DRYING 4- BY 8-INCH DOUGLAS FIR FLOOR AND ROOF DECKING

(A contribution by the West Coast Kiln Club)

INTRODUCTION

This paper is designed to show the manner in which kiln clubs and individuals who have problems pertinent to the wood industry can work with state and federal research agencies to find solutions for their problems. It also is designed to answer some questions on drying 4- by 8-inch decking and beams for plank-and-beam construction. The laboratory work is not completed and, therefore, this should be treated as a progress report.

The Problem

Over a year ago, the question was raised at a West Coast Kiln Club meeting: "What schedule is recommended for drying Douglas fir, three inches and thicker?" At that meeting and subsequently, the question was discussed by the members and as much information as possible was collected from those with experience in drying this material. The information was collected at the Oregon Forest Products Laboratory, accompanied by a request for assistance in determining a proper drying schedule.

Kiln Club Contribution

Prior to initiation of this project, several members of the West Coast Kiln Club including Gordon Wilkinson, Lumber Manufacturers, Inc., and Roy Doster, Rosboro Lumber Company, provided information on kiln schedules they have used and degrade they have encountered. This information provided a basis for designing experimental schedules. While these men and others contacted did not mention any unexpected amount of degrade or difficulties in drying this thick material, realizing that it was unusually thick material and perhaps subject to a high percentage of degrade, all said it took a long time to dry and reduction in kiln time was desirable.

After experimental charges have been dried, results of the laboratory findings will be discussed at a future kiln club meeting. Comments and suggestions of kiln club members could lead to additional study. Final test of an experimental schedule would be trial in commercial application. It is hoped that one of the club members will run a charge on a commercial scale with the most promising experimental schedule.

Suggestions arising from experimental study should be given a fair trial with commercial equipment, since laboratory developments are of little value to industry if not tested in practice.

Final results of the work will be reported in a laboratory publication, which will be available to anyone interested. Comments or criticisms that club members might have, based on commercial charges, will be welcomed, since these comments should help guide future investigations.

EXPERIMENTAL PROCEDURE

The initial phase of the experimental work had to do with determining effect of dry-bulb temperature on this material. An effort was made to reduce the effect of wet-bulb temperature until we had determined the optimum initial dry-bulb temperature. This was done by maintaining the same EMC (equilibrium moisture content) conditions of 15 per cent on matched samples for four dry-bulb temperatures: 130, 150, 175 and 200 F. Test material for these and subsequent charges consisted of 10 matched samples (end-coated) in lengths of three, four and six feet, depending on the number of kiln charges of matched pieces that were to be involved. All material was Coast-type Douglas fir selected for flat grain to show maximum degrade effect that might be expected from a given charge.

Specific gravity of the material ranged from 0.40 to 0.57. Initial moisture content varied from 32 to 59 per cent. All material was dried to about 14-18 per cent.

Amount and extent of checking were primary factors in determining degrade. Checks were rated as:

- Small--up to 4 inches long
- Medium--from 4 to 10 inches long
- Large--over 10 inches long, less than 1 inch deep
- Degrade--1 inch or deeper, any length; depths of opposite checks to be combined.

After the optimum initial dry-bulb temperature was determined, various EMC conditions were tried both with the optimum dry-bulb temperature and with other dry-bulb temperatures.

In addition to normal kiln-drying procedures, two pretreatments were tried:

- Treatment with Morton salt at the recommended rate of 50 pounds per M fbm
- Steaming at 212 F for 12-24 hours before kiln drying.

On determining the optimum drying conditions, experimental kiln charges of 20 pieces, each six-feet long, were dried to confirm the results of previous efforts.

Results Thus Far

After drying four matched charges in EMC conditions of 15 per cent with initial dry-bulb temperatures of 130, 150, 175 and 200 F, respectively, results indicated there was little in favor of one dry-bulb temperature over another in this range. Since a similar amount of degrade resulted regardless of the temperature at EMC conditions of 15 per cent, it was decided that an initial dry-bulb temperature of 175 degrees would be the best for future work. The temperature of 200 F was decided against since the wood darkened and, further, it was a temperature at which many dry kilns would not be operated readily.

