TIMBER TECHNOLOGY BULLETIN

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REVIEW ON SIX TYPES OF LOG CUTTING METHODS IN VARIOUS APPLICATIONS: PART 1

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INTRODUCTION

Some people may think that log processing is merely a process of pushing a block of 'perfectly circular' cylinder into sawing blade(s) to produce the desired dimensions of cut. This would be true if all logs are regular in shape. The fact that most logs are now obtained from logged over forests apparently produce logs of not only smaller in size and irregular in shape, but also inherent with various types of growth defects such as hollow cavity and incipient rots. Nevertheless, it is known that timbers with higher quality (in terms of visual effect and physically, and those of larger sizes) fetch much better price in the market. The recovery for such quality of timbers is considered 'high in value recovery' since it relates to higher revenue generated.

In practice, timbers of different dimensions are priced differently. For example, cutting widths of 12 inch and above fetch much higher price partly to compensate the loss in volume recovery. It is often cut upon special request. It also depends on the availability of large diameter logs at that point in time. The same applies to quarter-sawn timbers (Pictures 3a and 3b) which always relate to better stability in service, also fetches a premium. Its supply depends on the availability of suitable log sizes and the availability of a specialized saw, i.e. pony saw for example.

In the computation of recovery of a piece of log, particularly after the price of logs has escalated very much since the last decade, not only is volume recovery important, value recovery is given much more emphasis as it dictates the profitability of the whole exercise. The actual return lies in the profit made in the conversion of the logs after deducting relevant costs including log purchase.

In some applications whereby dimensional stability is emphasized, cutting method has to accommodate accordingly. It is established that quarter-sawn produced much stable boards compared to that of flat sawn (Pictures 6a and 6b). The latter is known to cup (curve up or down) while the former swells or shrinks uniformly upon exposure to changing service environment. The rate of expansion or shrinkage of timber is partly influenced by the direction of annual rings and medullar rays.

Y. L. Tan

Figure 1 Logs with defects

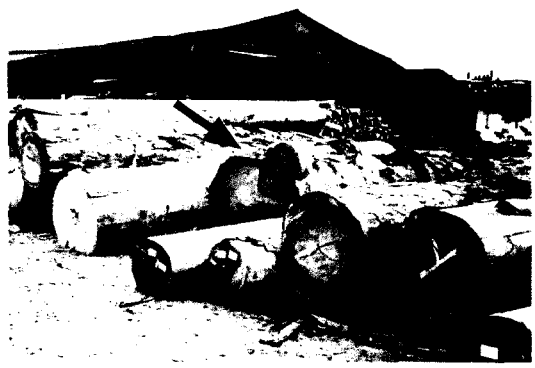


Figure 2 Irregular-shaped log (refer to arrow) and logs with defects

At present, several timber cutting methods have been practiced by saw millers based on various criteria such as log species (softwood or hardwood; plantation species or forest species), sawing facilities (type of saw used), grade of incoming logs, and customer's specifications (aesthetic and/or dimensional stability consideration). Different sawing methods, however, generate different rate of recovery.

This paper gives an overview on the log cutting methods commonly practiced locally as well as some applied overseas but have potential to be applied in our country.

Another article entitled "Comparison of Volume and Value Recovery for Six Log Cutting Methods in Various Applications - Part 2" which covers analysis on value and volume recovery for cutting methods published in this paper will be presented in the next issue of the Bulletin. The article serves as a reference to sawmill operators whereby profitability and suitability are their major concern.

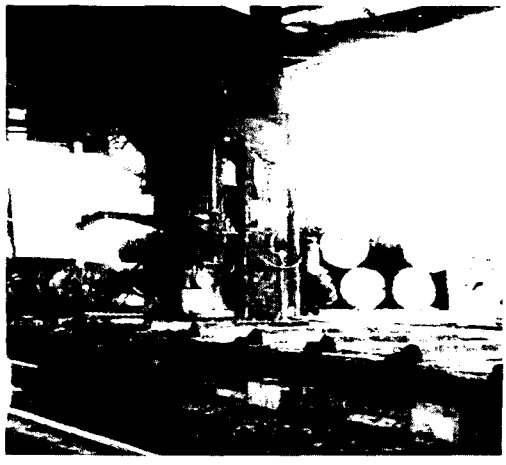


Figure 3 A common Breakdown Saw used to break down large logs

Figure 4 Workers breaking down smaller dimension logs using Band Re-saw

TIMBER CUTTING METHODS

There are six types of log cutting methods adopted by the sawmill industry worldwide which can be categorized into two broad categories as follows:

(A) Common cutting methods

(i) Live sawing or through-and-through;
(ii) Sawing with a breaking cut;
(iii) Cutting of quarter sawn or radial sawn or rift sawn.

