Technical Report No. 1

ITTO-ISWA Project PD 286/04 Rev.1 (I)

"Strengthening the Capacity to Promote Efficient Wood Processing Technology in Indonesia"

IMPLEMENTATION OF IN-HOUSE TRAINING ON WOOD PROCESSING TECHNIQUES

Executed by:
The Indonesian Sawmill and Woodworking Association (ISWA)
in collaboration with
The Ministry of Forestry of Indonesia (MOFI)
with the assistance of
The International Tropical Timber Organization (ITTO)

Jakarta, September 2009

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FOREWORD

This technical report documents the conduct of the in-house training on wood processing techniques under the ITTO Project PD 286/04 Rev. 1 (I): "Strengthening the Capacity to Promote Efficient Wood Processing Technologies in Indonesia" which had been implemented by ISWA in collaboration with the Ministry of Forestry of Indonesia from August 2005 to July 2009.

I wish to express our sincere gratitude to all concerns that have involved in the implementation of the project and in preparing this report. I am particularly thankful to the companies hosting the in-house training sessions, to Dr. Han Roliadi and Mr. Sae Yung Kim for their contribution to the editing of the initial draft report and translating it to English and to the Project Key Personnel for their hard work in designing and publishing the report for dissemination to project beneficiaries.

May this technical report contribute to our struggle for improving efficiency of wood processing in Indonesia in view of sustaining the benefits of the wood industry sector to the national economy.

Jakarta, September 2009

Dra. Soewarni
Chairperson of ISWA

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Implementation of In-house Training on Wood Processing Techniques

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1. INTRODUCTION

1.1 In-house training on wood processing technique

One of the activities of Project PD 286/04 Rev. 1 (I) "Strengthening the Capacity to Promote Efficient Wood Processing Technologies in Indonesia" originally defined in the project proposal was Activity 3.2 under Output 3 which read "Implementation of 8 training courses on sawing methods, saw-doctoring and other basis wood processing techniques such as molding profile/knife grinding, kiln drying and preservation with a target of training about 200 practitioners in Kalimantan, Java, Sumatra and Eastern Provinces as well as evaluation of training courses".

Upon consultation with ISWA Regional Offices and ISWA members in several provinces, it was concluded that modification of Output 1 "four wood processing training and one product quality testing facilities available to woodworking factories" was imperative if the objectives of the project were to be achieved successfully. Establishing four small-scale wood processing training facilities on the existing wood working factories in Java, Sumatra, Kalimantan and Eastern Provinces was considered very difficult and costly to realize and maintain considering the fact that establishing four training centers would mean that training would be conducted on pooled or class room lecturing format followed by field demonstration on the subjects lectured. It was argued by members that pooled training format has several weaknesses including:

i) To be effective, pooled or class lecturing requires comparable occupational and educational background amongst trainees which in reality difficult to observe,

ii) Mills were reluctant to host participants for practical field works by outsiders for business confidentiality reason,

iii) Participants will be limited in number for financial reason and will normally be confined to lower level employees,

iv) Individual mills are facing different operational problems at technical and managerial levels; while some problems may be common to many mills, some others are unique, company specific, in nature that require special treatments,

v) In-house training was considered as a pragmatic format of training as it allows direct examination of technical and managerial weaknesses on the spot, demonstration of the necessary procedures and techniques and discussions on the ground. More importantly, in-house training format provides ample room to accommodate large number of participants and to hold discussion between experts and participants of different levels including owners, executives, managers, supervisors and operators.

Therefore, ISWA had proposed to the Project Steering Committee (PSC) at its first meeting in October 2005 to employ an in-house training in place of pooled-training class lecturing format and the proposal was approved by the PSC. As the mode of training had been changed from pooled/class sessions to in-house training format, the activities pertaining to Output 3 had also been redefined as follows:

- ✓ Activity 3.1 was dropped as its purpose was covered under Activity 1.2,
- ✓ Activities 3.2 through 3.4 had been combined and redefined as "implementation of 150 sessions of in-house training on wood processing techniques, quality/industrial management and marketing at 50 mills in 5 provinces".

Therefore, the intended training under the original Activity 3.2 has been implemented under the newly defined Activity 3.1 that reads "Implementation of 150 sessions of in-house training on wood processing, product quality/industrial management and marketing at 50 mills in 5 provinces". Note that each of the planned in-house training sessions simultaneously covered the three subjects namely wood processing techniques, quality/industrial management and marketing of wood products.

1.2 Operational efficiency vs business competitiveness

Efficiency of operation is one of the key determinants of the level of competitiveness of a business firm. It is essentially the ratio between output and input of a process, i.e. efficiency = output/input, normally expressed as percentage. A mill manager yielding 0.5 m^3 of wood products (output) through processing of 1 m^3 of log (input) is said to have made a 0.50 or 50% of processing efficiency. It should be noted that the physical efficiency as just illustrated does not very useful for purpose of business decision-making. It is more meaningful to compare the monetary values of output to input; the larger the ratio, the more efficient a firm would be in monetary terms. It is so because physical efficiency does not always correspond to financial efficiency due to low selling price of processed product for instance, brought about by poor performance or quality of the product.

Conceptually speaking, the level of operational efficiency of a business firm is determined by a number of forces which directly or indirectly affect the monetary values of outputs and inputs of a production process. Most important ones are:

- ✓ Economies of scale: decreasing fixed cost component by producing larger volume,
- ✓ Learning effects: decreasing production cost due to increasing experience and productivity of employees,
- ✓ Application of appropriate technology and methods of operation,
- ✓ Sound marketing strategy and tactic,
- ✓ Effective inventory system,
- ✓ Professionalism and skills of human resource,
- ✓ Innovation oriented R & D, and
- ✓ Infrastructure of a firm, especially its leadership that is capable of developing and maintaining commitment to efficiency of operation

An efficient operation will result in low production cost and enable a firm to sell its products at lower price compared to its competitors thus raising the level of competitiveness.

This in-house training concerned primarily with managerial and technical skills of human resource involved in wood processing and with appropriateness of the technology and operational methods in use.

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2. METHODOLOGY

2.1 Selection of participants

ISWA member companies were intended as the primary beneficiaries of the Project other than the wood industry as a whole. Therefore, participants were selected ISWA members. In 2005, there were nearly 1,600 registered ISWA members comprising large, medium and small-scale companies having different features as summarized in Table 1. Scale of operation was taken into account when selecting only fifty participating mills in total. Geographic distribution of ISWA members was also considered in the selection process. Two provinces in Java, two provinces in Kalimantan and one province in Sumatra were included to reflect sources of wood material feeding the mills considering the fact that shortage in raw material supply is the most important limiting factor to many mills in their operation.

In recent years, mills in Java have been using mostly planted wood as the raw material obtained from domestic and foreign sources; the mills in Kalimantan as to date still rely heavily on natural forest as the source of wood while mills in Sumatra have processed both planted and natural wood in a more or less balanced quantity. Distribution of selected participants of the in-house training are presented in Table 2.

Table1. Salient features of wood processing mills by scale of operation

Aspect	Scale of operation		
	Small	Medium	Large
Area of mill compound	< 1 Ha	1-5 Ha	> 5 Ha
Wood supply	Irregular Limited quantity	Regular and irregular	Mostly regular by contract or import
Complication of process	Simple limited automation	Semi automation	Complete automation some computerized
Number of employees	< 100	100-500	500
Product lines	Few products some by order	Many products mostly by order	Numerous products mostly by order
Monthly production capacity	< 250 m^3	250-750 m^3	> 750 m^3
Market destination	Mostly domestic	Domestic and Export	Mostly export

2.2 Scope of the in-house training

The aspects and elements of wood processing covered by the in-house training were:

a. Log handling at logyard

b. Sawmilling
   - Log crane
   - Log carriage
   - Breakdown and pony sawing

c. Plymilling
   - Veneering/wood slicing

Table 2. Participating mills in the in-house training

Province	Industrial Scale					
	Small		Medium		Large	
	Number	%	Number	%	Number	%
North Sumatra	3	6	4	8	5	10
Central Java	2	4	3	6	8	16
East Java	2	4	3	6	9	18
East Kalimantan	3	6	1	2	3	6
South Kalimantan	3	2	4	8	1	2
Total	11	22	13	26	26	52

d. Saw-doctoring
   - Bandsaw blade and circular saw
   - Knives (molder, planer, rotary and wood slice)

e. Conditioning and air drying

f. Kiln-drying and boiling
   - Kiln dry
   - Boiler

g. Wood processing
   - Cross-cutting
   - Grading and sorting
   - Laminating
   - Molding
   - Planing
   - Rip sawing
   - Sanding
   - Coating and painting
   - Repairing and finishing

h. Packaging

2.3 The strategy adopted

The trainings on wood processing techniques targeted fifty mills of different scales of operation located in the provinces of North Sumatra, Central Java, East Java, East Kalimantan and South Kalimantan. Planned schedule of the training sessions is as summarized in Table 3.

The tools and instruments used during the in-house training are as listed in Annex.

During the first visit, a quick technical audit was carried out. The audit covered the aspects and elements as described in the previous section. Technical auditing was performed as follows:

✓ The training experts, concerned owners, executives, managers, supervisors and operators, as appropriate, paid visit to the individual chains of process to see how the process was performed using what machine and equipment;

- ✓ Any deviating procedures and techniques were then identified;
- ✓ The appropriate procedures and techniques were then explained and demonstrated as necessary on the spot and relevant technical advice provided; and
- ✓ Standard operating procedures applied at each process chain was also examined and their weaknesses pinpointed.

Table 3. The planned in-house training sessions

Province	1st batch	2nd batch	3th batch
North Sumatra	16 – 29 March 2006 13 mills	20 February – 3 March 2007 13 mills	17 – 28 April 2008 13 mills
Central Java	8 – 19 May 2006 12 mills	9 – 18 April 2007 12 mills	12 – 29 February 2008 12 mills
East Java	1 – 14 February 2006 11 mills	10 – 11 August 2006 3 mills 18 – 29 January 2007 14 mills	3 – 13 December 2007 14 mills
East Kalimantan	22 – 29 August 2007 7 mills	9 – 14 June 2008 7 mills	7 mills
South Kalimantan	31 August – 4 Sept. 2007 4 mills	16 – 18 June 2008 4 mills	4 mills
TOTAL	**47 mills**	**53 mills**	**50 mills**

During the subsequent visits, as appropriate, quick technical audit was repeated as in the first one to see if the technical advices given at the preceding session were practiced and brought improvement about. Any remaining weaknesses or process irregularities were discussed and technical advice again provided for lessening or removing the weaknesses.

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3. SOURCES OF IN-EFFICIENCY OBSERVED AND RECOMMENDED PRACTICAL MEASURES

3.1 Realized in-house training sessions

It was originally planned to conduct 150 in-house training sessions covering 50 mills located in 5 provinces as described in the previous section. However, only 139 sessions could be realized. The first two sessions covered fifty mills in all provinces whilst the third session excluded 11 (eleven) mills in East Kalimantan and South Kalimantan for technical reasons including unavailability of International Expert, closing down and merging of participating mills and the remaining sanctioned time available for implementing the project. The third visit to the latter eleven mills was initially scheduled for early 2009. Realized sessions are summarized in Table 4.

Table 4. Realized in-house training sessions by province and training batch.

Province	1st batch	2nd batch	3th batch
North Sumatra	16 – 29 March 2006 13 mills	20 February – 3 March 2007 13 mills	17 – 28 April 2008 13 mills
Central Java	8 – 19 May 2006 12 mills	9 – 18 April 2007 12 mills	12 – 29 February 2008 12 mills
East Java	1 – 14 February 2006 11 mills	10 – 11 August 2006 3 mills 18 – 29 January 2007 14 mills	3 – 13 December 2007 14 mills
East Kalimantan	22 – 29 August 2007 7 mills	9 – 14 June 2008 7 mills	Canceled
South Kalimantan	31 August – 4 Sept. 2007 4 mills	16 – 18 June 2008 4 mills	Canceled
TOTAL	**47 mills**	**53 mills**	**39 mills**

Total number of participants was 860 comprising owners, executives, managers, supervisors and operators.The large number of participant and involvement of owners and executives are among the strengths of this in-house training. Experience shows that owners and executives very rarely attended class-room and field-demo type of training. Involvement of owners and executives are indeed very useful as they are the ones that make decision on needed investment, the true motivators of change, and they have the opportunity to observe themselves the actual technical and operational problems that might have never been reported by managers and supervisors.

3.2 Observed weaknesses in wood processing

Weaknesses in the conduct of wood processing varied between mills in terms of category and intensity. Some mills were weak in performing break-down sawing while others were weak in sanding; some mills were weak in veneer slicing while others exhibited poor gluing; yet another mills performed poorly in saw-doctoring. The weaknesses observed are brieband described below.

