YIELD IMPROVEMENT IN MANUAL RIPSAW OPERATIONS

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The ripsaw cuts boards parallel to the grain, usually sawing along the board length. In the traditional crosscut first operation, the objectives of manual ripsaws are to: 1) manufacture parts of specified width; 2) remove manufacturing defects and those wood characteristics unacceptable in the final product; and 3) produce a straight edge suitable for gluing. These objectives need to be achieved while minimizing the amount of waste generated and sent to the hog (or grinder).

As the ripsaw operation is the major defecting process in a crosscut-first rough mill, the volume of wood loss (some may be usable but is wasted) is greater than elsewhere in the rough mill. There are usually recovery opportunities that can be found in the wood waste placed on the hog belt. This section examines the practices and tools that can improve yield recovery at the manual ripsaw operation.

Ripsaw practices to Improve Yield

The habits and practices of operators can have a large impact on the yield produced at the straight-line ripsaw. The practices recommended here can improve yield for those operations that are successful in getting their operators to implement them.

<u>Minimize edge trim</u> - Excessive edge trim is a major factor contributing to reduced yield at the ripsaw. Edge trim should be reduced to no more than the thickness of the saw blade. The initial edge at the ripsaw can be just sawdust in rough mills that have well-maintained saws and flat stock. Ideally, the amount of wood removed should be just enough to clean up the edge of the board. Sharp and properly tensioned saw blades do not need to be buried in the wood to produce a good cut. However, kickback of the edging strips may occur when using poorly maintained saws, or when warped or skip dressed boards are sawn, so each situation must be considered carefully.[1]

<u>Place kerf inside the defect</u> - The saw cut should be made through the edge of the defect, not through the clear wood adjacent to the defect. Obviously, consideration must be given to the acceptability of sloping grain that is common around knots. Accurate

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[1] In general, kickback occurs when the pieces being cut lose contact with the feed system and come into contact with the rotating saw blade. A summary of actions to minimize the risk of kickback injury follows:

- Stand to the side, not directly behind the saw infeed.
- Maintain all kickback control features: anti-kickback fingers; corrugated feed chain surfaces; pressure rolls and springs; and replace or recut worn feed chains and chain race.
- Set saw to the correct height, and maintain alignment of the saw arbor.
- Properly adjust the pressure rollers for lumber thickness and keep them clean.
- Maintain correct saw blade tension and watch for uneven or high teeth.
- Be aware of warped and thin lumber, lumber with wane, and narrow strips.
- Consider additional kickback guards.

You should contact your ripsaw manufacturer for more detailed information.

ripping, possible with the tools described below, can result in considerable yield improvements and material cost reductions.

<u>Fixed widths and random width parts should be ripped together</u> - Ripping only fixed width parts (also called solids or specific widths) will result in a large amount of waste because multiples of the desired part width will seldom equal the board width. Yield will be improved if random width parts for panel glue-up can be ripped from the same length board sections as the fixed width parts. An alternative to ripping random width parts would be to have a range of multiple widths being cut from the same length stock.

Some ripping examples will be presented to illustrate some of the yield improvement ideas that have been introduced. Throughout these examples, keep in mind that the two main objectives of the ripsaw operation are to remove defects and size parts to required widths, but that each saw kerf contributes significantly to the amount of waste produced at the ripsaw.

