KILN SCHEDULES, KILN DESIGN, HOT CHECKS, FINAL MOISTURE - THE HIDDEN CONNECTIONS

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Often the connections that relate these items elude our grasp. However, just because we are unable to recognize the connections - in no way means that the connections do not exist.

We all work with kiln schedules, making adjustments as product, resource, and conditions change. Then we compare the difference in drying, using such tools as average moisture content, distribution of moisture, prong tests, and other gauges of drying. Today I'm going to discuss some factors relating to kiln design and how the kiln design relates to drying uniformity.

About a year ago I was assisting a western mill to improve their drying uniformity. This mill was drying hemlock dimension from small diameter logs. The dimension stock was being dried in several single track, concrete block, flat roof, line shaft, 104' long, steam heated kilns using conventional drying schedules.

The hot check data recovered by the customer indicated the present hot check procedure was not a good indication of final moisture content. When the drying was terminated at a consistent hot check moisture content, the final moisture was sometimes wet, sometimes too dry. In the customers words - **"Hot check procedure is not a good indication of average final moisture content."**

This started us thinking about the design of the kiln and the somewhat random locations where the hot checks were taken. In the previous year, I had taken many temperature profiles of similar single track line shaft kilns and had noted some inconsistency in the temperature down the length of the kiln. I related this inconsistency to varying air flows between the open side of the fan wall and the closed side of the fan wall (Figure 1). It seemed that in the single track line shaft kiln, the air had difficulty making the sharp turn behind the fan wall in order to provide uniform air flow (velocity) through the heating coils. It also seemed that the larger volume of air passing through the coil at the open side of the fan wall provided a smaller temperature rise and the smaller volume of air passing through the coils on the blank side of the fan wall provided a greater temperature rise. This seemed to explain why there could be a significant temperature difference in the air entering the load as you progress down the length of the kiln.

With these previous experiences in mind, we began to question the location and the randomness of our hot meter checks. After all, the purpose of the hot meter check is not just to terminate drying but to terminate drying so that the final moisture content of the finished lumber will be grouped in the target zone. If the method of recovering the hot meter moisture content is not consistent, it can never be a reliable tool to terminate drying and correlate to final moisture content.

To test our theory that there may be a predictable relationship between the kiln design and uniformity of moisture content we did the following:

1) Marked the location on the kiln wall indicating the open side of the fan housing and the closed side of the fan housing.

2) Six separate kiln charges of 2 X 4 hemlock were dried, hot checked, pulled and surfaced.

3) 50 hot checks were taken below the open side of the fan wall and 50 were taken below the closed side of the fan wall. (At locations marked on the kiln wall.)

4) The separate sets of data were compared to final moisture content readings of the in-line meter at the planer (Table 1).

It is interesting to note that in all the kiln charges, the average of the hot checks taken at the open side of the fan wall were higher in moisture content than those at the closed side of the fan wall. Also note that in 5 of the 6 kiln charges the average of the hot checks taken at the open side of the fan wall were significantly closer to the final average moisture content taken at the planer by the in-line meter.

TABLE 1. Comparison of moisture content.

	HOT CHECKS		
KILN #	CLOSED SIDE	OPEN SIDE	FINAL M.C. AT PLANER
7	15.1	15.9	16.9
2	15.7	17.1	16.7
7	13.0	14.5	14.7
14	13.0	13.7	12.2
12	13.4	14.4	14.2
13	13.7	14.4	14.4
TOTALS OF ALL SIX CHARGES	13.98	15.0	14.85

TABLE 2. Comparison of difference in MC.

KILN #	HOT CHECKS				FINAL M.C. PLANER
	CLOSED SIDE		OPEN SIDE		
7	15.1	+0.8	15.9	+1.0	16.9
2	15.7	+1.4	17.1	-0.4	16.7
7	13.0	+1.5	14.5	+0.2	14.7
14	13.0	+0.7	13.7	-0.5	12.2
12	13.4	+1.0	14.4	-0.2	14.2
13	13.7	+0.7	14.4	0.0	14.4
TOTALS OF ALL SIX CHARGES	**13.98**	**+1.02**	**15.0**	**-0.15**	**14.85**

It is interesting to me that this pattern is as pronounced as it appears to be. It is also a puzzle that the higher moisture content is below the open side of the fan wall. At first thought, I would expect the open side of the fan wall to be exposed to higher air velocity and therefore be lower in moisture content. But remember what we talked about earlier, lower air flow over the heating coil creates a higher temperature rise.

