DEVELOPMENT OF GRADING SYSTEMS FOR SHORT-LENGTH LUMBER

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Abstract

The abundance of low grade hardwood timber and a shortage of high grade timber of many species has led to the examination of alternative processing methods for converting logs to lumber. One technique for using lower grade logs is to produce short length lumber. However, present grading rules for short length lumber are not good predictors of the lumber's true value. A new method of grading short length lumber is proposed, with furniture part yield data presented to show the methods effectiveness. A batch grading system is also illustrated.

Problem and Hypothesis

A. General Problem

In the Southern and Eastern hardwood forests located in the Appalachian and Piedmont regions, there are large quantities of low-grade hardwood trees and logs (i.e., trees or logs that are crooked, small diameter, or knotty). Table 1 indicates the hardwood tree grade distribution in Virginia. This distribution is typical for the hardwoods in the Eastern U.S. These low-grade trees generally cannot be profitable harvested and profitably converted into lumber products by conventional processing methods, as low-grade logs may yield less than 15% of their gross volume into No.1 Common and Better lumber. Therefore, these logs are usually too low in potential value to be profitable harvested and sawn. (See Table 2 for a typical distribution of yield and value for red oak logs.) Those hardwoods that have been harvested in the past, and for the most part will be harvested in the near future, have tended to be the higher quality trees and logs. Consequently, because the hardwood resource is predominately low grade, much of the hardwood resource is unused, resulting in the loss of ability to properly manage the forest, as well as an apparent surplus supply of hardwoods. The net result over the years has been a general decline in hardwood quality for many premium species, as the best trees were removed.

In addition to low-grade trees, there is also a significant source of low grade logs generated during logging operations -- that is, upper grade trees, with lower grade logs in the top sections, are felled and then the low-grade sections are bucked out and may often be left in the woods. This low-grade log residue, however, is suitable for furniture stock (Dunmire et. al., 1972). in the Appalachians, a 1 acre sample plot had 69.3 tons of residue of which 15.1 tons (22%) were sawable as small logs (Craft, 1976).

Table 1 -- HARDWOOD TREE GRADE DISTRIBUTION IN VIRGINIA

Tree Grade (USFS)	Volume MM Bd Ft	%
1	3,104	8
2	5,502	15
3	14,255	38
Below 3	14,776	39

Source: VA. Div. of Forestry, 1985

Table 2 -- TYPICAL YIELD AND VALUE FROM 12- TO 16-FOOT RED OAK LOG

Log Grade (USFS)	Yield No.1 + Btr	Value of Lumber (Green)	Value per Log (Gross)
1	74% (42%)	$695/MBF	$105
2	56% (31%)	575/MBF	55
3	23% (13%)	379/MBF	23

Source: Wengert, unpublished data.
Note: Yield is percent of total lumber that is No.1 and Better. Number in ( ) is percent of total log volume that is No.1 and Better.

The difference in value per log (Table 2) between log Grade 1 and 3 is due both to the smaller diameter of grade 3 logs and their poorer quality (i.e., knottiness). This value per log data illustrates the reason why lower grade logs are not desirable in the sawmill, if and when upper grade logs are available.

From a timber management and land management point of view, this unused lower grade hardwood resource is (or results in) a misuse of our country's natural resource. It would be most advantageous to be able to consider lumber production as a management tool for most or all standing timber, not just the upper grades. Such ability will be more likely to assure a variety of other benefits (wildiife, recreation, and watershed) from our forests as well as assure quality hardwoods for future generations.

(We do not mean to imply that there is presently no use for low-grade hardwoods. Those low-grade forests within 75 miles of a pulp mill and low grade, low density species near a waferboard plant are presently used and provide some timber management options. These uses are, however, very low value uses with low stumpage values. As a result, these uses do not provide much economic incentives for timber management before or after harvesting. Fuel wood also uses low-grade trees.)

It should be apparent that if lower grade hardwoods are to be profitably and widely utilized, they must be converted into higher valued products, such as furniture parts, rather than into the traditional low-value products such as

chips, pallet lumber, or fuel, In order that management, harvesting, and processing can become economically viable.

A promising technique for processing the low-grade, low-value hardwood resource (that Is short, knotty, crooked logs) Into high value products has been demonstrated (Coleman and Reynolds 1973, Beaudoin et. al. 1982). This technique involves the conversion of short logs, called bolts, from low-grade trees Into short length lumber (6-feet long or shorter) or into rough sized parts for furniture, cabinets. However, before this short length lumber can be marketed successfully, competing with the traditional long length material, a value assessment technique and a marketing procedure for such lumber must be developed. Doing so will create a viable short, low quality log processing Industry.

B. Is There a Need for Short length Lumber?

There are four dominate reasons why the production of short length lumber is so promising. First, as mentioned above, short length lumber produced from low quality, short length logs has, overall, the tendency to produce high value products from low-valued timber. (See final column in Table 3.) Second, there Is generally higher yield and less waste in short, low-grade log processing compared to long, low-grade log processing. Third, most uses for hardwood lumber -- pallets, furniture, cabinets -- require short length pieces of wood. And finally, there is considerable energy savings by drying short length lumber or furniture pieces because a greater percentage of usable wood is dried, rather than drying (as is conventionally done with long length lumber) 50 percent usable wood and 50 percent waste.

