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CONSIDERATIONS ON CHARACTERISTICS OF WOODS WHICH CAN
INFLUENCE THE CHOICE AND PECULIARITIES OF THE MACHINES DESTINED
FOR WORKING THEM 1/

by

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- 1/ The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO. This document has been reproduced without formal editing.

1) Introduction

Having to choose a machine tool it is necessary to consider first of all the characteristics of the raw material to be worked, in this case the wood. However, the wood is not a homogeneous material with constant characteristics: there are many parameters which interfere to modify the hardness, the resistance to tool progress and rubbing, etc. Among these parameters the most evident are the volumetric mass, moisture percentage, direction of cutting for logs also the diameter.

At the factories which work woods coming from countries at temperate climate, when the machines are installed for a production line, these elements are perfectly known and remain unchanged during the entire life of the machine, thus calculations can be made and the machines proportioned to the work to be done. Supposing for instance that some logs of spruce have to be cut for current joinery works: in this case the wood to be worked has a density in green conditions varying between 700 and 900 kg/cu.m; with moisture surely below 60 per cent and diameters included between 25 and 50 cm. We have therefore some well established working conditions and the experience acquired for centuries allows us to exactly evaluate the influence that such conditions have on the basic elements of the head saw: type of tooth, speed of feeding, speed of cutting, power required. These elements as a whole will then allow making a rational choice.

However, in a country with needs requiring to work different woods the situation changes very much, and the range of variations increases much more in the tropical countries because of the wide variety of woods and the large dimensions of the logs.

Since the technicians will have to choose for most of the countries represented here at the UNIDO Course, the machines suitable for working varied tropical woods, it seems necessary to us to draw the attention on the characteristics of tropical woods, taken as a whole, which can influence their cutting in boards and beams, the planing, peeling, slicing, working with different tools, glueing, painting and finishing in general; moreover, the artificial drying operations will have to be separately examined.

2) Peculiar Characteristics of Tropical Woods

A question which is possible to examine from a general point of view is the following: which are the differences between the tropical woods and those of the temperate regions? There is not a clear demarcation line at all because "Natura non facit saltus" (the nature does not make jumps) but it is a question of higher frequency of certain characteristics.

2.1) Dimensions of Trees

It is possible to affirm that when the trees are living on a suitable soil from the ecological point of view, either for tropical or for temperate forests, in the former ones they reach much larger dimensions than in the latter ones: everybody knows the marvels of Nature represented by the Sequoias and the Douglas Firs of North America or by the Eucalypts of Australia, which are both Temperate Regions. However, when we have to take into account the whole of the trees exploited in specific countries, and not the single tree, we must reach the conclusion that the average tree cut in the Tropical region is surely larger than the one cut in the Temperate region. As a matter of fact, in the forests of Europe and North America which are rationally managed, a tree is considered mature when its diameter is between 40 and 60 cm at breast height: under easy loading and transport conditions, also the trees which reach a diameter between 12 and 15 cm can find their market. In the tropical forests, in view of the choice that is made in connexion with high quality types and of the great difficulties connected with all logging operations, the only trees which are cut are the ones from which it is possible to get a volume capable of covering, with remarkable advantage, all the expenses for cutting, logging, transport, yard organisation, etc. After all, the trees to be considered in this case are all in the large diameter category: minimum 50 to 60 cm max. 1.50 up to 2 meters.

While for the past the trees were cut in logs of reduced length, the present trend is to carry the longest possible dimensions, the availability of cranes on tractors, fork lifts, trucks for transports of logs and, in short, of powerful units, eliminates any limit for weights and dimensions of the pieces to be moved.

2.2) Internal Stresses

Few foresters and technicians are aware of this subject which, however, is extremely important because it is continually necessary to face the perplexing consequences due to the forces which are present in the standing tree and which break out at the felling or cutting moment. The phenomena which are visibly caused by these forces appear more frequently and evidently in the series of woods of the tropical countries than in those of the temperate countries; while for the latter ones we have only to mention the beech, oak, eucalyptus and some fast growing poplars, for the tropical countries we have an impressive series of species affected: in Africa there are the Akatio, Agba, Azobé, Emien, Ilomba, Limbali, Makoré, African Mahogany, Ossoko, Sipo, etc.; in Asia there are the Balau, Bintangor, Durian, Geronggang, Inzia, Kapong, Kapur, Keruing, Lauan, Mayapis, Mangkulang, Meranti (or Seraya), Merawan, Rosewoods, Sao, Terap, etc.

