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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

HEILBORN GMBH ANLAGEN FÜR DIE HOLZINDUSTRIE

Postanschrift Mail address
Postfach 100555 P.O. Box 100555
8200 Rosenheim Germany
Telex
Hausanschrift Haus address 8200 Rosenheim
Germany

Telefon Phone (08031) 18090
Telex 525769 heil d
Telefax (08031) 180990
Cable Heilborn Rosenheim

Managing Director Gerald Rhein

Bankverbindungen Bankers
Bayerische Vereinsbank AG Rosenheim
670 4611 (BLZ 711 200 72) swift BVB BE DE MM 435
Commerzbank Rosenheim
610 792 (BLZ 711 400 41) swift COBA DE FF 711
Amtsgericht Traunstein HRB 947

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UNITED NATIONS INDUSTRIAL
DEVELOPMENT ORGANISATION

Contract No. 91/222

PROJECT No. SI/BHU/90/802

Activity Code J12209

FINAL REPORT

ASSISTANCE TO THE GEDU WOOD MANUFACTURING CORPORATION IN MACHINE OVERHAUL AND REPAIR IN THE KINGDOM OF BHUTAN

Date : October 1992

Prepared by: O. Serrano
Heilborn GmbH
8200 Rosenheim
F.R. of Germany

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INTRODUCTION

The present " Final Report" summarises the different works carried out at the Gedu Wood Manufacturing Corporation (GWMC) in Gedu, Kingdom of Bhutan, as technical assistance rendered in overhauling and repairing part of the equipment which serves for the manufacturing of sawn and seasoned timber, plywood, blockboard and furniture.

Important information is given as to how to adjust, maintain and operate the key equipment.

In most of the cases, the procedure followed for the specific repair of a piece of equipment has been described, in order to be used as a guideline in case a similar problems develop in the future.

Based on the "Fact Finding Mission" Report dated January 1992, the equipment overhaul and repair was carried out in two stages:

1. First stage:

   In February 1992: Start of the overhauling works. The Major part of the activities were performed. Internal defects in some key equipment was detected which made necessary the acquisition of additional spares, as these were not available on site.

   Gedu Wood Mfg. Corpn. made the arrangements for obtaining the necessary import licenses and financing. The spares were available at the end of June 1992.

2. Second stage:

   End of June 1992: The remaining work was completed by the middle of July.

The present report will be developed in close reference to the "List of tasks to be done" which is attached herewith as Annex 1.

This list was prepared during the "Fact Finding Mission" in collaboration with the GWMC Management staff. As the period set out for the overhauling tasks were fairly short, the most important items were marked with an asterisk (*) and had to be treated as priority items.

It is to be noted that between the first mission in December 1991 and the completion of the tasks in July 1992, a number of breakdowns were recorded and looked after depending on the time available and the level of emergency of the case.

Even though the "Terms of Reference" of UNIDO's contract calls only for machine overhaul, this report also refers to some technological and technical constraints which might help GWMC in avoiding mechanical breakdowns and improving in the product quality.

The present maintenance staff was involved during the overhaul / repair works and was made aware of the importance in taking care of the equipment by preventive maintenance as well as correct adjustment and operation of the machines.

It has to be said, that our team enjoyed the positive support from senior and middle managent of GWMC which helped a lot in the successful performance of the assignment.

As the Gedu Wood Complex is very large in terms of the number and range of equipment, it is suggested for GWMC to seek a continuity in technical assistance on a short term basis, for not more than 3 man/month a year, with a similar scope than this contract. This will definitely decrease the amount of breakdowns, increase production, reduce running costs and train the local staff in a professional way.

A) Overhaul / Repair Work

The sequence followed in the description of the work carried out is consistent with the list shown in Annex 1.

All the jobs marked with an asterisk (*) were completed. Additional repairs were made depending in the urgency and time availability. Reference will be make in the same sequence to the above mentioned list.

1. Log Debarker

- Bearings of the milling head replaced.

- Front sliding bush for the swing shaft replaced.

- Tightening of the foundation bolts.

- Manufacture of greasing nipples.

- Complete clean up and lubrication of the milling head.

General recommendations: it is very important to keep the carbide tipped milling knives in a sharp and clean condition not only in order to achieve a better debarking quality, but to avoid overloading of the milling motor and it's auxiliary components.