To demonstrate the potential for short length lumber, a study conducted at Luther Compton and Sons Lumber company in Bluefield, VA evaluated the yield of furniture parts sawn from short logs which were originally long logs of USFS hardwood log grades 1, 2, and 3. Yields (rough parts volume compared to log volume) decreased only several percent for each lower grade of log (Table 3). Log values for grade 3 logs were nearly 2/3 higher when converting the logs into furniture parts directly rather than going first to lumber and then Into parts. In addition, the furniture part market is a much more active market than the market for low-grade lumber.

TABLE 3 -- SHORT LENGTH YIELDS AND VALUES

Log Grade (USFS)	Part Yield	Value/Log	Increased Value
1	69% (34%)	$104	-1%
2	66% (33%)	62	13
3	60% (30%)	37	61

Source: Wengert, unpublished data.
Note: Yield Is BF parts to scaled BF. Number In ( ) is yield based on volume of parts to log volume. Increase value is a comparison to long log values in Table 2.

From the information in the above paragraphs, it is clear that short length systems do offer the opportunity for substantially increased returns from low-grade logs. However, when it is considered that today these low-grade trees are seldom harvested and low-grade logs are seldom sawn, the more significant impact is that short length, low-grade log harvesting and processing can be made viable.

C. Hypothesis

It is apparent that short length lumber has many advantages to timber and land management activities, to conservation and wise use of our natural resource, and to the wood products industry and consumers. Existing technology is sufficient to manufacture short length lumber, although there are several areas that require additional attention to refine or optimize processing.

Although there are many deterrents to presently producing and marketing short length lumber -- such as no log grading guide lines, limited sawing equipment, poorly defined drying procedures, restrictive lumber grades, and poor manufacturing appreciation -- only lumber grading is discussed in more detail in this paper.

One of the keys to marketing hardwood lumber is the grading system. Value is established based on these grades. The major drawback to manufacturing short length lumber is in marketing it under present lumber grading rules.

it is the hypothesis of this analysis that if a satisfactory grading system (which is the key to a marketing system) for short length lumber were developed, then short length lumber will become a viable product.

Approach to Problem Solution

A. Present Grades for Short Lumber

The purpose of a lumber grading system is to estimate the value of the lumber to the user. In the NHLA standard rules for hardwood lumber there are rules for grading short length lumber. (In this context, we are considering short length lumber to be 3-inches to 8-inches wide and 4-feet to 8-feet long.) With the impetus to be able to assess most accurately the value of short lumber mentioned above, the present NHLA grades were evaluated (Tables 4 through 6).

Table 4 -- The minimum surface area (percent) that must be clear, in one rectangular shaped piece, for several sizes of Select grade short lumber.

LENGTH	WIDTH			
	4"	5"	6"	7"
6'	92%	73	92	79
8'	100	82	83	89

Note: Lumber on the 1/2 BF was rounded down.

Table 5 -- The minimum surface area (percent) that must be clear, In one rectangular shaped piece, for several sizes of No. 1 Common short lumber.

LENGTH	WIDTH 3"	4"	5"	6"	7"
4'	100%	75	90	75	64
6'	67	75	60	67	67
8'	75	75	60	67	

Note: Lumber on the 1/2 BF was rounded down.

What does short length lumber look like? In a word, it is mostly clear (Figure 1). The defects are few and, in order to achieve the needed clear area in Just one piece, the knots and other defects are concentrated In a small area at the ends or on an edge.

Table 6 -- The minimum surface area (percent) that must be clear, in one (* or two) rectangular shaped piece, for several sizes of No. 2 Common short lumber.

LENGTH	WIDTH 3"	4"	5"	6"	7"
4'	67%	50	60	50	43
6'	44	50	40	50*	43*
8'	50	75*	45*	60*	54*

Note: Lumber on the 1/2 BF was rounded down.
* Two clear areas can be combined.

B. The Cost of Manufactured Parts

Any change In grading rules must consider the user as well as the producer. If furniture and cabinet manufacturers are to use graded short length lumber, it must be economically attractive and not Just good for forest management. Therefore, first consider the cost of manufacturing furniture parts from 4/4 red oak No. 1 Common lumber. The following assumptions were made:

Rough lumber cost	$550/MBF
Stacking cost	20/MBF
Drying costs	55/MBF
Shrinkage	6%
Rough mill mfr. cost	370/MBF
Rough mill yield	55%
Fuel credit	34/MBF

With these assumptions, the cost of manufacturing 1000 BF of parts is $1551 or $1.55 per board foot (Table 7). If the rough mill yield were decreased 5% to 50%, the cost would Increase to $1.67 per board foot.

Table 7 -- The cost of manufacturing 1000 BF of furture and cabinet parts.

ITEM	VOLUME	COST
Rough lumber	1934 BF	$1064
Stacking	1934	39
Drying	1934	106
Shrinkage	1818	0
Rough mill Mfr.	1000	370
Fuel credit		78
TOTAL	1000 BF	$1551

As an example using the value of parts, consider a 4-inch by 6-foot piece of lumber. It scales as two board feet. The clear area for each grade (SEL requires 92 to 100%; No.1 requires 75 to 92%; and No. 2 requires 50 to 75%) times the board footage value of $1.55 (Table 7) yields the potential value of the lumber (Table 8).

Table 8 -- Value of the short length lumber when converted to parts.

GRADE	RAW MATERIAL PRICE	PART VALUE	INCREASED VALUE
SEL	$1.50	$2.81 to 3.10	1.97
No. 1 C	1.00	2.32 to 2.81	2.57
No. 2 C	.50	1.55 to 2.32	3.87

The increased value is the part value compared to the lumber value.