> *Example 1:* In the first example, the stock to be ripped is a completely clear, six-inch wide section (see Figure 1). Fixed width parts 2¼-inches wide and random width strips are required from this particular length. This board section may be ripped in several different ways, as shown in Figure 1a, 1b, and 1c. Considering Figure 1a, the first rip straightens the outside edge. The second cut produces one 2¼ inch fixed width part, while the third cut produces another. The fourth and final cut straightens the outside edge on the remaining narrow, random width strip which will be edge glued into a panel.
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> A slightly different approach to ripping this same board section is shown in Figure 1b. Before any parts are removed the two outside edges are straightened with the first and second rips. This method is somewhat safer than that shown in Figure 1a since it avoids ripping a narrow random width by itself. In both examples the same part volume is produced resulting in a part yield of 87.5% for both cases ([2¼ + 2¼ + ¾] ÷ 6).
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> There is still another approach that can be used to rip this board as shown in Figure 1c. In sawing random width parts at the ripsaw, an effort should be made to avoid the generation of narrow, random width strips. Narrow strips can be out of square, and the effort in handling and gluing narrow strips may exceed the cost benefit gained from the yield improvement. At many mills, the minimum acceptable random width strip is limited to 0.75-inches for these reasons. Some operations are able to avoid generating narrow strips by ripping a wider random width strip, as shown in Figure 1c. Yield of parts is increased to 90.6%, a 3% yield increase over examples 1a & 1b.
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> It is important to remember that each saw kerf reduces solid wood to sawdust. It may not be necessary to machine both edges of fixed width solid parts since it will be further machined by the moulder. Considering the example shown in Figure 1c, additional yield can be obtained by not ripping the outside edge of the

fixed width part (omitting rip 1). This assumes that the board is reasonably straight to start with. By not ripping the edge we can shift the position of the fixed width part and increase the width of the random width strip by the kerf thickness (3/16") to 3-3/8 inches. The yield of usable parts is now 93.7%, and we have reduced the number of rip cuts required.

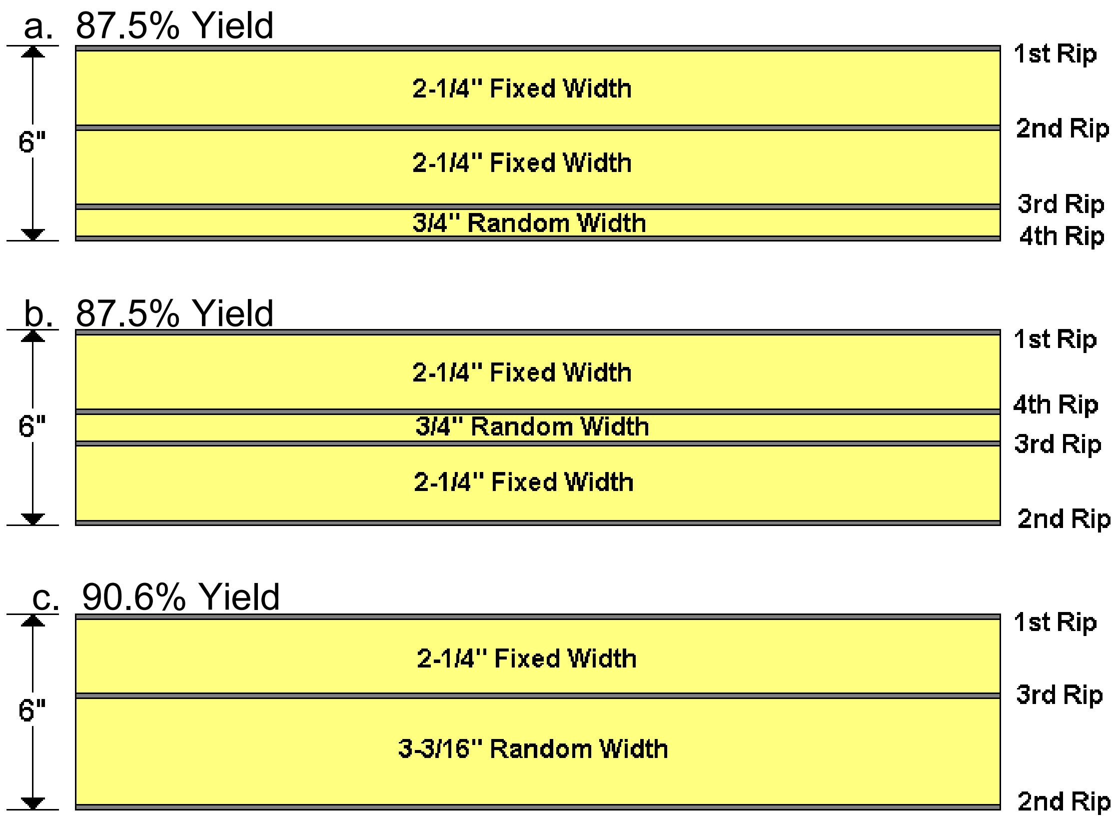

Figure 1. Three different methods of ripping a clear board section to produce 2-1/4" fixed widths and random width strips.

