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Sawing Methods for Improving Lumber Yield Recovery of Out-of-Shape Hardwood Saw Logs

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Abstract

Not every saw log is straight and cylindrical in shape. In fact, logs are commonly out-of-round, tapered, or crooked, and often a combination of these shapes. Sawmill operators employ every means to recover as much yield as possible from each log. Yield recovery can be the difference between a profitable and a nonprofitable log. There are opportunities for improving yield in out-of-shape hardwood saw logs while still maintaining lumber quality.

Cover Photo

Crooked, tapered butt log. Photo by Neal Bennett, U.S. Forest Service.

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INTRODUCTION

Not every saw log is straight and cylindrical in shape. In fact, logs are commonly out-of-round, tapered, or crooked, and often a combination of these shapes. Log buyers have scaling and grading rules in place to avoid paying for yield losses from out-of-shape logs, but sawmill operators employ every means to recover as much yield from each log as possible. Thus, free lumber can be extracted if the sawyer develops a sawing plan for each log that minimizes the potential yield loss that frequently results when sawing out-of-shape logs. This extra board footage can be the difference between a profitable and a nonprofitable log. If you are a sawmill operator, it is critical you know the economic value of your logs when converted into lumber or other end products, as well as the cost of buying logs and sawing logs into lumber.

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It must be stressed that lumber yield from a log is secondary to lumber quality. Each log placed on the sawmill deck must be evaluated and sawn to produce the most valuable end products possible. This process starts by determining the best opening face (BOF) which refers to the first face sawn that will result in the best overall sawing of the log. As a general rule when using BOF sawing techniques, keep as many defects as possible on the "corners" between the cutting faces. These defects will end up on the edges of the boards and can be ripped out with the edger if they are going to reduce the board grade.

Most logs sawn with a portable sawmill are not debarked. Aside from the added wear on saw blades, the presence of bark does provide a great advantage in that the sawyer is able to see most of a log's defects and judge how deeply they penetrate into the log. Opinions vary among sawyers whether to start with the worst face or the best face because once the first face is cut, the other three faces are locked in. The reason for cutting the worst face first is so the face can be used as a bearing surface to ensure good, accurate cut boards on the other faces. The reason for cutting the best face first is so this face will be properly aligned and will not get messed up when the first cut is made.

OUT-OF-ROUND LOGS

Out-of-round logs can have many causes. A tree that grows on a hillside will produce extra wood on the downhill side to support the tree. Wounds, seams, and limb growth on trees can also cause out-of-round logs. Finally, some species of trees tend to be more out-of-round than others. An out-of-round log does not necessarily result in yield loss (Rappold et al. 2007). The worst case is a log that has a substantially different shape on one end than the other. Otherwise, most of the board footage can be recovered using smart sawing techniques. Figure 1a illustrates a round log end with a diameter of 18 inches. Figure 1b illustrates an out-of-round log end with an average diameter of 18 inches. Both figures have approximately the same calculated area. If one assumes these figures are the small end of a 12-foot-long log and boards are sawn in the sawing pattern as shown, the lumber yield would be approximately 199 board feet for each log shape. Figure 1c illustrates a log end with the major diameter on one end turned 90 degrees from the major diameter of the other end. This log also has an average diameter of 18 inches but would yield only 170 board feet of lumber. The log represented in Figure 1c can produce a greater yield if some short jacket boards (less than 8 feet long) are acceptable. All three examples produce more lumber than the Doyle scale prediction of 147 board feet.

If a wound is substantial enough to affect the shape of a log, one can assume that it is old and penetrates deep within the log. Decay and mineral stain are likely present in the wound area and can further reduce the log's value. To minimize the loss of board grade, straight seams and smaller wounds can be placed at the corners between cutting faces (Fig. 2). However, if wounds are large or a seam tends to twist around the log as is common in species such as sugar

