LONG LENGTH CUTTINGS FROM NO. 2 COMMON HARDWOOD LUMBER

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Abstract

Long length cuttings (up to 60 inches) are obtainable in abundance from No. 2 Common oak lumber. Cutting for the maximum area of clear one face (C1F) parts 18 to 60 inches in length, we found that 46 percent of all the cuttings were 36 inches long or longer. The recovery of the long length cuttings did not reduce the overall yield of parts produced from the lumber. Computer simulation of conventional rough mill practices was based on a detailed analysis of 4,500 board feet of No. 2 Common oak lumber.

INTRODUCTION

SHOULD YOU use No. 2 Common hardwood lumber for dimension cuttings that are longer than 40 inches? The industry generally says "no", but we believe the right answer may be "yes". With current practice, a load of lumber is sawed for a specified order which contains a limited number of cutting sizes. Processing is done quickly, and the memory and judgment of the saw operator are important. A 40-inch length limit is accepted as a maximum for No. 2 Common.

What is commonly done and what is possible are not always the same. To find out what is possible, we used computer simulation to analyze over 4,500 board feet of No. 2 Common oak lumber. We found that it is possible to get a substantial volume of 40-inch and longer clear one face (C1F)[1] cuttings from No. 2 Common boards. Our results represent the optimum yield; how close a mill approaches this optimum will depend on the skill and efficiency of its operators.

[1]"Clear one face" as defined by National Hardwood Dimension Manufacturers Association shall be clear one face, both edges and both ends, and may contain defects of a sound nature on the reverse side.

THE STUDY

Our computer simulation study is an extension of work done by the Forest Products Laboratory (FPL) in Madison, Wisconsin *(1, 2, 3, 4)*. From their work you can determine the volume of lumber, by grade, that is required to fill a specified cutting bill. Multiplying these volume estimates by the cost of lumber gives us the grade of lumber with the lowest raw material cost.

It is common practice in the furniture industry to limit the length of cuttings produced from No. 2 Common lumber to 40 inches, and the FPL yield data reflect this practice. Their predictions of dimension stock yields for No. 2 Common are, therefore, limited to cuttings between 10 and 40 inches long. We extended their simulation model by increasing the minimum cutting length from 10 to 18 inches and the maximum length from 40 to 60 inches. Both of these changes would normally be expected to reduce the overall yield.

Computer Simulation

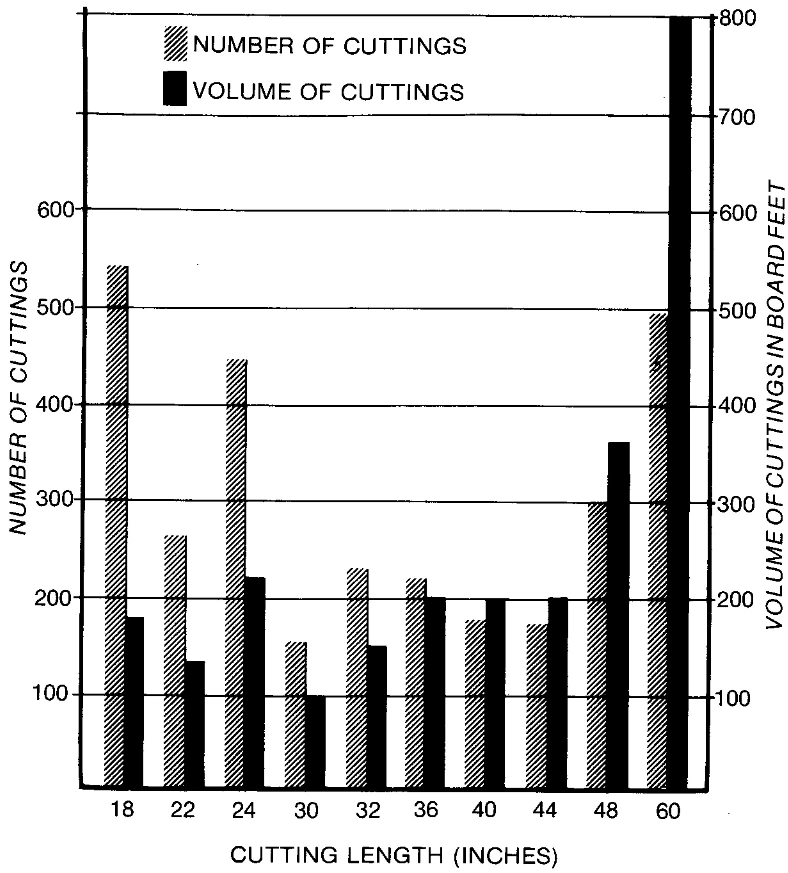
Our computer program simulates the cutting up of a board into dimension parts of specified sizes, maximizing the total area of the cuttings obtained from the board. The program obtains its cuttings in a manner compatible with conventional rough mill cut-up procedures. For example, all cuts made must run the full width or length of the board or section of board being analyzed. The initial cut on the board may be either a rip or a crosscut. If the first cut is a rip, then the rip line must run the entire length of the board. Likewise, if the first cut is a crosscut, it must extend across the entire width of the board. After the initial cuts are made, subsequent cuts need only extend across the length or width of the sections of the board produced by the original cuts.