After deciding on a dry-bulb temperature of 175 F, further work was aimed at finding the best initial wet-bulb temperature. Three kiln charges were run in EMC conditions of 12, 10 and 8 per cent, respectively. Some of the results of these tests are shown in Table 1. EMC conditions of 12 per cent appeared to give best results.

Following these three charges, a verification kiln run was made in which 20 six-foot pieces were dried. Initial dry-bulb temperature was again 175 degrees, and EMC conditions of 11-12 per cent were maintained until the moisture content was below 20 per cent, at which time EMC conditions were changed to 6 per cent. The material was dried to 14 per cent, which required 305 hours. Two other kiln charges were dried, each containing 20 pieces matched with pieces in the verification run. Pieces in one charge were salt-treated; in the other charge, pieces were steamed before drying. Results indicated that presteaming was of little or no benefit, but pretreatment with salt had some value in reducing checking. Some previous kiln charges had given similar results.

Sample material dried in these verification charges was stored for three months or longer to determine the amount of honeycomb, if any, that might occur. On cutting these samples, no honeycomb was found. One piece showed the result of an end check that extended for almost the full length of the piece. Since all of our samples were end-coated, it is possible that more pieces might have extended end checks. It seems desirable, therefore, to end-coat if possible.

CONCLUSIONS

- Temperatures in the range of 130 to 200 degrees F with constant EMC conditions of 15 per cent appeared to have little effect on checking.

- The kiln schedule consisting of an initial dry-bulb temperature of 175 F and EMC conditions of 12 per cent until the material reached 20 per cent, after which the EMC conditions were lowered to 6 per cent, appeared to give best drying results in shortest possible time. While these results are not considered to be ideal for lessening checking, a great deal depends on how serious the so-called degrade and large checks are considered to be. Furthermore, it is not likely that an entire kiln charge in a commercial operation would consist of flat-grain material, as in wood studied, and consequently, less degrade could be expected.

- Pretreatment with a salt such as the Morton Lumber Cure reduced amount and extent of checking.

- There was no honeycomb evident in any of the kiln-dried pieces, except on ends of freshly cut samples that were left in a heated room.

Work to be Done

Further work is to be done with low initial dry-bulb temperatures of 100-130 F. Then matched samples in two charges will be dried, one charge with the higher temperature schedule suggested above; the other to be dried with the best low-temperature schedule. Results will be analyzed and compared to formulate recommendations for a kiln schedule to be tried commercially.

Table 1. Drying Data for 4- 8-inch Flat-grain, Structural Grade, Douglas Fir Decking.

Pieces in charge	Length	Specific gravity range		Moisture content	Kiln conditions			Time to 18% MC	Planed pieces checked			
						EMC			Bark face		Pith face	
		Low	High		Dry-bulb	Initial	Final		Large	Degrade	Large	Degrade
	Feet			%	F	%	%	Hours				
Matched charges												
20	6	0.44	0.57	38-42	175	11	6[1]	240	1	2	1	1
20	6	0.44	0.57	38-42	175	11	6[1]	293[2]	1	1	1	1
20	6	0.44	0.57	38-42	175	11	6[1]	290[3]	5	1	2	0
Matched charges												
10	4	0.40	0.54	36-59	175	12	12	288	0	0	1	0
10	4	0.40	0.54	36-59	175	10	10	290	0	1	4	1
10	4	0.40	0.54	36-59	175	8	8	225	0	1	3	0
Matched charges												
5	3	0.42	0.54	33-51	175	8	8	132	0	1	1	0
5	3	0.42	0.54	32-41	130	8	8	213	0	2	1	1
Matched charges												
5	3	0.40	0.46	35-49	175	11	11	200	2	0	0	0
5	3	0.40	0.46	35-49	175	11	11	212[3]	0	0	0	0
Unmatched charge												
5	3	0.41	0.52	33-58	175	12	8	195[4]	2	0	2	0

[1]EMC lowered to 6% when MC (moisture content) was 17%.

[2]Steamed 12 hours before drying.

[3]Treated with Morton salt; showed some checks before drying.

[4]EMC lowered to 8% when MC was 21%.