: 0 ktons/year GS: 0 ktons/year CH: 21 ktons/year CC: 260 ktons/year (Total:281 ktons/year)	PL RCM ↓ BAF SPM RCL	not evaluated	×	not evaluated	×
3	GH: 211 ktons/year GS: 0 ktons/year CH: 0 ktons/year CC: 0 ktons/year (Total:211 ktons/year)	PL RCM ECL ↓ ↓ RCL	not evaluated	×	not evaluated	×

○ : good △ : fair × : poor

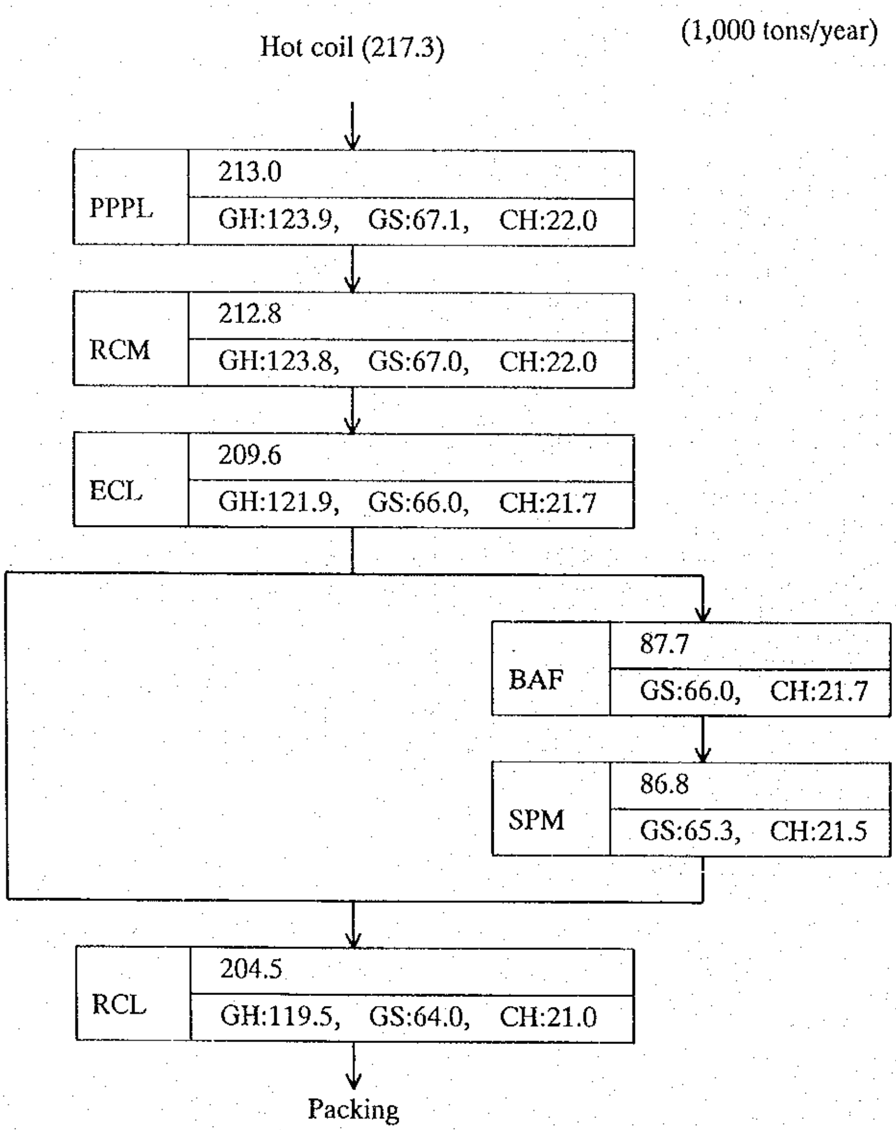


Fig. IV-3-1 Production Flow of CASE 1

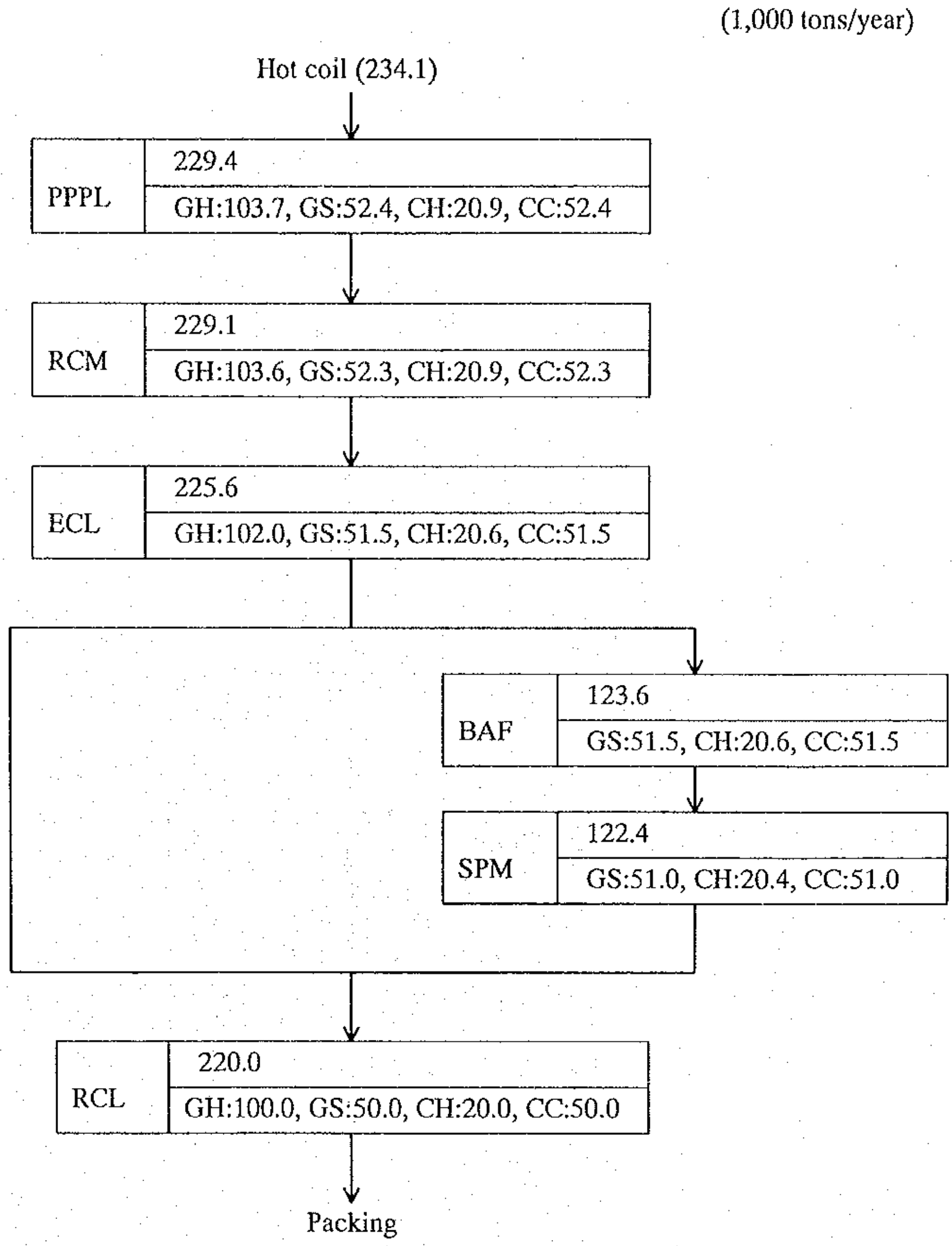


Fig. IV-3-2 Production Flow of CASE 1-1

(1,000 tons/year)

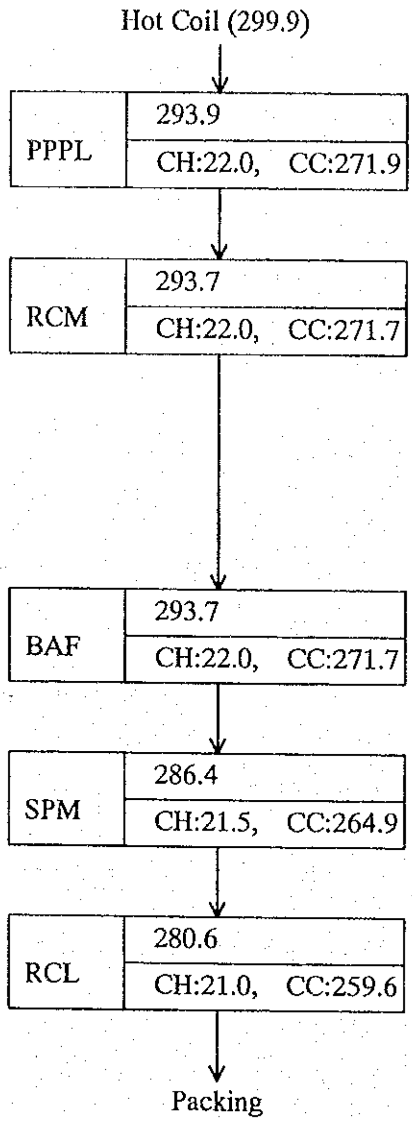


Fig. IV-3-3 Production Flow of CASE 2

(1,000 tons/year)

