Optimizing *Crosscut* & *Chop Saw* Operations

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Since the 1990s, many rough mills have adopted semi-automatic optimizing lumber crosscutting or strip chopping systems to improve processing efficiency and profitability. With these systems, defects are located by employees, who then mark the board's or strip's edges before it is scanned and optimized. The scanner detects the leading and trailing ends of the board along with the fluorescent crayon marks.

In fully-automated optimization, which is more common in the softwood industry, the scanner is used to detect defects without marks. Increases in lumber yield of 4 to 10 percent have been achieved by some rough mills after adopting optimizing saws. (*See footnotes 1, 2, 6, 7.*)

Another benefit from optimizing saws is improved safety because the operator is removed from the saw. Reduced operator/marker training time and increased cutting consistency throughout the day and week are other benefits attributed to optimizing saws. Some component manufacturers also may realize greater scheduling flexibility and find it feasible to process fewer part quantities.

Whether all optimizing saws deliver these benefits depends largely upon how the saw is used and whether sound process and quality control practices are adopted. Yield benefits are derived from optimizing saws when more part sizes and grades are cut simultaneously than would be possible with a manual saw. Yet, some rough mills install new saws without installing additional sorting stations and/or storage space for parts.

More Lengths = Higher Yield

A study of the yield effect of processing more lengths at one time revealed that cutting 15 part lengths together, rather than in three groups of five lengths each, increased yield by 10 to 12 percent. (*See footnote 9.*) In another study in which additional lengths were added one at a time to a cutting bill, adding a fifth length increased yield by 4 percent and each additional length resulted in a smaller yield increase. When the number of lengths was increased from four to eight, the total increase in yield was about 10 percent. (*See footnote 8.*)

Some mills with insufficient sorting capacity will increase yields by manually sorting strip widths then processing only one or two widths at a time through the optimizing saw. This allows the processing of additional lengths per width on saws with limited sorting capacity, though at increased cost for material handling. Ideally, if a gang saw rips an average of four widths simultaneously, the sorting station should be designed to cut an average of eight different lengths per width. This would require 32 part-sorting stations, assuming that only one part grade is recovered per part size. Few optimizing saws are installed with a sorting station that has this much capacity.

Basic Considerations for Saw Operators

Many operating guidelines for defect/grade markers working with optimizing saws are similar to those for operators of manual crosscutting/chopping saws. Operators and supervisors should read *Length Cutting on a Manual Crosscut Saw* (*See footnote 5.*) for a general overview of how marking/cutting decisions affect lumber yield.

Generally, most of the cuts made on a crosscut saw in a crosscut-first rough mill are made to cut the piece of lumber into the lengths needed for the current part order, with most of the defecting accomplished on the straight-line ripsaw. By contrast, in a rip-first rough mill most of the defecting occurs on the chop saw. In both cases, it is the second cutting operation that performs the majority of the defect removal.

Phil Mitchell's article published in the April 2003 issue of *Wood & Wood Products* (*See footnote 5.*) includes the following key concepts:

- To obtain the best yield, the cutoff saw's defect marker in a crosscut-first rough mill should not try to remove all defects; most defecting can be done in the ripping operation that follows. A rule of thumb for many mills is that only those defects that occupy at least one-half of the board's width should be

Improved safety and increased production are just two of the benefits achieved with optimized ripsaw systems.
Photo courtesy of Mereen Johnson.

removed on the crosscut saw.

If long cuttings are especially important and valuable, defecting on the lumber cutoff saw should be minimized. If longer cuttings are not particularly difficult to obtain or valuable, defecting with the cutoff saw can be increased.

• The defect marker at the crosscut or chop saw should inspect both sides of the board or strip. When cutting Clear-Two-Face parts, place the worst face of the board or strip up for easy viewing. When cutting Clear-One-Face parts, orient the best face up. The use of mirrors, positioned so that the board or strip marker can see the underside of the piece he or she is working with, can be very effective. It takes several days, and usually a temporary slowdown, before a new defect marker becomes accustomed to the mirrors, but speed and accuracy gradually increase. Ultimately, their use will improve marking speed, marking quality, or both.

• The first cut is made to square the end and remove end checks. However, a single end split of more than 1 to 2 inches should be left for the ripsaws to remove. This distinction cannot be made if an optimizing saw is set up to automatically end-trim each board by a specific amount.