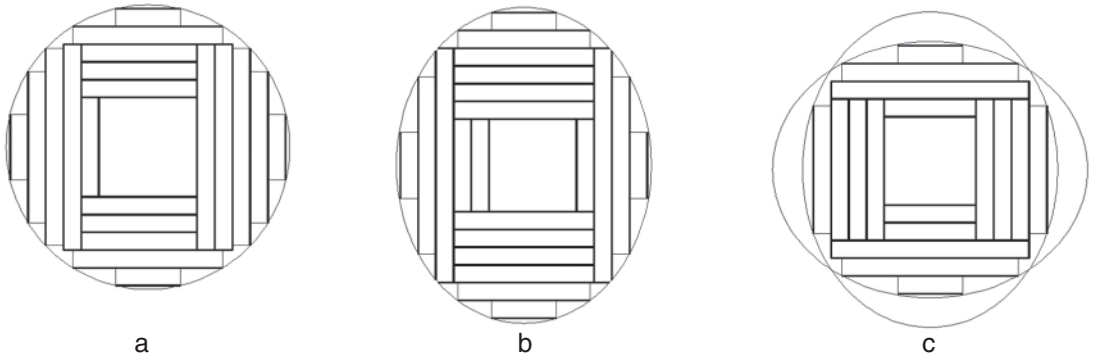

Figure 1.—Sawing patterns for different log shapes, each with an average diameter of 18 inches: a) small end of round log; b) small end of out-of-round log; and c) an out-of-round log with the major diameter on one end turned 90 degrees from the major diameter on the opposite end.

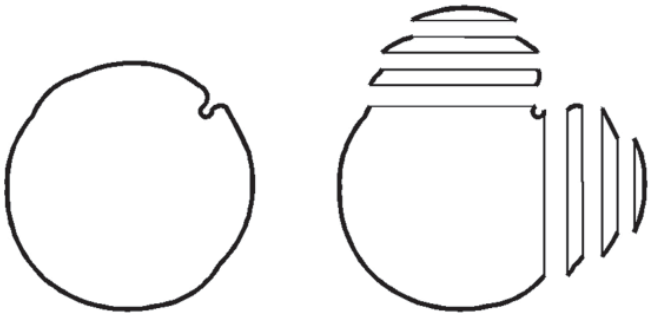

Figure 2.—Log with seam diagram.

Figure 3.—Toe board leveling log parallel to the saw blade.
Photo by Neal Bennett, U.S. Forest Service.

maple (*Acer saccharum* Marsh.), this remedy will not work as well. In this case it is best to try to contain the seam or wound in one face, which will generally be the poorest face. Other log defects should be dealt with using a similar strategy. If a log is of such low quality that neither strategy is possible, consider whether there is any money to be made sawing that low quality log. When sawing costs are considered, a poor quality log may cost more to saw than the value of the resulting lumber. In this case, the log is best sent to the firewood pile.

TAPERED LOGS

A tapered log, usually a butt log, decreases in diameter from one end to the other. When a tapered log is cut into lumber, there generally is a yield loss at the large end, and the lumber lost is often the clearest wood on the log. Methods for improving yield in tapered logs include crosscutting logs into shorter segments and accepting shorter lumber, tapered sawing, and live sawing. Tapered sawing is the practice of adjusting the small end of a log on the sawmill deck until the outside of the log is in the same plane as the saw blade (Fig. 3). Normal placement of a tapered log on the sawmill deck without adjusting the taper will result in the first slab being wedge shaped and possibly losing some quality boards on the thick end of the slab. Tapered sawing results in a wedge shaped (tapered) center cant where the lumber is usually of lower quality anyway. All four faces can be taper sawn. If the leftover cant is saleable, the cant faces are straightened last. Successful tapered sawing requires additional care to the point of using a level to make adjustments to a log or cant face when it is turned to the saw blade. Of course, additional care equates to slightly longer sawing times.

Figure 4.—Log being live sawn. Photo by Neal Bennett, U.S. Forest Service.

Figure 5.—Live sawn board showing varied grain pattern. Photo by Neal Bennett, U.S. Forest Service.

Live sawing is when boards are sawn straight through the log resulting in most of the boards being in a single plane (Fig. 4). Live sawing a log is fast and easy but may not produce a grain pattern that is desirable to the end user. Additionally, live sawn boards are more difficult to dry without cupping because most boards contain both edge and flat grain wood (Fig. 5).

Figure 6.—Wedge shaped boards from taper sawn log. Photo by Neal Bennett, U.S. Forest Service.

Maximizing yield at the sawmill does not mean all the yield gains will last past the edger. Tapered and live sawing produce some wedge shaped boards that are wider on one end than the other (Fig. 6). Misshaped boards straightened at the edger will result in board footage losses of as much as 20 percent.

