REHABILITATION PLAN
FOR
BLOOMING MILL OF HELWAN WORKS
E.I.S.C.O.
IN
THE ARAB REPUBLIC OF EGYPT

JUNE, 1979

JAPAN INTERNATIONAL COOPERATION AGENCY

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Preface

The Japan International Cooperation Agency (JICA) was entrusted by the Japanese Government with the duty of studying the planned rehabilitation for the blooming mill of Egyptian Iron and Steel Company (EISCO) in Helwan for the Government of the Arab Republic of Egypt.

With the cooperation of Japanese governmental organizations concerned and the Japan Iron and Steel Federation, JICA organized and sent a mission to Egypt for the on-site study of the EISCO blooming mill from March 15 to March 30, 1979. The Japanese mission was composed of three experts and headed by Yasuaki Shinohara, Manager, Equipment Department, Muroran Works, Nippon Steel Corporation. In Egypt, the survey team conducted a full inspection of the EISCO facility, held discussions with EISCO personnel, and obtained many items of data necessary for a clearer understanding of the problems EISCO faced. The results of careful analysis of the data obtained and extensive technical study as well as the on-site survey have been compiled into this final report.

We sincerely hope that our final report will benefit the prosperity of the Egyptian steel industry and, at the same time, further promote friendly relations between Egypt and Japan.

Finally, I wish to take this opportunity to express my hearty gratitude to the Government of the Arab Republic of Egypt and other authorities concerned for their kind cooperation and assistance extended to our survey team, without which the survey work could not have been carried out so successfully.

Shinsaku Hogen

President

Japan International
Cooperation Agency

Members of Japanese Survey Team

Mr. Yasuaki Shinohara	(Refractories)
Mr. Yoshiaki Kitamura	(Equipment)
Mr. Takashi Takeuchi	(Operation)

Members of Egyptian Technical Team

Head	Eng. Shatella	(Rolling mill)
Members	Eng. Moustafa	(Rolling mill)
	Eng. Taha	(Blooming mill)
	Eng. Wageeh	(Mechanical maintenance)
	Eng. Khattab	(Electric maintenance)
	Eng. Hegazy	(Refractories)
	Eng. Sallam	(Instrumentation)
	Eng. Oraby	(Purchasing)
	Eng. Fattah	(Coordination)

Itinerary of Japanese Survey Team for Rehabilitation of Blooming Mill of Egyptian Iron and Steel Company in Helwan, Egypt

March 16 - March 29, 1979

March 16 (Fri)	Arrival at Cairo
17 (Sat)	Courtesy call on Japanese Ambassador, JICA office, and Chairman of EISCO
18 (Sun)	Preliminary meeting with Egyptian counterparts Observation of blooming mill
19 (Mon)	Discussion with Egyptian counterparts (soaking pits) Survey of soaking pits
20 (Tue)	Same as above
21 (Wed)	Discussion with Egyptian counterparts (blooming mill) Survey of blooming mill
22 (Thu)	Same as above
23 (Fri)	Team meeting
24 (Sat)	Selection of drawings
25 (Sun)	Selection of drawings
26 (Mon)	Preparation of interim report
27 (Tue)	Presentation and explanation of interim report
28 (Wed)	Meeting with JICA and Japanese embassy staffers General observation of Helwan Works
29 (Thu)	Departure from Cairo

CONTENTS

1. GENERAL

1. General

1.1 General

This rehabilitation plan covers the blooming mill of EISCO in HELWAN, Egypt. The blooming mill went into operation in 1954.

Because of its severe obsolescence for the recent years, the blooming mill has been unable to achieve production targets and has become the bottleneck at the Demag Plant. The recent production result of the blooming mill of EISCO is shown in Fig. 1-1.

Five JICA's experts are rendering operational assistance to this blooming mill also since October, 1978.

Through operational assistance, the restoration of the production is anticipated only up to 12,000 T/M in comparison with the scheduled production, 16,000 T/M.

Therefore, the rehabilitation of soaking pits and blooming mill is essential to restore the scheduled production of 16,000 T/M. This rehabilitation plan for the blooming mill is based on the above mentioned point.

Since the plan has been prepared within a short period time from limited data, EISCO should make careful technical study, particularly as regards the building and equipment foundations. The blooming mill plant will regress into the present poor condition unless maintenance is properly performed after this rehabilitation.

1.2 Prerequisites

(1) Prerequisites for production

After consultation with EISCO, production is set at 193,200 t/y on an ingot basis. This production figure includes 30,000 t/y of cold ingots from the LD converter plant in accordance with the present circumstance.

(2) Prerequisites for equipment rehabilitation

Equipment renewal due to obsolescence is mainly aimed at restoring the blooming mill into the original condition. Those pieces of existing equipment which are not operating satisfactorily will be modified by changing their specifications. The rehabilitation plan includes increase in the capacity of the soaking pit cranes, relocation of soaking pit pressure control dampers for Nos. 1 to 6 soaking pits and resultant change in the flues of these soaking pits, and replacement of some AC motors by DC motors.

1.3 Scope of rehabilitation plan

The scope of the rehabilitation plan is as follows:

(1) Soaking pits (including soaking pit cranes)

(2) Blooming mill and auxiliaries

(3) Roller Tables

(4) Electrical equipment (including communication system)

(5) Auxiliary equipment (centralized grease equipment)

(6) Civil and building works

The building work does not include reinforcement of the soaking bay building (except replacement of the crane runway girders), and modification of the column foundations. The civil work does not cover pile driving because detailed design calculation sheets, foundation drawings, design conditions and other applicable data are not available.

1.4 Conclusion

The results of study on the rehabilitation plan of the blooming mill of EISCO are summarized as follows:

(1) When rehabilitated as proposed by the present plan, the blooming mill of EISCO will be able to process 16,800 t/month of ingots against the present capacity of about 10,000 t/month.

(2) The 140 x 140 size blooms intended for the light-section mill, which account for approximately 60%of production shall be continuously cast as far as possible. Or ingots shall be first rolled into large-section semifinished products at the blooming mill and then shall be reduced into billets of the 140 x 140 size at the heavy-section mill.

(3) This rehabilitation plan needs a total investment of about 2,932 million yen (13.34 Mill. U.S.$) on a Japanese basis. About 290 million yen (1.32 Mill. U.S.$) shall be additionally required as consulting fees for detailed engineering, construction, etc.

(4) Introduction of startup technical assistance from a steelmaker of a developed country seems necessary to improve EISCO's technical levels in parallel with the rehabilitation plan. This startup technical assistance shall have to be provided by two engineers for six months after the startup of the rehabilitated blooming mill.

A cost of about 37 million yen (0.17 Mill. U.S.$) shall be additionally needed for this purpose.

(5) Rehabilitation of the manipulator and working roller tables takes the longest period of time, probably about four and a half months at site on a Japanese basis.

