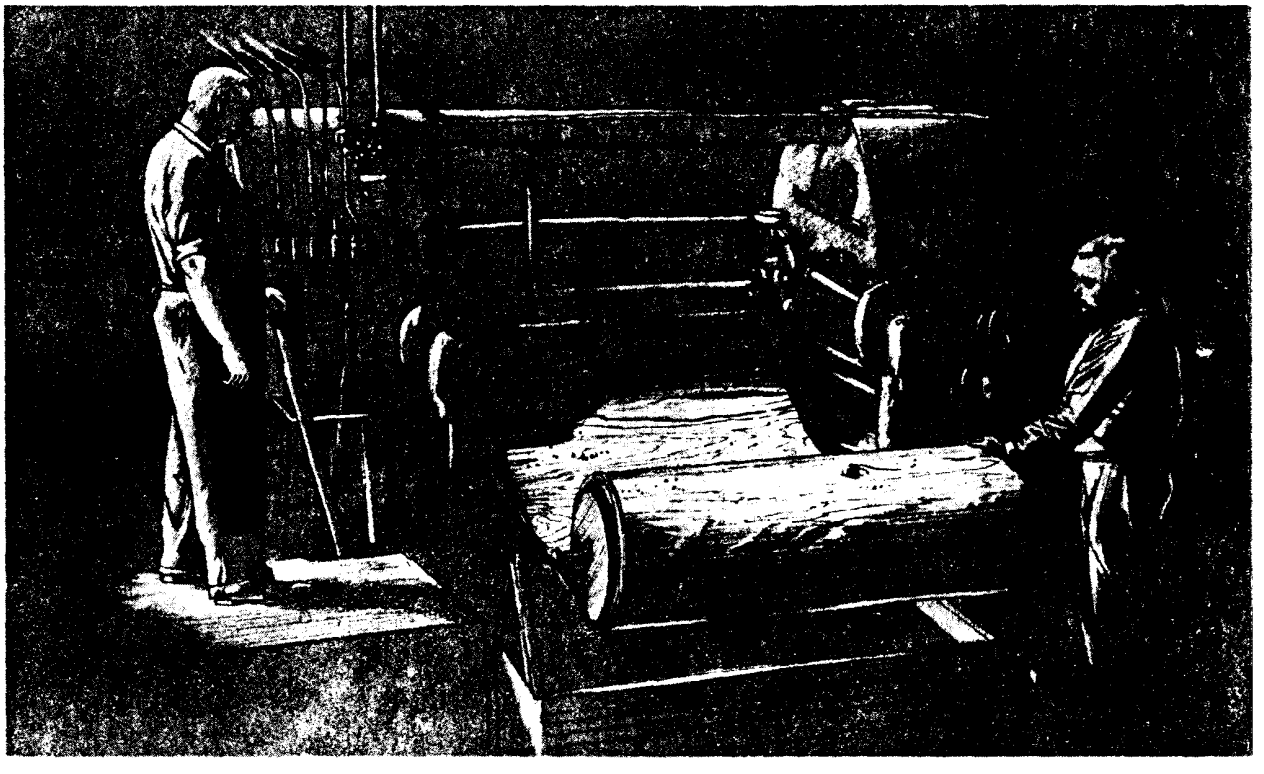
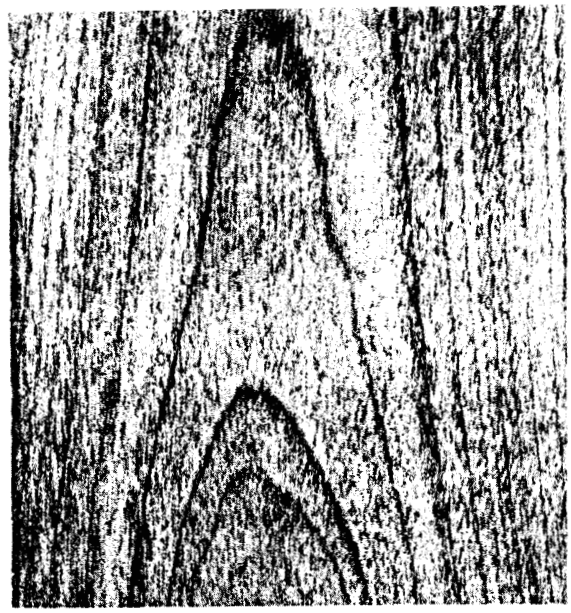
U.S. FOREST SERVICE | RESEARCH PAPER | FPL 9 | OCTOBER | 1963

