OPTIMIZING CROSSCUT AND CHOP SAW OPERATIONS

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During the 1990's, many rough mills adopted semiautomatic optimizing lumber crosscutting or strip chopping systems to improve processing efficiency and profitability. As part of these systems, humans locate defects and mark their edges before a board or strip 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 (1, 2, 6, 7). Other rough mills have experienced less substantial and generally disappointing results after installing optimizing saws. The use of optimizing crosscut and chop saws leads to yield increases and cost savings for many rough mills. It is not, however, unusual to attend meetings of secondary manufacturers and hear stories of optimizing saws that have been retired. An indisputable benefit from optimizing saws is improved safety in that the operator is removed from the saw. But most rough-mill managers also expect an increase in lumber yield and productivity per 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 optimizing saws deliver these benefits depends largely on 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 (9). In another study in which additional lengths were added to a cutting bill (one at a time), 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 (8).

Some rough mills may have sufficient sorting space but fail to use it upon realizing that when lumber and strip markers put more marks on a board (as is necessary when multiple part grades are used), the productivity (lineal feet per shift) of the saw and marker is reduced. 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* (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 but most of the defecting is 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.

The Mitchell article (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 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 they are 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 an inch or two 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, 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. This results in a greater loss in yield on optimizing saws associated with end-trim. Alternatively, 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 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 (e.g., ¼ 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 available clear length was insufficient.

  The average mark placement error measured at three rough mills was about 1.7 inches (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 to 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 (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 (< 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 (3). Potential lumber/strip markers can have visual perception difficulties (that may be correctable) that diminish the quality of their marking decisions. Regular eye exams, quality checks, and periodic training can 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 semiautomatic 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 (typical accuracy in 2002 is ± 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 degree of damage to wood products (9). Systems with the highest feed speeds typically have the largest scanning error rates (4). 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 (4).

Several other important features that can vary among optimizing saws include: a) the part priority modes of the saw; b) whether the saw can center parts in clear areas; c) whether the saw can be set to automatically end trim lumber/strips by a given amount on the leading end; d) whether the saw can cut longer, lower grade but higher value parts by combining two sections of the marked board; and e) whether the saw can automatically place new parts on the saw's computer when a part-quantity requirement has been achieved. Each of these features, if present, should have a positive impact on yield but many are misused by markers/operators/supervisors who haven't received adequate training.

Evaluate Sawing Performance Regularly

Machine (saw and scanner) characteristics and problems must be understood and tracked by mill personnel (supervisors, lead operators, maintenance personnel, and defect markers) 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 (4). Quality control tests of system accuracy should be conducted daily.

Measures that should be tracked include grade marks missed by scanner, phantom marks created by scanner, the percentage of pieces cut too short and too long (4), 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 so they can 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. When you purchase a new optimizing saw, the saw's supplier will offer training sessions -- take advantage of every such training opportunity since the payback will be large.

The most common problems that are encountered with optimizing saws include:

- Miscut parts in which the first part cut per board or strip is the wrong size caused by 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.
- Sawcuts 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.
- Sawcuts that are offset from crayon marks by a nonuniform 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.

The Greatest Opportunity… and Greatest Current Failing

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 critical information that should be used to plan production for maximum yield 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.

Maintain Balance and Focus

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 but quickly shift focus 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.

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