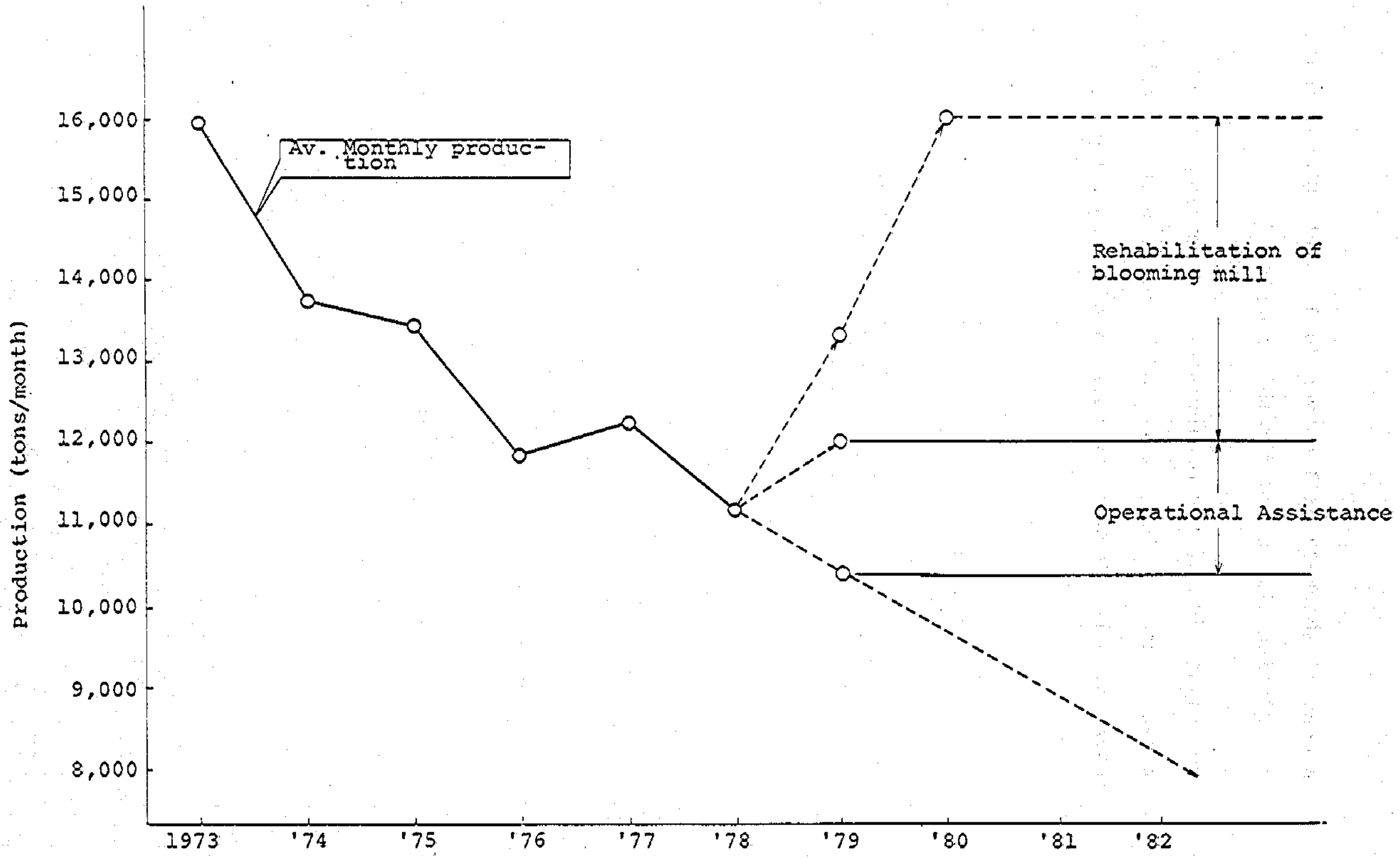


Fig. 1-1. Average monthly production of the blooming mill of EISCO

2. PREREQUISITES FOR EQUIPMENT REHABILITATION PLAN

2. Prerequisites for equipment rehabilitation plan

2.1 Production plan

This production plan has been worked out by consultation between EISCO and the Survey team. Ingot sizes are the same as the two mould types of K33 and K40 presently used and are shown in Table 2-1.

The production plan for each of the three steelmaking plants is determined as follows.

The production plan for the Thomas converter plant upon completion of Operational assistance is 9,600 x 12 t/y.

The production plan for the electric furnace plant upon completion of Operational assistance is 4,000 x 12 t/y.

Although no ingots should come to the blooming mill from the LD converter plant according to the original plant design, 3,000 t/month of cold ingots are now supplied to the blooming mill. Thus, the production plan for the LD converter plant is supposed 2,500 x 12 t/y.

Therefore, the total production plan is 16,100 x 12 t/y on an ingot basis.

The production plan by ingot size is based on the 1978 production results of the two ingot sizes.

The production flow sheet is shown in Fig. 2-1, and the production plan is given in Table 2-2.

The yields shown in Table 2-2 are the present values.

Table 2-1. Ingot sizes

Mould	Ingot size			Weight (t)
	Top (mm)	Bottom (mm)	Height (mm)	
K33	445 x 445	510 x 510	2,150	3.0
K40	445 x 565	510 x 630	2,150	4.0

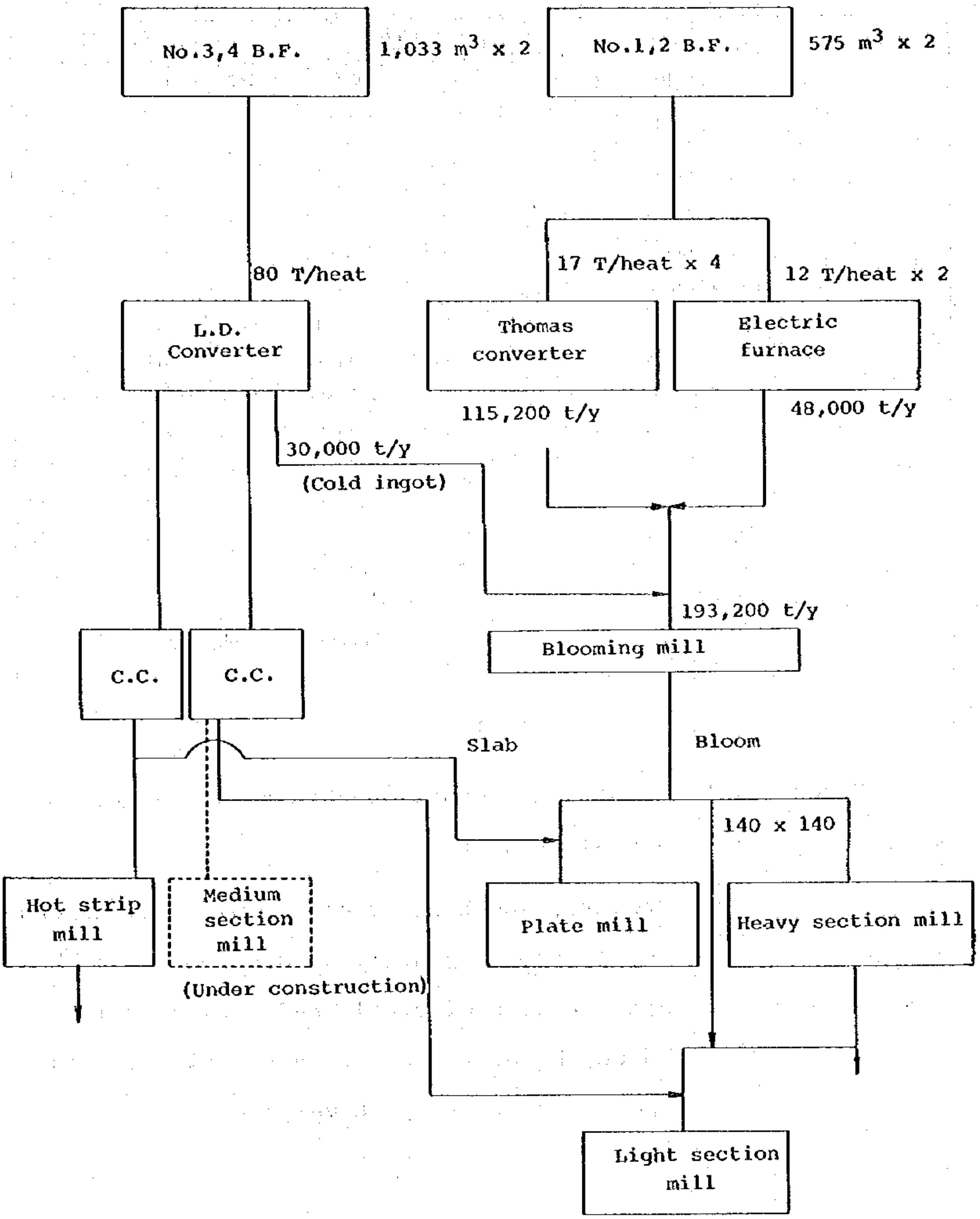


Fig.2-1. Production flow sheet

Table 2-2. Production plan

	Mould name	Bloom and Slab dimensions (mm) x (mm) x (mm)	Ingot		Yield (%)	Product	
			Ratio (%)	Quantity (t/y)		Ratio (%)	Quantity (t/y)
Bloom	K33	140 x 140 x (1,800~2,200)	57.6	111,250	80	58.0	89,000
	K33 or K40	140 x 200 x (4,000~4,500)	2.6	4,990		2.6	3,990
	"	140 x 240 x "	8.4	16,300		8.5	13,040
	"	140 x 260 x "	13.4	25,900		13.5	20,720
	"	140 x 280 x "	3.6	6,900		3.6	5,520
	"	150 x 190 x "	-	-		-	-
	"	180 x 340 x "	0.8	1,540		0.8	1,230
	"	200 x 360 x "	2.2	4,220		2.2	3,380
		(Subtotal)	(88.6)	(171,100)	(80)	(89.2)	(136,880)
Slab	K40	120 x 450 x (1,100~1,350)	4.3	8,380	75	4.1	6,290
	"	140 x 450 x "	3.6	6,960		3.4	5,220
	"	150 x 450 x "	0.9	1,640		0.8	1,230
	"	170 x 450 x "	2.6	5,120		2.5	3,840
		(Subtotal)	(11.4)	(22,100)	(75)	(10.8)	(16,580)
Total			100	193,200	79.4	100	153,460

Notes: (1) Ingot and product quantities are values of annual production.