RECOMMENDED VENEER GRADES

for the development of hardwood veneer log grades



FOREST PRODUCTS LABORATORY | FOREST SERVICE | U. S. DEPARTMENT OF AGRICULTURE | MADISON, WIS.

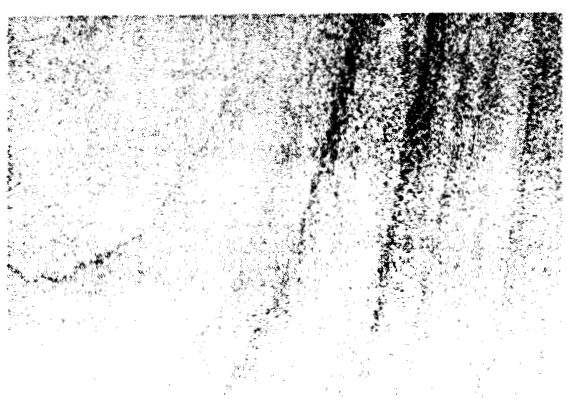


SUMMARY

The quality of a log or tree refers to those properties that make it suitable for conversion into end products for a given use, and leads to a system of sorting the products into groups with similar characteristics.

The research reported herein was conducted for the purpose of establishing hardwood veneer grades to be used in developing hardwood veneer log and bolt grades. The recommended Forest Products Laboratory hardwood veneer grades attempt to reduce the need for individual judgment required by specifying type, number, distribution, and size of defects permitted in each grade.

Studies were made at four veneer mills on yellow birch, hard maple, and redgum. The FPL hardwood veneer grades segregated veneer in the green condition into groups that reflect the utility of the veneer in the dry condition.



RECOMMENDED VENEER GRADES for the development of hardwood veneer log grades

by

JOHN W. HENLEY,[1] Technologist
RICHARD O. WOODFIN, JR., Technologist
HENRY H. HASKELL, Technologist

Forest Products Laboratory,[2] Forest Service
U. S. Department of Agriculture

INTRODUCTION

One major research problem in the field of quality evaluation that was recognized by the U.S. Forest Service Log Grade Committee was the development of hardwood veneer log grades. Before veneer bolt and log grades can be developed, standard hardwood veneer grades are required. This need reflects one of the basic concepts outlined by the Log Grade Committee: that is, the end product must have well-defined standards or grades before a grading system can be developed for logs or trees that produce the end product. The existing hardwood veneer grading rules are not specific and leave much to the judgment of the grader. Also, the existing grades do not specify the number and size of defects allowed in the various grades. Veneer grading systems were found to vary with the individual plant, the grader, and plant procedures. Such grade systems did not have consistent relationships nor express a specific market value.

The Forest Products Laboratory has developed and completed the evaluation of a hardwood veneer grading system that can be used to develop grades for hardwood veneer logs and bolts. The grades in general follow the specifica-

[1] Now with the Pacific Northwest Forest and Range Experiment Station, Portland, Oreg,

[2] Maintained at Madison, Wis., in cooperationwith the University of Wisconsin.

tions of the Hardwood Plywood Institute[3] and the Commercial Standard, CS 35-61.[4] However, an attempt has been made to reduce the need for judgment required of a grader by specifying the type, number, distribution, and size of defects permitted in each grade.