Example 2: It is more often the case that the board sections to be cut at the ripsaw will not be clear as in the previous example but will contain defects that need to be removed. The board section passed on to the ripsaw from the crosscut saw in Figure 2a is again 6-inches wide and contains several defects. This board contains a knot, an area of stain, and wane along the length of one edge. Again, a 2¼ inch wide fixed width and random width parts are to be cut. As shown in Figure 2b, the first rip removes the wane and straightens the edge. The second rip straightens the other outside edge. The third rip produces the 2¼ inch fixed width part, while the 4th and 5th rips remove the defects and generate two random width strips. The yield for this ripping solution is 67.7%.

Figure 2b illustrates good ripping practices - the edging strips were minimized and the kerf was placed into the defect, maximizing the amount of good clear wood available. Figure 2c, on the other hand, illustrates poor ripping practices as exhibited by the very wide edging strips produced and the placement of the kerf totally outside the defect area, wasting usable wood around the defect. The two random width strips are probably too narrow to use economically and safely. In the properly ripped board (Figure 2b), 67.7% of the board is converted to useful parts, while in the poorly ripped board (Figure 2c) only a 54.2% yield results.

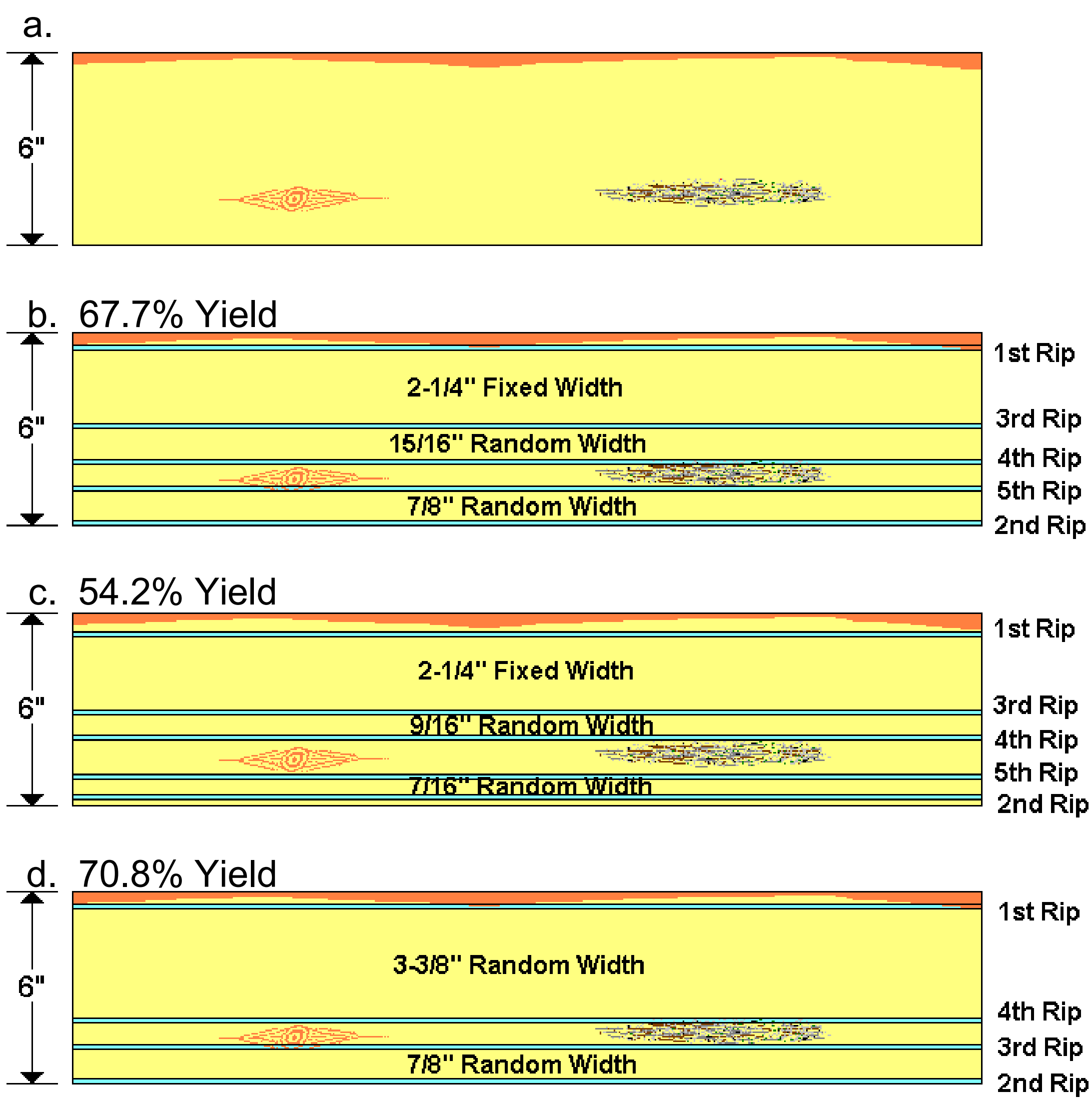

Figure 2. Four different methods of ripping a board section containing defects.

For completeness, example 2d illustrates how ripping wider random width parts in lieu of fixed-width parts can increase yield and reduce the number of narrow strips that are produced. For some rough mills this cutting strategy is a viable option but for those that do not have a large glued-up panel market this approach may not be feasible.

Example 3: Figure 3a presents a board in which the location of the defects may not permit any fixed width parts to be cut. As shown in Figure 3b, the first two rips straighten the outside edges and remove the wane located on one edge. The subsequent rips bury the saw into the defect area and produces three minimally acceptable random width strips (each 0.75-inches wide) with straight edges ready for edge gluing. Strips containing defects can be sent to the salvage saw, typically a small crosscut saw used to remove defects and produce shorter parts. Possible salvage saw cuts are shown as dashed, vertical lines.

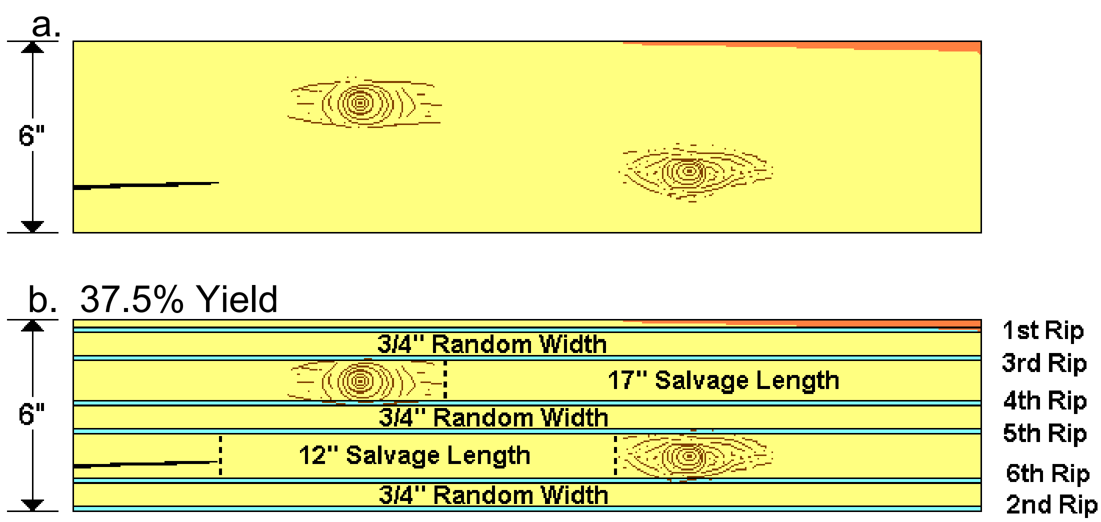

Figure 3. Board section containing many defects from which only random width strips can be ripped. Salvageable areas are also shown.

