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EXPERT SERVICES IN SAW-DOCTORING

DP/SRL/72/020

SRI LANKA

Technical report:
FOLLOW-UP TECHNICAL ASSISTANCE MISSION
TO THE CEYLON PLYWOODS CORPORATION

Prepared for the Government of Sri Lanka by the
United Nations Industrial Development Organization
acting as executing agency for the
United Nations Development Programme

[redacted]

United Nations Development Programme

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Technical report: Follow-up technical assistance mission to the Ceylon Plywoods Corporation

Prepared for the Government of Sri Lanka
by the United Nations Industrial Development Organization,
executing agency for the United Nations Development Programme

Based on the work of G. A. Woods, saw-doctoring expert

United Nations Industrial Development Organisation
Vienna, 1976

Explanatory notes

References to dollars ($) are to United States dollars, unless otherwise stated.

The monetary unit in Sri Lanka is the rupee (SRs). During the period covered by the report, the value of the rupee in relation to the United States dollar was $US 1 = SRs 8.66.

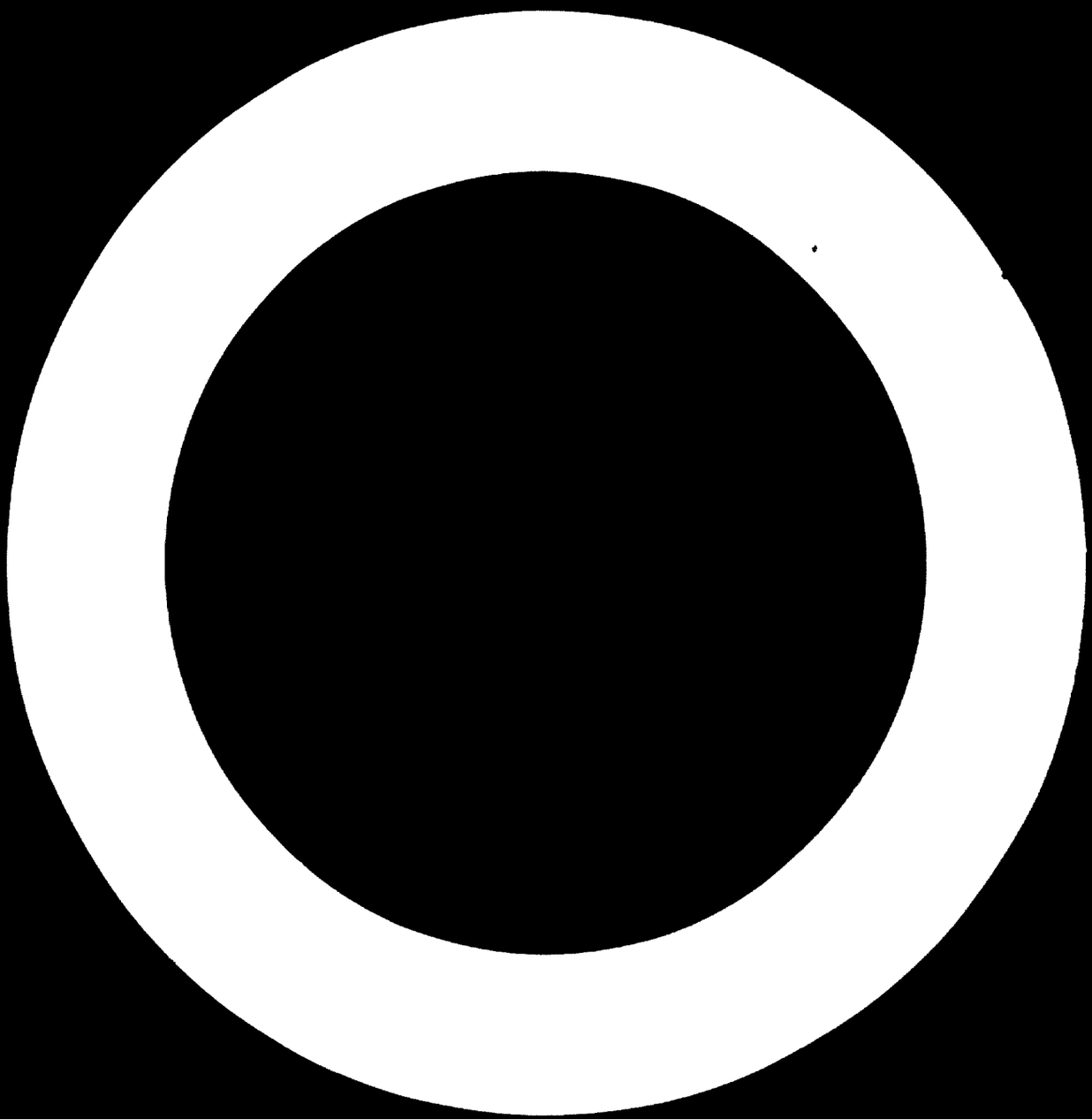
ABSTRACT

The expert was sent to Sri Lanka in July 1974 for the project "Expert services in saw-doctoring"[1/] (DP/SRL/73/020) of the United Nations Development Programme (UNDP). The United Nations Industrial Development Organization (UNIDO) was the executing agency. The mission was to last for six months but as this was insufficient time to complete the work, an extension of six months was approved. Owing to delays in the arrival of machinery for another project to which the expert had been assigned, he was able to accept this extension of contract. However, after completing a total of ten months[2/] he was called away to start the other project. He later returned for two months, from 5 May to 27 June 1976, to complete his assignment for the above-named project.

The management of the Ceylon Plywoods Corporation felt that the saw-doctoring was proceeding satisfactorily at the main factory at Kosgama, where the expert spent most of the first ten months of the assignment, and requested that the expert, who is qualified in other aspects of woodworking, look into the reasons why most of the other companies and workshops are losing money on their operations. Because of the limited time available, it was agreed that he would spend most of his time at the sawmill and furniture factory nearest to Colombo where he would try to correct as many time-wasting and incorrect practices as was possible in two months' time and at least put into motion some improvements in plant layout.

1/ The original title of this project was "Expert services in saw-doctoring, timber prefab technology and chipboard technology".

2/ See UNIDO, "Saw-doctoring training and technical assistance", terminal report prepared by G. A. Woods for the project Expert Services in Saw-doctoring, Timber Prefab Technology and Chipboard Technology (DP/SRL/73/020), 21 March 1975.



