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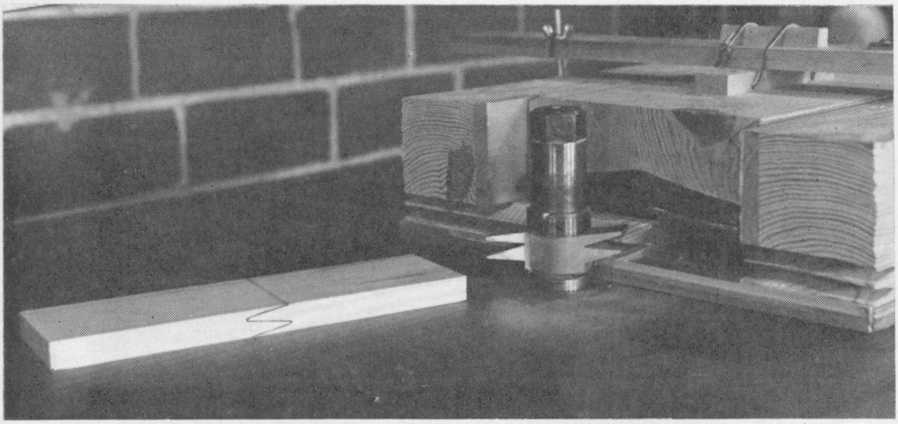

END JOINTS *for* SOUTHERN PINE

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EVERY DAY thousands of short pieces of southern pine lumber go to waste because there is no market for such sizes. On the other hand, most mills cannot produce enough large-size, high grade material to meet the demand.

To help lumbermen with this problem, the Agricultural Experiment Station of the Alabama Polytechnic Institute has been conducting research on the problem of making glued end joints for southern pine.

The joint presented here shows great promise of reducing mill waste by making possible the salvage of short pieces of lumber. In addition, this joint can help expand the markets for southern pine by allowing the production of grades and sizes of lumber not now available.

DESIGN *of* NEW END JOINT

While it is relatively easy to glue boards together side by side or face to face and get strong joints, production of strong end joints has always been difficult. Preliminary work on simple scarf joints has showed that strong end joints can be made in southern pine lumber. These simple scarf joints, however, waste lumber and do not lend themselves to high production, low-cost methods of manufacture. On the other hand, there are many types of fingered end joints in use today that can be mass produced. However, the more common types furnish little more than a third of the strength of clear wood when broken in bending. In an effort to combine the desirable strength prop-

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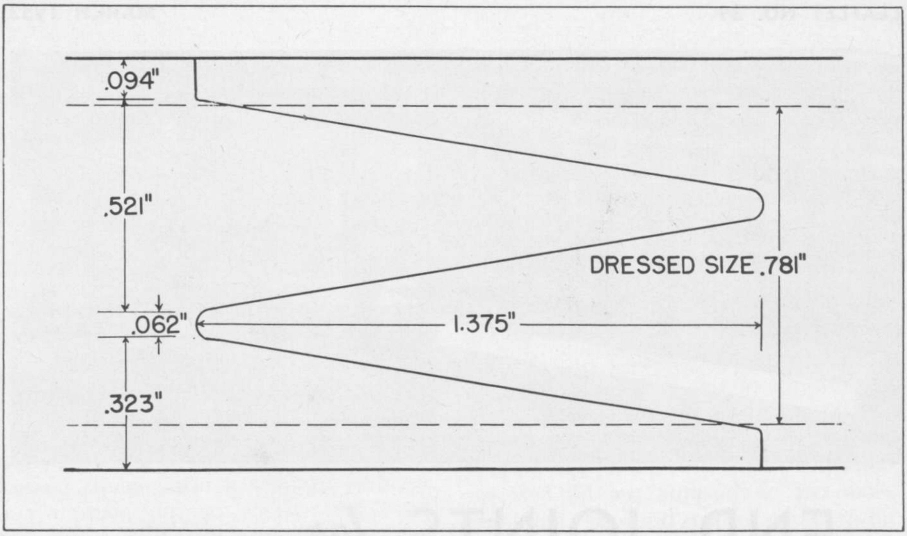

FIGURE 1. The end joint, as viewed from the edge of a 1-inch board. The dotted lines show how the top and bottom truncations will be removed when dressed to 25/32 inch, leaving a 1:6 scarf joint at each surface.

erties of the scarf joint with the desirable production characteristics of the fingered joint, a new type of fingered joint was designed (Fig. 1). In a beam this joint will support over twice as much load as similar joints.