<u>Operators must know what defects are acceptable</u> - It is essential that ripsaw operators (both infeed and off-bearer operators) know and understand their end-product requirements. Without an adequate understanding of acceptable defects, two very different types of mistakes can occur, both of which will impact yield. The failure to remove defects that should be removed will result in a defective part that may be further processed and even used in an assembly before the defect is found, resulting in rework or rejection of the assembled product. At the other extreme, it is more likely that without adequate instruction, the tendency of the ripsaw operators will be to reject small defects and blemishes that may be acceptable in certain parts, and instead produce clear-two-face parts in all cases. For the inexperienced or unsure operator, producing a clear part is the safest course of action as it will always exceed quality standards. But the cost of this unnecessary quality will be reflected by the volume of wood on the hog belt and by reduced yield.

During the removal of defects at the ripsaw, it is important that the operator keep the salvage saw operation in mind. Although the ripsaw operator should remove all objectionable defects from parts, not all defects need to be removed from salvageable material. Material containing defects can be passed to the salvage saw (typically a crosscut saw after the ripsaw) which can efficiently recover sizes in the cutting bill. For example, the crosscut sawyer may have previously placed defects into an intermediate length board section (generally a good practice). The alert ripsaw operator, after sawing the intermediate length parts, will recognize that a short part can be obtained and will allow the salvage saw to recover it by removing the defect. The ripsaw operator should not lose sight of the opportunity provided by the salvage saw for the recovery of shorter parts.

The need for operators to be trained and to understand quality criteria seems so fundamental, yet often operators are not adequately trained. The first step in training operators is for management to establish and write down quality criteria. Writing it down establishes a base line that will serve for future reference. The objection is raised that there are too many shades of gray in establishing quality criteria because not all defects fit into the established grade definitions. However, if obvious cases of unacceptable defects or acceptable blemishes are classified, the process of establishing quality criteria will develop a better understanding of product need at all levels--first with management, and then with operators.

In establishing quality standards, it is important that operators understand that these standards can vary not only according to species, but also according to the design and finish of the product, and according to customers. These quality standards need to be communicated to the operators on a regular basis by management. One tried and true method is the use of sample boards with representative defects illustrating different grades. A newer method is the use of interactive computer programs complete with text and photos that can be accessed by a computer located on the floor. The use of computer technology has the advantage of being able to contain a lot of information that can readily and easily be updated but the disadvantage of not being visible at a quick glance.

Minimize edge allowance - The traditional amount of extra width added to moulder stock for sizing rough mill parts is ¼". Reducing this allowance should be considered. Some manufacturers have reduced moulder allowance from ¼" to 1/8" for shorter moulder stock (≤ 24") and to 3/16" for longer stock (>24").Consider a part whose rough size is 1.75" and is machined at the moulder to a width of 1.5-inches—i.e., an edge allowance of ¼ inch. Reducing the allowance from ¼" to 1/8" recovers an additional 1/8" for every part machined. What this means, in effect, is that for every 13 pieces cut, one 1-5/8" rough part will be gained simply due to the reduction in edge allowance (7% improvement in utilization). For those parts whose allowance can only be reduced to 3/16" the utilization gain will be about 3.5% - an extra part for every 27 sawn parts.

Edge allowance also can be effectively reduced by using the splitter saw at the moulder to separate multiple run parts. This substitutes one thin kerf produced at the moulder for two (often wider) ripsaw kerfs. Finally, consideration should be given to ripping interior parts to net size (that is, no edge allowance is required, as there is no need to mould these parts).

Avoid producing oversized parts - It is common practice to find rough mill parts that are manufactured 1/16" wider at the ripsaw than specified by the route sheet. This may be done by the ripsaw operator to insure that the parts are wide enough to meet the moulder requirements and thus avoid a shortage caused by parts that are too narrow. This is a prime example of how important it is for everyone to understand how they can influence cost and profit. For example, in ripping a 2-inch wide part, if it is manufactured only 1/16" oversize this represents a 3% yield loss. The underlying cause may be due to equipment problems, such as a loose fence at the saw. The equipment needs to run well enough that the operators can confidently cut to the required specifications.

