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DIMENSION CHANGES IN MILLWORK DUE TO VARYING ATMOSPHERIC CONDITIONS

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Building contractors sometimes encounter certain difficulties with millwork that may be overcome in a large measure by giving adequate attention to a number of factors. This paper will discuss these factors without detailing the technical reasons for occasional unsatisfactory behavior of woodwork. If, however, additional information is desired it will be furnished, as far as it is available, upon request to the Forest Products Laboratory, Madison, Wis.

Most of the troubles with millwork that has been properly manufactured are due to changes in dimension that occur when the wood is exposed to varying atmospheric conditions. Although similar changes may occur as a result of improper manufacture, that phase of the problem is outside the scope of this paper, which will be confined to exposure troubles. The changes in dimension correspond to changes in the moisture content of the wood and these in turn are affected by the atmospheric conditions, including both temperature and the amount of moisture in the air. As a matter of fact, there is a definite relationship between the moisture content of wood and the atmospheric conditions to which it is exposed. Broadly, the more moisture in the air the higher will be the moisture content of the wood.

A change in the moisture content of the wood depends on the relative humidity of the surrounding air, which is the ratio of the weight of water vapor actually in the air to the maximum weight that could occupy the same space at the same temperature. When the amount of moisture in the air would result in too high a moisture content in the wood, the relative humidity may be decreased by raising the temperature.

In Figures 1 and 2 are shown two common forms of instruments, either of which may be used for determining the relative humidity of the atmosphere. Both have similar mercurial thermometers and the bulb of one thermometer in each instrument is covered with a cloth wick kept moist. The first instrument is fanned vigorously for several minutes before the thermometers are read and the second instrument is whirled. The first is called a wet-bulb and dry-bulb hygrometer, and the second, a sling psychrometer. The readings of the pair of thermometers in either instrument, when referred to a table furnished with it, afford a means of determining the relative humidity.

If in the storage shed or in a building under construction there is no source of moisture other than the air, the increase in temperature necessary to insure a desirable moisture content for interior doors will vary with the existing temperature and the relative humidity. Suppose, for example, that the existing temperature and relative humidity are 30° F. and 80 per cent, respectively. If the air is heated to about 55° F. it will be possible to prevent an undue pickup in moisture content. Similarly, if air at 70° F. and 80 per cent relative humidity is heated to 100° F. the same purpose can be accomplished.

If other moisture is present it will be evaporated at the increased temperatures, and having a greater pressure than the vapor in the air outdoors it will pass through the walls and through cracks around windows and doors, so that eventually the desired relative humidity will obtain.

Although heating of the air is justified up to a certain point, it should not be inferred that the more heat in the storage space the better, for such is not necessarily the fact. The reason is that the temperature may be raised to such a point that the relative humidity will be reduced to too low a percentage and the stored wood will then dry and shrink an undue amount. The changes in dimension under such temperature conditions may be large enough to become vexatiously évident in the form of openings at the joints in a door, for example, and in its cupping or twisting or otherwise distorting.

Lack of care in providing proper protection in a shed or otherwise is very likely to lead to a succession of difficulties. One part of the assembly may absorb more moisture than another, thus causing unequal swelling and consequent warping either then or later when the wood redries. A second effect may be the opening of the joints as a result of alternate wetting and drying. Another possibility is that the window frames will swell so much that they will not fit the openings left by the brick layer or stone mason. Lastly, the frames may warp so much that the sash will not fit without an undue amount of labor, either on the sash or on the frame. In any event, when the frames dry out again, in place, the various cracks that will result will cause vigorous complaints from the customer and will cost the contractor much goodwill and may cost him some money, in addition to the extra labor cost that he has already had in getting the frames into place and getting the sash to work in the frames.

Instances have been reported in which closet doors and corridor doors have warped badly during the construction period. In one instance the temperature in the rooms was 75 degrees F. while that in the corridors was 50 degrees F. (The temperatures in the closets is not known, but was no doubt lower than 75 degrees F.) The difference in temperature made a difference in relative humidity on opposite sides of the doors, thus causing the side exposed to the lower relative humidity to dry and to shrink before the other side. The difference in shrinkage caused the doors to become concave on the room side. This warping could have been reduced if the doors had been left open so that both sides would have been exposed to substantially the same atmospheric conditions.