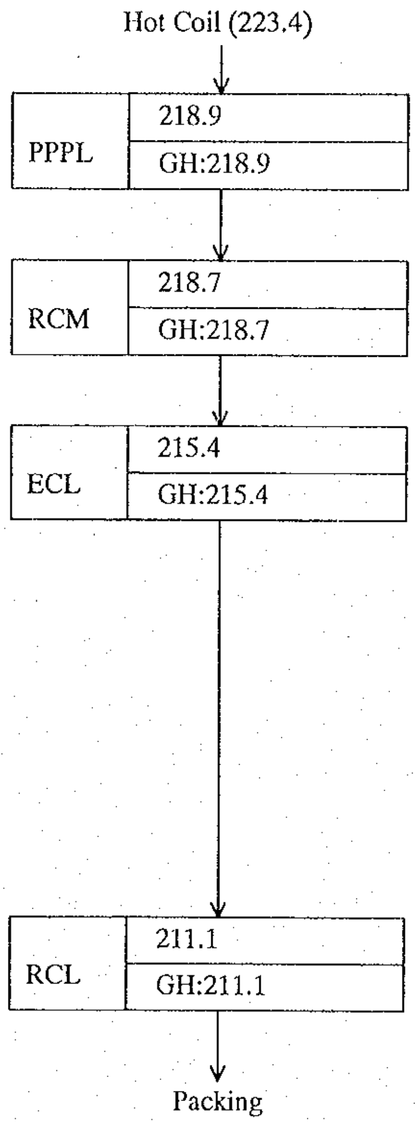


Fig. IV-3-4 Production Flow of CASE 3

Chapter V Plan for Construction of New Cold Rolling Mill Complex

1. Designing of Process

The following three preconditions are adopted in designing the process of the new cold rolling mill complex.

1) Proven technologies which are widely used in the existing steel industries and do having no elements of development are to be adopted for all the equipment.
2) The initial investment cost is to be minimized in principle.
3) The future expansion plan up to 500,000 tons/year is to be taken into consideration with regard to the land space and the plant layout at the time of designing the new cold rolling mill complex. However, any civil and building work and equipment for the expansion is not included in this FS.

1.1 Production Process for Each Grade

For GH products annealing and skin-pass is not required. From the market study, it is revealed that ECL is necessary for processing GH. Tension leveler is to be equipped at Re-coiling(RCL) in order to correct the shape of thin gauge products.

All the GS and CH products are considered to be processed at ECL in this FS. However, the cleanliness of the surface might not be required by some customers.

Paper packing is to be adopted for packing process considering the fact that all the products produced at the new cold rolling mill complex are expected to be consumed in Viet Nam.

The production process for each grade which is to be produced at the new cold rolling mill complex is shown below.

1) GH : PL → RCM → ECL → RCL → Packing
2) GS : PL → RCM → ECL → BAF → SPM → RCL → Packing
3) CH : PL → RCM → ECL → BAF → SPM → RCL → Packing

1.2 Specifications of Hot Coil

The performance of a cold rolling mill complex is much affected by the hot coil specifications to be fed, such as coil weight, thickness and quality. Accordingly, in order to calculate the performance figures, such as production capacity and availability of cold rolling mill complex, the hot coil specifications need to be defined.

In this FS the following specifications of hot coils are assumed;

(1) Maximum coil weight: 25 ton

Larger hot coils are to increase the production capacity of the cold rolling mill complex. At the same time, however, the investment cost of the equipment for production and coil handlings such as cranes is also to increase as hot coils become larger. At the moment, the hot coils which are shipped to overseas weigh 25 tons maximum. In this FS this value of 25 tons is used.

(2) Weight per unit width : 20 kg/mm-width

Weight per unit width is used to define the maximum outer diameter of hot coil. 20 kg/mm-width corresponds to the outer diameter of 2000 mm. The outer diameter affects the specifications of each equipment, and in this FS the value of 20 kg/mm-width which is widely used in the existing cold rolling mill complex is adopted.

(3) Thickness: 1.6 ~ 3.6 mm

The thickness of hot coils dominates very much the performance of a cold rolling mill complex ,such as production capacity and quality of products. The preconditions of the thickness of hot coils corresponding to that of cold rolled products, together with the resultant number of passes required at the cold rolling mill, are shown in Table V-1-1. The appropriate number of passes is set to avoid too large equipment.

Table V-1-1 Relation between Hot Coil Thickness and Cold Coil Thickness (width is 1,000mm)

Hot coil thickness (mm)	Cold coil thickness (mm)	Number of passes at cold rolling mill
1.6	0.16	5
1.8	0.22	5
2.0	0.45	4
2.5	1.12	3
3.6	1.8	3

(4) Width: 650 ~ 1,300 mm

From the market survey the width of the products are found to be 650 to 1,250 mm. The maximum width of 1,300 mm is to be used considering the possibility of trimming.

One thing for which an extra consideration has to be given is the possibility of producing the cold rolled sheets with larger width. This product is mainly used for automotive industry and the width is usually 1,250 to 1,850 mm. In this FS the production of the said wide products is not taken into consideration due to the following reasons ;

1) For at least a few years after the start-up of the new cold rolling mill complex, there seems to be no possibility of the automotive industry procuring the cold rolled steel sheets from the mill in Viet Nam.
2) For the production of the said wide products an extra initial investment cost is required.

(5) Other quality requirements:

In addition to the above-mentioned items (1) to (4) other major quality items of hot coils which would affect the performance of cold rolling mill complex are shown in Table V-1-2. For GIS and CH products hot coils with high quality are indispensable.

Table V-1-2 Quality Requirements for Hot Coils

Quality of hot coil	Required quality	Influences on cold rolling mill	
		Pickling	Cold rolling & successive process
Mechanical properties	Finishing temperature of hot rolling mill	-	·Gauge deviation due to uneven hardness ·Edge crack
	Coiling temperature of hot rolling mill	·Worsening of pickling quality	·Gauge deviation due to uneven hardness ·Worsening of γ-value
Dimensions	Strip thickness	-	·Worsening of gauge of cold rolled products
	Strip width	·Edge trimming troubles ·Increase of yield loss	-
	Crown	·Strip walk	·Off-shape (uneven waviness)
	Coil inside diameter	·Deterioration of Mandrel insertion work ·Slip marks	-
Appearance	Telescoping	·Strip walk ·Handling damage (Edge bend)	-
	Camber	·Strip walk ·Edge scar	·Edge cracks due to edge scar ·Strip walk ·Sticking
	Overlap	·Dividing, discarding	-
	Edge crack	·Clipping, dividing	·Strip breakage
	Surface defects	·Strip breakage ·Increase of yield loss	·Strip breakage ·Increase of yield loss

1.3 Specifications of Cold Rolled Products

Specifications of cold rolled products are assumed as follows based on the market survey of GIS and CRS.

(1) Weight of product coils

GI substrates, which are expected to account for 90% of products in the new cold rolling mill complex, are purchased in the form of coils by GI manufacturers in Viet Nam. CH products are purchased in the form of both coils and sheets. Considering the proportion of GIS production in the new cold rolling mill complex, most of the products are to be delivered to the customer in the form of coils. Accordingly, all the products are presupposed to be delivered in the form of coils.(Max.weight: 12 tons)

For sheets the required cutting work is to be done at the existing coil centers, so that no cutting facility is considered in the new cold rolling mill complex. Dividing of coil for final products are to be made at RCL.

The coil weight and the proportion of the production amount for each coil weight is shown in Table V-1-3.

Table V-1-3 Coil Weight Conditions of Products

Products	Dividing at RCL	Coil weight of Products	Proportion
GIS	2	7 ~11 ton	50 % of total amount of GIS products
	4	3 ~ 6 ton	50 % of total amount of GIS products
CRS	2	7 ~12 ton	50 % of total amount of CRS products
	4	3 ~ 6 ton	50 % of total amount of CRS products

(2) Thickness

Based on the result of market survey the following thickness range is adopted.

GIS : 0.15 ~ 0.8 mm

CRS : 0.35 ~ 1.8 mm

(3) Width

Based on the result of market survey the following width range is adopted.

GIS : 650 ~ 1,250 mm

CRS : 650 ~ 1,250 mm

(4) Required quality at international standard

The required quality of the cold rolled products is to be specified item by item in the contract with the customers. One example of required quality standard specified in JIS(G3141) is shown in Table V-1-4 for reference.

Table V-1-4 Example of Required Quality at International Standard

(CRS(Commercial Quality Grade) Thickness : 0.6 mm, Width 1,000 mm)

Quality Item		Required Quality
Thickness deviation		Target thickness ±0.06 mm
Width deviation		Target width +0 mm ~ 7 mm
Shape	Warp, Wave	Maximum 12 mm
	Local edge wave	Maximum 8 mm
	Local center buckle (wave)	Maximum 6 mm

Items with regard to the mechanical properties and surface quality to be considered for the production of cold rolled sheets for high class use such as home appliance are shown in Table V-1-5.

