

5.5. Required fund

Of these required fund for sawmill facilities investment, those for machines and cubicle need foreign currency. Breakdown by domestic and foreign currencies is as follows.

Table 9. Breakdown by domestic and foreign currencies for sawmill facilities investment (US\$)

	A Plant		B Plant	
	Foreign C.	Domestic C.	Foreign C.	Domestic C.
Machines	299,320		114,450	
Cubicles	35,370		15,980	
Building and foundation		452,480		135,840
Total	787,170		266,270	

(US\$1 = Yen 220 = 7.82 ksh)

5.6. Operating plan of sawmill

The estimated profit and loss account of the sawmill is prepared based on the following assumption.

- (1) The sale price of sawn-wood, not considering the annual increase based on the rising percentage of commodity price, is assumed to rise from the fourth year 5% every year.
- (2) The recovery percentage of the product is assumed as follows.

1st year:	45%
2nd year:	55%
3rd year:	60%

This recovery rate, if sawmill equipments of the current plan are introduced, the percentage in Japan would be higher but considering the condition of Kenya, the percentage to this extent could be attained.

- (3) Of the log cost, the stumpage licence fee, considering the advice of the World Bank, is to rise 10% every year for 10 years and 8% from the 11th year. The present situation seems to be considerably low from the world standard.
- (4) The wage rate of sawmill and logging workers is to increase 8% annually. Apart from the general wage, the remuneration and salaries of the officers is to increase 8% from the fourth year.
- (5) Items of oil and maintenance are needed for felling and hauling of saw logs from the felling site to the mill. They include the fuel such as heavy oil, light oil and gasoline for hauling facilities as lorry and caterpillars and repairing of these facilities.

In the field, these items are counted in a lump as general expenses and they are hard to grasp in detail but from the view point of management, it is reasonable to list separately as direct expenses of materials.

For this reason, considering the field situation, 70% of stumpage licence fee is allotted to the fuel and repair expenses needed for log hauling.

- (6) The power expenses are the electric power for operation of sawmill machines. On reference to Prices for Electricity Supplies in Kenya (The East African Power and Lighting Co., Ltd.), the electric power charge is calculated as power expenses.
- (7) Maintenance cost and others are those for repairing machines and equipments and others in the sawmill which are equivalent to the power expenses.
- (8) General expenses are equivalent to general management and sales expenses of Japan but considering the classification of items in Kenya, such expenses are to double the personnel expenses as the officers' remuneration and salaries.
- (9) Profit and loss of outside business include interest to the loaned capital and miscellaneous profit and loss of outside business but for calculation, the invested money to each mill is divided into foreign and domestic money and the interest is 4% and 10% respectively and the sum is accounted.
- (10) Net profit is 70% of net income before tax.
(Remark: Estimated from the corporation tax of Japan.)
- (11) When the profit and loss account of sawmill is made, if the local balance sheet and a statement of profit and loss account were available, it was convenient but as no such information was available, the estimate was made based on the result of the survey and the situation of Japan.

Table 10. Operating plan for A type plant (Constructed in first year)

(Unit: ksh)

	1st year		2nd year		3rd year		4th year	5th year	6th year	7th year	8th year	9th year	10th year	11th year	12th year	13th year	14th year	15th year
	Factor	Value	Factor	Value	Factor	Value							Sales 1.05 licence 1.10	Sales 1.06 licence 1.08				
Revenue	Recovery rate 45% 6,480 m ³ /year	3,888,000	Recovery rate 55% 7,920 m ³ /year	4,752,000	Recovery rate 60% 8,640 m ³ /year	5,184,000	5,443,200 @ 630	5,719,680 @ 662	5,996,160 @ 694	6,298,560 @ 729	6,531,840 @ 756	6,946,560 @ 804	7,292,160 @ 844	7,724,160 @ 894	8,199,360 @ 949	8,691,840 @ 1,066	9,210,240 @ 1,066	9,763,200 @ 1,130
Operating cost																		
Materials		1,554,000		1,695,600		1,841,640	2,070,170	2,258,570	2,464,370	2,689,120	2,934,620	3,202,780	3,495,730	3,775,390	4,077,420	4,403,610	4,755,900	5,136,370
Stampage licence fee	14,400 @60	864,000	14,400 @66	950,400	14,400 @72	1,036,800	1,140,480 @79.2	1,254,530	1,379,980	1,517,980	1,669,780	1,836,760	2,020,430					
Logging labour cost	$\frac{\times 12}{25} \times 300$	90,000	$\frac{\times 12}{25} \times 324$	97,200	$\frac{\times 12}{25} \times 350$	105,000	$\frac{378}{113,400}$	$\frac{408}{122,440}$	$\frac{441}{132,270}$	$\frac{476}{142,850}$	$\frac{514}{154,280}$	$\frac{555}{166,620}$	$\frac{599}{179,950}$					
Oil & maintenance		600,000		648,000		699,840	816,290	881,600	952,120	1,028,290	1,110,560	1,199,400	1,295,350					
Sawmill labour	$\frac{\times 12}{25} \times 300$	90,000	$\frac{\times 12}{25} \times 324$	97,200	$\frac{\times 12}{25} \times 350$	105,000	113,400	122,470	132,270	142,850	154,280	166,620	179,950	194,350	209,900	226,692	244,830	264,410
Sawmilling expense		240,000		259,200		279,940	302,340	326,520	352,640	380,840	411,320	444,220	479,760	518,140	559,590	604,360	652,710	652,710
Power expenses		120,000	10,800/mon	129,600	11,664/mon	139,970	151,170	163,260	176,320	190,420	205,660	222,110	239,880					
Maintenance cost & others		120,000		129,600		139,970	151,170	163,260	176,320	190,420	205,660	222,110	239,880					
Total operating cost		1,884,000		2,052,000		2,226,580	2,485,910	2,707,560	2,949,280	3,212,810	3,500,220	3,813,620	4,155,440	4,487,880	4,846,910	5,234,660	5,653,440	6,053,490
Total operating income		2,004,000		2,700,000		2,957,420	2,957,290	3,012,120	3,046,880	3,085,750	3,031,620	3,132,940	3,136,720	3,236,280	3,352,450	3,457,180	3,556,800	3,709,710
Sales and administrations																		
Officer's remuneration and salaries	$\frac{\times 12}{3} \times 3,000$	108,000	$\frac{\times 12}{3} \times 3,000$	108,000	$\frac{\times 12}{3} \times 3,000$	108,000	$\frac{3,240}{116,640}$	$\frac{3,500}{125,970}$	$\frac{3,780}{136,050}$	$\frac{4,082}{146,930}$	$\frac{4,408}{158,690}$	$\frac{4,760}{171,380}$	$\frac{5,140}{185,090}$					
General expenses		200,000		216,000		233,280	251,940	272,100	293,870	317,370	342,760	370,190	399,800					
Depreciation		697,480		697,480		697,480	697,480	697,480	697,480	697,480	697,480	697,480	697,480					
Sub total		1,005,480		1,021,480		1,038,760	1,066,060	1,095,550	1,127,400	1,161,780	1,198,930	1,239,050	1,282,370	1,329,160	1,379,700	1,434,270	1,493,220	1,556,880
Net operation income		998,520		1,678,520		1,918,660	1,891,230	1,916,570	1,919,480	1,923,970	1,832,690	1,893,890	1,854,350	1,907,120	1,972,750	2,022,910	2,063,580	2,152,830
Profit and loss outside business		-		-		1,048,000	1,008,000	969,000	929,000	890,000	850,000	811,000	771,000	732,000	693,000	653,000	614,000	562,000
Net income before taxes		998,520		1,678,520		870,660	883,230	947,570	990,480	1,033,970	982,690	1,082,890	1,083,350	1,175,120	1,279,750	1,369,910	1,449,580	1,590,830
Net profit		698,960		1,174,960		609,460	618,260	663,300	693,340	723,780	687,880	758,020	758,340	822,580	895,830	958,940	1,014,710	1,113,580

Table 11. A plant constructed in second year (2nd build)

(Unit: ksh)

	1st year		2nd year		3rd year	
	Factor	Value	Factor	Value	Factor	Value
Revenue	Recovery rate 45% 6,480 m ³ /year	3,888,000	Recovery rate 55% 7,920 m ³ /year	4,752,000	Recovery rate 60% 8,640 m ³ /year	5,443,200
Operating cost	@600		@600		@600	
Materials		1,695,600		1,841,640		2,008,330
Stampage licence fee	14,400 @ 66	950,400	14,400 @ 72	1,036,800	14,400 @ 79	1,137,600
Logging labour cost	25 × 324 × 12	97,200	25 × 350 × 12	105,000	25 × 383 × 12	114,900
Oil & maintenance		649,000		699,840		755,830
Sawmill labour	25 × 324 × 12	97,200	25 × 350 × 12	105,000	25 × 383 × 12	114,900
Sawmilling expense		259,200		279,940		302,320
Power expenses	10,800/mon	129,600	11,664/mon	139,970	12,597/mon	151,160
Maintenance cost & others		129,600		139,970		151,160
Total operating cost		2,052,000		2,226,580		2,425,550
Total operating income		1,836,000		2,525,420		3,017,650
Sales and administrations						
Officer's remuneration and salaries	3 × 3,000 × 12	108,000	3 × 3,000 × 12	108,000	3 × 3,240 × 12	116,640
General expenses		216,000		233,280		251,940
Depriciation		753,280		753,280		753,280
Sub total		1,077,280		1,094,560		1,121,860
Net operation income		758,720		1,430,860		1,895,790
Profit and loss outside business		-		-		1,131,840
Net income before taxes		758,720		1,430,860		763,950
Net profit		531,100		1,001,600		534,770

Table 12. A type plant constructed in third year (3rd build)

(Unit: ksh)

	1st year		2nd year		3rd year	
	Factor	Value	Factor	Value	Factor	Value
Revenue	Recovery rate 45% 6,480 m ³ /year	3,888,000	Recovery rate 55% 7,920 m ³ /year	4,989,600	Recovery rate 60% 8,640 m ³ /year	5,719,680
Operating cost	@600		@630		@662	
Materials		1,841,640		2,008,330		2,164,490
Stampage licence fee	1,440 @72	1,036,800	1,440 @79	1,137,600	1,440 @85	1,224,000
Logging labour cost	25 × 350 × 12	1,050,000	25 × 383 × 12	1,149,000	25 × 414 × 12	1,242,000
Oil & maintenance		699,840		755,830		816,290
Sawmill labour	25人 × 350 × 12	1,050,000	25 × 383 × 12	1,149,000	25 × 414 × 12	1,242,000
Sawmilling expense		279,940		302,320		326,520
Power expenses	1,1664 /mon	1,39,970	12,597 /mon	151,160	13,605 /mon	163,260
Maintenance cost & others		139,970		151,160		163,260
Total operating cost		2,226,580		2,425,550		2,615,210
Total operating income		1,661,420		2,564,050		3,104,470
Sales and administrations						
Officer's remuneration and salaries	3 × 3,000 × 12	1,08,000	3 × 3,240 × 12	1,16,640	3 × 3,500 × 12	1,26,000
General expenses		233,280		251,940		272,100
Depriciation		813,540		813,540		813,540
Sub total		1,154,820		1,182,120		1,211,640
Net operation income		506,600		1,381,930		1,892,830
Profit and loss outside business						1,222,390
Net income before taxes		506,600		1,381,930		670,440
Net profit		354,620		967,350		469,310

Table 13. Operating plan for B plant (Constructed in first year)

(Unit: ksh)

	1st year		2nd year		3rd year		4th year	5th year	6th year	7th year	8th year	9th year	10th year	11th year	12th year	13th year	14th year	15th year
	Factor	Value	Factor	Value	Factor	Value							Sales 1.05 licence 1.10	Sales 1.06 licence 1.08				
Revenue	Recovery rate 45% 1,890 m ³ /year	@ 600 1,134,000	Recovery rate 55% 2,112 m ³ /year	@ 660 1,267,200	Recovery rate 60% 2,304 m ³ /year	@ 600 1,382,400	@ 630 1,451,520	@ 662 1,525,250	@ 694 1,598,980	@ 729 1,679,620	@ 756 1,741,820	@ 804 1,852,420	@ 844 1,944,580	@ 895 2,062,080	@ 949 2,186,500	@ 1,006 2,317,820	@ 1,066 2,456,060	@ 1,130 2,603,520
Operating cost																		
Materials		398,400		434,880		475,120	518,710	566,350	618,410	675,310	737,500	805,480	879,800	950,180	1,026,190	1,108,290	1,196,950	1,292,710
Stampage licence fee	3,840 m ³ /year	@ 60 230,400	10%UP	253,440	10%UP	278,780	306,660	337,330	371,060	408,170	448,990	493,890	543,280					
Logging labour cost		18,000	8%UP	19,440	8%UP	21,380	23,090	24,940	26,940	29,100	31,430	33,940	36,660					
Oil & maintenance		150,000	8%UP	162,000	8%UP	174,960	188,960	204,080	220,410	238,040	257,080	277,650	299,860					
Sawmill labour		36,000	8%UP	38,880	8%UP	41,990	45,350	48,980	52,900	57,130	61,700	66,640	71,970	77,730	83,950	90,670	97,920	105,750
Sawmilling expense		100,000		108,000		116,640	125,980	136,060	146,940	158,700	171,400	185,120	199,920	215,920	233,200	251,860	272,000	293,760
Power expenses		50,000	8%UP	54,000	8%UP	58,320	62,990	68,030	73,470	79,350	85,700	92,560	99,960					
Maintenance cost & others		50,000	8%UP	54,000	8%UP	58,320	62,990	68,030	73,470	79,350	85,700	92,560	99,960					
Total operating cost		534,400		581,760		633,750	690,040	751,390	818,250	891,140	970,600	1,057,240	1,151,690	1,243,830	1,343,340	1,450,820	1,566,870	1,692,220
Total operating income		599,600		685,440		831,590	761,480	773,860	780,730	788,480	771,220	795,180	792,890	818,250	843,160	867,000	889,190	911,300
Sales and administrations		422,410		428,810		435,720	447,020	459,230	472,420	486,660	502,050	518,660	532,280	551,300	571,850	594,040	618,010	643,900
Officer's remuneration and salaries		48,000		48,000		48,000	51,840	55,990	60,470	65,310	70,540	76,180	77,950					
General expenses		80,000	8%UP	86,400	8%UP	93,310	100,770	108,830	117,540	126,940	137,100	148,070	159,920					
Depreciation		294,410		294,410		294,410	294,410	294,410	294,410	294,410	294,410	294,410	294,410					
Sub total																		
Net operation income		177,190		256,630		395,870	314,460	314,630	308,310	301,820	269,170	276,520	260,610	266,950	271,310	272,960	271,180	267,400
Profit and loss outside business						338,000	325,000	313,000	300,000	288,000	275,000	263,000	251,000	238,000	226,000	213,000	203,000	185,000
Net income before taxes		177,190		256,630		57,870	△ 10,540	1,630	8,310	13,820	△ 5,830	13,520	9,610	28,950	45,310	59,960	68,180	82,400
Net profit		124,030		179,640		40,510	—	1,140	5,820	9,670	—	9,460	6,730	20,260	31,720	41,970	47,730	57,680

Table 14. B plant constructed in second year (2nd build)

(Unit: ksh)

	1st year		2nd year		3rd year	
	Factor	Value	Factor	Value	Factor	Value
Revenue	Recovery rate 45% 1,890 m ³ /year	@600 1,134,000	Recovery rate 55% 2,112 m ³ /year	@600 1,267,200	Recovery rate 60% 2,304 m ³ /year	@630 1,451,520
Operating cost						
Materials		434,880		475,120		518,710
Stampage licence fee		253,440		278,780	10% up	306,660
Logging labour cost		19,440		21,380	8% up	23,090
Oil & maintenance		162,000		174,960	8% up	188,960
Sawmill labour		38,880		41,990	8% up	45,350
Sawmilling expense		108,000		116,640		125,980
Power expenses	Same as the factors 2nd year of constructed in second year	54,000		58,320	8% up	62,990
Maintenance cost & others		54,000		58,320	8% up	62,990
Total operating cost		581,760		633,750		735,390
Total operating income		552,240		633,450		716,130
Sales and administrations		452,360		459,270		466,730
Officer's remuneration and salaries		48,000		48,000	8% up	48,000
General expenses		86,400		93,310	8% up	100,770
Depreciation		317,960		317,960		317,960
Sub total						
Net operation income		234,280		174,180		249,400
Profit and loss outside business						365,000
Net income before taxes		234,280		174,180		△106,600
Net profit		163,996		121,926		-

Table 15. B plant constructed in third year (3rd build)

(Unit: ksh)

	1st year		2nd year		3rd year	
	Factor	Value	Factor	Value	Factor	Value
Revenue	Recovery rate 45% 1,890 m ³ /year	@ 6 0 0 1,34,000	Recovery rate 55% 2,112 m ³ /year	@ 6 3 0 1,33,0560	Recover rate 60% 2,304 m ³ /year	@ 6 6 2 1,525,250
Operating cost						
Materials		475,120		564,060		566,350
Stampage licence fee		278,780		306,660	10% up	337,330
Logging labour cost		21,380		23,090	8% up	24,940
Oil & maintenance		174,960		188,960	8% up	204,080
Sawmill labour		41,990		45,350	8% up	48,980
Sawmilling expense		116,640		125,980		136,060
Power expenses	Same as the factors for second year of construct- ed in first year	58,320		62,990	8% up	68,030
Maintenance cost & others		58,320		62,990	8% up	68,030
Total operating cost		633,750		735,390		751,390
Total operating income		500,250		595,170		773,860
Sales and administrations		484,710		492,170		500,230
Officer's remuneration and salaries		48,000		48,000		48,000
General expenses		93,310		100,770	8% up	108,830
Depriciation		343,400		343,400		343,400
Sub total						
Net operation income		15,540		103,000		273,630
Profit and loss outside business						394,200
Net income before taxes		15,540		103,000		△ 120,510
Net profit		10,880		72,100		

CHAPTER VI. IMPROVEMENT OF LOGGING AND SKIDDING FACILITIES OF SAWMILLS

Each sawmill procures logs every year on the basis of stumpage sale from the plantations of the national forest under felling licence of short term (1 year) or long term (5 years).