A. Log handling at logyard

Common weaknesses observed:

Many mills did not treat logs at logyard properly and resulted in downgrading of quality, and in some instances, damaged processing equipment, e.g. band saw blade:

- ✓ Logs were stacked in open area, directly expose to rain and sunlight and in contact with muddy or sandy soil;
- ✓ Figs 1 to 4 illustrate improper handling of logs at a logyard;

Figures 1-2. Logs piled directly on earth

- ✓ Many cracked or split logs were not attended using S-hook or end coating in order to prevent crack propagation.

Figure 3. Logs split without S-hook

Figure 4. Logs without treatment got rotten

Demonstrated/recommended actions:

Logs at logyard should receive proper treatment at logyard as follows:

- ✓ Logs must be protected from direct exposure to rain and radiation by applying appropriate cover on top of logs pile;
- ✓ Logs shall not be stacked in direct contact with earth but on top of wooden or concrete tiles;
- ✓ Crack or spilt at log ends must be prevented from propagating by applying plastic S-hook or end-coating;
- ✓ Logs must be washed with water before loading onto carriage to ensure cleanliness of the logs;
- ✓ Logs must be prevented from the attack of pest and disease through fumigation or other treatments as appropriate.

B. Sawmill

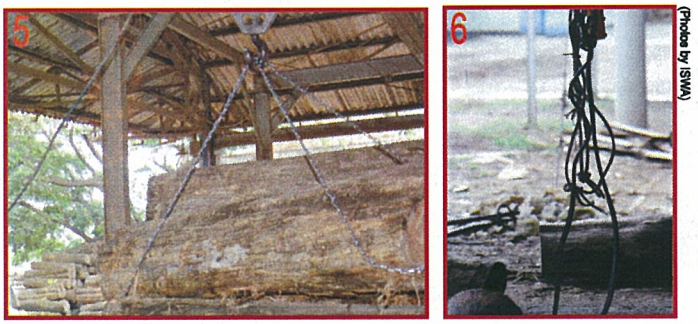
1) Log crane

Common weaknesses observed:

- Most of the cranes used steel cable (sling) or steel chain, some were worn out or damaged;
- Use of worn out or damaged cables is dangerous especially during rainy season when logs get slippery;

Demonstrated/recommended actions:

- Use clamping devices in place of cable or chain;
- In case steel cable is used, routine maintenance and periodic replacement is required.

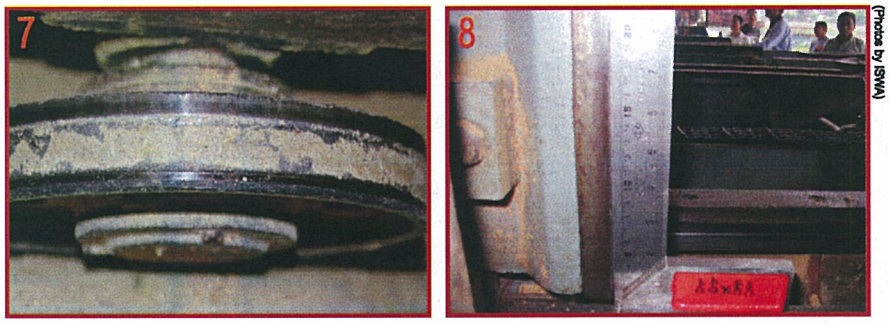


Figures 5-6. Log craning using damaged steel chain and steel cable

2) Log carriage

Common weaknesses observed:

- Carriage wheels were seldom equipped with sawdust scraper which hindered smooth movement of the carriage;
- Log-skid bed was not positioned at the right angle to the knee and fork head was not perpendicular to the band saw giving rise to angled sawing of wood;
- Rails which were not completely straight, or not similar in height, particularly at end-connection parts, or unequal in lateral-space distance resulting in unequal thickness or curving of sawn timber and the presence of sawmark;
- Foundation of band saw was weak causing vibration and defected sawn timber;

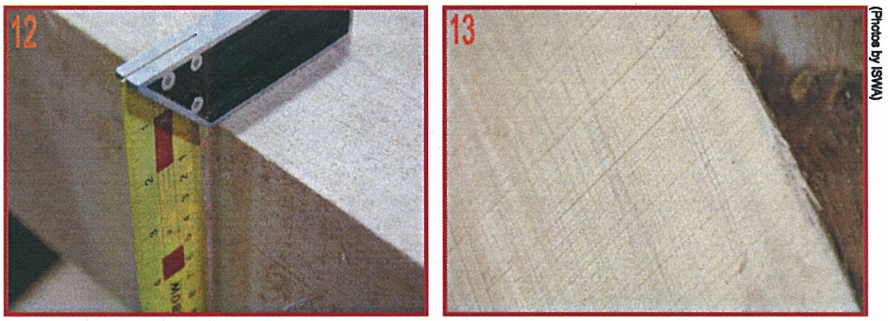


Figures 7-8. Wheel covered by sawdust (7); log skid bed and kneenot not perpendicular (8)

- Paper brake and pulling cable (cable sling) which were seldom replaced, hindered the log-carriage movement, and hampered sawing operation;
- Log carriage was seldom equipped with mirror to help operator observe the condition of a log to saw and use of laser ray is infrequent during the wood sawing;

Figures 9-11. Fork head and band saw not perpendicular (9); rails not straight (10); rails not leveled (11)

- When a mirror was installed, most operators of sawing seldom paid attention to the mirror and instead performed sawing using instinct or feeling.



Figures 12-13. Angled end sawn timber (12); sawmark on sawn timber (13)

Demonstrated/recommended actions:

- Carriage wheels should be always equipped with scrapper particularly at the side facing band saw;
- Ensure that the position of log skid bed knee with fork head, and band saw is correct before starting sawing operation;
- Make sure that rails are straight, similar in height particularly at the end connection parts, and equal in lateral distance;
- Routine maintenance of paper brake as well as pulling cable is essential;
- Placing of a mirror behind the log carriage is helpful for sawing operator to observe and examine log condition and to determine the right sawing strategy;
- To optimize wood recovery, the observation mirror is better combined with use of laser ray.

3) Break-down and pony sawing

Common weaknesses observed:

- At some mills, the base foundation of break-down machine, pony device, and saw was weak by using wooden support and resulted in vibrating and shaking machine and consequently, defected sawn wood;
- Improper greasing of bearing in terms of timing, application of as well as quality of grease caused disturbance to the rotation of band wheels and band saw and resulted in saw mark as well as irregular dimension of sawn wood.

(Photos by ISWA)

Figures 14-16. Improper greasing of band wheel bearing: late greasing (14), incorrect application of grease (15) and use of low speed grease (16)

Demonstrated/recommended actions:

- The foundation for breakdown machine, pony device, and saw table should be strong and firm enough to bear the load weight, thereby preventing the position of machine and other device from moving;
- The bearing system should be regularly greased using the right quality of grease that is properly applied;
- Use a high speed type of grease that can bear temperature up to 260 °C or above.

4) Improper use and setting of band saw

Common weaknesses observed:

- Lack of attention to the properties of wood when selecting a band saw to use;
- Position of upper and lower band wheels was not in a straight line that the distance between the base of gullet and the side of wheel is not the same for both wheels which had resulted in vibrating of the band saw thus saw mark and saw burn.

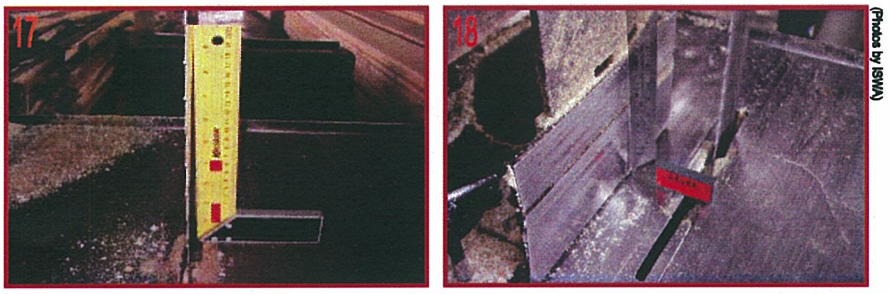
Demonstrated/recommended actions:

- When selecting a band saw to use, properties of wood raw material must be taken into account;
- Position of the upper and lower band wheels must me in a straight perpendicular line in order to avoid defected sawn timber;
- Ensure that the distance between the base of gullet and edge of band wheel is 3 mm;
- Consult with Technical Report No. 2 for technical detail of band wheels setting up;
- The material for lateral guide should be of hard-texture wood, and it is suggested to never use steel or other metals, since it is easily damaged and also destroys the band saw;
- Besides lateral guide, a weighing load should be used to make the band saw withstand shaking, avoid sawn wood with snake-like shape and to resist the unstable movement of the saw.

5) Position of band saw, table, and stopper

Common weaknesses observed:

Position of band saw, table, and stopper was not at the right angle and resulted in angled sawing despite the right type of band saw used.



Figures 17-18. Not perpendicular positions of band saw and table (17); table and stopper (18)

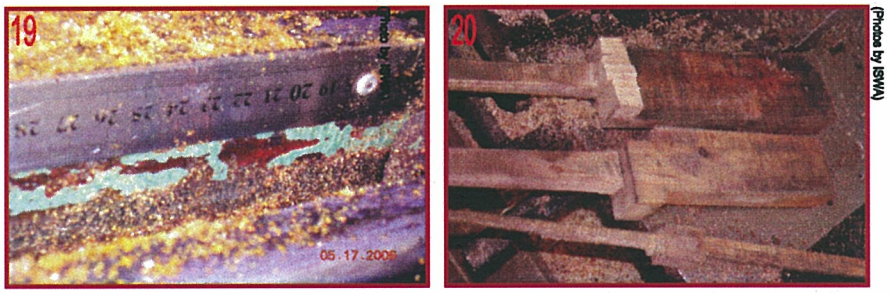
Demonstrated/recommended actions:

Make sure that the band saw, table saw and stopper are in the right position before starting operation.

6) Sawdust scrapper at the band wheels

Common weaknesses observed:

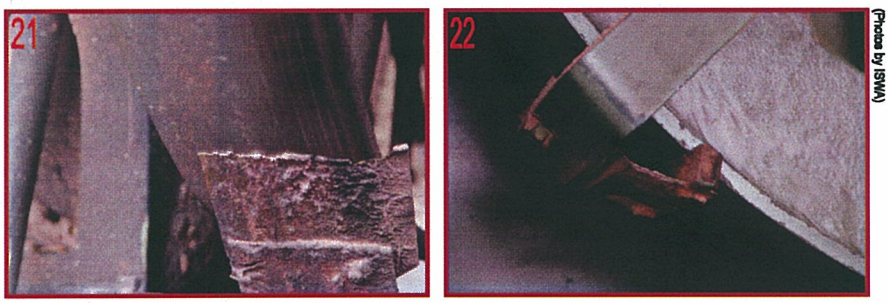
- The scrapper for sawdust at the band wheels already damaged and caused the accumulation of sawdust on the surface of the wheels and further unstable rotation of the band saw;
- The marks on the measuring device for wood thickness and width on the table saw (standard from the factory) were mostly damaged, unclear, or faded away;
- The scratching and making holes on the table to measure width/thickness of wood damaged the table itself.



Figures 19-20. Damaged measuring device (19), and wooden device as replacement (20)

Demonstrated/recommended actions:

- It is necessary to install scrapper on the upper and lower band wheels using hardwood in order to avoid damaging of the wheel surface (see Figures 21-22);
- Install a standard measuring device (ruler) at the upright side of sawing table in order to be easily observed and give accurate results;
- If a wooden manual measurement is used, make sure that it is made of hardwood with accurate scale.

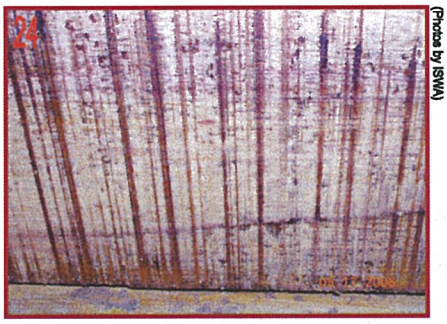


Figures 21-22. Install scrapper on the upper and lower band wheels

7) The cooling of band saw

Common weaknesses observed:

- The cooling of saw used residue of solar/diesel fuel or solar added with detergent, without considering what wood species to be sawn;
- The use of solar residue as a cooling medium left the sawn wood with dirty marks and caused problem in painting and coating process;
- Heated band saw inevitably expanded thereby becoming sandwiched between sawn wood and obstructed sawing work.



Figures 23-24. Use of diesel fuel residue and detergent as coolant (23); and the resulting sawn timber (24)

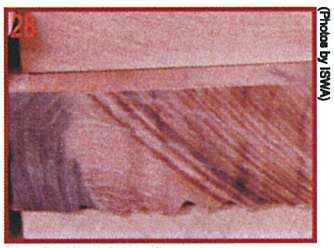
Demonstrated/recommended actions:

- Use a mixture of water and detergent in proportion of 5 liters and 5 grams, respectively, as the coolant for a band saw for hard-texture wood;
- For band saw of soft-texture wood, the cooling agent is the mixture of water (20 liters), solar (0.25 liters), and detergent (1 sachet/5 grams);
- Or else, use cooling liquid called "cutting oil" which is recently available in domestic market.

