WHAT IS KILN DRY LUMBER?

A Suggestion for an Improvement in Method of Specifying

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Any one unfamiliar with the lumber business might naturally infer that "kiln dry lumber" was lumber which had been kiln dried. He might infer, also, and with equal propriety, that "Oregon pine" was pine which grew in Oregon. But those who are wise to the deals of the game know better. "Oregon pine" is really Douglas fir and most of it comes from Washington at that, and real kiln dry lumber is something more than simply the product of a dry kiln. Because a crock is made in China does not of itself qualify it to be classed as Chinaware.

Unfortunately, the term "kiln dry" as used today is practically meaningless, and no two parties agree as to just what is meant when the term is used in specifications. Lumber which has been run through a dry kiln may be very far from what is intended when it is specified as kiln dry. It would be interesting to jot down the various ideas among those in the lumber industry as to the meaning of this term. Some definition which could be generally accepted as standard is badly needed. It must be sufficiently definite to cover all requirements, yet broad and simple enough to apply to a test of the material which is practicable and which can be made by the inspector at the same time he is inspecting the lumber for other conditions.

Moisture Limits

At first thought it might seem as though all that were necessary would be for the various interested parties to get together and to decide definitely upon certain moisture limits to be adopted as standard. But here is just where the rub comes, for the moisture content of lumber will not stay put. It is constantly varying with changes of the weather. Suppose we were to say that a moisture content of 5 percent should be prescribed as the desideratum. If the lumber is taken out of the kiln with an average of 5 percent and shipped or stored in an open shed in the summer time, it will most likely increase to an average of 8 percent in a couple of months' time, and may ultimately come up to 10 or 12 percent. Yet it will still be
kiln dried lumber. As a matter of fact, if the drying has been properly done it will still be in better condition for manufacture than will ordinary air-dried lumber at the same moisture average. The main difference is that the kiln-dried material will be dry on the inside whereas the air-dried material will more than likely be still fairly damp inside, although it may be dry on the outer surface. The surface moisture is easy to dry out again, but the internal moisture is very obstinate to get rid of. So, although the kiln-dried material may have reabsorbed enough moisture on the surface to bring its average up to 8 percent or more, it will still be more desirable than air-dried lumber, and might with propriety be classed as "kiln dry." This is probably the best test which can be applied to determine whether lumber has been kiln dried or not.

What is Meant by "Kiln Dry?"

Considerable advance, however, has recently been made in the direction of defining what is meant and what is desired by the term "kiln dry." This has been brought about by prescribing the moisture content tests, and limiting the allowable variation in distribution of moisture between the core and the surface; and in the pronged disk tests for casehardening. Such tests for properly kiln-dry lumber are coming to be accepted as highly desirable. Nevertheless, although they sometimes serve the purpose, they are still not ideal. It is frequently difficult to fulfill the specified conditions and in some cases it may be unnecessary as far as the intended use is concerned. That is to say, the specification as to the average moisture content and its distribution may not be the really important thing. For example, if oak plank intended for use at some future time should show a considerable variation in moisture from recent exposure to damp weather this might not disqualify it provided it were dry in the center even though it might fail to fulfill specifications. The reabsorbed surface moisture can readily be dried out again. The important thing in this case is whether the center of the plank is sufficiently dry.

Moreover the moisture distribution test is sometimes cumbersome to apply and subject to considerable error in execution.

If the purchaser should not use the lumber until a considerable time after it has left the dry kiln, of what use would it be to him to specify that it should have been say, 5 percent at the time it was removed from the kiln? Would it be any better, then, to prescribe a moisture content at the time of using? Probably so, and this is occasionally done. But in order to do so, suitable storage conditions must be assured in order that the lumber may be kept in proper condition from the time it is removed from the kiln until used. But even so, the seller can often give no guarantee as to what moisture the lumber will contain at the time the buyer uses it. Here is the dilemma
often faced by the lumber business when it attempts to make the average moisture percent a basis for specifications: The only moisture condition which the seller can always reasonably guarantee is its condition at the time it leaves the dry kiln -- and that is of little interest to the buyer or manufacturer. On the other hand, it is the moisture condition at the time he uses the lumber which is of great concern to the buyer, and this cannot always be assured by the seller (except where the lumber is stored under controlled conditions). Is the game then a draw? Is there no way out of this dilemma? I think there is.

A Possible Solution

In presenting the following possible solution, I have no wish to disparage the moisture distribution method of specifying kiln-dry lumber now coming into use, but rather to offer a suggestion which might be worth considering for development into practical use. Unfortunately, actual data is not at hand to substantiate its possible value or practicability; but the statements made are, nevertheless, based on many years' experience and study. Here is the idea:

In the first place we must determine exactly what it is that the buyer or manufacturer wants as to the condition of his lumber. Secondly, how can the mill man give him this desideratum and stand back of it with a guarantee? Is average moisture content a suitable criterion? Does it afford a means for answering either question? Average moisture content by itself is of very little significance. What the manufacturer wants to be assured of is principally two things: (1) that the lumber is thoroughly dry on the inside, and (2) that the moisture is uniformly distributed throughout the length of each piece. If these two requirements are fulfilled, it matters little whether the average moisture is 5 or 8 percent; but if either condition be unfulfilled, trouble is almost certain to result, even though the average moisture be within the specifications.