I reason that the higher temperature air tends to overdry the outside edge of the load directly below the closed side of the fan wall. However, since the air flow would tend to be less in these areas, the air would be cooled more quickly and tend to make the opposite side of the load higher in moisture content. Remember in a line shaft kiln, if the air enters the load below the closed side of the fan wall, it exits below the open side of the fan wall.

Some may say these numbers are not significant, I tend to think they are. If through more careful selection of your hot checks you can terminate drying in a manner that allows your lumber to consistently correlate more closely to the desired final moisture content, several benefits will be gained.

1) Wets are reduced.

2) Overdry is reduced.

3) Kiln hours will be saved.

4) The degrade associated with overdry is reduced.

In summary, be aware of how the design of your kiln may effect the moisture uniformity of the load. Also be aware of how certain areas of the

load may not be representative of your final moisture content. After all what is the purpose of the hot check? It is an indicator of when to terminate drying. However, if due to kiln design you know certain areas are consistently dryer than other areas, you will tend to discard those readings in favor of the wetter ones.

One final thought. Proving that a predictable pattern of moisture distribution exists in your kiln is the first step in modifying the design to correct the problem.

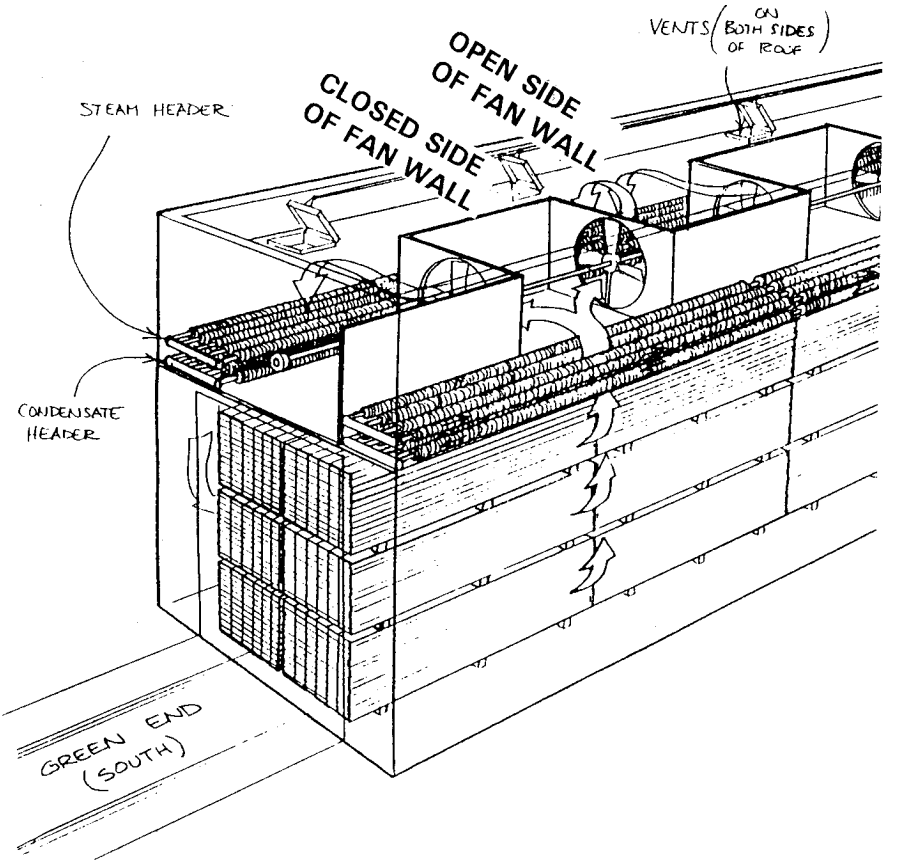

FIGURE 1. Open and closed sides of fan wall.