In another building the corridor doors were hung before the terrazzo floor was laid and the absorption of moisture from the floor and subsequent drying caused the doors to bow sharply at the bottom. The explanation is that the corridor side of the doors absorbed moisture and tended to swell. The tendency was opposed, however, by the opposite side of the door, with the result that the corridor side was compressed to some extent. Thus the corridor side had a dimension that was smaller than it would have had at its moisture content if the swelling had been unrestrained. Consequently, when it redried, the corridor side shrank to excess, by an amount approximately equal to its compression. The increased shrinkage then caused this side to become concave. In this instance it would have been advisable to have postponed hanging the doors until after the terrazzo floor was laid.

In Figure 3 is shown the middle portion of a three-panel softwood door that has undergone no change in moisture content and is entirely satisfactory. In Figure 4 is another door of the same type that has absorbed moisture and then dried below its original moisture content, thus causing the joints to open. Note the shrinkage in the width of the wide, upper panel as indicated by the vertical lines at the points of the arrows. These lines were drawn on the panel at the inner edges of the stiles before shrinkage occurred. The overall shrinkage in the width of the door was about a quarter of an inch. Note also the opening between the middle rail and the muntin.

The changes in dimension in Figure 4 correspond to those occurring when a door is exposed to dampness and is then placed in a dry location. The absorption of moisture, as already explained, may occur in a shed or in a building being erected. Then when the building is heated, the wood dries and shrinks, certainly enough to make the owner dissatisfied, and possibly enough to cost the contractor the expense of replacement.

Another example of shrinkage is that of mitered joints illustrated in Figure 5. The separation of the edges occurred because the wood was machined and fitted at too high a moisture content.

Although most of this discussion refers primarily to doors, it is likewise applicable to other interior woodwork, such as casing, molding, and base, and especially to flooring.

To summarize the foregoing: Difficulties arising from changes in dimensions of properly constructed doors and other interior woodwork