C. Proposed Grading Methods

The values in Table 8 are based on the assumption that the clear area is totally usable. But what about the mill that can't use the exact size of the clear area, but requires a slightly smaller size? For them, the value would be less. The question is "How can the value of short lumber be more accurately established?" (Certainly the present NHLA rules do assess the value, but as indicated above, tend to penalize the short length more than is justified.)

There are many possible ways to grade lumber, often depending on the intended use for the lumberTherefore, to refine the problem here, it is assumed that the highest value use for short length lumber will be In furniture and cabinet industries. Therefore, the assessment will be based on the lumber's ability to provide furniture and cabinet parts. Lumber failing to meet the furniture grade will be assessed for the potential to supply pallet material.

A grading system can be based on visual or computerized Inspection and can assign a grade to each individual board, or it can assign an overall grade for a

batch of lumber. Three approaches are suggested here as having the great potential for success and adoption by the industry

1. Individual Visual Board Grading

In this proposed system, following present lumber grading procedures, new grading rules would be established that better assess the value of short length lumber.

2. Automated individual Board Grading

In this proposed grading system, the lumber is scanned piece by piece with an optical system linked to a computer. Clear areas will be evaluated with respect to the cutting sizes of a specific manufacturing pi ant. The clear areas will have a value which will include the cost of cutting, drying, and handling. As an extension of the grading operation, it will be possible to code each board with instructions for the subsequent cut-up operation. Rough mill operations can thereby be fully automated.

3. Automated Batch Grading

This suggested grading system for short hardwood lumber is based on the concept that the value of lumber can be established based on the lumber's potential to supply a given number of specified sizes of furniture cuttings. As an extension of the concept of method #2, the third method also requires that the lumber automatically be assessed for knots, wane, drying defects and size. board and fits cutting sizes into the clear areas. But in this case, the cutting part sizes and the number of parts of each size is fixed.

It is proposed that this batch assessment be in terms of several "standard" cutting bills that are a) heavy to long length cuttings, b) heavy to mid-length cuttings, and c) heavy to short lengths. A batch of short length lumber could be assessed then on its ability to fill these three bills. Lumber would be marketed and valued assigned based on these bills. in essence, the lumber would be measured and valued, not on the MBF measure and traditional lumber grade, but rather on how much of one of the three standard bills that the given volume of lumber would fill. (Naturally, from a handling standpoint, some limits on lumber size and the total volume may have to be established.)

(Many products are sold in this way. Paint is sold by the gallon, but the amount needed is based on the coverage--340 sq. ft. per gal. for smooth surfaces, 175 sq. ft. for rough. Food is often marketed based on the number of servings, rather than just weight alone. And logs are sold based on the estimated lumber yield, rather than their gross volume!)

Three possible cutting bills are shown (Table 9). For these cutting bills, the required board footage of lumber of four different grades, including conventionally graded, No.1 Common short length lumber, can be calculated (Table 10). The high potential of short length lumber (that is, the high percentage of clear area compared to longer length lumber) is shown by the low footage required for No. 1C, SL in all three bills.

Table 9 -- Three possible cutting bills for batch grading.

CUTTING BILL A		CUTTING BILL B		CUTTING BILL C	
Quantity	Size	Quantity	Size	Quantity	Size
500	3" x 40"	150	6" x 30"	250	3" x 50"
400	RW x 26"	800	RW x 24"	500	RW x 3"
250	RW x 15"	250	RW x 15"	250	RW x 15"

Note: RW means random width pieces of 1.25 to 3.0-inches in width, edge glued and ripped into 3.0-inch wide strips

Table 10 -- Lumber required (BF) to fill three standard cutting bills given in Table 9.

LUMBER GRADE	CUTTING BILL A	B	C
FAS	935	910	865
No. 1 C	1000	1000	1000
No. 2 C	1205	2190	1215
No. 1C, SL	770	735	720

Note: SL = short length lumber.

D. Eliminating Lumber Grading

Another method of using short length lumber is for a sawmill to produce parts directly from the lumber, thereby eliminating the need for grading. in fact a better system is to produce parts directly, skipping the lumber step (and eliminating edging and trimming of rough lumber as well). A Canadian study (Flann and Lamb, 1966) on hard maple showed increases in value without edging of over 10 percent. This concept is basically the SYSTEM 6 method developed by the US Forest Service. The only major manufacturing problem area today with System 6 is the drying step. As yet, no drying method is available for satisfactorily drying parts without excessive warp (especially diamonding and crook). Continued research in drying may eliminate this road block in the future.

The reason for the interest in this "logs to lumber" approach is that it is possible to take a low value ($100/MBF), but plentiful No. 3 hardwood log (US Forest Service log grade) and produce 550 BF of parts from 1000 BF of logs with a part value of $852. Converting a 1000 BF of No. 3 logs into lumber and then using the No. 2 C and Better lumber for manufacturing parts will yield only 334 BF of parts with a value of $517.

Methods and Results

A. Visual Grading

The study of a possible grading system for short length lumber involved the creation of a 3600 piece data set of short length lumber, analyzing these pieces of lumber for potential value In a furniture or cabinet operation (value was assumed to be indicated by rough mill yieid), and then relating value to visual characteristics of the lumber to establish a viable grading (and therefore value estimating) system.

