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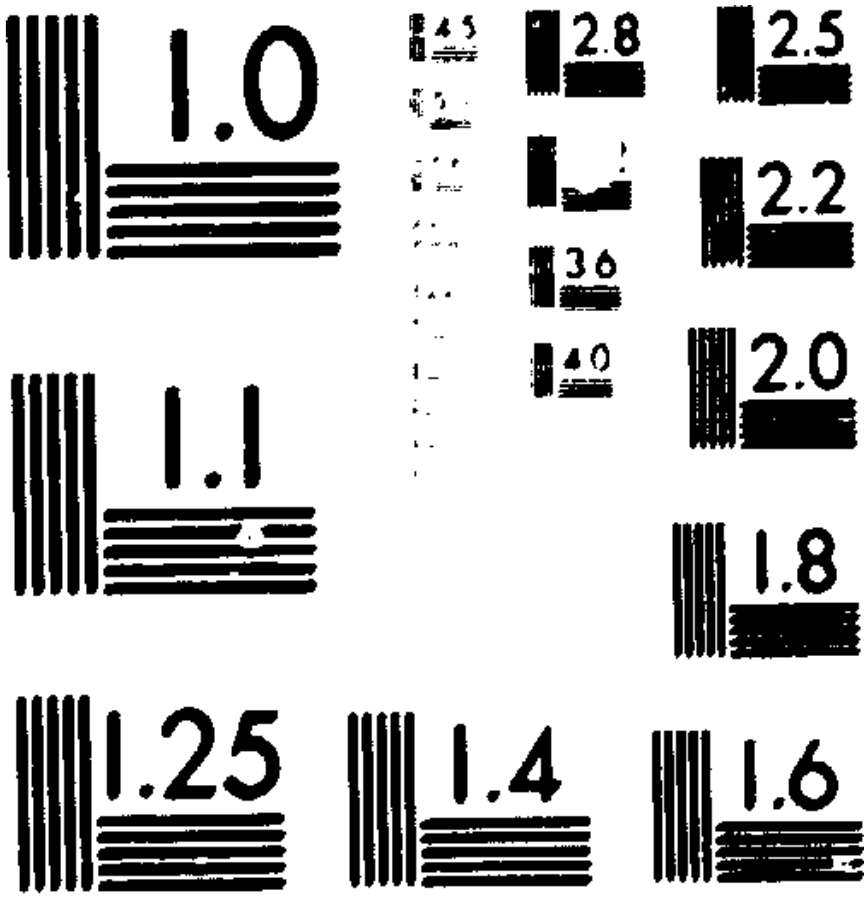

10462

Distr.
LIMITED

ID/WG.338/10
8 May 1981

ENGLISH

United Nations Industrial Development Organization

Seminar on Economic Criteria for the Selection
of Woodworking Machinery and Plant Systems

Hannover, Federal Republic of Germany, 19 May - 2 June 1981

SELECTION OF MACHINES FOR SAWMILL OPERATION IN RELATION TO RECOVERY FOR CONDITIONS IN DEVELOPING COUNTRIES *

by

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1. Introduction

While sawmilling operations in the years after the last war was a matter of common knowledge and basically related to regionally-available logs and the regional market, sawmilling today has become an industrial operation, not only using logs from all over, but also catering for local and export markets.

How significant the change was in the operation during the past years, is probably easiest understood by the fact that until recently, any sawmill size was always and exclusively identified by the input quantity, while nobody ever considered the output of such an operation. Increasing costs, however, not only in developed countries, but also in such countries where indigenous timber is still plentifully available, in connection with stronger competition, have forced the sawmillers to follow a traditional way of operation as well as to look critically into the selection of products, the selection of systems and related machines and into the selection of a system, which provides the most efficient operation and recovery.

2. Influencing factors on sawmill operations

Sawmill operations in these times are certainly influenced by the products and the markets which are available or which have to be covered. Also log diameters, the question whether softwoods or hardwoods are to be used and the quality of the raw material is decisive for the selection for the most improved operation.

With respect to the market, another factor must be mentioned, which is the quantity of every single product in relation to the total operation, because it makes a great difference if only two or three different products are manufactured throughout the year, or if the machines must be readjusted every half an hour, as the quantity of each product and order is too small.

