REDUCING THE HAZARDS OF INADEQUATELY DRIED LUMBER IN POSTWAR HOUSING

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For ordinary peacetime needs, the sawmill capacity of this country has in the past been somewhat greater than is required to fill orders for lumbar, and stocks accumulate at the sawmill. Time is thus allowed for stock to be adequately seasoned before it is sold. During periods when the demand for stock exceeds the capacity of the mills, however, the stock on hand becomes smaller and smaller, the time allowed for seasoning decreases, and if the demand becomes great enough the lumber may be sold as fast as it can be cut and without any time for seasoning. Such a condition of demand exceeding supply began to develop before Pearl Harbor, has been with us ever since, and will continue until stocks can again be built up at sawmills and distributing yards. How long it will take is anybody's guess, but if the enormous building program planned for immediate postwar work goes ahead according to schedule it will be a long time indeed before yard stocks can be accumulated and adequately seasoned lumber will be available. Meantime, various difficulties due to use of unseasoned material can be expected.

When unseasoned framing lumber is used, subsequent shrinkage may result in excessive plaster cracks, distortion of door and window openings, the binding of moving parts, doors that will not latch, loosening of nails that weakens the structure, pulling of fastenings, openings and cracks that permit air infiltration, decay hazards, and other defects too numerous to mention but which add to upkeep, disfigurement, and annoyance. It is true that, during the war emergency, most buildings have been constructed of framing lumber that has not been adequately seasoned; in fact, in some cases it was almost as green when it was installed as when it came out of the sawmill. It is also true that above the floor level this material gradually dried out after erection, that the defects which occur where unseasoned lumber is used have developed, and satisfactory service cannot be expected.

Over basementless structures the floor beams and joists sometimes did not dry out, decay set in within a few months, and expensive repairs were necessary.

Construction materials are of two classes: (1) those which are used for beams, joist, studs, rafters, and sheathing, commonly called framing or yard lumber; and (2) those which are used for flooring, finish, trim, doors, and windows, called finishing lumber, Most items of framing lumber are customarily air-dried, while all finishing lumber should be kiln-dried, This difference in seasoning practice is largely a matter of expediency, since it is possible to kiln-dry framing lumber in items up to 2 inches thick if suitable kilns in adequate numbers are available.

Sap, which is principally water, is the lifeblood of a living tree. After the tree is felled and converted into lumber, however, most of this moisture must be removed before the material is suitable for use. In seasoning the material to remove the excess moisture, considerable shrinkage develops and it is well to have this dimensional change take place before rather than after the material is assembled in a structure or finished article .

Studies at the Forest Products Laboratory show that, in any seasoning process, all of the moisture present is not removed from the wood (1). [1] Mood will give off or take on moisture from the surrounding atmosphere until the moisture in the wood has come to a balance with that of the atmosphere. Assuming a constant temperature, the ultimate moisture content that a given piece of wood will attain will depend entirely upon the relative humidity of the atmosphere. This relationship is illustrated in figure 1, which shows, for example, that, at a constant temperature of 70° F. and 60 percent relative humidity, wood will eventually come to a moisture content of 11 percent.

Changes in relative humidity of the atmosphere vary throughout the day and also by seasons, so that wood is virtually always undergoing slight changes in moisture content. The change in ordinary lumber sizes is gradual and is retarded by protective coatings, such as paint and varnish.

In seasoning greenwood, certain precautions must be taken; if dried too fast, it may be seriously damaged by checking, splitting, and warping. In air drying 1-inch framing lumber, it is customary to allow about 90 days in the yard during spring, summer, and fall, and a longer period in the winter. In fact, in some parts of the country practically no drying takes place during wet winter months. Thicker material takes proportionately longer for yard drying. Thoroughly air-dried stock may have a moisture content of 14 to 15 percent, but the average will probably be nearer 17 percent in the Middle West.

Lumber that is used to erect a heated building in the same area continues to dry until it is in equilibrium with the atmosphere in the structure. Obviously, some shrinkage takes place, and better results would be obtained if the stock had been seasoned before use to the moisture content it eventually attains. This would involve kiln drying the stock, since the low moisture content that is attained in the heated building cannot be attained in yard drying. The air-dried material could be dried to the required moisture content If it were stored in open piles for several months in a heated storage space.

It is unlikely that lumber kiln-dried before erection to the moisture content it will attain in use will pick up enough moisture during the period

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[1] Numbers in parentheses refer to literature cited at the end of this article.

of construction to raise its moisture content to that of air-dried stock when the house is enclosed. The moisture content actually reached during the exposed period will generally be definitely less than the average moisture content of air-dried stock, and subsequent shrinkage will be correspondingly reduced. The advantages of using framing lumber kiln-dried to about 10 percent are discussed in a Forest Products Laboratory publication (4).

The problem facing builders today, however, lies in the fact that most of the framing lumber available for immediate construction is in an unseasoned condition. No method or material has yet been discovered that will completely prevent moisture content changes in wood. A method has been developed by which wood can be stabilized so that moisture content changes have almost no effect on its dimensions, but this method is expensive and limited in its application. It is not a method that can be applied to framing lumber.