Four studies have been completed that were designed to evaluate the performance of the recommended veneer grades in segregating veneer into categories that reflect utility of the veneer. These studies were conducted at the following locations:[5] A Vermont mill producing yellow birch (Betula alleghaniensis) veneer for door skins; two Wisconsin mills, one producing yellow birch veneer for wall panels and door skins, and the other producing hard maple (Acer saccharum] veneer for chair seats and backs; and a Georgia mill where redgum (Liquidambar styraciflua) veneer was produced for stock plywood panels.

The approach taken in testing the veneer grades was to determine the utility of the veneer segregated by the grading rules for various uses, species, and areas of production.

GENERAL INSTRUCTIONS

1. These grades are to be applied to veneer strips of the spurred or clipped length produced from a bolt or log and with a minimum green width of 6 inches. There is no maximum width of strip. Length refers to the distance along the grain of the veneer, and width refers to the distance across the grain.

2. All veneer strips shall be measured at the narrowest part of the piece and without allowance for trimming or shrinkage. Strips with the minimum width must have sound edges.

3. Defects (except splits) 1/64 inch wide. or less, across the grain can be considered as removed with one cut of the clipper.

4. Grades must be applied to recover the maximum amount of the highest grade veneer.

5. All veneer that does not meet the grade specifications is termed "residue."

DESCRIPTION OF TERMS USED IN THE GRADES

Grading Defects

A defect, as used here, is defined as any irregularity occurring in or on wood that adversely affects its appearance, strength, durability. or utility values. The defects specifically recognized in these grades are described below. When characteristics not described in these grading specifications are encountered

[3] Hardwood Plywood Institute. Hardwood Plywood Manual, Second edition, pp. 9-10. 1962.

[4] U.S. Dept. of Commerce. Commercial Standard CS 35-61, Hardwood Plywood. 1961.

[5] Appreciation is extended to the following companies for their assistance and cooperation in permitting these research studies to be conducted at their veneer mills: the Bradley Plywood Corp., Savannah. Ga.; the Larson Plywood Co., Sheboygan, Wis.; the Owens-Illinois Plywood Co., North Troy, Vt.; and the Penokee Veneer Co., Mellen, Wis.

they will be considered in relation to described defects according to their adverse effect on appearance, strength, durability. or utility values of the veneer.

The following characteristics are grading defects and their presence is limited by the grading specifications:

Brashness.---A condition of wood characterized by low shock resistance for the species and by abrupt failure across the grain without splintering when the piece is bent only a small amount.

Cross break.--Separation of the wood cells across the grain of the veneer piece; usually accompanied by splintering.

Decay.--A disintegration of the wood substance due to the action of wood-destroying fungi. Decay that has not proceeded far enough to soften or otherwise perceptibly impair the hardness of the wood but usually accompanied by a slight discoloration or bleaching that gives the wood a dull and lifeless appearance is termed incipient decay. However, it is not recognized as a separate grading defect.

Gum spots. - -Well-defined accumulations of solid gum that occur between displaced wood elements. Sound gum spots have no openings larger than 1/64 inch. An open gum spot has an opening larger than 1/64 inch.

Holes.--Openings resulting from mechanical damage.

Knots,--Cross or longitudinal sections of limbs with grain running at about right angles to the grain of the veneer of which they are a part. Knot size is determined by the character of the grain of the knot and is measured at the points where the grain of the knot is most differentiated from that of the surroundingwood. Knots are measured to the nearest one-quarter inch and further classified into two groups:

(1) Sound knots are solid and firmly fixed in the piece of veneer of which they are a part. Sound knots have no openings or pith larger than 1/64 inch.

(2) Open knots or knotholes are voids where a portion of or all of the knot has dropped out. This includes knots with checks and pith wider than 1/64 inch.

Open insect damage--Holes, grooves, or passages in the wood that are caused by the movements of insects.