8) Common wood defects resulting from sawing process

Common weaknesses observed:

Sawn timber defects resulting from sawing frequently observed at the mills were: sawn timber was not right-angled due to the improper position of band saw and saw table, band saw and stopper, and log trimming not at the right angle as well; fuzzy or hairy surface sawn timber due to blunt saw teeth; saw marks due to the width of sawing teeth, or right and left openings of sawing teeth not equal, or due to shaking band saw; saw burn caused by the sawing teeth sandwiched between wood being sawn (see Figs. 25-28).



Figures 25-28. Angled sawn timber (25); fuzzy surface (26); sawmark (27); and saw burn (28)

Demonstrated/recommended actions:

- The band saw, saw table, and stopper, and log trimming must be positioned at the right angle;
- To avoid saw mark, the width of sawing teeth, or the right and left openings of sawing teeth must be equal;

- To avoid saw burn, the sawing teeth should not be sandwiched between the wood being sawn;
- To avoid yielded sawn wood full of sawdust, the size of gullet should not be too small.

C. Plymill

1) Rotary machine

Common weaknesses observed:

The weaknesses encountered in rotary slicing machine were, among others,: the bar shaft where the chuck is placed, shacked severely, rendering the wood grain not straight, and resulted in unequal thickness between left side and right side of the veneer produced; the chuck used was already worn out and damaged, thereby lessening its gripping capability; in addition, the chuck as used provided only one size of log diameter (16-20 cm), gave rise to large diameter peeling residual (core) although many mills have utilized the core in finger jointing for laminated stick or bare core.

Figures 29-30. Core diameter of 16-20 cm (29); of 5-7 cm (30)

Demonstrated/recommended actions:

Use the chuck ranging from large to small size (e.g. 24 cm, 20 cm, 16 cm, 10 cm, and 5 cm). The chuck size should be suited to the logs that will be peeled into veneer. Many mills in peeling (veneering) have afforded leaving behind the core with 5-7 cm diameter. This core can still be used for broom stick, dowel, painting stick, etc.

2) Knife

Common weaknesses observed:

- The mouth, space between knife surface and machine body, was not equal in width at the right side and at the left side. This condition rendered unsimilar thickness of left side and right side of the veneer produced;
- Condition of the rotary knife as encountered was partly already damaged and dull. As such, the surface of veneer was wavy due to damaged knife and hairy/fuzzy due to the dull knife;
- Knife sharpening was not done properly;
- The residual cores directly fell on to the floor without pillow-like cushion, thereby damaging the core structure (e.g. breaking apart).

Demonstrated/recommended actions:

- Installment of rotary knife on the machine body must be accurate;
- The sharpening of knife must be done in a correct manner; consult Technical Report No. 2 for details of knife caring;
- Use old, unused tire, as a cushion to prevent cores from hitting floor directly.

3) Slicer

Common weaknesses observed:

- Position of table and guillotine knife was not at the right angle, rendering the veneer cut not- straight (angled) and the size of veneer in width as well as length unequal between the left side and the right side;
- Position of knife was not-firm/shaky causing also unequal size of veneer in width as well as length between the left side and the right side;
- The space between knife and machine body was too narrow, thereby hindering the input flow of veneer sheet to be cut or trimmed and also damaging the veneer itself;
- The guillotine knife was frequently already damaged (broken and wavy) and dull causing fibered side of veneer.

Demonstrated/recommended actions:

- Position of table and guillotine knife must be at the right angle;
- The knife must be placed firmly to avoid shaking;
- Mouth (space) between knife and machine body should not be too narrow;
- The guillotine knife must be kept sharp.

4) Size of pallet and of veneer

Common weaknesses observed:

- In stacking or piling of veneer sheets, the size of pallet used did not correspond to the size of veneer causing veneer damaged particularly at the end or side parts;
- Too large volume of veneer was stacked as one bundle.

Demonstrated/recommended actions:

- The size of pallet should correspond to that of veneer;
- To the extent possible, use wood waste as the pallet material;
- Do not to pile too many sheets of veneer in one bundle; each layer is best comprised of two sheets and layers are separated using wooden sticks.

5) Wood slicing

Common weakness observed:

Use of log squares caused break off of wood slice at the end parts and one side not right-angled.

Figure 31. End split of log squares

Demonstrated/recommended action:

To avoid the breaking of wood slice at the end part of the resulting wood slice, plastic S-hook must be applied.

6) The boiling of logs

Common weaknesses observed:

- The boiling of log squares was not properly done;
- The logs were not completely submerged/soaked in the boiling water causing uneven hardness of wood.

Figure 32. Improper boiling of log squares

Demonstrated/recommended actions:

- Log squares must be properly stacked and completely soaked in the boiling pond;
- The upper part of logs should be provided with a weighing load, to make sure that the entire logs are submerged in the water;
- The temperature and boiling duration must correspond to wood properties.

7) The slicing machine

Common weaknesses observed:

- Most mills used already old-fashioned machines;
- The installment or setting of knife to the machine body was not appropriate thereby producing slices with unequal as well as uneven thickness;
- Dark room caused difficulty in the setting of machine body and inspecting the resulting slices;
- Dull and damaged knives were still in use by many mills resulting in low quality of wood slice due to the presence of fuzzy and irregular dimension;
- The pressure applied was not well suited with wood species causing alteration of position and unequal length of slices;
- The length of pallet did not correspond to (shorter than) that of wood slices and caused defects particularly at the end or side parts of the slices.

Demonstrated/recommended actions:

- Use up to date, appropriate technology for wood slicing;
- Installment (setting) of knife to the machine body must be appropriate and firm to ensure high quality of wood slice produced;
- Dark room must be properly illuminated to make sure that knife is appropriately and firmly positioned;
- Examine knife condition regularly and draw up a schedule for knife replacement and the knife sharpening;
- As regards slicing machine, it is necessary to pay attention to, among others, knife condition, knife setting on the machine body (high and straight), stopper condition,

pressure as well as part of the product being pressed as they can affect the final product of wood slice;

- In stacking of product, the length of pallet must correspond to that of wood slice and wood waste can be utilized for pallet;
- To prevent wood slice from becoming defective, do not stack too many wood-slice sheets in one pile but only around two sheets.

D. Saw-doctoring

Saw doctoring signifies the most important activity in the wood processing to achieve added value of wood raw material in accordance with the market demand. Saw doctoring on band saw blade, knives (circular saw, molder knife, planner knife, rotary blade, and wood-slice knife) has become the main problem in wood industries that it deserves serious attention. Saw-doctoring process can bear significant effect on finished products of the processed wood.

1) Band saw blade

a) Band saw room and selection of band saw

Common weaknesses observed:

- Most of the rooms visited were dark, dirty, and untidy and resulted in inconvenience and inaccuracy of working, thereby lowering quality of work results;
- Selection of band saw must be based on the wood species to be sawn; most of the mills failed to pay attention to this matter.

Demonstrated/recommended actions:

It is necessary to see to cleanliness, tidiness, air circulation, and illumination of saw doctoring room.

b) Benching equipment and related tools

Common weaknesses observed:

- Many benching tables were rough and damaged, positioned not parallel with the stretching roller and effected smoothness of leveling and stretching work results;
- Stretching roller was usually worn out, upper and lower wheels already smooth/not rough any longer on its surface;
- Many mills did not perform proper straightening, tensioning and leveling.

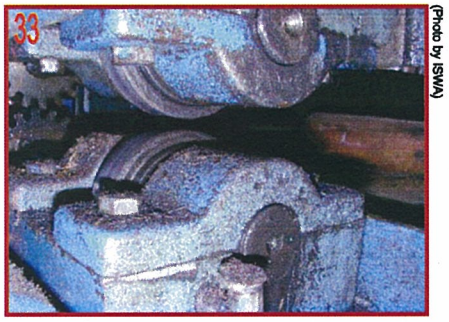


Figure 33. Worn out stretching roller.

Demonstrated/recommended actions:

- Dirty table should be cleaned;
- Position the table and stretching roller in such a way that they become parallel and leveled;

- Replace or lathe the surface of sharpening wheel such that the diameter of the center part of the wheel equals to 1 mm or in accordance with factory standard;
- The contact and touching point between two wheels must form one point (about 1 mm in diameter); otherwise the band saw will sustain greater pressure, when the point have large diameter;
- When the position of illumination lamp is exactly over the table, this can cause difficulty to the technician to examine whether the band saw is leveled out. Therefore, the lamp must be placed in the opposite direction to that of the technician, thereby effectively assisting in examining the levelness of band saw.

c) Stretching or tensioning of band saw

Common weaknesses observed:

- Most mills failed to perform band saw stretching adequately especially due to lack of tools and equipment and weak technical skills;
- Tensioning using the temperature below 300 °C, the band-saw metal will stay hard, thereby causing difficulty in hammering; if the temperature is higher than 400 °C, the band-saw maybe broken off.

Demonstrated/recommended actions:

- In tensioning, it is necessary to use standard hammer, suited with the thickness of band saw;
- Do not ever use a construction or worn out hammer;
- If a light-weight hammer is used, then the surface of band saw will undergo meaningless change; if it is too heavy, the surface of band saw may be broken off or ruptured;
- The hammering direction should be perpendicular to the band-saw surface. In this way, results of hammering on the band-saw surface will be even. If the hammering direction is rather slanting, the hammered surface will not be evenly stretched;
- The tensioning temperature should be between 300 °C and 400 °C;
- In heating that uses oxy-acetylene flame, the position of torch pipe and the band-saw surface should make a 30° angle, and in distance between the tip of torch pipe and the band saw surface should be around 10 mm;
- The tensioning/stretching should be carried out repeatedly until the surface of band saw becomes completely flat.

d) Straightening of band saw

Common weaknesses observed:

- Band-saw clamps were seldom used during the straightening work and affected the height of saw teeth;
- If the height of saw teeth is not equal, then only the taller saw teeth work and this will render the saw teeth easily broken off or ruptured due too heavy work load.

Demonstrated/recommended actions:

- Use band-saw clamp and then perform the straightening;
- Level the back part of band saw using standard hammer in order to avoid vibration in using;
- Use the standard measuring gauge for straightening.

e) Leveling of band saw

Common weaknesses observed:

- Weak evaluation of the flatness of band saw surface;
- Placement of illumination lamp was incorrect,

Demonstrated/recommended actions:

- Use straight-edge template to correctly evaluate the flatness of band-saw surface;
- The illumination lamp should be in the opposite direction with the operator; as this will assist in determining the condition of band-saw surface; mark with chalk or crayon the band-saw surface that shall be leveled out; perform the heating on the marked band-saw surface and hammer it with standard hammer; and reexamine the flatness of hammering results on the band-saw surface.

f) Joining of band-saw

Common weaknesses observed:

Many mills failed to perform proper joining of band saw either in preparation, welding and sharpening work.

Demonstrated/recommended actions:

- Do the joining in perpendicular way and the hammering parallel to the joining part at the right – left edges and the back part;
- Do the hammering as such that it progresses in an "eight" route (consult with Technical Report No. 2 for technical details);
- Edge of the saw must be sloping with the width about 1/10 of the thickness of band saw;
- Make sure that the joining results coincide one another to assure a strong join.

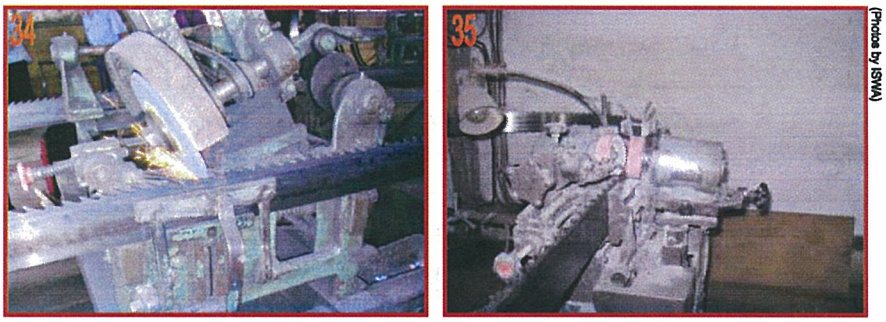
g) Installing a stellite

Common weaknesses observed:

- Many mills did not install satellite properly that the band saw is sometimes shaking;
- Temperature of welding was determined artificially.

Demonstrated/recommended actions:

- The operator installing a satellite must be in a sitting position to avoid the shaking of band saw that will bring about bad results;
- When the welding temperature in installing the stellite is less than 450 °C, the stellite will be easily loose and fall off the saw tooth while when the welding temperature is greater than 450 °C, the saw tooth will be easily damaged;
- Determine the right temperature needed for installing of stellite by scratching the crayon at the tip of saw tooth then heat it using torch flame (red color) until the crayon scratch melts which indicates the temperature reaches 450 °C;
- Soon afterwards, the stellite is installed using the welding (blue flame color);
- The proportion of intensity between the red-color flame and the blue-color flame is 3:1;
- After installing of stellite (stellite tipping), the saw tooth should undergo grinding and sharpening. Such grinding and sharpening comprise among others the grinding and sharpening the foremost front part of the saw tooth using grindstone (sharpening) wheel; the grinding and sharpening of the edge part is by using double-side sharpener.

