

THE REAL WORLD OF MOISTURE CONTENT CONTROL

Ray L. Todd
West Coast Lumber Inspection Bureau
Portland, Oregon

I would like to start by making it perfectly clear that I am not an expert on lumber drying and its related problems. My entire experience in this field consists of one week of weighing kiln samples at one of Charlie Kozlik's kiln drying short courses at Oregon State. In fact, I sometimes question that there are any experts in this field, as we normally define an expert. The leaders in this field probably should be called the high priests or head witch doctors or some such term.

I read somewhere that "Moisture content is defined as the weight of water in a wood sample, expressed as a percentage of the oven-dry weight of the wood. Moisture content may vary from zero for oven-dry wood to over 100 percent when the water in the sample weighs more than the wood fiber." To a layman in the field of lumber drying, and I consider myself as such, it appears that this is the sum total of the exact knowledge and total agreement in the field of lumber drying. However, this is your image and your problem.

My problem is that as a staff member of the West Coast Lumber Inspection Bureau, we are charged with the responsibility of measuring and enforcing moisture content regulations for lumber. I am reminded of a definition of the game of golf which is something to the effect that "Golf is a futile attempt to put an insignificant ball into an obscure hole using inadequate tools." Moisture content measurement and control lends itself to a very similar definition.

Drying lumber to the new moisture content requirements of the recently adopted lumber standards is not an easy task as many of our member mills have discovered. The handbooks tell us that freshly sawn lumber can have moisture contents that are very high. The average for Douglas fir is 37% in the heartwood and 115% in the sapwood. For hemlock, the figures are 85% and 170% respectively. These are average values. Some pieces of wood will go well over 200% in moisture content, particularly in hemlock. Lumbermen use many descriptive terms to describe these pieces, the most socially acceptable of which is sinkers. So lumber can be dry or green, or very green. It's all a matter of degree until you get to the American Softwood Lumber Standard PS 20-70 and then there is no degree anymore. It's either green or it's dry. PS 20-70 contains the following definition. . . "DRY LUMBER For the purpose of this standard, dry lumber is defined as lumber which has been seasoned or dried to a moisture content of 19% or less." "GREEN LUMBER For the purpose of this standard, green lumber is defined as lumber having a moisture content in excess of 19%." It's a go or no go proposition, and 19% is the magic figure.

Since the standard is so explicit about what is green and what is dry, it would be nice if it were equally explicit in telling you how to measure a piece of lumber to determine if it is indeed green or dry. Unfortunately, all the standard says is "Provisions for seasoned lumber shall be expressed in terms of maximum moisture content to be allowed at any point on each piece." Now this statement can be interpreted to mean that if you could find a spot or pocket in a piece that was over 19%, the piece could not be called dry. This of course is unrealistic because of the variation of moisture content within even a seasoned board. An interesting study was made some years ago on the distribution of moisture in a 16 foot 2x6 Douglas fir plank. The average of the entire piece

was 18% but the range of moisture content within the piece was from 10% to 142%. This brings up the question of how big an area or volume of a piece should be measured to determine the moisture content of that piece. We badly need a definition for this.

Product Standard PS 20-70 goes on to say "The restrictions on the moisture content of seasoned lumber shall apply at the time of shipment, at the time of dressing, and at the time of any reinspection. Moisture content determination shall be made with electric meters of the type described in Section 9, Method B of ASTM-D-2016, Standard Methods of Test for Moisture Content of Wood, and the procedures to be used in making this determination shall be in accordance with those described in Section 11, Method B of ASTM-D-2016. Many people in the industry, after their first look at these procedures, predicted that a request for reinspection for moisture content would accompany each order for dry lumber. The feeling was that with the wording of the lumber standard, and the procedures of ASTM, it would be impossible to technically qualify a shipment of lumber as dry. This situation has not developed and we have had very little problem with nuisance type claims on moisture content. We have found that if the lumber is reasonably well dried, there will be no complaint and if there is a complaint, there is usually no question about the lumber being wet.

The ASTM procedures are quite vague which has made it necessary for inspection agencies to develop practical methods of measuring moisture content. From a practical standpoint, all inspection agencies use essentially the same procedures to examine lumber for conformance to moisture content specifications. Generally only a sample of lumber is checked with a moisture meter to determine if a larger lot of lumber meets moisture content requirements. Moisture content is measured with a standard electric meter and a single reading is taken in the center of the board between 2 and 4 feet from the end. Care is taken to avoid obvious wet or dry spots or characteristics such as knots which would affect the reading.

Most inspection agencies today use the power loss type of meter in preference to the resistance or needle type meter because of the speed and convenience of this type of meter. There has been some controversy regarding the relative merits of the different types of moisture meters which are available. All of the meters work but the question is, how well do they really work? Again, in this never never land of moisture content control, surprisingly little information on this subject is available. Recently a very good report on electric moisture meters has been issued by the Canadian Forest Products Laboratory. I would like to read the summary from this report as it is directly concerned with comparing the different meters.