1. Short Length Lumber Samples

The first task was to generate short length lumber that would then be graded and analyzed for value in furniture and cabinet manufacturing. Short length lumber were generated using a computer program specifically written for this study. Using this program the lengths of the defective boards were varied in one foot increments between four and eight feet. Eight data sets of 90 pieces of lumber in each set were generated for each lumber length. In each data set, the lumber widths were generated randomly in the range of four to eight inches.

For each piece of lumber, one inch square defects or "knots" were generated and randomly placed on the surface of the board, except the knot positions were restricted so that the closest distance between any two knots was two inches. The number of knots was different in each data set of a given length of lumber -- from one to eight. in other words, a data set of 90 boards was generated for each lumber length and number of knots, making eight data sets for each length. With five lengths, there were a total of forty data sets with a total of 3600 pieces of short length lumber.

2. Determination of Yields for Short Length Lumber

After generating the defective board configurations, a methods of determining the yield of the boards after cutting was needed. Program CORY was chosen for use in this study. Program CORY is a FORTRAN based program written by Charles Brunner of Oregon State University. The program uses a so called "divide and conquer" algorithm in which the strategy is to identify those kerf lines most likely go give the highest yield and to evaluate each of them using a limited number of the largest clear areas rather than ail available clear areas. This type of solution allows low-grade materials containing many defects to be evaluated rapidly and efficiently.

3. Program CORY -- Input

Program input for CORY is divided into four general areas:

a) Processing information. Processing information includes user determination of where the first cutting operation will be rip or crosscut, input of a weighting factor, and a quality factor. CORY allows three options in how a board will be divided. The first Iwo, rip or crosscut first, may be specified by the user. The third option, called "best", divides the board in a manner which will give the highest yield as determined by the program after comparing rip and crosscut output. The weighting factor allows the user to tell

the program to place greater emphasis on cuttings which are longer. The quality factor determines if the cuttings will be clear on two faces, clear on one face, or sound on two faces.

b) Cutting bill information. Cutting bill information allows the user to specify the minimum cutting lengths, and the minimum and maximum cutting widths. The overall thickness of the cuttings is also specified.

c) Program execution information. Program execution information includes the number of boards to be run and the type of output desired.

d) Board defect and board dimension information. Defect information consists of specifying the overall board dimensions along with the positions, sizes and types of defects.

4. Data Generation Using Program CORY

The short length data set was run through CORY with cutting lengths of 12-, 18-, 24-, 36-, and 48-inches. Yields were tabulated for each lumber length class and for each number-of-knots category. After all five cutting lengths were run, the data were rerun using the four longer lengths. Then, the data were rerun using the three longer lengths. Finally, the data were rerun using the two longer lengths.

In addition, some of the data were run with a rip first cutting option and then rerun with a crosscut first cutting option. With the 90 piece data sets, there were no significant differences In overall yield between these two cutting options.

Graphs (Figures 2 through 6) of yield versus the number of knots and the lumber length show an excellent relationship. Because overall yield is a function of the shortest cutting, It can be concluded that the number of knots and board length can be used to predict the yield and therefore value of short length lumber. Because these relationships are straight lines, with only one deviation for the 6-foot lumber with one knot, it should be valid to use Intermediate points between the lumber lengths. Also shown on these curves are the expected yields for standard, long length FAS and No. 1C lumber.

B. Batch Grading

For the study on batch grading, three cutting bills were used (Tables 11 through 13). Cutting bill "A" consists of predominately short cuttings (16 to 32-inches long) as would be required in a cabinet manufacturing operation. Cutting bill "B" has cutting lengths from 12 to 48-inches long as might be found in a casegoods' manufacturing operation. Cutting bill "C" has lengths from 18 to 72 inches.

Table 11 -- Cutting Bill "A".

Cutting Size Length (In.)	Cutting Size Width (In.)	Number of Cuttings	Volume of Cuttings (Bd. Ft.)
32-1/2	2-7/8	6000	3893
27	2-1/4	9000	3797
25-1/2	2	2500	885
20-3/4	2-1/4	3000	973
16-1/4	2-7/8	6000	1947

Note: All cuttings are based on pieces of the Indicated length and 1-1/2-inches wide or wider, which are edged glued together and then resawn to the required width.

Table 12 -- Cutting Bill "B".

Cutting Size Length (In.)	Cutting Size Width (In.)	Number of Cuttings	Volume of Cuttings (Bd. Ft.)
48	2	2000	1333
44	2-7/8	5000	4392
29-1/4	2-1/4	2500	1143
28-3/4	2-7/8	4000	2296
27	4-15/16	625	579
19-7/8	2-1/16	2500	711
16-3/4	1-1/2	2500	436
13-7/8	2-7/8	5000	1385
12	1-9/16	5000	650

Note: All cuttings are based on pieces of the indicated length and 1-1/2-inches wide or wider, which are edged glued together and then resawn to the required width.

Table 13 -- Cutting Bill "C".

Cutting Size Length (In.)	Cutting Size Width (In.)	Number of Cuttings	Volume of Cuttings (Bd. Ft.)
72	1-1/2	1620	1215
60	3	1890	2362
44	1-1/2	3510	1609
36	3	2700	2025
28	1-1/2	2700	787
24	1-1/2	2700	675
20	3	2700	1125
18	1-1/2	2700	506

Note: All cuttings are based on pieces of the indicated length and 1-1/2-inches wide or wider, which are edged glued together and then resawn to the required width.