Unfortunately all these influencing factors mentioned so far are very much connected with each other and it is not possible to give strict rules with regard to the one or the other factor. While certain products can naturally only be made from logs with larger diameters, in other cases those factors depend so much upon each other. While small diameter logs are usually not connected with defects such as pinholes and rotten heart, there are other defects to be strongly considered, such as many knots, bent and twisted logs and sometimes serious fungus problems. Large diameter logs, on the other hand, which come from tropical forests, are usually subject to pinholes, rotten heart and very often, fungus too.

When the most effective operation of a sawmill is considered, it is certainly not related to the only existing sawmill in a small community and situated next to a forest, because such a sawmill will naturally have to cater for the needs of the community and will have to provide all kinds of products independent of the more economical mass production in its operation, especially if the next community is quite far away. Such a case is to be exluded from these considerations here. Also such cases must be excluded, where local conditions restrict a sawmill to the use of a certain raw material, such as in sawmills in Thailand, where only teak is cut, even for construction lumber.

In general terms it might still be acceptable to say that for small diameter logs, which are fairly straight, the use of gang saws is very common. In many cases, there is not much edging in the operation, but the logs pass only once through the gang saw and are then stacked and sold without any edging. This is also understandable, because for edging there is not enough lumber available from one log of the same quality and of the same width.

Also it might be correct to say, that large diameter logs and such logs which are bent or twisted are mainly cut on band saw operations. In such band saw operations, very small sawmills have only one band saw converting the whole log into the sawn lumber as required. In the usual operation, the first gang saw will take over the breakdown operation while pony rigs or table resaws follow in sequence for resawing the lumber. At this stage also edgers are very common in the layout.

There is a way of operation which might be called 'flitch' operation. This means that the first saw - whereby this might be a gang saw or a band saw - pre-cuts the logs in a way that flitches are cut. The thickness of the flitch after resawing will be the width of the boards.

Such a flitch operation might be done on automatic resaws (band saws) as well as on gang saws. Due to the fact that the width of the planks is already fixed in the flitch, such an operation provides for very even products, but it is also suitable for production with large quantities of the same product. At this stage it must be mentioned that, not only the quantity of the single product is decisive for the selection of such a flitch operation, but certainly also the

question whether the logs are sufficiently free from defects. If there are too many defects in the logs, it might be necessary to take out too many boards after the flitch operation for recutting, which would reduce the actual advantage of this kind of production.

3. Consequences for the selection of machines

For the sake of completeness it must be mentioned that certainly large diameter logs cannot be cut on gang saws only, because the diameters of several logs might be larger that the operational width of the standard gang saw. Therefore it might be correct to say that for cutting tropical timber, gang saws might only be considered for resawing production steps. This again leads to flitch operation with all advantages and disadvantages mentioned above.

Other operations are considered in the following way:

Circular saws

- for logs as well as boards, but having a relatively considerable cutting loss;
- for sawing cants to boards, also as a double arbor edger, showing excellent surface quality and fast feed speeds of up to 60 m/min

Band saws

- for varying individual cuts and in case a universal use is required.

Gang saws

- for use in lumber production when the respective dimensions need not be modified during the intervals between a change of blades

Chippers

- mostly used for processing thin logs on a very large scale.

Besides such straight operations it is quite common to combine machines.

In a normal sawmill equipped with gang saws, it is quite common to have not only one but several gang saws in operation. Usually, one is always situated aside but behind the first gang saw. This will allow either dependant operation for full log cutting or operation with flitches. For side planks, edgers are available, but due to the fact that there are not so many side planks, the number of edgers is usually limited to one or two.

In a typical band saw operation, it depends on whether small or large diameter logs will be cut. For small diameter logs the arrangement is similar to a gang saw operation whereby the first band saw will take over the cutting of side board, while the second band saw will take over the flitch operation. Instead of a second band saw there could also be a gang saw, if dimensions are large enough of even quality and quantity.

In a typical sawmill which is equipped for large diameter logs, such as from tropical forests, there will always be a very large breakdown band saw with automatic carriage. Here only very few planks or boards will be cut in the final thickness, as the log is mainly broken into smaller pieces, which can be handled more easily. These pieces are then taken to resaws which are either equipped with carriages or roller feed or just ~~which are just~~ table band saws. If the log quality allows it and the market requires large quantities of even thickness and width in the boards, a gang saw might also be very suitable for the resawing operation.