This logging operation is carried out directly by each mill for which an operation group is organized.

Of 18 mills surveyed, we visited felling site of 2 mills and following points are desirable to improve.

6.1. Improvement of logging operation

- (1) The operation crew is not properly allocated to commensurate with the operation process. This operation process is divided into felling crew (felling-limbing-bucking), skidding crew (preyarding-tractor-loading – tractor-skidding & driving-unloading) – and log transportation crew (loading on truck-transportation-unloading at mill-log piling at mill). It is an ideal that its process proceeds like the conveyor system. For this purpose, based on measurement and grasp of standard operational volume needed for proper implementation of process control, arrangement of personnel required and machineries required should be decided. Needless to say, particular consideration is needed for arrangement of machines suitable to size and quality of logs as well as the number of personnel required.
- (2) Re-consideration is needed for introduction of machines fit for materials. Furthermore, the system to re-educate the driver of the machine is needed.
At each mill surveyed, when we heard of the actual condition of the machine for works near forest, a set of truck for yarding and transporting has many troubles in trailer and owing to incapability of repair due to lack of parts, nearly 1/2 or 1/3 of the machines are not in work and the operational rate of these machines is quite low. As a result, as yarding and transporting operation by these machines do not proceed smoothly, the system of log procurement is uneven and it is noticed that the rate of operation is greatly affected.
- (3) Of the working process, the point which particularly needs improvement is lack of operational tools used in preyarding work (log turner, hook and pick). Yarding tractor is not provided with winch for pulling felled trees. It is desired that truck with winch for yarding is provided.

It is also necessary to pay attention that erosion of forest land by disturbance of ground surface by the traditional operation is brought about.

- (4) Loading of logs on transportation lorry at the mill near the forest is almost exclusively done by man power but it is necessary to increase the efficiency of loading and load per lorry by the introduction of proper machines such as loaders.
- (5) Introduction of machine to pile up raw materials in the mill and improvement of road surface which is the main transport road in the mill are necessary. At least, in order to make the machine work efficiently, it is desirable that drainage as well as gravelling are carried out and if possible, pavement too.
- (6) In order to make the repair of logging machines smoothly, repairing equipment should be prepared as annex to the repair shop of sawmill machines and it is needed to establish the facilities for parts control and training of skilled workers.

6.2. Required fund for improvement of logging facilities

Introduction of new machines for logging or its required fund is calculated respectively based on the sawmilling capacity and operation degree of each mill.

There is no peculiar new machine for logging and it is enough to increase the number of existing machines. The required fund is calculated based on the above and the local price. In all mills surveyed, 12 mills reported the number of machines possessed. Since the possession is consisted of some 30 lorries and some 25 tractors. An estimation was made assuming the increase of facilities by twice as much as they are.

Required fund

Lorry, etc.	16 x ksh 100,000 = ksh 1,600,000
Tractor, etc.	24 x ksh 200,000 = ksh 4,800,000
Total:	ksh 6,400,000

These required fund is included in construction of sawmills.

Logging facilities are multiple use machines and as it is considered that they are available in the country, calculation was made with local cost but those of modern good performance are now being developed in many countries.

Generally, tools of workers at the felling site (log turner, hook and pick) are lacking which is the cause of lowering of operation degree. Without insisting to the traditional felling method, there is a need to consider an introduction of small tractor and crane for loading at the felling site.

CHAPTER VII. INTRODUCTION OF NEW WOOD BASED INDUSTRY

In order to attain the modernization of wood industry, it is basically necessary to replace existing machines and equipments of sawmill by modern ones but that is not all for the attainment of modernization of all wood industry. It is necessary to develop the industries which contribute to the effective utilization of mill residues or secondary process sawn timber. In this chapter, consideration on the matter related to the above and as a result, the industry which is considered suitable to introduce are discussed.

7.1. Manufacture of wood waste briquette

One of the big problems which existing sawmill confronted is to find out the effective utilization of mill residues. At present, in every mill, large volume of sawdust and off-cuts are left unused. Some of them are used as local household fuels but the degree of their utilization is low and they not only hamper the management of sawmill but in many cases, incur some cost because of thrown-away.

The amount of mill waste including saw dust will reduce remarkably by the introduction of new sawmill machinery but still more, effective utilization of saw dust is quite necessary.

We recommend the production of wood waste briquette for effective utilization of mill residues, particularly saw dust.

Wood waste briquette is produced, moulding saw dust and other wood slips under high temperature and high pressure and used for household fuel and industrial purpose. This is one of intelligent utilizations of saw dust and other mill waste.

In Kenya of today, most of timber felled are consumed as fuel and the utilization of timber as fuel, viewed from supply of town gas and other home use energy, is expected to increase along with swell of population. On the other hand, harvesting of fuel wood by local people is a hindrance to rational forestry management, protection of forest resources and land conservation. Production and supply of highly efficient household fuels and industrial fuels from wasted sawdust heretofore is considered quite a meaningful industry from the viewpoint of national economy.

However, it may take some time that the wood waste briquette, which is not quite familiar with the people of this country, is accepted by the market. It is considered that the briquette can be used for some industrial purpose, particularly for soap manufacturing and tea production. In this case too, it may take some time to get popularity. In some case, some modification of burning apparatus may be needed.

In this sense, construction of briquette plant is to be promoted coping with expansion of demand. Under this plan, 3 plants are to be built in 3 years.

7.1.1. Outline of wood waste briquette plant

Expected production	Annual production	900 ton
Input of materials	Yearly	1,800 m ³
Number of employees	8	
Major machines and equipments		
(a) Furnace	1	
(b) Rotary drier	1	
(c) Screw conveyor	1 set	
(d) Forming machine	1	
Total		
US\$86,310 (CIF MOMBASA, including import duty)		
Building area	150 m ²	
Required fund for construction 1,025,650 ksh.		

7.1.2. Investment for construction of wood waste briquette.

(1) Machines and equipments of briquette plant is stated in 7.1.1.

(US\$86,310 = ksh 675,000)

(2) Details of cubicle are as follows.

Cubicle	37,000 ksh
First wiring	8,000
Cabinet panel	23,000
Second wiring	15,000
Control panel	Included in machines
Total	83,000

(3) Cost of foundation work

Foundation work of major machines 20 m³ × 1,300 ksh = 26,000 ksh

(4) Cost of installation work

Although the installation work in Japan needs forklift or wrecker, in Kenya, such work is being done by workers.

Workers wage 10 person × 50 days = 500 course
 500 course × 20 ksh/day = 10,000 ksh

(5) Plant construction work

Size of briquette plant is 15 m x 10 m = 150 m².

Roofing work	43,600 ksh
Steel frame work	130,800 ksh
Building foundation work	43,600 ksh
Total	218,000

(Work expenses per m² is 1,450 ksh)

(6) Domestic transportation cost of machines

Domestic transportation cost of machines is calculated on the assumption of 639 km from MOMBASA to NYERI.

8.5 ton x 430 ksh = 3,655 ksh

(7) Other expenses

Other expenses for plant construction is calculated taking consideration of the condition of the spot when the field survey was made.

Total investment required is shown in Table 16.

Table 16. Briquette plant investment and its recovery (ksh)

Item	Invested am't	Recovery years	Annual recovery
Machines & equipments	675,000	10	67,500
Cubicles	83,000	10	8,300
Foundation work cost	26,000	10	2,600
Installation work cost	10,000	10	1,000
Building	218,000	24	9,083
Miscellaneous	10,000	2	5,000
Domestic carriage of machine	2,650	2	1,330
Total	1,025,650		94,820

7.1.3. Required fund

The investment for plant construction is stated in 7.1.2 of which breakdown by domestic and foreign currencies is as follows.

	Foreign currency (US\$)	Domestic currency (US\$)
Machines & equipments	86,310	
Cubicle	10,620	
Buildings & others		48,300
Total	US\$145,230	

7.1.4. Operating plan of briquette plant

Of the profit and loss account of briquette plant, the sale price, considering the charcoal price, is 10 ksh per 15 kg.

Because of a new product, the sale price is deferred 3 years and since then, the annual increase of 5% is estimated. Sawdust as material though unused up to now, is valued 40 ksh per m³. With rise of price of the product, the valuation of the material is to rise. The rising percentage of general manufacturing cost is 8% per year.

The profit ratio of briquette plant is relatively high.

Table 17. Operating plan of briquette plant (Constructed in the first year)

(Unit: ksh)

	1st year		2nd year		3rd year		4th year	5th year	6th year	7th year	8th year	9th year	10th year	11th year	12th year	13th year	14th year	15th year
	Factor	Value	Factor	Value	Factor	Value												
Revenue	900 t 10ksh/15kg	600,000		600,000		600,000	630,000	661,500	694,580	729,310	765,780	804,070	844,270	894,930	948,630	1,005,550	1,065,880	1,129,830
Operating cost																		
Materials																		
Saw dust	1,800 m ³ 40ksh/m ³	72,000	40ksh/m ³	72,000	40ksh/m ³	72,000	75,600	79,380	83,350	87,520	91,900	96,500	101,330	140,980	149,440	158,410	167,910	177,980
Hauling	2 300ksh/12	7,200	2 324ksh×12	7,780	2 350 × 12	8,400	9,070	9,800	10,580	11,430	12,340	13,330	14,400	15,550	16,790	18,130	19,580	21,150
Total		79,200		79,780		80,400	84,670	89,180	93,930	98,950	104,240	109,830	115,730	156,530	166,230	176,540	187,490	199,130
Mill labour	6 300 × 12	21,600	6 324 × 12	23,330	6 350 × 12	25,200	27,220	29,400	31,750	34,290	37,030	39,990	43,190	46,650	50,380	54,410	58,760	63,460
Manufacturing cost																		
Power cost		10,000		10,800		11,660	12,600	13,610	14,700	15,880	17,150	18,520	20,000	21,600	23,330	25,200	27,200	29,380
Maintenance		20,000		21,600		23,330	25,190	27,210	29,390	31,740	34,280	37,020	39,980	43,180	46,630	50,360	54,390	58,740
Total		30,000		32,400		34,990	37,790	40,820	44,090	47,620	51,430	55,540	59,980	64,780	69,960	75,560	81,590	88,120
Total operating cost		130,800		135,510		140,590	149,690	199,400	169,770	180,860	192,700	205,360	218,900	267,960	286,570	306,510	327,840	350,710
Total operating income		469,200		464,490		459,410	480,320	462,100	521,810	548,450	573,080	598,710	625,370	626,970	662,060	699,040	738,040	779,120
Sales and administration																		
Officer's remuneration & salaries		24,000		24,000		24,000	25,920	27,990	30,230	32,650	35,260	38,080	41,130	44,400	47,970	51,810	55,950	60,430
General expenses		10,000		10,800		11,660	12,600	13,610	14,700	15,880	17,150	18,520	20,000	21,600	23,330	25,200	27,220	29,400
Depreciation		94,820		94,820		94,820	94,820	94,820	94,820	94,820	94,820	94,820	94,820	98,820	94,820	94,820	94,820	94,820
Sub-total		128,820		129,620		130,480	133,340	136,420	139,750	143,350	147,230	148,700	155,950	160,820	166,120	171,830	177,990	184,650
Net operating income		340,380		334,870		328,930	346,980	325,680	385,060	405,100	425,850	450,010	469,420	466,150	495,940	527,210	560,050	594,470
Profit and loss outside business		-		-		98,300	95,600	92,900	90,200	86,500	83,800	81,000	78,300	75,600	72,900	69,700	66,500	63,500
Net income before taxes		340,380		334,870		230,630	251,380	232,780	294,860	318,600	342,050	369,010	391,120	390,550	423,040	457,510	493,550	530,970
Net profit		238,270		234,410		161,410	175,970	162,950	206,400	223,020	239,440	258,310	273,780	273,390	296,130	320,260	345,490	371,680

Table 18. Operating plan of briquette plant constructed in second year.

(Unit: ksh)

	1st year		2nd year		3rd year	
	Factor	Value	Factor	Value	Factor	Value
Revenue		6 0 0,0 0 0		6 0 0,0 0 0		6 3 0,0 0 0
Operating cost						
Materials						
Saw dust		7 2,0 0 0		7 2,0 0 0		7 5,6 0 0
Hauling		7,7 8 0		8,4 0 0		9,0 7 0
Total		7 9,7 8 0		8 0,4 0 0		8 4,6 7 0
Mill labour		2 3,3 3 0		2 5,2 0 0		2 7,2 2 0
Manufacturing cost						
Power cost		1 0,8 0 0		1 1,6 6 0		1 2,6 0 0
Maintenance		2 1,6 0 0		2 3,3 3 0		2 5,1 9 0
Total		3 2,4 0 0		3 4,9 9 0		3 7,7 9 0
Total operating cost		1 3 5,5 1 0		1 4 0,5 9 0		1 4 9,6 8 0
Total operating income		4 6 4,4 9 0		4 5 9,4 1 0		4 8 0,3 2 0
Sales and administration						
Officer's remuneration & salaries		2 4,0 0 0		2 4,0 0 0		2 5,9 2 0
General expenses		1 0,8 0 0		1 1,6 6 0		1 2,6 0 0
Depreciation		1 0 2,4 1 0		1 0 2,4 1 0		1 0 2,4 1 0
Sub-total		1 3 7,2 1 0		1 3 8,0 7 0		1 4 0,9 3 0
Net operating income		3 2 7,2 8 0		3 2 1,3 4 0		3 3 9,3 9 0
Profit and loss outside business		—		—		1 0 6,1 6 0
Net income before taxes		3 2 7,2 8 0		3 2 1,3 4 0		2 3 3,2 3 0
Net profit		2 2 9,1 0 0		2 2 4,9 4 0		1 6 3,2 6 0

Table 19. Operating plan for briquette plant (Constructed in the third year)

(Unit: ksh)

	1st year		2nd year		3rd year	
	Factor	Value	Factor	Value	Factor	Value
Revenue		6 0 0,0 0 0		6 3 0,0 0 0		6 6 1,5 0 0
Operating cost						
Materials						
Saw dust		7 2,0 0 0		7 5,6 0 0		7 9,3 8 0
Hauling		8,4 0 0		9,0 7 0		9,8 0 0
Total		8 0,4 0 0		8 4,6 7 0		8 9,1 8 0
Mill labour		2 5,2 0 0		2 7,2 2 0		2 9,4 0 0
Manufacturing cost						
Power cost		1 1,6 6 0		1 2,6 0 0		1 3,6 1 0
Maintenance		2 3,3 3 0		2 5,1 9 0		2 7,2 1 0
Total						
Total operating cost		1 4 0,5 9 0		1 4 9,6 8 0		1 9 9,4 0 0
Total operating income		4 5 9,4 1 0		4 8 0,3 2 0		4 6 2,1 0 0
Sales and administration						
Officer's remuneration & salaries		2 4,0 0 0		2 5,9 2 0		2 7,9 9 0
General expenses		1 1,6 6 0		1 2,6 0 0		1 3,6 1 0
Depreciation		1 1 0,6 0 0		1 1 0,6 0 0		1 1 0,6 0 0
Sub-total		1 4 6,2 6 0		1 4 9,1 2 0		1 5 2,2 0 0
Net operating income		3 1 3,1 5 0		3 3 1,2 0 0		3 0 9,9 0 0
Profit and loss outside business		—		—		1 1 4,6 6 0
Net income before taxes		3 1 3,1 5 0		3 3 1,2 0 0		1 9 5,2 4 0
Net profit		2 1 9,2 0 0		2 3 1,8 4 0		1 3 6,6 7 0

7.2. Construction of secondary processing mill

For rationalized utilization of sawnwood and improvement of management of sawmill, it is a pertinent measure to construct a secondary processing mill to produce parts of furniture or housing components.

Nevertheless, the scale of sawmill, in general, is relatively small and even if the facilities are planned to modernize, the scale is not at all large. In consequence, it is not always considered pertinent that each sawmill install processing mill of its own. If respective sawmill has such mill, quite small process facilities are reasonable.

It is considered reasonable that the processing mill of a scale to some extent be constructed in the area where sawmills are relatively concentrated, managed by the cooperative society of sawmills or a certain company organized under joint investment in order to produce and supply furniture or its parts or housing components.

7.2.1. Items of products and production

Because of diversified items of secondary processed goods and the number of process in manufacturing, there is a difference in the number of workers engaged. And depending on the arrangement of processing order, the efficiency is influenced and the selection of design and the precision of process have much influence on the value added of the products.

Therefore, a reasonable number of workers including machinists required in the facilities of the preceding paragraph and assemblers and others are set up and representative item of processed goods are shown and a rough estimate is made on the assumption of the required personnel to process respective goods and the monthly production.

(a)	Workers (machines, assembly and painting)		60 workers	
(b)	Items of products and production capacity			
1.	Dining room set	1 table 4 chairs	60 workers	400 sets/month
2.	Dressor	1.5 m x 2 m x 0.6 m with drawers	60 workers	300 pcs/month
3.	Wooden door	1 m x 2 m with frame	30 workers	600 pcs/month
4.	Flooring block	30 cm x 30 cm	30 workers	2,000 m ² /month
5.	Blockboard	Lumber core 1 m x 2 m	15 workers	1,500 sheets/month
6.	Housing wall panel	4 m x 6 m Banding panel	30 workers	300 sheets/month
(c)	Building area			
	Plant	1,000 m ³		
	Warehouse	300 m ³		
(d)	Required fund for construction		4,055,960 ksh	

7.2.2. Investment in equipments

Of the secondary processing plant, considering the result of the survey, it is desirable to establish new plants of moderate size. Therefore, the machine and equipments of paragraph 1 will be suitable for this purpose considering the conditions of Kenya. Since these machines are easy to install, the installation cost is almost included in the construction cost of building.