Workstation Design and Tools that can Improve Ripsaw Yield

In the first part of this paper, the practices that will improve yield at the straight-line ripsaw were discussed. Of equal importance is a well-designed workstation that includes tools to assist operators in the successful implementation of these practices. The ripsaw station should have sufficient lighting to allow correct defecting. The workstation should be designed such that only minimum operator effort is required to bring a board section to the saw table, and that will allow the operator to maintain a smooth working rhythm. Pallet stock should be positioned consistently in a location that can be easily reached by the operator. The use of scissor lifts to raise palletized stock will help eliminate bending, reduce back fatigue and injury, and increase productivity.

Operators of ripsaws that are coupled directly to the crosscut saws will often spend time and effort retrieving board sections from a belt feed or a jumbled pile at the base of a gravity slide. Excessive pile ups at the base of gravity slides can sometimes be reduced by cutting different length lumber or shorter lumber at the crosscut saw. The former will result in the production of a different mix of section lengths while the latter will reduce the productivity of the crosscut saw, allowing the overwhelmed ripsaw time to catch up. Some additional tools that can improve ripsaw yield will now be presented.

Laser lights - The use of a laser light, aligned with the saw blade, will project the saw's path onto the board at the ripsaw infeed table. Installed above the saw and projecting a straight line of light onto the board, laser lights help operators to feed the board into the ripsaw accurately and quickly. Use of this widespread technology assists operators in: accurately locating and excluding defects from parts, minimizing edge strips, accurately burying the saw kerf into the defect area, and maximizing the width of random width parts. Although the greatest benefit of laser lights is derived when cutting longer parts, many operations benefit from their use with all part lengths.

Floating rip fence - The floating rip fence facilitates the sawing of random width parts and fixed width parts at the same time. Typically a counterweight and cable allow the fence to be easily moved to control the width of the cut. The ability to rip random width parts for glue-up in addition to fixed width parts from lumber greatly enhances ripsaw yield.

Pop-up fence - Sometimes referred to as a disappearing fence, the edge of the pop-up fence is aligned with the saw blade so that relatively straight boards can be edged without producing an edging strip. Pop-up fences are often recommended only for lengths less than 36 inches since the amount of crook in longer boards will not clean up. The pop-up fence may consist of a spring loaded, hinged plate on the ripsaw table whose edge acts as fence when it is used to edge a board. If a board needs to be defected or ripped to a width using the conventional fence, the board is placed on top of the pop up fence. The weight of the board presses the pop-up fence flat with the surface of the ripsaw table. Other pop-up fences are designed to be operated using a foot pedal.

Flip-stops - As described above, it is sometimes better to rip a wide random width part rather than produce a fixed width and narrow random width strip because yield will be higher and the random width strip may be too narrow to use. This may be difficult to put into practice since the fence stop will prevent the fence from moving to a position that will allow a cut wider than the fixed width. Attaching a hinged flip-stop to the conventional stop will give additional flexibility to the ripsaw. When the operator determines that producing a wider random width part is the better option, the flip-stop can be raised, allowing the fence to move back further, and the wider, random width strip to be sawn.

Thin kerf saws - Conventional rip saw blades typically have kerfs that range from 5/32- to 3/16-inches (0.15625" to 0.1875"). Yield losses at the ripsaw are affected by the width of the saw kerf. Yield losses due to ripsaw kerf typically range from 7 to 12%. Many operations have found yield savings by using saws with thin kerf saw blades whose kerfs range from 0.080 to 0.125-inches. For example, consider Figure 1c above, in which a 6-inch wide board has three kerfs. If each kerf was 3/16-inch, then 9.4% of the board yield is lost as sawdust. On the other hand, if a thin kerf saw having a kerf of only 0.100-inches is used, the yield loss due to kerf is only 5%. Average yield savings at straight-line ripsaws attributable to the use of thin kerf saws are expected to be about 2 to 3%. Using thinner saws generally requires the use of large saw collars to provide extra stability and that more attention be given to saw maintenance. It is important to note that many operations have not had success implementing thin kerf technology probably because they were unable to provide the high degree of saw maintenance required.

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