Summary

"Both the resistance and power loss meters displayed similar accuracy in assessing moisture content when compared with the oven-dry method. They were also similar in precision with tolerance intervals of approximately + or - 1.5% for lodge pole pine, and + or - 3% for white spruce. Proper usage of the meters requires an adjustment of all readings taken first for temperature and second for species. In addition, variation in density of lumber will necessarily cause some discrepancies in moisture content determined by an RF meter while resistance readings will be effected by the depths to which insulated needles are driven." If I may take the liberty of summarizing the summary, it says none of the meters are real precise but they are all comparable as far as accuracy is concerned.

A very practical criteria for choosing the type of moisture content measuring equipment is to get the same, or at least something which will give similar results, as the inspection agency which will be checking your lumber.

Whatever its moisture content, lumber will season in place to an equilibrium moisture content which is dependent on the time of year and geographical location.

Many authorities claim that for the best performance, wood should be installed at a moisture content near the mid-point between the high and low moisture content values it will obtain in service. The range in moisture content which can be expected for various areas is as follows: The range will be 7% to 10% in Denver, Colorado. It will be 10% to 12% in New York City. It will be between 13% and 15% in Chicago, Illinois and Portland, Oregon. And it will range between 16% and 19% in San Francisco, California. Framing lumber is seldom this dry at the time of installation. It would normally be impractical to try to live with a requirement that the lumber be this dry at the time of installation. The required moisture content of wood at time of installation is sometimes regulated by the Building Codes. Of the three Model Building Codes, two have no moisture content requirements. These are the Basic Building Code and the Uniform Building Code. The other, the Southern Standard Building Code, contains the following statement: "All lumber members 2" and less in thickness shall contain not more than 19% moisture at the time of permanent incorporation in a building or structure. The minimum property standards of the Federal Housing Administration state "Moisture content of timbers, dimension lumber and board lumber 8" or less in width shall not exceed 19% at time of installation. Moisture content of all boards wider than 8" and of timber and dimension lumber in areas where the average annual precipitation is 15" or less shall not exceed 15% at time of installation."

Most local codes are based on one of these model codes and the moisture content provisions are worded accordingly. In the West, which is normally the Uniform Building Code, usually there are no restrictions on moisture content. In the South, which generally bases its codes on the Southern Standard Code, the requirement is 19%. Generally these requirements have been interpreted to apply at time of second inspection or wrap-up when the building frame is completed and weather-proofed and ready for the interior finish.

We now have over a year's experience with the new seasoning provisions of Product Standard 20-70. Prior to publication of this standard, policing of moisture content was confined mainly to reinspections. When the new Rules were published showing different finished sizes for green and dry lumber, the Bureau was required to police moisture levels in lumber grade marked with stamps indicating the lumber is dry. No difficulty was experienced in moisture levels of KD Douglas fir. Hemlock or hem-fir was a different matter however as many mills discovered when trying to qualify for use of dry stamps. In some instances, the stock was dried too much resulting in considerable degrade. In other instances only 75% to 80% of the pieces in the kiln charge qualified as dry, the balance being quite wet. Some mills are still having this second problem today and are not catching these wet pieces until after the lumber has been surfaced in which case you have wet lumber run to the dry size. This lumber has, and is, being restamped with S-GREEN stamp showing the dry size. While this is legal under the American Standards, it is not a very satisfactory solution to the drying problem and is almost guaranteed to get you into trouble sooner or later. A few

mills have tried air-drying. Some of the air-dried lumber encountered has been found at a satisfactory moisture level but in many cases a large percentage of the pieces contained excessive moisture. In much of the West Coast region it appears that air drying to 19% maximum moisture content is not practical. The many problems encountered initially in implementing the new moisture content requirements are now decreasing and much better overall drying is being accomplished. Generally, mills drying lumber have cooperated well with the Bureau in maintaining proper moisture levels and the overall drying efficiency has been good. More is being learned about drying and today mills are doing a better job on reasonable schedules.

From the viewpoint of an inspection agency such as the West Coast Lumber Inspection Bureau, I can summarize the moisture content measurement and control situation as follows: It would be desirable if lumber drying were more of a science and less of an art. To a layman such as myself, lumber drying appears to be more closely akin to witchcraft or black magic than to a branch of wood science. I think you should change this image if you can. After all, if I can't understand it, I'm against it, or at best very suspicious.

There is a lot of work to be done in defining policies and procedures regarding the measurement of moisture content. The ASTM standard needs a lot of work to really make it usable. We also need statistically sound sampling programs so that conclusions about a large quantity of lumber can be made by testing a small lot. And finally, we need testing equipment which will give reproducible results.