(2) Properly speaking, yield should vary depending on specific steel grades. Because the distribution of steel grades by size is not known, however, the present yields of blooms and slabs are respectively shown.

2.2 Operating conditions

The workable time of the EISCO blooming mill is calculated by assuming four 10-hr periods of ordinary maintenance per month and one 15-day period of major maintenance per year. Operating conditions of the blooming mill are as shown in Table 2-3.

Table 2-3. Operating conditions

Item		h/y	Remarks
Calendar time (A)		8,760	24 h x 365 d
Scheduled shut down	Annual maintenance	360	24 h x 15 d
	Ordinary maintenance	460	10 h x 4 times/month x 11.5 month/y
	Inspection and adjustment	240	
(Subtotal) (B)		(1,060)	
Workable time (C)		7,700	(A) - (B)
Failure waiting time (D)		2,040	
Rolling time (E)		3,652	
Working ratio (%)		47.4	(E)/(C) x 100%

(1) Calendar time

Calendar time is 365 days per year.

(2) Annual maintenance

Major maintenance will be conducted, once per year, mainly on rolling equipment.

This annual maintenance usually covers seven to ten days in Japan, but is planned to last 15 days in case of the blooming mill of EISCO.

(3) Ordinary maintenance

By considering the present situations of the blooming mill of EISCO, ordinary maintenance will be performed four times per month and last 10 hours per time.

(4) Inspection and adjustment

Fifteen minutes will be usually spent per shift to inspect and adjust the rolls of the blooming mill.

This time of roll inspection and adjustment must be deducted from the periods of ordinary and annual maintenance because roll inspection and adjustment are included in the ordinary and annual maintenance.

Therefore, the time required for roll inspection and adjustment becomes as follows:

Time required per year = [(365 - 15) d/y x 3 shifts/d -
11.5 months/y x 4 times/month x
2 shifts/time] x 0.25 h/shift
= 240 h/y

(5) Roll change

Only one type of roll is used at the blooming mill of EISCO, and the rolls are estimated to last 30,000 to 40,000 tons of ingot rolling before change and are considered to be changed only due to their wear in normal use. Therefore, the rolls are to be changed once or twice for two months.

Thus, the time for roll change is included in the period of ordinary maintenance.

(6) Failure wating time

The following items are included in the failure waiting time;

a) the stoppage time due to failure of the blooming mill and its auxiliaries,

b) the waiting time for handling a slab or bloom with a claw crane,

c) the waiting time for soaking during which ingots are not heated to the desired temperature within the specified time in a soaking pit.

The operating results of the blooming mill at Nippon Steel's Muroran works are given in Table 2-4 for reference. The operating results of the blooming mill of EISCO are shown in Table 2-5.

This failure waiting time is set at 2,040 h/y.

The stoppage time for failure is estimated at 50% of the past data of the blooming mill of EISCO, taking into consideration that of the MURORAN blooming mill which is similar to the EISCO mill, and by assuming implementation of thorough maintenance by EISCO.

Waiting time for ingot soaking is estimated at 50% of the past data of EISCO by taking into account the improved working ratio of the soaking pit and blooming mill line.

(7) Rolling time

Rolling time depends on types of ingots and size of slabs and blooms.

When calculated from the production plan shown in Table 2-2 and from the average rolling capacity of 52.9 t/h described later in Item 3.2, necessary rolling time becomes about 3,650 h. This value is slightly small as the working ratio of a blooming mill and feasible enough for the blooming mill of EISCO.

With 15-day annual maintenance planned, the number of workable months becomes about 11.5 months.

Thus, monthly rolling time is:

$$\text{Monthly rolling time} = \frac{3,650}{11.5} \fallingdotseq 320 \text{ h/month}$$

Table 2-4. Operating results of the blooming mill of Muroran

Item	1976			1977
	Oct.	Nov.	Dec.	Jan.
Calendar (h)	744.00	720.00	744.00	744.00
Ordinary maintenance (h)	91.60	24.23	31.73	44.00
Workable time (h)	652.40	659.77	712.27	700.00
Failure waiting time (h)				
Mechanical failure	26.33	33.30	53.60	40.85
Electrical failure	0.98	4.78	4.12	1.48
Wait for soaking	15.58	9.27	40.27	51.49
Wait for charging	1.70	1.50	1.98	1.70
Power failure	0.00	0.00	0.00	0.00
Utility	0.00	0.00	0.00	0.00
Misoperation	0.00	0.00	0.00	0.00
Inspection	13.13	13.47	13.98	12.40
Roll change	37.27	28.58	35.32	39.38
Other	6.43	1.13	1.67	1.87
Total	101.42	92.03	150.94	149.17
Actual rolling time (h)	550.98	603.74	561.33	550.83
Working ratio (%)	84.5	86.8	78.8	78.7
Production (ton)	111,527	131,271	125,320	119,565
Rolling capacity (t/h)	202.4	217.4	223.3	217.1

Notes; Operating results during nearly full production are given here to indicate failure data.

Bloom cross section: 65, 80, 100, 120 and 150 mm square

Ingot weight: 5.45 and 8.0 t

Table 2-5. Operating results of the blooming mill of EISCO

Item	1978		
	Sep.	Oct.	Nov.
Calendar time (h)	720.00	744.00	720.00
Ordinary maintenance (h)	44.00	42.40	48.15
Workable time (h)	676.00	701.60	671.85
Failure wating time (h)			
Mechanical failure	57.30	72.45	47.45
Electrical failure	36.48	73.20	56.20
Wait for soaking	128.30	147.35	242.45
Wait for charging	37.26	33.40	23.25
Power failure	56.20	20.25	1.00
Utility	28.15	4.30	26.20
Misoperation	11.20	17.25	20.00
Total	354.81	368.20	416.55
Actual rolling time (h)	321.19	333.40	255.30
Working ratio (%)	47.5	47.5	38.0
Production (ton)	9,086	9,404	7,265

2.3 Unit consumption of materials and utilities

The present plan assumes no changes in requirements for utilities, such as fuel, water, compressed air and electricity, because it is mainly aimed at equipment rehabilitation.

Bottom-making material must be used in the soaking pits. If fine coke is used as bottom-making material, for example, its consumption becomes as shown in Table 2-6.

Table 2-6. Fine coke consumption

	Unit consumpiton (kg/ingot-t)	Annual consumption (t/y)
Fine coke	3.0	580

3. STUDY OF BLOOMING MILL CAPACITY

3. Study of blooming mill capacity

3.1 Soaking pits

Formulas developed by the Iron and Steel Institute of Japan are used for calculating the capacity of soaking pits in Japan.

The formulas are as follows:

$$P_h = \frac{1}{24} \times \frac{24 - (Tb+Te)}{T_p+T_o+T_c+T_d} \times \overline{W_t} \qquad (t/h\cdot pit)$$

$$T_p = C_1 \times \frac{(\overline{W_t})^{0.8} \times (\overline{TT})^{0.62}}{(Q_p)^{0.50}} + C_2 \qquad (t/pit\cdot cycle)$$

$$T_c = \frac{\overline{W_t}}{W} \times tu \qquad (t/pit\cdot cycle)$$

$$T_d = \frac{\overline{W_t}}{P_r} \qquad (t/pit\cdot cycle)$$

where P_h : Capacity of soaking pit per pit t/h·pit

T_p : Heating time h/pit·cycle

T_o : Over-soaking time h/pit·cycle

T_c : Ingot charging time h/pit·cycle

T_d : Ingot discharging time h/pit·cycle

T_b : Bottom-making time h/d

T_e : Idle time of soaking pit h/d

W_t : Total weight of ingots to be charged t/pit·cycle

TT : Track time h

Q_p : Maximum heat input 10^4 Kcal/h

tu : Time required to charge one ingot h/ingot

P_r : Rolling capacity t/h

C_1, C_2, T_b, T_e, T_o : Coefficients (Refer to Table 3-1)

Table 3-1. Coefficients for formulas

Steel grade	C_1	C_2	T_b (h/d)	T_e (h/d)	T_o (h/pit·cycle)
Killed steel	0.52	4.62	0.15	3.00	1.00
Semikilled, rimmed steel	0.71	2.85	0.15	3.00	1.00

3.1.1 Charging conditions

Ingots made from one heat of steelmaking furnaces are usually charged into a single soaking pit. Since the holding capacity of one soaking pit does not match the heat size of steelmaking furnaces at EISCO, the present charging methods are employed as follows:

(1) Hot ingots

Two heats charging

Ingots made from two Thomas-converter heats = 34 t/pit,
or ingots made from two electric-furnace heats
= 24 t/pit

Three heats charging

Ingots made from two Thomas-converter heats
and one electric-furnace heat = 45 t/pit

(2) Cold ingots

K33 : 12 ingots x 3 t/ingot = 36 t/pit
or K40: 10 ingots x 4 t/ingot = 40 t/pit

3.1.2 Type of ingots and steel grade

Table 3-2 shows the distribution of steel grades and types of ingots as calculated from the production of the three steelmaking plants.