These cutting bills were then run through a computer program called OPTIGRAMI, written by the U.S. Forest Service, to determine how much standard, long length lumber (FAS, No. 1 Common, and No. 2 Common) would have to be used to fill the bills. The optimum mix is that mix of FAS, No. 1C, and No. 2C that results In the minimum overall cost of manufacturing (including raw material). In addition, CORY was run with 6- and 8-foot, 1- and 3-knot and with 8-foot, 5 knot short length lumber to determine how much short length lumber would have to be used to fill the bills. The results of these analyses are presented in Tables 14 through 16, by cutting bill.

Table 14 -- Required lumber to fill cutting bill "A"

Lumber Grade	Required Gross Volume	Yield (Parts/Lumber)
	(Bd Ft)	(Pct)
Optimum Mix of FAS, No. 1C, & No. 2C	19,482	59
FAS only	15,112	76
No. 1C only	16,614	69
6-Ft, 1-Knot	14,139	86
6-Ft, 3-Knot	15,320	79
8-Ft, 1-Knot	14,377	85
8-Ft, 3-Knot	15,196	80
8-Ft, 5-Knot	15,490	79

Table 15 -- Required lumber to fill cutting bill "B".

Lumber Grade	Required Gross Volume	Yield (Parts/Lumber)
	(Bd Ft)	(Pct)
Optimum Mix of FAS, No, 1C, & No. 2C	18,799	69
FAS only	16,468	78
No. 1C only	17,878	72
6-Ft, 1-Knot	14,973	86
6-Ft, 3-Knot	18,089	71
8-Ft, 1-Knot	14,796	87
8-Ft, 3-Knot	15,245	80

Table 16 -- Required lumber to fill cutting bill "C".

Lumber Grade	Required Gross Volume	Yield (Parts/Lumber)
	(Bd Ft)	(Pct)
Optimum Mix of FAS, No. 1C, & No. 2C	18,927	64
FAS only	15,822	76
No. 1C only	17,388	70
6-Ft, 1-Knot	13,225	92
6-Ft, 3-Knot	17,901	68
8-Ft, 1-Knot	13,954	93
8-Ft, 3-Knot	14,950	81

This analysis of the lumber required to fill the bill illustrates how this concept works. Further, this analysis reflects again the high value of short length lumber and the suitability of using knots as an indicator of yield and, consequently, value. As might be expected, a l-knot piece is nearly clear and therefore yields are quite high, especially with cutting bill "C".

Summary and Suggestions

The research conducted in these various studies has demonstrated that a simple lumber grading system based on the number of knots and lumber's length for short length (4- to 8-feet long and 4- to 8-inches wide) is feasible. The grading rule separates the lumber into various yield classes and therefore value class.

This work has also demonstrated that high yields are possible from short length lumber.

This work demonstrated the potential for a batch lumber grading system based on standardized cutting bills. This system has the advantage of being separated from the standard grading rules which require certain edging practices, certain lumber sizes, and penalizes short lumber. In a batch system, the purchaser is buying cuttings, not waste lumber.

The major deterrents to the development of a short lumber market are drying and historic practices of using long length lumber.

Future work should be directed toward drying short length lumber. In addition, a demonstration of the yield and processing techniques for short length lumber should be planned for the furniture and cabinet industry (perhaps following some of the plans of the System 6 project).

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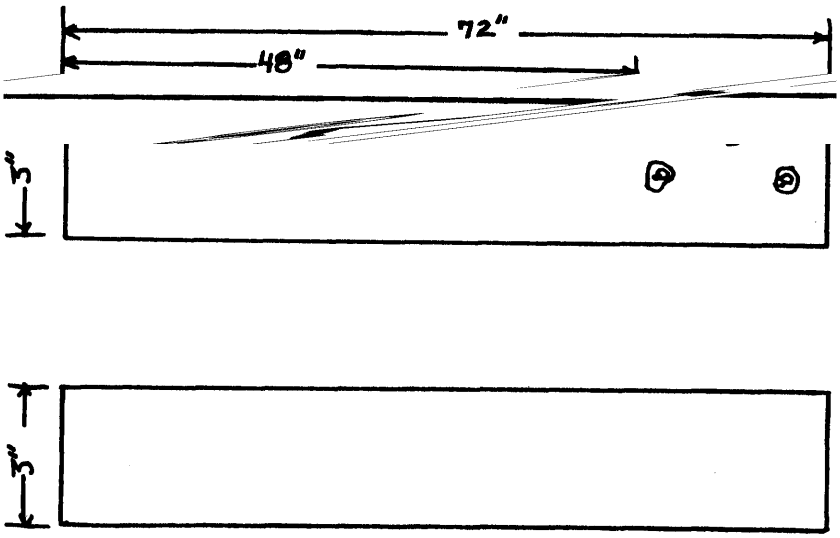

Figure 1 -- No.1 Common hardwood lumber -- worst (top) to best (bottom).