The plant building, calculated based on the required work site, is 1,000 m². An incidental material warehouse of 100 m² and a product warehouse of 200 m² are needed.

(1) Machines and equipments

Major machines and equipments and their prices are as follows.

The price of machine is CIF MOMBASA including import duty.

Machines and equipments of secondary processing mill

(CIF MOMBASA & included import duty)

Machines	No.	US\$
1. Cross-cut saw	1	11,900
2. Four side planing & moulding machine	1	66,200
3. Hand feed planer	1	6,500
4. Single surface planer	1	15,000
5. Rise & fall circular saw mill	3	11,900
6. Wood lathe	1	6,830
7. Cramp carrier	1	52,700
8. Grease spreader	1	9,000
9. Hot press	1	38,100
10. Band-saw mill	1	5,850
11. Hollowchisel mortiser	2	11,460
12. Router	1	5,730
13. Moulder	1	7,030
14. Stroke sander		3,420
15. Tool grinder & sharpener		3,360
16. Knife grinder & sharpener		6,120
17. Double sizer	1	20,600
18. Trolley	20	6,100
19. Painting facilities	1	7,930
20. Portable dust collector	5	7,650
Total		303,380

(2) Cubicle

Required power for secondary processing equipments is 128 kw and required cubicle, including first and second wirings is 1,700 ksh/kw.

$$1,700 \text{ ksh} \times 128 \text{ kw} = 217,600 \text{ ksh}$$

(3) Investment in building

Construction cost of plant building is:

1,000 m ² × 1,450 ksh =	1,450,000 ksh
Roofing work	290,000
Steel frame work	870,000
Building foundation work	290,000
Total	1,450,000

(4) Domestic transportation of machines

Domestic carriage of machines for secondary processing is assumed the land carriage from MOMBASA to NYERI.

$$37.05 \text{ ton} \times 430 \text{ ksh} = 15,932 \text{ ksh}$$

7.2.3. Required fund

The required fund for construction of secondary processing plant is as follows.

Item	Investment	Recovery year	Annual recovery (ksh)
Machines & equipments	2,372,430	10 years	237,250
Cubicle	217,600	10 years	21,760
Building	1,450,000	24 years	60,420
Domestic carriage of machines	15,930	2 years	8,000
Total	4,055,960		327,430

Breakdown by currency is as follows.

Foreign money	Machines & equipments & cubicle	US\$331,210
Domestic money	Buildings	US\$187,460

7.2.4. Operating plan of secondary processing plant

As stated in the above, the value to be added of the secondary processed goods greatly differs depending on selection of products, setting up of progress of work and skill of workers. Keeping these in mind, the products are assumed the dining room's articles as daily necessities and the price of the product is figured out taking reference to the price delivered at plant inside of Kenya.

Of the depreciation of machines and equipments of plant, the year is set at 10 years.

In actual production, the products are of mixed items.

The profit and loss account of the secondary processing plant is made based on the following assumption.

(1) Production of secondary processed goods, considering the skill of the workers, is assumed to increase by following steps.

First year	60% of the whole production capacity
Second year	80% of the whole production capacity
Third year	100% of the whole production capacity

- (2) The sales price of the secondary processed goods is fixed for the first 3 years and from the fourth year it is raised up by 5% every year. As a result, the net income will show a sharp increase.
- (3) Sawn wood as a major material are purchased from outside. Therefore, the purchased price of sawn wood is deferred for first 3 years and from the fourth year, it rises by 5% every year and 6% from the 11th year.
- (4) The cost of sub-materials which are utensil, metal fittings, nails and adhesives needed for manufacture of secondary processed goods is estimated at a half of the cost of major material.
- (5) Plant labour cost of 60 workers is to increase by 8% every year.
- (6) Processing cost includes those of operation, power and fuels and is estimated 4 times as much as plant labour cost.
- (7) General management and sales cost includes those expenses as for personnel and office work and estimated at 10% of the revenues.
- (8) Depreciation cost and profit and loss outside business are estimated based on investment in plant facilities of every fiscal year.
Profit and loss outside business, the interest is divided into foreign and domestic currencies and estimated 4% and 10% respectively and the sum is calculated.
- (9) As a result of profit and loss account of secondary processing plant, a large amount of profit was gained which is resulted from the assumption of uniform increase of unit price of secondary processed goods as with sawn wood, i.e., 5% from the 4th year, and 6% from the 11th year.

Table 20. Secondary processing plant (Construction for the 1st year)

Unit: ksh

	1st year		2nd year		3rd year		4th year	5th year	6th year	7th year	8th year	9th year	10th year	11th year	12th year	13th year	14th year	15th year
	Factor	Value	Factor	Value	Factor	Value												
Revenues		4,608,000	80 %	6,144,000	100 %	7,680,000	8,064,000	8,467,200	8,890,560	9,335,090	9,801,840	10,191,930	10,806,530	11,454,920	12,142,220	12,870,750	13,643,000	14,461,580
Operating cost																		
Sawn wood	720 m ³ 3,000 ksh	2,160,000		2,160,000		2,160,000	2,268,000	2,381,400	2,500,470	2,625,490	2,756,770	2,894,610	3,039,340	3,221,700	3,415,000	3,619,900	3,837,090	4,067,320
Sub-material	50 %	1,080,000		1,080,000		1,080,000	1,134,000	1,190,700	1,250,240	1,312,750	1,378,380	1,447,300	1,519,670	1,610,850	1,707,500	1,809,950	1,918,550	2,033,660
Sub-total		3,240,000		3,240,000		3,240,000	3,402,000	3,572,100	3,750,710	3,938,240	4,135,150	4,341,910	4,559,010	4,832,550	5,122,500	5,429,850	5,755,640	6,100,980
Plant labour cost	60 300ksh × 12	216,000	60 324 × 12	233,280	60 350 × 12	2,520,000	272,160	293,930	317,450	334,284	370,270	399,890	431,880	466,440	503,750	544,050	587,570	634,580
Processing cost		864,000		933,120		1,008,000	1,088,640	1,175,730	1,269,790	1,371,380	1,481,080	1,599,570	1,727,540	1,865,740	2,015,000	2,176,200	2,350,300	2,538,320
Total operating cost		4,320,000		4,406,400		4,500,000	4,762,800	5,041,760	5,337,950	5,652,460	5,986,500	6,341,370	6,718,420	7,164,720	7,641,250	8,150,100	8,693,510	9,273,880
Total operating income		288,000		1,737,600		3,180,000	3,301,200	3,425,440	3,552,610	3,682,630	3,815,340	3,950,560	4,088,110	4,290,200	4,500,970	4,720,650	4,949,490	5,187,700
Sales and administration																		
Ordinary cost	Revenue × 10%	460,800		614,400		768,000	806,400	846,720	889,060	933,510	980,180	1,029,190	1,080,650	1,145,490	1,214,220	1,287,080	1,364,300	1,446,160
Depreciation		327,430		327,430		327,430	327,430	327,430	327,430	327,430	327,430	327,430	327,430	327,430	327,430	327,430	327,430	327,430
Sub-total		788,230		941,830		1,095,430	1,133,830	1,174,150	1,216,490	1,260,940	1,307,610	1,356,610	1,408,080	1,472,920	1,541,650	1,614,510	1,691,730	1,773,590
Net operating income		△500,230		795,770		2,084,570	2,167,370	2,251,290	2,336,120	2,421,690	2,507,730	2,593,950	2,680,030	2,817,280	2,959,320	3,106,140	3,257,760	3,414,110
Profit and loss outside		-		-		602,000	581,000	560,000	540,000	518,000	498,000	477,000	457,000	435,000	415,000	394,000	373,000	330,000
Net income before taxes		△500,230		795,770		1,482,570	1,586,370	1,691,290	1,796,120	1,903,690	2,009,730	2,116,950	2,223,030	2,382,280	2,544,320	2,712,140	2,884,760	3,084,110
Net profit				795,770		1,037,800	1,110,460	1,183,900	1,257,280	1,332,580	1,406,810	1,481,870	1,556,120	1,667,600	1,781,020	1,898,500	2,019,330	2,158,870

Table 21. Processing plant constructed in secondary year

Unit: ksh

	1st year		2nd year		3rd year	
	Factor	Value	Factor	Value	Factor	Value
Revenues	60% of plan	4,6 0 8,0 0 0	80% of plan	6,1 4 4,0 0 0	100% of plan	8,0 6 4,0 0 0
Operating cost						
Materials						
Sawn wood		2,1 6 0,0 0 0		2,1 6 0,0 0 0		2,2 6 8,0 0 0
Sub-material		1,0 8 0,0 0 0		1,0 8 0,0 0 0		1,1 3 4,0 0 0
Sub-total		3,2 4 0,0 0 0		3,2 4 0,0 0 0		3,4 0 2,0 0 0
Plant labour cost		2 3 3,2 8 0		2 5 2,0 0 0		2 7 2,1 6 0
Processing cost		9 3 3,1 2 0		1,0 0 8,0 0 0		1,0 8 8,6 4 0
Total operating cost		4,4 0 6,4 0 0		4,5 0 0,0 0 0		4,7 6 2,8 0 0
Total operating income		2 0 1,6 0 0		1,6 4 4,0 0 0		3,3 0 1,2 0 0
Sales and administration						
Ordinary cost		6 1 4,4 0 0		7 6 8,0 0 0		8 0 6,4 0 0
Depreciation		3 5 3,6 2 0		3 5 3,6 2 0		3 5 3,6 2 0
Sub-total		9 6 8,0 2 0		1,1 2 1,6 2 0		1,1 6 0,0 2 0
Net operating income		△ 7 6 6,4 2 0		5 2 2,3 8 0		2,1 4 1,1 8 0
Profit and loss outside		—		—		6 5 0,1 6 0
Net income before taxes		△ 7 6 6,4 2 0		5 2 2,3 8 0		1,4 9 1,0 2 0
Net profit				3 6 5,6 7 0		1,0 4 3,7 1 0

Table 22. Processing plant (Constructed in third year)

Unit: ksh

	1st year		2nd year		3rd year	
	Factor	Value	Factor	Value	Factor	Value
Revenues	60% of plan	4,608,000	80% of plan	6,451,200	100% of plan	8,064,000
Operating cost						
Materials						
Sawn wood		2,160,000		2,268,000		2,381,400
Sub-material		1,080,000		1,134,000		1,190,700
Sub-total		3,240,000		3,402,000		3,572,100
Plant labour cost		252,000		272,160		293,930
Processing cost		1,008,000		1,088,640		1,175,730
Total operating cost		4,500,000		4,762,800		5,041,760
Total operating income		108,000		1,688,400		3,022,240
Sales and administration						
Ordinary cost		768,000		806,400		846,720
Depreciation		381,900		381,900		381,900
Sub-total		1,149,900		1,188,300		1,228,620
Net operating income		△ 1,041,900		500,100		1,793,620
Profit and loss outside		—		—		702,170
Net income before taxes		△ 1,041,900		500,100		1,091,450
Net profit				294,700		76,4010

7.3. Construction of tea-chest mill

Sufficient informations on availability of peeler logs from indigenous forests were not obtained during this survey but according to the obtained informations, the amount of possible supply of peeler logs of Kenya is on the increase. On the other hand, the production and exports of tea are steadily increasing which contribute much to the progress of national economy. In this sense, the design of plywood mill for manufacturing tea-chest was attempted.

Although, it is considered necessary to construct a tea-chest mill for future development of tea industry, for construction of a mill, it is necessary to make detailed survey on availability of logs, mill site, marketability of products and other items. In this report we describe only outlines of tea-chest plant.

The outline of planned tea-chest mill is as follows.

7.3.1. Outline of tea-chest mill

1. Size of tea-chest	19" x 19" x 24"
2. Production	50,000 pcs./month 2,000 pcs./day
3. Thickness of plywood	3/16"
4. Species	Meru oak and other hardwood and softwood
5. Recovery	50%
6. Input of logs	26.28 m ³ /day
7. Shift	1 shift
8. Vapour pressure of dryer	6 kg/cm ²

Major Machines & Equipments and Required Fund

Item	No.	Value US\$
1. Deck saw	1 set	5,020
2. Hoist (3 ton)	1 set	7,350
3. Monorail for hoist	1 set	3,670
4. Rotary lathe (1,500 mm L)	1 set	124,300
5. Motor for lathe (37 kw)	1 set	36,800
6. Reeling and unreeling system	1 set	98,000
7. Synchroniser	1 set	17,020
8. High speed automatic clipper	1 set	46,500
9. Air compressor for clipper	1 set	5,180
10. High speed lifter	1 set	5,660
11. Knife grinder	1 set	41,600
12. Hand clipper	1 set	20,100
13. Veneer roller dryer	1 set	577,900
14. Grease spreader (4 rolls)	1 set	55,000
15. Conveyor	1 set	4,530
16. Table lifter	3 set	16,980
17. Glue mixer (250 kg)	1 set	5,220
18. Pre-press	1 set	53,700

19. Hot-press (15 steps)	1 set	153,500
20. Double saw set	1 set	163,200
21. Wide belt sander	1 set	68,500
22. Boiler	1 set	148,200
23. Dust collector	3 set	3,420
24. (including option)		30,330
Total		<u>CIF MOMBASA 1,691,680</u>

The total amount of machines and equipments is about U.S.\$1,700,000 (1978 price: 1 US\$ = ¥220) in which the import duty at Kenya is included but not local cost for mill construction and expenses for dispatching engineers for guidance of construction and production.

Mill building requires 15 m wide, 117 m long, and total area 1,755 m² (minimum overhead 4.5 m). When the mill is actually constructed, it is necessary to include these costs beside the price of machinery. These costs are considered to be approximately the same amount to the necessary fund for preparing machines and equipments.

7.4. Construction of particle board mill

Manufacture of particle board is one of the most reasonable industries for utilization of residues of wood processing mills and we examined the possibility of construction of particle board mill to utilize effectively waste wood of sawmills.

Notwithstanding, construction of particle board mill in Kenya involves some difficulties and we can not recommend the construction for the time being. The reasons are as follows.

(1) Material problem

From the world standards, the rational scale of particle board production is 30,000 ~ 50,000 ton per year which is on the increase in recent years. Suppose the annual production is 50,000 ton, the required material is nearly 100,000 m³ a year.

Even if the sawmill attained the modernization, the production scale is relatively small and the degree of regional concentration is low. Under such conditions, collection of large amount of waste wood is difficult from the viewpoint of cost. Even if the materials include thinned wood, for management of particle board mill of average production scale, it is difficult to collect required materials at reasonable price.

Particularly, a particle board mill is generally a highly automated industry which requires various installations. In order to reduce the production cost, it is absolutely necessary to maintain high degree of operation.

(2) Market of product

The important market of particle board is the production of furniture. Recently, in the U.S. and Scandinavian countries (Japan too), the product is increasingly used for construction, particularly shingle and sub-flooring board, but in Kenya the product is used for nothing but furniture. But the particle board in this country is not much used for furniture and even if much efforts are devoted to the development of demand, it is dangerous to expect that the market for particle board expands rapidly. If the overseas market is expected, the dominant market will be in the European countries. In the European countries, the tendency of surplus production facilities of particle board continues and such situation reflects on the price of product and considered to continue for some years to come and in the sector of particle board, it is considered extremely difficult that the product of Kenya can hold competitive power in the European market.

Particle board in itself is a product of less bearable burden of freight and the international trade in recent years are dominant within the European region, and in developing countries particle board mills were constructed so far in an expectation of exports but in many cases ended in disappointment and prudence is particularly needed in construction of particle board mill.

Lately, a small scale particle board mill is designed in an attempt to attach to wood processing mill and such mill is considered to attach to large scale wood processing complex to rely for its raw material supply on its own waste wood only, but such undertaking does not seem to meet the present situation of Kenya.

For above reasons, construction of particle board mill is to wait until these difficulties are solved.

CHAPTER VIII. MARKETING OF WOOD PRODUCTS

It goes without saying that at present, each mill is doing nothing for marketing. It should be done that the manufacturing cost of own product is accurately grasped and based on it, sale activity to be developed.

8.1. Domestic market

It is considered that sawmills in Kenya in respect to sale are under relatively favorable condition. Lately, with improvement of national life, the demand for sawnwood is increased and they do not feel any difficulty in selling their own products without doing particular sale campaign and resultantly, it is considered that cognizance of mill manager on the importance of marketing is lowered. In fact, we witnessed many customers were waiting the delivery of ordered goods.

Sufficient knowledge on timber demand and timber market is necessary for profitable sale of sawnwood and for this purpose, the market research is needed.

Nevertheless, it is difficult for mills scattered in various districts to do proper market research and employ sales-men for selling of the products. Therefore, it is desirable that provision of necessary basic materials for sawmill marketing or any assistance to actual sale are to be done by the joint enterprise of the industry or the government or the competent agencies.

The recommendable enterprise related to marketing is the construction of a timber yard. That is, a timber yard is constructed and products of many mills are collected there and sold to customers in Nairobi or in selected municipalities where more sawnwood products are consumed.

Merits of construction of timber yard are as follows.

- (1) To ensure saw millers of a stable operation by taking regular delivery of the member saw miller's production;
- (2) To establish a joint marketing system which would strengthen the bargaining position of their products, thus promoting the profitability of member sawmills and their sound management;
- (3) To provide the buyers with a variety of timber products, both in specifications and species, which each individual sawmiller would not be able to supply alone and thereby contribute to the improvement of marketing powers of the member sawmillers;
- (4) To facilitate one-stop-shopping for the benefits of the buyers.

It is suggested that the site and scale of timber yard should be decided taking consideration of scale of sawmill in each municipality and possibility of collection from sawmills.

The thinnest board which the sawmill in Kenya can produce is 25 mm board. That is one of the reasons for the low demand for thin board but the main reason is considered that present sawmilling facilities can not produce thinner board than that of 25 mm. Virtually, in components of housing construction materials, there should be considerable demand for board of 1 cm or less in thickness.