Table 3-2. Distribution of steel grades and types of ingots

Steel-making plant	Ratio (%)	Type of ingot (%)		K33 (%)			K40 (%)		
		K33	K40	R.SK	K	Cold	R.SK	K	Cold
Thomas	60	100		60					
E. f'ce	25	10	90	2.5			20.8	1.7	
LD	15	50	50			7.5			7.5
TOTAL	100	70	30	70			30		

Notes; R : Rimmed steel
SK : Semikilled steel
K : Killed steel
Cold: Cold ingot

3.1.3 Track time

Track time is indicated by the time interval between the end of teeming liquid steel into moulds and the end of charging ingots into a soaking pit.

Track time is as shown in Table 3-3.

Table 3-3. Track time

End of teeming	
Time for solidification	Rimmed and semikilled steel: 25 min killed steel: 90 min
Waiting for stripping	4 min
Stripping	2 min x N ingots
Loading	1.5 min x N ingots
Waiting for transportation	8 min
Transportation	15 min $\frac{1.5\ \mathrm{km}}{5\ \mathrm{km/h}} = 0.2\ \mathrm{h} \simeq 15\ \mathrm{min}$
Waiting for charging	10 min
Charging	1.5 min x N ingots

Notes: (a) N is the number of ingots.

(b) Waiting time is based on the Nippon Steel

Taking into consideration waiting time for tapping, track time is set as Table 3-4.

Table 3-4. Track time

Plant	T	E	LD	LD	T+E
Steel grade	R.SK	K	Cold	Cold	R.SK
Type of ingot	K33	K40	K33	K40	(K33)
Charged quantity (t)	34	24	36	40	45
Track time (h)	2.78	4,37	-	-	2.98

Notes; T : Thomas converter

E : Electric furnace

LD : LD converter

3.1.4 Results of calculation

When calculated using the formulas given in Item 3.1, soaking-pit capacity becomes as shown in Table 3-5.

Table 3-5. Results of calculation

Plant	T	E	LD	LD	T+E
Steel grade	R,SK	K	Cold	Cold	R,SK
Type of ingot	K33	K40	K33	K40	K33
Charged quantity (t)	34	24	36	40	45
Capacity (t/h)	39.7	19.9	25.1	27.8	47.2
Ratio (%)	13.4	1.7	7.5	7.5	69.9

Notes: (a) Pr (rolling capacity) is 52.9 t/h as described later.

(b) Capacity is the total of 8 soaking pits.

The average capacity of soaking pits which accounts for distribution of steel grades becomes as follows:

$$\text{Average soaking-pit capacity} = \frac{1}{\frac{0.134}{39.7} + \frac{0.017}{19.9} + \frac{0.075}{25.1} + \frac{0.075}{27.8} + \frac{0.699}{47.2}}$$

$$= 40.4 \text{ t/h}$$

Since ordinary soaking pits can be made available for 7,000 h/y of ingot soaking, capacity of soaking pits becomes approximately 283,000 t/y.

3.2 Blooming mill

3.2.1 Rolling capacity of blooming mill

The rolling capacity by product size of blooming mill is calculated by the following formula:

Rolling capacity by product size (t/h)

$$= \frac{\text{Unit weight of ingot} \times 60 \times 60}{\text{Total rolling time(s)} + \text{Idle time (s)}}$$

This rolling capacity is calculated under the following conditions:

(1) The capacity is calculated from the EISCO pass schedules for three product sizes of 140 x 140, 140 x 200 and 140 x 450 mm with some modification.

These three pass schedules are shown in Table 3-6.

(2) The diameter of rolls is a maximum of 900 mm and a minimum of 810 mm at the roll collar, with the average being 860 mm.

The roll diameter used for calculations is the center diameter of caliber of each pass at the average roll diameter.

The shapes of roll calibers are shown in Fig. 3-1.

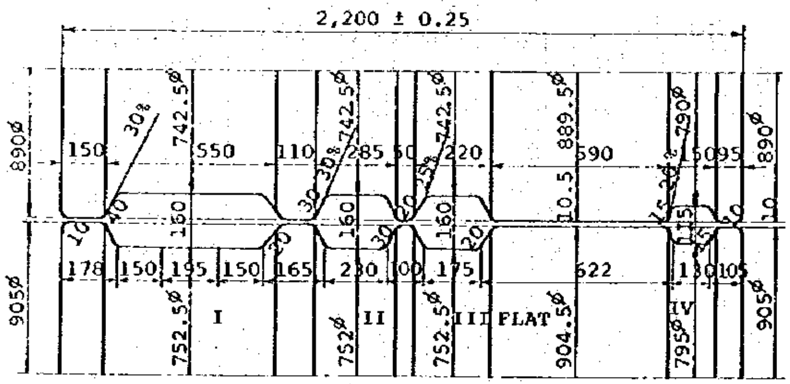


Fig. 3-1 Caliber Arrangement

Table 3-6. Typical pass schedules

Pass No.	K33 (3t) → 140x140		K40 (4t) → 140x200		K40 (4t) → 140x450	
	Caliber No.	Thickness x Width (mm) x (mm)	Caliber No.	Thickness x Width (mm) x (mm)	Caliber No.	Thickness x Width (mm) x (mm)
1	I	435 x 490	I	570 x 480	I	560 x 485
2		385 x 495 Ⓣ		520 x 510		510 X 510 Ⓣ
3		435 x 395		475 x 512		460 x 515
4		385 x 405		435 x 515 Ⓣ		410 x 520
5		340 x 415		460 x 440		365 x 525
6		300 x 425		410 x 445		320 x 530
7		260 x 435		360 x 450		275 x 535
8		225 x 440 Ⓣ		305 x 455		280 x 545 Ⓣ
9	II	400 x 230		260 x 460	II	500 x 235
10		345 x 235		225 x 470 Ⓣ		460 x 240 Ⓣ
11		290 x 245	II	410 x 230	FLAT	185 x 470
12		235 x 255 Ⓣ		355 x 240		135 x 480 Ⓣ
13		255 x 235		295 x 250	IV	450 x 140
14		180 x 250 Ⓣ		240 x 260 Ⓣ		
15	III	220 x 180		235 x 245		
16		175 x 180 Ⓣ		185 x 250 Ⓣ		
17		175 x 175	III	220 x 195		
18	FLAT	155 x 175 Ⓣ		200 x 200 Ⓣ		
19		155 x 160		175 x 200		
20		135 x 160 Ⓣ	FLAT	140 x 220 Ⓣ		
21	IV	140 x 140	IV	200 x 140		

Notes; Ⓣ denotes the turning of blooms and slabs

(3) The product size mixes for calculating the rolling capacity are summarized in Table 3-7 from Table 2-2 in Item 2.1.

Table 3-7. Product size mix for calculating rolling capacity

	Bloom & slab dimensions (mm)	Ingot ratio (%)	Remarks
Bloom	140 x 140	57.6	
	140 x 200	2.6	Represented by 140 x 200 size
	140 x 240	8.4	
	140 x 260	13.4	
	140 x 280	3.6	
	150 x 190	-	
	180 x 340	0.8	
	200 x 360	2.2	
	(Subtotal)	(88.6)	
Slab	120 x 450	4.3	Represented by 140 x 450 size
	140 x 450	3.6	
	150 x 450	0.9	
	170 x 450	2.6	
	(Subtotal)	(11.4)	

3.2.2 Results of calculation

When the elongation of slabs or blooms per pass and the total pass time are calculated from Table 3-6, the rolling capacity of the blooming mill becomes 44.6 t/h for the 140 x 140 size, 62.0 t/h for the 140 x 200 size, and 113.4 t/h for the 140 x 450 size.

From the product size mix shown in Table 3-7, the average rolling capacity becomes as follows:

$$\text{Average rolling capacity (t/h)} = \frac{1}{\frac{0.576}{44.6} + \frac{0.31}{62.0} + \frac{0.114}{113.4}}$$

$$= 52.9 \text{ t/h}$$

Table 3-8. Results of calcualtion

Ingot	K33	K40	K40
Slab & Bloom dmensions (mm)	140x140	140x200	140x450
Ingot weight (t)	3	4	4
Rolling time (s)	99.4	98.9	39.0
Idle time (s)	142.7	133.3	88.0
Total time (s)	242.1	232.3	127.0
Rolling capacity (t/h)	44.6	62.0	113.4

Since the time available for rolling is 5,660 hr (7,700 h/y - 2,040 h/y) per year as shown in Table 2-3 in Item 2.2, the annual rolling capacity of the blooming mill is 52.9 t/h x 5,660 h ≒ 300,000 t/y.