There are, or" course, certain expedients that can be employed either to hasten the seasoning before the building is plastered or to minimize in some degree the effects of shrinkage. When conditions permit, framing lumber should be bought as far ahead of actual construction as possible and piled on stickers according to standard piling practice (2). Each month it is in the pile will advance its seasoning materially. Another method, end racking, might be employed at the building site. By this method, a bar is set up between two frames and against it the lumber items are set edgewise, boards alternating on opposite sides of the bar (2). This method of piling results in rapid. drying. In general, it can only be used for species of wood that are not inclined to check and split. With other species, it is used only for short periods of 3 to 5 days on the assumption they will be taken from the rack and flat piled before checking, splitting, or warping develops.

Halting the progress of the building after it is framed, sheathed, roofed, and ready for lathing will also result in comparatively rapid seasoning. It would require several weeks of this type of exposure, however, to lower the moisture content of green framing lumber to the equivalent of an air-dried condition. The object, of course, is to have as much as possible of the shrinkage take place before plastering, so that subsequent plaster cracking can be minimized. Such exposure is likely to mean that the framing members above the first floor will dry more than the floor joist, which are subject to a damp basement or, where there is no basement, to damp soil below the joist. Every effort should be made to allow good circulation Of air below the floor joist and to drain water away from the building so that the soil below the joist will be as dry as possible.

During the colder seasons of the year, the rate of drying is slowed up materially unless augmented by some heat. Heating the inside of the building to 20° F, or more above the outside temperature at any time of the year will materially increase the rate at which drying takes place.

If part of the material available is seasoned or partly seasoned, this material should be used for girders, floor joist, and for lintels over openings and the greener material for ceiling and roof joist. If seasoned material is unavailable for girders consideration should be given to support by nonshrinking materials.

After lathing, strips of expanded metal lath should bo applied over the regular lath in all corners and over doors, windows, and other openings to reinforce the plaster at these critical points. Though such strips do not prevent all plaster cracks, they do prevent some, and they also break down what otherwise might be a single large crack into several small cracks.

Since the vertical shrinkage of the joists and plates is cumulative, there will be more evidence of shrinkage in the second floor than in the first floor of an all-frame house (3, 6). On this basis, one-story houses will suffer less than two-story houses, and owners might consider building one-story houses when these can be made to suit their needs.

Side-wall and roof sheathing lumber should be narrow stock. The shrinkage in narrow boards is less than in wide boards and it follows that the distortion on the nails will be less with narrow than with wide boards, affording greater rigidity in the structure, There will also be less distortion on the nails of siding or other covering material. Sheathing boards should not be over 8 inches wide; 6 inches is preferable,

The width of stock used for roof sheathing has an important bearing upon the appearance and life of asphalt shingle roofs. The exposure of the shingles, usually about 5 inches to the weather, determines the spacing of the shingle nails. Sheathing boards wider than this spacing will in some cases have two shingle nails in the width of the board. The shrinkage of the board between these nails is likely to cause the roof shingles to heave along the length of the board, causing an unsightly roof because the shingles do not lie flat, and allowing the wind an opportunity to tear the shingles off.

Consideration should also be given to adequate bracing of the structure, either by means of diagonal sheathing or by "let-in" bracing. The latter type can be 1- by 4-inch material running diagonally from plate to cap in the outside faces of the studs. Such braces should be located at or near each corner of' the building.

Under present conditions, framing lumber that is unseasoned is the material most likely to cause trouble. Material used for interior finish and flooring is of higher grade than that used for framing, and the rough lumber is usually kiln-dried to a suitable moisture content before it is remanufactured into finished material. Moreover, it is generally carefully stored in closed sheds or warehouses by the manufacturer, the wholesaler, and the retailer before it is delivered to the building. From the time it is delivered until the building is completed and occupied, however, this high-grade material may be exposed to atmospheric conditions that permit

it to pick up moisture and expand. If so exposed it will later shrink, unsightly cracks and openings will occur, and usually the dealer will be charged with having sold unseasoned material, The dissatisfied owner expects the contractor to correct the condition, the retail and wholesale dealers are sometimes expected to bear part of the expense in making repairs or adjustments, and all involved are unsatisfied with the results.

Where adequate protection is prodded for the finish lumber after delivery to the building, these difficulties are unlikely to occur. The most simple and positive method of protection is to heat the building from time the finish is delivered until the building is occupied (5). The temperature should be maintained at least 15° F. above outdoor temperatures and not allowed to cool below 62° to 65° F. when outdoor temperatures are below 45° F. During warm weather it is safe to cut off the heat during the day, when the workers are on the job, but the. temperature should be raised as described at all other times, even during warmweather. Ordinarily the heating plant is not installed and ready for use at the time the building is ready for the finishing material, but arrangement should be made with the heating contractor to have his plant ready and operating when the first load of finish is delivered, Where this would be impractical, some type of space heater could be used in place of the heating plant.