Rough veneer.--Veneer that is not smoothly cut and will not produce a smooth surface when one-quarter of the veneer thickness is removed by sanding. Roughness may occur as the result of natural features of the wood or by mismanufacture.

Splits.--Separations of the wood fibers parallel to the grain of the wood. Separations occurring as a result of "checking" or "shake" are classified as splits. A tight split is one not wider than 1/64 inch. An open split is one that is more than 1/64 inch wide.

Permissible Characteristics

The following are characteristics permitted by the grading specifications and not considered to be grading defects:

Distorted grain (burls).--Swirls or twists in the grain of the wood, generally rounded in outline, and usually resulting from overgrowth of dead branch stubs. Such areas do not contain a knot or a pith center.

Sound discolorations (stain). - -A sound, firm part of the veneer where color

varying from the natural cast of the veneer is evident and is caused by sap stain, mineral stain or streak, gum, water stain, chemical stains such as iron stain, or oil drips. See A (clear) grade for the only limitations on mineral stain or streak.

Sound insect damage.--Insect damage that is completely and firmly filled with frass and pith. Refer to A (clear) grade specifications for the only limitation on sound insect damage.

SPECIFICATIONS FOR RECOMMENDED HARDWOOD VENEER GRADES

A (Clear) Grade

Veneer in this grade must be smooth and free of defects. Distorted grain (burls) is permitted. Sound discolorations (stain) and sound insect damage are permitted with the following limitations: mineral stain or streak and soundinsect damage may not be over 1/16 inch wide by 1/2 inch long, and must be at least 21 inches from any other mineral stain or streak or sound insect damage.

B (Sound) Grade

Veneer in this grade must be smooth and free of open defects. This grade admits distorted grain, sound discolorations, and sound insect damage, as in grade A but without limitation of size or number. In addition, sound knots up to 3/4 inch in average diameter, sound gum spots, and tight splits are permitted.

Larger knots and splits, open knots and large knot holes, decay, brashness, cross breaks, holes, and roughness are not permitted.

C (Utility and Back) Grade

Veneer in C grade may contain the defects of the B grade. In addition, there may be open knots, knot holes, holes, or open insect damage up to 2 inches in maximum diameter for a single hole or a group of holes up to 4 inches in aggregate diameter in any 12-inch-square area. Knots that contain decay are permitted if the surrounding wood is sound and the knot holes plus the decayed area meet the size limitations for open knots or knot holes.

Cross breaks and roughness are permitted if their largest dimension does not exceed 2 inches.

Splits up to 1 inch wide at the widest point shall be admitted if they are one-fourth or less the length of the veneer sheet. Splits 1/2 inch wide at the widest point may not be over one-half the veneer length. Splits 1/4 inch wide at the widest point may be over one-half the veneer length.

Larger knots, splits, holes, cross breaks, roughness, open insect damage, and decayed areas are not permitted.

PROCEDURE

Specific study procedures varied slightly with each mill but overall concepts remained constant. Each mill was selected on the basis of study objectives,

end products, and availability of veneer logs and species.

All studies started with logs selected at the mills and included the range of log sizes and quality being peeled. Based on the Hardwood Log Grades for Standard Lumber,[6] log quality ranged from No. 1 through No. 3 and poorer.

Mill practices of log bucking, bolt heating, debarking, and veneer peeling varied somewhat for each of the four studies. The bucking operation at three of the mills was performed prior to heating the logs, and after heating at the fourth mill. At three of the mills the bolts or logs were heated in hot water vats, and in a steam chamber at the fourth. One mill banded bolt ends with steel straps in an attempt to reduce end-checking during heating. At three mills bolts were debarked after heating. The thickness and length of veneer produced varied between mills. Thicknesses of 1/28, 1/22, 1/18, and 1/16 inch, and spurred lengths of 24, 36, 75, 86, and 100 inches were produced.