To complete this section, it is also necessary to mention the circular saws again. These are still in operation where the loss of raw material due to the thick sawblades is not important. They are also in operation for very small diameter logs where no side planks can be produced, but which are only for construction timber.

At this stage it must be mentioned that band saw operations are usually much more flexible that those equipped with gang saws. Nevertheless, gang saws have many advantages which might be mentioned as such:

- continuous feed, meaning uninterrupted blade operation, without idle intervals;
- on all models, even conventional types, precise sawn dimensions can be obtained, which means less allowance for further processing, as for instance planing;
- less addition for overdimensions equire smaller sawn dimensions, as such offering better recovery from the raw material;
- for construction timber, the lengths can reach up to 60' and more;
- simple blade maintenance.

In fact, there are no convincing arguments against the use of gang saws for hardwood sawing, because the sawblades require less treatment and only simple maintenance.

A skilled operator is able to carry out a change of sawblade in just about 8 minutes normally it will not take more than 15 minutes either. Achieving maximum operation with a gang saw, of course, presupposes a certain knowledge and experience.

Storing space should be provided for the machine to ensure a continuous feed. When sawing logs longer than 20', the output is increased by as much as 10 percent, employing the same number of staff and using the same equipment if there are no gaps of, for instance 2' between the logs, but log following log. The production capacity of gang saws depends on the following features:

- sash width (mostly 22" and 30")
- number of blades in sash (up to a maximum of 20 blades)

- number of revolutions (300 to 360 rpm)
- stroke (20", 24", 28")
- motor power (50 to 200 kW, according to machine and capacity required)

For big production output and flitch sawing behind a band saw, gang saws with 8 feed rollers are frequently used to maintain exact feed speeds. Such 8 roller attachments are also installed in gang saws for sawing short logs of over 3' length. The drive mostly consists of a short circuit rotor motor driving the machine via countershaft.

Continuous feed of lumber to the machine is achieved when sawing logs by:

- an infeed carriage turning the log into position, with lateral adjustment, while an auxiliary carriage supports and holds the log.
- the logs are taken on to the carriage either by hand or by conveyor, beginning about 3' before the gang saw to allow ample time for centering and closing up to the preceding log.
- for lumber with at least one flat precut surface a roller conveyor with lateral adjustment is sufficient.
- having combined sawing of logs or cants, only carriages ensure a satisfactory feed.

4. Yield of operation

Before considering the yield of operation and the possible ways to achieve a high recovery rate, it is necessary to identify first how this yield is calculated. This is very necessary because there are countries and areas in the world where everybody considers cubic meters in true volume. There the calculation of the sawmill recovery is very easy, because input and output are both measured in true volume and in cubic meters.

There are also areas and countries in the world where various scales are used. This is where a calculation begins to get very difficult and critical, because if log input, for example, is measured in Hoppus tonnes and sawmill output is measured in board feet, there is hardly any direct or even indirect relation between the two, rather figures only.

The fact that such unrelated terms are still being used underlines what was mentioned in the beginning; that sawmilling was subject to log input only and not at all to yield, recovery or output.

To be precise - and precision in measuring is the first precondition for the knowledge of what is going on in a sawmill and, this again is the first precondition for any improvement - it is essential to use terms of measurment, which can be related to each other. At this stage, it is probably not necessary and not appropriate to hail the metric system, because it is so easy for those who have never used anything else, but metric. It is essential to compare measurements in

true volume and not in any scale - whether using metric figures or inches or whatever.

However, scales are still in use and therefore, it is necessary to identify those also. In the following example, this is shown:

Bringing scale figures back to metric, it must be known that '1 Hoppus ton of round logs' represents 1.81 cubic meters of true volume logs, while '1 Hoppus ton of sawn lumber' represents 1.416 cubic meter. This is actually the system of a scale telling the user that if he cuts the logs according to the scale calculation, he will produce 1 Hoppus ton of sawn lumber out of 1 Hoppus ton of logs. Taking these figures into the mathematical relation, it shows that this counts for a yield of 78% which is very high, even under rationalised and efficient conditions.

To complete this section, it is necessary to give some indication of common yields of sawmill operations:

While softwood sawmills in Europe consider mainly a recovery of between 70-75%, the yield of a sawmill for tropical timber is usually not much higher than 50%. Sawmills are known where the recovery is as low as 25%.