(B) Other methods (potential to be used by the local industry)

(i) Sawing around at 180°;
(ii) Sawing around at 90°; and
(iii) Cutting of flat-sawn or back sawn or plain sawn or tangential sawn;

Each sawing method has its advantages and disadvantages. A brief description on the cutting methods with slice view log patterns, its suitability as well as their pros-and-cons are presented in the following tables. The growth rings appeared on the drawings of logs, though not applicable in most hardwood timbers in reality, is presented to facilitate illustration of sawn type (Quarter sawn and Flat-sawn).

(A) Common cutting methods

(i) *Live sawing/through-and-through*

Description

- Also referred to as Plane sawn.
- The simplest cutting method and most commonly practiced by sawmills cutting small diameter logs.

Cutting method

- Log is sawn by a series of parallel cuts. The width (thickness) of each pair of parallel cuts follows the order specifications.

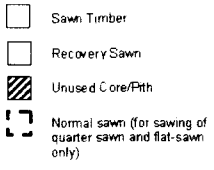
Cutting equipment

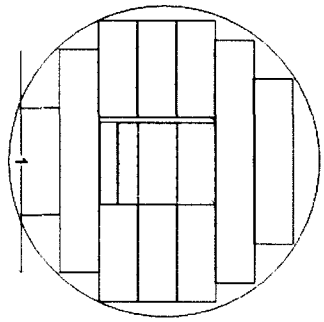
- Commonly cut using multiple band saw or gang saw. Smaller diameter logs are usually cut using Re-saw.
- Re-saw bandsaw at top wheel 42 inches.
- 4-inch width and 17-18 British Width Gauge (BWG) is the common saw blade size used for Re-saw.

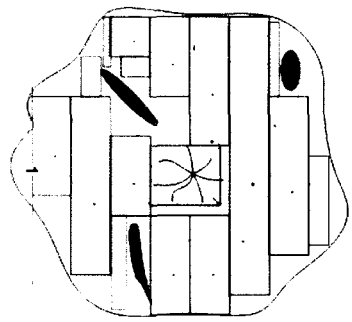
Log cutting method

Simulated live-sawing on a perfect round-in-shape log

Simulated live-sawing on an irregular shape log







Picture 1a

Picture 1b

Advantages

- The most economical cutting method as it does not require any turning of logs nor skill-demanding in making cutting decision.
- The fastest timber conversion method with the highest production rate.

Disadvantages

- Since cutting of logs does not consider pieces of timbers with defects, it is lowest in value recovery.

Recommendation for use

- Suitable for less defective and **small diameter logs** such as plantation species like Rubberwood, Acacia and pine.
- Not practiced in local sawmills cutting forest species.

(ii) *Sawing with a breaking cut*

Description

A cutting pattern most commonly practiced by our local sawmills cutting larger diameter forest logs (log diameter greater than 18"). The prime concern is to avoid defects and to anticipate embedded defective locations if any.

Cutting method

Step 1: Log is cut into halves (if no visible core defects occur); known as the breaking cut.

Step 2: The location where placement of the breaking cut is crucial as it dictates subsequent recovery.

Step 3: The halved logs are then sawn around to produce flitches, followed by either saw-around or live-sawing to convert into intended sizes. Pith and log defects are avoided as much as possible during each cut.

Cutting equipment

- Uses breakdown saw and re-saw.
- Single bandsaw is commonly employed in both Breakdown saw and Re-saw.

Breakdown saw

- A single-blade vertical band Breakdown saw is commonly used to breakdown the logs into quarters or flitches. The flitches will then be sawn using single bandsaw.
- The size of breakdown saw is common at 60 inches.
- 17-18 British Width Gauge (BWG) is used; same as Re-saw.
- Chucks and carriage are incorporated to the Breakdown saw to assist in cutting.