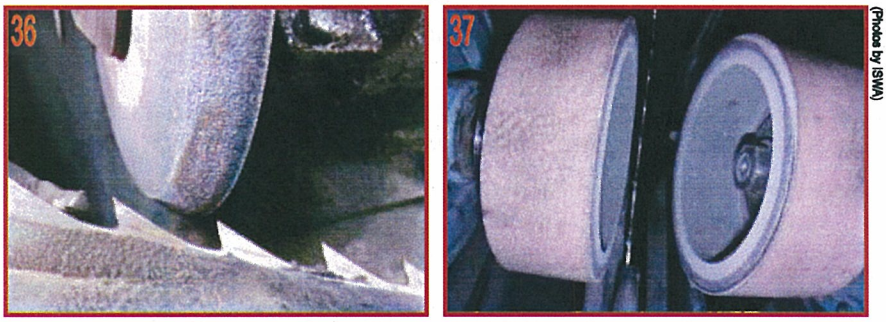


Figures 34-35. Teeth grinding and sharpening (34), double-side sharpener (35)

h) Surface of grinding (grindstone) wheels

Common weaknesses observed:

- Surface of grinding stone was already scratchy and craggy which affected badly the shape and size of saw-tooth gullet, resulting in unequal height of saw teeth, the saw teeth less sharp and easily broken off;
- The round-shaped grinding stone with rough surface affected the clearance and hook angles, saw-blade sharpness, and saw-tooth gullet;
- Installment of grindstone wheel with improper angle will bring out saw teeth with unequal height as well as width which is mirrored at the color of grinding stone surface;
- White color indicates that the surface of double-side sharpener does not touch the saw teeth, while the part that touches it reveals black color;
- This situation renders the tallest saw teeth easily broken off or ruptured, during operation the band saw vibrates causing the size of sawn products not corresponds to the desired size, and saw mark appears on the surface of sawn timber.



Figures 36-37. Scratchy and craggy grinding stone (36) and incorrect setting of double-side sharpener (37)

Demonstrated/recommended actions:

- The grind-stone wheel should undergo dressing using dressing stone;
- The grinding and sharpening of the edge part of saw tooth using double-side sharpener is useful for shaping of the left-right side and upper side of saw tooth;
- The width of saw tooth on left and right sides should be less than half the width of band saw blade which can be achieved by regulating the angle of grindstone wheel at the double-side sharpener;
- The proper placement of illumination lamp for acquiring appropriate light is crucial as it affects the control of the double-side sharpener during its operation.

i) Swage and spring setting

Common weaknesses observed:

- If the saw teeth is laterally bent exactly above the root, then the saw teeth will be easily broken off or ruptured,
- Excessive shaping will make the saw teeth not well arranged, consume much electricity, and lower the quality of the surface of saw teeth,
- Conversely, too little shaping will cause high friction between wood and the saw, and the saw teeth becomes too hot.

Demonstrated/recommended actions:

- The shaping of spring setting at saw teeth is by laterally bending the saw teeth a little above the saw-teeth root to the left and to the right, manually or using automatic lateral-bending machine.
- Such bending is around 1/3 (for hardwood) to 1/2 (for softwood) the height of saw teeth and all the saw teeth should be bent at the same bending range.

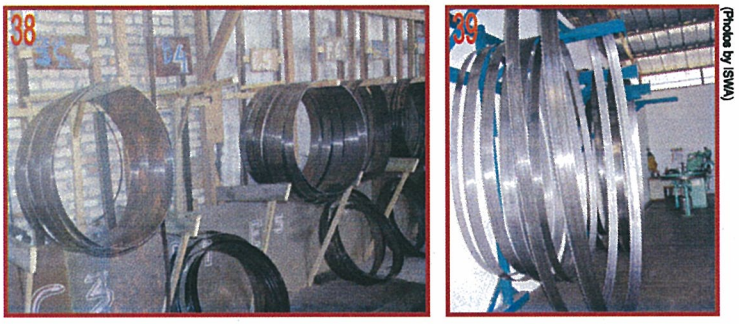
j) Maintenance and storage of band saw

Common weaknesses observed:

- Most mills did not pay much attention to maintenance and storage of band saw thereby shortening the service life time.

Demonstrated/recommended actions:

- Proper maintenance and storage can prevent the band saw from twisting, stretching, elongating, becoming rusty and dirty,
- The band saw must be stored in dry and clean place,
- To avoid twisting, the band saw must be stored like a belt or ribbon and its center part is weighted with a weighing load,
- To avoid elongation and rust, the band saw should be hung, but a support is provided at its base; hung band saws must not be touching one another,
- To avoid rust more effectively, the surface of band saw before being stored can be lubricated with oil or grease.



Figures 38-39. The band saw in dry and clean place

2) Knives (circular saw, molder, planer, rotary and wood slice)

a) Grinding, sharpening and cooling agent

Common weaknesses observed:

- The knife following the grinding with a machine was seldom sharpened using hand-held sharpening tool (honing stone) in order to make the knife blade smoother;

- If the grinding and sharpening were done with machine only, there appeared grain-like impression with black color (grains) and iron grain (burr) on the edge of knife blade, and the knife became less sharp;
- The way of sharpening knife was inappropriate by many mills;
- The knife which was already dull or not sharp were still in use;
- Up-cutting sharpening of knife caused the heat distributed over the knife body; conversely, down-cutting sharpening of knife bring about the build-up heat concentrated on the edge of knife blade, prompting the grain-like appearance with black color (grains);
- A knife became hot during sharpening due to improper use of coolant;
- In fact, some mills used expired coolant.

Demonstrated/recommended actions:

- Knives consist of two types i.e. HSS and TCT. HSS is for soft-texture wood, while TCT is for hard-texture wood;
- In their use, the blade angle of knife also differs: HSS knives use blade angle of 41^{o} - 42^{o}, while TCT knives use blade angle of 45^{o};
- Measuring a knife-blade angle is done using protractor;
- Measuring of knife-blade angle deserves carrying out after knife sharpening to avoid wrong use of knife type;
- It is suggested to use double-bevel knives particularly for hard-texture wood;
- The way of preparing double-bevel knives is as follows:
  - ✓ Metal or small wood with jig is placed on a knife sharpener as a support sloping at 45^{o}-42^{o} or about 2^{o}-3^{o} deviating from the standard;
  - ✓ Blade of knife with double-bevel has two angles will lower sloping, and the sharpening is done with hand sharpener stone;
  - ✓ Knife blade with double-bevel renders the knife stronger, sharper, and lasting longer compared to the knife with single-bevel.
- Sharpening knife with hand-held honing stone is to be performed as follows:
  - ✓ The sharpening tool is turned in clockwise direction with three replications (minimum) at the knife blade beginning with the rough sharpening stone until finally the very smooth sharpening tool;
  - ✓ The back part of knife is also sharpened in the same way as that of knife blade;
  - ✓ The already dull knife or broken off should be leveled out at its blade surface prior to sharpening;
  - ✓ The knife broken off with the depth over 5 mm is better not used;
  - ✓ In sharpening the knife using machine, pay attention to the surface of sharpening-stone; it should be even (leveled out), not concave or convex;
  - ✓ If the stone surface is not even or not leveled out, it should be dressed with a dressing stone;
  - ✓ Rotating direction of a honing stone should be clockwise or in up-cutting direction.
- A heated knife during sharpening must be cooled using the right cooling agent;
- Proper use of coolant e.g. proportion and condition will avoid the knife becoming hot;
- Use coolant that contains chemical and water; recommended proportion of coolant and water is 25:100; example of such coolant is the so-called "kurecut";
- Other aspect that deserves attention is the coolant condition; when the coolant becomes white in color and turbid, it is already expired; conversely, when the coolant is still green in color, this implies that it is still worth using.

Figs 40-41 Measuring of knife blade angle (40); and double-bevel knife making (41)

b) Installment of knife (cutter) at the cutter block

Common weaknesses observed:

- The height and weight of knife are not similar (not compatible); therefore, only taller and heavier knives were functioning; this situation rendered the knives easily damaged (broken off or ruptured), and also made the planed wood defective;
- The damaged knife blade affected the resulting cut wood to be processed, as shown by the presence of line along the surface of product, thereby necessitating a re-work.

Demonstrated/recommended actions:

- The height and weight of knives should be compatible; the surface of knife blades are even (leveled off) and the height of knife blades at the cutter block should also be similar;
- Appropriate and accurate installment of knives at the cutter block will ease further process, particularly in wood sanding.

Figures 42-44. Measuring height of knives using micrometer (42), using optic machine (43) and measuring evenness of knives using special ruler (44).

c) Operators at saw-doctoring section

Common weaknesses observed:

- Most of the operators as such did not pay much attention to the maintenance and storage of circular saws;
- Many operators wrongly cleaned the surface of circular saw using strong soda (NaOH) which damaged the protecting metal thereby accelerating the saw rust and triggering hole-shaping on the saw surface.

Demonstrated/recommended actions:

- To clean a circular saw, use kerosene, "pay-off" solution, or "larzip-15" solution;
- Before storing knives, lubricate them with grease or oil, covered with oily paper or other thin paper; the knives are to be stored neatly on the shelf not in contact with each other;

- Avoid the storing of knives in places contaminated with dust and other dirt in order to prevent knives from becoming rusty.

Figure 45-47. The proper way of storing cutter blocks (45); circular saws (46); and molders (47)

E. Conditioning

The aspects that deserve thorough attention regarding conditioning, either indoor or outdoor are: conditioning site, wind direction, base where wood is piled-up, sticker, pilling of veneer or wood slice after being dried, way of wood piling or stacking, labeling and protection.

1) Conditioning site

Common weaknesses observed:

- Many sites for conditioning were unclean, either indoor or outdoor;
- Sometimes, the placing of wood pile did not consider direction of wind blow.

Demonstrated/recommended actions:

- Ensure that conditioning site, either indoor or outdoor, is clean;
- In placing of wood pile, direction of wind blow must be taken into account as air circulation accelerates the conditioning process, particularly in kiln-drying;
- Place the wood to be dried perpendicularly to the wind direction.

2) Wood stacking, stick and pallet

Common weaknesses observed:

- At many mills, the sticks used in wood stacking were the same wood material as the wood to be dried;
- Wood sticks were of different dimension causing stacked wood unevenly positioned and bowing or curving;
- Distance between the wood sticks was too far or too near; in case the distance was too far, many woods bowed (curved) or even broken (ruptured); conversely, the too near distance hindered air circulation and slowed the conditioning process;
- Size of pallet was not suited with that of wood stuffs under work thereby damaging the stuffs particularly at the end or edge parts or becoming broken or ruptured.

Demonstrated/recommended actions:

- The distance between wood sticks must be suited with the length and thickness of wood under conditioning;
- Dimension of sticks must be similar to avoid wood from bowing, curving, etc.;
- Do not use wood sticks the same as the wood to be conditioned;
- Make sure that the size of pallet used is suitable with that of the wood stuffs to be handled;

Figures 48-49. Sticks are the same as the wood to be dried (48); random stacking (49)

3) Conditions of wood to be dried and support sticks

Common weaknesses observed:

- Woods to be dried already bowed or (curved) or already attacked by molds/ fungi;
- Lacked of attention to condition of wood to be dried, e.g. wood with bark, covered with sawdust, dirt, or dust; which affected moisture content of dried wood;
- Different wood species were mixed in one pile whilst drying properties of these species might not be the same;
- Sortiments of wood with different dimension were stacked in one pile causing uneven moisture content at the end of drying time;
- Distance between woods in the pile was too close, thereby hindering air circulation and hence causing uneven MC.

Demonstrated/recommended actions:

- The supporting material or wood sticks must be of hard-texture wood having moisture content lower than that of the wood to be dried and must be free of defects;
- Paint the stickers with different colors, each color is to be used for a group of piles of the same species, dimension, etc.;
- The wood to be dried should not be bowed (curved) or not already attacked by molds/ fungi;
- Wood to be dried should not contain wood bark, covered with sawdust, dirt, or dust;
- Species of wood to be dried should not be mixed in one pile;
- Thickness of wood to be dried should be the same or homogenous or if thickness is not homogenous, wood with smaller size should be placed at the upper pile;
- Distance between woods to be dried should not be too close;
- Begin stacking by placing sticks first at the ends of wood and towards the center of stacking layer at appropriate distance then continue upwards that at the end the sticks shall look like a vertical line;
- The size of and distance between sticks must be suited with the thickness of woods to be dried.