5. Improvement of the recovery

This paper considers mainly the selection of appropriate machines for an efficient sawmill operation. The machines alone, however, do not unfortunately secure such an operation but proper maintenance in connection with a sawmill organisation is necessary for the achievement of such a kind of operation.

In many of today's operations, it quite normal for the Sales Department to tell the sawmill foreman what kind of products have been sold and which are to be produced. Then it is mainly left to the operators in the sawmill to get these products out of the logs. These operators decide where to cut the log first, where to set the second cut and further on, where to start using the resaws and the edger. Unfortunately, most of these cutting operations are left totally to the operators and these men do not receive any instructions from the management or from the office. Logs are cut into halves or quarters and are then sent to the resaws until finally some final products are left over - out of most of the logs, which are turned into useless waste.

Other operations cut flitches at the breakdown saw but flitches where the thickness not only varies from flitch to flitch, but also is not related to the marketable width of the plank. The result is the same as described before; it means that the pieces of lumber must be cut again and again and every sawing operation means a smaller product and a larger portion of waste.

Contrary to such a kind of uncontrolled operation, it is recommendable to organise an 'Operations' Organising Department' (OOD). Such a department might be equipped with experienced operators and also with an engineer and might be directed during the initial period by an outside expert.

The first subject of the OOD will be to establish 'Sawing patterns'. These sawing patterns may originally be very theoretical, but in the course of further operation and gathered experience, these sawing patterns will be modified and will consider log defects and specific conditions of every independant sawmill.

After such sawing patterns have been established, the OOD will not only give the instructions to the sawmill operators as to which way the logs should be cut, but also they will give instructions to the log yard under which criteria the logs have to be graded and stored and out of which storage blocks logs will be used for a certain operation.

The OOD will also be responsible for the preorganising of the available orders in such a way that equal products of various orders will be cut together in the same operation instead of cutting one order at a time.

Last but not least, the OOD will also control and direct the maintenance and saw-doctoring department, as for certain orders, it might be necessary to start with freshly-ground sawblades and to have a readjustment of the machine before the start of such orders, while others may require less maintenance and less saw-doctoring.

As such, the OOD may select five different orders for the following day's operation and - according the existing raw material - may calculate that for the production of the quantity of all the necessary scantlings out of those five orders, 75 logs of x" diameter and y' length are needed. Thus the OOD will give instructions that those 75 logs must be brought from the log yard to the sawmill early enough to be availabl there for the following day's operation.

The OOD will then select the sawing pattern and will send it to the sawmill operator with the instructions for that day's operation to follow this particular pattern.

Knowning that for this kind of operation the sawblades must be changed twice during the day's shift, the OOD will also give instructions to the saw-doctoring department to make sure that the required sawblades are available in good condition.

Working this way, the main achievement is that the responsibility for the sawmill operation is taken away from the saw operators and is transfered to the engineers in the office. The cutting of the logs is not done any longer by 'feeling', but according a pre-set pattern, which is based on experience and which must be corrected continuously in accordance with new experiences.

How important such a strict consideration of the yield of the operation is, can be shown by a simple example:

If a sawmill is based on a log input of 100.000 m^3/year and the recovery is only 30%, it means that 30.000 m^3 of sawn

lumber can be sold annually.

If a recovery of 50% can be achieved, it means that 20.000 additional cubic meters of sawn lumber can be sold every year without any additional log input. Based on today's sawn lumber prices, this might easily be a further revenue of between US$ 5 - 10 Million per year. For such an amount, it is definitely worth considering improvements in the yield and recovery because every percent in achieved improvement counts.

6. Summary

Tc summarise the points again, it should be said that

- it is firstly necessary to identify the local conditions exactly with regard to the available raw material, its quality or defects, its location and transport conditions and storage time,
- to identify also the conditions of the various markets in relation to prices obtainable and production costs needed, before any decision is made about the system of the sawmill operation to be chosen.