The internal stresses, the theory of which is too complicated and long to be explained here, show themselves - in the standing tree - through a stress at the stock periphery and a compression in the internal part, close to the pith. When the tree is felled and cut all these forces loosen and consequently the periphery tends to shorten, the internal part to lengthen and the final result is the opening of several cracks, in the shape of crow's feet, starting from the pith. It often happens that these cracks reach the periphery and really open the log into 4 or 5 independent sectors, out of which it is not any more possible to take any profit. However, even if there are not such large cracks, at the sawing time the boards are affected by the stresses on their edges and open or undergo a strong deformation. The internal stresses are often accompanied in the tropical species by the so-called "brittle heart" which is a central wooden area devoid of any fibrousness and with lower mechanical resistance; along the entire brittle heart area it is also possible to see a succession of cross cracks in the wood on the internal side of the log, which can just be perceived by an unskilled eye; it is evident that this wood cannot be employed for any building or joinery use.

2.3) Extracts and Inclusions

The components of the cell walls, namely cellulose, lignin and hemicellulose, are identical for all woods and differ only by the percentages in which they are contained in them. However, these are not the only components of the wood, because in the ligneous tissues it is possible to find two other categories of substances deposited in the cell juice. The first one belongs to the soluble substances, called "extracts" and the other belongs to the insoluble materials.

The extracts can vary from one specie to another and, consequently, determine in the woods where they are found some specific and peculiar characteristics.

Several tropical species and especially the dark-colored ones have a remarkable content of extracts: these substances (for instance the tannins) can increase the wood resistance to the biological deterioration and thus be undeniably useful, other substances can, on the contrary, etch the tool steel and the plate of the kilns, stain the damp wood, or cause troubles to the workers exposed to the dust which is released during machining and finishing.

A rubber resin or tacky content can make sawing and milling difficult because of the scales deposited on the steel; this is not a specific peculiarity of tropical woods, however it can cause real troubles when working certain qualities of woods. However, the most prejudicial cases are due to the presence in the wooden tissue of insoluble mineral substances having high hardness characteristics. These substances (usually phosphates, carbonates or silicates) can produce some agglomerate which appear like irregular stones, even large as a fist, disseminated in the wood (it is the case of Iroko or of some Meranti) or else are in the shape of stuff filling the internal cracks and fractures of the log (it is the case of Doussié).

These are real concretions which inevitably cause breaks in the saw blades or in the cutters of the tools. Instead of aggregating to form some masses having a certain volume, the insoluble substances can sometimes be scattered in crystals or granules of smaller diameter

(1/50 to 1/20 of mm) inside the cell cavity; the wooden tissues look perfectly normal but during sawing an increased resistance is noticed and also a teeth wear which is greater and faster compared to the normal wood. Even though the crystals are not always made by silica only, these woods are called "siliceous".

The forest administrators and sawyers are much afraid of these woods because their sawing and working are difficult and expensive. The tropical woods affected by this trouble are many, some of them are: the Akatio, Makoré, Azobé, Mvingui, Mukulungu, Aiclé, Abiurana, some Lauan and Meranti, the Geronggang, Kapur, Keruing, Mengkulang, Mersawa, etc. It is again necessary to underline that the presence of certain substances of toxic nature in certain extracts can cause some troubles to the workers' health; this is for instance the case of Beté. Obviously, this has nothing to do with the power or type of machine to choose, but it requires a very accurate study of the removal systems for sawings and dust.

2.4) Deviation of Fibers and Tissues

The tropical woods, more frequently than those of the temperate regions, have the fiber direction which is not oriented parallel to the log axis.

The result is a marked counterlip which makes sawing, planing and rubbing difficult, but can at the same time, if the fibers are divided into narrow and parallel bands or follow certain arrangements, increase the value of the woods for decoration. This is the case of Sapelli, Sipo, of American Mahoganies, of Ipe Tabaco, Afrormosia, red Luans, etc. After the above general considerations we are now going to make a short examination of the working stages.