Table V-1-5 Items to be Considered for Mechanical Property and Surface Quality of High Class Cold Rolled Sheets

Characteristic	Items to be considered
1.High formability	①Hot coil quality
	②High reduction at cold mill
	③Annealing temperature control at BAF
2.Improved surface quality	①Hot coil quality
	②Roll specification at each equipment
	③Lubrication control at cold mill
	④Cleaning capability of ECL and BAF

1.4 Working Hours of Each Equipment

Working hours of each equipment is shown in tableV-1-6. 24 hour continuos operation with meal back-up persons is presumed for every equipment. The figures in the table are obtained based on the real operational indices in the existing cold rolling mills in Japan.

Table V-1-6 Working Hours of Each Equipment

		PL	RCM	ECL	BAF	SPM	RCL
Yearly hours	(hours/year)	8760	8760	8760	8760	8760	8760
Time for maintenance	(hours/year)	576	480	480	360	*1	360
Yearly maintenance	(days/year)	10	10	10	5	*1	5
Monthly maintenance	(hours/year)	28	20	20	20	*1	20
Available time for working	(hours/year)	8184	6711 *2	8280	8400	897	8400
Availability	(%)	85	92	94	99	95	92
Actual working time	(hours/year)	6956	6174	7783	8316	852	7728

*1 : included in RCM

*2 : The time of 672 hours required for device exchange from RCM to SPM and vice versa is taken into consideration in addition to time for maintenance

1.5 Yield of Each Equipment

At each equipment an yield loss occurs by cutting the defective parts, sampling for inspection and trimming. Furthermore, at PL an additional yield loss is expected due to the reaction between iron and hydrochloric acid. The yield loss at each equipment is shown in TableV-1-7. The figures in the table are obtained based on the real operational indices in the existing cold rolling mills in Japan.

Table V-1-7 Yield of Each Equipment

	PL	RCM	ECL	BAF	SPM	RCL
Yield (%)	98.0	99.9	98.5	100.0	99.0	98.0

2. Required Performance and Specifications of Equipment

2.1 Pickling Line (PL)

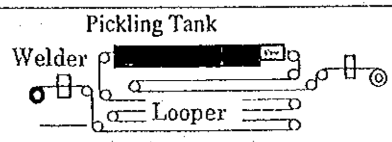
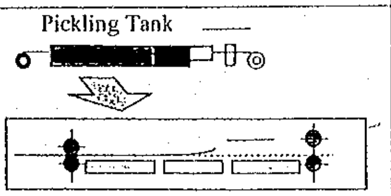
The scale of the surface of hot coils is to be eliminated by the reaction with the hydrochloric acid while the hot coils passing through PL. The de-scaled surface of coils is indispensable for the succeeding processes. After being pickled, the coils are washed, dried, trimmed and oiled.

(1) Required performance
PL is to be furnished with all of the following functions ;

1) Descaling of hot coils
2) Trimming of coils
3) Oiling (Rust preventive oil)
4) Inspection and removing defective parts of coils
5) Cutting into specified unit weight for P/O coils
(However, processing amount of P/O at Pickling line is not considered in this FS as a result of the market survey.)

(2) Selection of process
1) PL equipment is classified into two groups, conventional type and push-pull type. The comparison between the conventional type and the push pull type is shown in Table V-2-1. In the conventional type of PL the head of the coil is welded to the tail end of the coil ahead, and thus the pickling work is made continuously. On the other hand, in PPPL the coils are proceeded to the pickling tank one by on, and thus the pickling work is made intermittently. The push pull type pickling line (PPPL) is recommended in this FS. The criteria of the process selection are a) the number of PL constructed in the past for the production capacity planned in this FS, and b) the required initial investment cost for the equipment. For the production capacity of 220,000 tons/year PPPL type has been adopted predominantly. In addition, the required initial investment cost for the conventional type is expected to be three times as much as PPPL type.

Table V-2-1 Comparison between Conventional Type and Push Pull Type Pickling Line

	Conventional type	Push Pull type
Schematic image	 Welder and loopers at entry and exit required	
Threading method	Continuous	Batch
Max. Line speed (mpm)	400 (Center)	200
Rough estimation of production capacity (kton/year)	300 ~2,000	200 ~600
Rough estimation of equipment cost*[1] (M US$)	30 ~50	10 ~15

*1: Production capacity: approx. 250,000 tons/year

2) With regard to the acid to be used, hydrochloric acid (HCl) is recommended. In the past sulfuric acid (H_2SO_4) was used occasionally, however, HCl is better with regard to a) surface quality after pickling and b) pickling efficiency. In the recent years HCl is used predominantly for pickling of low carbon steel. The temperature of HCl during pickling is to be raised up to 90℃ to allow the better pickling efficiency.

3) Side trimmer is to be equipped.

4) Oiler is to be equipped.

5) Enough inspection space is to be secured for quality inspection of products.

6) Acid regeneration plant (ARP) is to be equipped for treatment of strong waste acid. The necessity of ARP was confirmed by the result of the site survey that there is not enough capacity in Viet Nam to treat the strong waste acid.

7) For the future plan of increasing processing amount, for example, from 250,000 to 500,000 tons/year, a construction of another PPPL is recommended. This recommendation is made because of the following reasons;

   a) Initial investment cost can be kept low.

   b) For Push Pull type the equipment for 500,000 tons/year becomes very large, and there are not many equipment suppliers which have experience of construction of Push Pull type with that capacity. The maximum speed required will be more than 200 mpm if the planned grade and size mix is to be applied.

(3) Basic specifications of equipment

Major specifications of the equipment obtained from the hot coil specifications and planned production capacity are described below.

1) Grades to be processed : Hot rolled low carbon steel (CQ, DQ, DDQ, Full Hard(FH))
(Coiling temperature (CT) of hot coil is to be less than 630℃.)
2) Thickness to be processed : 1.5 ~ 5.0 mm
3) Width to be processed : 650 ~ 1,300 mm
4) Coil size
   a) Entry
      Inner coil diameter : 762 mm, 609 mm, 508 mm
      Outer coil diameter : maximum 2,000 mm
      Coil Weight : maximum 25 tons
   b) Delivery
      Inner coil diameter : 508 mm
      Outer coil diameter : maximum 2,000 mm
      Coil weight : maximum 25 tons
5) Pickling equipment type : Push-pull type (PPPL)
6) Pickling speed : maximum 80 mpm
7) Production capacity : 220,000 tons/year
8) Major equipment
   a) Entry coil car
   b) Pay off reel
   c) Leveler
   d) Entry shear
   e) Stitcher
   f) Side guide
   g) Pickling tank
   h) Rinsing tank
   i) Dryer
   j) Edge trimmer
   k) Bridle roll
   l) Delivery shear
   m) Oiler
   n) Tension reel
   o) Delivery coil car
   p) Acid & rinse circulation system
   q) Fume exhaust system

(4) Schematic drawing of equipment
Schematic drawing of PPPL is shown in Fig.V-2-1.

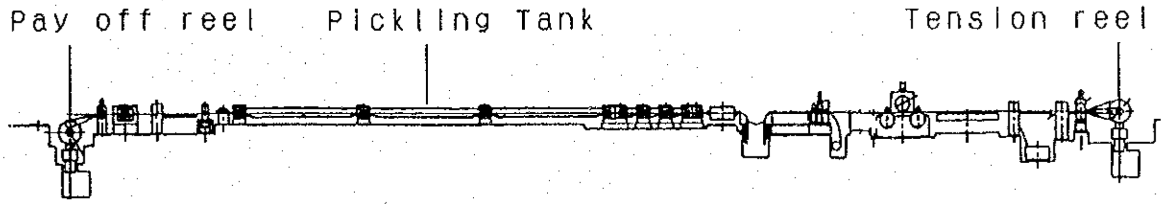


Fig.V-2-1 Schematic Drawing of Push Pull Type Pickling Line

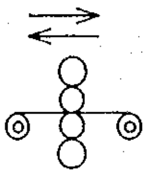
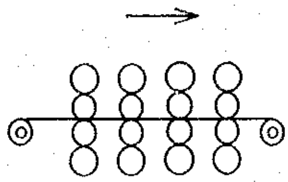
2.2 Cold Rolling Mill (CM)

The cold rolling mill reduces the thickness from that of hot coil to that of the specific order. An emphasis is to be laid on securing accurate thickness and good shape, which can be obtained only by satisfactorily computerized and automated equipment.

(1) Required Performance
CM is to be furnished with all of the following functions ;
1) Production capacity
2) Control of thickness
3) Control of shape (affecting the threadability of the succeeding processes and the shape of final products)
4) Control of surface quality (affecting that of final products)

(2) Selection of Process
Cold rolling mill is classified into two groups, a reversing type and a tandem type. The comparison between reversing type and tandem type is shown in Table V-2-2. For the reversing type, one or two stands with rolls are located in the center of the equipment and the thickness of the strip is reduced by the strip being rolled forward and backward with the required number of passes. The reversing type has a relatively small production capacity. The reversing type cold rolling mill can be made a combination type rolling mill, namely it can be used as a skin-pass mill (SPM). On the other hand, for the tandem type, three to six stands with rolls are located and the rolling is made only in one direction. The tandem type has a larger production capacity.
The reversing type cold rolling mill (RCM) is recommended in this FS. The criteria of the process selection are a) the number of CM constructed in the past for the production capacity planned in this FS, and b) the required initial investment cost for the equipment. For the production capacity planned RCM has been adopted predominantly. In addition, the required initial investment cost for the tandem type is expected to be three times as much as RCM.

