USDA FOREST SERVICE RESEARCH NOTE NE-121
1970

N
E

FOREST SERVICE, U. S. DEPT. OF AGRICULTURE, 6816 MARKET STREET, UPPER DARBY, PA.

PHYSICAL SUITABILITY OF APPALACHIAN HARDWOOD SAWLOGS FOR SAWED TIMBERS

Abstract.—A study of the physical suitability of Appalachian hardwood sawlogs for manufacture of sawed timbers revealed that: most grade 1 logs can be used to saw timbers as large as 8 by 9 inches, end dimension; most grade 2 logs are suited for manufacture of timbers 6 by 8 inches and smaller; and most grade 3 logs are suited for manufacture of timbers 5 by 7 inches and smaller.

Little is known about the suitability of Appalachian hardwood logs for manufacturing timbers. A recent Forest Service study of the yield of timbers of various size from different grades of hardwood logs may help millowners more accurately match tie and timber orders with their log resource. Also, millowners not producing timbers could use this information in making decisions concerning entry into the tie and timber market.

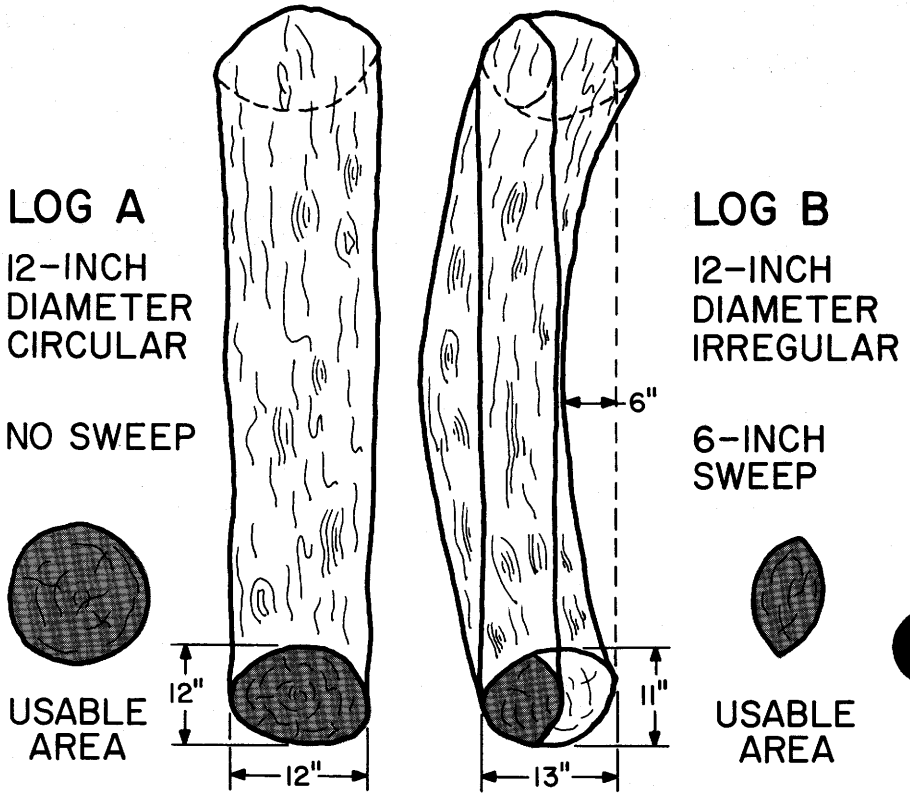
Study Methods

830 sample logs were selected at random from logs at three mills in southern and central West Virginia. Logs from three species groups—red oaks, white oaks, and hickories—were included in the sample. These species make up most of the growing stock in the Appalachian Region, and most timbers manufactured in the Appalachian Region are sawed from these species.

The logs were graded in accordance with the USDA Forest Service grading system,[1] which includes five grades: 1, 2, 3, tie and timber, and

[1] Ostrander, M.D., and Others. A GUIDE TO HARDWOOD LOG GRADING. USDA Forest Serv. NE. Forest Exp. Sta., Upper Darby, Pa. 50 pp., illus. 1965.

Figure 1.—Effects of sweep and shape on the portion of the log usable for manufacture of timbers.



local-use. Logs that graded 3, tie and timber, or local-use were grouped and are referred to in this report as grade 3 logs.