3.3 Soaking pit cranes

When ingots are carried by soaking pit crane to the ingot receiving table, the ingot discharging cycle's comes into question in relation to rolling capacity (t/h) of the blooming mill. Study is thus made here of discharging ingots from No. 7 soaking pit which is located farthest from the ingot receiving table. The results of study are given in Table 3-9.

Table 3-9. Results of calculation

Item	No. 7 soaking pit	
	Distance (m)	Time (sec)
Travelling with tongs lifting	45.0	37
Lowering	2.0	9
Gripping	-	5
Lifting	3.6	14
Traversing	9.0	16
Travelling with tongs traversing	45.0	37
Lowering and Releasing	-	10
Total		128

Notes: (a) Main specifications of soaking pit cranes are the same as those of the existing cranes.

(b) The starting point is the ingot receiving table.

According to Table 3-8 in Item 3.2, the rolling cycle time is 242 sec for the 140 x 140 size, 232 sec for the 140 x 200 size, and 127 sec for the 140 x 450 size.

If the existing soaking pit cranes are to be replaced by considering ingot discharging from No. 7 soaking pit, the travelling speed of the new cranes should be increased from 100 m/min to 120 m/min. When calculated from this higher crane travelling speed, the total discharging cycle time becomes about 122 sec from 128 sec.

3.4 Shearing

A formula developed by the Iron and Steel Institute of Japan is used for calculating the shearing capacity in Japan.

The formula is:

$$Psi = \overline{F}s \times C \times W/(1 + n_b/n_s + ni) \qquad (t/h)$$

where,

$\overline{F}s$: Maximum number of cuts per hour at normal stroke = 450 cuts/h

C : Coefficient = 0.9

W : Unit weight of ingot (t)

n_b : Number of products per unit weight of ingot

n_s : Number of pieces simultaneously cut per stroke = 1

n_i : Number of additional cuts for both ends = 4

(1) Product size and number of products per ingot

The relationship between the product size and the number of products per ingot is shown in Table 3-10.

Table 3-10. Relationship between the product size and the number of products per ingot

	Size (mm)	Total elongation (m)	No. of products per ingot (pieces)	The length of products (m)
Bloom	140 x 140	19.9	9.5	2.2 - 1.8 m; Average of 2.1 m
	140 x 200	18.3	4.6	4.5 - 4.0 m; Average of 4.0 m
	140 x 240	15.3	3.8	ditto
	140 x 260	14.1	3.5	ditto
	140 x 280	13.1	3.3	ditto
	150 x 190	18.0	4.5	ditto
	180 x 340	8.4	2.1	ditto
	200 x 360	7.1	1.8	ditto
Slab	120 x 450	9.5	7.9	1.35 - 1.1 m; Average of 1.2 m
	140 x 450	8.1	6.8	ditto
	150 x 450	7.6	6.3	ditto
	170 x 450	6.7	5.6	ditto

Notes: (a) K33 ingot is used as the basis for calculation for the 140 x 140 size.

(b) K40 ingots are used as the basis for calculation for all the other sizes.

(2) Results of calculation

The shearing capacity calculated by the above-mentioned formula is given in Table 3-11.

Table 3-11. Results of calculation

	Size (mm) x (mm)	Shearing capacity (t/h)	Rolling capacity (t/h)
Bloom	140 x 140	83.8	44.6
	140 x 200	168.8	62.0
	140 x 240	184.1	
	140 x 260	190.6	
	140 x 280	195.2	
	150 x 190	170.5	
	180 x 340	228.2	
	200 x 360	238.2	
Slab	120 x 450	125.6	113.4
	140 x 450	137.3	
	150 x 450	143.4	
	170 x 450	152.8	

The table shows that the shearing capacity is more than enough for the rolling capacity of the blooming mill.

4. EQUIPMENT REHABILITATION PLAN

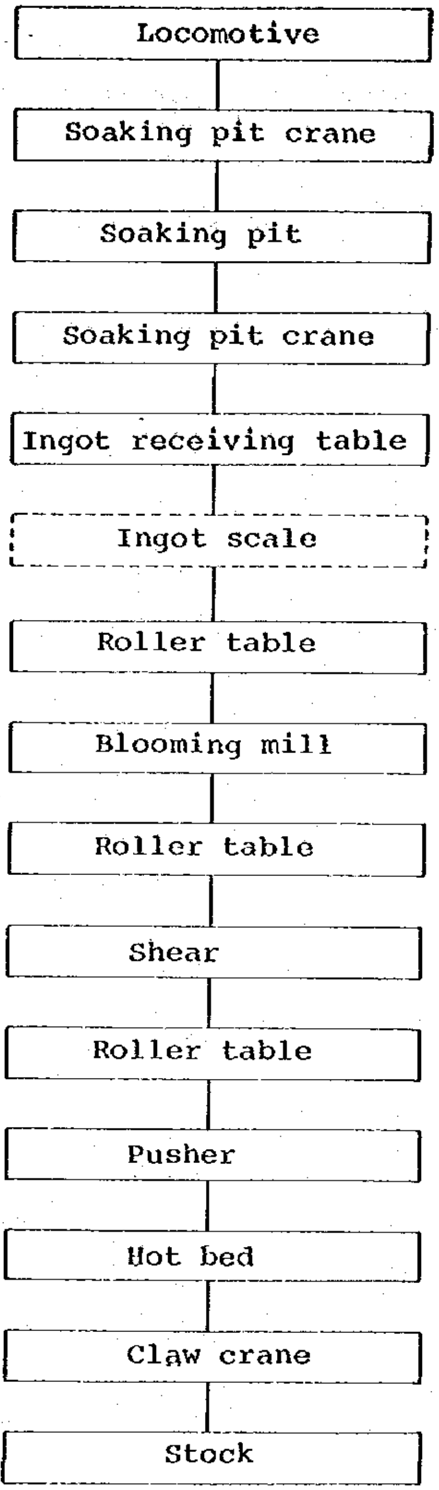
4. Equipment rehabilitation plan

4.1 Equipment flow diagram

Fig. 4-1. shows the equipment flow sheet and major items of equipment rehabilitation.

The rehabilitation plan for the blooming mill is shown in Dwg. No. RP-0001.

Remarks



Renewal of two cranes: Capacity 3t → 5t

Renewal and modification of 8 pits
(Flue, Stack, Refractories, Receuperator,

Damper, Pit cover, Cover crane, and
Instrumentation)

Renewal

Installation of 5-t ingot scale
(if necessary)