Table V-2-2 Comparison between Reversing Cold Rolling Mill and Tandem Cold Rolling Mill

	Reversing Cold Rolling Mill	Tandem Cold Rolling Mill
Schematic image		
Number of stands	1 ~ 2	3 ~ 6
Rough estimation of production capacity (kton/year)	100 ~ 300	500 ~ 2,000
Rough estimation of equipment cost*1 (M US$)	15 ~ 25	45 ~ 75

*1: Production capacity: approx. 250,000 tons/year

For the expansion plan up to 500,000 tons/year, there are following two possibilities ;

1) Firstly, one stand reversing cold rolling mill with a provision of two stand reversing cold rolling mill (tandem reversing mill) is to be installed. For the expansion, the second stand is to be added to the said reversing mill. Furthermore, an independent skinpass mill may be also installed at the time of expansion.
2) Firstly, one stand reversing cold rolling mill is to be installed. For the expansion, Another one stand reversing cold rolling mill is to be installed. Furthermore, an independent skinpass mill may be also installed at the time of expansion.

The above 2) is recommended due to the following reasons ;

a) The initial investment cost for the above 1) is higher than that for the above 2).
b) As the provision of the second stand, namely the above 1), requires additional space, the yield is worsened at the head and tail ends of coils for tandem reversing mill.
c) For the revamping work for a tandem reversing mill, namely the above 1), a long period of shutdown is inevitable, thus affecting the production capacity to a considerable extent. On the other hand, the above 2) requires only a limited period of shutdown for revamping work.
d) At the time of expansion, a wider products, namely five feet or six feet products are possibly demanded, depending on the development of Vietnamese industries such as automobile and home appliance, by the customers. The above 1) can not cope with the said demand of wider products, whereas the above 2) can cope with such need simply by designing the new cold rolling mill with a different width condition.

(3) Mill type of cold rolling mill

There are a few equipment types of cold rolling mills in operation in the world. There are three possible mill types for the cold rolling mill planned in this FS. These mill types together with their characteristics are shown in Table V-2-3. The criteria of the selection are the items listed

in Table V-2-3, 1) to 7).
Firstly, Senzimir type is turned down for the following reasons ;

a) An independent skin pass mill is required, resulting in an increase of the initial investment cost.
b) Senzimir type is not widely used for the low carbon steel production in the world.

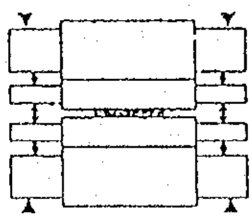
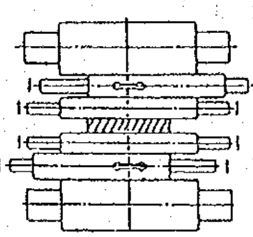
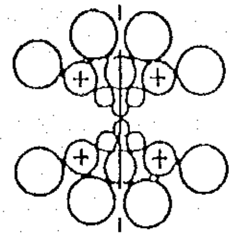
4-Hi type cold rolling mill requires less initial investment cost compared to 6-Hi type, however, considering the following disadvantages of 4-Hi type, 4-Hi type cold rolling mill is not profitable.

a) 4-Hi type mill has less capability of shape control compared to 6-Hi type mill which has the intermediate rolls, resulting in less stability of operation and higher yield loss.
b) 4-Hi type mill has to have several different roll curves of work rolls for crown and shape control, resulting in an increase of work load at the roll shop and also an increase of cost for work rolls possessed.

Considering the above-mentioned points, 6-Hi type cold rolling mill is recommended in this FS.

Table V-2-3 Comparison of Mill Type

· Precondition: Products are CRS and GIS (maximum width 1,250 mm).

	4-Hi	6-Hi	Senzimir
Schematic image	 WR, BUR Total 4 rolls / stand Medium WR Simple constitution	 WR, IMR, BUR Total 6 rolls / stand Medium WR Simple constitution	 WR, IMR, BUR Total 20 rolls / stand Smaller WR Complex constitution
1)Thickness accuracy *1	◎	◎	◎
2)Flatness controllability	○	◎	◎
3)Product quality	◎	◎	◎
4)Productivity (Work efficiency)	◎	◎	△ (High frequency of roll changing)
5)Possibility of skinpass rolling	◎	◎	× (Smaller WR)
6)Roll shop	○	◎	△ (High frequency of roll changing)
7)Major products	Low carbon steel	Low carbon steel	Special steel (Stainless steel, Electrical steel etc.)

◎: Excellent ○: Good △: Fair ×: Poor

*1:with Hydraulic screw-down cylinder, AC motor and AGC system

(4) Items affecting the performance of cold rolling mills

Conditions of items affecting the performance of cold rolling mills are shown in Table V-2-4. Some recommendations are described in Note in the table. These items have to be considered in designing the cold rolling mill equipment.

Table V-2-4 Conditions of Items Affecting Performance of Cold Rolling Mill

Required performance of cold rolling mill	Conditions of items affecting the performance	Note
1.Production capacity	①Hot coil specifications	Appropriate thinner thickness results in a reduction of number of rolling passes required, thus increasing production capacity. For the quality, refer toⅣ.2.
	②Products coil specification	Depend on the market
	③Max. rolling speed	
	④Motor power	
	⑤Work roll diameter	Small rolls result in lower work efficiency because of high frequency of roll changing. Large rolls result in limited reduction ratio.
	⑥ Lubrication	High Lubricated type is preferable.
	⑦Roll changing type	
	⑧Existence of Pay off reel	
2.Control of thickness	①Automatic Gauge Control (AGC)	Tension & Reduction feedback type is preferable.
	②Thickness Gauge	X ray type is preferable.
	③Screw-down Cylinder	Hydraulic type is preferable.
	④Drive Motor	AC is preferable.
3.Control of flatness	①Mill type	6Hi is preferable.
	②Roll bending	Bending with negative and positive type is preferable.
4.Control of surface products	①Work roll texture	High accuracy roll grinder & dull finishing machine are preferable.
	②Lubrication	Less remaining type is preferable.
	③Lubrication system	Hoffman filter, Magnet separator & Mill washing system are preferable.

(5) Calculation of production capacity of reversing cold rolling mill (combination type)

1) Annual Production Capacity

Annual Production Capacity = (8760 - A - B) × T/H

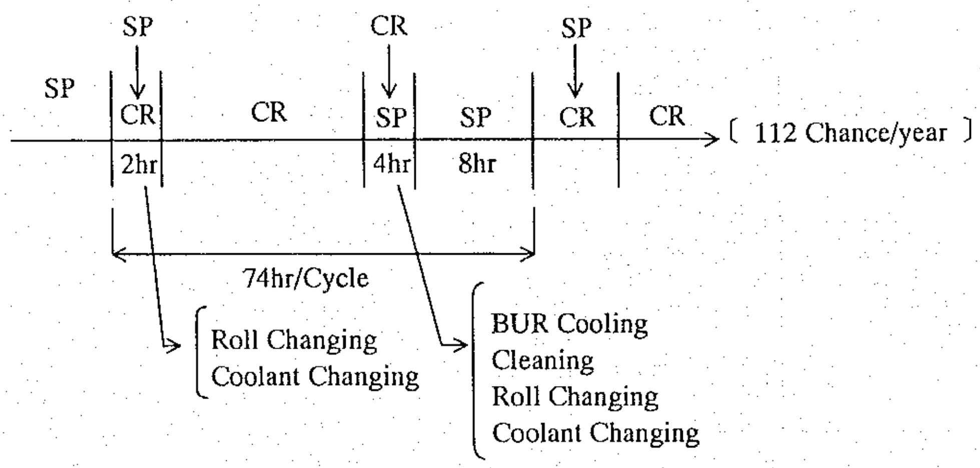
〔8760 = 24 hr/day ×365 day〕

A : Scheduled Line Stop Time (hr)