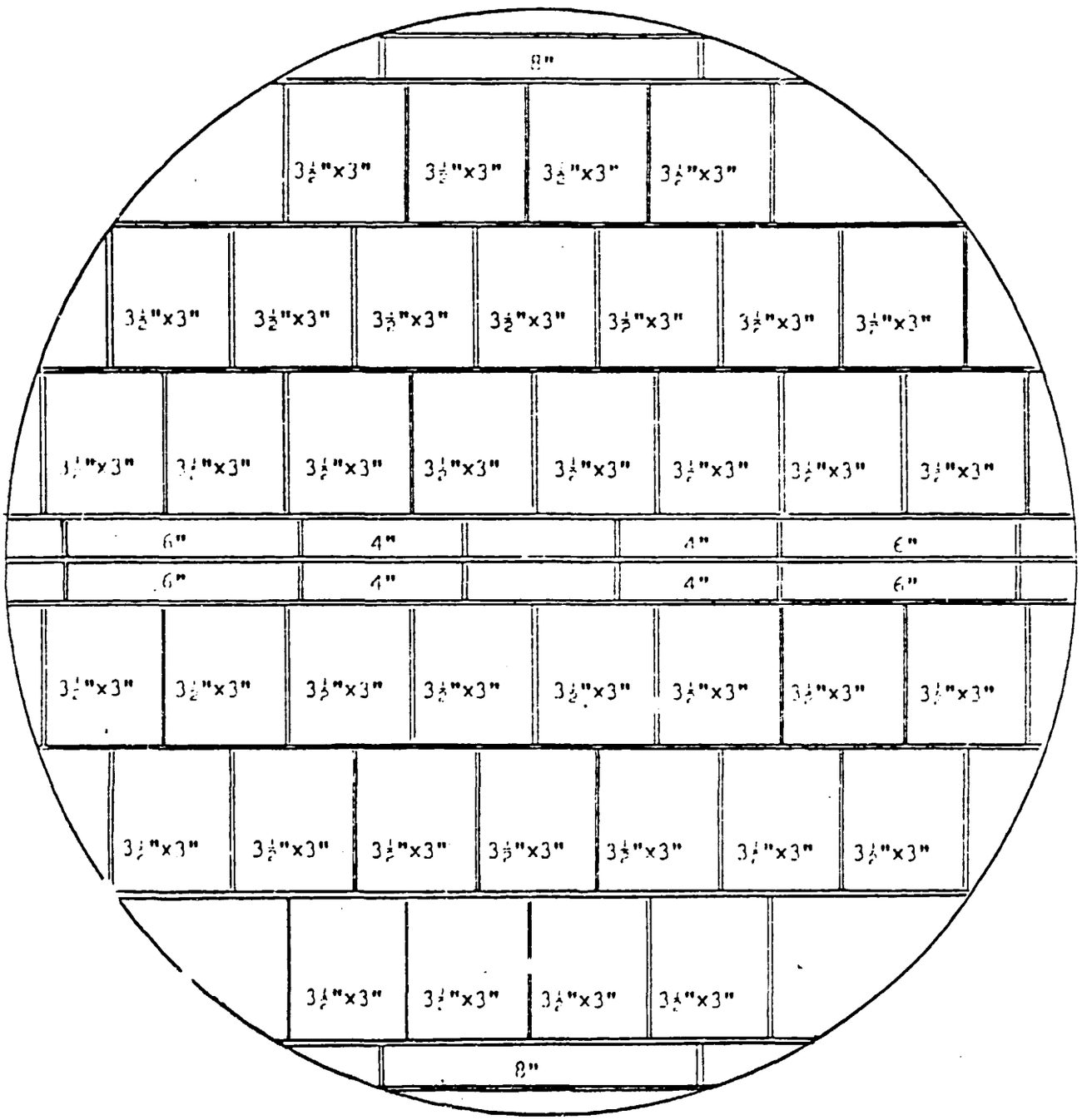
In relation to the system being chosen, it will then be necessary to select the most suitable machines whereby the criteria mentioned before should be carefully considered.

Also the best-chosen set of machines does not ensure an efficient operation unless, after the basic training of the operational personnel and the maintenance crew, also a most

suitable organisation is established to streamline the activities of the sales organisation with the most efficient operation in the sawmill itself.