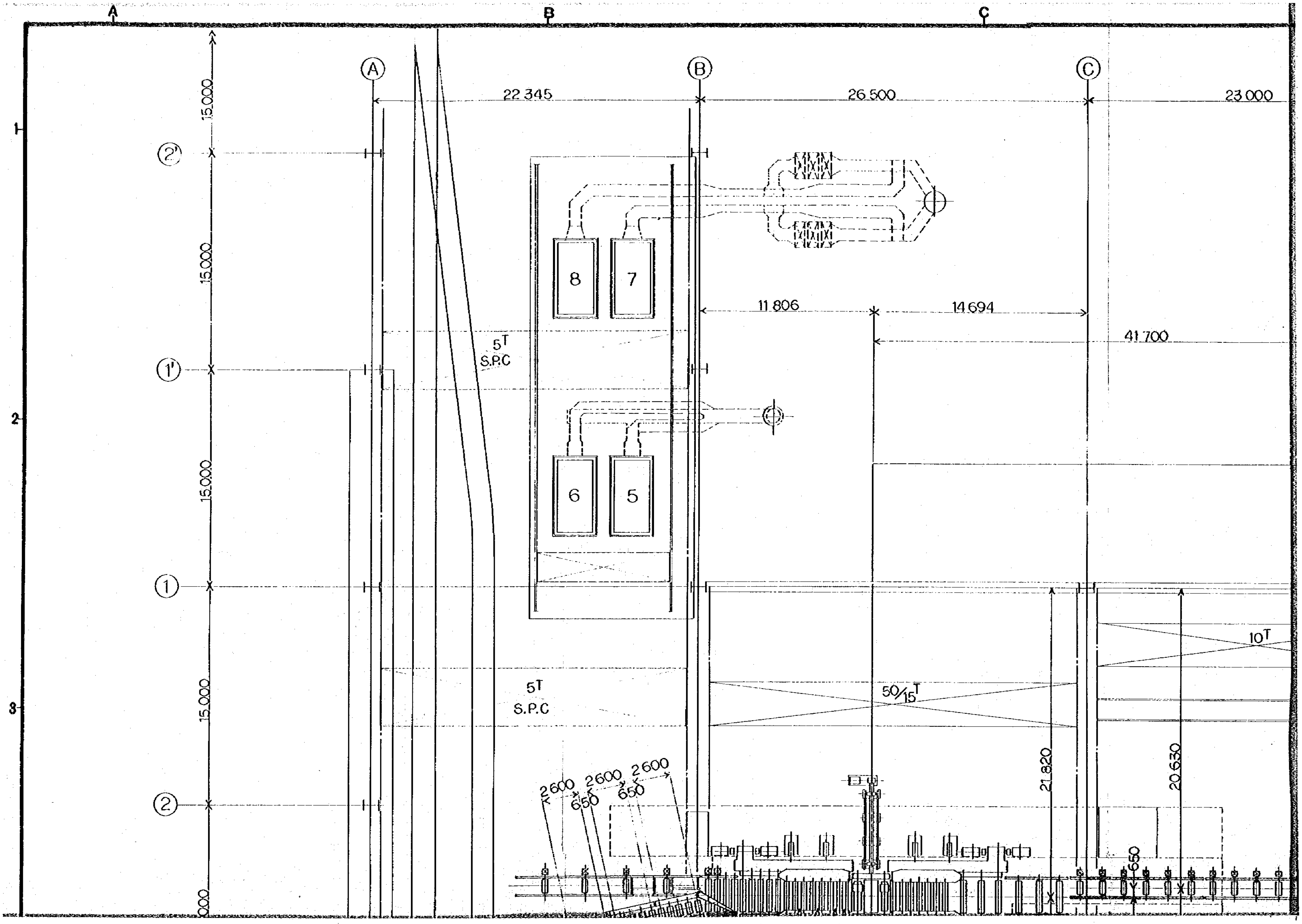
Renewal

Renewal (Manipulator, Screwdown motor,
Screwdown speed reducer, Electrical
equipment)

Renewal

Renewal

Fig. 4-1. Flow diagram and major rehabilitation


A
B
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11 806
14 694
41 700
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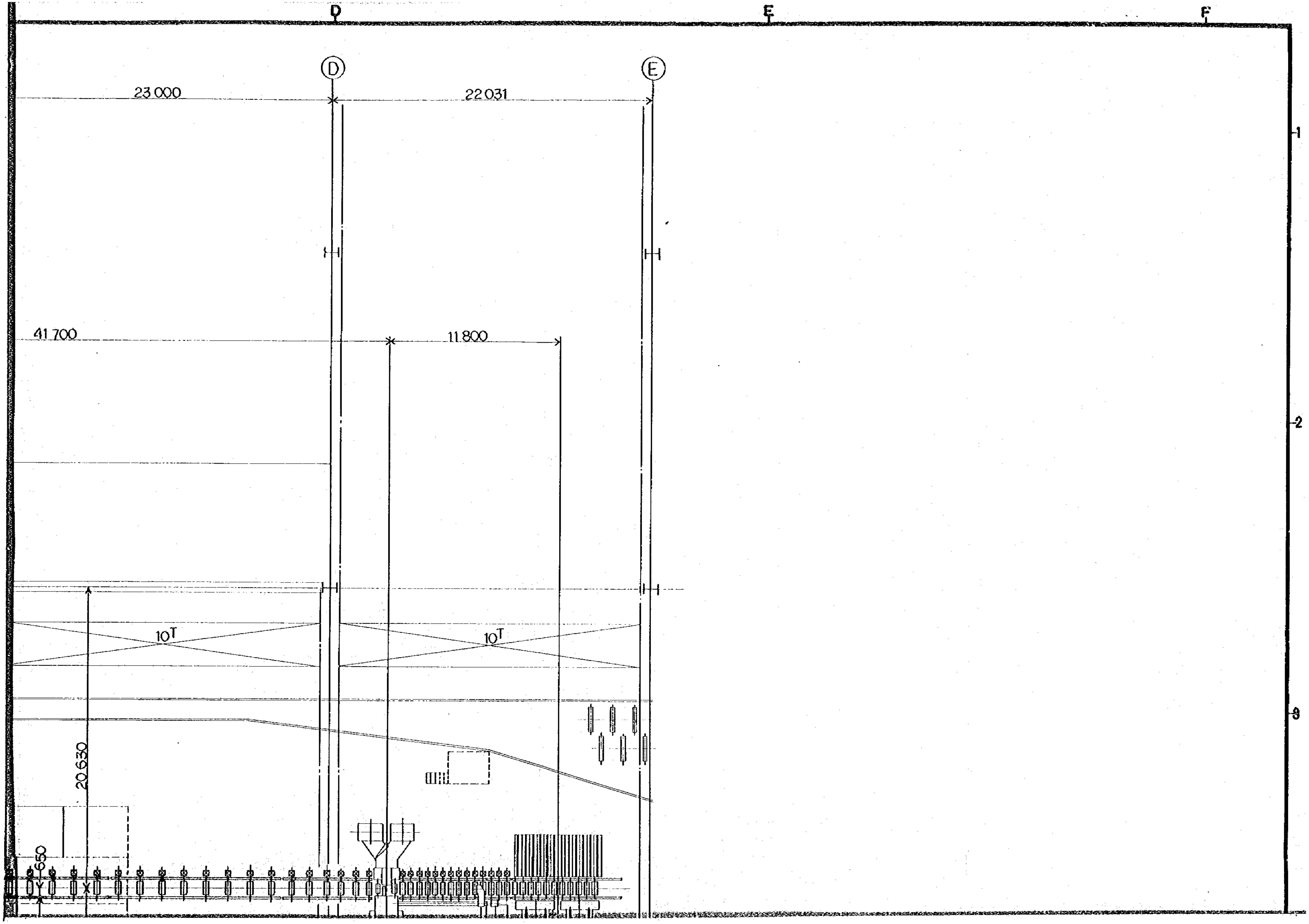
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11 800
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20 630
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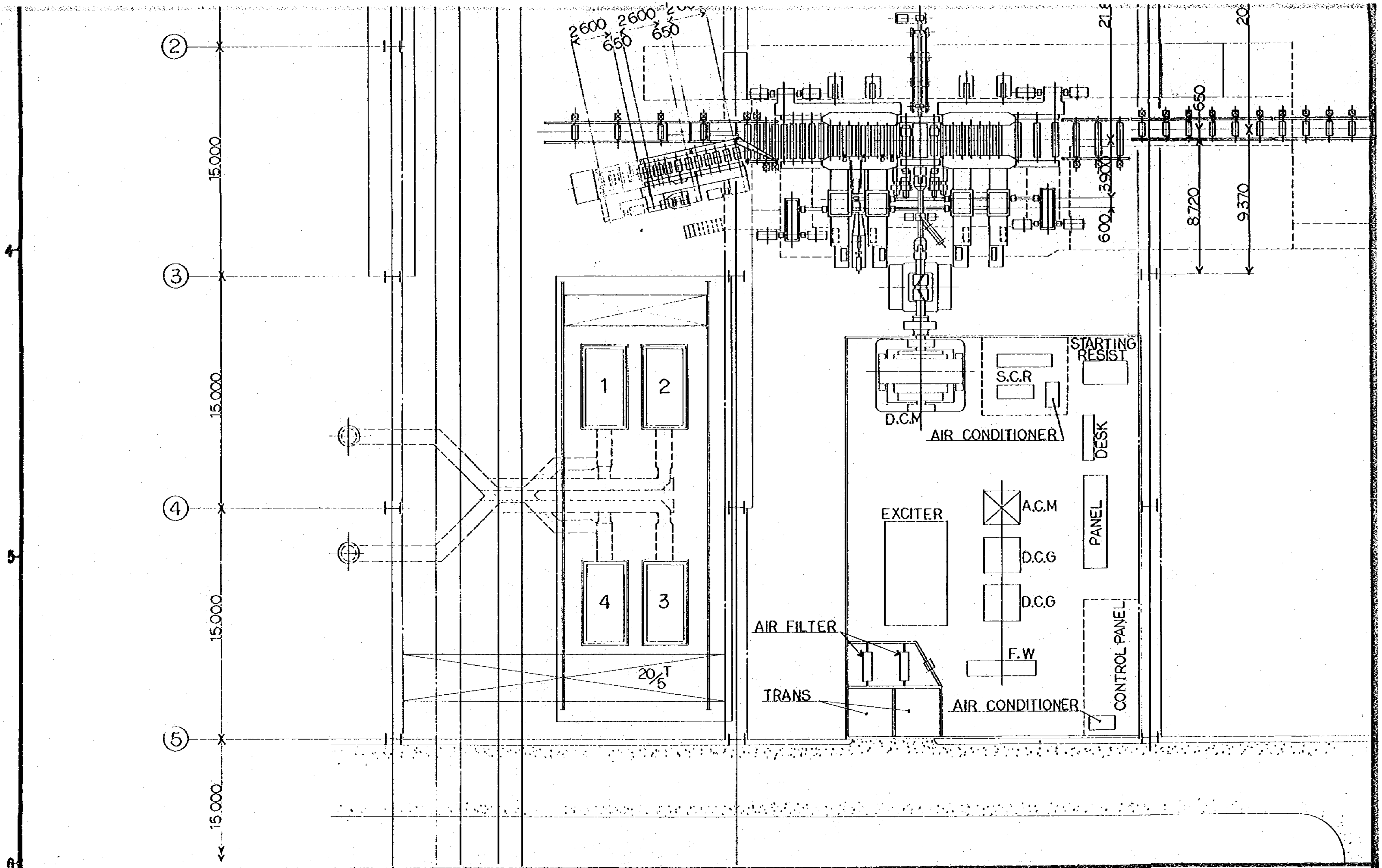