① Scheduled Maintenance Time : 480 hr/year

〔Annual : 10 day, Monthly : 20 hr〕

② Cold Rolling — Skinpass Changing Time : 672 hr/year



B : Down Time (hr) : CR → 537hr/year, SP → 45hr/year

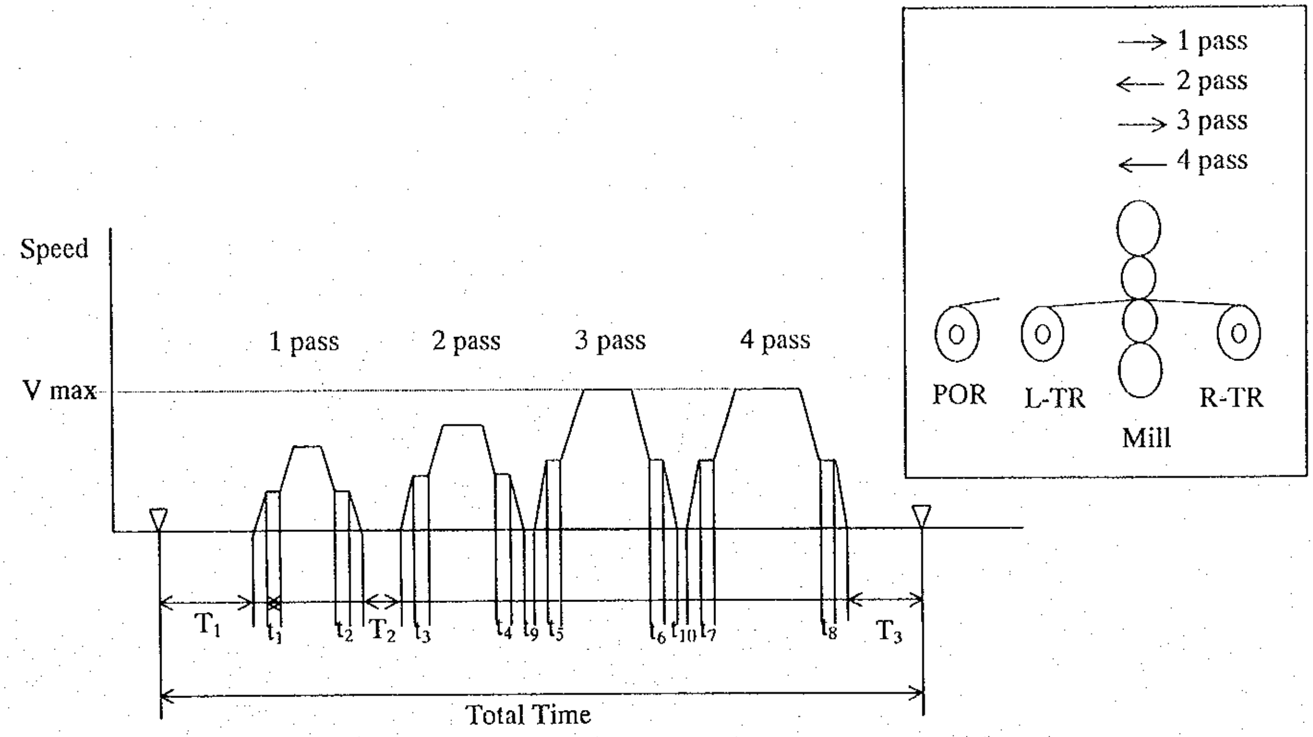
→ Roll Changing Time, Roll reconditioning Time etc.

→ 7026 × T/H

The production amount is obtained by the working time multiplied by T/H(tons/hour : hourly production amount). The working time is obtained based on the calendar yearly hours of 8760 with the reduction of the time for maintenance (480 hrs) and that for changing the mill to skinpassing function (672 hrs). The time for operational loss (582hrs) such as roll changes and roll reconditioning is also deducted from the calendar yearly hours.

2) Calculation of T/H of cold rolling

The speed pattern of cold rolling is shown in Fig.V-2-2 for the case of four pass thickness reduction. The horizontal axis represents the time and the vertical axis the rolling speed.



$$T/H = \frac{\text{Coil Weight}}{\text{Total Time}} = \frac{W}{(T_1 + T_2 + T_3) + \sum_{i=1}^{10} ti + \sum_{i=1}^{4} (tai + tdi) + \sum_{i=1}^{4} \frac{W''}{\rho \times ai \times b \times Vi}}$$

W	:	Coil Weight	tai	:	Acceleration Time
T_1	:	Threading Time (POR to R-TR)*1	tdi	:	Deceleration Time
T_2	:	Threading Time (Mill to L-TR)*2	ρ	:	Specific Gravity of Iron
T_3	:	Threading Time (R-TR to L-TR):3	ai	:	Strip Thickness
$t_{1\sim8}$	:	Run-Hold Time	b	:	Strip width
$t_{9\sim10}$	:	Pass Change Time	Vi	:	Line Speed
			W"	:	Coil Weight excluding Acc. & Dec. Section

*1: Time between the head end of the strip leaving POR and that head end arriving at R-TR through the mill.

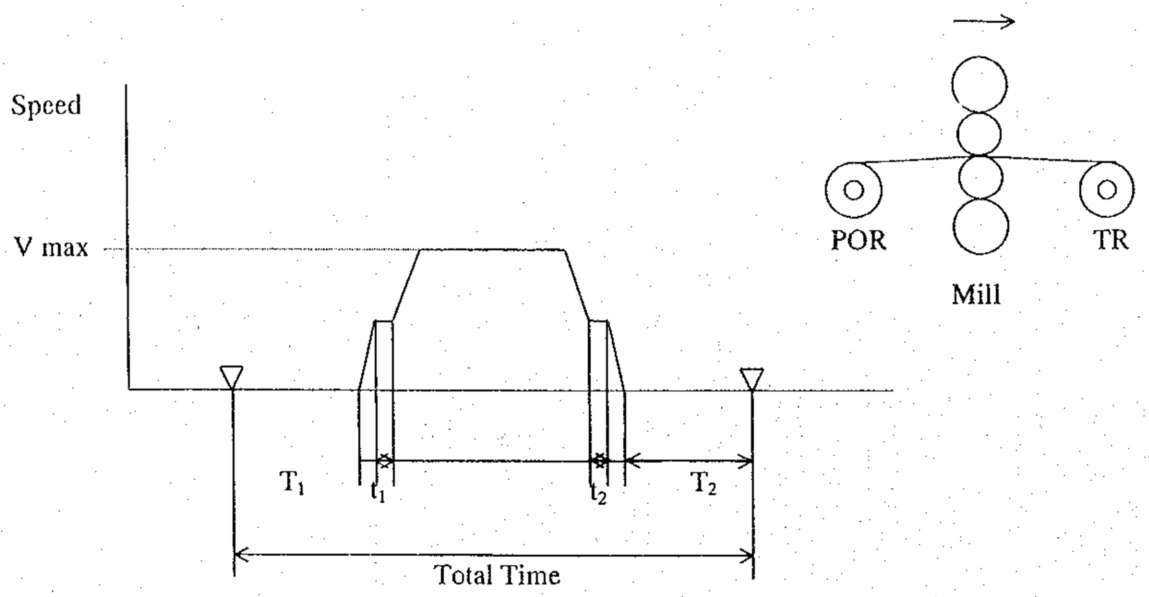
*2: Time between the tail end of the strip arriving at the mill from POR and that tail end going back and arriving at L-TR.

*3: Time between tail end of the strip leaving R-TR and that tail end arriving at L-TR through the mill.

Fig. V-2-2 Speed Pattern of Cold Rolling Mill

T/H is obtained from the weight of the coils produced divided by the time required for the production of the said coils. The time required for the production is to include that for preparation of rolling work, adjusting during rolling and handling of product coils. In this FS the rolling speed pattern and the time required for the said operational works are assumed based on the operational data of the existing mills in Japan.

3) Calculation of T/H of skinpass mill



$$T/H = \frac{\text{Coil Weight}}{\text{Total Time}} = \frac{W}{(T_1 + T_2) + (t_1 + t_2) + (t_a + t_b) + \frac{W''}{\rho \times a \times b \times V\,max}}$$

Fig.V-2-3 Speed Pattern of Skinpass Mill

The speed pattern of skinpass mill is shown in Fig.V-2-3. The skinpass rolling is always made with one pass reduction. In this FS the rolling speed pattern and the loss time required for the operational works are also assumed based on the operational data of the existing mills in Japan .

(6) Basic specifications of equipment

Major specifications of the equipment obtained from the planned production capacity is described below. As the cold rolling mill is a combination type, namely the mill is used as a skin-pass mill as well, the specifications of skin-pass mill are also described.

1) Grades to be processed
   RCM : Pickled low carbon steel (CQ, DQ, DDQ, FH)
   SPM : Annealed low carbon steel (CQ, DQ, DDQ)
2) Thickness to be processed
   RCM : Thickness of pickled coil 1.5 ~ 4.0 mm
   Thickness of rolled products 0.15 ~ 1.8 mm
   SPM : 0.2 ~ 1.8 mm
3) Width to be processed : 650 ~ 1,300 mm
4) Coil size
   Inner coil diameter : 508 mm
   Outer coil diameter : maximum 2,000 mm
   Coil weight : maximum 25 tons
5) Rolling speed : maximum 1,300 mpm
6) Production capacity
   RCM : 21,3000 tons/year
   SPM : 87,000 tons/year
7) Major equipment
   a) Coil car for pay-off reel
   b) Pay-off reel
   c) Coil car for right tension reel
   d) Right tension reel
   e) Coil car for left tension reel
   f) Left tension reel
   g) Right bridle roll
   h) Left bridle roll
   i) Rolling mill (Approx. 4,000 kw, including AGC, Roll bender and Hydraulic roll load system)
   j) Roll changing device
   k) Roll coolant system
   l) Mill fume exhaust system
   m) Inspection station
   n) Process control computer

(7) Schematic drawing of equipment

A schematic drawing of the reversing cold rolling mill is shown in Fig.V-2-4.