It is further recommended to fill up the pit under the milling head, compact the soil and apply gravel or a thin concrete layer on the top. This will facilitate the maintenance and reduce cleaning time of the pit, especially during the rainy season. Note: this pit was originally designed for the installation of a belt conveyor for the transport of bark waste for further disposal. As the conveyor was never purchased, there is no use for the pit and the waste can continue to be removed manually.

2. Peeling lathe

It is important to mention that the peeling lathe has not been overhauled since the day of its installation in 1983. There were some repairs carried out by the manufacturer's technicians in 1985, but it was mainly the straightening of the knife holder which had been bent during an accident.

Furthermore, the central lubricating pump for the entire machine has been out of order since end of 1983. For many years several lubrication points could not be reached .

During the last one or two years, the condition of the peeler started deteriorating rapidly, so that the quality of the veneer was getting worse.

The big variation in thickness of peeled veneer affected the plywood quality and complicated the manufacturing process: drying, splicing, glueing and, the worse case was during sanding, as it caused sanding through during calibration.

The following activities were carried on the lathe:

- Cleaning of the main 2-speed clutch gear box and replacing with new oil.

- Changing the seals in the main clutch cylinder and in the rotating system for air admission.

- The hydraulic pump for the back up rollers was broken. During the second phase of the assignment, the pump was replaced, the hydraulic system was cleaned and new flyer-chains for the back up rollers were installed.

- On cleaning the hydraulic tank we found a lot of mud at the bottom of the tank. After cleaning the oil was replaced. New filters were installed.

- A cover from one of the dynamo hydraulic cylinder was leaking. After opening the cover we found a loose allen bolt from the piston. The head, on coming out, cracked. The cover of the cylinder was then bent and leaky. The remaining part of the bolt was removed, the thread was cleaned and a new bolt was fitted. We also fitted back the cover after sealing the surface.

- A new central lubrication pump was fitted. New pipes, fittings and grease nipples for the lubrication were also installed in the entire machine. For lubrication guide, see Angelo Cremona Manual starting from page 105.

The following chapters in the same Manual will serve as a guide to the following topics:

Chapters:	5	Lubrication drawing
	6, 7	Frequency of Lubrication
	8	Types of recommended lubricants
	9, 10, 11, 12	Central-lubrication system

Some important technological / technical aspects

Besides the main technical conditions of the machine, here are also some points in its handling and operation which are extremely important in order to achieve a good quality peeling.

1. Adjustment of the knife and pressure bar. (Angelo Cremona Manual Pg 22 folio No.8)

Upon checking the machine, it was discovered that 4 pieces of the part 15706 'pressure bar regulation screw extension' were damaged.

Damage to the screw extension can only be derived from incorrect operation and using too much force during turning. It is very important to note that the positioning screws for the pressure bar be alternatively pressing and retracting.

This means that screws 1,3,5,7,9, are positioned for retracting and 2,4,6,8,10 screws are positioned for pressing at the pressure bar. Movement of the bar is controlled by the neighbouring screws. It can be easily checked whether the bar is free to move and that is when the washer between the set of screws and the body can be turned. For reference: Manual Pg 25, PL2, PL3, PL4

It is extremely important that the horizontal opening AOV and the vertical opening AVF be exactly the same over the whole length of the knife. (ref: Pg 24, folio No:10)

It was found that the knife tends to bend sometimes as such, that the knife edge being pressed behind the line of the pressure bar. This is explained by the fact that the cutting angle is too small and the concavity of the knife is insufficient..

If the cutting angle is too small (ref: Pg 84/85), the wood presses powerfully against the surface of the knife and as a result a knot can cause a bend in the knife. (ref: Pg 84, Fig ib).

To find the initial cutting angle follow the instructions given in A. Cremona's user manual Pg 79.

The level of the knife is correct if the carriage is positioned 150 mm from the spindle centre.

Concavity of the Knife

The concavity of the knife reduces the friction between the knife and the log. Upon measuring, the concavity was less than 0.04 mm. (ref: Pg 79, folio , Pg 80). The recommended concavity should be between 0.1 and 0.2 mm.

The knife grinding operation itself was not likely to supply a perfect knife. Instead of using original peeling knives, knives which were formerly used in the clipper were used.

The back surface of these knives was found to be very often uneven. With an uneven surface at the back it is not possible to get a straight edge on the bevel.

Furthermore, the rear end of the knife has to be checked before grinding and if necessary it has to be ground until it is 100% even.