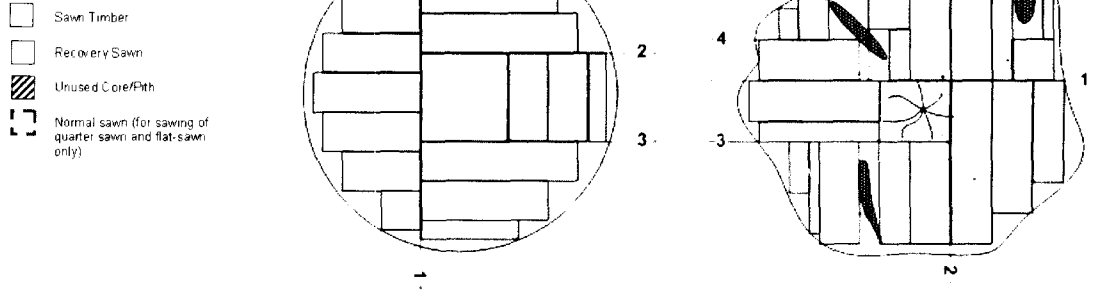
Re-saw

- Specifications of re-saw same as in **A(i)**.

Log cutting method

Simulated live-sawing on a perfect round-in-shape log

Simulated live-sawing on an irregular shape log



Picture 2a

Picture 2b

Advantages

- The location of the first breaking cut can be used as guidance to examine the location of other defects. This will assist sawyer in making the subsequent cuts.
- Better value recovery compared to live-sawing.
- Faster production rate compared to sawing-around method.

Disadvantages

- Lower production rate than live-sawing.
- Higher cost of production.
- This method demands skilled and experienced headsawyer and the number of expertise in this field are diminishing.

Recommendation for use

- Suitable for cutting high graded logs.
- Cutting of graded logs can be optimized with technology tools such as optical scanners and Best Opening Face (BOF) system which are more properly used in advanced countries.

Description

- Quarter sawn (a.k.a. radial sawn/rift sawn) is a type of sawn which offers the highest quality in terms of dimensional stability and aesthetics.
- Due to high wastage produced in cutting, they are most expensive in price and only cut when specially ordered. Only selected species such as Mersawa (C.Y. Goh, pers. comm.) which are common in certain market will be in the cutting list.

Cutting method

- Log is cut at 90° to the "growth rings" to produce a "vertical" grain pattern. The illustrated growth rings only occur in softwoods (Used here for illustration purpose).
- Sawing of quarter sawn hardwoods uses rays which stems out from the pith as guidance during sawing.
- It is also known as cutting the board on the radius. The long face of the timber is perpendicular to the growth rings (for softwood spp.) or parallel to wood rays (for hardwood spp.).

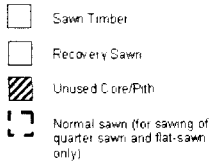
Cutting equipment

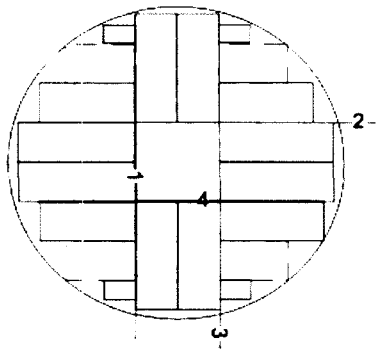
- Breakdown saw and re-saw for sawing large diameter log. The breakdown saw is equipped with pneumatic semi-automatic turning device known as pony saw to assist in turning large logs into the desired orientation.
- Smaller capacity sawmills only use Re-saw to cut smaller diameter logs into quarter sawn. All holding and turning of medium to small diameter logs are done manually.

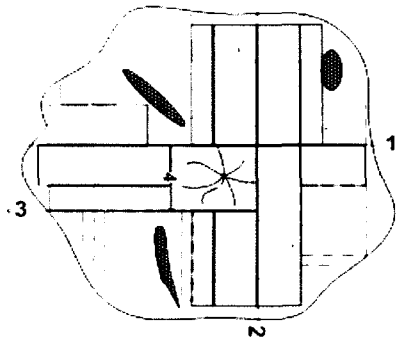
Log cutting method

Simulated live-sawing on a perfect round-in-shape log

Simulated live-sawing on an irregular shape log







Picture 3a

Picture 3b

Advantages

- The wood grain in quarter sawn timber runs uniformly parallel along the timber and does not shrink or swell easily, therefore it is more stable and less prone to defects such as shrinkage, twisting or cutting.