Figures 50-51. Conditioned timbers contain bark (50); covered by dust (51)

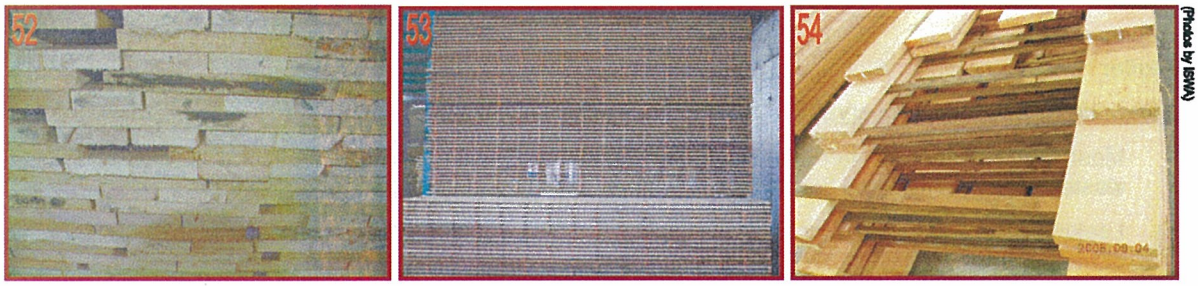


Figure 52-54. Conditioned timbers stacked without air circulation (52); Conditioned timbers properly stacked (53-54)

4) Conditioning of veneers and wood slices

Common weaknesses observed:

The veneers were just piled up in great number as one bundle; this brought about their uneven ultimate MC, the veneers at the upper part to bow (curve) and to dry faster than those in the middle or lower part.

Demonstrated/recommended actions:

- It is better that every one to two veneer sheets piled-up are provided with thin stickers,
- The conditioning way for veneers is similar to that for wood slices,
- It is suggested that the wood slice is hung (suspended) per sheet in the way similar to using coat hanger or arranged by placing them on shelf,
- Every pile or bundle of veneers or wood-slices are marked with labels for inventory control in further process,
- It is necessary also to apply a cover at the upper part of wood-slice pile during the outdoor conditioning to reach their air-dry MC to avoid the wood-slice directly hit by heat or by rain hence securing their even MC.

F. Kiln-dry and boiler

1) Kiln-dry

Common weaknesses observed:

- Many chambers shaped rectangular which did not facilitate a smooth and even flow of air;
- Wall and floor of many chambers were rough or partly damaged thereby obstructing an even air flow;
- Sub-ceiling near the chamber door was frequently made-up of construction wood positioned higher than the surface of sub-ceiling which tended to lessen air velocity,
- The distance between edge of the sub-ceiling and chamber wall was, at many mills, too wide.

Demonstrated/recommended actions:

- The four sided walls of a kiln chamber is best shaped in a curving fashion in order to facilitate an even and smooth air flow;
- Make sure that wall and floor of a chamber are smooth or constructed of smooth material, e.g. aluminum, zinc, etc., thereby facilitating a smooth air flow;
- The proper sub-ceiling is the one with even surface and provided with folded part which functions to direct wind in the right direction and speed when the fan is in operation;
- The distance between the edge of sub-ceiling and chamber should not be too wide.

2) Boiler

Common weaknesses observed:

- Most of the boilers in operation used heat or fire-stove with small openings utilizing wood wastes, sawdust or liquid fuel, as the source of energy that converts water to vapor;
- Leaking pipe and valve near or at the boiler were not uncommon rendering ineffective use of heat energy;
- Damaged pressure and temperature gauges also were common;
- Many mills preferred to use saw dust or wood waste as source of energy although liquid fuel may generate larger amount of power;
- Boiler capacity was often forced to work overcapacity causing many boilers to explode.

Demonstrated/recommended actions:

- A mill should conduct a study regarding the use of different sources of energy before deciding which one is most economical to use;
- Network of boiler pipe should be installed by considering the distance between boiler and drying-kiln chambers to ensure that the amount of hot air generated by the boiler reaches the chamber in an efficient manner;
- There should be no leaking pipe and valve near or at the boiler;
- Damaged pressure and temperature gauges should be immediately repaired or replaced in order to assist the operator in proper control of hot-vapor flow;
- Operating capacity of a boiler shall not exceed its design set by the manufacturer in order to avoid the boiler from exploding.

G. Wood Processing

Wood processing signifies the activities that comprise preparing the panel from drying process in the drying kiln, conditioning, until the final product in accordance with the market demand. The process begins from the cross-cut (circular, arm, and jumping saw), selection (grading/sorting), jointing (finger joint), molding, planing, laminating/gluing (hot and cold press), clamping, panel saw (table or arm saw, double end), rip saw (single or double), sanding, and painting/coating. Most of the weakness/problems and recommended actions to deal with such are described in the following:

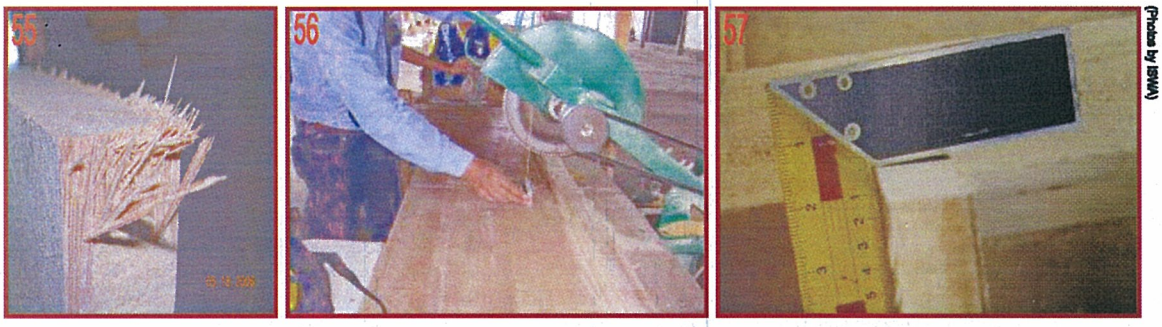
1) Cross-cut (circular, arm, and jumping saw)

Common weaknesses observed:

- Machines for cross-cut (circular, arm, and jumping saw) were not properly and accurately installed and caused the shaking when the machines were in operation and gave rise to defected products;
- At many mills dull knives were used and resulted in fuzzy end parts of panels;
- Position of knife, table, and stopper was not at the right angle with each other, causing angled cut panel and inefficiency in jointing process particularly at the preparing of tongue and groove joints.

Demonstrated/recommended actions:

- The cross-cut machines (circular, arm, and jumping saw) must be properly and accurately installed, thereby securing their stable position;
- The knife blade must always be in sharp condition;
- Position of knife, table, and stopper must be at the right angle with each other;
- The round saw plate must be even, height and sharpness of knife blade must correspond to the pre-specified technical standard.



Figures 55-57. Improper installment of cross-cut machine causing fuzzy product (55); table and knife not perpendicular (56); causing angled cut panel (57).

2) Grading and sorting

Signifies the stage/process of selecting material in accordance with its quality and color suited with the production plan

Common weaknesses observed:

- This process normally did not use the machine, but was fully based on experience and knowledge of operator therefore results of the work were subjective;
- Many mills misplaced the illumination lamp thus did not facilitate an accurate and efficient process of grading.

Demonstrated/recommended actions:

- Place sufficiently bright illumination lamp in the right position to facilitate accuracy and efficiency of grading process;
- Pay attention to the condition, size, and height of the table; the table should be flat, spacious and its height is suited with tallness of the operator.

3) Gluing

a) Sorting of materials

Common weaknesses observed:

- The materials (panel) selected for further process after the cross-cut process were not uniform in size (thickness, width, and angle);
- The irregular sizes caused problem in the preparation of groove and tongue while jointing results appeared wavy;
- The panel or stopper at end of the table was not rightly angled causing the jointing results shaped like snake and resulted in inefficient planing process and large quantity of wood waste.

Demonstrated/recommended actions:

- The cross-cut materials (panels) selected for further process must be uniform in size (thickness, width, and right-angle);
- Stopper must be installed in the right angle.

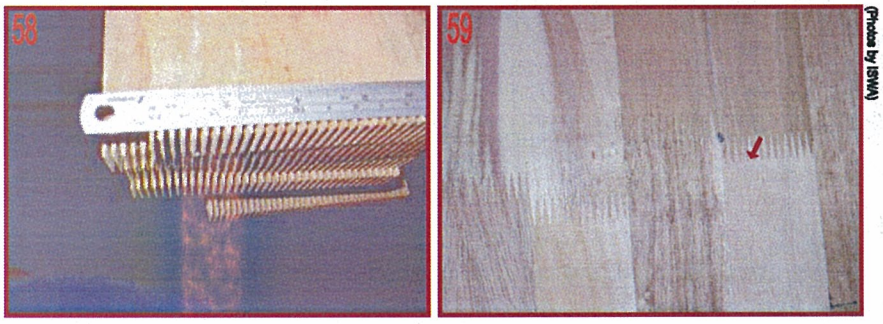
b) Knife blade (in group or single)

Common weaknesses observed:

At many mills, the knife blade had sharpness, height, width, and distance that were not in conformity to those of standard; specified by manufacturers.

Demonstrated/recommended actions:

The knife blade should have sharpness, height, width, and distance in accordance with the pre-specified standards in order to ensure quality groove and tongue and avoid the presence of pinhole that affects the strength of joint.



Figures 58-59. Tongue and groove joints not uniform in height (58); and occurrence of pinhole at the joints (59).

c) Use of glue and hardener

Common weaknesses observed:

- Use of glue/adhesive and hardener, particularly in the way of mixing of glue ingredients, was mostly inappropriate and inaccurate except in the use of glue without hardener;
- At many mills mixing of glue and hardener was done manually and incomplete;
- The mixing of glue and hardener was often performed during the gluing process and resulted in unevenly mixed hardener, different drying time, weak and easily loose gluing bond and excessive consumption of hardener.

Demonstrated/recommended actions:

- Mixing of glue and hardener manually must be done completely that the resulting mixture is in a perfectly mixed state;
- The mixing of glue and hardener must be performed separately before the gluing process;
- Glue and hardener must be stored in a cool place to avoid drying process.

d. Polishing using glue spreader and brush

Common weaknesses observed:

- At many mills, tube/container of glue spreader was damaged and caused uneven spread of glue on the panel, thickened glue at the damaged spot and wasted a lot of glue;
- At many mills polishing using a brush caused abundant use of glue, and unevenly spread of glue due mainly to the horizontally positioned panel, inappropriate brush construction and excessive dipping of brush into glue.

Demonstrated/recommended actions:

- The tube of glue spreader must always be in good condition, and not damaged;
- Clean the container after using the glue spreader;
- In order to efficiently use glue, it is enough to polish only 2/3 of the surface area of a tongue which can be done by adjusting the tube position;
- It is best to position the panel to be glued vertically in order to avoid accumulation of glue at the panel surface;

- Apply glue to only 2/3 of tongue surface;
- Use a suitable form of brush with plastic hair to facilitate evenly and thinly spread of glue.

Figures 60-62. Damaged cylinder of glue spreader (60); horizontally positioned panel for gluing (61); using unsuitable brush for gluing (62).

e. Condition of jointing machine (table, stopper, mouth/opening of the clamp, pressing tool, and cutting knife)

Common weaknesses observed:

- Many mills used already aging table, stopper, clamp, pressing tool, and cutting knife without adequate maintenance;
- Many jointing tables were covered by glue spills while many stoppers at the end of assembly table were not at the right angle causing the jointing during the pressing easily broken or bent;
- At some mills, mouth of the clamp was not suited with panel thickness therefore enforcing of putting the panel into the machine was common thus damaged the panel itself;
- Proportion (ratio) between the panel length, length of the pressing-tool, and the pressing angle sometimes did not receive due attention;
- Many knife blades were not sharp causing the end of the cut panel fuzzy or grained-out.

Demonstrated/recommended actions:

- Condition of table, stopper, mouth clamp, pressing tool, and cutting knife must be well maintained;
- Jointing table must always be cleaned of glue spill; and stopper at the end of assembly table must be at the right angle;
- Mouth of clamp must be suited with panel thickness, thereby avoiding the forcing of putting the panel into the machine;
- Proportion or ratio between the panel length, length of the pressing-tool, and the pressing angle must not be ignored;
- Attend sharpness of knife blade and prepare a proper schedule of knife sharpening.

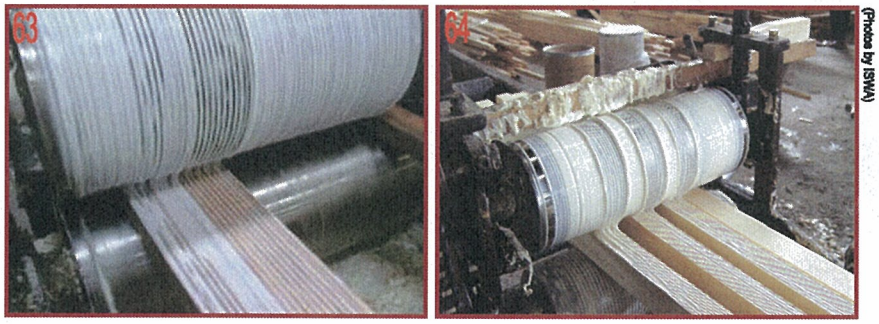
f. Finger-jointing process

Common weaknesses observed:

- The size (thickness and length) of panels differs considerably from one another and affected the clamping process: the board becoming wavy, a lot of panel material wasted and adversely affect planing and sanding processes;
- Glue was not evenly spread over the panel surface due mainly to dirty roller glue spreader, damaged glue spreading opening and the inappropriate glue mixing.