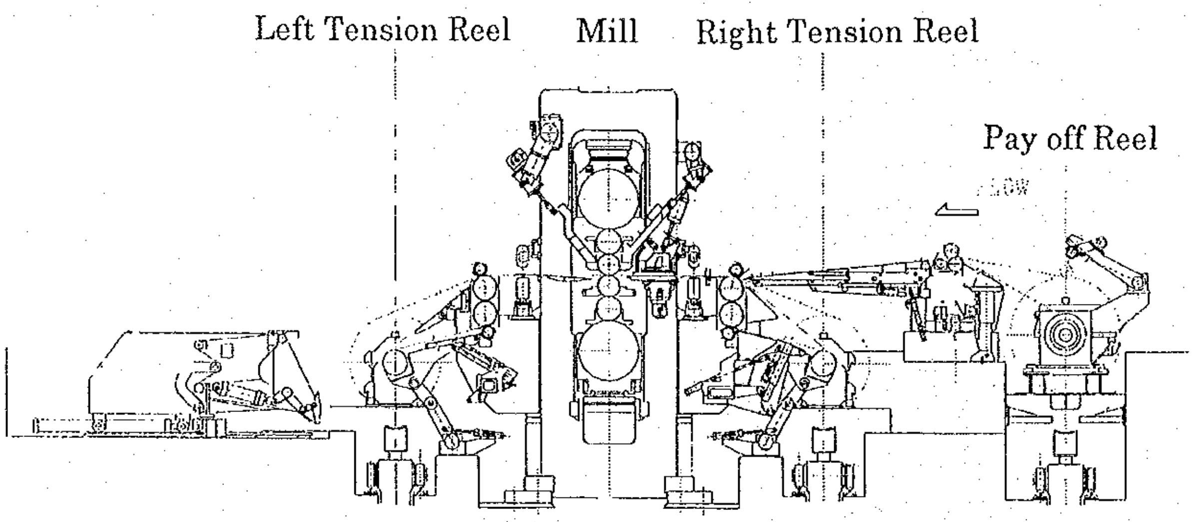


Fig. V-2-4 Schematic Drawing of Reversing Cold Rolling Mill

2.3 Electrolytic Cleaning Line (ECL)

ECL is to clean the surface of the rolled strip by removing the lubricant and other adherence to the strip, thus eliminating the quality problems of the succeeding processes.

(1) Required performance

ECL is to be furnished with all of the following functions ;

1) Removing oil adhering to the surface
(From the market study, it is revealed that ECL is necessary for processing GI substrate (Full hard)).
2) Tight winding of coils (to avoid the quality problems at BAF)
3) Removing defective parts of coils (including the removal of off-gauge parts at cold rolling mill)

(2) Selection of process

At the present moment the cleaning method which is widely used in the steel industry in the world to remove the lubricant adhered to the strip surface is the combination of the following three degreasing methods. Accordingly, the same cleaning method is recommended in this FS.

1) Chemical degreasing with alkaline
With regard to the alkaline to be used, Ortho Sodium Silicate is recommended.
2) Mechanical degreasing with high rotating brush
3) Electrochemical degreasing with electrode
Horizontal bath type is recommended.

(3) Basic specifications of equipment

Major specifications of the equipment required from the planned production capacity are described below.

1) Grades to be processed : Rolled low carbon steel
2) Thickness to be processed : 0.15 ~ 1.8 mm
3) Width to be processed : 650 ~ 1,300 mm
4) Coil size
   Inner coil diameter : 508 mm
   Outer coil diameter : maximum 2,000 mm
   Coil weight : maximum 25 tons
5) Rolling speed : maximum 350 mpm
6) Production capacity : 210,000 tons/year
7) Major equipment
   a) Entry coil car
   b) Pay-off reel
   c) Entry shear
   d) Welder (Limited overlap type)
   e) Alkali dip tank
   f) #1 Scrubber tank
   g) Electrolytic cleaning tank (Grid to grid type)
   h) #2 Scrubber tank
   i) Final Rinsing tank
   j) Dryer
   k) Bridle roll
   l) Delivery shear
   m) Tension reel
   n) Delivery coil car
   o) Alkali circulation system
   p) Fume exhaust system

(4) Schematic drawing of equipment

Schematic drawing of electrolytic cleaning line is shown in Fig. V-2-5.

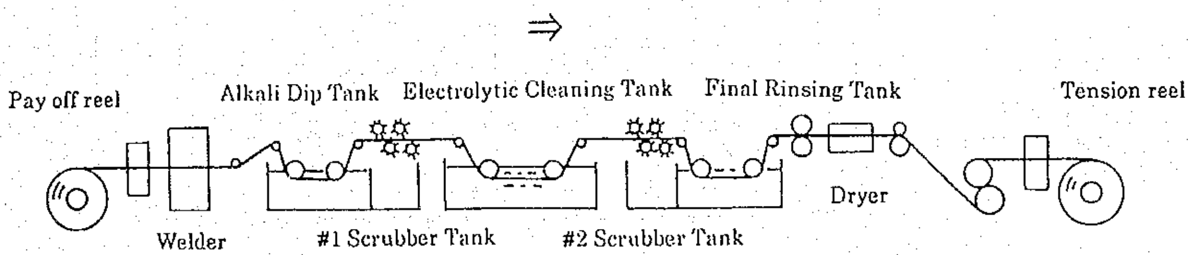


Fig. V-2-5 Schematic Drawing of Electrolytic Cleaning Line

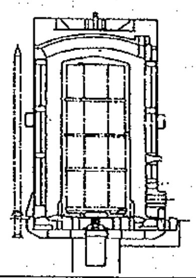
2.4 Annealing Furnace

Grains of the strip are elongated by the cold rolling, and the strip becomes hard and brittle. Thesse elongated grains recrystallize and have grain growth into the uniform grains by the annealing in the atmosphere with reduced pressure. This annealing furnishes the strip with the required mechanical property of elongation.

(1) Required performance:
Annealing furnace is to be furnished with all of the following functions ;
1) Control of mechanical property (Recrystallization of grains)
2) Removing oil adhering to the surface

(2) Selection of process
1) Annealing furnaces are classified into two groups, box annealing furnace (BAF) and continuous annealing line (CAL). The comparison between BAF and CAL is shown in Table V-2-5. At BAF the coils are annealed in the form of coils as they are. On the other hand at CAL the coils are annealed continuously after being rewound.
Box annealing furnace (BAF) is recommended in this FS. The criteria of the process selection are a) the number of annealing equipment constructed in the past for the production capacity planned in this FS, and b) the required initial investment cost for the equipment. For the production capacity of around 90,000 tons/year BAF type is adopted predominantly. In addition, the required initial investment cost for CAL type is expected to be three times as much as BAF type.

Table V-2-5 Comparison between BAF and CAL

	Box annealing furnace (BAF)	Continuous annealing line (CAL)
Schematic image		
Production capacity (for CRS annealing, 1,000 tons/year)	20 (for 1 unit) ~	400 ~ 1,000
Rough estimation of equipment cost*1 (M US$)	2.5 ~ 5	20 ~ 30

*1 : equipment for the production capacity of CRS of less than 500,000 tons/year

2) BAF is classified into two groups by the atmosphere gas to be used, H2 type and the conventional type. The comparison between H_2 type BAF and the conventional type BAF is shown in Table V-2-6.

The H_2 type is recommended in this FS. The criteria of the process selection are a) quality of products, b) production efficiency, c) the number of annealing equipment constructed in the past and d) the required initial investment cost for the equipment. For quality of products, H2 gas has higher reducibility than HN gas and inhibits the occurrence of temper color caused by the oxide film. In addition, H2 gas has higher heat transfer, resulting in more uniform mechanical property. For production efficiency, H2 gas, as is mentioned, has higher heat transfer, meaning higher production efficiency. As to the number of annealing furnaces in operation, the H2 gas type has been getting more common in these days although the conventional type used to be common in the past. For the initial investment cost, there is no significant difference between these two types.

Table V-2-6 Comparison between H_2 Type BAF and Conventional Type BAF

		H_2 type	Conventional type
Atmospheres (vol. %)		H_2: 100%	H_2: 5%,N_2: 95%
Product quality	Tempering color	◎	○
	Property variations	◎	○
	Surface cleanliness	◎	○
Productivity		◎	○
Initial Investment cost		about same for the same production quantity	

◎: Excellent ○: Good

3) Coil Cooling Unit (CCU) is to be equipped for the prevention of rust after annealing at BAF. This equipment prevents annealed coils from rust by charging dry and cool air to the coils.

(3) Basic specifications of equipment

Major specifications of the equipment required from the planned production capacity are described below.