The desired cutting lengths and widths must be specified. The computer program accommodates up to 10 widths and 10 lengths and will allow any combination of them; thus a cutting bill of 100 different sizes is possible. The program orders the cuttings on the basis of area, the cutting having the largest area being ordered first. In cases where the cutting area is the same for two or more cuttings, the longer length is given priority. We used the following sizes:

Widths: 1½, 2, 2½, 3, 3½, 4, 4½, 5, 5½, and 6 inches.

Lengths: 18, 22, 24, 30, 32, 36, 40, 44, 48, and 60 inches.

Figure 1.—Yield, by number and volume, of C1F dimension parts from No. 2 Common oak lumber.



In addition to the specification of cutting sizes, the program requires input data on the location of all defects within each board. To provide these data, we collected a sample of 637 No. 2 Common 4/4 red and white oak boards and recorded the locations of all defects on them. Each defect was coded to indicate the type of defect and whether it occurred on the grade side or the back side of the board. Twenty-three defect types were recognized and recorded.

Our 637-board sample contained a total volume of 4,625 board feet in boards ranging from 4 to 16 feet in length and from 3 to over 16 inches in width. The sample was selected from four mills (three in West Virginia and one in Virginia). The lumber was kiln dried to an average moisture content of 7 percent.

RESULTS

While No. 2 Common lumber is commonly used to produce short cuttings, our results show that there is a higher potential for larger length cuttings than is normally thought. For example (fig. 1), the volume recovered in 60-inch cuttings was four times that of the 18-inch cuttings (806 versus 186 board feet). In fact, each of the cutting length classes 36 inches long and longer contained more volume than the 18-inch class.

One-third (1,554 board feet) of the original board volume was recoverable in cuttings 40 inches and longer (table 1). The 60-inch cuttings accounted for more volume, 17.4 percent, than any of the other cutting lengths. It is important to note that the high yields in these longer lengths were not obtained at the expense of overall yield from the lumber. Of the total board volume in the sample, over half (2,544 board feet) was recoverable in C1F cuttings.

In addition to the volume of cuttings obtained, the distribution of the cuttings by length and width was recorded (table 2). All 100 possible cutting sizes were represented in the yield. Only 15 percent of the cuttings recovered would be classified as small cuttings, that is, cuttings less than 24 inches long and also less than 3 inches wide. Eighty-five percent of the total number of cuttings would therefore be classified as large. The 60-inch

Table 1.—*Board foot volume and percent yield by cutting length of C1F dimension parts produced from a representative sample of No. 2 Common oak lumber*

Cutting length (inches)	Yield by length class		Cumulative Yield (top to bottom)	
	Board foot volume	Percent of total board volume[a]	Board foot volume	Percent of total board volume
60	806	17.4	806	17.4
48	357	7.7	1,163	25.1
44	199	4.3	1,362	29.4
40	192	4.2	1,554	33.6
36	193	4.2	1,747	37.8
32	160	3.5	1,907	41.3
30	105	2.3	2,012	43.6
24	219	4.7	2,231	48.3
22	127	2.7	2,358	51.0
18	186	4.0	2,544	55.0
Total	2,544	55.0	—	—

[a]Base: 4,625 board feet of lumber input.