Demonstrated/recommended actions:

- Ensure that the size of panels should not differ from each other;
- The glue spreader must always be clean, the hole for glue spreading must not be damaged and glue mixing should be appropriate.



Figures 63-64. Roller glue-spreader partly damaged (63); in good condition (64).

g. Hand glue spreader

Common weaknesses observed:

Most of the operators thought that the greater the use of glue, the stronger the joint would be while in fact, too much use of glue brought out the situation where the outer part of the glue would dry but the inner part remained wet, the situation that weakened glue strength and posed problem in planing and sanding processes.

Demonstrated/recommended actions:

- When hand glue-spreader is used, pay attention to glue viscosity and use brush to spread the glue evenly;
- Use the hand roller commonly used in wall painting to ensure easy and even spread of glue.

h. Arranging panels for clamping

Common weaknesses observed:

The arrangement of panels for clamping was frequently inappropriate and inefficient; this is because in order to get the desired panel size, panel should be cut at both left and right sides (edges), thereby generating a lot of panel wastes.

Demonstrated/recommended actions:

To avoid generating panel wastes, then both left and right sides of panel to be cut should be straight starting from lower to the upper parts of the panel; the use of stopper is recommended; with such arrangement, only one side (edge) of the panel is cut, while for the other side, not much cut is necessary.

i. Clamping condition

Common weaknesses observed:

- The clamping device is sometimes covered by dried and hardened the glue;
- The hardened and thickened glue affected the panel surface that resulted from the clamping, i.e. wavy appearance.

Demonstrated/recommended action:

It is suggested to scrape the residual glue accumulated on the panel surface.

j. Laminating process

Common weaknesses observed:

- Lacked of attention to the installing and caring of laminating tool and inefficient use of glue;
- Sometimes, the pressing tube was leaking thus lowered the pressing capacity;
- Position of cold press was not flat and caused uneven spread and unnecessary high consumption of glue;
- Many screw rollers were dirty, damaged, and covered by glue which hindered easy moving of panels;
- Most of the laminating tools were damaged, particularly at the edge part, causing the glue did not reach the panel edges.

Demonstrated/recommended actions:

- Pay due attention to the installing and caring of laminating tools and efficient use of glue;
- The pressing tube at the hot press should not be leaky;
- Position of cold press should be flat;
- Screw roller should be clean, in good condition, and not covered by glue;
- The laminating tools should be in good condition and ready for operation;
- Use the merchant-type hand roller to evenly spread glue on the entire panel surface;
- Pay attention to the installing of machines (hot or cool press) and prepare a schedule regarding periodical caring/maintenance of tool and machine.

4) Molding

Common weaknesses observed:

- Many molding machines were old, lacked of maintenance and related tools damaged;
- Although many mills use new and modern machines, product quality management did not receive due attention;
- In the molding process, there was a lack of attention to molding-pressure, feeding speed, molding technique and product assembling;
- Feeding-pressure and feeding-speed gauges were mostly damaged and difficult to read causing difficulty in controlling of saw mark or snapping;
- Damaged gauging device must be replaced before using.

Demonstrated/recommended actions:

- Many mills need to invest in new molding machines in order to facilitate high productivity and efficiency in molding process;
- Related molding tools and facilities must receive due attention to maintenance;
- Pay greater attention to molding product quality control;
- In molding process, due attention must be given to molding pressure, feeding speed, molding technique and assembling of products;
- Do not use dull knife to avoid hairy products.

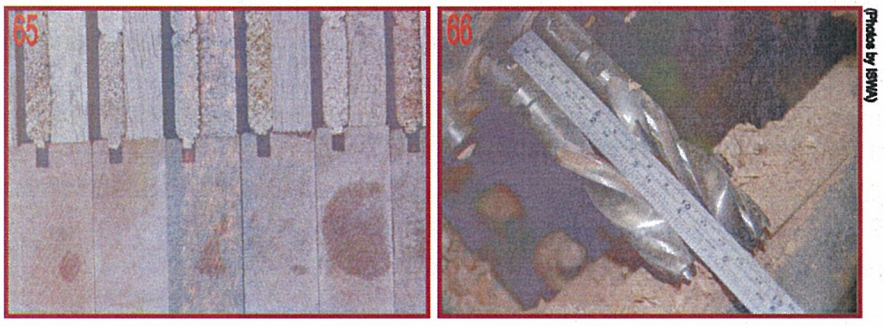
Condition of knife blade

Common weaknesses observed:

- The height of knife blade for molding was unequal, dull and some already damaged;
- The machine shuddered during grooving process causing the resulting tongue to break or rupture, occurrence of pinhole and easily broken joints;
- The size of male and female molding-knives were inaccurate causing occurrence of empty space during the jointing or assembling;
- The use of drilling head was inappropriate between its size and length causing the drilling holes did not fit to each other;
- The operator often forced to put the panel into the machine by hammering or panel was fed into the machine intermittently causing damage to machine and occurrence of snapping on the panel.

Demonstrated/recommended actions:

- Pay due attention to the single knife blade, grouped knife blade and arrangement of profile knife at the molding machine;
- In order to produce high quality product, molding machine must be positioned firmly and knife blade is always sharp;
- Measure knife blade for molding using micrometer;
- Sharpness of drilling head deserves close attention to avoid the situation whereby the drilling holes are not fitted with each other, easily broken or too loose;
- Pay attention to accuracy of size in the molding-process;
- To produce quality molding products, it is suggested to use modern machine such as CNC (computerized numeric control) for which highly skillful operator is needed;
- Repair or replace the inaccurate feeding-pressure and feeding-speed gauging devices;
- Do not force to put a panel into the machine by hammering and panels shall be fed into the machine in a continuous manner;
- Examine accuracy of a product using standard device such as tongue and groove-shaping metal and micrometer.



Figures 65-66. Result of inappropriate size of male and female knives (65); drilling heads with differing length (66).

5) Planing

a) Condition of knife for planing

Common weaknesses observed:

- Many mills used broken or damaged knife blade and caused the occurrence of lines on the planed wood;
- The cutter block was positioned lower than that of the planing table and caused unsmooth planed or the wood was not planed at all;

- The cutter block was positioned much higher than the planing table, the planing practically converted the wood material to wood waste and planing knife was quickly got dull.

Demonstrated/recommended actions:

- Ensure that the knife blade in use is in good condition;
- Knives on cutter block must have the same height and weight, sharp at all time and suitable for the wood to be planed thus the knives will not be affected by high speed rotation and their service life time is prolonged;
- Cutter block must be positioned firmly to ensure stability when the machine operates at high speed, its position must be higher than the planing table.

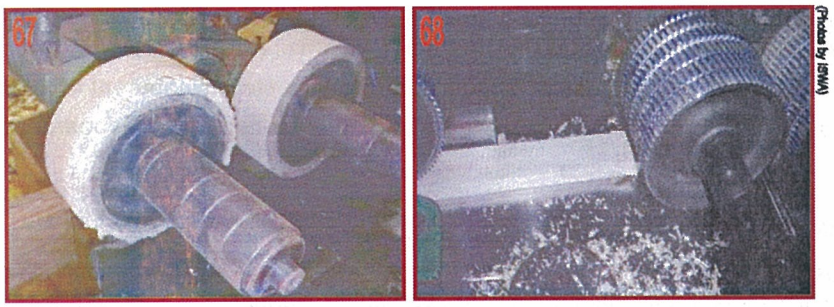
b) Rubber roller and iron roller

Common weaknesses observed:

- Rubber rollers as used were mostly damaged, and their hardness did not meet the required standards causing the roller did not strongly press the panel and got damaged;
- The use of two kinds of rubber rollers, rubber and iron rollers, during the planing brought about different pressure on panel surface, inefficient operation and occurrence of press mark on the planed wood.

Demonstrated/recommended actions:

- Rubber rollers must be kept in good condition, and their hardness meets the required standards to stand with high speed rotation of machine;
- Do not use rubber and iron rollers, simultaneously;
- If simultaneous use is required, iron roller should be placed at the front and rubber roller at the rear;
- The size of roller must correspond to the size of wood to be planed.



Figures 67-68. Rubber roller (67); and iron roller (68) having width differs from the panel.

c) Planing technique

Common weaknesses observed:

- Many measuring devices of feeding pressure and feeding speed were damaged and difficult to read causing the operator unable to accurately judge the pressure and speed required for different wood species, appearance of undesirable press mark and snapping;
- Many operators frequently enforced putting the wood into the planing machine or made intermittent wood feeding rendering the machine easily got damaged and the appearance of snapping on planed wood.

Demonstrated/recommended actions:

- Immediately repair or replace damaged measuring devices for feeding pressure and feeding speed,
- Do not force putting wood into a planing machine nor feed the machine with wood intermittently,
- To ensure that the planing work runs well and smoothly, sawdust sucker with flexible hose must be used to avoid the accumulation of sawdust and small wood particles on the planing machine which can cause snapping as well as roller mark to occur, knife dull fastly and fire disaster.

6) Panel sawing

Panel sawing signifies process of cutting the board laterally and lengthwise in accordance with the need and to dress the length and width sides in order to look symmetrical.

Common weaknesses observed:

- The ring as used on the table saw, arm saw, and double end was already damaged or worn out which caused the shaking of knife blade and inaccurate cutting;
- The knife blade as used was not sufficiently sharp and caused the occurrence of hair on the edges and ends of the board.

Demonstrated/recommended actions:

- Make sure that all rings are in good condition and knives are kept sharp;
- The rings and knives must be maintained periodically.

7) Single or double rip sawing

Rip sawing refers to the machine to produce thin wood sheets, commonly used as coater of the surface of rectangular beam, door, etc, in order the products look like a fancy wood.

Common weaknesses observed:

- Most of knife blades were damaged and not sufficiently sharp causing the occurrence of lines or saw marks on the thin-wood surface and lowered cutting speed;
- Rings were dissimilar in thickness thus produced wood sheets with different thickness;
- The axle as installed for knife place was shaking and resulted in the appearance of saw marks.

Demonstrated/recommended actions:

- The knives must be kept sharp, sharpness and blade width must satisfy the factory standard while circular saw blades must be even on the surface;
- The rings must have similar and even thickness in accordance with the desired thickness of thin wood;
- Ensure that the axle is stable, free of shaking.

8) Sanding

Sanding signifies the latest process of wood processing in order the product surface is as smooth as possible.

Common weaknesses observed:

- Pressure-measuring gauge was damaged and not useful for controlling the steady level of pressure which resulted in uneven and rough result of sanding;

- Conveyor was covered by a lot of glue and caused the position of panel or lamella at the conveyor unequal in height rendering the sanding results uneven;
- Sanding-paper roller was damaged and tore the sanding paper;
- The central part of the passing roller was damaged and rusty which tore the sanding paper and affected the extent to which the sanding paper touches the panel surface;
- The use of sanding paper was inefficient;
- Position of illumination lamp was improper;
- Dust sucker did not function;
- Lacked maintenance of machine and tools.

Demonstrated/recommended actions:

- Immediately repair and replace damaged pressure gauges to facilitate control of steady pressure;
- Clean conveyor of any glue;
- Repair or replace damaged sanding-paper roller and passing roller;
- Provide support for collecting sanding results at the height similar to that of feeding-panel table.

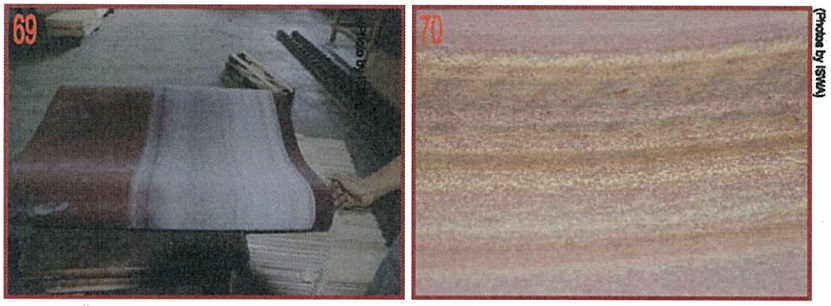
a) Use of sanding paper

Common weaknesses observed:

- Sanding was not appropriate that only part of the paper performed the sanding;
- The part of sanding paper that did not perform the sanding was black in color, while the part that did the sanding was white in color; this situation was brought about by unequal pressure or due to the damaged sanding-paper as well as passing paper roller; in some mills, only a part of the conveyor width was used which was caused by dissimilar width of panel to sanding paper;
- Panel or lamella was covered with glue which made the sanding paper covered by glue as well.