With application of modern band-saw mill, production of thin board is fully attainable. At present, wood from which 25 mm board can not be produced is wasted. If sawmilling is developed to produce 10 mm thick board, recovery ratio can raise up higher than planned 60% and for expansion of market for new materials which could be produced through modernization of mill, the whole industry should devote their efforts toward enhancing marketing.

8.2. Overseas market

In recent years, Kenya is exporting sawnwood products of 15,000 – 30,000 m³ yearly to Tanzania, Uganda, the European countries and others. Although the exports to the major market; Europe one of the major market, is on the decrease lately, this is considered due to severe requirement on quality on the part of Europe and the domestic consumption is on the increase.

In spite of the Kenyan export of timber for the European market being decreasing, from the long term point of view, the European market, especially that of the EEC countries, is still of the greatest importance.

The supply/demand situation in the European countries differs among them and the United Kingdom and the Netherlands are very much dependent on their imports of timber. Furthermore, the Federal Republic of Germany, endowed with large forest resources, imports a large portion of consumption of forest products and, for instance, one third of its consumption of softwood lumber comes from abroad. Sawnwood production of France including sawnwood from imported logs is nearly 85% of domestic demand. It is predicted that in future, timber consumption in European countries increases to a large extent and according to "European Timber Trends And Prospects, 1950 – 2000 (1977)" published as findings of joint survey of ECE and FAO, while the total timber consumption (roundwood equivalent) in Europe was 400 million m³ in 1970, it is estimated at 765 million m³ in 2000 and accompanied by such situation, more imports of sawn softwood is anticipated and it is expected that there will be a possibility of increased exports of Kenyan sawnwood.

The important items in sawnwood consumption in Europe, especially among the EEC countries are construction, furniture and joinery materials. Construction timber, particularly structural timber is supplied from Canada and Nordic countries. Some countries, especially the United Kingdom, the largest importer, requires stress graded timber.

Considering species and characteristics of Kenyan wood, interior joinery and furniture

facture furniture and joinery are demanding quality controlled products based on a given specifications. The exportable products, not to say about necessity of reasonable price, should meet the requirement of the consumer country in species, size, quality and precision of dimension.

The sawnwood produced in Kenya can not meet with the requirement of processing mill of industrialized country in quality and precision of dimension. Unless the product is fully managed by the modern facilities, it can not develop the export market.

The second requirement in the overseas market is the continuous supply. Selection of materials by the industrialized processing mill is dependent upon whether or not the materials can be supplied in stabilized quantity and price. The materials supplied sporadically or of unreliable delivery, even if the price is reasonable, can not be used at the highly mechanized plant. Continuity and stability of supply are the important factors. To ensure these factors, the timber yard plays an effective roll.

Sufficient market research is needed for development of overseas market of Kenyan sawnwood and under the cooperation of International Trade Center (Geneva) and other international agencies, it is necessary to carry out the market research or sale promotion of Kenyan wood. It is important to know what the market wants.

8.3. Construction of timber yard

Construction of timber yard requires building and land. The land price differs greatly among big cities, local towns and their vicinities and as the site is not yet decided now, the required fund is hard to estimate.

The building's area and required fund for construction in the local city is as follows.
(Domestic money)

Monthly lumber sales	2,000 m ³
Rotation	2 times/month
Capacity per unit area	2 m ³ /m ²
Required area for building	500 m ²
Required fund for construction	725,000 ksh (US\$92,710)
(500 m ² × 1,450 ksh = 725,000 ksh)	

Remark: Unit price of construction is subject to ICDC proposed price.

CHAPTER IX. TRAINING CENTER

As organizations of training skill, FITC (Forest Industries Training Centre) and KITI (Kenya Industrial Training Institute) are available. The woodworking sector of KITI is provided with necessary facilities for training of woodworking technique and is considered to contribute to the training of leaders of wood processing sector in future but FITI which is responsible for sawmilling sector does not fulfill its function because most of facilities were lost by fire.

For the training of employees who support the development of wood industry, it should play more positive role. For this purpose, machines and equipments of Type A sawmill level now under planning should be installed, with and if possible, it is desired that some of wood-working machinery is attached to. It is a matter of government decision whether the facilities are installed in FITI or the facilities are transferred to the control of the proposed TDC. Anyway, proper consideration should be paid that the sale of products which might be carried out as secondary business of the training organization will not hinder the private enterprise. In order to implement modernization of sawmill effectively, it is necessary to introduce the technology of advanced nations positively and it is also necessary to accept the dispatch of technical leaders for a long term for construction of mills or to dispatch specialists to developed countries for training.

The training centre will have to provide other machines and equipments than the sawmill but for the current purpose to educate sawmill workers at FITC, the machines and equipments of Type A sawmill are provided.

In this case, the required fund for machines and equipments and construction is the same as shown in 5.2.1 and 5.5. The total required fund is as follows.

Required fund for construction	
Foreign currency	US\$334,690
Domestic currency	US\$452,480
Sub-total	US\$787,170
Cost of dispatching construction experts	US\$ 9,940 (3rd class one 3 months) (¥2,187,000)
Cost of dispatching instructors	US\$115,800 (2nd class one 2 months) (3rd class one 2 months) (¥25,467,000)
Total	US\$912,910

Training course

a. Sawmilling techniques course

Trainees: 10 (graduates of middle school)
Period: 6 months
Major items: General knowledge on timber – wood conversion – quality control – inspection
Machine operation
Machine structure

b. Saw doctoring course

Trainees: 10 (graduates of middle school)
Period: One year
Major items: General knowledge on timber
Machine structure
Machine operation
Saw doctoring – saw welding – stretching – tensioning – swage and shaper

CHAPTER X. PLANNED IMPLEMENTATION OF MODERNIZATION

It is necessary by all means to introduce new and efficient machines and equipments for modernization of existing sawmills. Notwithstanding, this is not all the means to attain modernization of wood industry. For effective management of modern facilities, appropriate guidance of experienced leaders and training of employees on skill are needed. In the wood industry of Kenya, experienced workers in charge of mill management are extremely in deficit and it is urgently needed to fill up the organization to perform these trainings.

For modernization of sawmill and introduction of new wood industry, and well balanced, prudent and planned development progress of market are desired.

10.1. Annual plan for modernization

When the machines and equipments of sawmill are improved and effective band-saw mill is introduced instead of circular saw mill, the recovery ratio is raised up and supply of sawnwood is increased, while it is natural to consider that input of log rises due to improvement of facilities. This means a remarkable increase of supply of sawnwood.

When rationalization and modernization of planned sawmill are implemented almost simultaneously, it is clear that there is a possibility to invite rapid increase of supply of sawnwood to the market and as a result, there is another possibility that over-supply brings about confusion of sawnwood market.

In consequence, in implementing modernization of existing sawmill, facility increase well balanced with the expansion of market, is desirable. Then, the annual plan for improvement of facilities is needed.

In the case of introduction of a new industry, acceptance of products by the market and training of employees need fairly a long term. Based on careful annual plan, systematic implementation is desired.

In this report, suppose the modernization of timber industry is implemented in 3 years, the required fund is figured out as follows. According to this plan, the details of mill construction plan is as follows.

Table 23. Yearly plan of establishment of mills

	First Year	Second Year	Third Year	Total
Sawmill (A Type)	3	3	2	8
Sawmill (B Type)	3	3	2	8
Briquette mill	1	1	1	3
Secondary processing mill	1	1	1	3
Tea-chest factory		(Survey)	1	1
Timber yard	1	1	1	3
Logging facilities	1/3	1/3	1/3	

Remarks: Expansion of logging facilities should be carried out one-third of the total planned equipments accompanied with the modernization of sawmills.

In regard to mill site, particularly in case of sawmill, mills should be scattered in NYAHURURU, NAKURU and NYERI where existing mills are somewhat concentrated and construction of modern mills should be selectively promoted.

It is considered pertinent that waste wood briquette mill would be built at each mill in NYAHURURU, NAKURU and NYERI where sawmills are rather gathered.

Construction of secondary processing mill should take consideration of market of products. Preferably, mills are located in the center of wood industry or densely populated cities as NAIROBI, NYERI and NAKURU.

Construction of tea-chest mill will need further survey but considering tea production and possibility of supply of national forest timber, EMBU or MERU would be recommendable.

CHAPTER XI. REQUIRED FUND FOR MODERNIZATION

For implementation of modernization of wood processing industry, a large amount of money is required. Such fund for construction of each industry and the management account are shown in respective section. The required fund for construction under the annual plan is shown in 11.1.

When the modernization is implemented based on the annual plan, it is necessary to estimate the rise of the price of machines and other expenses in future. In the trial calculation of this plan, the price is on the estimation of annual increase of 7%. However, it is considered that local cost as construction will increase faster than the above and in this plan, the calculation is made on the assumption of annual increase of 8%.

11.1. Construction fund for plant, etc.

Table 24. Required fund for modernization of timber industry (US\$)

Facilities	No. of Construction	Required fund	
		Foreign money	Domestic money for construction, etc.
First year			
Training center	1	299,320	452,480
Sawmill A	3	1,004,070 (334690 × 3)	1,357,440 (452480 × 3)
Sawmill B	3	391,290 (130430 × 3)	407,520 (135840 × 3)
Briquette plant	1	96,930	48,300
Secondary processing plant	1	331,210	187,460
Timber yard	1		92,710
Total of the first year		2,122,820	2,545,910
Second year			
Sawmill A	3	1,074,360	1,466,040
Sawmill B	3	418,680	440,120
Briquette plant	1	103,720	52,170
Secondary processing plant	1	354,400	202,460
Timber yard	1		100,130
Total of the second year		1,951,200	2,260,920

Third year			
Sawmill A	2	685,380	1,055,550
Sawmill B	2	298,660	316,900
Briquette plant	1	110,980	56,350
Secondary processing plant	1	379,200	218,660
Timber yard	1		108,140
Total of the third year		<u>1,474,220</u>	<u>1,755,600</u>
Chest plant	1	1,936,800	1,900,000 (Est.)
Total		<u>3,411,020</u>	<u>3,655,600</u>
Grand Total		7,485,040	8,462,430

Remarks: Cost of logging facilities is included in sawmill.

Summarization of the above for planned three years is as follows.

Table 25. Total cost for modernization of plants (Unit: US\$)

	No. of plant	Foreign money	Domestic money	Total
Training center	1	299,320	452,480	751,800
Sawmill A	8	2,763,810	3,845,990	6,608,800
Sawmill B	8	1,108,630	1,154,620	2,263,250
Briquette plant	3	311,630	155,280	466,910
Secondary processing plant	3	1,064,810	602,660	1,673,390
Timber yard	3		298,060	298,060
Sub-total			6,562,430	12,110,630
Chest plant	1	1,936,800	1,900,000	3,836,800
Total		7,485,040	8,462,430	15,947,470

Beside the above, if the expenses for dispatching engineers for plant construction and operational guidance amounting about US\$230,000 is added, except the tea-chest plant which needs survey, the total of about US\$12,300,000 is required.

11.2. Dispatching engineers for plant construction, etc.

Dispatching of experts is needed for installation of machines in sawmill A and B types, briquette plant and secondary processing plant, trial operation and training of skilled workers.

11.2.1. Basic idea of dispatching experts

(1) Training center

From installation of sawmill machine, experts are dispatched to educate basic technology of sawmilling for training of instructors of sawmill and saw-doctoring in Kenya.

Period: Two years (long term)

Qualification: One senior engineer (sawmill technique)
One technical expert (saw doctoring)

(2) Sawmills Type A and B

Experts are dispatched for installation of machine, trial operation and education of skilled workers for sawmills A and B inclusively.

Period: One year (long term)

Qualification: Two technical engineers

Selected: From private enterprise

(3) Briquette plant

Experts are dispatched to educate skilled workers and instruct machine installation and trial operation.

No. of expert: 1

Period: 6 months (3 times in the 1st, 2nd and 3rd years)

Selected: From private enterprise

(4) Processing plant

Experts are dispatched for machine installation, trial operation and training of skilled workers.

No. of expert: 1

Period: 2 months (3 times in the 1st, 2nd and 3rd years)

Qualification: Technical engineers

Selected: From private enterprise

11.2.2. Rough estimate of cost of dispatching experts

The cost of dispatching experts to each plant of the preceding paragraph is as under based on the standard of JICA.

Table 26. Cost of dispatching experts (Unit: ¥1,000)

Item	Unit price	Training centre		Sawmill		Briquette		Second. processing	
Experts		Class 2, 1 person Class 3, 1 person		Class 3, 2 persons		Class 3, 1 person		Class 3, 1 person	
Outfitting allowance	Class 2 180.0 Class 3 165.0		180.0 165.0	2	330.0	1	165.0	1	165.0
Air freight	426.0	2	1,704.0	2	1,704.0	1	852.0		852.0
Daily allowance	Class 2 3.8 Class 3 3.2	days 6	22.8 19.2	days 6	38.4	days 90	288.0	days 60	192.0
Lodging	Class 2 11.4 Class 3 9.8	days 4	456.0 392.0	days 4	784.0	days 90	882.0	days 60	588.0
Basic allowance of service	Class 2 277.3 Class 3 259.8	Mon. 24	6,655.2 6,235.2	Mon. 2	6,235.2		-		-
Arrival allowance	Class 2 152.0 Class 3 130.0	1 1	152.0 130.0	Person 2	260.0		-		-
Domestic allowance	Class 2 228.0 Class 3 194.0	Mon. 24	5,472.0 4,656.0	2 12	4,656.0		-		-
Total			25,476.2		13,302.0		2,187		1,979
Grand total			25,476.2	times 1	39,906.0	times 3	656.1	times 3	5,391

	(¥1,000)	1,000 ksh	US\$
Training centre	25,476	906	115,800
Sawmill	39,906	473	60,500
Briquette plant	6,561	233	29,800
Secondary processing plant	5,391	192	24,600
Total	77,334	1,804	230,700

- Note: (1) Subject to JICA standards
(2) Share of sawmill is 2/3 of A mill and 1/3 of B mill
(3) Exchange rate: US\$1 = 7.82 ksh = ¥220

CHAPTER XII. REDEMPTION OF INVESTMENT

The investment in equipment of sawmill, briquette plant and secondary processing plant is covered by loan and the interest rate is assumed to be 4% per annum for foreign money and 10% per annum for domestic money.

Loan condition

Interest	Foreign money	4% per annum
	Domestic money	10% per annum
Term	15 years	
Redemption	Deferment of 2 years: uniform redemption of the principal for 13 years.	

Redemption plan of respective plant is as follows.

Table 27. Redemption plan for A type sawmill

A plant

Redemption of fund – A plant (Unit: 1,000 ksh)

Foreign money: 2,833 (Interest per annum 4%) Domestic money: 3,539 (Interest per annum 10%)

$3,064 \div 13 = 236$ uniform

Yearly	Foreign money				Domestic money				Total repaid
	Principal	Interest	Repaid	Balance	Principal	Interest	Repaid	Balance	
1				2,946				3,539	
2		117		3,064				3,892	
3	236	123	359	2,828	300	389	689	3,592	1,048
4	236	113	349	2,592	300	359	659	3,292	1,008
5	236	104	340	2,356	300	329	629	2,992	969
6	236	94	330	2,120	300	299	599	2,692	929
7	236	85	321	1,884	300	269	569	2,392	890
8	236	75	311	1,648	300	239	539	2,092	850
9	236	66	302	1,412	300	209	509	1,792	811
10	236	56	292	1,176	300	179	479	1,492	771
11	236	47	283	940	300	149	449	1,192	732
12	236	38	274	704	300	119	419	892	693
13	236	28	264	468	300	89	389	592	653
14	236	19	255	232	300	59	359	292	614
15	232	9	241	0	292	29	321	0	562

Table 28. Redemption plant for B type sawmill

B plant

Redemption of fund – B plant (Unit: 1,000 ksh)

Foreign money: 1,073 (Interest per annum 4%)

Domestic money: 1,063 (Interest per annum 10%)

$1,116 \div 13 = 86$

$1,169 \div 13 = 90$

Yearly	Foreign money				Domestic money				Total repaid
	Principal	Interest	Repaid	Balance	Principal	Interest	Repaid	Balance	
1				1,073				1,063	
2				1,116				1,169	
3	86	45	131	1,030	90	117	207	1,079	338
4	86	41	127	944	90	108	198	989	325
5	86	38	124	858	90	99	189	899	313
6	86	34	120	772	90	90	180	809	300
7	86	31	117	686	90	81	171	719	288
8	86	27	113	600	90	72	162	629	275
9	86	24	110	514	90	63	153	539	263
10	86	21	107	428	90	54	144	449	251
11	86	17	103	342	90	45	135	359	238
12	86	14	100	256	90	36	126	269	226
13	86	10	96	170	90	27	117	179	213
14	86	9	95	84	90	18	108	89	203
15	84	3	87	0	89	9	98	0	185

Table 29. Redemption plan for briquette plant

Briquette plant

Redemption of fund – Briquette plant (Unit: 1,000 ksh)

Foreign money: 675 (Interest per annum 4%)

Domestic money: 84 (Interest per annum 10%)

$702 \div 54 = 13$

$92 \div 13 = 7.1$

Yearly	Foreign money				Domestic money				Total repaid
	Principal	Interest	Repaid	Balance	Principal	Interest	Repaid	Balance	
1				675				84	
2				702				92	
3	54	28	82	648	7.1	9.2	16.3	84.9	98.3
4	54	26	80	594	7.1	8.5	15.6	77.8	95.6
5	54	24	78	540	7.1	7.8	14.9	70.7	92.9
6	54	22	76	486	7.1	7.1	14.2	63.6	90.2
7	54	19	73	432	7.1	6.4	13.5	56.5	86.5
8	54	17	71	378	7.1	5.7	12.8	49.4	83.8
9	54	15	69	324	7.1	4.9	12	42.3	81
10	54	13	67	270	7.1	4.2	11.3	35.2	78.3
11	54	11	65	216	7.1	3.5	10.6	28.1	75.6
12	54	9	63	162	7.1	2.8	9.9	21	72.9
13	54	6	60	108	7.1	2.1	9.2	13.9	69.2
14	54	4	58	54	7.1	1.4	8.5	6.8	66.5
15	54	2	56	0	6.8	0.7	7.5	0	63.5

Table 30. Redemption plan for secondary processing plant

Secondary processing plant

Redemption of fund – Secondary processing plant (Unit: 1,000 ksh)

Foreign money: 2,590 (Interest per annum 4%) Domestic money: 1,466 (Interest per annum 10%)

$2,694 \div 13 = 208$

$1,613 \div 13 = 125$

Yearly	Foreign money				Domestic money				Total repaid
	Principal	Interest	Repaid	Balance	Principal	Interest	Repaid	Balance	
1				2,590				1,466	
2				2,694				1,613	
3	208	108	316	2,486	125	161	286	1,488	602
4	208	99	307	2,278	125	149	274	1,363	581
5	208	91	299	2,070	125	136	261	1,238	560
6	208	83	291	1,862	125	124	249	1,113	540
7	208	74	282	1,654	125	111	236	988	581
8	208	66	274	1,446	125	99	224	863	498
9	208	58	266	1,238	125	86	211	738	477
10	208	50	258	1,030	125	74	199	613	457
11	208	41	249	822	125	61	186	488	435
12	208	33	241	614	125	49	174	363	415
13	208	25	233	406	125	36	161	238	394
14	208	16	224	198	125	24	149	113	373
15	198	8	206	0	113	11	124	0	330

CHAPTER XIII. ECONOMIC EFFECT AND PROBLEMS OF MODERNIZATION OF TIMBER INDUSTRY

For promotion of modernization of timber industry, a large amount of money is required and its effect upon the national economy is quite large. It is not always easy to evaluate quantitatively but the profitability of sawmill, briquette plant and processing plant is considerably high and the ability of redemption to the investment is considered enough.

