

NEWS AND VIEWS OF THIS KILN DRYING BUSINESS

The Problem: Do Cross-Piled, Cross Circulation Lumber Dry Kilns Produce Uniformly Dried Lumber?

The Answer:

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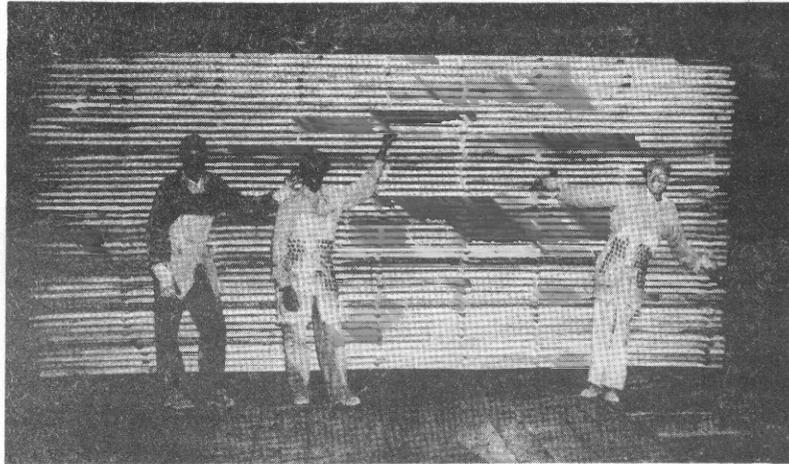
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For many years the conversion of cross-piled, natural-circulation lumber dry kilns to forced-air-circulation kilns of one type or another, has posed serious problems to kiln engineers. The success of the forced-air-circulation, end-piled kiln suggests that the conversion of the cross-piled kiln should involve rearranging tracks and piling equipment in accordance with end-piled kiln design, but in many instances such a modification is virtually impossible.

Many early attempts to convert natural-circulation, cross-piled kilns to forced-air-circulation kilns by blowing the air lengthwise of the kiln and parallel to the stickers in an effort to avoid changing the piling and loading method did not prove highly successful. The excessively long air travel permitted short circuiting of the air between loads, ceiling, and walls, and resulted in inefficient, non-uniform drying. As plant layout and trackage systems often did not make conversion to end-piled kilns practical, the modification into forced-air-circulation kilns was not attempted.

Within the last 15 years, many of these older units have been converted to forced-air-circulation kilns by using fans or blowers to force air through the load parallel to the lumber and against the stickers. The heating systems had to be changed, but surprisingly enough the cross-piled, cross-circulation kiln has given excellent performance. Those which are successful are probably provided with motors of a higher horsepower than would be required in an end-piled kiln of similar capacity. More power is needed to force the air through the small spaces between the boards than would be required if the air moved parallel to the stickers.

The cross-piled, cross-circulation kiln requires that the lumber be piled with spaces between the boards of everylayer. As the air is blown parallel to the board, the stickers block the flow of air unless such openings between the boards are provided. No



Kiln truck in cross-piled, cross-circulation kiln. Fans and heating coils are below truck level. Fan baffle on ceiling prevents loss of air over top of load.

doubt some air moves diagonally across the boards between the stickers, but the main air movement is considered to be parallel to the boards. Thus, it is very important that the boards be carefully spaced during piling. In general, it is recommended that a 2-inch space be left between the boards on each layer to facilitate air movement.

In cross-circulation, end-piled lumber kilns, the desired uniformity of circulation between layers of boards is gained by providing plenty of space between the kiln loads and the kiln walls. In some of the more recent installations of internal-fan kilns, this space may be as much as 3 to 4 feet. This space is called the plenum, and its purpose is to convert as much as possible of the velocity pressure produced by the fans to static pressure. Thus the pressure differences between the two sides of the truckload will be about the same at all levels or layers.

The converted cross-piled kiln seldom has enough room between the ends of the truckloads and the walls to allow a man to squeeze past. It would seem, therefore, that adequate plenum space is not available to assure reasonably uniform circulation from the top to the bottom of the load. Even so, uniformly dry stock

can be produced in a converted dry kiln of this kind.