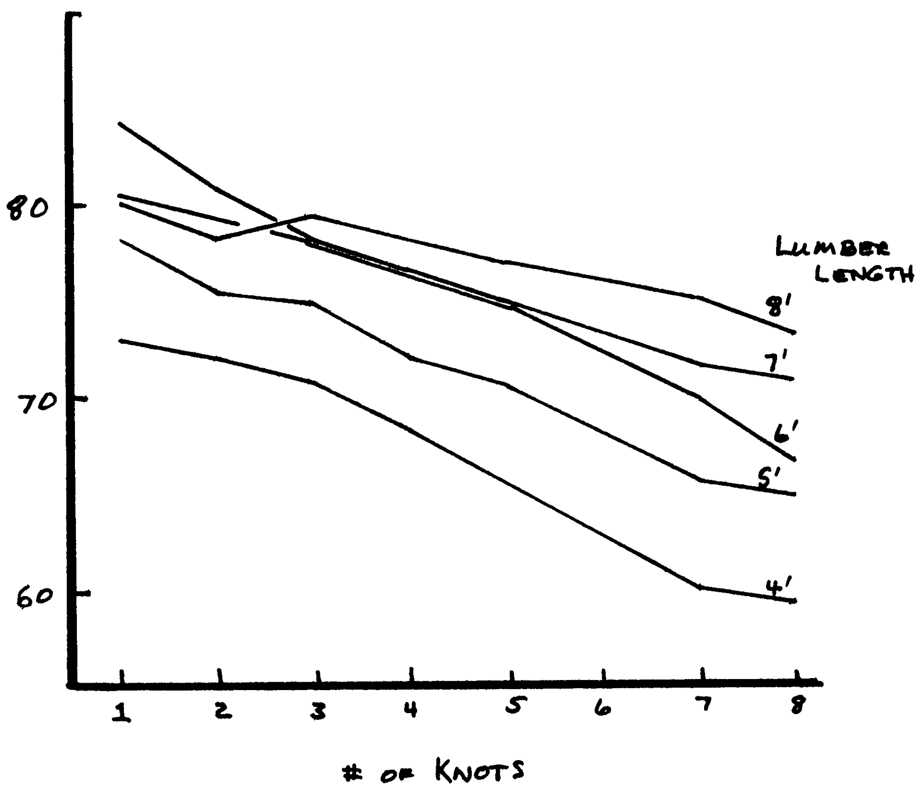

Figure 2 -- Yield for 24-inch minimum cutting length.

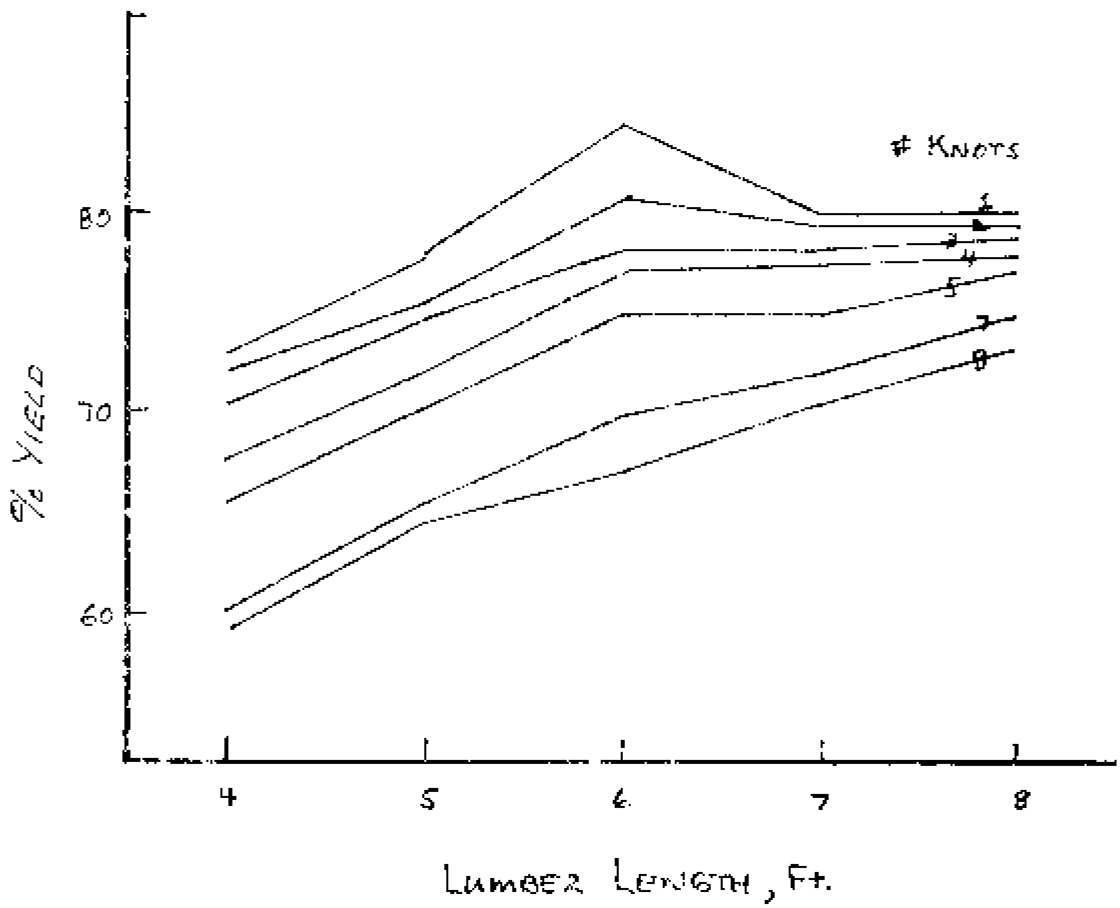

Figure 3 – Yield for 12-inch minimum cutting length.