Some of effects of modernization of timber industry are as follows.

(1) Effective utilization of timber resources

Most of sawmills at present are old-fashioned and the yield percentage of conversion is quite low and much residuals like saw-dust are unused and thrown away. The modernization of sawmill almost doubles the products from valuable timber resources and gives a large merit to the national economy.

In addition, the manufacture of briquettes with sawdust is quite important to the national economy since it produces daily necessities through the effective utilization of unused resources and it controls the uncontrolled timber felling for fuel collection which contributes to the national land safeguard.

(2) Improvement of quality of products

When the timber mill is modernized, the quality of timber products is greatly improved and the stable supply of best products can be attained to the housing construction and furniture industry.

(3) Raising up of licence fee

When the sawmill is modernized and timber recovery rate is made higher, it is possible to raise the licence fee for felling of national timber and then, with this fund, intensive forest management can be attained.

(4) When new mills are constructed, the local employment is promoted and they contribute to the development of local economy.

(5) The introduction of new techniques to the sector of timber processing, stimulates the existing mills and contributes to the improvement of overall technology.

Notwithstanding, the implementation of such modernization plan accompanies some problems.

(1) The core of such project is the private enterprise and its scale is relatively small and in order that the government may afford aid smoothly to such enterprises, there will be more difficulties than the usual project.

(2) Beside the timber mills to be modernized, there are some mills of market-oriented timber industry in big cities.

- (3) Unless the project of non-profitmaking sector such as reinforcement of training facilities is implemented simultaneously, the effectiveness of modernization can not be manifested.
- (4) When modernization plan is realized, stable supply of logs of 150,000 m³ is needed every year and eventually, more intensive forest management is required.

CHAPTER XIV. GOVERNMENT'S MEASURES TO BE TAKEN FOR IMPLEMENTATION OF MODERNIZATION PLAN

While we have discussed on the present situation, problems and modernization of sawmill, in order to solve various problems and promote modernization, there are many difficulties in the sectors of funds and technology.

For smooth promotion of the modernization, the pertinent guidance to be taken by the Government of Kenya is desired for. Important measures now being considered are as follows.

14.1. Promotion of joint-ownership of sawmill and joint venture

The mills surveyed have their own problems and the common problems which each mill confronts the solution. The common problems are:

- a. Repair system of sawmill machines and logging facilities
- b. Establishment of timber yard for sale of products.
- c. Utilization of residues as sawdust.

It is quite effective that neighbouring mills cooperate in solution of these problems.

There would be two ways for solution. The one is to establish new facilities at the present location and promote the solution of common problems and the other is that each mill concentrates in one complex and coordinates the production items of each mill and establish the facility for solution of common problems at the same site.

In case of promotion of joint enterprise, the members share the cost and expenses of construction, machines and equipments and when the fund is in short, it would be necessary that the Government will finance the fund or subsidize the interest. In order to expedite the enterprise effectively, preferential taxation would be desirable.

When the complex is established for promotion, the State build up the sawmill complex and ineffective sawmills near the forest are removed and concentrated in one complex where the electricity is available.

In this case, the State bears the expenses of procurement and establishment of site and the mill pays the expenses of procurement of mill site, construction of sawmill, machines and equipments and installation of joint facilities. It would be effective if the State takes measures of loan or subsidy for these expenses.

The followings are considered particularly necessary to recommend or subsidize in the joint facilities of sawmills.

- a. Joint saw doctoring shop
- b. Joint repair shop of sawmill machines
- c. Joint repair shop of logging facilities

- d. Common yard of sawnwood products.
- e. If necessary, joint processing mill for flooring board, panel parquett and components of furniture.

It would be effective that these joint facilities are established in and near NAKURU, MOLO, HYAHURURU, NYERI, EMBU and MERU. Sawmill complex is supposed to be near NAKURU and NYERI.

14.2. Measures to renew the facilities of sawmill

For rationalization and modernization of machines and equipments of sawmill, the government's positive policy and aids are desired for.

The policies under consideration are as follows.

14.2.1. System of a long term loan at low interest

Along with modernization plan of sawmill, when machines and equipments are renewed or a new mill is built, it is desired that the government establishes a system to loan a whole or a part of the fund for construction.

Samples of such loan are as follows.

- (1) Debtor – Sawmillers having felling licence or their cooperative society
- (2) Term of a loan – within 15 years
- (3) Interest rate per annum – 4% for foreign money, 10% for domestic money
- (4) Redemption – deferment of 2 years. Payment by uniform installments – 13 years

14.2.2. Lease system of machines and equipments

For promotion of modernization of machines and equipments of sawmill, it is desirable to take a system that the government purchases such machines and equipments and lends them sawmills and after a given period, transfers them.

An example of this system is shown below.

- (1) Borrower – Sawmiller or their cooperative society
- (2) Term of loan – within 10 years
- (3) Rent – 7% interest per annum for balance of loan
- (4) With the proposal of the sawmiller during the term, the government sells the machine and equipments at balanced price.
- (5) Machines and equipments considered pertinent for loan will be:

Carriage with setworks (circular head saw)

Bandsaw mill with carriage

Auto table

Table band-saw mill with roller
Table band-saw mill
Cross-cut saw
Ripper
Log transport facilities
Conveyor
Saw sharpener
Forklift
Insecticide injection can
Wood working machine (including sander)
Lorry
Tractor
Loader
Chainsaw
Chipper
Shearing machine
Press machine
Briquette manufacturing machine

14.2.3. Preferential measures for taxation

When machines and equipments of sawmill are in need of rationalization or modernization, it is desirable to take a preferential measures as reduction of years of depreciation or tax reduction for certain types of machines and equipments.

In this survey, machines and equipments in need of modernization are as follows.

- (a) Band-saw mill
- (b) Carriage with setwork
- (c) Forklift
- (d) Electric receiving board
- (e) Vehicle such as lorry, tractor
- (f) Wood waste briquette manufacturing machine

It would also be effective that measures to shorten the depreciation year, exemption or reduction of taxes for designated machines and equipments.

14.3. Expansion of training facilities for sawmilling technique

As the mills we visited are scattered near the forest or in the urban area, it is difficult for a mill to know the situation of other mills. Still more, it is more difficult to learn sawmilling technique of other mills to contribute to the improvement of technology of its own.

For this purpose, it is advisable that the State completes the training facilities of sawmilling techniques to help the sawmill and efforts are made to train and educate sawyers.

The training centre for sawmilling is to be provided with following machines and equipments. However, for the time being, at least sawmill facilities are required.

- (a) Modern line
 - 1. Band-saw mill with auto carriage
 - 2. Auto table band-saw mill
 - 3. Roller band-saw mill
 - 4. Table band-saw mill
 - 5. Cross-cut saw
- (b) Existing line
 - 1. Circular head saw
 - 2. Circular saw mill for resawing
 - 3. Cross cue saw
- (c) A set of saw sharpening machines
- (d) Insecticide impregnation can
- (e) Woodworking machines
- (f) Circular saw mill for firewood
- (g) Chipper
- (h) Wood waste briquette manufacturing facilities
- (i) Grading and assorting place for sawnwood
- (j) Arrangement of sawnwood and storage
- (k) Trainees' lodging
- (l) Establishment of a system to send each mill instructors of sawmilling technique
- (m) Introduction of sawmilling technique of overseas, for example, from Japan
 - 1. Visit to Japanese sawmills should be seriously considered, and training of managers and foreman of major sawmills in Japan should also be considered.
 - 2. A system to invite experts from Japan is to consider.

14.4. Reinforcement of guidance and subsidization to marketing activity

The sawmill is generally small in scale and still more, each mill is scattered in many parts of the country and as a result, there are various problems.

Although reinforcement of marketing is preferably promoted by individual mill, it is rather difficult to appoint a salesman at each mill and collect market information. It is desired that the State would make its efforts toward helping the market promotion activities of sawmill as well as the progressive guidance and strong subsidization for the improvement of machines and equipments.

As for marketing, the following matters are in need.

- (a) Subsidization to yard facilities of sawnwood.
- (b) Reinforcement of guidance on transport and distribution structure of sawnwood.
- (c) Reinforcement of guidance on quality and specifications of sawnwood.
- (d) Promotion of development of demand and extension of sawnwood.
- (e) Implementation of informative measures of market information of sawnwood.
- (f) Development of market of wood products and collection of market information abroad.

CHAPTER XV. OPINION TO THE ESTABLISHMENT OF PROPOSED TDC

The government should give direction and appropriate measures for the modernization of wood industry. The institutional requirement for such modernization should be left to the descretion of the government.

However, the establishment of a specialized agency will be essential for achieving the modernization. Particularly in the present situation where there is no association of sawmillers and related industries, the creation of an organization like the proposed TDC may indeed be imperative. TDC should be empowered to take such measures to be taken by the government as discussed in Chapter X.

The operation of TDC should not, however, kinder the activities of private enterprises.

CONCLUSION AND RECOMMENDATIONS

The forest area of Kenya is small. The country can not be regarded rich in forest resources. Among the wood based industry, sawmilling is a dominant sector. In addition a considerable number of wood processing mills are also in operation. Most of the machinery and equipments are out of date and their performance lacks efficiency. Modernizing the industry will lead to the more effective utilization of forest resources and the better operation results of sawmills and other wood based industry.

For the modernization of timber industry, the following actions are recommended:

- (1) The old type circular saw mill of existing sawmills should be switched over to efficient bandsaw mill to improve production efficiency and recovery rate.
- (2) Logging facilities of sawmill is extremely inadequate and should be improved.
- (3) It is advisable to establish briquette plant for utilization of waste wood, particularly saw dust. Such action would also be effective in preventing uncontrolled felling tree for fuel and conserving the forest resources.
- (4) For overall development of wood industry, processing plants for secondary timber products should be build as a joint enterprise of sawmillers to manufacture components of furniture and housing.
- (5) It is considered reasonable that tea-chest plant should be constructed to support the promotion of tea exports. For this purpose, further detailed survey is needed.
- (6) The construction of particle board plant for utilization of wood waste poses a problem of collection of materials and market of product, and therefore, should be deferred for future considerations.
- (7) Training of employees in factory operations is essential and therefore, training centres should be equipped to provide effective training.
- (8) A phased approach based on annual planning is necessary for the implementation of the modernization plan. If all the above-mentioned 16 sawmills are modernized at the same time, it may result in excessive supply of products. Hence, the tempo of modernization should be set against the rate of increase in demand.
- (9) Action by the government is also called for; The establishment of proposed TDC as an executive organ would be appropriate. However, the function of TDC should be defined in such a way as to avoid undermining of private industry initiatives.

The objective of the modernization of the wood industry is to enhance the national economy by utilizing effectively the present and future timber products and hereby supplying at a stable basis essential goods for the living. Therefore, the expansion of the production capacity of wood industry should be closely correspondent with the lumber supplying capacity of the forest.

Particularly, most of raw materials of wood industry of Kenya are softwood from man-made forest. The demand of softwood timber in the world as a whole has been increased quite rapidly in recent years for construction and paper production materials. By the end of this century, it is estimated that there would be deficit in supply in some industrialized area. Softwood in Kenya has a possibility to contribute to the national economy in future far much more than now. While the effective utilization of timber is promoted, more efforts should be made toward intensification of the management of forests including man-made forest to accumulate the forest resources. If the modernization of wood industry brings about the depletion of forest resources and erosion of land, the modernization of wood industry would not only be meaningless but also would result in the irrecoverable loss to the nation.

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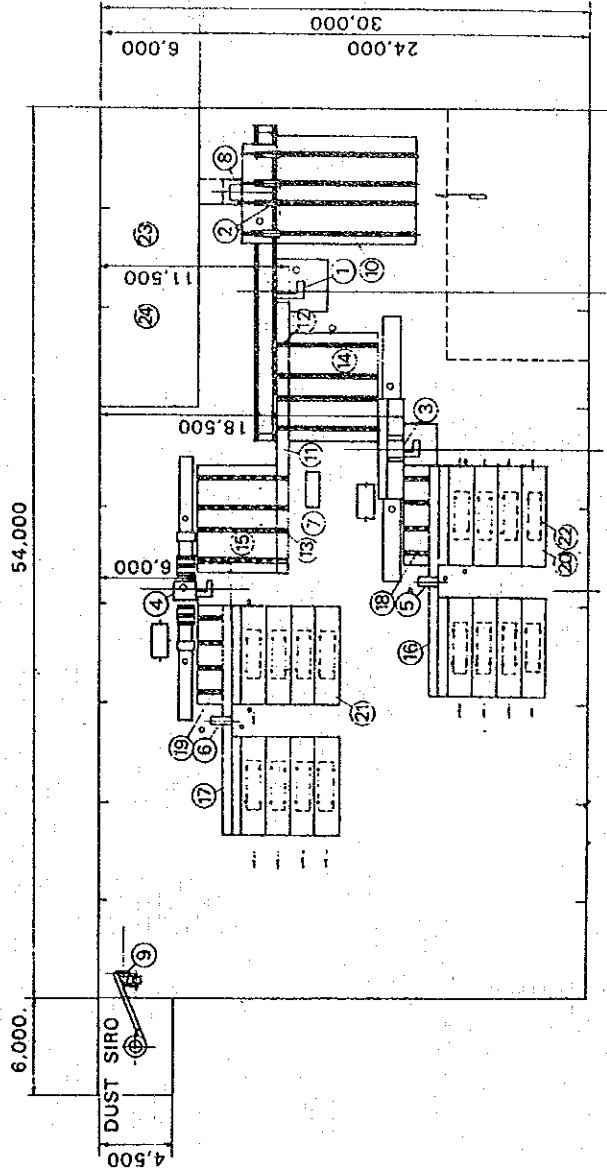
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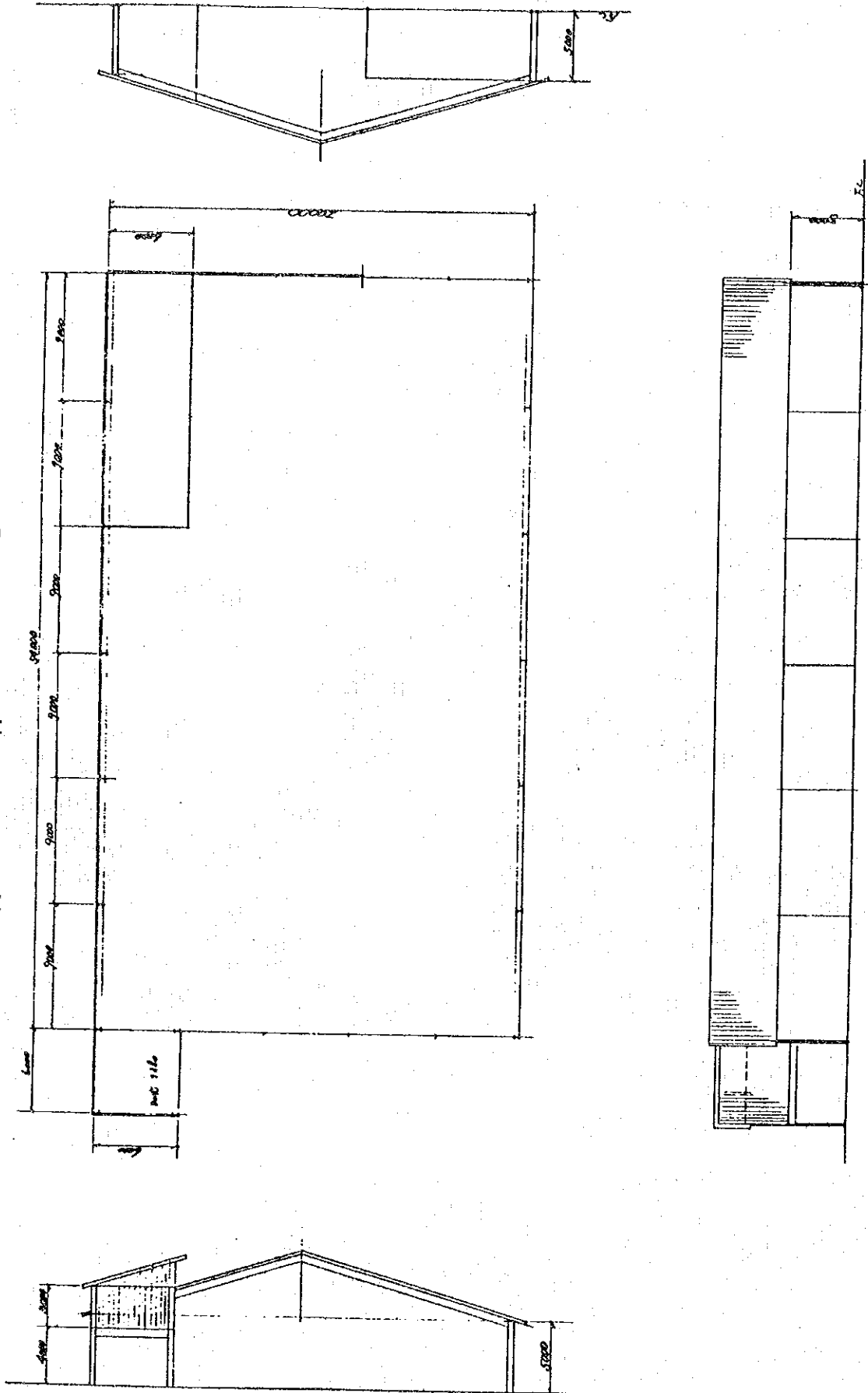
Appendix 1 LAYOUT OF SAWMILLING PLANT Type A



