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CUTTING HARDWOOD CANTS CAN BOOST SAWMILL PROFITS

The markets for hardwood lumber are now strong, and sawmill profits are increasing. But this favorable market-price situation is the exception rather than the rule. Usually hardwood sawmill operators are confronted with ever-decreasing profit margins. During the past decade, while lumber prices have remained relatively constant, most logging and sawmilling costs have increased from 30 to 45 percent.[1, 2]

To stay in business, lumbermen have had to modernize their equipment and reorganize their lumber-production techniques for more efficient operation. Despite the recent increase in hardwood lumber prices, many hardwood lumbermen are still searching for opportunities to increase their profit margins.

One of the most promising opportunities for increased income is the manufacture of cants from the low-grade heart portion of sawlogs. A cant is a large timber, cut by the headsaw, for structural use or for further reduction into lumber by another saw in the same mill. Usually a cant contains the knotty heart of the log.

Although these heart sections of sound Appalachian hardwood sawlogs may be free of scale defects such as decay, shake, and split, they usually contain grade defects that reduce the quality of lumber sawed from them. This lumber often sells for less than the cost of manufacture: losses may range up to $30 per 1,000 board feet.

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[1] Martens, David G. LOG GRADES — A KEY TO PREDICTING SAWMILL PROFITS. South. Lumberman. 210 (2612): 29-34, illus., 1965.

[2] Sarles, R. L. TEN-YEAR CHANGES IN SELECTED LOGGING AND SAWMILLING COSTS. South. Lumberman. 210 (2620): 28-30, illus., 1965.

Since there are a variety of market outlets for cants as solid timbers, one method of reducing these losses would be to saw the low-grade heart sections of logs into cants instead of 1-inch boards. Three possible advantages of thicker cuttings were foreseen: (1) a reduction in saw-kerf loss, (2) a reduction in sawing time per log, and (3) an improvement in lumber quality.

A Study of Cants

To determine how much volume and product value could be increased by sawing sawlog hearts into cants rather than 1-inch lumber, a study of cant production was made recently by the U. S. Forest Service's Forest Products Marketing Laboratory at Princeton, W. Va.

To make these comparisons, we diagramed to scale on cross-section paper 12 cant sizes and superimposed on each diagram the largest volume in 1-inch lumber that could be sawed from each size of cant (fig. 1). The end dimensions of the 12 cant sizes studied ranged from 4 by 4 inches to 8 by 8 inches.

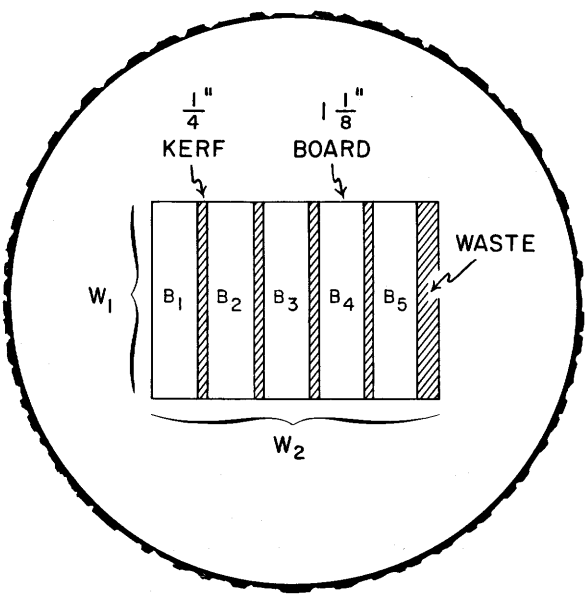

Figure 1. — Log cross-section, showing recovery of 1-inch lumber in a 5-by-7 cant.

$$\text{Cant volume} = \frac{W_1 \times W_2 \times L}{12}$$

$$\text{1-inch volume} = \frac{n\,(B \times W_1) \times L}{12}$$

W_1 = cant width (inches)
W_2 = cant depth (inches)
L = length (feet)
B = 1-inch board nominal thickness
n = number of boards in cant

To obtain log-conversion data, we made a time study at a local sawmill. For one group of logs, we recorded the time required to saw 1-inch lumber, whereas for another group of logs we recorded the time required to saw each log into lumber and a cant.

In our study, we defined the experimental conditions precisely. The following assumptions were made:

1. Each cant log would be sawed to develop the maximum volume of 2 Common and Better grade lumber from the outer part of the log, whereas the portion of the log containing lumber of grades 3A Common and poorer would be made into cants and sold as timbers.

2. Each lumber log would be sawed to develop the best grade of 1-inch lumber in all portions of the log, including the heart.

3. All logs would be 12 feet long and would have both a gross and net log volume of 100 board feet. Log scale would equal lumber tally for board logs.

4. All nominal 1-inch boards would have an actual board thickness of $1\frac{1}{8}$ inches after sawing to allow for shrinkage.

5. Sawmill production rate would be 1,700 board feet per hour of 1-inch lumber with a $\frac{1}{4}$-inch saw kerf. The mill would operate at full capacity for 8 hours per day.

