Overcoming warp in studs produced from southern pine cordwood—8-foot stock—into marketable studs

A PROCESS for converting southern pine veneer cores into 8-foot 2 by 4's of SPIB Stud grade and better has been developed at the Alexandria, Louisiana, Utilization Laboratory of the Southern Forest Experiment Station. The research leading to this development suggests that a similar process could be practical for converting 8-foot southern pine cordwood into studs—two studs from every stick. (Photo right).

In the interest of simplicity, it will be assumed that cordwood can be procured in a very limited diameter range—from a minimum of 5½ inches inside bark at the small end for very straight bolts, to a maximum of 6¾ inches for straight bolts or slightly larger for crooked bolts.

Southern pine in this diameter range probably averages less than 4 rings per inch. The specific gravity is lower than normal. The lumber warps severely during drying, because juvenile wood is always present and there is likely to be considerable compression wood.

Because of the low ring count, 2 by 4's cut from such wood can at best qualify for Stud grade. This grade, as defined by the Southern Pine Inspection Bureau, has stringent warp limitations: The maximum allowable deviations over an 8-foot piece are ½ inch for crook, ⅛ inch for bow, and ¼ inch for twist.

The objective of the research at Alexandria was to devise a manufacturing process by which bolts containing high proportions of juvenile and compression wood could be made to yield straight studs.

Seven unconventional manufacturing processes were evaluated on southern pine veneer cores, which have most of the characteristics of bolt wood. Three of the processes succeeded in holding aD studs within the warp limitations of the Stud grade. One of them appeared most suitable for converting 8-foot boltwood.

Prototype studs were all Stud grade or better. Approximately 12 percent were SPIB #1; 15 percent, SPIB #2; and 73 percent, SPIB Stud. Immediately after machining (at 10-percent moisture content), crook averaged 0.05 inch, and twist and bow averaged 0.06 and 0.17 inch. When moisture content of these studs was reduced to 8 percent after machining, crook twist, and bow increased to 0.16, 0.12, and 0.32 inch. When moisture content was increased to 20.1 percent, crook, twist, and bow were 0.17, 0.11, and 0.22 inch.

When trimmed to 96 inches, the experimental studs weighed 10.23 pounds at 9-percent moisture content. Weight per MBF was 1,920 pounds. The studs averaged 3.8 rings per inch, with about 41 percent having 4 or more rings per inch. Their low specific gravity and low ring count made them somewhat weaker than southern pine studs in general. At 9-percent moisture content average ultimate strengths were 5,790 pounds per square inch in edgewise bending, 4,290 p.s.i. in full-length compression, and 3,500 p.s.i. in full-length tension. Modulus of elasticity averaged 1,280,000 p.s.i.

The sample was limited. More testing might disclose higher average values for specific gravity and strength. In any event, the strengths reported are more than adequate for loads imposed on studs.
The tests on veneer cores yielded more data on warp, grade yield, and strength than can be presented in this article. The information has been published as Research Paper SO-25 of the Southern Forest Experiment Station (701 Loyola Avenue, New Orleans, Louisiana 70113), and is available on request.

The production process. The process developed for manufacturing studs from 100-inch cordwood is summarized in the expanded-view drawing, right, above. The plant is planned to operate a single shift 5 days a week. It would have a sustained output of 16 studs per minute for 360 out of the 480 minutes—that is, 5,760 studs (2,880 bolts) per day. In addition to the 30,720 board feet of studs, 12 tons of green pulp chips and 29 tons of dry wood waste—principally shavings—would be made daily. About 25 tons of bark and 3 tons of green sawdust would be accumulated daily. These quantities are calculated on the assumption that the bolts are 100 inches long and average 6 inches in diameter at the small end, inside bark.

Commercial machinery is available to perform each step of the operation, although the machines have not previously been combined in the sequence described here. The estimated plant cost is $325,000. Estimates of returns and of other costs will be found at the end of this article.

Because the mill value of each 8-foot bolt within the narrow range of acceptability (5 1/4 to 6 1/4 inches) is determined by the pair of studs each will yield, the mill operator could buy at a flat price per stick. For instance, a flat price of $0.50 per bolt would work out to approximately $24 per cord for sticks measuring 6 inches outside bark and $16 per cord for sticks measuring 7 inches outside bark. Since the pair of studs cut from each stick contains 10 1/3 board feet, the price of $0.50 per stick amounts to a raw-material cost of $46.86 per thousand board feet of studs produced.

Scaling and storing. Daily input would be approximately 75 cords. Because payment would be by stick count, a photograph of both ends of each load would permit tallying in the office and reduced payment for undersize bolts. One man operating a forklift equipped with top tongs would be able to unload incoming trucks and pile the wood in windrows along one side of a log haul designed to move the bolts in endwise procession.