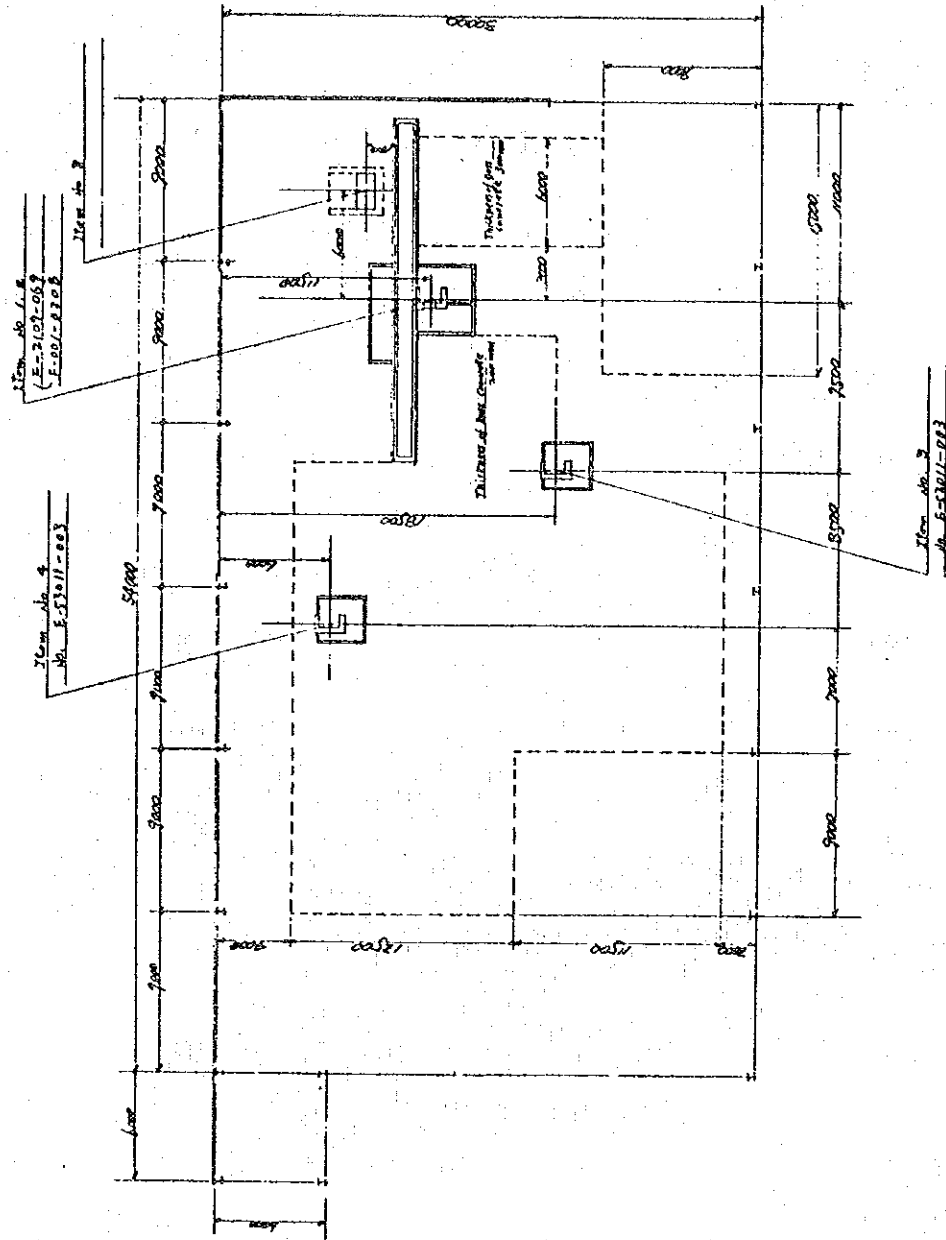
PARTICULARS

No.	NAME	SPECIFICATION	POWER	REMARKS
1	BAND SAW MILL	GCF 1200 Type	55KW 6P 1.5KW 4P 0.4KW 4P	
2	AUTOFEED CARRIAGE WITH ELECTRIC NETWORK	No of headblock 4P opening of headblock 900mm with electric network system	7.5KW 6P 11KW 6P 3.7KW 4P 0.75KW 4P	
3	BAND SAW MILL WITH AUTO TABLE	GCF 1100 Type AT-180 Type auto table	22KW 6P 1.5KW 4P 0.4KW 4P 2.2KW 4P 0.2KW 0.4KW	
4	BAND SAW MILL WITH ROLLER TABLE	GCF 1100 Type	22KW 6P 1.5KW 4P 0.4KW 4P 0.75KW 4P 1.5KW 4P	
5	CROSS CUT SAW	T-24 Type	2.2KW 4P	
6	CROSS CUT SAW	T-24 Type	2.2KW 4P	
7	AIR COMPRESSOR	Capacity 5TON	3.7KW 4P	
8	LOG TURNER	CKS-300 Type	5.5KW	
9	DUST COLLECTOR		22KW 4P	
10	CHAIN LIVE DECK	6.0m(L) x 4line		
11	LIVE ROLLER	165P x 600m x 750P x 77.0m arm 4P	2.2KW	
12	LIFT SKID			
13	LIFT SKID			
14	CONNECTIN			
14	CONNECTION ROLLER	5.0m(L) x 4line		
15	CONNECTION ROLLER	5.0m(L) x 4line		
16	DEAD ROLLER	500m x 700P x 13.0m(L)		
17	DEAD ROLLER	500m x 700p x 13.0m(L)		
18	CONNECTION ROLLER	1.5m x 4line		
19	CONNECTION ROLLER	1.5m x 4line		
20	BRIDGE SEPARATOR	8P		
21	BRIDGE SEPARATOR	8P		
22	TRUCK	TGP		
23	BAND SAW SHARPENER	CKS-M Type	0.75KW	
24	BAND SAW STRETCHER	T-M Type	0.4KW	

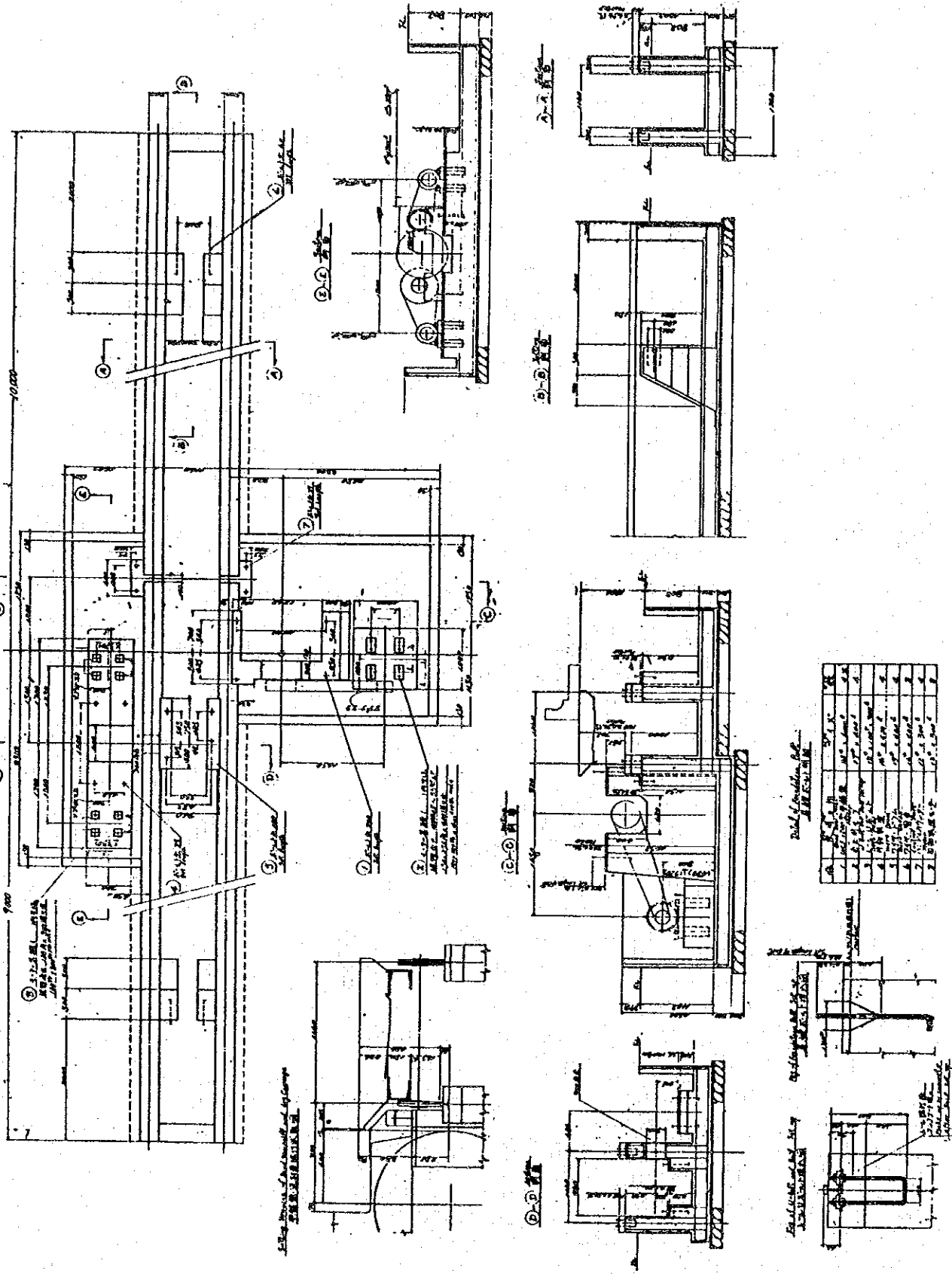
Appendix 1-1 TypeA BUILDING



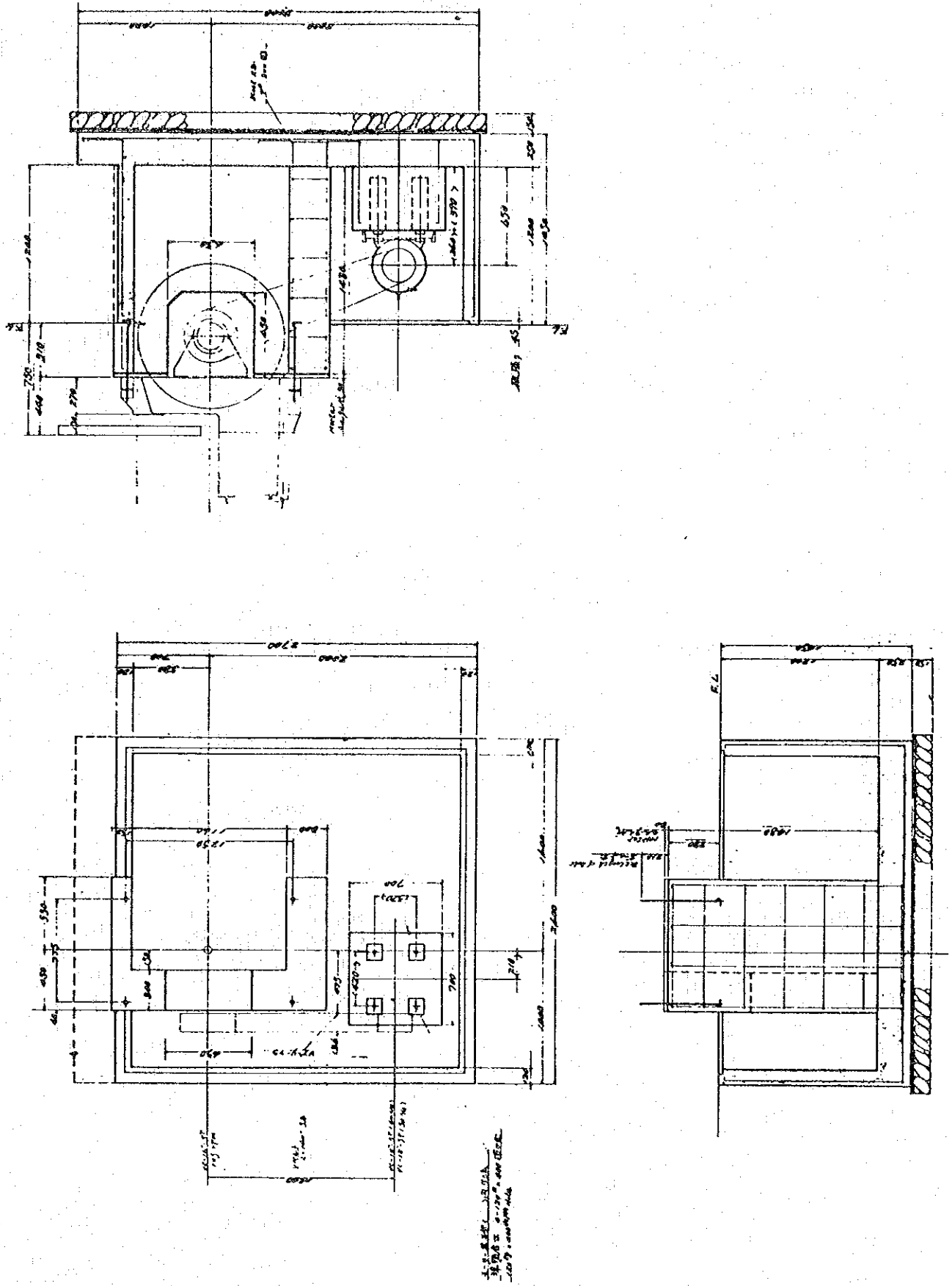
Appendix 1-2 Type A FOUNDATION



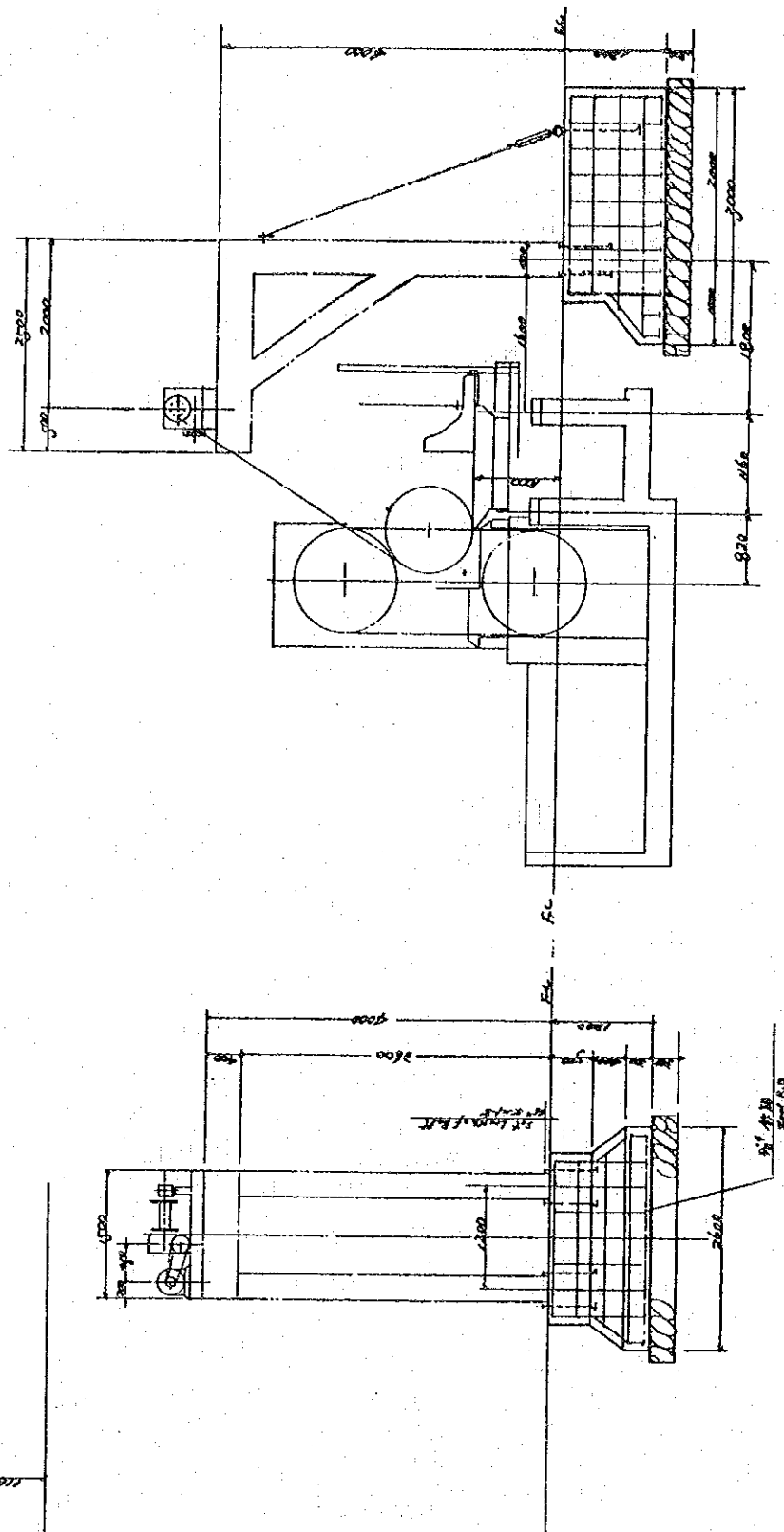
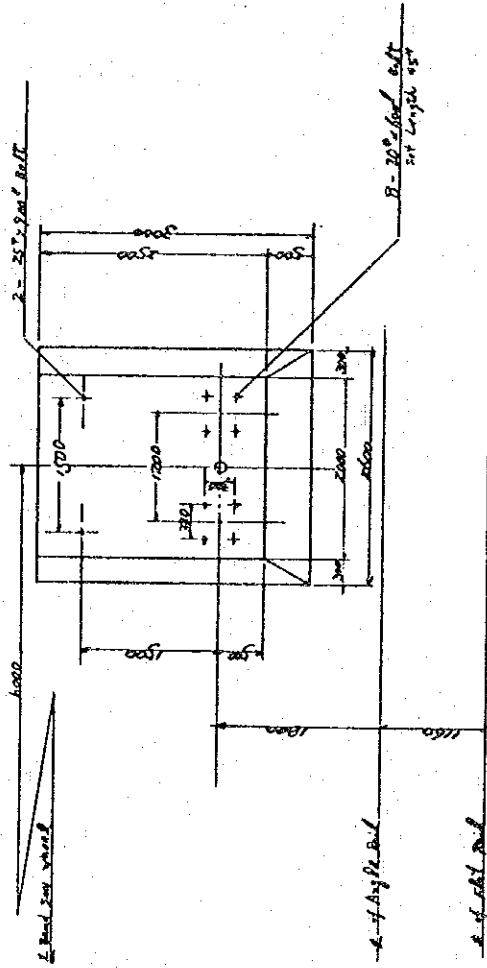
Appendix 1-3 Type A FOUNDATION OF MAJOR MACHINERY