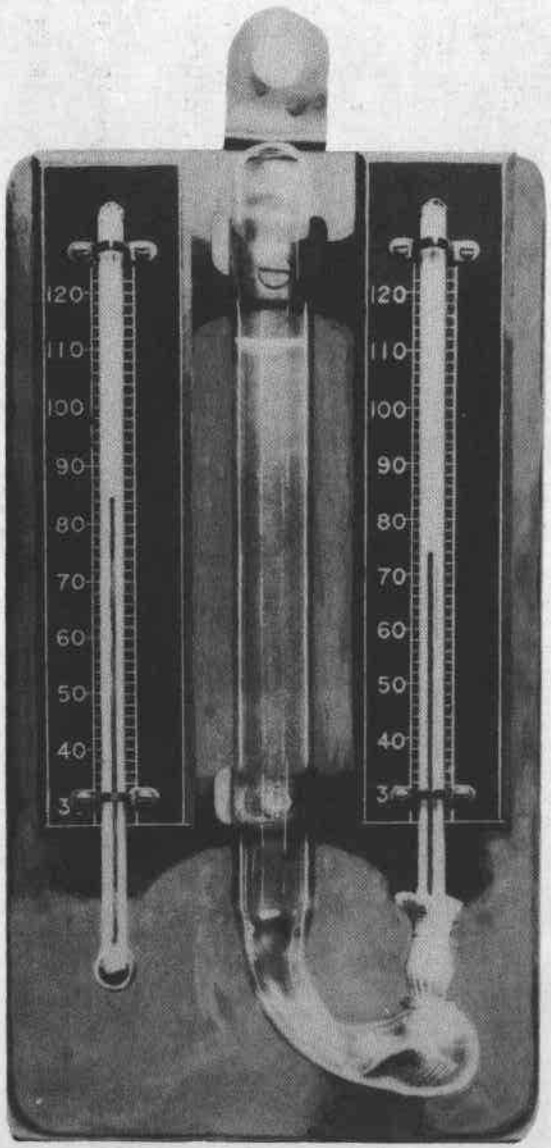

FIG. 1

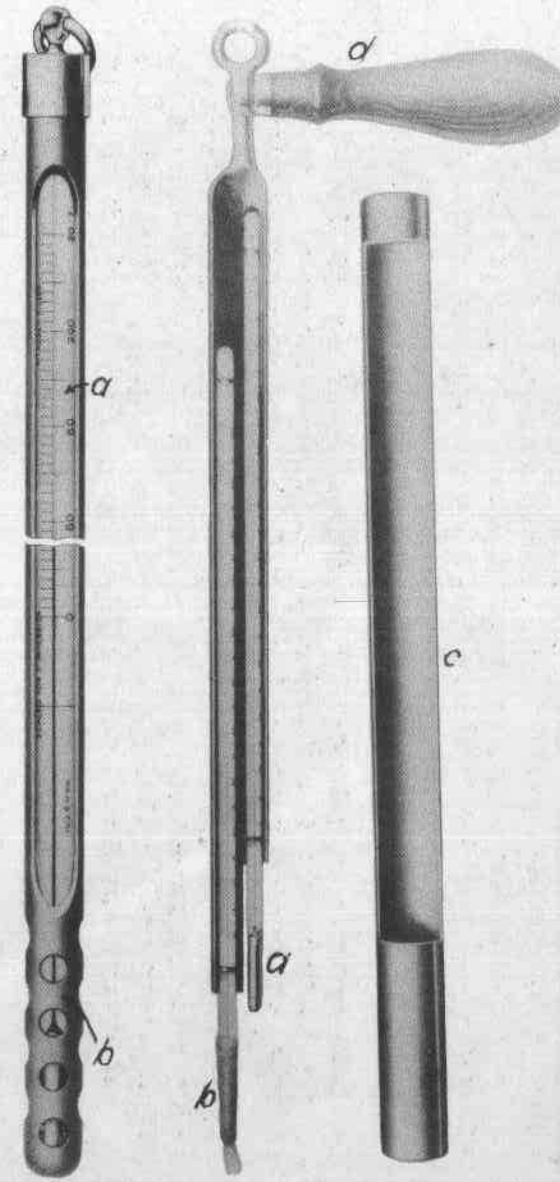

FIG. 2

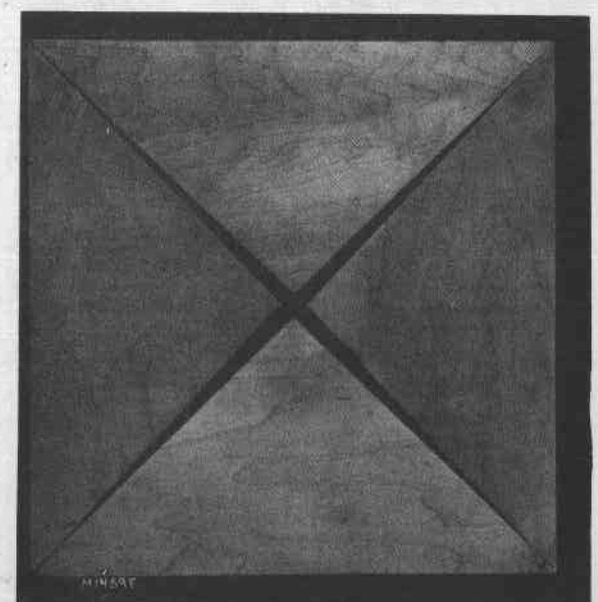

FIG. 5

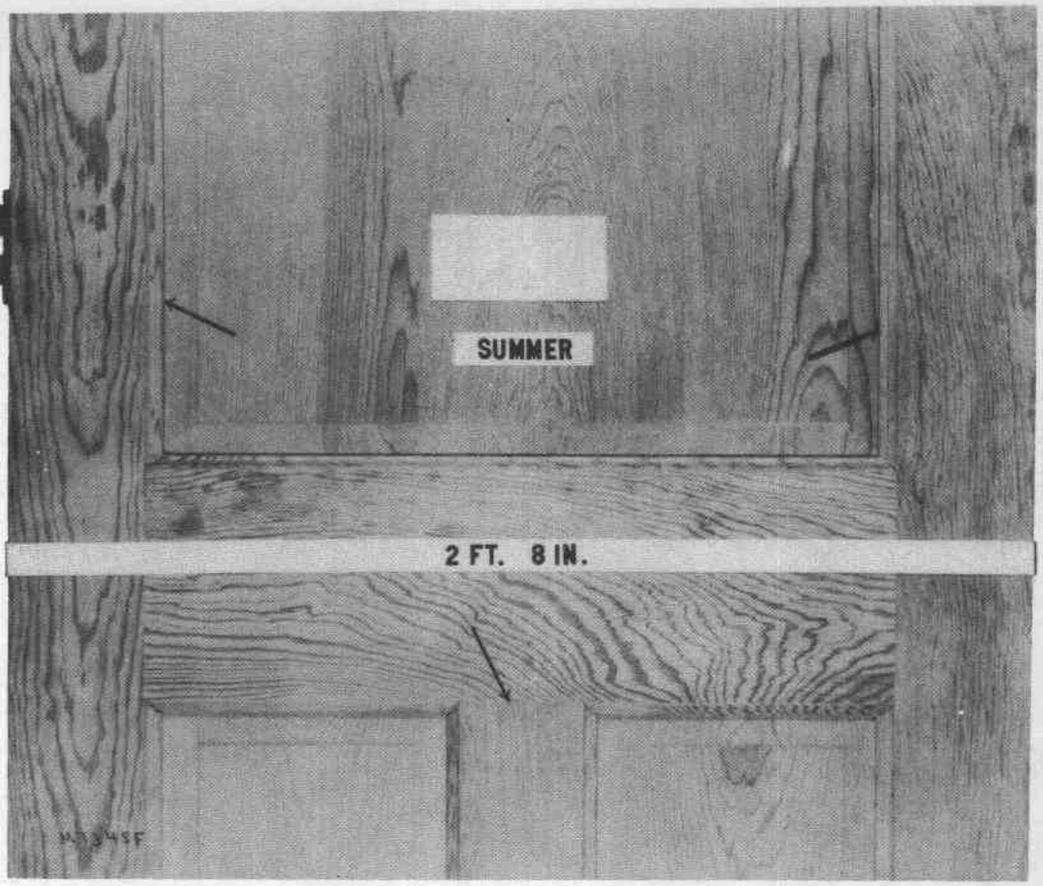

FIG. 3

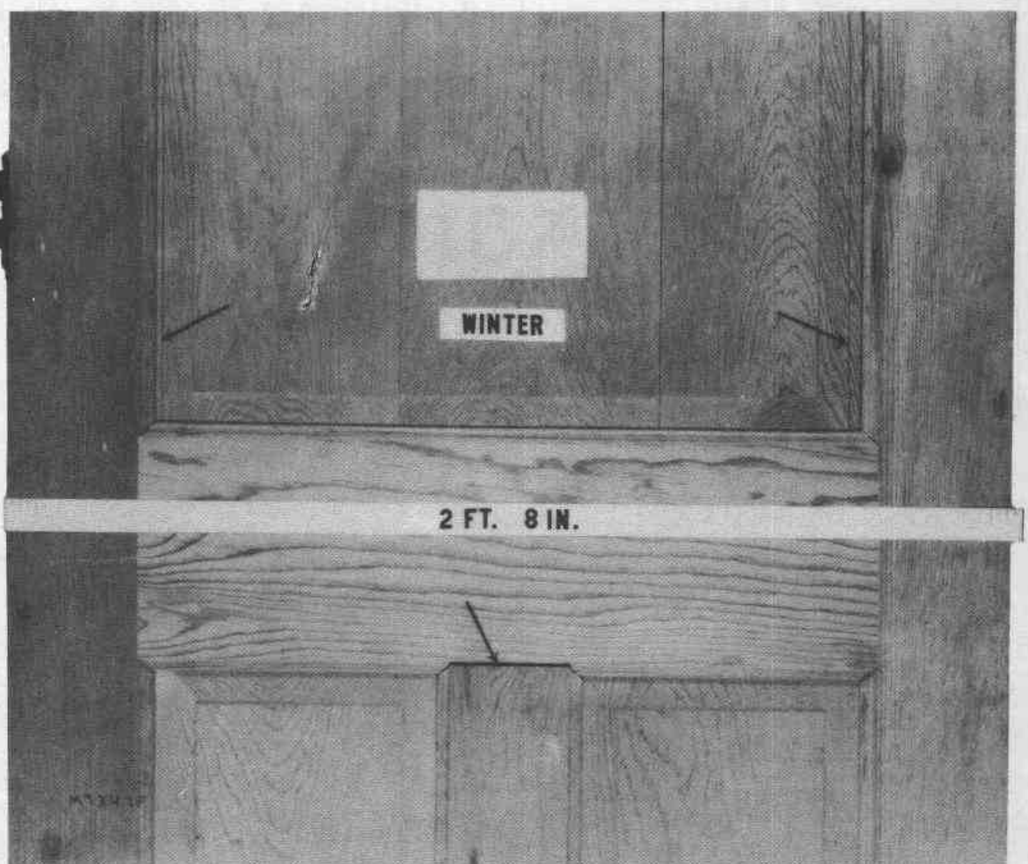

FIG. 4

are commonly the result of absorption of moisture either in a storage shed or in the building in which they are installed, and of subsequent redrying. The absorption of moisture can be reduced or prevented by storing the woodwork in a dry location. When the atmosphere is damp the simplest means is to heat the air perhaps 5 to 30 degrees F. to effect the necessary reduction in relative humidity.