Protection as described paid good dividends in a house built in Madison, Wisconsin, in 1938. This house was being finished in late September, but at a period when outdoor temperatures were in the eighties and the atmosphere humid. The heating plant was in operation and the carpenter's foreman was instructed to set the thermostat 15° F. above the outdoor temperature when he left the building after work. In the morning he was to turn it back and open up the house so that the working conditions would not be uncomfortable. The flooring and interior finish in this house are in perfect condition after 7 years, but other houses being finished at the same time but without protection had trouble as soon as the heat was turned on after the building was occupied, The floors developed wide cracks, doors warped, panels shrank, cracks developed in mitered trim, and stair treds creaked where they shrank may from the bearings. The contractor of one house was called back repeatedly and 2 years later was still involved in trying to remedy a situation that could easily and inexpensively have been avoided.

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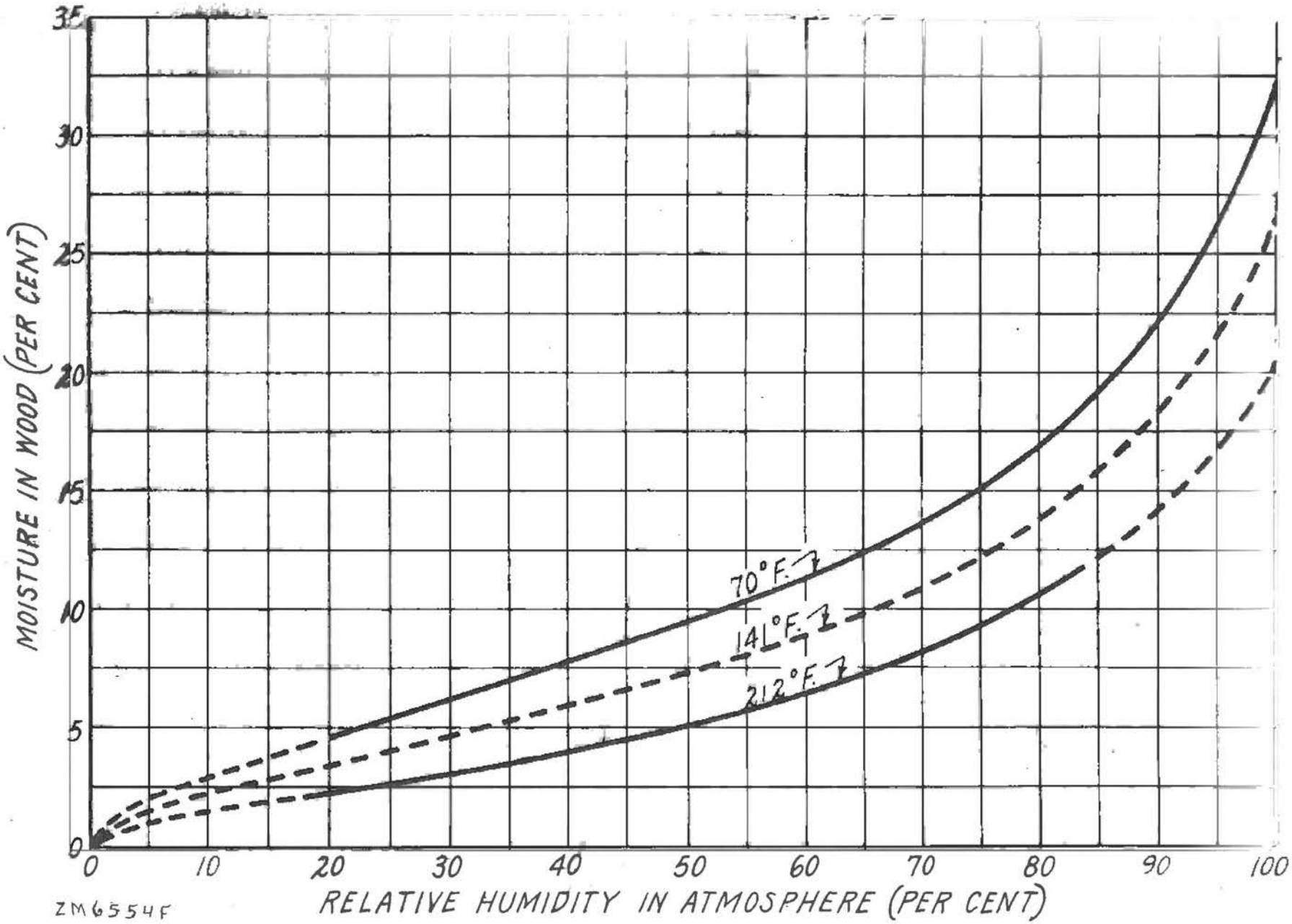
Figure 1.--Relation of the equilibrium moisture content of wood to the relative humidity of the surrounding atmosphere at three temperatures.


MOISTURE IN WOOD (PER CENT)
35
30
25
20
15
10
5
0
0
10
20
30
40
50
60
70
80
90
100
70° F.
141° F.
212° F.
RELATIVE HUMIDITY IN ATMOSPHERE (PER CENT)
ZM6554F