CONTENTS

Tables

Figures

INTRODUCTION

The project "Expert services in saw-doctoring"[1] (DP/SRL/73/020) of the United Nations Development Programme (UNDP), executing agency the United Nations Industrial Development Organization (UNIDO), commenced in July 1974 when a saw-doctoring expert was sent to Sri Lanka. The mission was to last for six months but as this was insufficient time to complete the work, an extension of six months was approved. The expert, owing to delays in another project to which he had been assigned, agreed to accept this extension of contract. However, after completing a total of ten months[2] he was called away to start the other project. He later returned for two months, from 5 May to 27 June 1976, to complete his assignment for the above-named project.

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Fields in which assistance was given are as follows:

(a) Log storage;

(b) Log conversion;

(c) Machining (secondary sawing and planing to size);

(d) Blade maintenance;

(e) Blade fitting;

(f) Machine maintenance (i.e. correct adjustment for efficient working, not routine lubrication etc.)

1/ The original title of this project was "Expert services in saw-doctoring, timber prefab technology and chipboard technology".

2/ See UNIDO, "Saw-doctoring training and technical assistance", terminal report prepared by G. A. Woods for the project Expert Services in Saw-doctoring, Timber Prefab Technology and Chipboard Technology (DP/SRL/73/020), 21 March 1975.

(g) Timber seasoning (drying);
(h) Movement of materials;
(i) Waste disposal;
(j) Rationalization of sawn wood sizes;
(k) Constructional design;
(l) Shop practice;
(m) Follow-up saw-doctoring training and troubleshooting at Kosgama.

FINDINGS

Many faults could be found in the methods and equipment being used and it was clear that all the employees of the factory, from the manager down to the labourers, need various degrees of retraining in basic skills. The expert's most difficult task was to avoid getting involved in trying to correct every fault that he saw and to keep to certain aspects which would benefit the factory most.

Of all the faults encountered, the use of unseasoned timber to manufacture furniture stood out as the one that perhaps was causing more waste in materials and time and engendered more customers' complaints than anything else.

The expert therefore, in view of the limited time available, decided to concentrate his efforts on (a) establishing correct air-seasoning procedures and (b) the supply to the machine workshop of standard sizes of seasoned timber without which any further improvements in the production of furniture would be impossible.

As the system of log conversion directly affects the amount of waste caused by drying defects and the time it takes to dry the timber, a new pattern of sawing the logs was established that will also reduce the amount of resawing necessary at a later stage in the production line.

Serious faults in blade maintenance and blade fitting were corrected, resulting in a much higher cutting speed in the vertical multiblade frame-saw machine.

Most of the slab offcuts from the sides of the logs were being sawn up and sold for firewood, resulting in not only a low recovery rate from the logs but also the selling of valuable timber at one third the cost price. The production of tea chest battens has been established, which should result in a good profit from these slab offcuts.

Although several physical improvements were made during the eight weeks of the assignment, the expert has drawn up plans for further improvements which, if approved by the Corporation, will have to be put into effect after his departure. These include the building of a log deck on which to unload and store logs, the moving of most of the woodworking machines to one of the carpentry workshops to make room for seasoning operations, and the erection of a shed

to be used to store timber and house the resawing unit. If these improvements are carried out and then administered correctly, they should not only benefit the Velona workshop but also the smaller Corporation workshops that obtain their timber from Velona.

Log supplies

	Fault	Suggested improvement
1.	The range in log length, 3-7 m, is too great, causing difficulties in handling and stocking for seasoning and in a high percentage of wastage from short logs.	A smaller range log length should be negotiated. A range of 4-5 m seems reasonable, especially for the class I and II logs used for furniture production.
2.	Most of the logs have one end that has been chopped into a point and in addition has a hole chopped into it to pass a pulling rope. Even though this useless end is not included in the measurement for pricing the logs, it causes many stoppages in the sawing operation and may cause damage to the vertical frame-saw machine if the ends break off from the plank or board during the sawing.	The logs should be cut off square at both ends in the forest, even if it costs a few cents extra.
3.	The general quality of the logs seems to be on the low side, especially when they are supposed to be class I and II. The use of crooked logs, which have to be cut in half before they can be sawn, is particularly wasteful.	Tighten up on the specifications and/or the inspection of the logs before they are loaded onto the lorries in the forest.
4.	Some logs are too dry when they are brought to the machine and in consequence have large shakes sometimes almost splitting the log down its entire length. In some instances, the log has to be split in two pieces before it can be passed through the log breakdown machine.	Insist on freshly-felled logs and keep storage time down to a minimum.

Log storage

1.	Logs are dumped anywhere there is space instead of being unloaded as near to the log breakdown machine as possible. Even if logs are offloaded next to the trolley, they still have to be manhandled onto it, pushed the full length of the mill and transferred across to the log carriage.	Logs should be offloaded as near to the log breakdown machine as possible so that the minimum amount of handling is necessary. Erect a log deck and sloping ramp onto which the logs can be offloaded and rolled down onto the log carriage of the horizontal frame-saw machine.

Fault	Suggested improvement
2. The dumping and dragging of logs by tractor over the ground to the sawmill means that they pick up dirt some of which is imbedded and cannot be removed even with wire brushes. This dirt blunts blades very rapidly pushing up saw-doctor costs, blade wear, replacement costs and increases machine downtime for blade changing which directly lowers production.	Offloading directly onto the suggested log deck will eliminate this completely unless logs are delivered dirty from the forest. If they are, this should be taken up with the suppliers, but in any case, logs will be more easily cleaned if stored on a log deck.
3. Logs dry out and splitting at each end causes considerable wastage.	First, freshly-sawn logs should be supplied. Secondly, they should be sawn as soon as possible after delivery. This means not stocking more than three to four days supply which should be sufficient to ensure continuous production even if one or two lorries break down. Thirdly, spraying the logs with water and painting their ends to seal the pores may be worthwhile if splitting continues after carrying out the previous suggestions.