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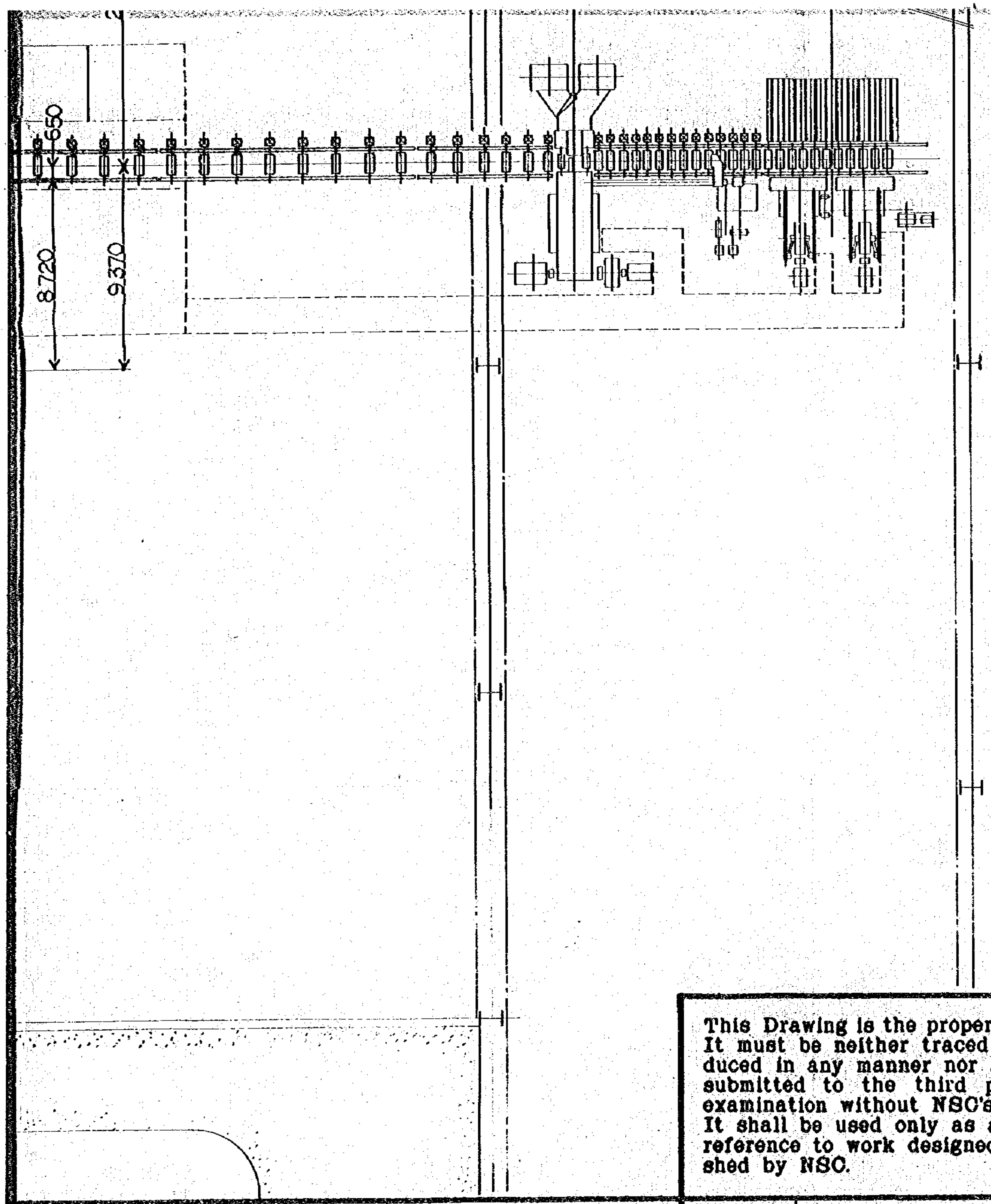

No.	MATERIAL	DIMENSION	QUANTITY	UNIT WEIGHT KG	TOTAL WEIGHT KG	NOTE

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NIPPON STEEL CORPORATION - NSC

CLIENT
EISCO

TITLE
BLOOMING MILL
REHABLITATION PLAN

	BY	DATE
DESIGNED		
DRAWN	T. Mouri	MAY. 79
CHECKED		
REVIEWED		
APPROVED		

SCALE 1/200
DATE MAY '79
DWG.No. RP-0001
REVISION

4.2 Soaking pit cranes

4.2.1 Present problems

The two cranes are time worn extremely and moreover, there is a big crack in the saddle, and this situation is considered very dangerous.

The designed gripping force is 3 tons, but the s.p. crane is used also for gripping 4 tons ingots.

4.2.2 Description of rehabilitation

The existing two soaking pit cranes shall be renewed. The designed gripping force shall be 5 tons to permit the use of the devices shown in Drawing No. RP-0002 in handling bottom-making material for the soaking pits and in removing cinder from the soaking pits. The designed travelling speed shall be changed to 120 m/min to speed up ingot transfer from Nos. 7 and 8 soaking pits.

4.2.3 Main specifications (common to two cranes)

Type	Overhead travelling and heavy-duty self-grabbing type
Gripping force	5 tons
Crane span	21,000 mm
Crane height	10,500 mm
Crane lift	6,500 mm (FL + 3,500 and FL - 3,000)
Width of crane rail	75 mm
Working speed	
Lifting	20 m/min
Traversing	50 m/min
Travelling	120 m/min
Revolving	5 rpm
Tongs control	4 times/min
Main power source	380 V, 50 Hz

An air-conditioning system shall be installed in the cab of each soaking pit crane.