【Annealing furnace】

1) Grades to be processed : Cold rolled low carbon steel
2) Thickness to be processed : 0.15 ~ 1.8 mm
3) Width to be processed : 650 ~ 1,300 mm
4) Coil size
   Inner coil diameter : 508 mm
   Outer coil diameter : maximum 2,000 mm
   Coil weight : maximum 25 tons
5) Grades to be produced : CQ, DQ, DDQ
6) Production capacity : 88,000 tons/year
   (CQ 84,600 tons/year, DQ 2,200 tons/year, DDQ 1,100 tons/year)
7) Annealing temperature : maximum 750℃
8) Furnace temperature : maximum 850℃
9) Stacking weight : maximum 100 tons/unit

10) Major equipment
   a) Base (4 unit)
   b) Reheating hood (2 unit)
   c) Cooling hood (3 unit)
   d) Downender (1 unit)

Note) There is no H_2 gas supplier outside the cold rolling mill complex. Accordingly, H_2 gas generator is to be installed in the complex. The storage facilities for N_2 gas for purging and LNG for fuel are to be installed in the complex.

【Coil cooling unit】
1) Entry coil temperature : 160℃
2) Coil temperature after cooling : 45℃
3) Time for cooling and storage : 5.2 days
4) Cooling base : 24 units

Note) With regard to the coil size the same specification is applied as the annealing furnace.

(4) Schematic drawing of equipment
A schematic drawing of a box annealing furnace is shown in Fig.V-2-6.

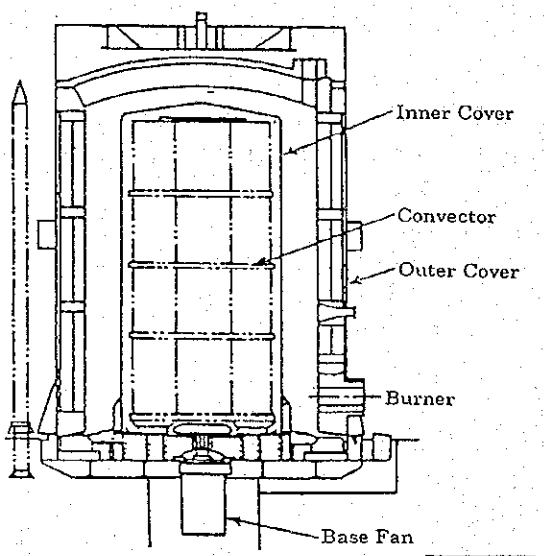


Fig.V-2-6 Schematic Drawing of Box Annealing Furnace

2.5 Skinpass Mill (SPM)

A skinpass mill (SPM) is to give the finishing touch to cold rolled products. The ductility of strip is increased and the yield point is eliminated by giving a light reduction. In addition, roughness is controlled and the shape is secured at SPM.

(1) Required performance:
SPM is to be furnished with all of the following functions ;
1) Light hardening and adding toughness to the steel
2) Elimination of yield point elongation
3) Impartation of required surface texture
4) Improvement of flatness

(2) Selection of process
As was mentioned in Cold Rolling Mill (CM) of Section 2.2 (2), one stand mill of combination type is recommended in this FS. This mill can be used both as a cold rolling mill and as a skinpass mill. The criteria of process the selection are a) the number of CM constructed in the past for the production capacity planned in this FS, and b) the required initial investment cost for the equipment. Refer to Section 2.2 for detail.

(3) Basic specifications of equipment
Refer to Section 2.2 (6).

(4) Schematic drawing of the equipment
Refer to Section 2.2 (7)

2.6 Recoiling Line (RCL)

The products produced based on the order from customers pass through the recoiling line(RCL). At RCL the thickness, width and surface quality of the strip products are checked and the coils are divided, if necessary, into the specific weight in accordance with the orders. A test piece is taken here and sent to test a laboratory for testing of mechanical properties and so on. In addition, the strip is oil coated for rust prevention.

(1) Required performance
RCL is to be furnished with all of the following functions ;

1) Inspection of width, gauge and surface defects, and removing defective parts
2) Cutting coils into a specified unit weight
3) Improvement of flatness
4) Trimming of coils
5) Oiling (rust preventative coating)

(2) Selection of process

1) An welder is to be equipped for threading of thin gauge sheet such as GI substrate.
2) A tension leveler is to be equipped for the improvement of flatness of thin gauge sheet (especially GI substrate (Full hard)).
3) Side trimmer is to be equipped.
4) Oiler is to be equipped.
5) Enough inspection space is to be secured for quality inspection of products, and thickness gauge meter is to be equipped.
6) Coil sleeve loader is to be equipped for the attachment of sleeves to products.
7) Test laboratory is to be equipped for sample testing of products.

(3) Basic specifications of equipment

Major specifications of the equipment required from the planned production capacity are described below.

1) Grades to be processed : Cold rolled low carbon steel sheet, and
   Cold rolled & skinpaseed low carbon steel sheet
2) Thickness to be processed : 0.15 ~ 1.8 mm
3) Width to be processed : 650 ~ 1,300 mm
4) Coil size
   Inner coil diameter : 508 mm
   Outer coil diameter : maximum 2,000 mm
   Coil weight : maximum 25 tons
5) Processing speed : maximum 650 mpm
6) Production capacity : 205,000 tons/year
7) Elongation by tension leveler : maximum 0.5% (for FH 0.3 mm × 1,000 mm)
8) Major equipment
   a) Entry coil car
   b) Pay-off reel
   c) Entry shear
   d) Welder (Unlimited overlap type)
   e) Tension leveler (including bridle roll at entry and delivery)
   f) Side trimmer
   g) Scrap baller
   h) Gauge meter (γ-ray)
   i) Oiler
   j) Delivery shear (Continuous cut type)
   k) Tension reel
   l) Coil sleeve loader
   m) Delivery coil car

(4) Schematic drawing of equipment

Schematic drawing of recoiling line is shown in Fig.V-2-7.

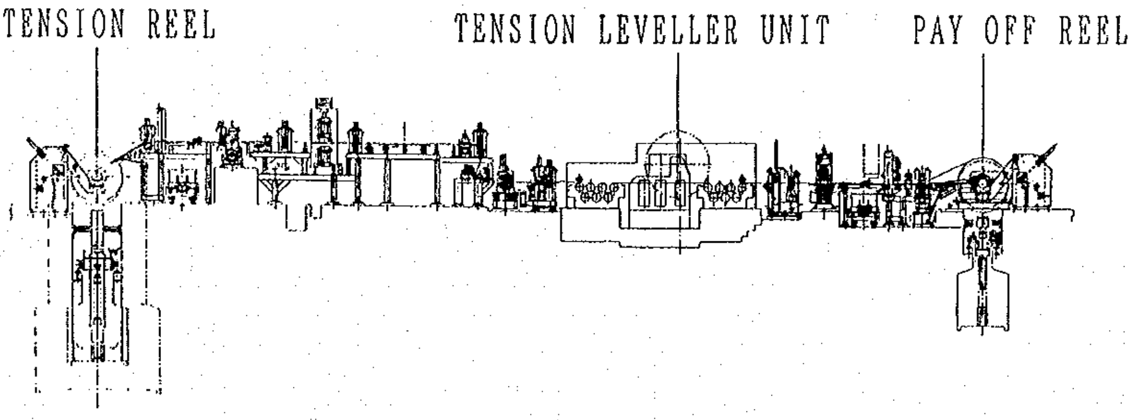


Fig. V-2-7 Schematic Drawing of Recoiling Line

2.7 Ancillaries

2.7.1 Water Treatment Facilities

(1) Preconditions

1) Quality of raw water

Major items with regard to water quality are as follows ;

- pH : 6.73
- SS : 0.4 mg/l
- Total hardness : 4.98 mg/l
- Chlorine content : 0.8 mg/l
- Chloride content : 17.55 mg/l

2) Quality of waste water

Viet Nam Standards C is to be applied, and major items with regard to water quality are as follows ;

- pH : 5.5~9
- SS : 200 mg/l
- COD : 400 mg/l
- Chromium(6) : 0.5 mg/l
- Mineral oil and fat : 5 mg/l
- Animal-vegetable oil and fat : 30 mg/l
- Total nitrogen : 60 mg/l
- Total phosphorous : 8 mg/l

3) Consumption of water for each equipment

Consumption of water for each equipment is shown in Table V-2-7.

Table V-2-7 Consumption of Water for Each Equipment

	Machinery Cooling	Inlet Temp.	Outlet Temp.	Industrial Water	Demineraliz-ed Water	Weak Acid Waste Water	Weak Alkali Waste Water	Oily Waste Water	Descalling Waste Water
	m^3/hr	℃	℃	m^3/hr	m^3/hr	m^3/hr	m^3/hr	m^3/hr	m^3/hr
PPPL	20	35	45	14		14		0.1	0.1
RCM/SPM	390	35	45		4			4	
ECL	36	35	45	21			21	0.1	
BAF	50	35	45					0.1	
RCL	39	35	45		1			0.1	
ARP				2		2			
Roll Shop					0.01				
Boiler					12				
Compressor	90							0.1	
H_2 Generator					2				
Test Lab.					0.01				
Water treat.				1					

(2) Water treatment flow

Water flow of the new cold rolling mill complex is shown in Fig.V-2-8.