Table 2.—*Length and width distribution of C1F dimension parts produced from a representative sample of No. 2 Common oak lumber*

Cutting length	Number of cuttings by width of cutting (inches)										Total	Percent of total cuttings[a]	Cumulative percent
	1½	2	2½	3	3½	4	4½	5	5½	6			
60	22	33	43	83	54	69	50	53	23	66	496	16.7	16.7
48	36	35	19	37	31	34	27	17	21	37	294	9.9	26.6
44	22	14	13	22	21	19	16	20	19	11	177	5.9	32.5
40	19	15	18	15	14	24	21	12	16	26	180	6.0	38.5
36	35	18	20	21	21	23	22	14	17	24	215	7.2	45.7
32	50	27	24	23	24	27	11	10	5	24	225	7.6	53.3
30	23	17	20	18	16	16	10	9	8	13	150	5.0	58.3
24	107	80	49	47	38	29	19	13	21	36	439	14.8	73.1
22	60	34	34	31	17	18	13	21	13	21	262	8.8	81.9
18	163	95	68	62	38	23	26	21	14	29	539	18.1	100.0
Total	537	368	308	359	274	282	215	190	157	287	2,977	100.0	—
Percent	18.0	12.4	10.3	12.1	9.2	9.5	7.2	6.4	5.3	9.6	—	—	—
Cumulative percent	100.0	82.0	69.6	59.3	47.2	38.0	28.5	21.3	14.9	9.6	—	—	—

[a]Base: 2,977 cuttings

cuttings alone accounted for 16.7 percent of the total number of cuttings produced.

DISCUSSION

These results suggest that the yield of long cuttings is sufficient to make No. 2 Common lumber the most economical choice for a wide range of cutting lengths. Comparing the raw material costs to produce 1,000 board feet of 1½ by 40 inch C1F parts from FAS, No. 1 Common, and No. 2 Common oak lumber, we find:

Grade	*Yield %*	*Lumber required to produce 1,000 board feet of parts bf*	*Lumber cost/Mbf*	*Cost of 1,000 board feet of parts*
FAS	61[a]	1,639	$245	$401
1C	47[a]	2,128	135	287
2C	34[b]	2,941	85	250

[a]Percent yield taken from charts in reference *1*.
[b]Percent yield taken from table 1.

Thus on the basis of the cost of raw material only, No. 2 Common lumber is clearly the most economical choice. However, a complete economic analysis must also take into consideration the manufacturing system and the relative costs of processing different grades of lumber.

The present method of converting lumber to dimension parts is to process a board through a series of crosscuts and rips to conform to a particular cutting bill. In other words, once a board is brought into the system it is processed through to completion. The computer simulation program we used functions in the same way, but the speed, accuracy, and analytical capabilities of the computer are infinitely greater than those of the saw operator. The yields were high for No. 2 Common because we used 100 different cutting sizes. However, we cannot expect the yields in a production plant to equal them; a crosscut operator cannot carry 100 different cutting sizes in his head and at the same time keep his rate of production and yield at a satisfactory level.

No manufacturing system can change the yield potential of a board, but one can affect the probability of attaining that potential. To realize the maximum potential of long cuttings from No. 2 Common lumber, changes must be made in the present manufacturing process. The length and width distribution of the cuttings obtained from our sample of No. 2 Common lumber justifies additional research to develop alternate methods of processing lumber into dimension parts. Accordingly, we have started to investigate the effect that rough mill cut-up practices have on the recovery of long length cuttings from low grades of lumber. We have designed a rough mill computer simulation model to develop a set of decision rules on how best to process low-grade lumber into dimension parts.

Although the quality of the lumber determines what cuttings you can get, the saw operator determines what you will get. Therefore, whatever decision rules are developed must be easily translatable into instructions that can be put into practice by the saw operator.

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