For boards with multiple end checks, markers must designate longer first-end trim lengths than would be made by a manual saw operator. This is because the marker cannot reevaluate the board end after the first cut to determine whether another trim cut is needed to complete the removal of checks or splits. Therefore, more substantial end trims are taken to reduce the risk that the first and last parts cut from the board or strip will be rejected, thus resulting in a greater loss in yield on optimizing saws associated with end-trim. Conversely, if larger end trims are not taken, more parts will be rejected, resulting in even greater yield losses and operating costs.

To determine the optimal length to remove in order to minimize yield lost, markers should regularly evaluate the end appearance of stacked "good" parts and trim (waste) sections removed from the boards/strips for checks. The trim amount should differ for different species. For example, check-prone species such as oak and beech must be trimmed more than other species. Trim amounts also can vary depending on the quality of the wood provided by different suppliers. Efforts should be made by the marking team and their supervisors to refine end-trim practices and emphasize the importance of the end-trim decision.

• Generally, spike knots, fuzzy grain and badly distorted or cross-grain should be removed at the crosscut saw in a crosscut-first rough mill. These defects affect much of the width of the board and, in the case of spike knots and cross-grain, can cause structural failures in the piece as it goes through subsequent machining operations such as the moulder.

It is more difficult to evaluate spike knots and fuzzy grain when flow through the marker station is fast paced. It is common for strip markers to process 20,000 lineal feet during an 8-hour shift, compared to a manual chopping operation which more typically processes 5,000 or fewer lineal feet.

It also is difficult to detect tiny defects when there is a fast-paced flow rate of boards/strips through the marker station. Presurfacing lumber to make defects more visible before the crosscut or ripsaw increases yield and reduces the number of rejected parts.

• Mark defects so that the marks touch the edge of the defect. There are occasions when even minor errors in mark placement (i.e., ½ inch) can result in a significant loss in yield. For example, a longer part that would fit between defects is not recovered because the marks indicated that the available clear length was insufficient.

The average mark placement error measured at three rough mills was about 1.7 inches. (*See footnote 4.*) On a 10-foot board, this means a yield loss of 1.4 percent per defect mark if the misplaced marks are placed farther from the defects than is optimal. This is typically the case since markers are particularly conscious of the need to minimize the number of rejected parts. It has been observed that a new marker will often mark closer to defects than will an experienced marker who processes lumber and strips at a faster pace than the novice.

• Removing boards/strips from delivery conveyors, forwarding boards/strips onto the saw's infeed, and distributing boards between marker stations should not be time- or energy-consuming tasks for markers — their time and attention should be oriented toward the marking task. Deep-piled station infeed conveyors slow the rate at which a marker can refill his/her marking table. The marker's job is made even more difficult if he/she must sort through or remove waste edgings produced at the ripsaw. Modifications in workstation design often improve both the quality and productivity of the defect-marking task.

Marking Accuracy

In a study of defect recognition and marking performance at six rough mills, there were significant differences in accuracy among defect markers at the various mills. (*See footnote 4.*) Lumber grade, the marker station's throughput rate and the complexity of the cutting bill affect accuracy. Poor accuracy (20 to 30 percent error rate) was associated with mills that process lower grade lumber at higher speeds using more complex and variable cutting requirements. Good marking accuracy (less than 10 percent error rate) was associated with mills processing higher grade lumber at a slower production rate through the marker station.

Markers in the same rough mill seem to have relatively similar defect identification scores compared to markers from different mills. Correct recall of the number, location and types of defects on boards presented to two operators at each of three rough mills showed variations in defect detection scores of 2.5, 4.5 and 7.0 percent between operators within each mill. (*See footnote 3.*) Potential lumber/strip markers can have visual perception difficulties that diminish the quality of their marking decisions. Regular eye exams, quality checks and periodic training can be used to improve marking accuracy, as can ensuring that the station has sufficient lighting, particularly where mirrors are used.

Important Characteristics of the Optimizing Saw

Mechanical and physical characteristics of the semi-automatic optimizing crosscut/chop saw can be as crucial to achieving the saw's full yield benefits as those of the defect markers.

