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One-day kilning dries pine studs to 10% moisture

USDA Southern Forest Experiment Station tested drying southern pine studs in air cross-circulated at velocity of 930 fpm and temperature of 240° F; wet-bulb depression was 80° F. Under same regime, 1" boards dried in 10 hours, plus time to condition

By DR. PETER KOCH

ENORMOUS FOOTAGES of southern pine studs are being manufactured from small logs and veneer cores. Many of the studs contain pith-associated wood, which is prone to warpage.

If they are to be grademarked as kiln-dried, southern pine studs must not exceed 15% moisture content. Industry practice is to grade and ship kiln-dried studs at moisture contents of 12 or 13%. Most of the studs find use in air-conditioned or heated buildings, however, and in service their moisture content declines to 9 or 10%. Both experience and research have shown conclusively that the additional drying causes studs to deform considerably.

In the author's opinion, manufacturers would best serve the consumer by grading and shipping southern pine studs at 10% moisture content. Such practice would require major changes in manufacturing procedures, but in the long run the industry would profit. Moreover, research has developed information that makes the necessary new drying technology possible.

This technology will be new in two important ways. First, the pieces will go through the kiln under some form of mechanical restraint that will in effect steam-straighten them and thus greatly increase the proportion that meet stud grade. Research on this phase has been described in the May 1971 issue of *Forest Products Journal,* pp. 17-24.

Second, drying times will be drastically shortened. High temperatures, large wet-bulb depressions, and high air velocities will cut schedules to 24 hours or less—and may halve energy requirements.

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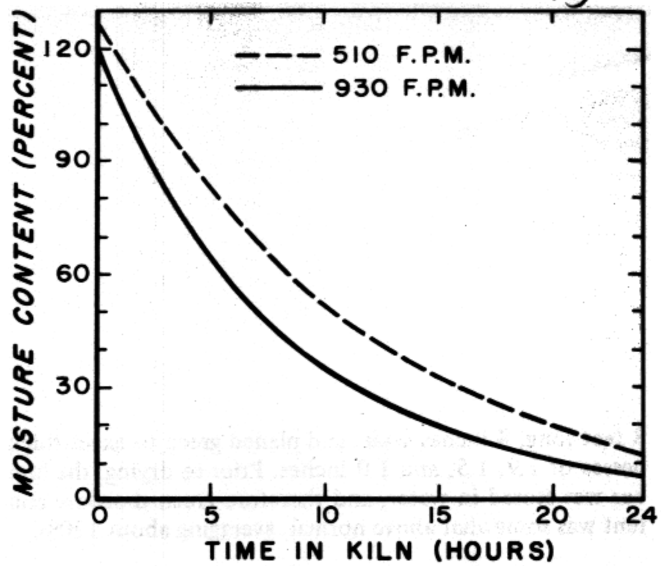

Figure 1: Increasing kiln airspeed from 510 to 930 fpm considerably reduced the time required for drying southern pine lumber. This chart is for boards 1.9" thick, dried at 240°F. and a wet-bulb depression of 80°F.

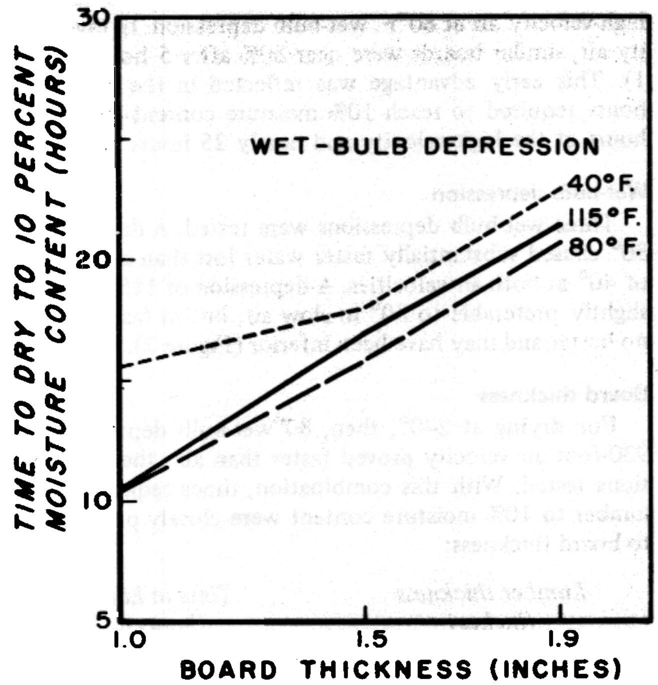

Figure 2: In 240° air moving at 930 fpm, a wet-bulb depression of 80° was at least as effective as a depression of 115°.