CROOKED LOGS

Sawing crooked logs (Fig. 7) is always challenging. If crosscutting into two shorter, straighter logs is not an acceptable solution, one can suffer significant loss in board footage. Clamping a crooked log securely on the sawmill bed must be given first consideration. On a portable sawmill, there may only be one way to position a crooked log so that it can be safely clamped to the sawmill bed for the opening cut. Past recommendations (Malcolm 2000) have suggested cutting the belly of the crooked log first, but on a portable sawmill that utilizes a horizontal running blade, securely clamping a log in this position can be very difficult. After a slab or boards are removed from the first face and the log has a flat bearing surface, the log can be turned 90 or 180 degrees to cut the second face. Getting a square cant from a crooked log is time consuming, and unless the log has a large diameter, there is usually not much quality lumber left to grade saw. Live sawing a crooked log as much as possible will speed up the sawing process somewhat but will again produce crooked boards (Fig. 8), and board footage losses will occur at the edger instead of at the sawmill if the boards are not crosscut first.

Cutting short boards can be a solution to achieving greater yield from a crooked saw log. National Hardwood Lumber Association (NHLA) lumber grading rules allow boards as short as 8 feet in length for FAS grade, 6 feet in length for Selects grade, and 4 feet in length for Common grades. A downside of this solution is that large volume end users such as furniture

Figure 7.—Crooked butt log. Photo by Neal Bennett, U.S. Forest Service.

Figure 8.—Crooked board face from crooked live sawn log. Photo by Neal Bennett, U.S. Forest Service.

plants greatly dislike boards that are less than 8 feet in length. Short lumber does not feed well on a furniture plant's traditional chain driven conveying system. Often these chain drive systems are spaced at 4-foot intervals, and if a board is not supported by at least three chains, it will fall through and jam the system. Smaller scale users (home craftsmen, small-to-medium size

custom furniture operations), however, are often quite happy with short lumber and see many positive aspects:

- Short boards reduce losses at the edger.
- Short boards are less cumbersome to handle and maneuver in a workshop.
- Short boards that are only 4 feet long fill about 80 percent of part length requirements of most cutting bills (Aramen et al. 1982).
- Processing short boards in the shop can result in less leftover material that tends to be stored for later use.
- Green short boards can be stacked end to end with a mixture of longer boards to make up stack lengths necessary for placement in a dry kiln.

A negative aspect to crosscutting a log is that two short logs take longer to saw than one long log, but the difference in yield and value may make this worthwhile. Using the U.S. Forest Service sawmill simulation program RAYSAW (Thomas 2013), a 16-foot-long Grade 3 log with 5 inches of sweep was cross cut into two 8-foot-long logs. The original 16-foot log yielded 48.07 board feet of lumber at a value of $26.39. The two 8-foot logs provided a combined yield of 54.15 board feet of lumber at a value of $37.79. The 13 percent increase in lumber yield was due to reduced edging waste on the shorter boards because the crook was reduced. Both short logs were still Grade 3, but most of the defects were on one log and thus provided better grade lumber that resulted in a 43 percent improvement in lumber value. NHLA grades for the lumber from these log sawing simulations were obtained from UGRS, another Forest Service software program (Moody et al. 1998), and lumber values were obtained from a recent Hardwood Market Report (2013). More extensive research in improving yield and value in saw logs using these computer programs is being planned. Consideration should be given as to whether it is more efficient to crosscut a log or crosscut the boards after sawing. This decision will be influenced by the equipment present at the sawmill operation.

NATIONAL HARDWOOD LUMBER ASSOCIATION LUMBER GRADING RULES

A sawmill operator selling lumber based on NHLA rules must have a good knowledge of the lumber grading rules (NHLA 2011). This includes the person performing the edging operation. Boards must be 6 inches wide green to grade out FAS. Care must be taken not to reduce a face that may produce FAS boards to less than 6 inches in width while removing a lower grade board from a perpendicular face. Removing the proper amount of wane from the board edge is also important, and you do not want to crosscut a quality log that may produce FAS lumber to lengths less than 8 feet. These guidelines should be adhered to whether the logs are out-of-shape or not.

A portable sawmill operator producing lumber that is not being sold as NHLA grade or is for personal use can disregard the NHLA lumber grade rules and produce board sizes desirable for their intended end use. When making furniture from long, wide boards, the first step is usually to chop the board into needed lengths and rip to narrow widths. Commonly, narrow strips are ripped out of wide boards then edge glued back together to make a furniture part. These edge

glued panels are considered more stable and more aesthetically pleasing than wide boards. Edge glued panels also provide more visual consistency within a suite of furniture that must match each other. If this practice is going to be the end result, you don't need long wide boards to start with.

SUMMARY

There are opportunities for improving yield in out-of-shape hardwood saw logs. Good decisionmaking is important. To maximize the yield and economic value of the end products, have a plan before the log is opened up. There are more critical decisions to be made on the outside of a log than the inside, because that is where most of the clear wood is located. Finally, maximizing yield has to be in balance with sawing times, and thus sawing costs.

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