Veneer Grading

Veneer from each bolt was graded in units about 50 feet wide. The 50-foot size was arbitrarily selected as preliminary investigations indicated that such a sampling unit would be advantageous for the type of statistical analysis to be used. It was determined that a minimum number of 110 sampling units would be needed at each mill for accuracy to the 95 percent level.

The veneer from a bolt was graded, green and dry, by Forest Products Laboratory personnel using the recommended veneer grades. The grading of the green veneer was done ahead of the clipper to obtain a theoretical maximum grade yield according to the recommended grades for hardwood veneer, without the influence of plant clipping. This, in effect, required the grader to mentally "clip" the veneer and grade the resulting pieces. The green veneer was not regraded after mill clipping. In application of the grades, the minimum-usable veneer width is 6 inches with no maximum width.[7] Where mill practice included actually cutting back dry veneer to raise the grade of individual pieces, the green veneer graded by the Forest Products Laboratory graders was mentally "cut back" in length,[8] to upgrade a piece.

The green veneer was clipped, sorted, and dried to a moisture content of 6 to 10 percent. Each piece of dry veneer was graded by a company grader. At three of the mills the recommended veneer grades were applied to the sheets of dry veneer after the veneer had been sorted into company grades. Dry-grading at the fourth mill was not possible.

Analysis

The yields of veneer from each study

---

6 Hardwood Log Grades for Standard Lumber. Forest Products Lab. Rept. No. 1737. 1953.

7 Assuming veneer grade did not change, the maximum width for these studies was limited only by the physical limitation of a grader in not being able to reach and measure beyond about 48 inches, without having to use mental addition.

8 Veneer length is the spurred length.

were analyzed separately. The analysis approach was to compare the existing plant-grading system with the system recommended by the Forest Products Laboratory. This permitted an evaluation of the degree of correlation existing between the quality of veneer segregated by the plant system and that segregated by the FPL system. Linear regression and correlation analysis measured the degree of association between the two systems. For statistical analysis the area of veneer in the company grades was the dependent variable, and the independent variable in the FPL grades.

Automatic computation and analysis of data was made from punched data processing cards.