The article just referred to outlined a high-temperature schedule found to be successful. Here, the purpose is to summarize additional research that has confirmed the schedule and yielded information about the effects of air velocity, lumber thickness, and wet-bulb depression. The information is from the Southern Forest Experiment Station's Wood Utilization Laboratory at Alexandria, La. In all, 108 kilnloads (24 boards per load) of southern pine lumber were dried at 240°F. in an air-stream mixture. Boards were

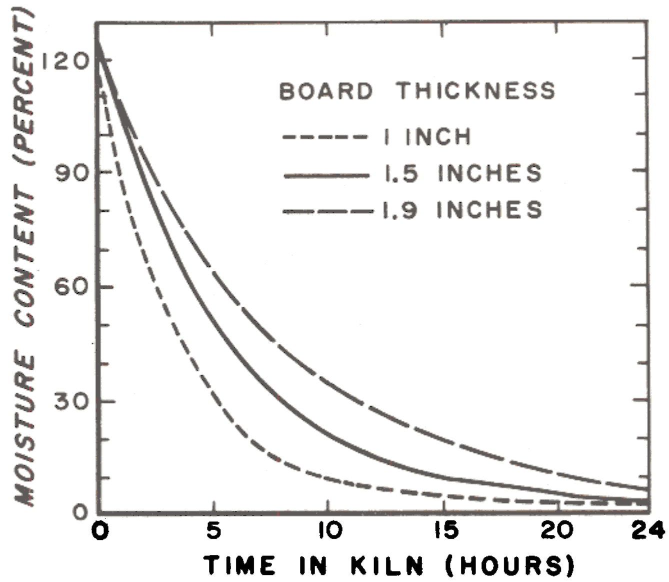

Figure 3: Time in kiln as related to moisture content of southern pine lumber of various thicknesses. Air temperature was 240°F., airspeed 930 fpm, wet-bulb depression 80°.

8 feet long, 4 inches wide, and planed green to exact thicknesses of 1.9, 1.5, and 1.0 inches. Prior to drying, the lumber was stored in water, and therefore green moisture content was somewhat above normal, averaging about 120%.

Air velocity

Air velocities tested were 510 and 930 feet per minute. In the early stages of drying, moisture content was reduced more rapidly at the high velocity. For example, the 1.9-inch lumber (about equal in thickness to unplaned studs) was brought to about 60% moisture content after 5 hours in high-velocity air at 80°F. wet-bulb depression. In low-velocity air, similar boards were near 80% after 5 hours (Figure 1). This early advantage was reflected in the number of hours required to reach 10% moisture content—that is, 21 hours at the high velocity and nearly 25 hours at the low.

Wet-bulb depression

Three wet-bulb depressions were tested. A depression of 80° caused substantially faster water loss than a depression of 40° at both air velocities. A depression of 115° appeared slightly preferable to 80° in slow air, but in fast air it was no better and may have been inferior (Figure 2).

Board thickness

For drying at 240°, then, 80°wet-bulb depression and 930-foot air velocity proved faster than all other combinations tested. With this combination, times required to dry lumber to 10% moisture content were closely proportional to board thickness:

Lumber thickness (inches)	*Time in kiln (hours)*
1.0	10
1.5	16
1.9	21

Thus, wood of stud thickness was dry in 21 hours (Figure 3). Prior work showed that casehardening in lumber dried at 240°F. can be relieved by steaming for an additional 3 hours at dry- and wet-bulb temperatures of 195° and 185°F.

Development of required hardware

Application of this new process of steam-straightening and drying southern pine studs at high temperature will require new kiln designs. The *Forest Products Journal* article previously referred to, outlined two kiln configurations. A third possible design is described here.

In this design, the studs would travel on edge through a continuous, multideck, roll-feed kiln. At a continuous feed of 0.5 fpm, a single deck 100 inches wide (40 studs on edge, spaced 5/8 inch apart) and 720 feet long could discharge 3,700 studs or 19,200 board feet every 24 hours. Multideck machines would conserve floor space and probably effect economies in heat utilization.

Studs in each deck of longitudinally traveling lumber would be forcibly held on edge between fixed rollers on a lower bed paired with fixed top rolls in an upper bed. The roll pairs would be spaced about 1 foot apart along the length of the dryer, and all would be power driven. They would be machined with matching, shallow, flat-bottomed grooves to accommodate rough green studs on edge (groove width would be about 1-7/8 inches); the grooves would be cut on 2½-inch centers—with relieved outer corners for easy entry of studs—to yield 40 grooves in rolls about 100 inches long. This spacing would leave 5/8 inch between studs for air to circulate vertically.

At the green end of the dryer, the roll pairs would be spaced vertically to accommodate a 4-inch-wide green stud, but toward the dry end the spacing would be gradually diminished to about 3-7/8 inches to follow width shrinkage of the studs. The grooved rolls would prevent crooking, bowing, or twisting as the studs passed through the kiln. For the restraint mechanism to function well, the lumber would have to be accurately cut and the rolls accurately aligned.

Such continuous drying would have the obvious advantage of eliminating the cost of placing and removing kiln sticks, as well as the cost of the sticks themselves. Also, the design is suitable for random-length lumber.

Not yet resolved is a method for cooling the lumber while it is still under restraint. Perhaps a refrigerated section, equipped with chilled rolls, could accomplish the necessary cooling as the lumber leaves the dryer. In brief, then, the dryer might have three zones. In the long first zone, lumber would be dried at 240°F. with a wet-bulb depression of 80° and an air velocity of about 1,000 fpm. In the short second zone, casehardening would be relieved by steaming at about 195°, with 10° (or less) wet-bulb depression. Finally, the studs would pass through a cooling zone before release from restraint. ■