Demonstrated/recommended actions:

- In order that all the surface of sanding paper is used or performs the sanding, the panel is put into the sanding-paper machine at an angle or diagonally;
- Avoid the panel or lamella being stuck by the glue; if so, the panel/lamella should be cleaned or cleared of the sticking glue after the laminating process;
- Make sure that glue is already dried/hardened so that during the sanding the glue will not thicken or accumulate, thereby prolonging the service life of sanding paper.



Figures 69-70. Inappropriate use of sanding paper (69); and sanding paper is covered by glue (70).

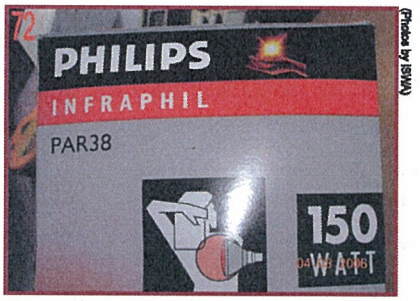
b) Storage of sanding paper and illumination lamp

Common weaknesses observed:

- Inappropriate way of storing the sanding paper rendered the paper becoming humid or too dry and hence easily damaged or torn apart;
- Inappropriately positioned lamp caused difficulty to the worker/operator in assessing the evenness and smoothness of the sanding-results.

Demonstrated/recommended actions:

- Prepare a hanging cupboard for storing sanding paper which must be kept closed and equipped with a 150-Watt lamp to keep the condition inside not-humid;
- Position of a technician should be in the opposite direction with that of the lamp noting that the lamp ray does not directly hit his/her years.



Figures 71-72. Sanding papers are stored in a cupboard (71); a cupboard is equipped with electric lamp (72).

9) Painting/coating

Common weaknesses observed:

- The placing and storing of paint and the placing and maintenance of related tools were done improperly and which obstructed the painting work thereby lowering the quality of painting results;
- The painting hat used cone but without machine and without the aid of UV rays which often produced uneven paint-spreading.

Demonstrated/recommended actions:

- The painting room should have a good air circulation and be equipped with air flow to hold tiny paint-drops resulting from the painting in order that those drops fall down onto the panel surface;
- Do not position air fan too close to the working table in order to avoid the paint being discarded a lot;
- Position the working table at the right height to facilitate affording optimal painting results;
- Place the paint separately from the place for other materials, particularly chemicals, to afford the possible work accident, risk of fire in particular,
- The painting assisted by the UV ray brings out the painting results with evenly-spread paint on the panel surface thus is worth employing.

H. Final Repair and Finishing

Common weaknesses observed:

- The putty was sometimes left open thereby becoming dry or hardened fast;
- Many mills performed sanding manually but made the workers involved got tired out causing defected sanding results;

- In repairing defective veneer, the punching knife used was sometimes not sufficiently sharp and brought about fuzzy closing-results or the punching knife was shaking causing inappropriate or inaccurate closing process.

Demonstrated/recommended actions:

- Do not let the putty for use open to avoid becoming dry or hardened; otherwise, the puttying process will be ineffective;
- Puttying results should be covered with wet fabric to keep the putty humid or in wet condition;
- The final work is performed using sanding-paper with the intention to produce smooth surface products when sanding is done appropriately;
- The way of repairing defective product is as follows:
  - ✓ Place the enclosing material underneath the product to be enclosed on its top; afterwards, slice the defective part using a cutter or thin knife until it reaches the base part; the shape of the slice is in a rectangular form in order that the closing using plastic tape becomes more accurate and efficient.

I. Common product defects in wood processing

Common weaknesses observed:

- Observed defects were mostly brought about by improper setting up of machines, inappropriate techniques, unsuitable tool and device and weak human capacity;
- Snapping (bends on the panel) defects due to imbalanced feeding pressure and feeding speed, position of silinder roller which was not high enough from the table, the panels being forcibly put into the machine or the panel being put intermittently into the machine; all were encountered during the planing process;
- Roller/pressed mark on the panel defects due to too-strong pressure imposed on the iron roller; this situation wais encountered in the molding and planing processes;
- Cutter mark defects due to imbalance between feeding-speed and machine speed (rpm), or number of knife blades which were fewer than required; this situation was encountered in the molding and planing processes;
- Fuzzy defects due to less-sharp knife, imperfect cutting until the lower part of the panel; this situation was encountered in the cross-cutting (arm or jumping saw) process;
- Burning marks defect due to sandwiched knife between two panels that resulted from the sawing; this situation was encountered in the cross-cutting or rip sawing process;
- Discoloration defects due to imperfect treatment of wood or inappropriate drying process, e.g. MC still too high; this situation is encountered prior to the cross-cutting process;
- Uneven thickness defects due to improper machine setting; this situation was encountered prior to cross-cutting process, in the molding or planing process;
- Snake-like appearance defects due to inaccurate tongue and groove; this situation was encountered in the finger-joint laminating process;
- Dusty air or air bubble defects due to the presence of oil spots on the panel or imperfect panel-closing, or MC still too high; this situation was encountered in the painting/coating process;
- Sanding mark defects due to dissimilar pressure or due to the panel not completely or evenly in contact with the sanding paper; this situation was encountered in the sanding process.

Demonstrated/recommended actions:

- As the above mentioned defects were the results of improper or inappropriate techniques of wood processing at the various processing chains, they can be prevented, eliminated or minimized only through training on technical skills in wood processing, training on

management of operation including quality control, investment for re-tooling and re-engineering, better response to market requirements and production planning as well as continued innovation on efficient processing techniques;

- The above mentioned defects, to some extent, can also be reduced through application of the various repairing and finishing techniques, samples of which are illustrated in the previous section. It must be emphasized that repairing defected product is meant to reduce loss due to inadequate conduct of processing. Avoiding defects in the first place must become the first choice of processors to do and this can be accomplished if, and only if, inputs of processing are available in terms of quantity, quality and timing encompassing physical, financial as well professional management and skillful technicians and operators.

J. Packaging

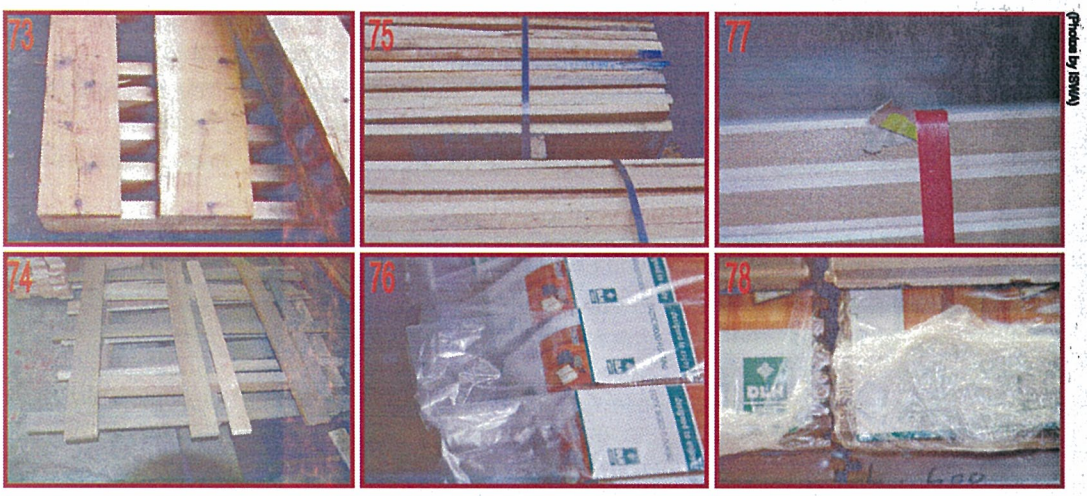
Packaging signifies the early step to get consumers interested in using the resulting products and in purchasing them based on the first sight, i.e. appearance. Packaging implies securing the products beginning from the producers until consumers, and pleasing the users. The materials that can be used for packaging are among others: pallet, bundle clamp, steel or plastic binder, trolley, label, paper or plastic sheets used to cover and protect the product from damage during storage transportation/delivery. Most of the mills have already owned those packaging facilities.

Common weaknesses observed:

- Only a few mills owned and used trolley (tool and device carriers),
- Generally, the pallet as used was of low quality in terms of strength and performance that could not safely protect products till destination,
- Inappropriate and inaccurate packaging were common rendered the products easily damaged and consequently, rejected by consumers/users,
- Unattractive appearance of the package made the products less attractive to the consumers/users.

Demonstrated/recommended actions:

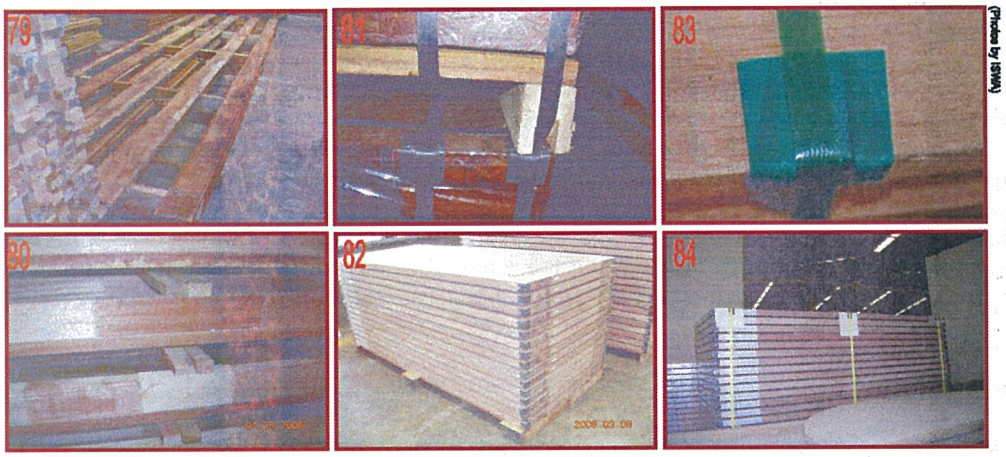
- The mills must have enough trolleys in order to avoid work accidents and also secure efficient operation,



Figures 73-78. Samples of inappropriate packaging.

- Use strong yet inexpensive pallet in packaging to ensure that the products shipped arrive at destination safely and undamaged,

- In designing and constructing package, performance, strength and cost of material should be used as the primary criteria.



Figures 79-84. Samples of appropriate packaging.

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4. DISCUSSIONS ON THE IMPACTS OF IN-HOUSE TRAINING

4.1 Expected outcome and impact

The ultimate expected outcome of the project was enhanced performance of participating companies. Increased efficiency was expected to be realized through training of practitioners, initially planned for 200 persons, in sawing methods, saw-doctoring and other basic wood processing techniques.

The expected outcome of the project is improved skills and capabilities in performing efficient wood processing and in product quality management to ensure the efficient and diversified use of tropical timber in Indonesia. The outcome was expected to generate positive impacts on the companies hosting the in-house training and the national wood industry in general in terms of enhanced performance and increased contribution the national economy after project completion.

In order to attain the outcome, the project had delivered three outputs namely:

i) 50 processing mills selected and hosted in-house training on wood processing techniques, product quality/industrial management, and marketing of wood products, while one wood product testing laboratory had been established at the ISWA headquarters in Jakarta;

ii) Information on wood properties of 45 wood species encompassing natural, planted and LUS as well as market information on five major export markets were compiled, published and distributed to target beneficiaries; and

iii) 139 in-house training sessions had been conducted at 50 mills in five provinces wherein 860 practitioners comprising owners, executives, managers/supervisor and operators were trained, as appropriate, on wood processing techniques, quality/industrial management and marketing of wood products.

The initial plan was to train 200 practitioners on wood processing techniques. The actual number of training participants was 860 personnel of the 50 host companies or on average 17 persons per company comprising executives, managers/supervisors, and operators. A number of training sessions were also attended by owners.

It should be made clear at this junction that the training on wood processing techniques had been implemented simultaneously with the training on quality/industrial management and marketing on every in-house training session conducted and all three trainings have contributed to the achievement of the project outcome at the project completion. That is to say that the 860 trained practitioners had attended the training on processing techniques, quality management as well as marketing of wood products.

It is important to note that the in-house training was implemented within a 3-year period: 36 sessions in year 1, 42 sessions in year 2 and 61 sessions in year 3. Consequently, the training on wood processing techniques should have generated impacts on the operations of participating mills at least since year 2, while the training was still in progress, in terms of improved skills in handling the inputs and outputs of wood processing. In other word, assessment of impacts here concerns with the immediate effect of the training on wood processing techniques, not with the impacts of the project after its completion.

4.2 Assessment of impacts of the training on wood processing techniques

It is desirable to assess impacts of the training in a quantitative manner in order to know precisely what the training has actually achieved. In order to do so, there is a need to compare pre-training situation to post training situation. In fact, it should be possible to know the yearly progress made by the participants if progress was properly documented. However, this desired type of assessment was not possible to do due to weaknesses in the planning and monitoring technique of the training.