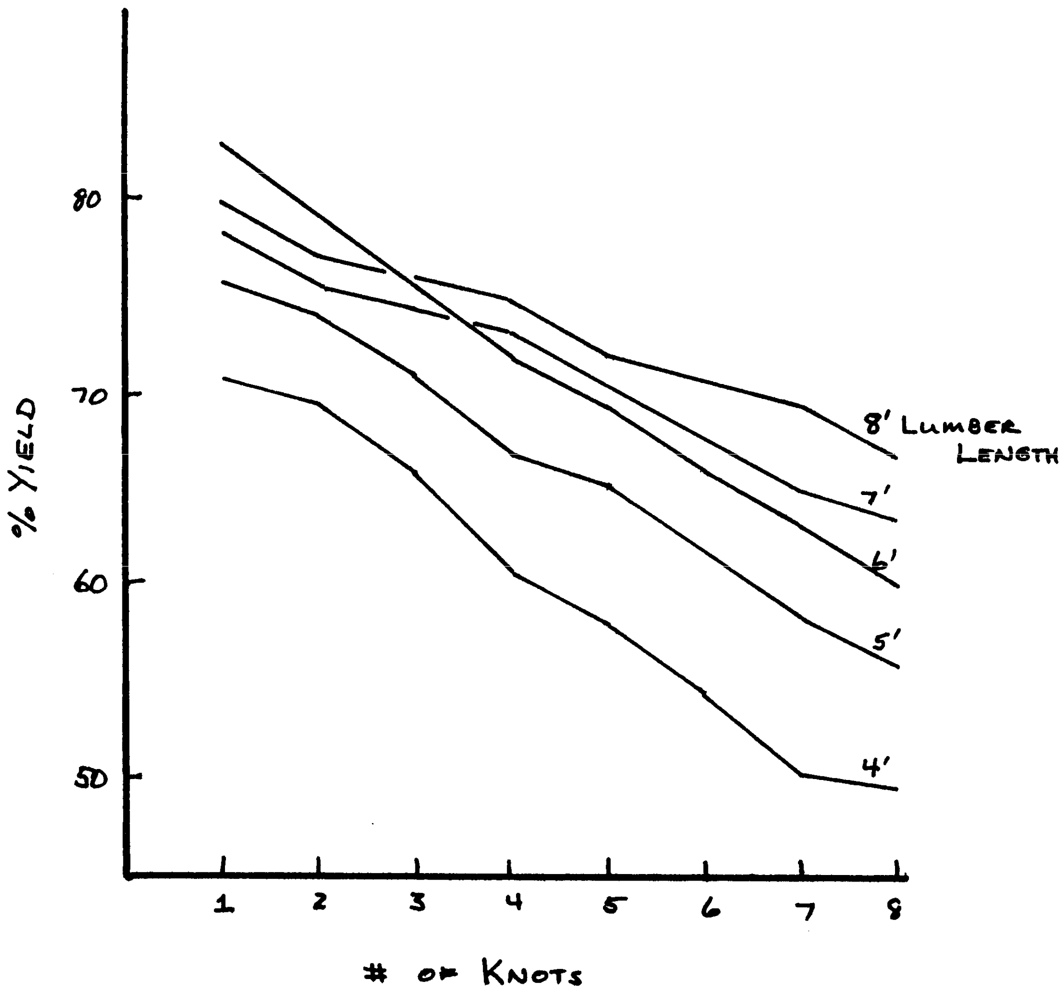

Figure 4 -- Yield for 18-inch minimum cutting length.