Diameter, sweep, internal defect, and shape were judged to be the major factors that determine a log's potential for production of sawed timbers. A log must be sound and have sufficient diameter to offset the effects of sweep and shape before a timber can be sawed from it.

Because the sample was taken at the mill, length was not considered as affecting a log's usefulness for conversion to timbers. All logs sampled had been cut to satisfy random-length orders for both lumber and timbers. Therefore, we imposed the precondition that timbers would be cut to the entire length of each log.

Measurements of diameter, sweep, and shape were used to determine the portion of the log from which a timber could be sawed. This procedure is schematically illustrated in figure 1. Log A is straight, has a circular end shape, and is 12 inches in diameter at the small end. Log B

is also 12 inches in diameter; however, it has irregular end shape and 6 inches of sweep. All of the surface area on the small end of log A represents the portion usable for manufacture of a log-length timber. Log B, because of irregular shape on its small end and sweep on one axis, has a smaller usable area. If sweep had occurred on both axes, an even smaller usable area would have resulted.

All 830 sample logs were tested for potential production of 10 timber sizes ranging from 4 by 6 inches to 10 by 10 inches, end dimension (fig. 2). Most timbers manufactured in the Appalachian Region fall within the limits of this range.

A pretest sample of 25 logs that were sawed revealed that the formula for an ellipse (fig. 2) adequately described the usable area projected onto the small end of the log. Measurements of the long and short axes of this area were used in defining the ellipse.

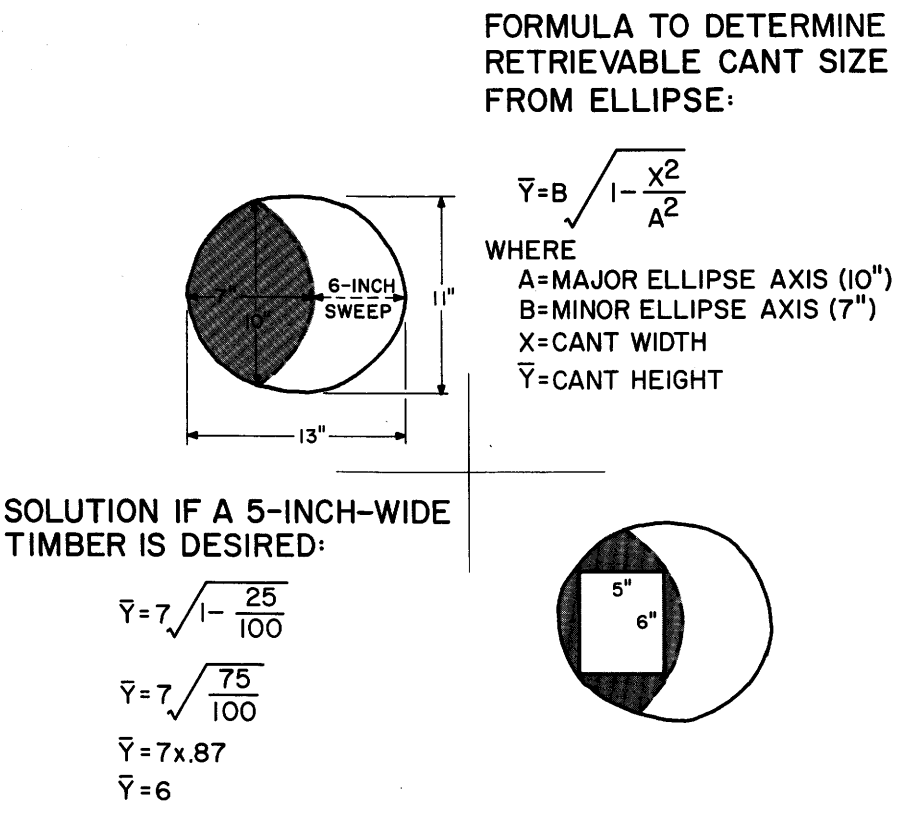


Figure 2.—Method for determining maximum retrievable timber size.

Results

Logs that have unsound internal defect will not yield an acceptable log-length timber. Thirteen percent of the grade 1, 11 percent of the grade 2, and 18 percent of the grade 3 sample logs were unsuited for sawing of timbers because of holes, decay, or shake. Grade 1 logs were predominantly butt cuts with typical butt flaws, so they were slightly more defective than grade 2 logs.