Joint strength *in* kiln-dried lumber. In dense longleaf pine this joint, when broken in the center of a beam, will average between 75 and 80 per cent of the strength of the clear wood. The average stress developed before rupture (11,300 pounds per square inch) is actually 4.7 times greater than the working stress (2400F) assigned to the best stress-grade of southern pine. In weaker specimens the wood

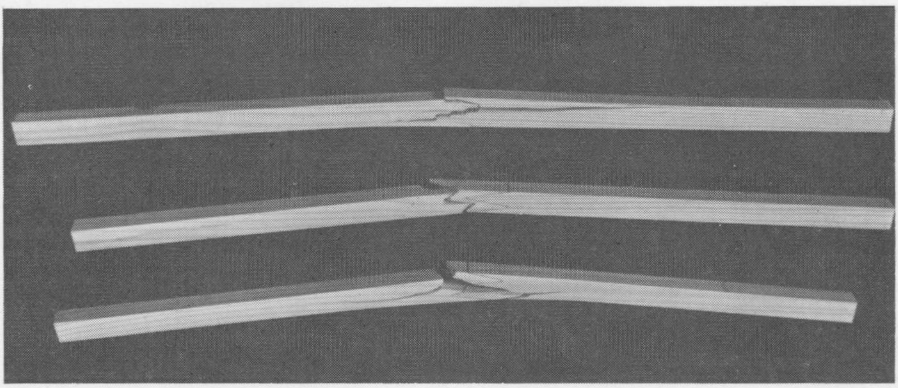

FIGURE 2. Typical breaks in end-jointed southern pine when tested to destruction in a timber-testing machine. Due to slight brashness, the first two beams broke entirely in the wood. Although the third beam broke partially along the joint, the rough nature of the break shows that the glue joint was strong enough to tear out pieces of wood.

will usually break without rupturing the joint. Such breaks in the wood are shown in the first two beams in Figure 2. Small square beams of this type give approximately the same strength regardless of whether the joint is placed flatwise or edgewise before breaking. As a demonstration of joint strength, Figure 3 shows a dressed 1 × 4 bent down under the weight of three men.

Joint strength *in* preservative-treated wood. Preservative-treated wood that has had the excess solvent removed by the solvent-recovery process can be satisfactorily end jointed with this new joint. End joints in such wood[1] gave bending strengths nearly 80 per cent as great as that of solid wood.

Since preservative-treated wood is designed to serve under extreme exposure conditions, the wet strength of any glued joint is of great importance. Some of the treated beams were saturated with water and tested wet. Preliminary results show that with a good, waterproof glue very satisfactory wet strengths are obtained.

METHODS *of* CUTTING *and* GLUING *the* JOINTS

The joints used in this study were cut with a two-winged solid cutter mounted on a spindle shaper. The boards to be jointed were held in a simple wooden jig designed for this purpose. The joints were cut by pushing the jig past the cutterhead with the edge of the jig held against the shaper collar (title illustration). No troublesome burning of the narrow tips of the cutterhead has been experienced.

In production the joints could be cut on a single-end tenoner or on a flooring endmatcher with a glue spreading attachment. Since this joint is reversible, both halves of the joint can be cut on the same cutterhead and the joint made to fit perfectly by turning one board over and pushing it endwise against the other. For a moderate rate of production, a single-end tenoner may be used. High speed production would require a complete flooring endmatcher with a glue-spreading attachment on each machine.

Strong joints have been obtained with resorcinol, phenolic, and urea type resin glues. Most of the joints tested have been hot pressed. Preliminary results, however, indicate that satisfactory joints can be made by curing the glue for a sufficient length of time at normal room temperature. In either event, it is not necessary to hold end pressure on the joint. Once the joint has been forced together endwise, it holds its position if top pressure is applied with a press having slightly roughened surfaces. This fact simplifies the design of production-type machinery to press and cure the joint.

