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Moisture Content Changes in Poorly-Piled Softwood Dimension Lumber

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INTRODUCTION

During the past few years, users of softwood dimension lumber have become interested in wood’s fourth dimension—its moisture content. Since a large volume of this lumber is used each year for building framings, residential builders have shown particular interest in the subject.

In the past, structural framing was exposed to atmospheric conditions for extended periods of time. This exposure time allowed the lumber to reach a moisture equilibrium with the surrounding atmosphere. If the lumber was improperly seasoned or had picked up moisture after seasoning due to exposure to the weather, it had a good chance to lose this excess before the building was completely enclosed and finished. Nowadays, it is the exception rather than the rule, for structural framing to be left exposed for any length of time.
Many unsightly defects and structural weaknesses may result from using framing lumber which has an excessive moisture content at the time of installation (8)*. With today's short exposure period in building, it has become mandatory that framing lumber be properly dried and stored prior to being installed.

The primary purpose of this limited study was to determine minimum acceptable "on-site" piling standards. An additional aim was to determine the extent of degradation by merely noting the general condition of the individual pieces as they went into the pile and comparing this with their appearance as the pile was finally dismantled.

PROCEDURE

Sixty pieces of properly kiln-dried 2" x 3" x 10' material were obtained. The species were approximately half Douglas fir and half western hemlock. All pieces were Construction grade.

Each piece was inspected for obvious defects, such as warp, cup, twist, checking and splitting; and then piled, Figure 1. In general, the lumber going into the pile was in excellent condition.

![Figure 1. Lumber pile with minimal covering consisting of 1" hardwood boards.](image)

Moisture content determinations were made with an electrical resistance-type moisture meter. Insulated probes were used to guard against incorrect moisture readings due to any surface moisture which could collect on the boards in the pile (5). All moisture content readings were made on a wide face near the center of each piece.

It was necessary to correct these moisture content meter readings due to varying wood temperatures (5). Interior wood temperatures at the time of meter reading were obtained by housing electrical temperature probes in three pieces of lumber located on each side and the middle of the pile. A 3/8" hole was bored into each piece from the center of the side to the

*Numbers in parentheses pertain to the references.
middle. A temperature sensitive semi-conductor element with lead wires attached, was placed in each hole and corked tightly to seal out moisture and air currents. This device bears the trade name, Thermistor, Model 45A2. Figure 2 illustrates the placement of equipment for measuring wood temperature.

Each of these devices was pre-calibrated so that electrical resistance readings were directly convertible to interior wood temperature readings. The degree of accuracy obtained was probably greater than that needed to correct the moisture meter readings. However, this method of measuring interior wood temperature was used because of its convenience.

Initial temperature and moisture content readings were taken on each piece going into the pile. The bottom row of boards in the pile was placed directly on the grass, Figure 1. One board containing a temperature measuring device was located in the West side of the North-South oriented pile near the center of height. Another was placed on the East side, near center height, and the third was located as centrally in the pile as was possible to obtain. It was felt that these locations probably represented the extremes of temperature variation within the pile. Subsequent readings were taken either early in the morning or late in the afternoon to minimize temperature differences between boards.

The pile was given a minimum cover of 1' random width hardwood boards, Figure 1. This was chosen to represent the least amount of cover any lumber pile might be given.

Subsequent moisture content readings were taken on each board after the end of 4, 11, 18, 39, 53, and 81 days of exposure to the weather. Care was taken in disassembling and assembling the pile to insure replacing each board in its initial position.

*Mention of any brand or name in this publication does not imply that the article so designated is recommended or endorsed by the Agricultural Experiment Station of Purdue University over similar articles not mentioned.
RESULTS

During the first 18 days of exposure, the weather was rather warm and dry. No precipitation occurred. During the remaining two months of exposure the weather was quite humid and cool. On the 35th day, precipitation in the form of rain totalled 0.56". From the 36th day to the 43rd day, the relative humidity was quite high and low ground fogs were common in the mornings. The only other rainfall occurred on the 56th day and lasted intermittently for 2 days for a total precipitation of 0.64". The remaining 25 days were relatively dry although considerably cooler than the first 18.

Table 1 is a compilation of the results of this experiment. It presents the average moisture content of the six boards making up a particular row, after a given number of days of exposure to the weather. Row number 10 was in direct contact with the