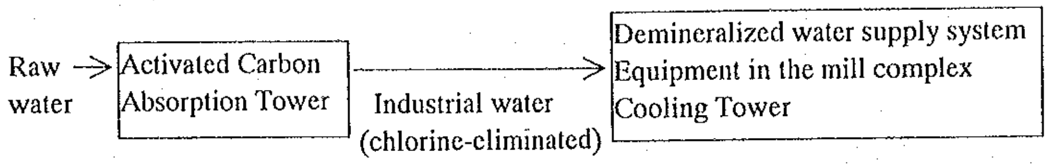
The quantity of raw water is 90m^3/hr. It is supplied to demineralized water supply system, each equipment in the mill complex and cooling tower, and some of the raw water is used as potable water. The waste water is generated at weak acid waste water treatment system and at weak alkali waste water treatment system, and is drained through pipe to outside the mill complex. In addition, the sludge is also generated at the said water treatment systems, and taken away from the mill complex by trucks.

(3) Basic idea of planning facilities

1) Industrial water supply system

The quality of raw water is satisfactory. As the value of SS is equivalent to that of filtered water, namely less than 1 mg/litter, there is no need to have the treatment of SS such as sedimentation and filtering.

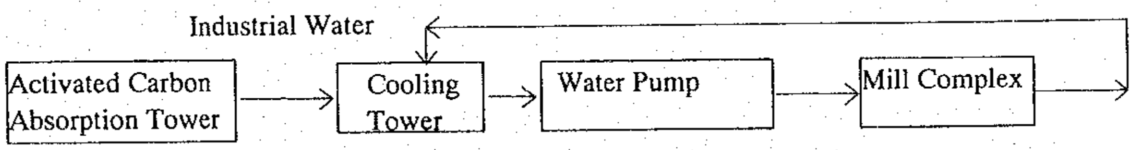
However, the residual chlorine is equivalent to that of drinking water, namely 0.8 mg/litter, which may possibly cause the corrosion of pipe and equipment. Accordingly, elimination of chlorine is taken into consideration by activated carbon absorption. The process of chlorine elimination is shown below. Activated carbon is to be changed every year and there is no recovery of the used carbon.



Activated carbon absorption tower : The residual chlorine is eliminated by activated carbon absorption.
With regard to piping route of industrial water, refer to Fig.V-2-10.

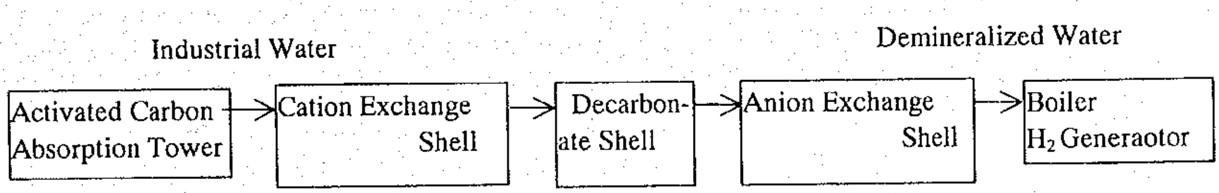
2) Machinery cooling water system

This water is circulated between equipment and cooling tower through water pump. The water temperature is to be maintained between 35℃ and 45℃. As the quantity of water is decreased by evaporation from the cooling tower, the industrial water is to be added.



With regard to piping route of machinery cooling water, refer to V-2-11.

3) Demineralized water supply system
Demineralized water supply system with two beds and three towers is to be installed. The process of producing demineralized water is shown below. Resin-regenerated waste water is to be treated at the weak acid waste water treatment system.

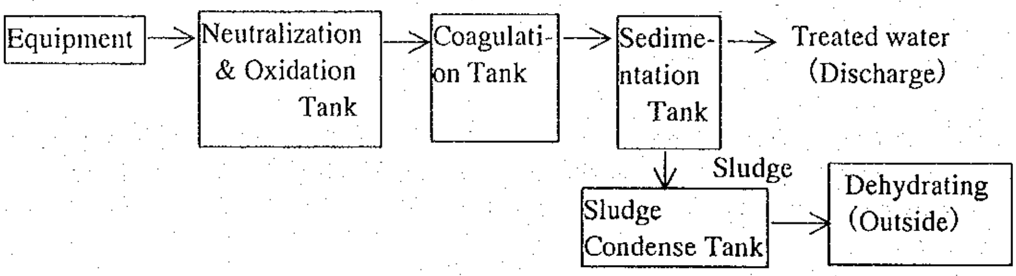


Cation Exchange Shell : Cation such as Ca^+ and Mg^+ is eliminated by cation exchange resin.
Decarbonate Shell : HCO_3^- is eliminated by aeration.
Anion Exchange Shell : Anion such as SO_4^{2-}, NO_3^- and Cl^- is eliminated by anion exchange resin.

With regard to piping route of demineralized water, refer to Fig. V-2-12.

4) Weak acid waste water treatment system

As the waste water is mainly composed of $FeCl_2$, the water treatment of neutralization, oxidation, coagulation and sedimentation is to be installed. Dehydrated sludge is to be taken away from the mill complex by trucks. The process of treatment is shown below.

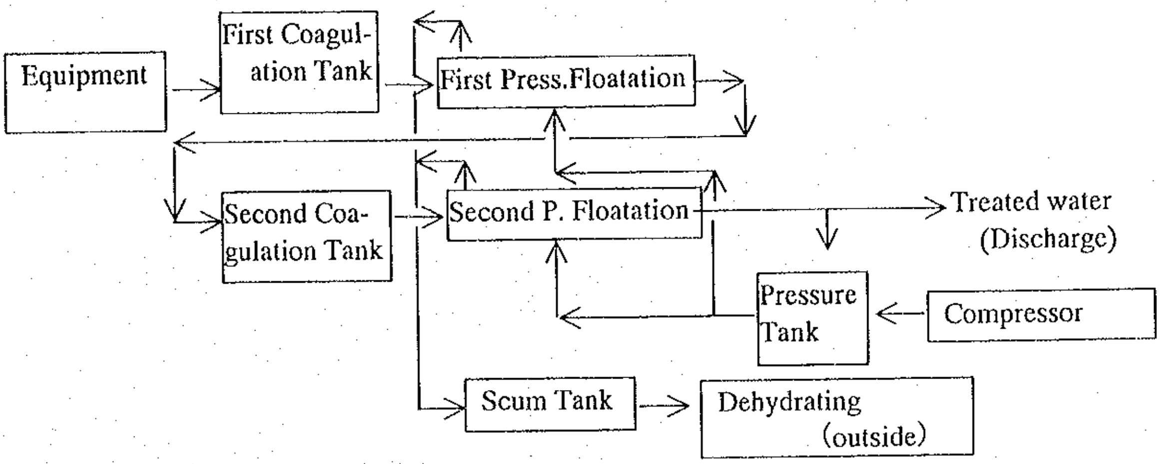


Neutralization and Oxidation Tank : Ferric hydroxide is sedimented and precipitated by neutralization by calcium hydroxide and oxidation by aeration.
Coagulation Tank : Particles precipitated by coagulants are combined together to become coarse particle.
Sedimentation Tank : the above coarse particles are to be separated from water by natural sedimentation.
Condense Tank : The above sedimented sludge is further condensed.
Dehydrating : The sludge is made solid by filter press.

With regard to piping route of acid waste water, refer to Fig. V-2-13.

5) Weak alkali waste water and oily waste water treatment system

As this waste includes the impurity of small oil particles in the waste, the treatment of double pressure floatation process is to be installed. Dehydrated scum is taken away from the mill complex by trucks. The process is shown below.



Coagulation Tank :Oily particles precipitated by coagulants are combined together to become coarse particle.
Pressure Floatation Tank : The pressured water with dissolved compressed air is injected to the treated water under depressurized atmosphere, thus creating small bubbles. These bubbles are likely to attach the oil particles and take them away from the water.
Pressure Tank : The compressed air is dissolved into the water.
Scum Tank : Storage of scum
Dehydrator : the scum is made solid by decanter.

With regard to piping route of alkali and oily waste water, refer to Fig. V-2-14.

6) Others
   a) Fire hydrant is to be installed. With regard to piping route of fire hydrant water, refer to Fig. V-2-15.
   b) Sewage is to be installed. With regard to piping route of sewage, refer to Fig. V-2-16.
   c) Potable water and sanitary sewage is to be installed. With regard to piping route of potable water and sanitary sewage, refer to Fig. V-2-17.

(4) Main specifications of the equipment
1) Residual chlorine eliminator : Activated carbon absorption tower 45 m^3/hr × 2 systems
2) Circulated cooling unit : Water pump 325 m^3/hr×0.55MP×3 (1 stand-by)
   Cooling tower 650 m^3/hr×1 (325 m^3/cell×2)
3) Demineralized water supply system : 20 m^3/hr×1 (2 beds and 3 towers)
4) Weak acid waste water treatment system : 33 m^3/hr×1 (Coagulation and sedimentation type)
5) Weak alkali waste water and oily waste water treatment system : 29 m^3/hr×1 (Double pressure floatation process)

6) Piping

a) SGP 25～350 A : 7,900 m
b) STW 400～450 A : 300 m
c) STPG 80～250 A : 400 m
d) Lining pipe 80～250 A : 900 m
e) VP 25～200 A : 4,600 m
f) HP500～1000 A : 1,100 m

The Viet Nam Standard C which is to be applied to the new cold rolling mill complex is satisfied by the above equipment with the said specifications.