Disadvantages

- Abundance of waste is produced as timber cuts with growth rings perpendicular to the width of flat surface will only be considered.
- Quarter sawn is also found slower in drying as compared to flat-sawn.

Recommendation for use

- Sawing of lumber with decorative figures for purposes such as kitchen cabinet, furniture, parquet, flooring, wall paneling...etc.
- Suitable for sawing lumber for parts requiring high dimensional stability such as door and window frame, floor boards and joinery.

(B) Other methods (potential to be used by the local industry)

(i) Sawing around at 180°

Cutting method

Step 1: First cut is made vertically.
Step 2: Log is turned through 180° for the second cut.
Step 3: The log is then turned through 90° and 3rd cut is made.
Step 4: The log is turned through another 180°. The cant is finally cut into timbers through-and-through.

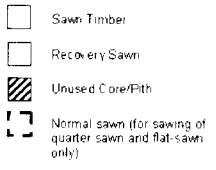
Cutting equipment

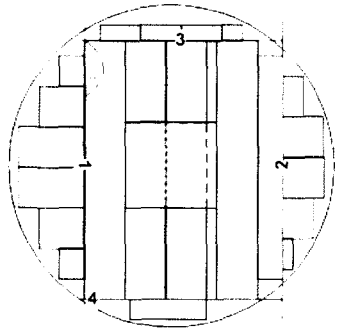
Breakdown saw and re-saw (refer to A (i) and A (ii)).

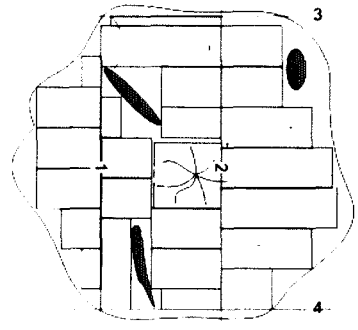
Log cutting difference in shape

Simulated live-sawing on a perfect round-in-shape log

Simulated live-sawing on an irregular shape log







Picture 4a

Picture 4b

Advantages

- Helps to reduce stress in logs which incurred during growth, thus helps to reduce warping.
- It is recommended to rotate the log 180° between cuts than 90° to reduce warp-causing imbalance in stresses. Less side-bend when drying, flatter grain and less log spring are observed.
- 180 degree turn is claimed to produce higher value recovery than 90 degree turn. It is able to produce wider timber pieces (www.woodweb.com) comparatively. However, this depends on the species the sawmill is working on and demand from the market. Many of the wide sizes (e.g.: 20" board) may not be in demand. Therefore, it is also another reason not recommended for cutting large logs.
- Less edging is needed; thus less maintenance and less sawing time required.

Disadvantages

- Higher idle time in handling of logs.
- Require skilled sawyer thus higher cost of production.

Recommendation for use

- Suitable for small diameter stressed trees/logs such as plantation logs. However, this depends on species type (refer to advantages).
- It is advised not to use 180 degree turn for larger logs or logs shape which is found unsafe to be turned or unable to rest stably on the carriage.
- Suitable for application used for decorative purposes such as kitchen cabinet, furniture, parquet flooring...etc.
- Suitable for timber parts which require high dimensional stability such as timber joints, door frame, floor boards...etc.

(iii) *Sawing around at 90°*

Cutting method

(iv) Turning through 90°

Step 1: First cut is made vertical.

Step 2: Turn the log at 90° for the second cut.

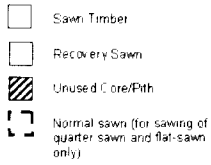
Step 3: The subsequent 3rd and 4th cut turns the log at 90° respectively.

Step 4: The final square cant is eventually sawn either through-and-through or turn-around.

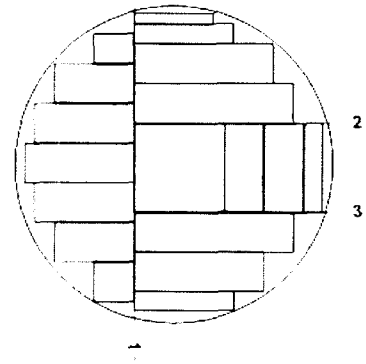
Cutting equipment

- Breakdown saw and re-saw (refer to A(i) and A(ii)).
- Logs can be handled more easily with semi-automated turning device (a.k.a Pony saw) on the carriage of headrig.