Log conversion

The expert introduced a system of log conversion which is most suited to the type of log breakdown machines installed, i.e. one horizontal frame-saw and one vertical multiple frame-saw. The advantages of the new system are as follows:

(a) The two machines are operated together so there is a situation created whereby the team of each machine has to keep up with the other which creates a slightly competitive spirit and has helped the increase in output realized even before a bonus scheme was introduced;

(b) The amount of work done by the machines on each log is far more than that done previously as now most of the secondary resawing has automatically been included in the log conversion, i.e. the slabs are already converted into boards so that all pieces come out of the second machine in square boards of basic standard sizes;

(c) The new system, together with the correct feeding of half logs and the cleaning of logs with wire brushes, has resulted in a 300% increase in blade life between sharpenings i.e. from 25 to 100 logs sawn on the vertical frame-saw where up to 16 blades are used together. Consequently, saving in machine downtime is quite substantial.

Fault	Suggested improvement
1. Logs were being sawn through and through leaving the timber in slab form, i.e. not edged but left with the bark on both edges. This method is satisfactory if a double-edger or if multiple straightline edging machines are available, but as this is not so, much time is wasted in secondary resawing.	The two frame-saws should be used as a team, as was the intention when they were installed. The horizontal single-bladed frame-saw removes one side, then the log is turned 180° and the other side removed, after which one or occasionally two more cuts are made to the width of the boards or planks used. These slabs are then passed to the vertical multiple frame-saw which converts them into standard-size boards. Note: This system has already been put into operation.
2. At present most of the slab offcuts from the sides of the logs are being cut up for firewood. Even though this is sapwood, it should be possible to recover some useful timber.	A team of two or three people should be employed fulltime in this work with the aim of producing useful timber from the offcuts from both log breakdown machines. The machine used for this purpose should be moved to a midway position between the two frame-saws.
3. The block and tackle which should be used to transfer the partly cut log from the horizontal to the vertical frame-saw machine had been moved and was being used to lift the logs from the trolley onto the carriage of the horizontal frame-saw.	Move the block and tackle back to its original position and use as planned to transfer logs onto the carriage and erect a temporary log deck. Note: This work has already been carried out.
4. No wire brushes or debarking tools are available to clean or remove dirty bark.	Make simple spade-like tools to remove dirty or loose bark. Purchase wire brushes and insist on their use. Note: Wire brushes are now in use.
Standardization of sawnwood sizes	
1. Previously, logs were sawn through and through into slabs and whilst this method leaves complete flexibility in the choice of sizes which can be resawn, it is wasteful because of seasoning defects, and far too time consuming.	Use both log breakdown machines in tandem and produce boards from the logs of standard dimensions.
2. Boards of too great a width are being used and this causes a high percentage of waste from seasoning defects and even rejects and complaints from customers when panels and table tops etc. split and/or warp.	Because of the system of seasoning, i.e. air drying and the availability of veneered particleboard and plywood, all furniture should be re-designed using plywood or particleboard where widths exceed 150 mm for such items as panels, table tops, cabinet sides etc.

Fault	Suggested improvement
3. Too many different sawn and non-standard sawn sizes are being used at present resulting in the wastage of both material and labour.	All designs of furniture should be examined and any non-standard sections altered to utilize standard sections. At the same time, the number of different sections should be reduced to the absolute minimum. To this end, and to assist metrification in the carpentry division, the expert proposed a table of standard sizes which it is hoped everyone will work within and perhaps rationalize even further. (See figure I.)
Timber seasoning	
1. Although some timber was put into piles with stickers in between for drying, the piles were placed sideways against a boundary wall thus completely preventing the necessary air circulation.	New sites should be cleared and space left between piles to ensure air circulation. Note: Action already taken.
2. Timber for drying was not properly raised off the ground. This, together with the above, can encourage fungal attack and some timber was completely ruined and had to be thrown away.	Timber for seasoning should be placed on level wooden beams resting on concrete blocks which prevents attack from termites and gives good air circulation under the timber. Note: Rubber tree trunks are used at present but a watch should be kept for termite activity.
3. Timber which has in the past been put into stick (piled and stacked for drying) has not been dated and some piles have been overgrown with weeds while other timber has been used freshly sawn.	Timber should be dated as soon as it has been put into stick, after which it must be used in strict order according to thickness. Obviously thick timber will take longer to dry than thin sections and the drying times of the various thicknesses will have to be found by testing with a moisture meter.
4. A lot of waste occurs from end shakes which are caused by the ends of wide slabs drying out before the middle portion.	Timber for air seasoning should be cut into narrower widths and not left to dry in slab form. This will not only reduce waste from end shakes but also considerably speed up the drying process. Note: This has already been put into practice.