6. Green lumber and cant prices would be: (a) $100 per 1,000 board feet for lumber in the combined grades of 2A Common and Better; (b) $58 per 1,000 board feet for grades 3A Common and poorer in the heart center portion of a log; (c) $50 per 1,000 board feet for cants, regardless of end dimension.

7. Total lumber-manufacturing costs would be $80 per 1,000 board feet, consisting of $20 per 1,000 board feet for stumpage plus $30 for logging and $30 for milling.

8. Cant manufacture would require no sawing time because the cant is the log portion left after high-grade lumber is removed.

9. The daily production of 1-inch lumber would be the same regardless of whether logs were sawed into boards or whether both boards and cants were produced.

10. Sufficient logs would be available for uninterrupted mill production even though cant manufacture requires a greater daily volume of raw material.

11. All logs would be of uniform size, shape, and quality and would be suitable for cant manufacture.

Analytical Procedures

To obtain a reasonably accurate estimate of the economic benefits from producing 1-inch lumber or producing both 1-inch lumber and cants, we had to evaluate the entire production sequence. This included the following factors: (1) volume yields for both boards and cants, including overrun and kerf losses; (2) proportionate sawing times for board logs and cant logs for all cant sizes tested; (3) delivered cost of extra raw material used when sawing cants because of greater daily volume output; (4) monetary returns from green cants and grouped lumber grades.

An abbreviated illustration of our analytical procedures is presented in table 1. This example applies to only one size of log and cant. The log is $14\frac{1}{2}$ inches in diameter, 12 feet long, and has a net yield of 100 board feet in nominal 1-inch lumber. The cant end dimensions are 5 inches by 7 inches, and this 12-foot timber has a net volume of 35 board feet. Data for individual logs have been expanded to a daily basis to provide a more vivid comparison between the two log-conversion techniques.

Table 1. — Sawing 1-inch lumber versus sawing lumber and cants: a comparison of daily yields, sawing times, production costs, and income

Item		Lumber log	Cant log
Lumber yield per log:			
2 Common and Better	*board feet*	75	75
3A Common and Poorer	*board feet*	25	—
Cant yield per log	*board feet*	—	35
Total volume per log	*board feet*	100	110
Sawing time per log	*minutes*	3.50	2.63
Logs sawed hourly	*number*	17.14	22.81
Logs sawed daily	*number*	137	182
Extra raw material for cant production	*logs*	—	45
	board feet	—	4,500
Daily volume yields:			
2 Common and Better	*board feet*	10,275	13,650
3A Common and Poorer	*board feet*	3,425	—
Cants	*board feet*	—	6,370[1]
Total	*board feet*	13,700	20,020
Daily gain from sawing cants	*board feet*	—	6,320[1]
Daily production costs:			
Lumber, all grades: 13.7 M at $80/M		$1,096.00	$1,096.00
Purchase extra logs: 4.5 M at $50/M		$ —	$ 225.00
Total		$1,096.00	$1,321.00
Daily gross income:			
Lumber: 2A Common and Better @ $100/M		$1,027.50	$1,365.00
3A Common and Poorer @ $58/M		$ 198.65	$ —
Cants: 6.37 M @ $50/M		$ —	$ 318.50
Total		$1,226.15	$1,683.50
Daily net operating income (Gross income — production costs)		$ 130.15	$ 362.50
Daily gain in operating income from sawing cants		$ —	$ 232.35

[1] The slight variation between cant gain and cant yield is due to elimination of fractional logs and to imperfect fit for cants.

Results

Volume yields are increased when sawlog hearts are sawed into cants instead of 1-inch lumber. Volume is saved because there is less waste from sawdust. In an earlier study to compare the feasibility of sawing crossties and/or 1-inch lumber from 8½-foot logs, Lane and Fechner[3] showed that the board-foot yield from logs sawed into ties was about one-third greater than the yield of logs sawed into lumber. This difference in yield between tie logs and lumber logs was considerably greater than the volume differences observed in our study. But our log size was larger and most of our cants were smaller than the ties used in Lane and Fechner's study. So our increased volume yield from cants would understandably be less.

The graphic placement of boards and saw kerfs upon the ends of the 12 different cant sizes showed that product volume would be 4 to 18 board feet greater than if these cants had been sawed into 1-inch lumber (table 2). However, the proportional increase in volume from cant cutting was not uniform among the 12 sizes tested. Variation occurred because certain

[3] Lane, Paul H., and Gilbert H. Fechner. SAWED TIE PRODUCTION IN THE TENNESSEE VALLEY REGION. Cross Tie Bull. 32 (12): 9-22, 1951.