At the beginning of the in-house training, the training experts should have developed an accurate baseline information on each of participating mills showing what aspects and elements to be considered along with their beginning state of performance. A practical monitoring technique should have been designed showing how and when to record occurring changes of the aspects and elements considered over time and how to measure the change. Practicality of the monitoring technique is critical in order to allow participants to apply the technique themselves.

The training experts did develop a sheet of performance that was completed during the conduct of the second and third visits, respectively, which expressed change in performance by percentage. To illustrate the monitoring technique employed by the training experts, below are random sample of progress documentation as recorded on one of the monitoring sheets:

- ✓ It was observed during the first session that the problems encountered by a company in saw doctoring were i) no coolant was applied in knives sharpening, ii) lack of dressing of diamond wheel; and iii) knives sharpening without honing stone.
- ✓ During the second session, around one year after, the experts noted that "not much progress made in knives sharpening and honing".
- ✓ The progress made between the first and second sessions was rated as a "30% improvement".

Above illustration indicates that the progress or change was indeed documented at the second and third sessions and expressed as percentage. It was not clear, however, the basis used for calculating the percentage. Moreover, the elements considered were not consistent over the entire sessions. The monitoring technique applied by the training experts was at best subjective and artificial in nature thus less useful for objectively and accurately gauging change in performance. The monitoring technique employed lacked scientific and process engineering basis.

The monitoring sheet filled out by the training experts at every single session did contain qualitative information on the progress made in wood processing techniques. The sheet, combined with photos picturing the changes that occurred at individual mills and actual experience of participants presented to the second national workshop on "improving efficiency of wood processing and quality of wood products", have been used to qualitatively assess the overall impacts of the in-house training on the conduct of in-house training on wood processing techniques at 50 mills and is presented in the subsequent section.

4.2.1 Overall impacts

Section 3 of this report presents common weaknesses of individual companies in performing wood processing. Relevant resolving practical measures for overcoming the weaknesses had been explained or demonstrated, at the request of participant, on site by the training experts. The extent to which the practical measures were adopted and practiced by individual companies in wood processing operations affected the level of improvement of performance they gained. The monitoring sheet prepared by the training experts indicated that some mills had made big progress, some mills made moderate progress yet some other mills made poor progress in improving efficiency of processing.

It was noted during the second national workshop that the level of progress made by individual mills was influenced by a number of factors including:

i) Involvement of owners and executives.

The companies whose owners and executives took part in the in-house training had significantly improved efficiency in wood processing. This is understandable as owners and executives saw themselves the operational weaknesses that had to be removed and what resources were needed to do so. Allocation of needed resources was simply dependent on business orientation of the owners. Involvement of executives in the

implementation and monitoring of the measures recommended by the training experts also helped improve performance.

ii) State of the art of existing technologies.

Mills operating using obsolete or inefficient machines and equipment made slow progress in improving performance. The mills might require big investment in re-engineering and re-tooling for which owners might ready to do fully or partly only after a time lapse. Mills operating using modern technologies made better progress in improving efficiency of processing as the mills did not require investment for re-engineering and re-tooling but more of skillful operators and technicians.

iii) Level of professionalism.

Those mills employing large number of skillful and experienced executives, managers and operators made much better and faster progress in improving performance than those with only a few skillful executives and employees.

The overall impacts of the in-house training as reported by the training experts and the training host companies can be summarized as follows:

i) Increased wood recovery

Some mills reported the gain in wood recovery brought about by the training. One company in North Sumatra for instance had increased recovery in the production of finger joint laminating board and S4S products up to 3%. This gain in recovery translated to a substantial amount of money. A number of mills have also qualitatively reported similar gain at different degrees;

ii) Reduced lumber defects

Some mills have successfully reduced the level of lumber defects in kiln-drying process by practicing the technical measures recommended by the training experts. One mill in Central Java for example, has reduced defected lumber up to 60% of its initial average volume;

iii) Reduced production cost

Some mills reported savings made in input cost. One company in East Java for instance, had made modifications to laminating and edging process conforming to the recommendations of the training experts. By so doing, the company has been able to reduce consumption of materials used in the laminating and edging processes and made substantial reduction of production cost;

iv) Shortened product flow time

Some mills have successfully shortened product flow time, the length of time needed to complete production process of an intended product. One participant from East Java for instance, has been able to shorten up to 40% of the initial average product flow time which is a substantial reduction in the consumption of energy and gain in productivity thus cutting down production cost;

v) Reduced wood waste

Many mills have successfully reduced wood waste at different stages of wood processing through improved processing techniques and intensified control of operation. One company in South Kalimantan for instance, reported a reduction of wood waste in saw milling up to 25% of its initial level which certainly a substantial cut in production cost;

vi) Improved maintenance of machines and equipment

Most of the mills have made significant improvement in the maintenance of machines and equipment after taking part in the training. Timely and proper maintenance of machines and equipment in accordance with the technical manual of a machine or equipment will ensure life time and operational period, reduce idle time due to breakdowns and increase productivity which in turn reduce production cost;

vii) Enhanced human resource management

Many mills have enhanced human resource management through various methods including development and implementation of training program, out of company and on the job training, enhanced communication between employees at different levels of management through more frequent meeting, formal and informal gatherings; and

viii) Changing attitude of owners and executives

Larger number of owners and executives have come to appreciate the role of efficiency of wood processing in determining the level of production cost thus profitability and business survival. They also have realized that improving efficiency, in many instances, requires investment in re-engineering and re-tooling as well as in managerial and technical trainings of employees.

4.2.2 Improved wood processing techniques

It should be emphasized that the above mentioned positive impacts are the result of the improvements made in executing the individual chains of wood processing operations. It should be noted, however, that achievement, in terms of increased efficiency, made by individual companies hosting the in-house training varied in terms of aspect and element of processing. Many mills documented substantial improvement in breakdown and pony sawing, some other mills reported great progress in laminating and finger jointing process, yet another mills experienced meaningful progress in kiln-drying process.

Generally speaking, majority of the participating companies have made great progress of various degrees in the conduct of logs handling at logyard, sawmilling, kiln-drying, saw doctoring further processing and finishing as well as packaging. This progress was made through improved conduct of processing techniques at the various process chains. For examples, most mills have now applied S-hook and used concrete tile on log piling at logyards; have been able to properly operate log carriage, set-up band saw and band wheels, correctly position band saw, sawing table and stopper; perform better drying process through improvement of chamber design and construction as well as boiler operation; perform better saw-doctoring through improved workshop room, re-tooling and re-hiring; etc.

One of the most encouraging results of the in-house training is the awareness of executives and employees on the role of efficiency plays in determining the level of production cost and business survival. Most mills reported this result to the second national workshop. Today, most employees perform their jobs in a more disciplined and careful manner. The employees have come to understand that technical errors must be avoided as each error, how tiny it might be, is costly thus must be forsaken to the extent possible.

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5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

a. In-house training is a pragmatic format of training because it is more effective in solving operational problems and in improving skills; it accommodates large number of participants with different educational and occupational background including owners, executives, managers and operators; it is more adaptable to a company's prevailing condition, specific issues and owned resources and; it can be conducted in a transparent manner as participants are members of the company itself.

b. The in-house training on wood processing techniques has contributed significantly to improved skills of participants in performing wood processing and given rise to enhanced performance in terms of increased wood recovery, reduced consumption of material inputs, declined wood wastes, reduced defected lumber in kiln-drying process, shortened product flow time and strengthened commitment to efficient operations.

c. Owners, and executives play critical role in increasing efficiency of wood processing and enhancing business performance. The host companies, whose owners and executives took part in the training and in the process of adoption of the technical measures recommended by the project, made more satisfactory progress than the companies whose owners and executives did not actively involve in the training.

5.2 Recommendations

a. It is more fruitful to employ a in-house training format than a conventional, class room lecturing plus field demonstration; it can cater the different needs of individual companies, it can be tailored to handle specific technical and managerial problems of individual companies.

b. Continued implementation of the technical recipes recommended by the project is imperative if the impacts generated by the training is to be sustainable. Owners and executives can motivate and direct employees to make change and they can decide on allocation of resources needed for stimulating and sustaining the desired changes.

c. To facilitate accurate assessment of the training impact, there is a need to develop accurate baseline information on the initial performance of individual mills and design a sound yet practical monitoring system of progress made over the period of training and beyond. Impact of the in-house training could not be assessed accurately due to weaknesses of the training design, inconsistency of observation between training sessions and weak techniques for measuring the changes occurring over time.

d. Indonesia is in need of similar in-house training program; future training should pay greater attention to small and medium mills especially those ones remotely situated. To increase effectiveness of the training, there is a need to strengthen the implementation strategy with respect to:

   i) More frequent visit, e.g. every six months;

   ii) Lengthened duration of individual visits, e.g. 3 days per visit;

   iii) Application of a robust monitoring system to keep track of progress in applying the technical guides given by project technical experts; and

   iv) Involvement of owners and executives as leading motivator of top-down changes.

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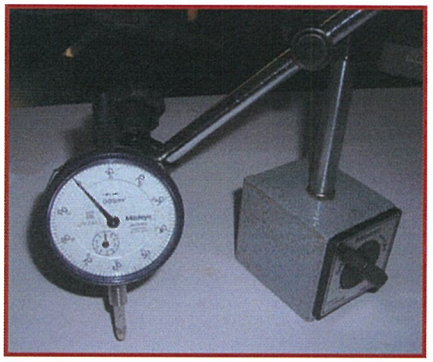
ANNEX

ANNEX. Tools and instruments used for the in-house training.

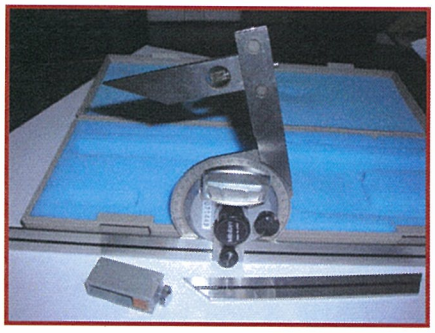
Anemometer

Rubber Hardness Tester

Micrometer Gauge

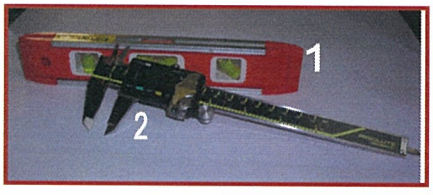


Dial Indicator + Magnetic Stand

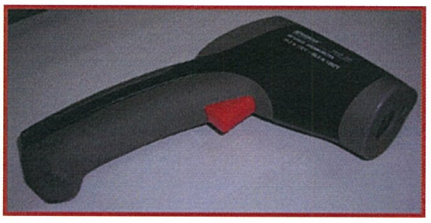


Digital Protactor

MC (Moisture Content) Meter



1. Water Pass; 2. Digital Caliper (Sigmat)



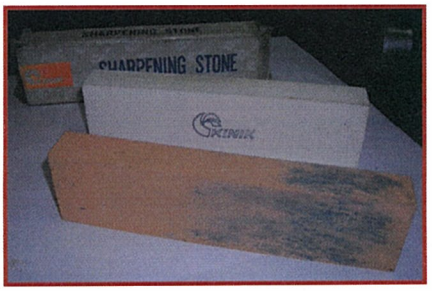
Laser Infrared Thermometer

High temperature bearing grease

Light Meter

ANNEX 1. Continued.....

Tachometer

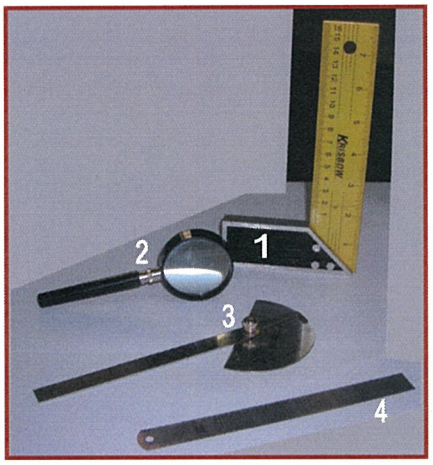


Sharpening (Honing) Stone

Vibration Meter

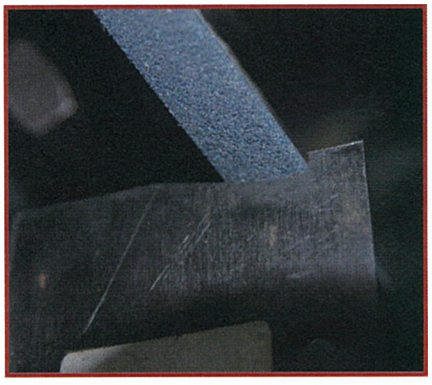
Gaugelength

Digital Multitester



1. Bevel meter; 2. Magnifier (Loup);
3. Protactor Angle; 4. Ruler Stainless

Tempilstik 460 ^{0}C / 860 ^{0}F



Straight Edge Template

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