3) Notes on the working stages of a normal mass production line

3.1) Handling of logs kept at stock-yards

The lifting and transport apparatus must be of high power and have a large flexibility of employment. If the stocking of the logs cannot be made in a watershed it will be necessary to provide for some rotary

watering pumps in order to keep the wood damp, thus avoiding the drying cracks and reducing the damages caused by wood-borers, insects and fungi.

The storehouse must be provided with a set of appropriate cross-cutting saws; the ones actually used are practically always the chain saws of great length, which can be easily moved with hands or are mounted on very low carts; it will also be necessary to have some metal brushes and monitors to clean properly the bores before sawing them.

In the regions where it is possible to fear the presence of metal chips in the woods (areas where some fighting or guerilla is taking place) it is recommended to keep an electromagnetic detector of the type used to find out the mines hidden in the ground.

3.2) Sawing

Before choosing the saw or the head saws, it is necessary to exactly forecast the work to be performed, i.e. to know which are the species available, their maximum dimensions (here the average diameter has a minor importance) and above all whether the species are one or more, with different characteristics; finally, which are the assortments to be cut (boards, beams, ties for railway, etc.)

During another talk a sawing expert will discuss the choice of saws and the question, still controversial, of the cutting speed and types of teeth. We will only recall here that, when the species to be cut show frequent internal stresses, it is necessary to carefully study the most advantageous solution out of the following three:

- a) perform the sawing in parallel boards (sandwich sawing) leaving the boards free to open in the middle;
- b) make use of a frame saw with two blades in order to eliminate four off-cuts (or slabs) with two passings, then the prism obtained shall be submitted to the reciprocating gang saw;
- c) use the band saw on the offcut by installing before the band two small circular saws with the purpose of eliminating the trimming on the plank side parts where the maximum contraction due to internal stresses is exerted.

The circular saws at right angle with the sawing plane of the band can be employed also to eliminate the brittle heart, as required.

The presence, in a wood to be worked, of large quantities of resin can suggest the installation on the saw lattice of a sprayer in order to spray on the blade a fluid capable of dissolving the deposits; finally, the use must never be forgotten of a device (scratch-brush or else) in order to fully remove the sawdust adhering to the cutting section.

For the cross cut of woods or for trimming the boards it will be necessary to use circular saws with teeth studied in a suitable way both for shape and setting; present trend is more and more oriented towards removable teeth made of wolfram carbide plates, especially when hard and abrasive woods with mineral particles have to be worked.

At the workshops where woods containing toxic extracts have to be worked or which are simply causing hindrances to the workers, the installation of suction units must be properly studied as has already been said (and it will be a good precaution to have the workers wear a gas mask and gloves).

It appears also very important the possible recovery of several rejects, which thing requires first of all a careful study of the transports inside the workshop and in a second time of the transformation of these rejects into chips and of their storing.

3.3) Peeling and Slicing

The dimensions of the logs are the factors which determine the dimensions and power required for operating the lifting units for the peeling and slicing machines. On the other hand, the cutters and the kilns, just as the glueing machines, presses and sanding machines must suit the dimensions of the finished products desired.

Since there is the possibility of having to face some "brittle hearts" the peeling machines must be built in such way as to be able to use jaws with different diameters.

At the same time, the steaming tanks shall be capable of giving work

performances suitable for any quality of wood, both from the point of view of steam temperature and of the length of treatment: it is very difficult to state general rules for types of woods which are known insufficiently, so it is much better to collect some real data taken by repeated practical experiences.

3.4) Machining (milling, tenoning, drilling and broaching)

The easy performance of all these operations is strictly connected with the wood density, the more or less satisfactory straightness of the fibers, the resin content and the presence of silicon granules. The concept of the required machines is not influenced by these elements, which are on the contrary essential for establishing the angles of attack and of sharpening, in addition to the characteristics of the blade steel.

In a large plywood factory the recovery and use of waste (which are in the form of rounding veneers, or cores from the heart) is an operation with great technical and economical importance which shall not be neglected or undervalued; it is therefore convenient to devote to it a special attention starting from the layout of the first project.