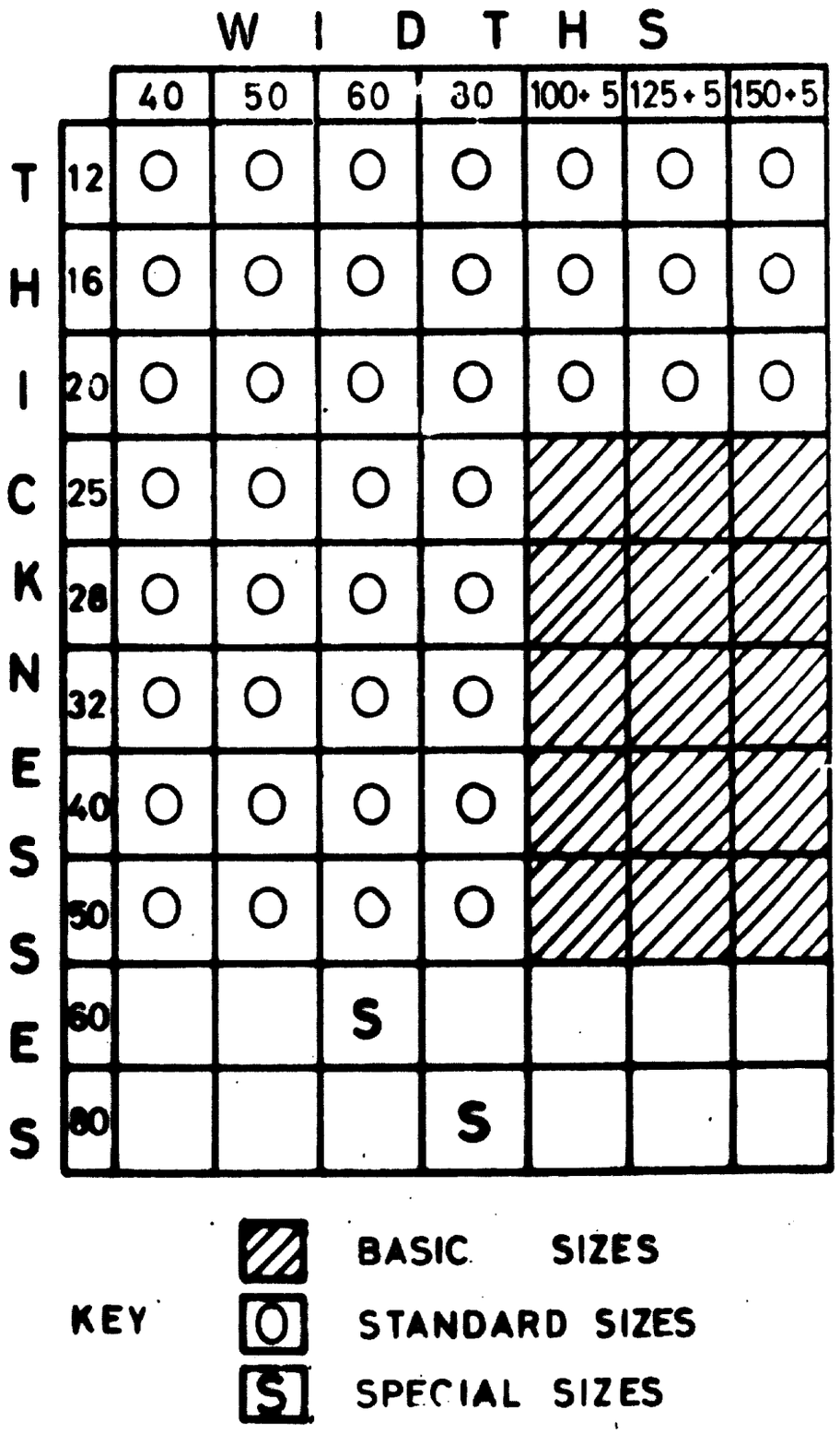


Figure I. Standardisation of sawnwood sizes
(In millimetres)

Fault	Suggested improvement
5. Piles of timber for drying were placed outside without any cover. This adds to the amount of waste by surface and end splits because of the strong sun and by the timber not drying in the rainy seasons.	Although individual roofs can be placed on top of timber stacks which are air drying, this does not prevent the ends of the timber from drying out very quickly and splitting because they are not protected from the sun. Although more costly, a proper timber drying shed is preferred which would give protection from both rain and sun. The existing machine workshop is both suitable and conveniently situated. Note: One third of the workshop has already been cleared and is being filled with timber in stick.
6. There was little or no planning of the sawmill's production which resulted in many stacks of 1 1/8-in. thick timber but no other sizes. This meant, for example, that when 2-in. thick timber was required by the machine workshop it was cut by the sawmill and passed, completely saturated with water, straight into the machine shop with the result that most of it was rejected during manufacture.	The production manager must plan his requirements well in advance and give these in writing to the sawmill manager. This may sound an impossible task when it is considered that thick sizes may take six months to dry, but exact quantities are not asked for, only rough percentages of the basic sizes used. It will also help to have some surplus dry timber in stock instead of wet logs.

Simplified measurement of sawn timber

Timber for air seasoning should be put into standard-size stacks with standard spaces in between each layer so that the cubic contents of each stack can easily be calculated for each different thickness of timber sawn. A convenient size for use with the metric system is 2 m wide by 2 m high by the length of the log from which the timber is cut. This length usually varies between a minimum and maximum agreed by the supplier of logs and the sawmill. Therefore, an average log length has to be used; one was caloulated from a sample of 50 logs which came to 16.9 ft (5,154 mm).

Each layer of boards stacked for drying with spaces in between each board so that air can circulate averaged a width of 5 ft (1,525 mm) of actual timber.

The number of layers of boards in each stack will of course vary with the thickness of the timber and for easy calculation the number of layers must be standardized for each thickness (tables 1 and 2).

Using 25 mm square stickers in between each layer of boards, the volume of each layer and of the whole stack can easily be calculated (tables 1 and 2).

Table 1. Volume of stacks of sawn timber of various thicknesses - British imperial units

Thickness (in.)	Volume/layer (ft^3)	Layers/stack	Volume/stack (ft^3)
1	7.0	40	282
1 1/8	7.8	38	295
1 1/4	8.8	35	308
1 1/2	10.6	31	329
1 3/4	12.4	28	347
2	13.3	27	371
2 1/2	16.5	24	397
3	20.8	20	415
4	27.8	16	445

Table 2. Volume of stacks of sawn timber of various thicknesses - metric units

Thickness (mm)	Volume/layer (m^3)	Layers/stack	Volume/stack (m^3)
25	0.2	40	8.00
28	0.22	38	8.36
32	0.25	35	8.76
40	0.31	31	9.61
50	0.39	27	10.53
60	0.47	24	11.28
75	0.59	20	11.80
100	0.79	16	12.64

When timber is supplied to other Corporation workshops it can eventually be supplied air seasoned and resawn to standard sizes. Because wth build-up of stocks will take several months, suuplies to other workshops should be made straight from the sawmill in the form of basic sizes which will require putting into stick on arrival at the workshop.

Measurement of all timber supplied to other workshops should in future be lineal i.e. in running feet or running metres, e.g.:

10,000 ft of 2 in. x 1 in.
1,000 ft of 4 in. x 2 in.

or

3,000 m of 50 mm x 25 mm
300 m of 100 mm x 50 mm

To assist in physically measuring each piece the expert has prepared two forms (one imperial and one metric units), which could be printed and used by the timber stores staff (tables 3 and 4). This will simplify the present system where every piece is written down individually. The suggestion was also made and adopted, to use a long wooden staff to measure the lengths instead of the present 2-ft rule.

Finally the timber stores staff should not be required to convert the lineal measurements; instead the accounts section should price and charge for the timber by lineal measurement.

Tea chest batten production

The manufacture of battens for tea chests from slab offcuts from the logs is an ideal way of utilizing these pieces, a high percentage of which would otherwise end up as firewood. The reason it is ideal is because the size, 21 x 21 mm, means that all but the smallest pieces can be cut up for this purpose.

In addition the slab offcuts are sapwood which is less dense and therefore softer than the heartwood of the log and again this will be more suitable for the battens which have to have good nailing properties.