It is believed that box piling of lumber for these cross-piled, cross-circulation kilns is very helpful and preferable to sorted-length piling, if warp is not a serious problem. The ends of the box-piled, mixed-length truckloads have considerable void space in them, which serves to increase the plenum volume. In the cross-circulation, end-piled kiln it is desirable to keep the resistance to air flow as uniform as possible. This is best accomplished by sorted-length piling. Box piling, rather than sorted-length piling, is recommended for cross-piled, cross-circulation kilns because of the increased plenum space provided.

A recent study of the uniformity of moisture content of lumber, kiln dried in a cross-piled, cross-circulation kiln, confirms the belief that this type of kiln can be successfully converted. The kiln in which the lumber was dried is 33 ft. long, and 19 ft. wide, and holds six trucks of lumber. Each truckload is 59 in. wide (the length of the stickers) and about 7½ ft. high. Nominal 1-in. stickers 59 in. long are used, and in piling the lumber 50 to 54 inches are laid down per layer. As the stickers overhang the lumber layers about 1-in. on each

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Kiln truck No.	Truck location	Average moisture content Percent
1	At door	5.32
2	2nd from door	5.43
3	3rd from door	5.39
4	4th from door	5.63
5	5th from door	5.43
6	Against back wall	5.74
Average for kiln charge		5.50

end, the board opening varies from 3 to 7 in. per layer. One-inch yellow-poplar lumber was kiln dried from an air-dry moisture content of about 25 percent to 5.5 percent in 4 days' time. The average moisture content of each of the six trucks is given in the tabulation above.

These moisture content averages were obtained by random tests on cuttings back of the planer with an electrical moisture meter. A total of 50 tests were made while each truckload was being taken down. Thus, the average moisture content for each truck is represented by tests of pieces in various layers from top to bottom and in various locations within the layers—end to end and side to side. Obviously, there is no practical difference in average moisture content

over the load. The 1-inch lumber was box piled. Loads 16 feet long included both 14- and 8-foot stock, and 12-foot loads included 10-, 6-foot, and shorter lumber. The kiln charge consisted of both 16- and 12-foot loads. The average moisture content of the upper third, middle third, and lower third of the six kiln trucks was as shown in center tabulation.

It is apparent that the circulation was adequate through these various levels of the kiln trucks. During the kiln run, the circulation was automatically reversed every 6 hours, and any possibility that the board ends were dryer than the central portions isn't likely, because the moisture meter readings were taken randomly.

As these moisture meter values are at the lower limit of usefulness of

at the time the study was made.

The excellent drying results in this cross-piled, cross-circulation kiln do not mean that similar results can always be expected in other conversions of the same type. The study does show, however, that good drying results can be obtained in such kilns. From the kiln engineering standpoint, conversions of this kind require extra power input for fan or blower operation. From the kiln operator's side, open piling and box piling are very important. The use of kiln samples in the operation of these kilns will test the ingenuity of the kiln operator, but by careful selection and placement of kiln samples, experience is gained that will enable skillful and good performance.

Kiln truck No.	Upper third Percent	Middle third Percent	Lower third Percent
1	5.3	5.3	5.3
2	5.6	5.4	5.3
3	5.5	5.5	5.2
4	5.5	5.6	5.7
5	5.5	5.6	5.3
6	5.6	6.0	5.6

between the six kiln trucks making up the kiln charge. No truck location could be said to be superior to another insofar as air circulation was concerned. If the circulation had been inadequate at any one location, a significantly higher average moisture content would have been expected.

Uniformity of dryness between various height levels in the kiln trucks is also of interest, for if differences are found then spots of inadequate circulation would be indicated. The kiln in which the test charge was dried is a long-shaft kiln with opposed fans located below the tracks. The kiln is steam heated, the coils being below truck level. A sheet-metal baffle is let down from the ceiling to the top of the truckload to prevent short circuiting of the air

the electrical resistance meter, there may be some doubt as to their accuracy. At the end of the kiln run a number of test boards were cut for moisture tests. These test boards were scattered throughout the kiln charge, and the moisture analysis was made by the oven-testing method. Thirty-eight tests were made in this way to represent the kiln charge as compared with 300 electrical moisture meter tests. The average moisture content and uniformity factors of the kiln charge as obtained by the two test methods are as shown below.

For practical purposes these average values are just about identical, and give greater assurance that the average values determined by meter readings are reasonably representative of the actual moisture conditions

	Average moisture content Percent	Uniformity factor
Oven-dry test method	5.54	0.45
Electrical meter test	5.50	.54