Buyers of optimizing saws rated 13 saw attributes to be of equally critical importance during the prepurchase evaluation period: cut-to-length accuracy (typically ±1⁄32 inch); ease of clearing jammed boards; length measuring design; mark detection design; overall production speed; waste handling; sorting accuracy; ease of use; board drive design; maintenance reliability; service reliability; warranties and assurances; and the degree of damage to wood products. (*See footnote 9.*)

Systems with the highest feed speeds typically have the largest scanning error rates. Also, there is an inverse relationship between the number of grade marks missed by the lumber/strip scanner and the number of phantom or nonexistent marks that are recognized; it is difficult to find and maintain the scanner sensitivity adjustment at the optimal setting. (*See footnote 4.*)

Several other important factors that can vary among optimizing saws include: the part priority modes of the saw; whether the saw can center parts in clear areas; whether it can be set to automatically end trim lumber/strips by a given amount on the leading end; whether the saw can cut longer, lower grade but higher value parts by combining two sections of the marked board; and whether it can automatically place new parts on the saw's computer when a part-quantity requirement has been achieved. Each of these factors, if present, should have a positive impact on yield as long as the markers/operators/supervisors have received adequate training.

Evaluate Sawing Performance Regularly

Machine saw and scanner characteristics and problems must be understood and tracked by mill personnel to optimize the performance of the existing system on a daily basis. An obvious and important conclusion of the rough mill study was that there are many sawing system errors that go undetected. (*See footnote 4.*)

Quality control tests of system accuracy should be conducted daily. Measures that should be tracked include grade marks missed by the scanner, phantom marks created by the scanner, the percentage of pieces cut too short and too long, and part rejection rates.

Defect marking personnel should be responsible for many of these measurements so that they feel ownership of the quality of the system's products and learn to be vigilant to more common problems and recognize those situations in which they are more likely to occur.

A maintenance specialist and the rough-mill supervisor or assistant supervisor should have an extensive knowledge of the optimizing saw and know how to troubleshoot problems. The markers also should be given training in troubleshooting problems. Saw suppliers typically offer necessary training sessions.

The most common problems encountered with optimizing saws include:

- Miscut parts in which the first part cut per board or strip is the wrong size. This is typically caused by a belt or other form of mechanical slippage, such as crayon buildup on the feed rollers.
- Miscut parts in which a given part is consistently too long or too short due to miscalibration of the computer's encoder.
- Saw cuts that are offset from crayon marks by a consistent distance along the length of the board or strip, caused by the camera being the wrong distance from the wood piece.
- Saw cuts that are offset from crayon marks by a non-uniform distance along the length of the board or strip due to mechanical slippage or poor calibration of the camera.
- Missed crayon marks due to a dirty or blocked camera lens.
- Missed marks due to low quality crayon marks caused by rough lumber or crayons that are very old and have been overexposed to the sun. New fluorescent spray systems may eliminate this problem.

Opportunities and Failings

The greatest opportunity for firms to improve the performance of the automated optimizing crosscut or chop saw lies in using the simulation capacity of the saw's computer.

The simulation software included with the saw can evaluate different cutting orders using different lumber grades and/or saw parameters. Employees who use the simulation software will become valued experts with their understanding of how part production and yield respond to changes in the cutting bill and the part values input into the saw's computer.

The consistency attributed to the optimizing saw often is lost when personnel with limited expertise adjust the value settings for different part lengths to emphasize production of a particular length. The resulting impact on yield and part-length recovery is seldom understood. By using data on board/strip lengths and widths measured by the scanner(s) located on the saw's infeed, valid simulations can be conducted and supplier-based differences in lengths and widths can be determined. The size data is critica information that should be used t(plan production for maximum yiel(and profit.

Train and Retrain

Many optimizing saw markers/operators who receive skilled training on saw setup, marking specifications and process control forget what they have learned by the time the new equipment is installed in the rough mill. Also, new operators often are not trained on more complex operational strategies and the higher level functions of the optimizing saw, or they are unable to absorb this information. Thus, it is important to conduct retraining sessions, even with experienced operators, in which the more detailed and complex strategies and features of the optimizing system are highlighted.

Unfortunately, the typical response to the question, "What distinguishes your best strip marker from an inexperienced strip marker?" is "productivity through the marking station." It is common for rough-mill managers to conduct in-depth feasibility studies and justifications that include yield standards before investing in optimizing technologies. However, their focus quickly shifts to production rates after installation. A combined emphasis on lumber yield, part quality and mill productivity needs to be in place if a rough mill is going to realize the benefits projected in the feasibility analysis. ◆

The above article is part of a series to be published by the U.S. Forest Service as the new rough mill operator's guide. Along with other articles, it is available online at the NCSU Wood Products Extension Web site, www.ces.ncsu.edu/nreos/wood under the publications heading.

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