The cost of the timber has already been allowed for in the waste factor when converting the log to timber, but even so, the price of SRs 2.10 per set of 12 battens leaves very little profit margin when we consider that 16 mitres and 8 square ends have to be cut and the surfaces of the battens have to be "smooth" - because of this the battens must have a sawn finish, otherwise the cost of planing to size, even on two sides only, would make any profit very difficult to realize. Of course the sawn finish must be a smooth one otherwise customers might reject the battens and the expert demonstrated how this can be achieved by (a) "side dressing" the spring set teeth; (b) making sure that the good surfaces are not ruined by the teeth coming up at the back of the blade;

Table 3. Sample form for recording measurements
- British imperial units

Thickness ..1/.in..

	6 ft	7 ft	8 ft	9 ft	10 ft	11 ft	12 ft	13 ft	14 ft	15 ft	16 ft	17 ft	18 ft	19 ft	20 ft
6 in.															
5 in.							Recorded Example								
4 in.															
3 in.															
2 in.															

Table 4. Sample form for recording measurements
- metric units

Thickness 25 mm

	2 m	2.5 m	3 m	3.5 m	4 m	4.5 m	5 m	5.5 m	6 m	6.5 m	7 m	7.5 m
150 mm								〃				
125 mm					〃			Recorded Examples				
100 mm												
75 mm												
50 mm												

and (c) teaching the take-off man to open up the cut as the timber comes off the rear of the machine. Ideally, a thicker riving knife should be fitted which would automatically ensure this.

Tests were carried out to define the amount of shrinkage that would take place during the drying of battens sawn from wet slabs to a moisture content of 14-16%. Ten samples were dried in a small oven, specially built for the purpose, and heated by an electric light bulb, having first been measured to the nearest 0.1 mm in both directions. The tabulated results show an average 1 mm shrinkage so that if a sawn size of 22 x 22 mm is used the battens' side should dry to 21 mm (13/16 in.) as specified. To ensure accurate sizes, a steel guage was made with 22 mm and 21 mm slots so that the sawer can test his fence setting on the first trial piece cut. The 21 mm slot can be used to test dried battens or dry waste timber if it is being used for batten production.

A combination jig has been designed to cut all three different lengths, two mitred and one square. This will allow the operator to cut random length material into any of the three sizes, thereby getting the maximum number of battens from each piece.

This product is perfect for the utilization of these slabs. However, to be successful it will require sound supervision to maintain the necessary output and quality control. Special points to watch are: the sizes, i.e., lengths, widths and thicknesses, and the smoothness of the sawn surfaces.

Kosgama

The expert looked into the production of the tea chest battens at the main woodworking complex at Kosgama and made the following comments:

(a) The cost of the timber alone, i.e. class II sawn to 1-in. planks and delivered to the machine workshop, is almost equal to the selling price of the sets of battens;

(b) When kiln seasoning is added to the cost of SRs 3 per cubic ft, then the loss on each set of battens at this stage is approximately SRs 0.80;

(c) If machinery costs plus overheads are added then the loss will be quite considerable. It is not really necessary to look into the financial side further as quite clearly some drastic change has to be made in the method of production and, above all, the cost of the timber used must be reduced.

Short-term recommendations

1. Two different systems of trials should be carried out using slab offcuts:

(a) Cross-cut only to multiple batten lengths in the sawmill then pass them on to the furniture factory;

(b) Resaw slabs to 22 mm thickness on the band resaw, then pass them on to the furniture factory. The expert does not favour the second method as the sawn surfaces will be rough and almost certainly not acceptable to the customers.

2. Kiln seasoning should be cut out; this is not necessary and far too costly.

3. Another jig, as designed by the expert at Velona, should be constructed and used for cutting the three different lengths both mitred and square ended.

4. An attempt should be made to isolate batten production and cost it separately and at the same time to find out how many workers are necessary to run the batten production unit.

Long-term recommendations

1. If the above experiments are successful, consideration should be given to making simple saw-benches to use for this work and to house them as near as possible to the outfeed end of the conveyor belt at the sawmill. This will eliminate or reduce transporting slabs and will not create a waste disposal problem in the furniture factory.

2. Each production unit, i.e., one ripsaw and one cross-cutting machine, can be duplicated as many times as is necessary to produce the required output and of course the unit could, if necessary, work two or even three shifts per day.

Waste disposal

Fault	Suggested improvement
1. Too much valuable timber is being sold for firewood at approximately 25% of its cost to the Corporation. Some loss from logs is normal, and is allowed for, but care must be taken to keep it to a minimum providing of course that converting the waste into useful timber does not cost more than it is worth.	The slabs cut from logs represent approximately 20% of the volume of each log, therefore, some attempt should be made to recover useful timber from these pieces. Tea chest battens seem to be the ideal item and every effort should be made to make this idea a success.
2. The practice of weighing firewood for sale should be stopped as it is far too time wasting.	It is suggested that firewood be sold in sacks at an appropriate rate. This not only eliminates weighing, but prevents customers taking away long pieces which are useful to the Corporation, as is done when bullock carts are used to take away the firewood.

Machining (secondary resawing)

With the correct use of the log breakdown machines, as introduced by the expert, the timber put into stick for seasoning is already cut to the basic standard-sized boards. This reduces considerably the amount of work necessary to resaw the remaining standard sizes and therefore frees several machines used for resawing together with their operators.

As each stack of timber becomes dry and ready for use it will have to be removed from the seasoning shed to make way for more wet timber. This means that the whole stack will be moved to the resawing shed (to be erected), placed on the timber deck and from there it will be sawn into the various widths and thicknesses of the most economical basic sizes. The machinist will know automatically which sizes are most urgent simply by looking at the timber rack in front of him in which the standard sawn sizes are stored ready to issue to the machine workshop. In other words, if there is little or no 50 x 25 mm board in the rack, he will cut some, and try at all times to maintain stocks of all the sizes used.

Any timber will be issued from this rack to the machine shop and other factories in lineal measure (feet or metres). From this rack the timber should, in most cases, pass through a cross-cutting machine on its way into the machine shop. (See figure II.)