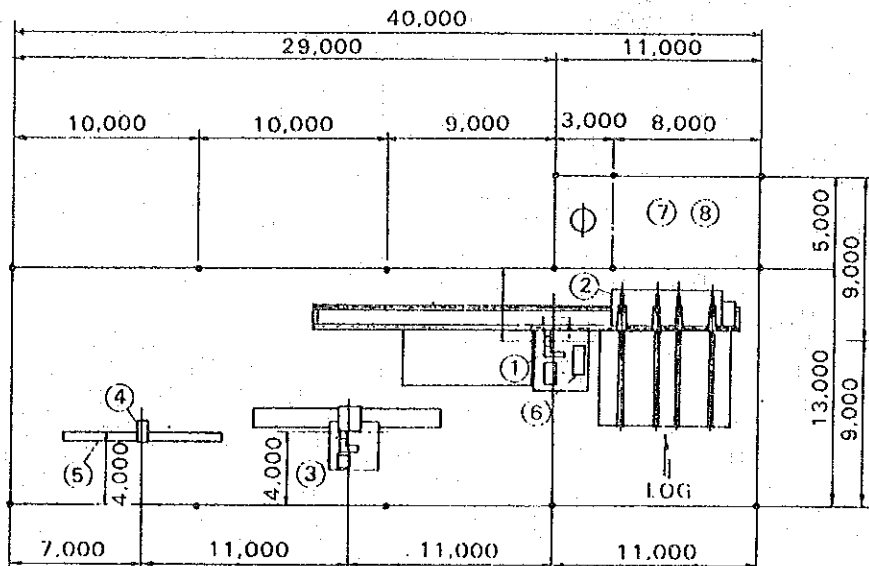
Appendix 1-4 Type A and Type B FOUNDATION OF 1100 TYPE BAND SAWMILL



Appendix 1-5 Type A FOUNDATION OF LOG TURNER



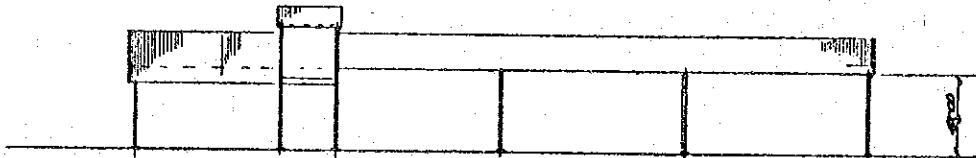
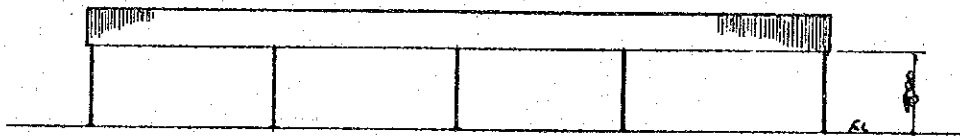
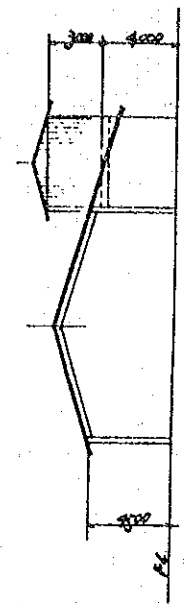
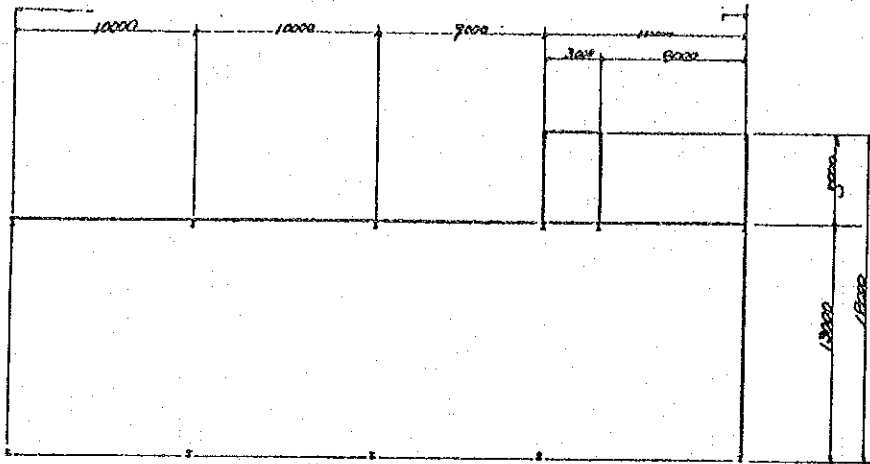
Appendix 2 LAYOUT OF SAWMILLING PLANT Type B



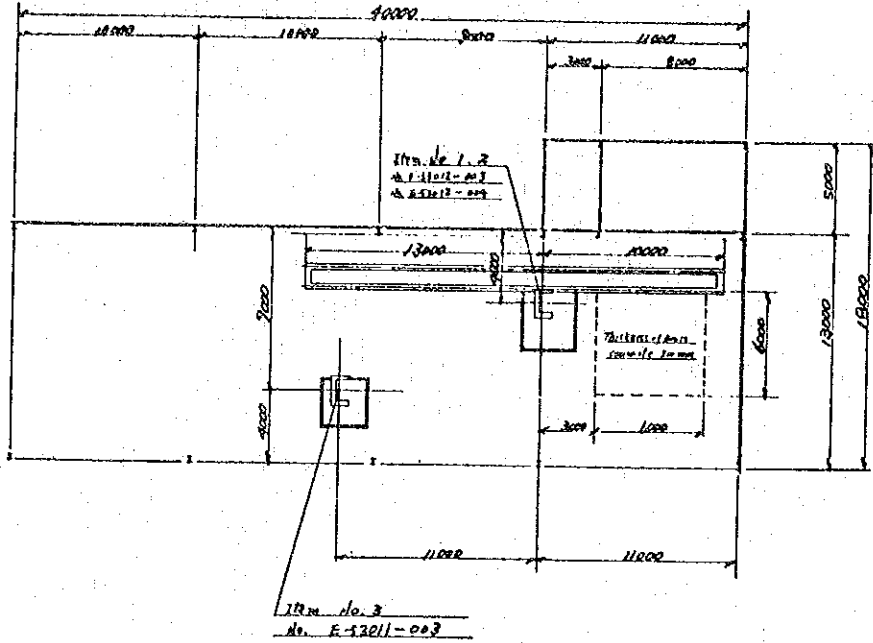
PARTICULARS

No.	NAME	SPECIFICATION	POWER	REMARKS
1	GCF1100 BAND SAW (WITH REMOVABLE TABLE)	saw wheel dia. 1100mm (ϕ)	37KW 1.5KW 0.4KW	
2	800 TYPE LIGHT TYPE AUTFEED CARRIAGE (WITH ELECTRIC SETWORKS)	opening of head block 800mm no. of head block 4P with electric setworks 900 type	5.5KW 2.2KW 0.4KW	
3	GCF1100 TABLE RE SAW	saw wheel dia. 1100mm (ϕ)	22KW 1.5KW 0.4KW	
4	CROSS CUT SAW	T-24 Type	2.2KW	
5	DEAD ROLLER	4m \times 2sq		
6	DUST COLLECTOR	CKS 200 Type	7.5KW	
7	BAND SAW SHARPENER	CKS M Type	0.75KW	
8	BAND SAW STRETCHER	T M Type	0.4KW	

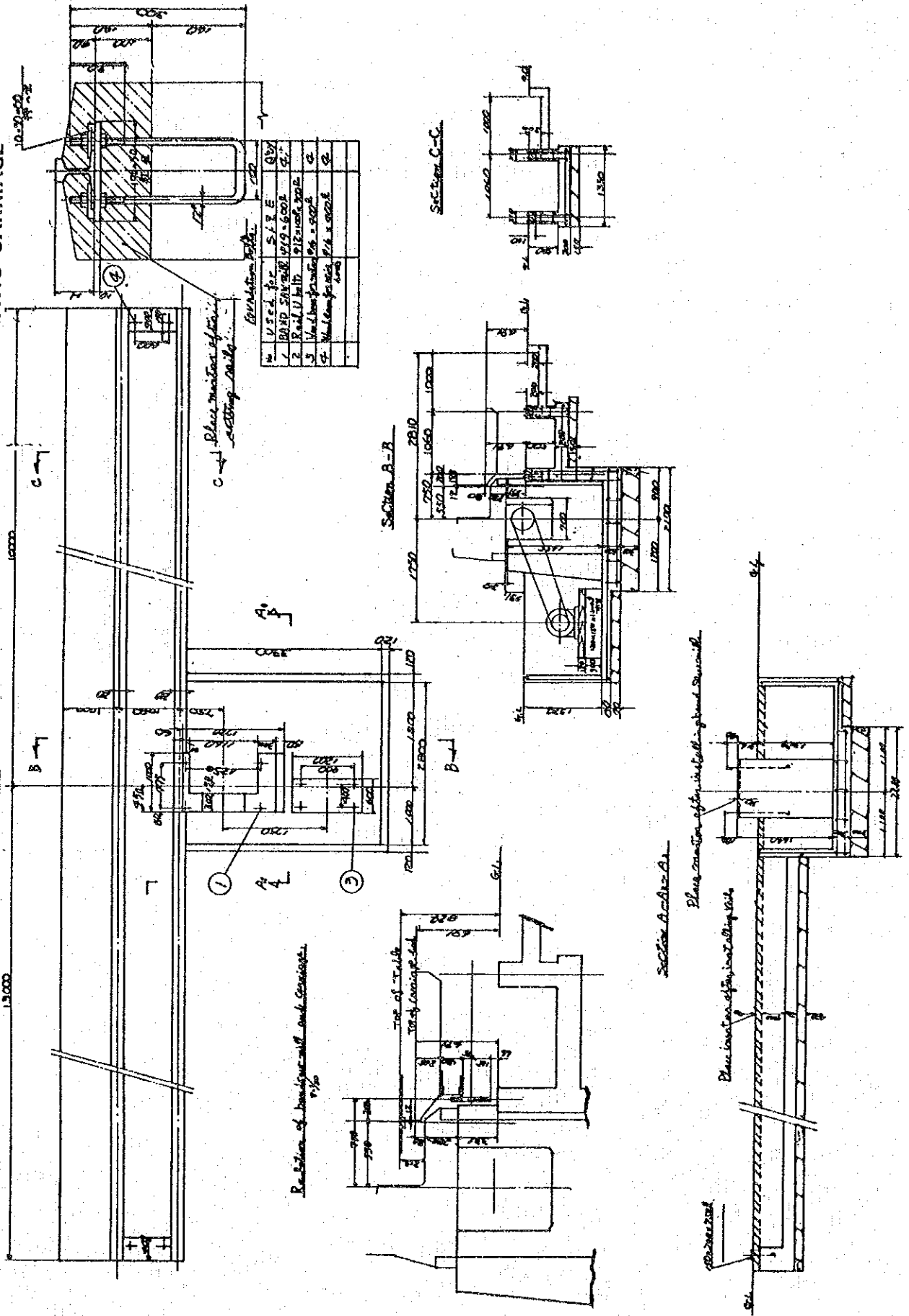
Appendix 2-1 Type B BUILDING



Appendix 2-2 Type B FOUNDATION



Appendix 2-3 Type B FOUNDATION OF 800 TYPE AUTOMATIC CARRIAGE



Material Table

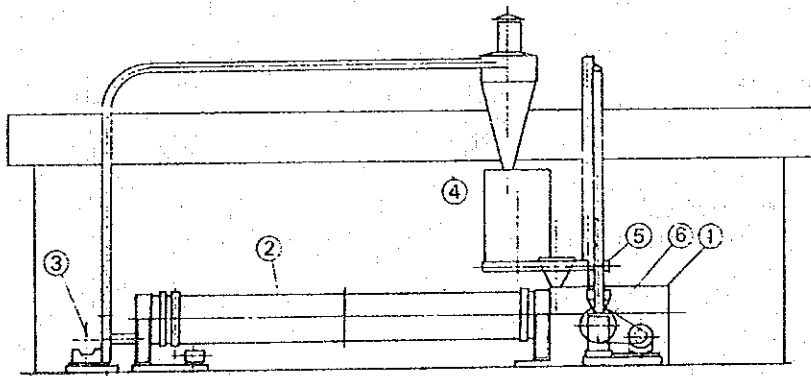
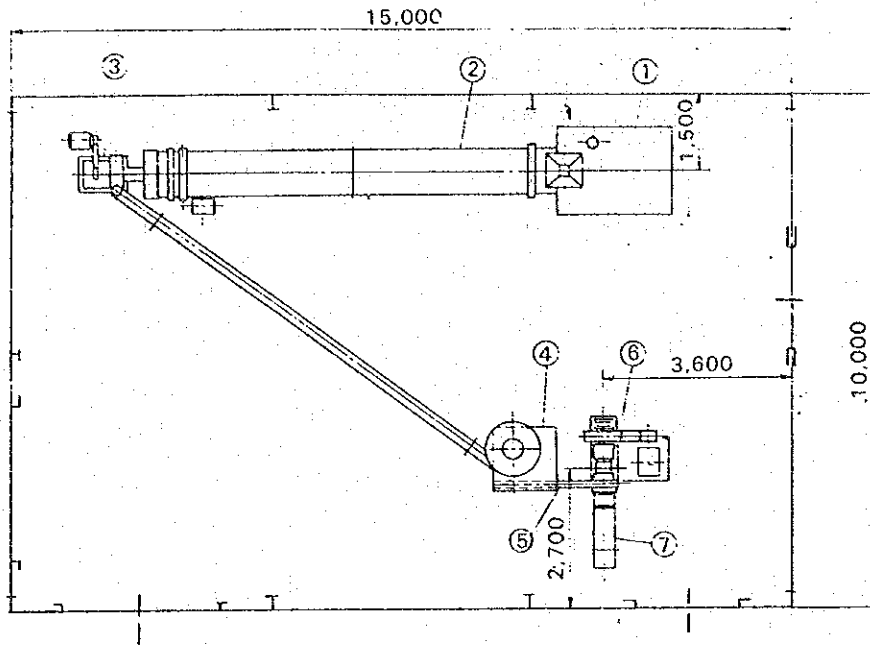
No.	U.S.C. No.	SIZE	QTY
1	20170	2 1/2" x 1/4" x 12"	2
2	20170	2 1/2" x 1/4" x 12"	2
3	20170	2 1/2" x 1/4" x 12"	2
4	20170	2 1/2" x 1/4" x 12"	2

Relation of base to mill and concrete
1/16"

