ROUGH THICKNESS REQUIREMENTS FOR RED OAK FURNITURE CUTTINGS

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ABSTRACT

Thickness losses encountered in kiln drying and dressing 4/4 red oak lumber were studied. Results suggest that rough dry lumber can be reduced to slightly less than 1 inch thick to produce moderately long, wide cuttings dressed two sides to a thickness of 13/16 inch. Rough dry thickness for panels should be slightly over 1 inch to dress to 13/16 inch. Green 4/4 lumber should be 1/8 inch thicker than required rough dry size to allow for shrinkage. Control of sawing variation and warp during drying are two major problems in trying to reduce green and rough thicknesses of hardwood lumber.

ROUGH THICKNESS REQUIREMENTS FOR RED OAK FURNITURE CUTTINGS[1]

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INTRODUCTION

How thick should red oak lumber be cut to produce furniture cuttings that must dress two sides to a thickness of 13/16 inch? The answer to this question is of considerable importance to hardwood lumber' producers and to furniture manufacturers and dimension mill operators. It is also of importance to the general public because it involves the utilization of a high value forest resource and because it is the public that ultimately pays for inefficiencies in the manufacture of any product.

If hardwood lumber is cut thicker than necessary to produce a satisfactory dressed cutting, the producer will get a lower yield from a given volume of logs: The consumer will have to pay more for the lumber he uses. Overly thick lumber also wastes an increasingly scarce, high-value forest resource and leads to greater power requirements in drying and dressing.

Thinner lumber may give higher yields and less waste at the production end of the line, but if it leads to more cuttings that will not dress and must be discarded, the resulting waste of wood, labor, and power in the rough-end could equal or exceed the savings at the sawmill.

The problem is to determine an optimum thickness that will minimize the total waste at both the sawmill and the rough mill and not increase labor and power requirements. This article reports the results of a preliminary study designed to examine the losses in thickness that occur in the drying and dressing of 4/4 red oak lumber.

[1] This study was made at the request of Thomas P. Brogan of the Hardwood Council; and Council members provided the lumber that was used. Technical advice on rough mill procedures was provided by Walton R. Smith and members of the Hardwood Research Council.

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METHODS

The study was made on five lots of rough green, mill-run 4/4 red oak lumber, each containing approximately 300 board feet. Each board was measured for minimum and maximum green thickness to provide an indication of sawing variation. A number of boards were selected from each lot to be measured for shrinkage during drying. On each selected board, three sample points were sanded lightly to provide a uniform surface for measurement of thickness before and after drying.

The stock was kiln-dried in two separate loads. Initial moisture content averaged 76 percent for one charge and 68 percent for the other. Both charges had 18-inch sticker spacing and air velocities of 350-450 feet per minute, reversing direction every 6 hours. A top loading of 30 and 50 pounds per square foot, respectively, for the two loads was used to reduce warp by simulating a larger load. The lumber received equalizing and conditioning treatments to achieve a final moisture content of 6-7 percent.

After drying, defects were located on each board and clear-cuttings were outlined on the surface. Three sizes of cuttings were made: large (60- x 3-1/2-inch), medium (24- x 4-inch), and random width (1-1/2- to 3-1/2- x 24-inch). Random width cuttings were used in glued 15 x 24-inch panels. Cuttings were laid out so that the first sawing operation would be to cross cut the boards into segments. The larger cuttings were obtained whenever possible and this, plus the rather limited range of sizes, precluded any attempts at maximizing cutting yields.

The outlined cuttings included no end checks, splits, wane, knots, or severe grain distortions on either face. No cutting was permitted to have more than 1/8 inch of cup or 1/4 inch of bow. Before crosscutting, the minimum thickness within the outlined area of each cutting was measured to 0.01 inch. This thickness minus the final thickness of the dressed cutting or panel would be used as a measure of the dressing loss.

After crosscutting, the board segments were skip-dressed by running them through a face joiner set to take a cut of 0.06 inch (slightly under 1/16 inch) followed by a cabinet planer set for a thickness of 1-1/8-inch. Both of these are lighter than the usual commercial settings for 4/4 lumber but the light cut was necessary to avoid excessive dressing losses on the thicker pieces. (Because of heavy cupping, segments from one lot were ripped before being skip-dressed.)

The skip-dressed board segments were then ripped to obtain the designated cuttings, and the random width cuttings were glued up into the 15-inch-width panels. The panels were assembled in a clamp carrier and the polyvinyl acetate adhesive was allowed to cure for at least 2 hours at room temperature.

Both panels and individual cuttings were dressed on an abrasive planer. The planer was set to remove 0.01 inch and each cutting and panel was run through repeatedly until each face was dressed clean. Then the thickness of each cutting and panel was measured; this thickness subtracted from the original minimum thickness was the loss in thickness due to dressing.

RESULTS

The mean shrinkage in thickness of individual lots (table 1) varied from 0.081 (about 5/64) inch to 0.099 (over 6/64) inch. The average over all lots was 0.089 (nearly 6/64) inch.

Because the mean shrinkage will be exceeded about half the time, it would be prudent to consider a shrinkage allowance that is larger than the mean. If it is desired to have an allowance that would be exceeded by less than 5 percent of the pieces (i.e., the 95 percent point of the shrinkage distribution), this study indicated that a value of 0.17 (nearly 11/64) inch would be needed. The 90 percent point was 0.15 (nearly 10/64) inch and the 80 percent point 0.12 (about 1/8) inch.