Movement of materials

Fault	Suggested improvement
1. The earth floor in the present machine workshop makes the movement of materials from one machine to another very difficult as small trolleys, which would be ideal for small furniture components, cannot be used.	The proposal to move the machines to one of the carpentry workshops would solve this problem as the carpentry workshop floor is concreted; all that will be necessary will be to make a number of trolleys with a top surface in the region of 900 x 1,800 mm.
2. The present layout of machines is perhaps more suited to joinery than furniture manufacture because the spaces between the machines are too big.	If the machines are moved to the new workshop they should not be bolted down until the movement of materials has been reduced to a minimum. Ideally, one machine operator should be able to pick up a component, carry out his process and place it on a table for the next machinist to pick up, without either of them having to move from their working position. Trolleys should be used only when this arrangement is not possible.

Key

1. Timber lorry
2. New log deck
3. Ramp down to first machine
4. Horizontal frame-saw
5. Vertical frame-saw
6. Stacks of seasoning timber
7. Timber deck to feed resaw
8. Resawing machine
9. Sawn-timber rack (standard sizes)
10. Cross-cutting machine
11. New machine shop
12. Panel components workshop

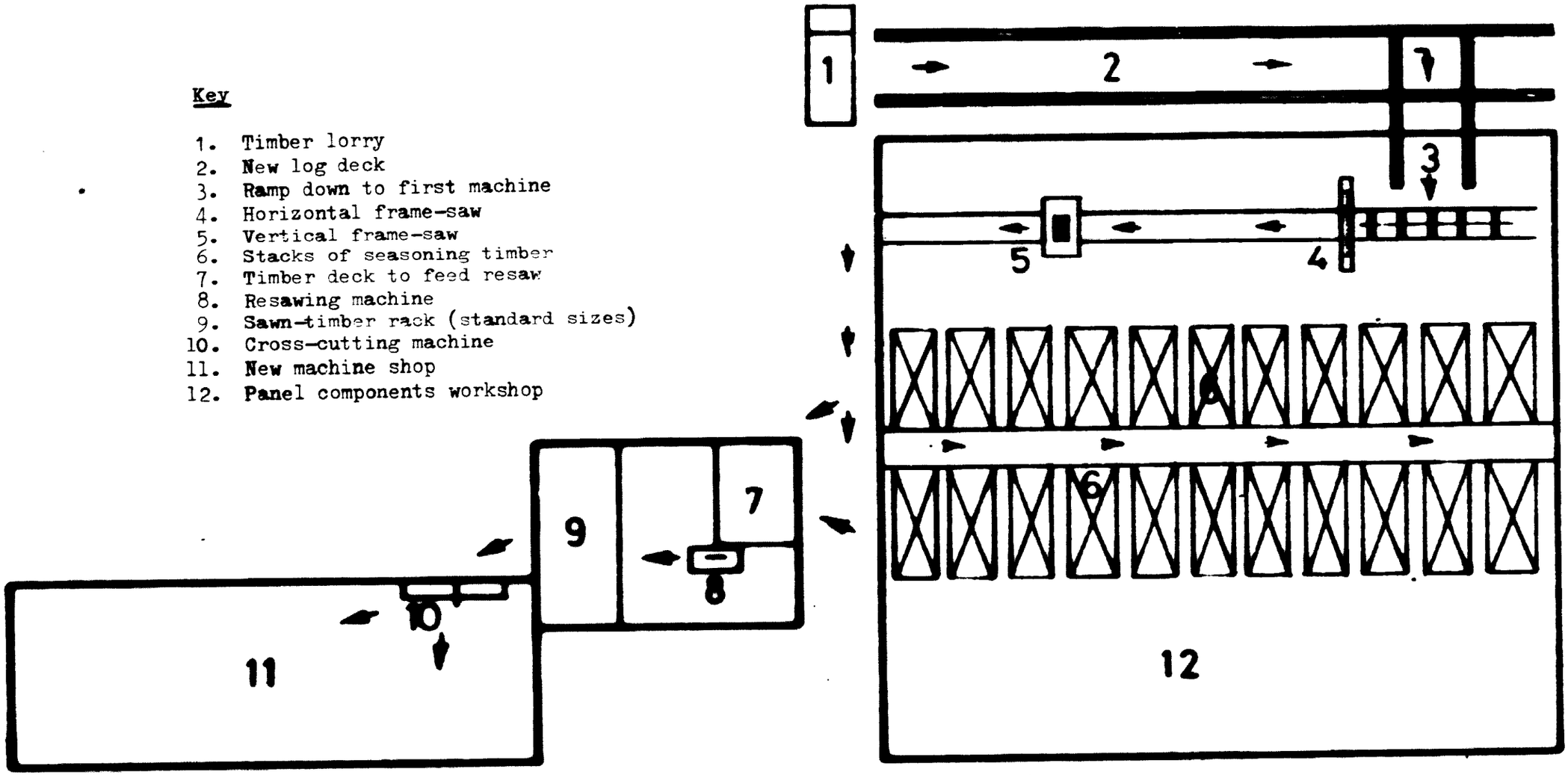


Figure II. Proposed reorganization of the saw mill and machine shop

Proposed reorganization of the sawmill and machine workshop

Planning a new factory layout is much easier than trying to improve an existing situation which imposes many restrictions including capital outlay. The proposed reorganization will accomplish several major improvements with the least expenditure on the part of the Corporation. The scheme will utilize existing buildings, with the exception of the resawing and dry-timber shed, and even that will use steel trusses and roofing from a building which collapsed during a storm.

The improvements will be:

(a) A timber seasoning shed with the advantages of reducing seasoning defects to a minimum and effecting a tremendous saving in rejected timber;

(b) The log deck will eliminate the need for the tractor to drag logs to the sawmill and will reduce the number of labourers employed on log handling from six to an estimated two. The log deck will also ensure that logs are kept clean with a consequent saving in machine downtime to change and sharpen blades;

(c) The transfer of machines to the carpentry workshop to make way for the air seasoning will provide the machine workshop with a concrete floor where components can be moved about much more easily and will not pick up dirt from the floor as is now the case;

(d) The transfer of the carpenters to a section of the finished goods store should not present any problems; the partitions removed from the new drying shed can be used to partition off the new workshop store;

(e) The transfer of the machines will give an opportunity for a completely new and improved layout of the woodworking machinery which should result in some improvement in efficiency in that vital section;

(f) The resawing shed will provide the necessary buffer between the seasoning shed and the machine workshop; complete stocks of dry timber of one thickness can be resawn in this shed without referring to the needs of the machine shop;

(g) The dry-timber rack in the resawing shed will provide an automatic visual guide to the resawing team as to what sizes should be sawn next, i.e., the sizes which are getting low in the racks;

(h) The dry-timber rack will also provide the timber store-keeper with a point from which he can accurately issue timber to the machine shop;

(i) The plans for the proposed panel components workshop, which would include the process of sanding, allow for expansion, which will take place if more use is to be made of chipboard and plywood;

(j) Finally the whole movement of timber, from the log to finished components, will flow reasonably well with very little time lost by unnecessary handling.