Place location of main setting bolts

Place location of main setting bolts

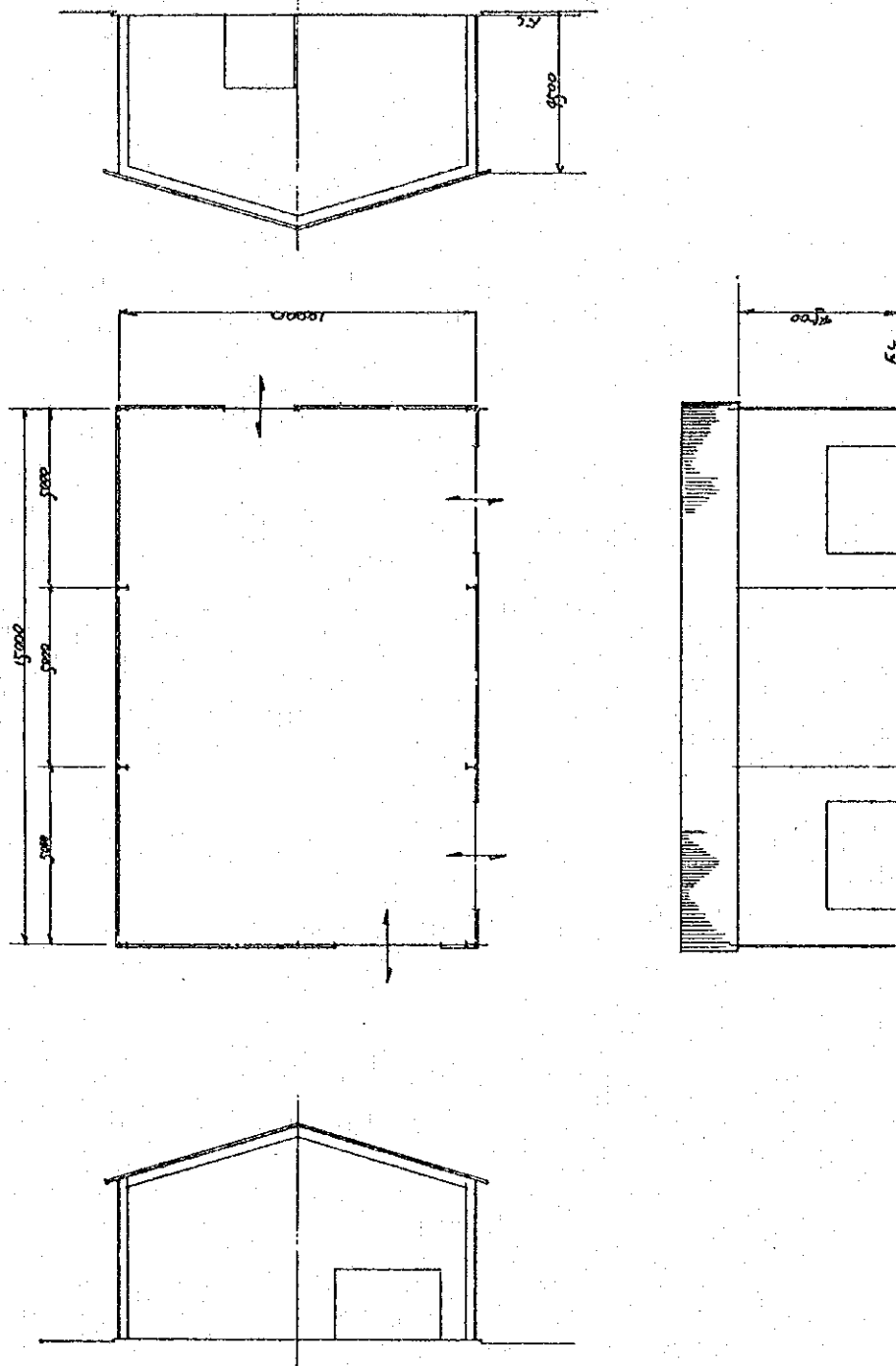
Appendix 3 **LAYOUT OF BRIQUETTE PLANT**



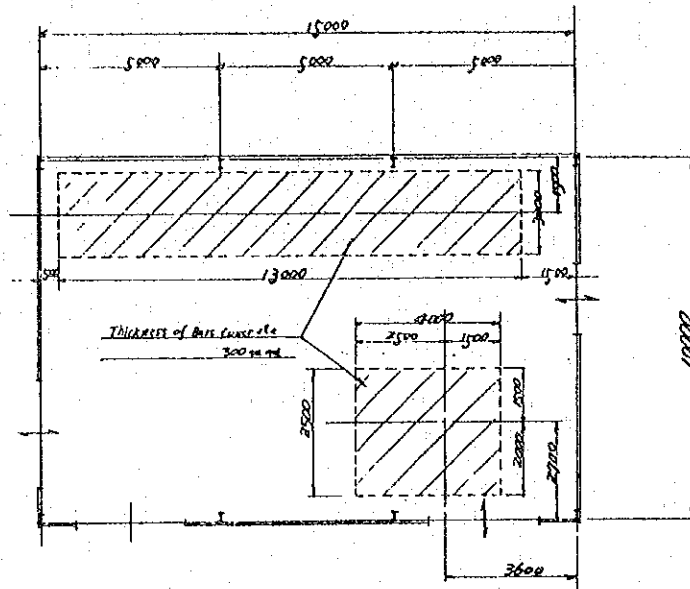
PARTICULARS

No.	NAME	SPECIFICATION	POWER	REMARK
1	Furnace			
2	Rotary Dryer	3 x 25	2.2 KW	
3	Fan	200 Type	5.5 KW	
4	Dry Material Storage			
5	Screw Conveyer	2.5 M	0.4 KW	
6	Forming Machine	Type 70	37 KW	
7	Smoke Exhaust Pipe			

Appendix 3-1 BUILDING FOR BRIQUETTE PLANT

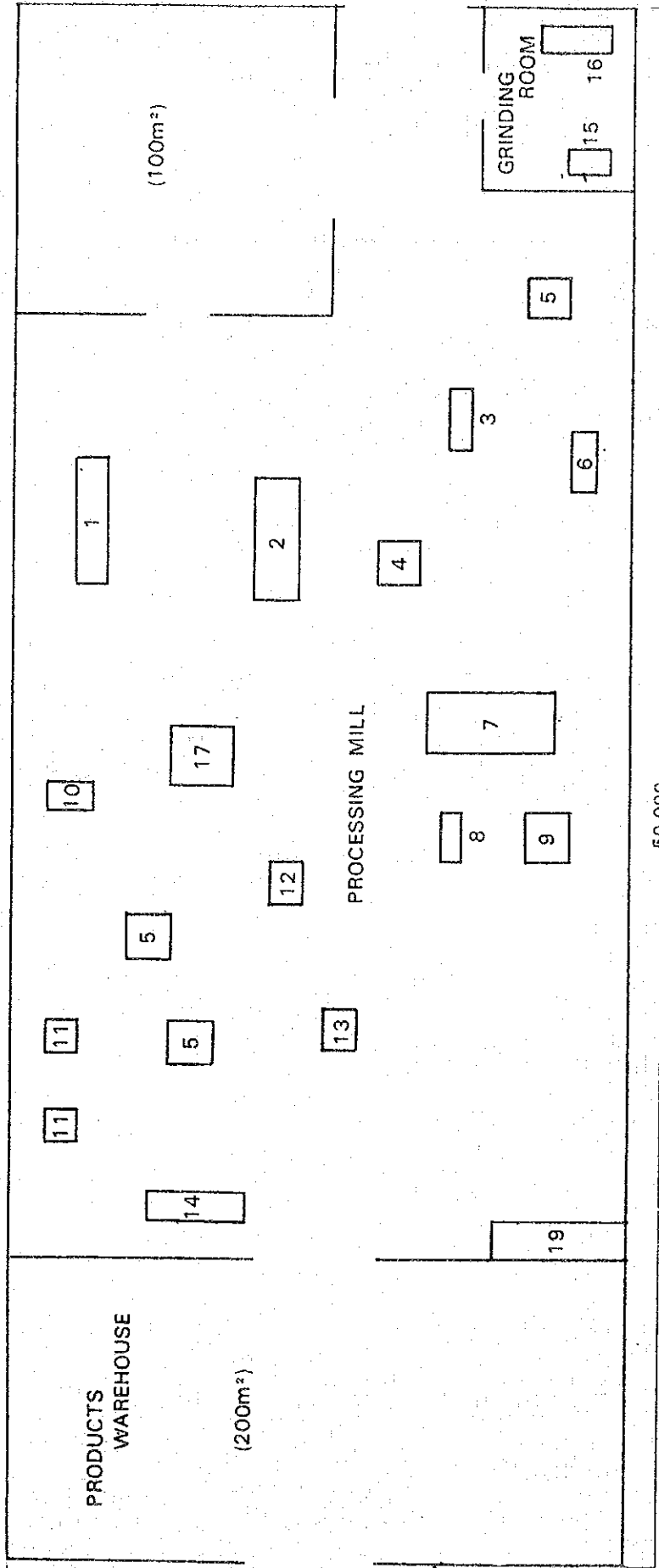


Appendix 3-2 FOUNDATION OF BRIQUETTE PLANT



Appendix 4 LAYOUT OF SECONEDARY WOOD PROCESSING MILL

(20 x 50 m)



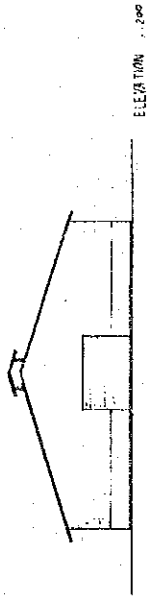
- | | | | |
|--|-------------------|-------------------------------|--------------------------------|
| (1) Cross-cut Saw | (6) Wood Lathe | (11) Hollowchisel Mortiser | (16) Knife Grinder & Sharpener |
| (2) Four Side Planing & Moulding Machine | (7) Cramp Carrier | (12) Router | (17) Double Sizer |
| (3) Hand Feed Planer | (8) Glue Spreader | (13) Moulder | (18) Trolley |
| (4) Single Surface Planer | (9) Hot Press | (14) Stroke Sander | (19) Painting Facilities |
| (5) Rise & Fall Circular Saw Mill | (10) Bandsaw Mill | (15) Tool Grinder & Sharpener | (20) Portable Dust Collector |

Appendix 4-1 BUILDING & FOUNDATION

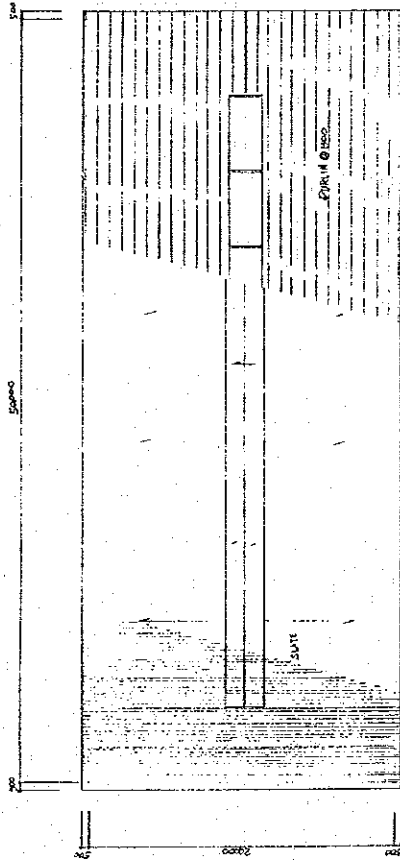
LAYOUT OF SECONDARY WOOD PROCESSING MILL
PLAN ELEVATION SECTION



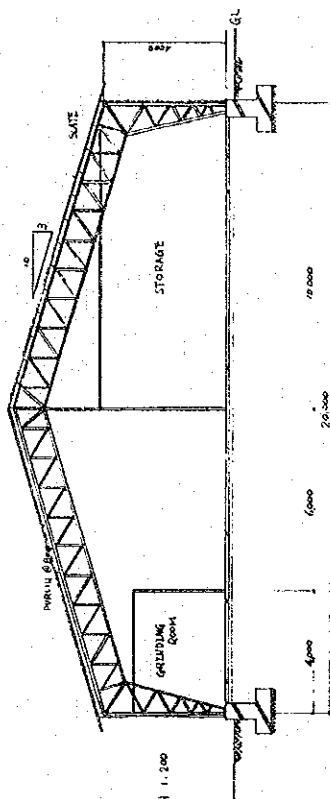
ELEVATION 1:200



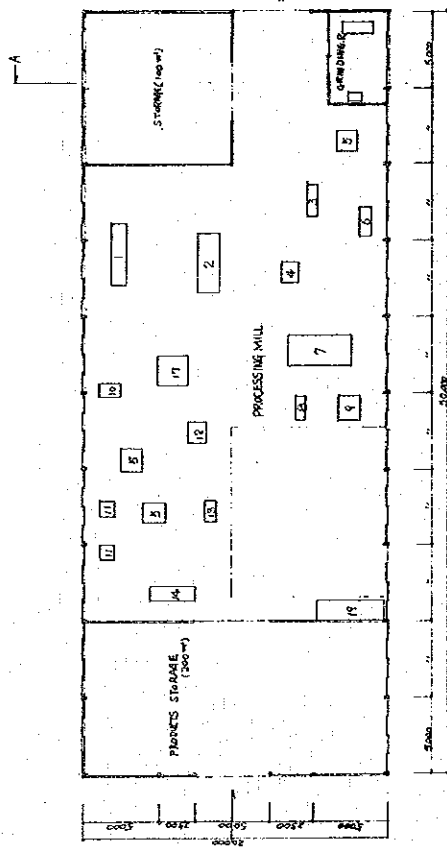
ELEVATION 1:200



Roof Plan 1:200



A-A SECTION 1:100



Floor Plan 1:100

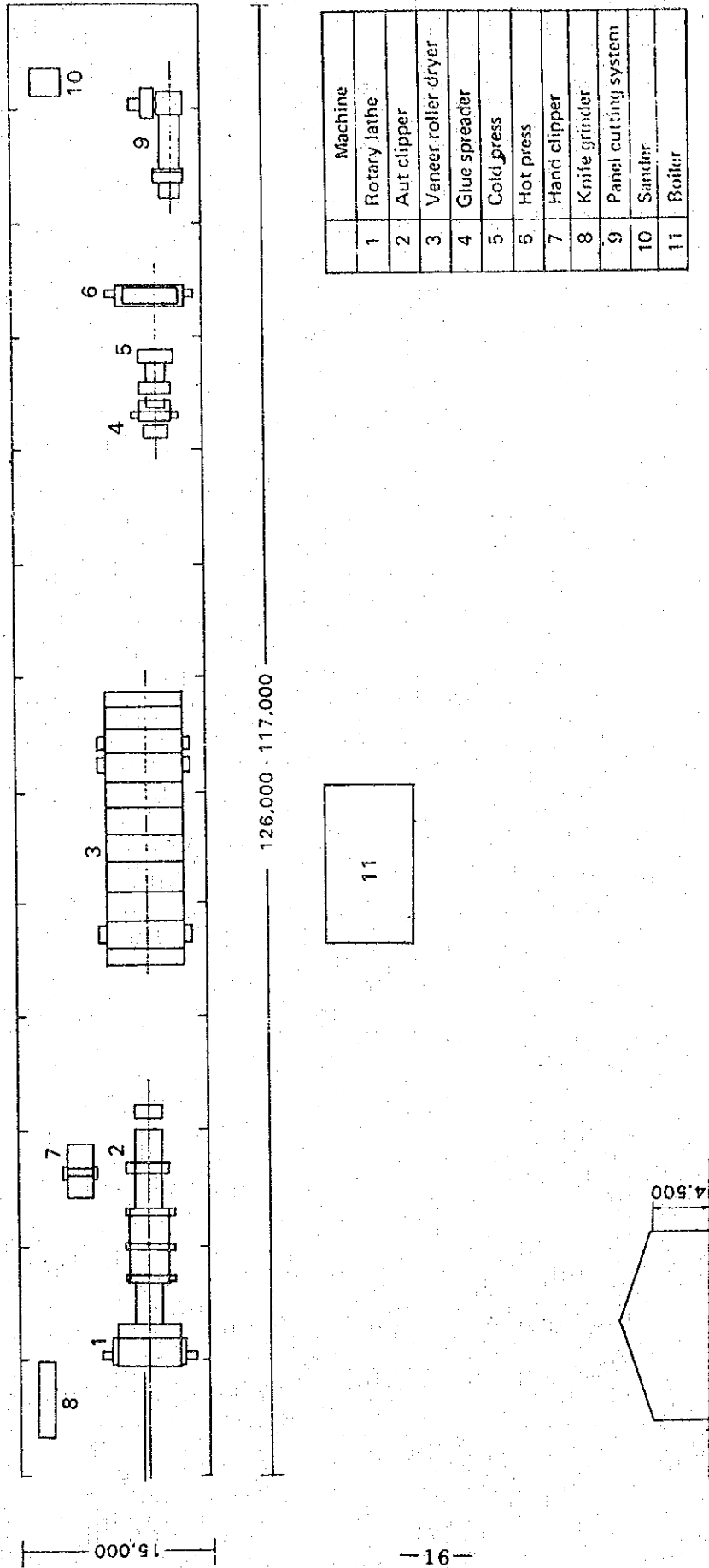
FLOOR AREA TABLE (m²)

PROCESSING MILL	700
MATERIALS STORAGE	100
PRODUCTS STORAGE	300
TOTAL FLOOR AREA	1,100

MACHINE TABLE

- 1 CROSS-CUT SAW
- 2 FOUR-SIDE PLANER & MOLDING MACHINE
- 3 HAND FEED PLANE
- 4 SINGLE SURFACE PLANE
- 5 RISE & FALL CIRCULAR SAW MILL
- 6 WOOD LATHE
- 7 CRAMP CARBER
- 8 LIVE SPRINGER
- 9 HOT PRESS
- 10 BANDSAW MILL
- 11 ROLLING MILL
- 12 ROUTER
- 13 WOODER
- 14 STROKE SANDER
- 15 TOOL GRINDER & SHARPENER
- 16 SLIFE-SLENDER P. SHARPENER
- 17 DOUBLE SCRIP
- 18 TROLLEY
- 19 PAINTING FACILITIES
- 20 PORTABLE DUST COLLECTOR

Appendix 5 LAYOUT OF TEA-CHEST PLANT



Machine
1 Rotary lathe
2 Aut clipper
3 Veneer roller dryer
4 Glue spreader
5 Cold press
6 Hot press
7 Hand clipper
8 Knife grinder
9 Panel cutting system
10 Sander
11 Boiler