Table 2. — Comparison of cant volume and 1-inch lumber yield that can be sawed from 12-foot cants of various end dimensions

Cant end dimensions	Cant volume	4/4 lumber yield	Volume difference	Proportionate volume increase from cants
Inches	*Board feet*	*Board feet*	*Board feet*	*Percent*
4 x 4	16.0	12.0	4.0	25.0
4 x 5	20.0	15.0	5.0	25.0
4 x 6	24.0	18.0	6.0	25.0
5 x 5	25.0	15.0	10.0	40.0
5 x 6	30.0	20.0	10.0	33.3
5 x 7	35.0	25.0	10.0	28.6
6 x 6	36.0	24.0	12.0	33.3
6 x 7	42.0	30.0	12.0	28.6
6 x 8	48.0	36.0	12.0	25.0
7 x 8	56.0	42.0	14.0	25.0
7 x 9	63.0	45.0	18.0	28.6
8 x 8	64.0	48.0	16.0	25.0

cant sizes could not be completely converted into boards without some waste other than saw kerf.

Theoretically, the gain from sawing cants should be 25 percent because there is a 1/4-inch kerf for each 1 inch board. But boards are cut 1-1/8 inches thick to allow for shrinkage; and when some cant sizes were diagramed, there were some cuttings that could not be counted as standard 1-inch lumber (fig. 1). In these situations the percentage gain from cant cutting was greater than in those situations where cants could be resawed into 1-inch boards with no waste other than kerf.

Although the reduction in saw-kerf waste is the most obvious source of overrun in cant manufacture, it is not the most important factor in obtaining the greater volume yields from logs sawed into cants. The greatest volume gain comes from the reduction in sawing time. Since cants are the parts of sawlogs left over after all grade lumber has been removed, they require no sawing time.

Theoretically, sawing time is directly proportional to volume sawed. For example, if a 5-by-7-inch cant contains 25 board feet of 1-inch lumber

Table 3. — Daily net operating income from 1-inch lumber production compared to daily net operating income from sawing logs into both cants and 1-inch lumber

(12-foot lengths)

Cant end	Daily net operating income[1]		
dimension (inches)	1-inch lumber	1-inch lumber plus cants	Gain from cants
4 x 4	$205	$307	$102
4 x 5	188	314	126
4 x 6	170	324	154
5 x 5	188	354	166
5 x 6	159	359	200
5 x 7	130	363	233
6 x 6	136	381	245
6 x 7	101	393	292
6 x 8	67	402	335
7 x 8	32	439	407
7 x 9	15	498	483
8 x 8	—2	487	489

[1] Difference between the value of lumber produced daily and the total cost of daily production. Lumber selling costs are not included. Values are to the nearest dollar.

and this cant is sawed from a log yielding 100 board feet of 1-inch lumber, the assumed gain from reduced sawing time would be 25 percent. However, in sawing it is customary to turn factory-grade sawlogs to obtain the maximum volume of high-quality lumber from the outer part of each sawlog face. Each turn requires time that could otherwise be spent in sawing. Therefore, the gain from sawing a cant, rather than 1-inch lumber, is slightly less than the proportion of the total log volume represented by that cant.

The effect of reduced sawing time is by far the most significant factor in obtaining the increased daily volume yield from cants. For instance, overrun from saw-kerf savings amounted to only 10 board feet per log or a total daily gain of 1,820 board feet. But the volume gained from reduced sawing time was 2½ times greater because each day an extra 4,500 board feet of logs were purchased and processed to maintain full sawmill operating capacity.

Of course the most important benefit from sawing cants is the increased income derived from this milling procedure. The manufacture of cants permits a hypothetical increase in daily gross income ranging from $102 to $489 (table 3). These figures are based upon optimum theoretical conditions where all logs are suitable for cant manufacture, all No. 3A Common lumber in the log is confined to the cant, and only one cant size is cut per 8-hour shift. The monetary savings accrue from three sources: (1) cant volume overrun from kerf savings, (2) daily volume gain due to less sawing time per log, and (3) general improvement in the quality and value of 1-inch lumber.

Conclusions

Under optimal theoretical conditions, gross sawmill operating income can be increased through cant manufacture by nearly $500 per day. In practice, however, the economic gains from cant manufacture will be considerably less: perhaps only 10 to 20 percent of the theoretical maximum. Some of the factors that control this potentially greater income are suitability of logs for cant manufacture, cant size, and market potential.

Sawmill operators can expect a greater overrun when sawing cants than when sawing 1-inch lumber. This overrun develops from the savings in kerf volume that would normally be wasted as sawdust when sawing standard lumber thicknesses.

Cant manufacture permits a substantial reduction in sawing time. Theoretically, cants require no conversion time because they are byproducts left after the better grades of lumber have been removed.

The time saved when sawing cants will provide daily volume gains that are considerably greater than the volume gained from cant overrun associated with saw kerf.

Since grade defects are frequently concentrated in the heart section of hardwood sawlogs, the average lumber quality produced by a sawmill will improve if hearts are sawed into cants. Only the better portions of the log will be sawed into 1-inch lumber. Thus average lumber value will increase because the lower grades will have been eliminated. Nor will there be a concomitant reduction in total dollar yield from cants because unit cant values remain nearly static within the range of the most commonly used sizes.

The high profit potential from cant manufacture should encourage hardwood sawmill operators to consider both the manufacture of lumber and cants. When factors such as log quality, mill capacity, and market potential have been thoroughly analyzed to show that cant production is feasible, this milling technique may provide the extra profits so urgently needed.

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