Diameter affects the utility of different log grades for the manufacture of timbers the most. Low-grade logs have smaller average diameters than high-grade logs, so fewer low-grade logs are suited for manufacture of larger timbers because of diameter alone. For example, all grade 1, 2, and 3 sawlogs[2] have sufficient diameter to produce 4- by 6-inch timbers provided they are not restricted by shape, sweep, or defect. And all grade 1 logs have sufficient diameter for 7- by 9-inch crossties, but many grade 3 logs have less than the 12-inch diameter necessary for crossties.

Logs that have sufficient end diameter for recovery of a timber of given size may not be suited for production of that timber because of sweep (fig. 1). The frequency of sweep was much greater in the smaller low-quality logs. Twenty-five percent of grade 3 logs had 2 inches or more sweep. Only 15 percent of the grade 2 logs and 12 percent of the grade 1 logs had this much sweep.

Irregular end shape was more common in grade 3 logs than in grade 2 or 1 logs. This irregular shape in low-quality logs was usually accentuated by the log being twisted.

Grade 3 logs.—Grade 3 logs are the most logical choice for tie and timber production as they yield mostly low-grade lumber that commands a low market price. Also, in the Appalachian hardwood region, low-grade logs make up over 60 percent of the growing-stock volume.[3] These physical characteristics make many grade 3 logs unsuitable for manufacture of larger size timbers; however, 72 percent of these logs will produce a 5- by 7-inch mine tie.

Sweep and unsound defect are more prevalent in grade 3 logs than in grades 1 and 2. Diameters of the grade 3 logs averaged only 13.0 inches. These factors restricted the number of grade 3 logs suitable for manufacture of timbers (table 1). Of the grade 3 logs studied, 76 percent

---

[2] Sawlogs must be at least 8 inches in diameter inside bark at the small end.

[3] Ferguson, Roland H. THE TIMBER RESOURCES OF WEST VIRGINIA. USDA Forest Serv. Resource Bull. NE-2. 121 pp., illus. NE. Forest Exp. Sta., Upper Darby, Pa. 1964.

Table 1.—Percent of sample logs suited for manufacture of sawed timbers, by grade

[Includes red oak, white oak, and hickory species groups.]

Timber size (end dimension)	Log grade		
	1	2	3*
Inches	*Pct.*	*Pct.*	*Pct.*
4 by 6	84	85	76
4 by 8	84	85	71
5 by 7	84	85	72
6 by 6	84	85	72
6 by 8	84	82	62
7 by 9	83	64	42
8 by 8	83	64	42
8 by 9	83	54	34
9 by 9	72	37	24
10 by 10	48	20	12

* Includes tie and timber and local-use grades.

could be used for sawing 4- by 6-inch timbers. As timber size increased, the percent of logs acceptable for manufacture of timbers decreased. For example, as timber size is increased to 7 by 9 inches, the percentage of suitable logs decreases to 42 percent. Only 34 percent of the logs could be used for production of 8- by 9-inch timbers.

Grade 2 logs.—Grade 2 logs contained less core defect than either grade 1 or grade 3 logs. Sweep and irregular shape occurred less frequently than in grade 3 logs, and the average diameter was 14.5 inches.

More than 80 percent of the grade 2 logs studied were suited for production of timbers up to 6 by 8 inches in end dimension (table 1). However, the utility of grade 2 logs for production of timbers decreased rapidly for timbers greater than 6 by 8 inches. One-half of the grade 2 logs could be converted to 8- by 9-inch timbers, and only 20 percent could be converted to 10- by 10-inch timbers.

Grade 1 logs.—Grade 1 logs were found to be the best physically suited for production of the timber sizes studied. The average diameter of grade 1 logs—16 inches—far exceeded the average for grade 3 logs. Sweep was not prominent in these logs, but internal defect did limit their utility for production of timbers. Because of this internal defect, grade 2 logs were equally well suited for conversion to timbers smaller than 7 by 9 inches.

Eighty-three percent of the grade 1 sample logs could be used to saw timbers as large as 8 by 9 inches. Approximately half of the samples met the requirements for conversion to 10- by 10-inch timbers.

—LAWRENCE D. GARRETT
Associate Economist
Northeastern Forest Experiment Station
Forest Service, U.S. Dep. Agriculture
Princeton, West Virginia

■