With a cutting angle of 20 degrees, all unevenness at the rear end is multiplied by a factor of 4.5. This means that a difference at the rear end of only 0.2 mm would result in a difference of nearly 1 mm on the edge.

To prevent the knife carriage from vibrating during the peeling operation, the threaded carriage spindle nuts on infeed hold the spring loaded against the spindle and the main nuts. One of this spring set was found to be completely loose. The maintenance crew was advised on how to adjust this system. In addition to this, there is also a good instruction given in the Angelo Cremona manual on page 104 on how to adjust the back-lash elimination device.

During the peeling operation, one has to make sure that there is no slip in the multiple disc dry clutch between the infeed thickness adjusting gearbox and the infeed spindles. While overhauling the clutch, it appeared that the discs were polluted with grease and the two bolts holding the angle lever for the clutch's release were broken. After cleaning all the parts, and replacing the worn out as well as broken parts , we adjusted and fitted back the dry clutch. There is also a description found in the Angelo Cremona Manual on page 102.

The main spindles which are guided in the bronze bushing were worn out by about nearly 1mm and therefore gave very bad peeling results. This is because the log was probably not guided. The thin veneer was continuously cracking during peeling and there were many variations in the veneer thickness. During the second stage of the overhaul work, new bushings were fitted.

A torsional damper, located in the gear wheel of the main shaft which is used to prevent logs from torsional vibration, was not in operation. The maintenance team was advised on how to bring the damper back into operation.

3. Pneumatic Clipper

The newly supplied knife holder was of the wrong size. Meanwhile it has been sent back to the manufacturer for replacement. The maintenance staff at GWMC is familiar with the fitting of the knife holder.

4. Core mechanical clipper

The variable hydraulic unit was dismantled earlier on and fitted together again in wrongly, which caused the unit not to work. The unit was dismantled again and assembled correctly. It is working again.

5. Capital slicer

The main sprocket feed wheel was replaced together with the pawl feed. Two 5/2 way valves for the break system have still to be replaced.

6. Angelo Cremona slicer

This machine works with very few problems.

During maintenance, however, it was found that the lubrication done on the machine was not very good. The maintenance team as well as the operators should therefore make use of the Angelo Cremona manual as reference and the following points should be noted:

Lubrication table	Pages: 95, 96 and 97
Table for lubrication	Page : 101

There is a special system for the oil circulation on the sliding rails, which is mentioned in the manual on pages 84 to 86.

During the mission, the lubrication oil tank was cleaned. A lot of mud was found at the bottom of the tank. The worn out lubrication pump was also replaced. The mechanical oil filter was fitted correctly. This was previously disconnected for maintenance and fitted back wrongly, thus causing no filtration of the oil. Ejecting rollers were also replaced.

7. Blockboard line

The blockboard line consists of the following machinery:

a) Double sided planer with multiple rip saw
b) Transport belts
c) 2 cross cut saws
d) Core Composer

This line was found to have a number of technical defects, wrong alignments and incorrect operation. The following descriptions shall assist GWMC in keeping track on the correct maintenance, adjustment and function of the complete line.

a) Double-sided planer with multiple rip-saw

This machine is considered to be the most important one in this line because it supplies the material to all subsequent machines. Here the following problems have been observed:

The bottom table rollers and the outfeed table rollers were positioned too low. They did not have any contact with the timber and could not perform their normal transport function. Even the height adjustment levers did not function any more because apparently they have never been used.

The lever for the height adjustment of the infeed table was completely broken away. The operator was even not aware that the downside planing can be adjusted.

Positioning of the downside cutterblock was out of function. The downside cutterblock is positioned by means of a lever with a scale and a cam. It was not possible to move the cam on either side. The proper functioning of this cam is extremely important for a correct setting of the planer knives.

The setting gauge for setting the planer knives was not found. The operators were found setting the planer knives visually. Doing it this way it is impossible to achieve an optimal planing result. The knives were scratching onto the steel table of the machine.

After insisting that a search be made for this gauge, it was eventually found at another machine. The operators were then given instructions on how to set the knives using the gauge. (Also see Kupfermühle's user's manual).

Pressure bar for down-side cutter block

This pressure bar was badly damaged. Of the 10 pressure units only 3 were still on the machine. (The spare part number was noted, and it shall be ordered)

Shaft for multiple rip-saw

The original shaft was damaged and has been substituted by a shaft which was manufactured in India. Some inaccuracies in manufacturing led to the bearings being eventually overheated and damaged.