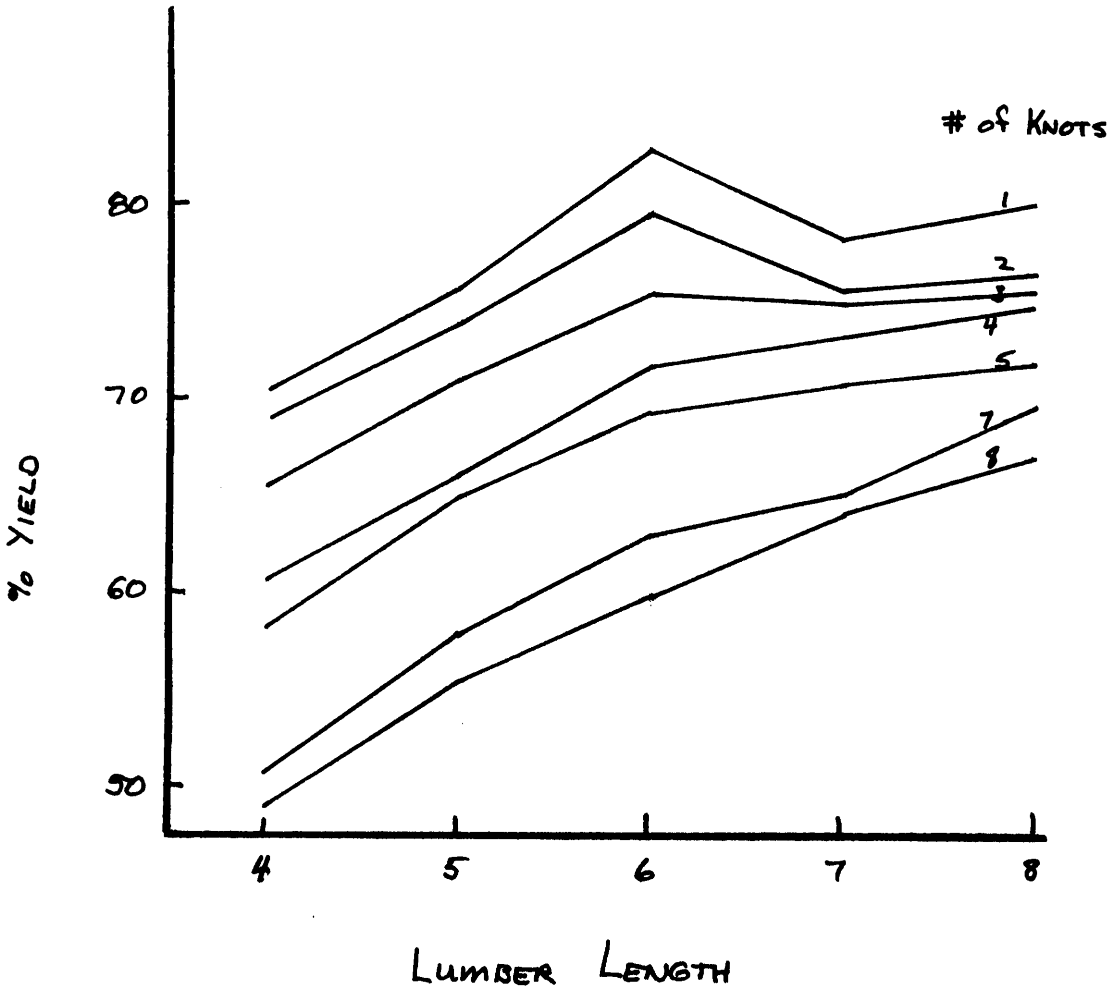

Figure 5 -- Yield for 18-inch minimum cutting length.

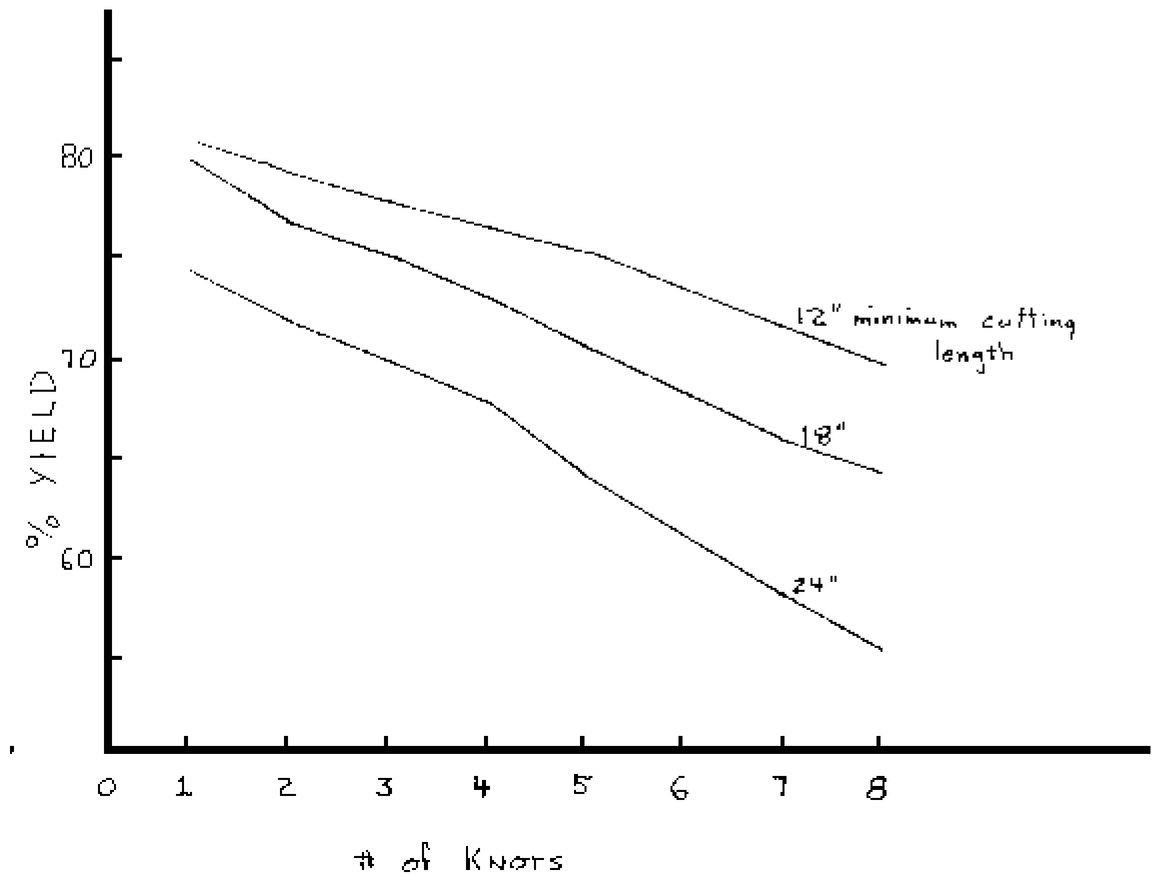

Figure 6 – Overall yield vs. # of knots for 6-, 7-, and 8-foot lumber.

PROCEEDINGS

FIFTEENTH ANNUAL HARDWOOD SYMPOSIUM

OF THE

HARDWOOD RESEARCH COUNCIL

APPLYING THE LATEST RESEARCH TO HARDWOOD PROBLEMS

The Peabody Hotel

Memphis, Tennessee

May 10-12, 1987