Dressing losses were expected to be greatest for the largest (60- x 3-1/2-inch) cuttings. However, it turned out that the large and medium (24- x 4-inch) cuttings had nearly the same losses. Both averaged a little less than 0.11 (under 1/8) inch (table 2). In general, results indicated that lumber with a minimum rough dry thickness of 1 inch is ample for producing cuttings with a dressed thickness of 13/16 inch. One inch is more than ample for a dressed thickness of 12/16 inch.

The 15- x 24-inch panels were a different matter. Average dressing loss was over 0.19 (12/64) inch and, at the 95 percent point, dressing loss was a startling 0.27 inch (table 3). This meant that for 95 percent of the panels to dress to a thickness of 13/16 inch would have required rough dry lumber with a thickness of 1.08 inch. Even a dressed thickness of 12/16 inch would have needed lumber that was 1.02 inch thick.

Although not included among the study objectives, sawing variation was measured and turned out to be the source of considerable wood waste. Even by today's standards, only two of the five lots had acceptable levels of sawing variation. In table 4, "scant sawing variation" data indicate the amount that a sawmiller must add to the minimum lumber thickness desired in order to be sure that most of the material produced will be acceptable. Even the best lot required an additional 0.095 inch of thickness while the worst needed 0.223 inch. Improvement of sawing practices would certainly save a great volume of wood and, in addition, might very well reduce drying costs and the amount of warp.

Table 1.—Shrinkage of lumber in kiln drying

Lot	Number of data points	Mean lumber thickness (green)	Reduction in thickness				
			Mean	Mean	80 percent point[1]	90 percent point	95 percent point
		In.	Pct.	In.	In.	In.	In.
1	51	1.167	7.04	0.081	0.11	0.12	0.13
2	60	1.131	8.70	.099	.14	.18	.21
3	45	1.144	7.41	.084	.11	.12	.15
4	33	1.211	7.45	.091	.12	.15	.16
5	36	1.144	7.86	.090	.12	.15	.15
Ave		1.156	7.75	.089	.12	.15	.17

[1]Eighty percent of the sample points had shrinkage equal to or less than the value given in this column. The 90 percent and 95 percent points are similarly defined.

Table 2.—individual cuttings: Dressing losses and rough dry thickness requirements[1]

Lot	Dressing loss				Rough dry thickness required for—							
					12/16 Dressed thickness				13/16 Dressed thickness			
	Mean	80 percent point	90 percent point	95 percent point	Mean	80 percent point	90 percent point	95 percent point	Mean	80 percent point	90 percent point	95 percent point
1	0.088	0.10	0.12	0.13	0.84	0.85	0.87	0.88	0.90	0.91	0.93	0.94
2	.122	.15	.17	.21	.87	.90	.92	.96	.93	.96	.98	1.02
3	.112	.13	.16	.16	.86	.88	.91	.91	.92	.94	.97	.97
4	.117	.15	.17	.20	.87	.90	.92	.96	.93	.96	.98	1.01
5	.114	.14	.16	.17	.86	.89	.91	.92	.93	.95	.97	.98
Ave	.108	.13	.15	.18	.86	.88	.90	.93	.92	.94	.96	.99

[1]All percentages defined as in table 1.

Table 3.—Panels: Dressing losses and rough dry thickness requirements[1]

Lot	Dressing loss				Rough dry thickness required for—							
					12/16 Dressed thickness				13/16 Dressed thickness			
	Mean	80 percent point	90 percent point	95 percent point	Mean	80 percent point	90 percent point	95 percent point	Mean	80 percent point	90 percent point	95 percent point
						In.						
1	0.149	0.19	0.19	0.20	0.90	0.94	0.94	0.95	0.96	1.00	1.00	1.01
2	.204	.24	.25	.25	.95	.99	1.00	1.00	1.02	1.05	1.06	1.06
3	.188	.21	.23	.23	.94	.96	.98	.98	1.00	1.02	1.04	1.04
4	.219	.26	.28	.30	.97	1.01	1.03	1.05	1.03	1.07	1.09	1.11
5	.205	.23	.25	.28	.96	.98	1.00	1.03	1.02	1.04	1.06	1.09
Ave	.193	.23	.24	.27	.94	.98	.99	1.02	1.01	1.04	1.05	1.08

[1]All percentages defined as in table 1.

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Table 4.—Sawing variation in rough green lumber

Lot	Within board variation		Between board variation		Total sawing variation	Scant sawing variation
	Average	Largest	Average	Largest		
			In.			
1	0.151	0.320	0.040	0.152	0.358	0.161
2	.176	.450	.041	.190	.419	.223
3	.070	.110	.033	.071	.198	.095
4	.137	.470	.047	.166	.383	.186
5	.101	.150	.025	.165	.230	.111

CONCLUSIONS AND DISCUSSION

This study suggested that red oak lumber can be reduced to a rough dry thickness of slightly less than 1 inch for cuttings with a dressed thickness of 13/16 inch. Rough dry thickness for cuttings to be laid up into panels should be slightly over 1 inch for the panels to dress to 13/16 inch. Green 4/4 lumber should be 1/8 inch thicker than required rough dry thickness, to allow for shrinkage.

Sizable reductions in wood waste could be obtained by sawmilling improvements that would cut down sawing variation and produce lumber of more uniform thickness. In fact, until sawing variation is under better control, it may be futile to think of reductions in standard thickness.