Upon disassembling the shaft, the fitting of the bearings was found to be incorrect. It was then necessary to turn the shaft at the contact surface and to put spacers between the bearings and the set.

After operating for 30 minutes, the temperature was measured and it was found to be 60°C which is acceptable.

b) Transport Belts

- No problems found.

c) Cross-cut saws

The cross cut saws used for cutting-off defects on the strips were found to be placed very inefficiently. They were standing too far away from the transport belt. Therefore, all the laths coming out of the Kupfermühle rip-saw planer had to be taken by hand from the belt to the cross cut and then all the way back again.

The cross-cut was installed directly beside the belt, in order to allow the operator to process the laths directly from the transport belts and then place them in the same flow without extra handling.

It was then necessary to build new tables for the cross-cut saw because the old ones were too low and had no space to store the laths until they were cut.

This way we have a continuous material flow, and unnecessary movements during this operation such in storing of the laths are therefore minimised.

d) Core-composer

The infeed table for the strips has been found in a very bad condition. The transport wheels as well as the transport chain was not rotating properly. The drive pulley for the chain was broken. The lath counter has been replaced. The dust extraction for the cross-cut did not function and caused the saw dust to adhere to the saw blade. The pneumatic and electric control have been overhauled.

Another problem observed on this machine is that the glue flows to different parts within the machine and not only on the strips to be glued causing problems in maintaining the machine clean. This is mainly caused by the viscosity of the glue, for which the machine is not designed-(Viscosity used is too low). As the glue presently used is very economical compared to PVAc glue, it is therefore recommended that a separate cleaning team be appointed to clean the machine during all production intervals such as lunch time and in the evening. This will allow the operator to start the machine the next day with it in a good condition.

Note:

The Steam pressure is too high. Ever since Urea formaldehyde glue has been used, the steam pressure was adjusted to a pressure of 7 bars. However, according to the instructions given by the machine manufacturer, the pressure is not to exceed 3 - 4 bars. Too high a pressure could damage the heating bars in such a way that their shapes would be transformed from a square to a cylindrical cross section.

8. Veneer Jointer and Splicer

The machine was dismantled from the rear-end. The rubber transport rollers as well as all damaged bearings and feed belts have been replaced. The whole machine has been cleaned and adjusted.

9. Haug splicer

The DC drive system was replaced. The heaters have still to be replaced, as soon as they have been received.

10. Kuper cross feed splicer

The cross feed splicer was completely overhauled and the key items like the glueing carriage, feed motor, all transport belts, shafts, pneumatic cylinders, fence blades, flexible cables, etc. were replaced.

The electric control of the machine was adapted to conform with the re-designed gluing carriage installed and final adjustment was made. It is very important to record all the set values of the electric / electronic controls. This was not done due to time constraints.

11. Hot Press

It was claimed that the heat temperature of the platen of the hot press was uneven. This has been measured together with the production foreman in-charge.

Upon measuring, the result showed that the heat distribution is nearly reaching 100% of the surface of the heating platen. For an exact measurement, the platens have to be nearly closed so that only the feeler fits into the gap of the heating platen. If the press is fully open, the results obtained would be inaccurate due to the cooling effect from the cold air.

X-Lift:

It was noticed that the X-lifts on both sides of the press were moving abnormally slowly. The hydraulic system was checked. A fault in the valves was found, as a result from a previous maintenance work done, when, one of the small pistons was wrongly positioned.

After rectification, the X-lift worked correctly.

12. Wide belt sander

The wide belt sander was found in good working condition. The main problem faced was the use of a wrong type of sanding paper.

It is important to use a low grit, like grit 60, in the first sanding group for calibration purposes.

The second sanding group is equipped with a sanding pad only for finishing, using a grit of 100.

During the general check it was noted that the infeed rubber belt was worn out and needsto be replaced in the near future.

13. Sawmill

Headrig bandsaw

The problems observed can be divided into 3 different sections:

- problems caused by the alignment and adjustment of the machine itself
- problems caused by the wood species
- problems caused by the saw doctoring procedures used

a) Alignment of rollers

The first problem detected was the alignment of the rollers. The saw blade was running too much on the inside of the lower pulley and at the same time the root of the tooth was running on the inside of the pulley surface causing damage to the surface. The whole alignment was checked and measured and various misalignments were detected. There was too much play in the dovy tail guide for the height adjustment and also a lack of lubrication.