In Figure 1 I have indicated four sections as cut across the boards, in each one of which the average moisture is 7 percent. Sections A and D represent the worst conditions, entirely unsuitable for kiln-dry lumber. In A drying has been very rapid, and the lumber was removed from the kiln while it was still losing moisture quite rapidly. In Figure 2 are shown the drying curves of two boards giving the average moisture contents after different lengths of time in the kiln. After D days the board indicated by curve A has reached an average moisture indicated by P, but it is still rapidly drying. In F days the other board has reached the same average of moisture P, but it will be noted that it has practically ceased drying (due to a higher humidity in the kiln). Now if A be removed after D days and B after F days both will have the same average moisture content P. But in A the inside will be still moist and the surface very dry, whereas in B the distribution
will be nearly uniform. These are the conditions illustrated in Figure 1 at A and B, respectively. B is in excellent condition, but A is very bad. Note particularly that both have the same average moisture.

In Section C (Figure 1) it will be noted that the inside is drier than the outside. This is a case of reabsorption, where the board has been kiln dried clean through to the center, but has subsequently taken on moisture from the air. Although the moisture distribution in this case is very abrupt, nearly as much so as in A, its condition is vastly superior to that of A, because the surface moisture will readily dry out again, but the internal moisture in A is very slow to remove.

The condition shown at D is particularly bad, because if the board be shaped while in this condition it will not retain its shape, for ultimately the moisture will distribute itself more evenly with corresponding changes in dimensions.

Uniform Moisture Distribution

With respect to the second desideratum, namely, that the moisture be uniformly distributed throughout the length of the piece as a whole, this is of great importance, particularly at the time the lumber is being manufactured into articles. Consider a case where two boards are jointed and glued along their edges, as in a table top, for example. Suppose that at the time they were jointed the boards contained 10 percent moisture at their centers, but only 5 percent at their ends. Eventually this moisture will distribute itself, causing shrinkage in the middle and swelling at the ends. The severe strain set up is likely to disrupt the glue joint, as indicated in Figure 4, or to cause the table to crack open near the middle. It matters little whether the table was manufactured at an average moisture of 5 percent or of 9 percent, since it will normally go through this range yearly, in our heated houses, between summer and winter. But it is of utmost importance that in either case the moisture be uniform throughout the length of the pieces at the time the table top is manufactured.

Bearing these facts in mind, I think it becomes evident that it may be possible to draw up a specification of kiln-dry lumber which will be intelligible and satisfactory to both seller and user.

The Internal Zone

I have shown in this discussion that the average moisture content is not always sufficient in a definition of "kiln-dry lumber," and furthermore specifying the moisture distribution across the section does not necessarily fill the bill. If, however, we consider the
internal zone, we will have something more significant to guide us in
determining whether lumber is in a satisfactory condition or not. The
surface changes rapidly with weather conditions, but the interior is
slow to change and therefore is quite stable. Moisture absorbed on
the outer zone dries off again readily, so that a condition such as C,
Figure 1, is easily handled and satisfactory, whereas a condition such
as A is difficult to cope with.

Suppose now that we should specify that the inner zone shall
have a moisture content not to exceed 7 percent, and pay no attention
whatever to the moisture content of the outer zone. Conditions C and B,
Figure 1, are thereby acceptable and A is excluded. D would also pre-
sumably be excluded. Suppose furthermore that we should specify that
the moisture difference between any two cross-sections of a board, say
4 feet apart, lengthwise, shall not exceed 2 percent, the second
desideratum will then be taken care of. For special cases qualifications
as to distribution across the board as well as lengthwise might be made.

The entire problem is thus simplified and a means offered for
specifying conditions that can readily be tested by the inspector.
All that is necessary to specify is two things: that the inner zone
(given thickness) shall not exceed a given moisture content; and that
the variation in average moisture content between two sections (given
distance apart) shall not exceed a given amount.

In the above discussion I have considered the moisture factor
only. To be complete, specifications for kiln-dry lumber must also
take into consideration, of course, the stresses due to casehardening.
The test sample for this condition, consisting of a pronged disk, has
been fairly well standardized and needs no discussion here. Such tests
should always be required, since casehardening may be entirely apart
from moisture distribution. In fact a board may have uniform moisture
and nevertheless it may be in very bad condition on account of case-
hardening stresses produced by improper kiln drying methods.
Figure 1
Figure 2
Figure 3

Figure 4