3.5) Glueing, painting and finishing in general

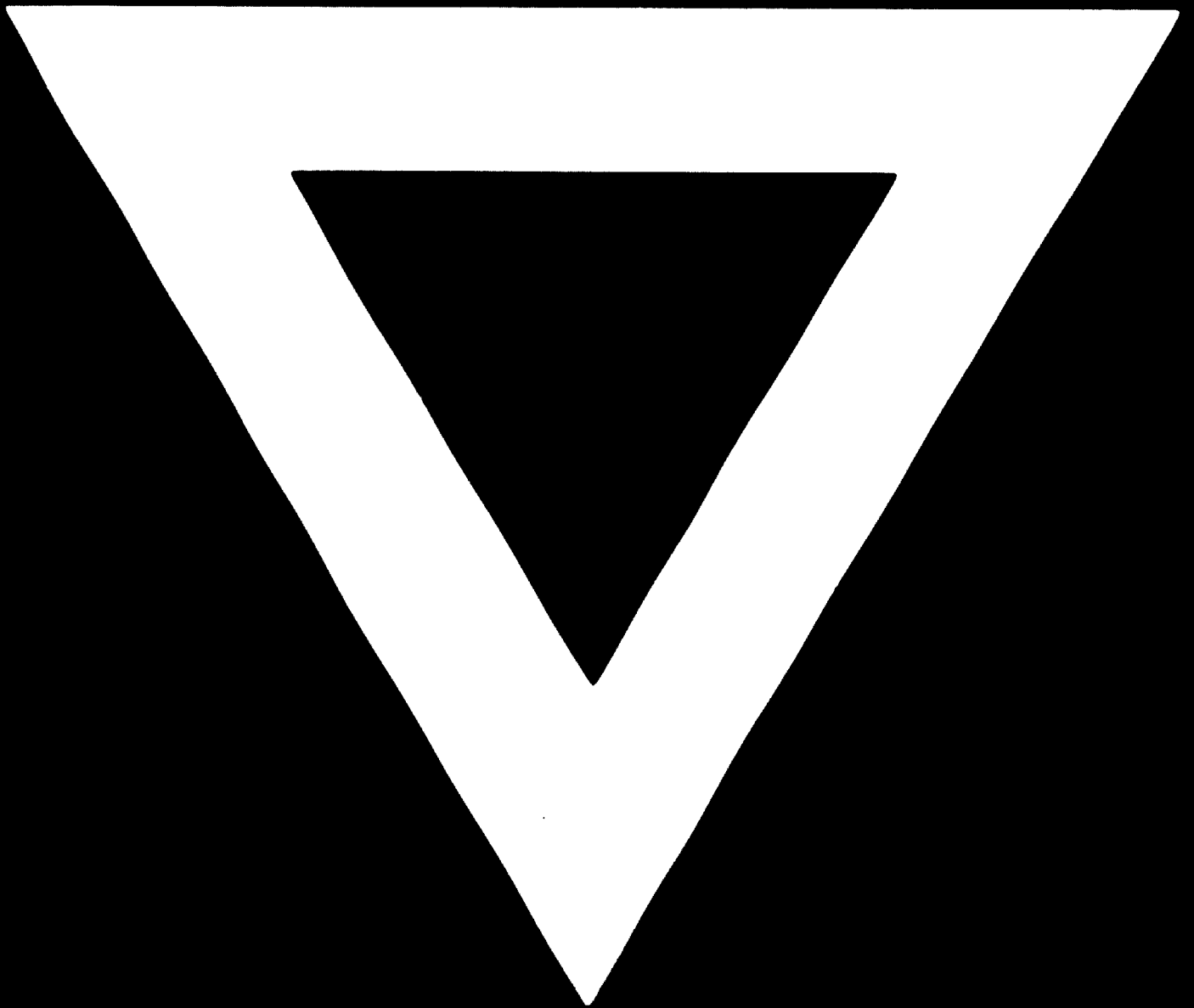
Here it is necessary to repeat some analogous considerations, that is to say that the required equipment is equally used both for tropical or not tropical woods with the only difference that for oily or fat woods, such as Iroko and Teak, it will be necessary to add to the production line a preliminary phase destined for eliminating from the surfaces all the substances which make difficult the adhesion of glues and paints.

3.6) Drying Kilns

We do not wish to discuss here the choice of the drying kilns from the point of view of the system to be adopted, we will only recall that, under the action of steam and heat, it is possible that some tropical woods, very rich in extracts, release some substances which are very corrosive for plates, pipes and for the equipment as a whole. This is an element which shall be carefully foreseen, because it might suggest not to resort to the traditional hot air system.



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