The upper shaft of the pulley is held in position by the cover of the bearing. This cover is manufactured with a step on the inside which gives the bearing the right position. Covers A and B were found to be different. After maintenance work was carried out, the positions of the covers have been exchanged it was this that gave the pulley a wrong position. After changing the covers, the situation improved but was still not satisfactory. The lower part of the pulley on the right side is in perfect alignment with the upper part of the pulley but the left side seemed 2 mm more behind.

Note: During the second mission, the main carriage was found to be the main problem for the cutting quality. Spares for the correction of the problem have been supplied.

The mechanism on the main carriage responsible for the off-set movement of the carriage while running backwards was found to be worn out. This caused an abnormal movement of the carriage while sawing and affected the quality of the timber.

b) Problems caused by the Wood

Apart from getting feedback from clients, we have noticed that the timber was not accurately sawn straight.

We therefore measured the timber and have come to the following conclusions: so long as the timber has a thickness of 1" or 2", the cutting result is found straight and clean. The problem only arises when the sawn timber has a thickness of 5" or more and the inner tension changes completely when the band saw cuts the log into big pieces.

During the cutting operation, the log usually splits and opens the ends.

This means that the remaining log on the carriage which is no longer straight eventually becomes bowed, and should we once again try cutting this log, we would then have a beam with a slightly narrower beginning and end than in the middle. This effect can vary with the inner tension of the log and we measured differences up to a maximum of 12 mm.

Should a client insists on a perfectly parallel timber, this defect can be avoided by cutting a small strip from the remaining log on the carriage which will serve as a straight line of reference and the cut to be made should be parallel to this surface.

c) Problems caused by the Saw Doctoring

During the time spent in the sawmill, the sawing results were acceptable. We were informed that this is not always the case. When the saw blades deviate in a snake like manner, this can only mean that there is insufficient saw doctoring especially in the tensioning of the saw blade.

The Vollmer tensioning machine was checked as well as its operation. Firstly, it was found that a very important guide roller was missing. Without this guide roller it is not possible to obtain a perfect tensioning result due to the fact that the saw blade does not run straight through the machine.

While dismantling the machine, more defects were found and were rectified, but apart from this, the most important of all is the correct way in in which the machine is to be operated.

We found that the maximum tension occurs in the middle of the saw blade whereas normally the maximum tension has to occur in the third part of the blade nearest to the teeth.

The rolling pressure has to be adjusted at the scale and decreases from the maximum in the first third of the blade to the outside.

(Details please refer to Annex III, Figures 1 and 2, Page 28)

d) Saw Blade Log Book

To-date there are no proper records/ identification for the saw blades used. A saw blade was given to the operator and from then on used until the sawing result are no longer acceptable . When the saw blade came back to the saw doctor, he does not know whether it was used for 30 minutes or 3 hours nor was he aware of what the specific problems were or are.

A serial number to each saw blade was given, which is written on the blade and also a log book was initiated in which all important data on the saw blades are to be recorded .

Whenever the operator puts a newly sharpened saw blade into the machine he should register the important information such as cutting time, wood species (more or less abrasive), damages, including other problems such as deviating, burned surface on the wood, uneven swaging etc.

This information will give the saw doctor a feedback and will enable him to make the changes required or will assist him in finding out the best way in preparing the saw blades for the various wood species.

Apart from this, he would be able to investigate whether a swaged or a stellite tipped saw blade has a longer working life. The records will show him the working life for any specific saw blade.

It is also possible to find out which of the saw doctors give a saw blade the longest life span and which of the operators consumes most saw blades. The saw blade log book also helps to provide a survey on the number of the saw blades which are in use if and when new saw blades have to be ordered.

Another very important aspect is the possibility of investigating the quality of blades from various manufacturers. It may be much cheaper to import saw blades from overseas instead of purchasing them from India even though there are additional transport costs, the log book would prove that these saw blades have lesser cracks in the tooth roots and 3 or 4 times more working time on the machine. The same is recommended for the circular saw blades and peeler and clipper knives.

13. Saw Doctoring

One can generally say that the Saw Doctor's shop is the key foundation for a good sawmill, obtaining a good output as well as quality of the sawn timber.