CUTTING PATTERN

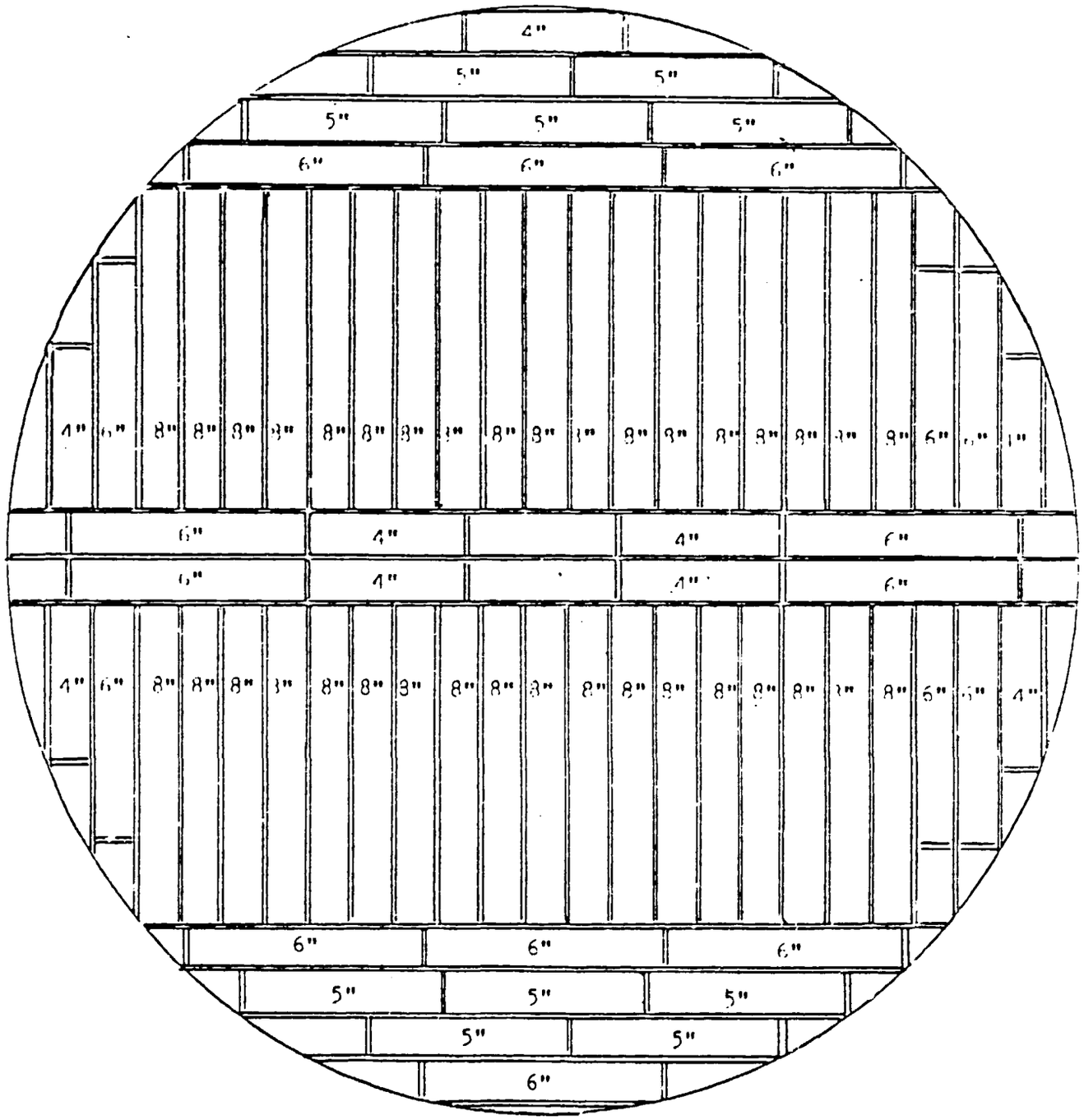
Scale: 1:4



4x4"x1"	4x0.0254x0.1016	= 0.0103225
4x6"x1"	4x0.0254x0.1524	= 0.0154838
2x8"x1"	2x0.0254x0.2032	= 0.0103225
38x3½"x3"	38x0.0889x0.0762	= 0.2562606
Total sawn timber		= 0.2923894 = 76.0%
Total diameter of log		= 0.3848450 = 100.0%

CUTTING PATTERN

Scale: 1:4



9x4"	9x0.0254x0.1016	= 0.0232257
10x5"	10x0.0254x0.1270	= 0.0322580
17x6"	17x0.0254x0.1524	= 0.0658065
36x8"	36x0.0254x0.2032	= 0.1858060
Total sawn timber		= 0.3070960 = 79.8%
Total diameter of log		= 0.3848450 =100.0%