Log cutting difference in shape

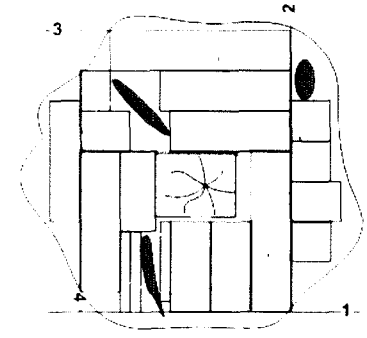


Simulated live-sawing on a perfect round-in-shape log



Picture 5a

Simulated live-sawing on an irregular shape log



Picture 5b

Advantages

- Helps to reduce stress in logs which incurred during growth, thus helps to reduce warping.
- Other advantages, refer B (i).
- Also less edging is needed; thus less maintenance and less sawing time required.

Disadvantages

- Higher idle time in handling of logs for those without semi-automatic turning device on the log carriage (known as Pony saw).
- Smaller dimension cuts than 180 degree turn.
- Require skilled sawyer thus higher cost of production.

Recommendation for use

- Suitable for small or medium diameter stressed trees/logs such as plantation logs. However, this depends on species type (refer to advantages) – same as 180 degree turn.
- Suitable for medium to small diameter logs. This is a safer cutting method than 180 degree turn.

(iii) *Cutting of flat sawn/back sawn/plain sawn/rift sawn*

Description

- Common cutting pattern in most places especially in the temperate countries.
- Also known as 'tangential cut' as the growth ring (for softwood species) can be seen tangent to the width of a timber cut or parallel to the rays (for hardwood species).

Cutting method

- Logs are cut at tangent to the growth rings (softwood) or perpendicular to the rays (hardwood). The long face of the timber is tangent to the growth rings or parallel to the rays.
- Sawing sequence is similar to that for the quarter sawing method.
- This cutting method is not practiced by local saw millers due to lack of market demand.

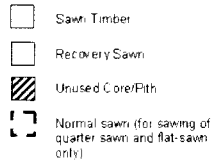
Cutting equipment

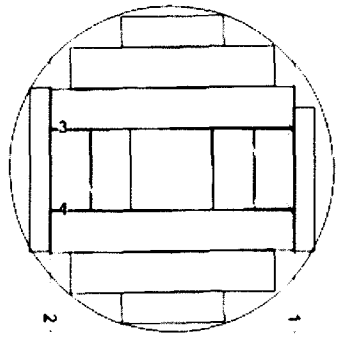
- Breakdown saw and resaw (refer to A(i) and A (ii)).

Log cutting method

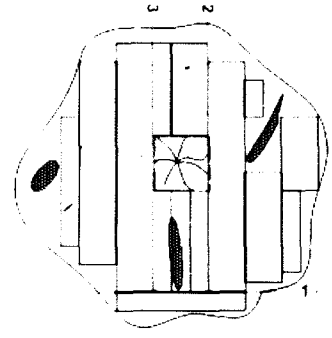
Simulated live-sawing on a perfect round-in-shape log

Simulated live-sawing on an irregular shape log





Picture 6a



Picture 6b

Advantages

- Less prone to splitting when nailing and fewer knots on edge.
- Flat sawn timbers tend to dry faster than quarter sawn.

Disadvantages

- Shrinkage across the width is twice that of quarter sawn timber.
- Prone to warping or rather cupping.
- Collapse (a drying defect) developed is more difficult to recondition.

Recommendation for use

- This process can be optimized with technology tools such as optical scanners and Best Opening Face (BOF) system.

CONCLUSIONS

Various methods of timber cutting have been briefly deliberated in this article. Some of them are currently in use while others have the potential to be employed locally in view of the emergence of smaller-diameter logs and plantation timbers in the market. The potential "new" methods of cutting such as turning around at 180 and 90 degrees pay special attention to stress-relief during cutting, thus minimizes chances of eventual warping which downgrades the quality of sawn timber. The flat-sawn method, however, could only be practiced when special demand prevails. With the escalation of production and material costs, timber cutting may become even more complex whereby value recovery is a function of log shapes and defects available, degree of mechanization, skill level involved, customer preference and so forth. The ultimate optimization, however, may only be realized when a mixture of such cutting methods and technologies is used, perhaps with the aid of modern tools such as optical scanners for image processing and Best Opening Face (BOF) software system for optimize and precision cutting.

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