It is therefore necessary to ensure that all machinery be kept in good running condition, the tools especially the grinding wheels which are basically meant for a special purpose and not be carelessly taken by the Saw Doctor for other purposes such as machine maintenance. Instead, special care should be taken e.g. using correctly the right tool meant for the particular machine.

Good maintenance is really necessary in a Saw Doctor's shop for e.g if we take a look especially on the dust mixture of carborundum, steel and iron oxide. This mixture is one of the worst abrasive compound which can come on a guide, a sliding bearing or any other mobile machine part.

It is therefore necessary to keep the machines themselves, all guides, and mobile parts as clean as possible.

Should there be loose covers, these should be repaired or replaced immediately. The right lubrication must be used for each and every machine and therefore the best way would be to use the machine Manufacture's Operating Instructions.

Another problem faced was the use of the wrong grinding wheels. In the Gedu Wood Factory, nearly all grinding wheels such those for band saw sharpening machines, planer knife grinding machines, bench grinding attachments were found to be too hard, that is the grinding grit does not break off the wheel when it is blunt and this eventually leads to the fact that the grinding work cannot be carried out properly. The steel gets too warm through the friction and loses its hardness.

An example of the above situation is : after overhauling a planer knife grinding machine we tried to operate the machine. While clamping the knives (made in India), on the working table, it wasapparent that the knives were not sitting well.

After examining the problem closely, the thickness was measured. It varies from about 0.9 mm to approximately 1mm on the rear side of the knives to the cutting edge which should be parallel, was found uneven up and down approx. 1.5 mm.

It is therefore nearly impossible to set the knives well for grinding. Another fact to note is that a bad accident may also happen when the thickness of the knives are not the same so that the knives cannot be held properly in the planer shaft itself. They may also break if they are not attached on their entire surface. Furthermore, the balancing of the shaft is much more difficult with uneven knives.

Recommended Characteristics for Grinding Wheels

See Annex IV, Page 30

a) Vollmer CNE special sharpening machine with straight and level grinding for circular and band saws.

Through the complete overhaul of the machine a number of worn out parts caused by abrasive dust or low lubrication emerged.

Some spare parts could be manufactured in the workshop, which made possible bringing the machine into operation again.

A list of spares required was submitted to the GWMC management.

On fitting the machine , there are some points which need to be taken into consideration, these are:

Eliminating the play in the grinding bearing guide (ref. Original Vollmer operating Instruction CNE Pg 28). On the same page ways for eliminating the play in the mounting bearing are mentioned.

Another point to consider is that the mobile grinding-motor support is fixed under the Torsion spring tensioning in such a way that the lifting cam has to take the whole motor load when making the lifting stroke.

When fixing the lifting bearing by tightening the conical ring nut, one must ascertain that the shaft of the grinding bearing is able to rotate freely.

For special lubricating and cleaning works, see original Vollmer Operating Instruction CNE 101 - 3 Pages 31, 32, 33 using the figures for one shift operation. For further adjustments also refer to the Vollmer operating instructions.

b) The Cana SL Automatic Bandsaw sharpener is similar to that of the CNE, the only difference is that there is a small second machine, the equalising Machine EMS which is inter-connected with a transmission behind the Cana SL.

For both of these machines a detailed list of required spares was submitted to Management. For all adjustments and especially the lubrication , see original Vollmer operating instruction Cana SL 101 - 17 Pages 6,7,11,12,13 as well as the operating instructions EMS 100 - 2 Pages 5,6,8,9.

c) On the Vollmer band saw blade rolling machine, the lubrication felts and the pressure rollers have to be lubricated after cleaning, the shaft and the oil of the gearbox has to be changed according to Vollmer's instructions.

d) In the saw doctor's shop there are two planer knives grinding machines, and one long flat grinding machine in the factory which is used for grinding the peeler, slicer and clipper knives. These machines have been serviced and here are a few points which have to be taken into consideration:

The carriages should run without play on the long guides and the guides for the infeed should also be cleaned as well as properly lubricated. They also should be adjusted in such a way that is no play, but however, still be able to move freely.

There were no major problems found on the other small machines for joinery such as the bandsaw blade grinder, carbide tipped saw blade grinder, except for minor defects, for example on indexing pins and , infeed-hooks for which we eventually have recommended to placed an order.

14. Boiler Plant

During maintenance on the scraper chain conveyor from the chipper to the silo, we found two completely worn out bearings. We advised the maintenance team on how to change these aged bearings as well as on how to repair the worn out base on the top section of the conveyor.