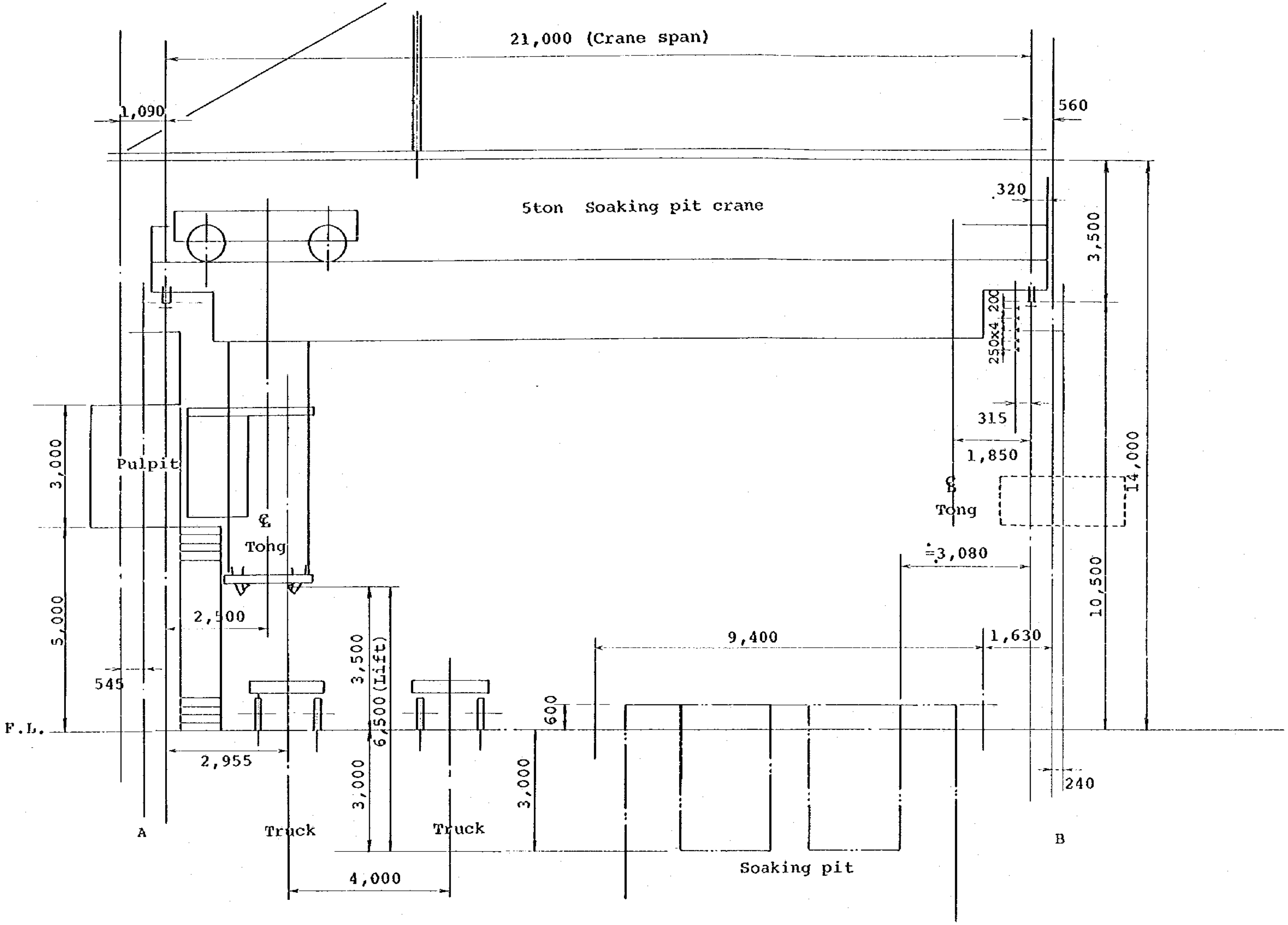
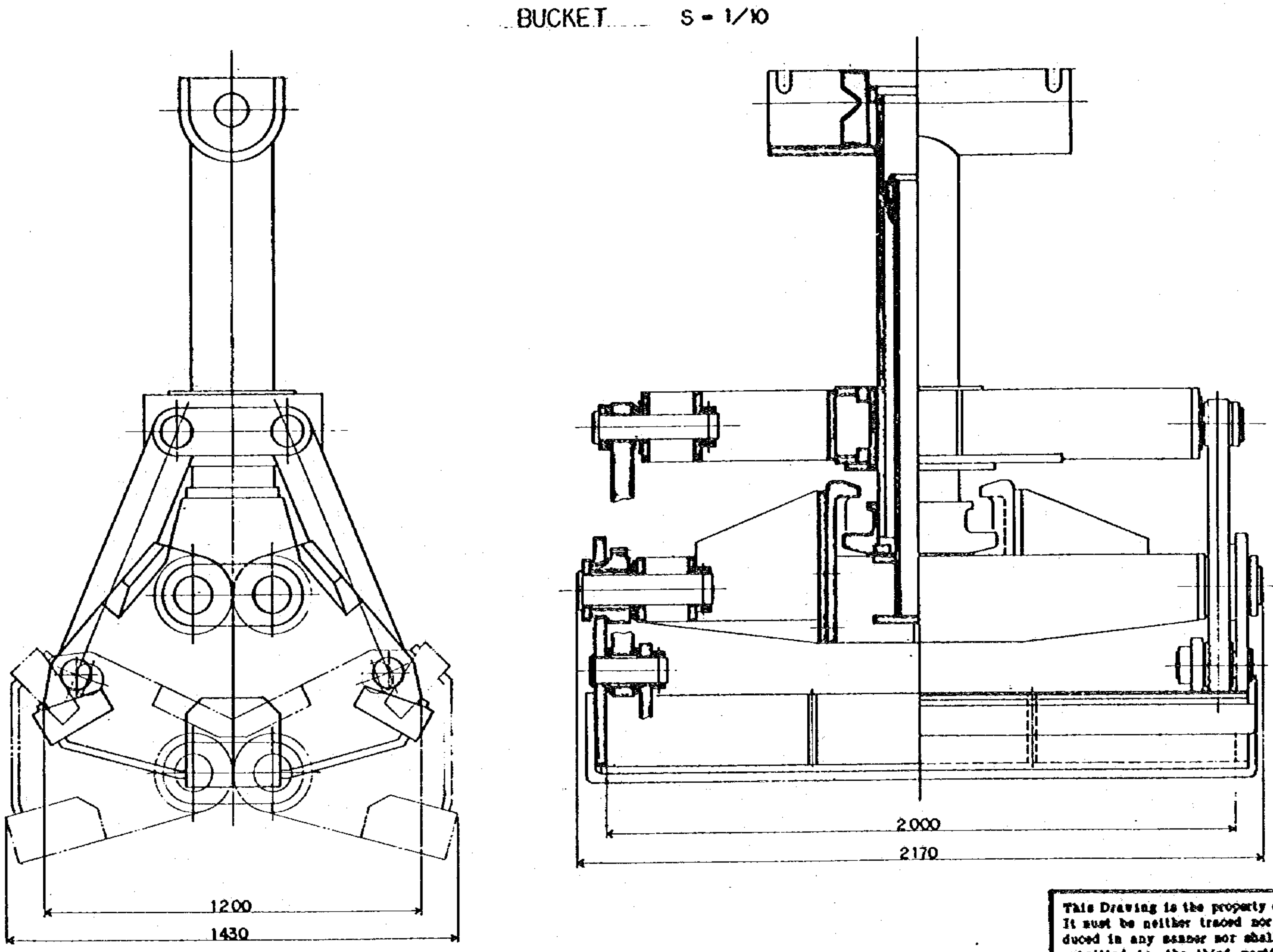
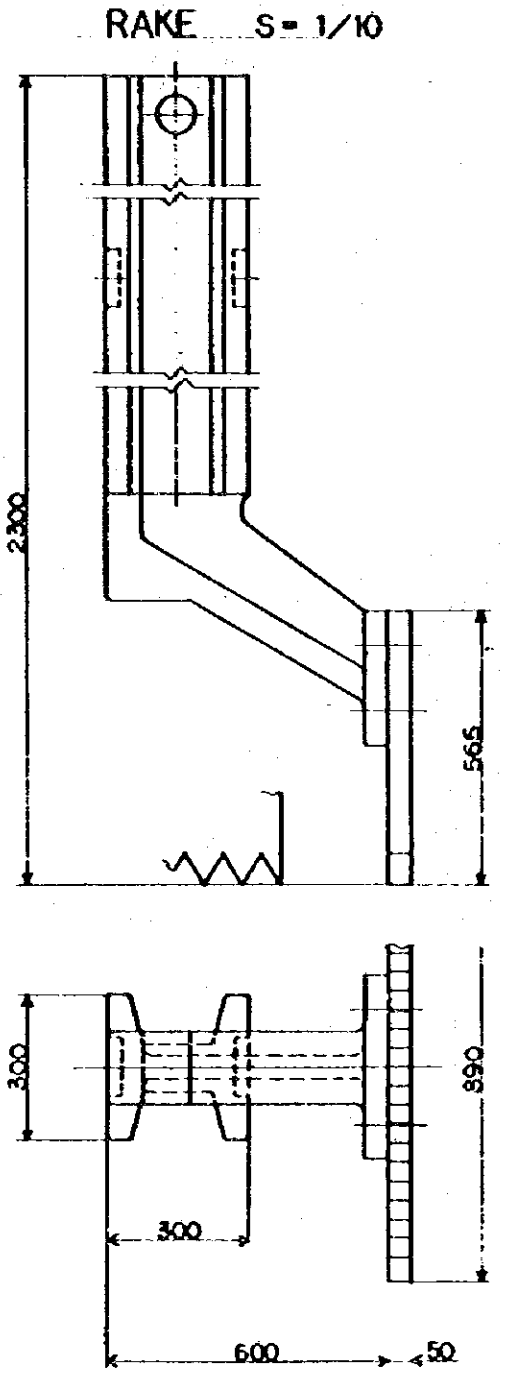


Fig.4-2. Soaking pit crane plan





No.	MATERIAL	DIMENSION	QUANTITY	UNIT WEIGHT	TOTAL WEIGHT	NOTE
				KG		

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NIPPON STEEL CORPORATION-NSC

CLIENT
EISCO

TITLE
SOAKING PIT
BUCKET & RAKE

	BY	DATE
DESIGNED		
DRAWN		
CHECKED		
REVIEWED		
APPROVED		

SCALE 1/10
DATE MAY '79
DWG No. RP-0002

REVISION

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