Center rippering. From the log storage piles, one man would manually roll eight bolts per minute into the endwise procession flowing through an unattended self-centering band ripsaw feeding at 80 feet per minute. The log roller would eject the occasional oversize and undersize bolts into separate storage racks ranged along the side of the conveyor opposite the incoming storage. The bolts would be resold without further processing—the small ones as pulpwood, the large ones to conventional mills for conversion to lumber or veneer.

Debarking and sizing green blanks. On emergence from the rip saw, each half-bolt would be automatically turned face down and then moved transversely to a planer-type automatic feeding table to again get the half-bolts in endwise procession flowing at 130 feet per minute. The half-bolts would proceed via a self-centering channel to a slab barker and then through a dip-chain straight-line ripsaw (or a modified surfacer-edger) equipped with top infeed rolls capable of accommodating half-bolts ranging in thickness from 2 to 5 inches. A single top chopping head mounted on the saw arbor would profile each core to a thickness of 2 1/4 inches and a width of 5 1/4 inches. The profiled cutterhead would carry only two knives and would rotate with the feed at 1,040 r.p.m. to yield chips 1/4 inch long. Alternatively, the surfacer-edger could be equipped with three chopping heads—one at the top and two at the sides. Chips would be conveyed into freight cars or vans. One man would monitor this debarking and sizing operation.
Stacking green blanks. Green blanks, 2½ inches thick, 5¼ inches wide, and approximately 100 inches long would be discharged to a sideways conveying table at a rate of 16 per minute and would proceed to a fully automatic stacker capable of building and discharging one 4-foot-square stickered package every 8 minutes. This packaging assumes 9 stud blanks per course, 9/16-inch stick thickness (5 sticks per course), and 14 courses per package—i.e., a total of 126 blanks or 672 board feet per package. One man would monitor the stacker operation at all times and would fill the stick hoppers. Each of the 5 hoppers would discharge approximately 98 sticks per hour.

A 75-foot storage chain would be required. It would hold eight packages (approximately 1 hour's production), and would have built-in bunks to enable it to be serviced efficiently by forklift.

KDn drying. The fork-lift operator would periodically (at least every hour) remove the stickered packages of green stud blanks from the storage chain and would side-charge a series of direct-gas-fired kilns equipped with humidity controls. Each kiln would hold 22,680 board feet—i.e., 36 packages side-loaded 4 deep, 3 high, and 3 long. If the drying schedule is conservatively estimated at 7 days, then 7 kilns would be required.

Face-jointing and straight-line ripping. It is proposed that kiln-dry stud blanks be mechanically unstacked onto a feed table for a 30-inch-wide facing planer. Perhaps half the blanks would go directly through the left side of the planer for facing and thicknessing to 1-3/4 inches. Badly bowed blanks would be fed through the right side of the planer for repeated facejointing via a merry-go-round conveyor until within one pass of a complete facejoint, at which time they would be fed through the left side of the machine. On rare occasions the operator might saw a foot or so off a badly warped end to facilitate jointing.

The top thicknessing cutterhead would extend only across the left 12 inches of machine width. The left side of the machine would discharge directly onto a self-centering table feeding a 2-saw dip-chain straight-line rip-saw set for 334-inch width. The saws would be integral with cutterheads designed to hog the edgings as produced. Sixteen stud blanks per minute would be discharged.

Double-end trimming, finish planing, edgemarking, and spraying. The partly machined straight blanks emerging from the rip saw would be automatically double-end trimmed to 96-inch length. Cutterheads mounted directly on the two trim saws would hog the trim ends. Trimmer blanks would drop automatically into a hopper feeding a 4-head planer and matcher at 130 lineal feet per minute. The man feeding the face jointer would pace himself to maintain a butted flow through the matcher.

Suitable edge markings would be applied to each stud while it was still in control of the matcher feedworks, and a spray chamber at the outfeed end would apply preservative and water repellent emulsion combined with a distinctive dye.

Grading and shipping. The matcher would discharge sixteen 96-inch studs per minute into the top of a hopper feeding a lugger transverse conveyor chain. A grader stationed at the beginning of this conveyor would grade-mark each stud. Virtually the entire output would be SPIB Stud grade and better, and would proceed through a normally idle double-end trimmer to a fully automatic stacker capable of building and discharging a solid-piled package every 30 minutes. Each package would be stacked 13 wide and 29 high to contain 377 studs (2,011 board feet).

A few studs would have defective ends. Such of these as could be upgraded by trimming a few inches from one or both ends would be pulled by the grader into temporary storage immediately behind the grading station. They would be re-introduced to the conveyor on those days when the double-end trimmer was in operation and would be cut to some specified shorter length for which orders were available—7 feet 6 inches, for example. Each saw would carry its own hoggging head to dispose of the trim ends.

Inevitably a few rejects would be produced. These would be stacked by the grader in forklift packages on two wheeled trucks—one for cut-up or factory grade and the other for rip grade from which the customer could recover a 2 by 3.