It is recommended to obtain as soon as possible a new chain for the conveyor feeding the fuel to the boiler, as it is in a very bad condition.

15. Kiln Dryers

The electronic control of dryers No. 1 and No. 2 were repaired and calibrated.

The electronic control on dryer No. 3 was checked and found correct. An automatic operation will only be possible after replacing the selector switch for "manual-closed-open" operation, which will be supplied shortly. The same applies for dryer No. 4, on which the electronic could not be checked due to the bad condition of the selector switches.

It is recommended to obtain the necessary spares to repair the steam pressure reducing valve, in order to automate the operation.

A set of gaskets for the stop valve feeding the kiln dryers have to be purchased, as it is currently leaking.

B) Conclusions

The significant amount of work accomplished was only possible with the close collaboration ot the GWMC personnel.

The primary constraint for improved maintenance and production is the lack of adequately skilled personnel.

We believe the future prospects of the company are very positive and we are willing to support the effort with the necessary technical and/or managerial experties.

In terms of guidance for maintenance in the future, it can be summarised as follows:

- All the required literature related to operation and maintenance manuals is available at GWMC.

- it is important to use the recommended lubricants or their substitutes for each and every machine. It is definitely not good to utilise the same grease for a bearing rotating 5000 rpm and for one rotating at 1500 rpm. This is especially true for the lubricating oil for pneumatic systems, which are very sensitive.

- grinding wheels when they are chosen correctly can reduce running costs.

- a better equipped workshop can also reduce cost by manufacturing a number of spare parts. Down time of the equipment will also be reduced.

- a reasonable stock of raw materials for the manufacture of spare parts has to be kept, such as different sizes of steel profiles, steel plates and shafts. The same applies for nuts, washers, grease nipples, circlips etc. These parts represent a low investment and their immediate availability reduces production costs.

- a minimum level of spare parts for the whole factory can only be made in close relation with a given budget.

- in many cases GWMC can save costs by utilising a certain amount of imported parts and/or consumables of a better quality and at nearly the same price to the Indian ones. This applies to grinding wheels, bearings, sanding paper, all type of knives and circular saw blades.

Annex I

List of tasks to be done / Spares required
as noted during the fact-finding mission
report dated January 1992

DEBARKER

- Broken bearing
- Tilting of head
- Milling knives
  worn-out
- Pit to be filled

PEELER (*)

- Sliding pads to be repaired
- Speed
- Main gear box checking
1 Variable speed gear box repair
1 Knife carriage repair worn bronze
- Back-up rollers repair
- Central lubrication pump
- Broken pressure bolts
- DC break contactor
- Discuss with A & C speed diagram
- Check main hydraulic pump and servicing

CLIPPER

(a) Pneumatic Clipper

- knife holder replacement
- Main cylinder servicing
- Transport belt replacement
- Size clipping does not work

(b) Core Mechanical Clipper

TU DT 2700
TU DT 2000

- Brake problem
- Gear box damaged

(c) Decorative Clipper TM

- brake damaged 1
- brake damaged 2

VENEER DRYER

- Broken mesh- how to repair
- Condensate traps leaking
- How to reduce speed of new band dryer

CAPITAL SLICER

- Directional Valve (pneumatic break) is not working
- Worm screw gives periodically problem (for carriage)
- Hydraulic pump coupling

ANGELO CREMONA SLICER

- Central lubrication pump to be serviced
- Check main control bearing
- Table lifting makes noise
- Ejecting rollers damaged

MINAMI VENEER CORE COMPOSER

- Glue applicator:motor rotor shaft broken
- Square shaft for clipping: knife worn-out

- Adjustment of thickness control Pneumatic valve for stacker aligning arms.

- Finger jointer needs complete adjustment

- Clutch and brake need adjustment

- Thickness detector - shaft worn-out

BLOCKBOARD LINE (*)

- Needs a thorough adjustment

JOINTER VENEER SPLICER

JOINTER (*) (Ruckle)

- Ruckle Veneer splicer & jointer

- Glue applicator out of order

SPLICER (*)

- Rubber transport roller to be replaced
- Feed belt to be replaced
- Reflecting mirrors to be replaced

HAUG SPLICER (*)

- Motor & Trimming belt to be replaced

KUPER Veneer Splicer (*)

- Machine overhauling

GLUE SPREADER

- Checking and servicing

HOT PRESS (*)