Blade maintenance (frame-saw)

Blade maintenance should include the following:

(a) Tensioning and levelling;

(b) Spring or swage setting;

(c) Sharpening.

The blades supplied for both the horizontal and vertical multiple frame-saw machines at Velona are of good quality and are tensioned at the manufacturers before delivery. Because of this, and the fact that frame-saw blades are often used successfully without further tensioning, most of the blades at Velona have not given trouble in this respect. However, it does not mean that the blades would not perform better if they were tensioned regularly.

Only spring setting has been used simply because the tools necessary for swage setting are not available. This method is quite satisfactory but the amount of set must not exceed half the blade thickness as was the case with some of the teeth examined by the expert. The blade thickness is 2 mm and the recommended amount of set should be 0.8 mm which is quite adequate and keeps within the maximum permissible set of 1 mm, even allowing for slight errors in accuracy.

	Fault	Suggested improvement
1.	The vertical frame-saw blades were being sharpened tapered (as only the bottom half of the blade was being used, the saw-doctors did not think it necessary to sharpen the top half). This caused the overhang of the blade, when fixed in the machine, to increase from the correct 12 mm to 40 mm, or more on some blades. For some reason the top and bottom rods which held the wooden spacers in place (and also limit the overhang of the blades) were interchanged, causing new blades to lean backwards instead of forwards.	For maximum production, blades should be sharpened by machine which will automatically keep them parallel and with all the teeth working equally. However until a machine is provided the saw-doctors will have to continue sharpening by hand grinding or filing. An improvement to total hand sharpening would be to send the blades in sets to Kosgama for machine sharpening at least every third sharpening so that the uniformity of the teeth will be maintained. Note: Blades have now been corrected and ground parallel.
2.	The set on the blades was not accurate enough and in some cases more than the allowed maximum of half the blade's thickness.	Use a more accurate set-gauge and set the teeth to 0.8 mm ± 0.1 mm. If possible, a dial type set-gauge should be transferred from Kosgama. Note: This has been done.

Fault	Suggested improvement
3. The horizontal frame-saw blades are sharpened extremely well considering that they are ground freehand, however, blades are becoming becoming very hollow (concave) on the back edge because of the excessive heat generated when sharpening the front edge. Providing the cutting edge is maintained straight, this will not cause any problems but it does increase blade wear.	Although very light grinding will help, machine sharpening is the only real answer to efficient sawing. File sharpening would eliminate this fault but is costly and time consuming. If blades were tensioned, this hollow back would not occur as part of the tensioning process is to keep the back edge straight.
4. The all important hook angle on both the horizontal and vertical frame-saw blades is not being maintained at a constant and correct angle.	Again, machine sharpening at Kosgama will help. For hand grinding, a board on which to rest the blades should be fixed to the grinding machine at 105^{o} to the side of the wheel thereby assisting in keeping the hook angle at 15^{o}.
5. The present grinding wheels are too thin and in consequence produce gullets of too small a diameter.	Change future orders to 12 mm, or even 16 mm, thick wheels.
6. Circular saw blades are being sharpened reasonable well by hand filing, however, top clearance and hook angles are too big resulting in weak tooth points and almost certain rapid blunting.	Hook angles should be no more than 30^{o} for ripping blades and 5^{o} for cross-cut blades. All top clearance angles should be 15^{o}. Top bevel on ripsaw blades should be 0^{o}-5^{o} maximum but on cross-cutting blades 20^{o} will give a cleaner cut to the end grain surfaces. Note: Some instruction has been given in hand sharpening and a tool for ranging down the teeth to maintain the blade round and ensure that all teeth cut equally has been made and demonstrated.
7. Sawn surfaces for the manufacture of tea chest battens have to be smooth according to specifications. Normal sawn surfaces are not good enough.	Side dressing of spring set teeth has been demonstrated and this, together with the use of an accurate set gauge, should give almost a planed surface.
Blade fitting	
1. It is absolutely essential that the vertical frame-saw blades be fitted into the frame parallel to the machine slides(which are basically vertical) otherwise the	At a suitable time, when production will not be stopped, the fitters should take up the excessive play in the machine slides by the adjustment provided. After this has been done, the clamping plates

Fault	Suggested improvement
up-and-down movement of the blades will tend to lift and push down the log, causing severe vibration. The machinists, whilst setting the all important first blade using a spirit level, rely on the machine being plumb and the machine slides having no sideways movement. In fact the slides have an estimated 3-5 mm side movement resulting in the blades running out of parallel to the movement of the frame.	on one side must be re-adjusted so that a clock dial gauge fixed to the machine and touching the blade side shows no variance between the top and bottom of the machine strokes. Note: Although the expert did not have the time to do this work, he adjusted the blades to run reasonably well and no harm should be done to them providing no-one alters his setting, until time is available for the correct adjustment, as detailed above.
2. Blade overhang on the vertical frame-saw was completely wrong because of the incorrect sharpening etc.	The position of the clamping bolts has been corrected and a gauge made to set the position of the blade straps. This will ensure that the correct 12 mm overhang is maintained.
3. The bottom wooden spacers, which determine the thicknesses sawn on the vertical frame-saw machine, were collecting sawdust on their top edges which was compacting and hitting the underside of the logs causing much vibration.	A new type of bottom packing has been introduced with sloping top edge surfaces to which the sawdust will not stick enough to cause contact with the underside of the log. Improvements in shape and size have also been introduced to both top and bottom packings and instructions given to gradually replace all old packings with the new design in metric sizes. The correct thickness is equal to the required timber size plus 2 mm.

Machine maintenance

1. The thickness planing machines' anti-friction rollers, infeed and outfeed, and the two pressure bars were out of adjustment causing poor feeding of the timber and irregular planed surfaces full of the telltale hollows characteristic of these mis-adjustments.	The expert demonstrated the correct setting of these various parts and it is hoped that the machinist and factory fitter are now able to correct these faults should they occur again.