ERRORS *to* AVOID *in* DESIGNING SIMILAR END JOINTS

It is believed that the present joint will have many uses; however, a manufacturer may want a joint that, although similar to this, is varied for some special purpose. In designing such joints, the common causes of weakness will be avoided by the following precautions:

1. Do not have a truncated tip at or near the surface of the board. The greatest strength is obtained by having a rather low-angle scarf extend to the surface. If the joint is well glued, this scarf will dress to a neat appearing joint; if poorly glued it will show a bad joint after surfacing, and can be readily rejected for uses requiring high strength.

2. Do not have broad tips on the fingers. The 0.062 inch tips on this joint seem quite satisfactory. Rounded tips 0.080 inch wide have also been used with no great reduction in strength.

3. Have as few truncated tips as possible. The present arrangement of three scarfs and two truncated tips seems to be the best combination for

[1] Copper-naphthenate treated lumber was furnished through courtesy of C. L. Brice of Brice Wood Preserving Corp., Archer, Fla.; and J. A. Greenwald of the Cuprinol Co., Tampa, Fla.

1-inch lumber. For 2-inch lumber it will probably be necessary to go to five scarfs and four truncated tips in order to keep the length of the fingers down to a reasonable figure.

4. Do not use extremely steep or extremely flat scarfs. Practical joints with strengths from 65 to 85 per cent of the bending strength of solid wood can be designed with scarf slopes between 1:4 (angle of 14°) and 1:8 (angle of 7.1°). Scarfs with slopes steeper than 1:4 show low strength values. Except for very special purposes, such as marine lamination, scarfs flatter than 1:8 should be avoided in a finger joint. Flat scarfs require either very long fingers, or many fingers and hence many truncated tips to serve as points of weakness.

USES *for* END JOINTS

The first and most obvious use of end joints is to salvage short pieces of lumber by gluing them into long pieces. Also, lengths can be made that would not be convenient to saw on the usual sawmill carriage. For example, 1 × 8 boards could be end jointed to a length of 24 feet and then laminated into 2 × 8 rafters 24 feet long.

Perhaps the most promising possibility in the use of end joints is to join short boards into long ones and then edge glue these long boards into wide panels in a continuous edge gluing press. These panels, 2 or 3 feet wide and perhaps 24 feet long, could be stocked by retail yards and ripped and cross cut to any size the customer might want. Such an arrangement would greatly reduce the inventory of a retail yard. These panels could also substitute for some of the uses of plywood and serve in some places where plywood is inadequate.

The production of these long wide panels would also reduce the cost of manufacturing commercial laminates of standard form. For example, 60-foot panels 3 feet wide could be glued into a curved laminate from which could be sawed the curved members for bowstring trusses. In the same manner, curved barn rafters could be mass produced by gluing up wide curved laminates and resawing them into rafters.

The fact that preservative - treated wood can be satisfactorily end jointed opens up new fields of use. For example, treated wood could be end jointed and edge glued into wide panels and then laminated into heavy arches for supporting highway and railroad bridges. Such wooden structures, of course, would have treated wood throughout and would be practically immune to rot or termite damage.

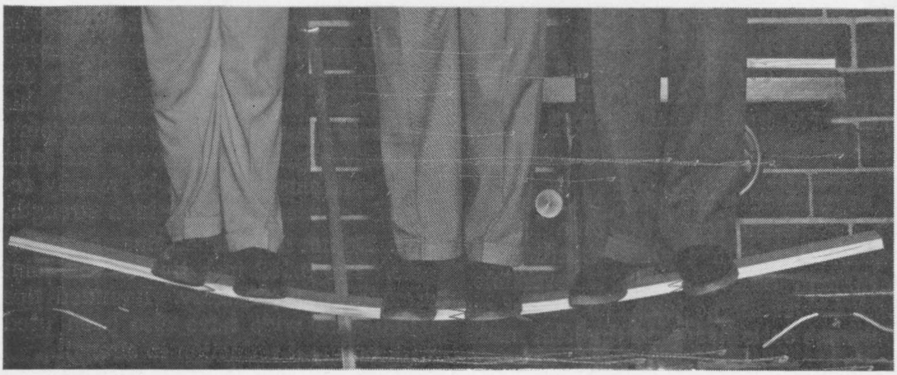

FIGURE 3. An end-jointed 1 × 4 supporting 535 pounds over a 4-foot span. The 1 × 4 had been dressed to standard size (25/32" × 3-5/8"). It should be noted that there is an end joint between the feet of each man.