- X-lift speed to be adjusted
- Temperature is different within the same platen

WIDE BELT DRUM SANDER (Weber) (*)

- Oscillation to be adjusted

- Pressure pad worn-out, To be changed

SAWMILL

MAIN HEADRIG (*)

- Carriage alignment
- Replacement of head block drive shaft
- Wheel alignment
- Wheel bearing to be replaced

TABLE BAND SAW

- Wheel alignment
- Bearing replacement
- Adjustment of feed speed
- General check

RESAW

-Check wheel alignment
-How to re-grind (crown) wheels

MAIN HEADRIG & TABLE RESAW

SAW DOCTORING

- Complete adjustment of swaging machine

- Automatic saw sharpeners need adjustment

KILN DRYERS (*)

- Fans get out of the shaft (only dryer 3 & 4 later model)

JOINERY

- WIDE BELT SANDER

- Oscillation (2 roller)

- Conveyor table

- meter for thickness

BAND SAW

- Wheel lining worn-out

BOILER

- Condensate trap:
  Traps leaking

- Pressure reducing valve

- Feed pump - main shaft

- Vibrator motor for Silo burnt

- Compressed air pressure drops

KILN DRYER (*)

1) Electronic control of kilns No. 1
   and No.3 is working correctly

- all position tested

2) Electric control of Kiln No. 4 not tested
   due to broken selector switches

3) Electric control of Kiln No. 3
   - heating O.K.
   - spraying O.K.
   - vents always open, no control

- Indicator lamps need replacement
- Electronic circuit diagram
  needed

(*) to be given priority

Annex II

Contractor's Personnel

The contractor's personnel involved in this project were:

Name	Project Function	Dates of Stay (Bhutan)
Olman Serrano	Team Leader	13.12. - 25.12.91 12.07. - 25.07.92
Johannes Wunsch	Overhauling works Machinery ajustments Maintenance	17.01. - 19.02.92
Bernhard Feldbacher	Overhauling works Maintenance Hydraulics	17.01. - 27.02.92 26.06. - 17.07.92
Wolfgang Weilke	Overhauling of Kuper splicer Electronic works	03.02. - 19.02.92 28.06. - 10.07.92

ANNEX III

Rolling Pressure

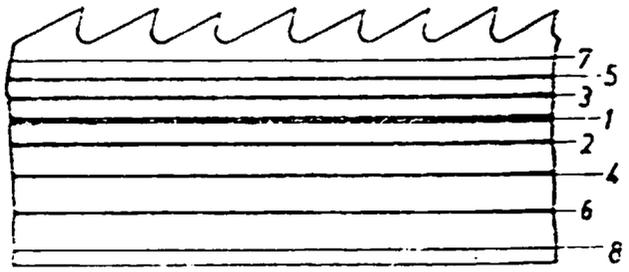

Fig. 1

Sequence and strength of the rolling pressure which has to be applied to the band saw blade.

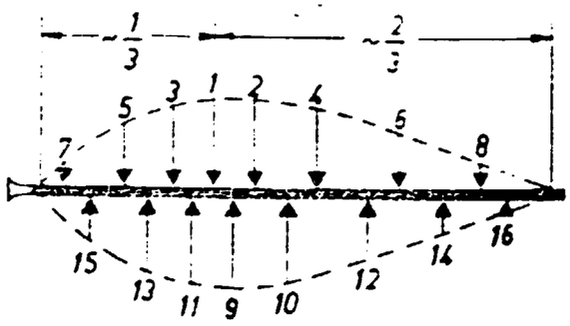

Fig. 2

Position of the rolling pressure applied to the band saw blade shown on both sides, including the sequence and strength of pressure. Length of the arrow shows the magnitude of the pressure.

ANNEX IV

Recommended Characteristics for Grinding Wheels

Standard Value for Woodworking Tools

Tool Type with Type of Alloy	Grit	Hardness V	Hardness B	Structure
Frame-saw, Pit-saw and Circular-saw Chrome-Vanadium	46-60	J -M		4-7
Bandsaw Chrome-Nickel				
a) Fine tooth	60-100	K-M /	9-10	4-5
b) coarse tooth	60-100	L-O /	8-11	5-6
Planing Knife				
a) Chrome-Vanadium	46-60	K-L	4-7	6-8
b) SS-Steel	36-50	G-J	3-6	8
c) HSS-Steel	36-46	E-G	2-3	6-12