Saw-doctoring follow-up at the Kosgama complex

It was possible to spend only a few hours at the saw-doctoring workshop at the main woodworking complex at Kosgama where the expert spent most of his time last year. During his visits he was able to point out the following faults and give advice on correcting them.

Fault	Suggested improvement
1. Teeth of the frame-saw blades were breaking off.	Too much set was being applied to the teeth probably starting cracks which, coupled with the additional load placed on the overset teeth, caused one to break off which in turn caused others to shear off and pile up behind the first tooth which would stick in the cut. Use the new dial type set gauge ordered for this purpose and do not exceed an 0.8 mm set.
2. Frame-saw blades were not tensioned correctly. The expert suspected that very little tensioning of these blades had been done since his departure last year. This, together with the excessive spring setting, is the cause of the blades not cutting properly; the fault does not lie in the shape of the teeth.	Frame-saw blades must be tensioned if trouble-free sawing and fast cutting are desired. There is no easy way out - the work has to be done and done correctly and it only becomes hard work when the process is neglected. Blades must be checked every time they are removed for sharpening.
3. New wide bandsaw blades were delivered, which were the wrong length, unfortunately too short, and the wrong pitch.	The expert's instructions should be followed pertaining to the standardization of wide bandsaw blades. 2/ Blades should be purchased in strip form and have 50 mm pitch teeth for all the different machines at all the different factories. The standardized widths and thicknesses should be noted.
4. The tooth depth on wide bandsaw blades was too large. This could cause cracks to develop in the weakened teeth.	The best possible tooth shape was introduced which had a 16 mm depth, the drawing of which is on the standardization chart, 3/ and the machine settings to produce this shape were listed on the machine-setting charts introduced by the expert. Machine operators should be supervised so that these settings are not altered.
5. Tooth profiles in general were not as they should be.	The correct settings for all blades including the numerous circular saw blades should be supervised.
6. Tooth profiles were very irregular and did not have the necessary smooth contour.	The machines for sharpening are even more worn that they were last year 4/ and are causing all sorts of problems which the operators do not understand. The expert's recommendations 5/ still hold that these machines must be replaced as soon as possible.

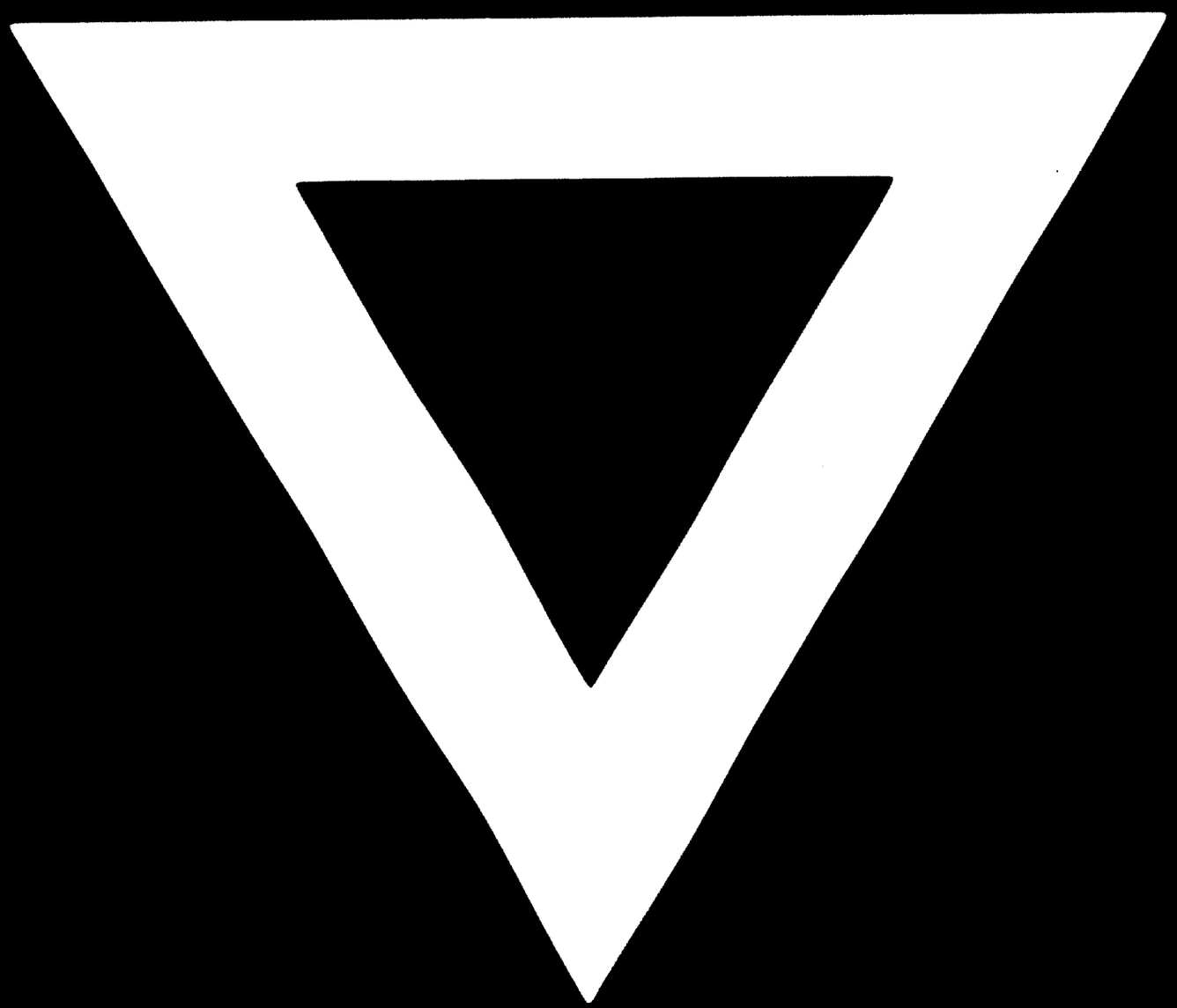
2/ UNIDO, op. cit., pp. 6 and 57.

3/ UNIDO, op. cit., p. 57.

4/ UNIDO, op. cit., p. 5.

5/ UNIDO, op. cit., p. 11.

A-273



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