<table>
<thead>
<tr>
<th>Row Number</th>
<th>0</th>
<th>4</th>
<th>11</th>
<th>18</th>
<th>39</th>
<th>53</th>
<th>81</th>
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<tr>
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<td>12.7</td>
<td>12.0</td>
<td>11.3</td>
<td>19.7</td>
<td>14.7</td>
<td>20.3</td>
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<tr>
<td>2</td>
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<td>14.0</td>
<td>13.0</td>
<td>11.7</td>
<td>19.0</td>
<td>16.5</td>
<td>21.2</td>
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<td>13.2</td>
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<td>4</td>
<td>14.3</td>
<td>14.3</td>
<td>13.2</td>
<td>12.0</td>
<td>13.0</td>
<td>13.3</td>
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<tr>
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<td>16.7</td>
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<td>14.8</td>
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<td>15.5</td>
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<td>14.0</td>
<td>17.5</td>
<td>17.0</td>
<td>19.5</td>
</tr>
<tr>
<td>9</td>
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<td>14.7</td>
<td>14.3</td>
<td>14.3</td>
<td>15.5</td>
<td>15.5</td>
<td>19.2</td>
</tr>
<tr>
<td>Upper side 10</td>
<td>14.7</td>
<td>14.0</td>
<td>14.3</td>
<td>13.2</td>
<td>17.3</td>
<td>18.0</td>
<td>21.2</td>
</tr>
<tr>
<td>Lower side 10</td>
<td>14.7</td>
<td>16.7</td>
<td>18.0</td>
<td>18.3</td>
<td>19.7</td>
<td>20.5</td>
<td>21.4</td>
</tr>
</tbody>
</table>

Average beginning moisture content

Average moisture content at end of dry weather

Average ending moisture content

| Relatively dry weather | Relatively wet weather |
ground and was therefore subject to moisture pick-up from the bottom as well as from the top and sides. Consequently, measurements were made on the bottoms and the tops of these pieces.

The table is arbitrarily divided at the 18th day, to separate the dry and wet weather periods which had opposite effects on the moisture content changes. It can be seen in Table 1 that the general trend was to lose moisture during the dry weather, and to gain moisture after the rains on the 35th and 56th days. The moisture content of the sixty pieces dropped from 14.4 percent to 12.8 percent during the dry weather. After the two rains, however, the average moisture content increased to 19.6 percent. Some boards in the pile were actually wet to the touch.

It should be pointed out that the moisture contents listed in the 'wet weather' section of the table are liable to error. Resistance-type moisture meters give reliable results when used on wood with a normal drying gradient. However, when the drying gradient is reversed, as it was during the wet period of this study, measurements of moisture may be in error. Insulated probes which were used, afforded some protection against error. It is the author's opinion that if errors were made in moisture determination, they were on the low side.

Figure 3 shows the checks and splits which developed in the ends of close-piled boards due to relatively rapid drying during the first part of the exposure period. Also during this time, several pieces in the top two rows warped enough to make them practically unfit for use as framing material.

A few days after the first rain, mold growth was noticed on several of the wetter boards near the center of the pile. Since molds and wood-rotting fungi, although distinctly different, develop under the same moisture conditions, the presence of mold indicates the possible presence of a wood-rotting fungus.

Figure 3. End view of pile showing checks and splits which developed as a result of rapid drying of the exposed ends.
RECOMMENDATIONS

The study clearly indicates the need for proper care when lumber is temporarily stored at the building site. With precautions, dimension lumber will tend less to gain excessive moisture, or to be degraded by warping and checking while being stored prior to use.

When lumber is received at the building site its moisture content should be determined. This will dictate how the lumber should be piled to preserve its quality if it is dry, or to speed up the drying process if it is relatively green. It is recommended that moisture content determinations be made with one of several types of meters available (5). The cost of one of these instruments may be saved on only one job in which lumber with excessive moisture content is eliminated.

Because most lumber yards store dry material properly, it would be wise to delay ordering dimension material until it is needed on the job, thereby eliminating or greatly reducing "on-site" piling and storage problems. Since this is not always possible, the following precautions can be taken in "on-site" piling of dry dimension material.

It is apparent in Table 1 that the lumber pile must be kept above the ground. The pile should be supported at least 6 inches above ground line. Weeds or grass should be kept from coming into contact with it.

If the dimension lumber has been properly kiln-dried, it may be close-piled, as was done in this experiment. The finished pile should be completely covered to protect it from rain, snow and sun. Suitable covers can be made from one of the various building papers, tarpaulins, or polyethylene sheets. When a transparent polyethylene sheet is used, lumber ends should be shaded to reduce the hazards of end-checking. Suitable sun shades can be provided by placing old boards or form lumber on top of the pile and overhanging the ends. These may be held in place with bricks or building block. This will also reduce any tendency for boards in the top rows of the pile to warp or twist.

If the dimension lumber is originally green or only partially dry according to moisture meter readings (moisture content above 20 percent), close-piling is not recommended. As with dry lumber, the pile should be kept free of the ground and any vegetation. Each piece in the pile should be separated from adjoining pieces by about an inch. This can be accomplished from row to row by using nominal one inch stickers, and within a row by proper care in spacing.

A pile of green or partially dry lumber should not have its sides and ends covered. Air movement through the pile is essential to dry the wood. However, the top of the pile must be covered to protect it from precipitation and sunlight; and the ends should be shaded to preclude excessive end-checking. Material should remain in the pile until its average moisture content is below 20 percent, before being used as a framing member.
Other recommendations, similar in principle, can be found in the Wood Handbook (8), and in Wood Frame House Construction (1).

REFERENCES


7. Staff, Canadian Forest Products Laboratories, 1952. *Moisture Content Changes in Seasoned Lumber in Storage and in Transit*, Vancouver Laboratory Bulletin No. 102, Canadian Department of Resources and Development, Forestry Branch, Ottawa, Canada.