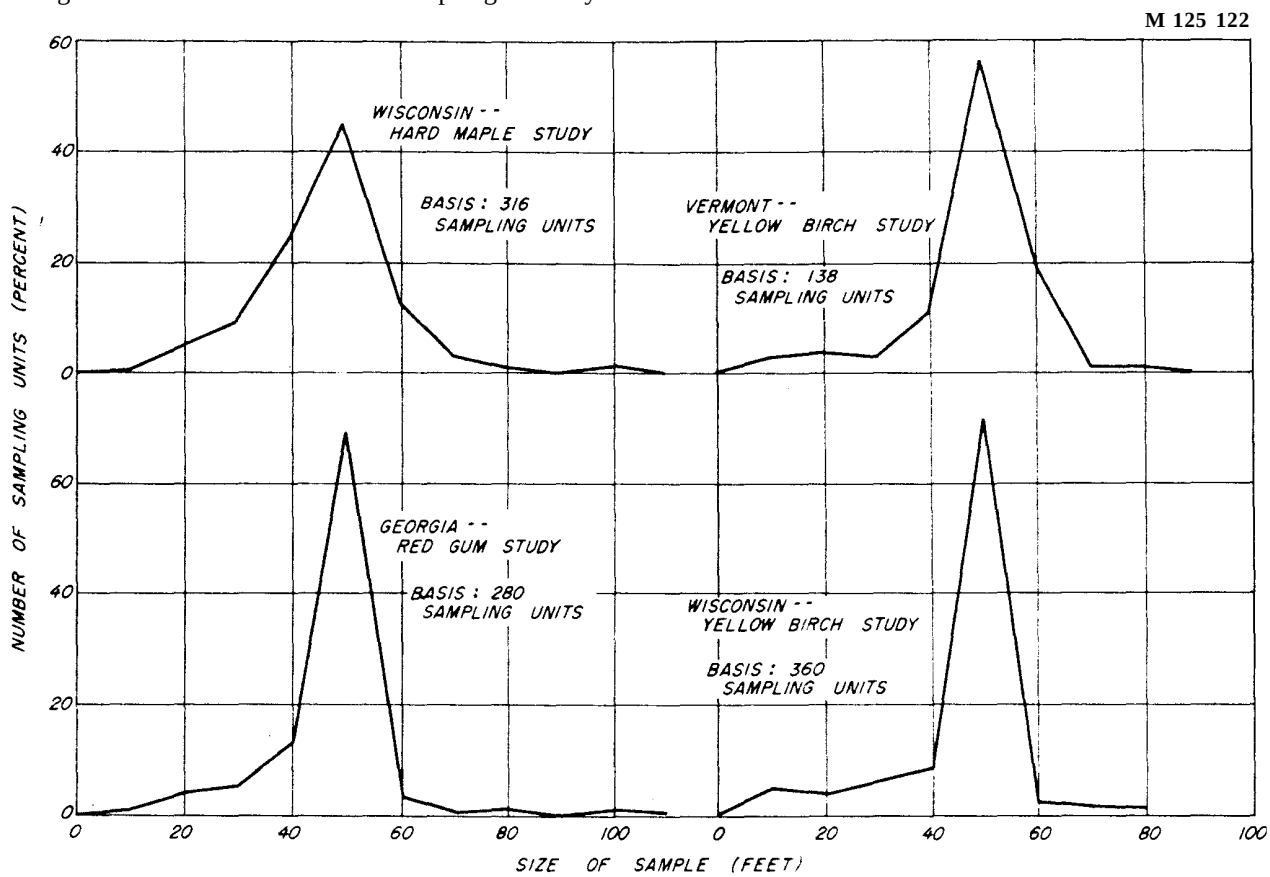
RESULTS AND DISCUSSION

Grades and Volumes

A total of 1,094 sample units of green veneer (321,703 square feet) were included in the four studies. Size distribution of the sampling units is shown in figure 1. A summary of the distribution in square feet of veneer is shown by studies and FPL grades in table 1.

Vermont Study (Yellow Birch).--Results of the Vermont yellow birch study were based on 138 sampling units of veneer containing 46,553 square feet of green veneer. According to the recommended

Figure 1.--Sizedistribution of sampling units by 10-foot-widthclasses.



Forest Products Laboratory grades, 33.5 percent of this green veneer was of grade A, 22.2 percent of grade B, and 34.9 percent of grade C quality, while the remaining 9.4 percent was termed residue. From this amount of green veneer, 26,869 square feet of dry usable veneer was obtained. The company termed 65.4 percent of this dry veneer face grade and the remainder back grade. The study methods did not permit the development of a table of yields by company grades within Forest Products Laboratory grades.

Wisconsin Study (Yellow Birch) .--Results of the Wisconsin yellow birch study were based on 360 sampling units of veneer containing 110,279 square feet of green reeled veneer and 20,029 square feet of green round-up veneer. According to the recommended grades 85,277 square feet of the green reeled veneer and 17,862 square feet of the green round-up veneer was A, B, and C quality, and the remaining 27,169 square feet was residue. The Forest Products Laboratory grades segregated this total of 130,308 square feet of green veneer into 45.9 percent grade A, 8.2 percent grade B, 25.1 percent grade C, and 20.8 percent residue. A total of 78,952 square feet of dry usable veneer was obtained.

Table 1--Yield of total green veneer as segregated by Forest Products Laboratory grades

Study	Sampling units		Yield (FPL grades)			Residue	Yield (total usable dry veneer)
	No.	Total green veneer	A	B	C		
		sq. ft.	Pct.	Pct.	Pct.	Pct.	sq. ft.
Vermont--yellow birch	138	46,553	33.5	22.2	34.9	9.4	26,869
Wisconsin--yellow birch	360	130,308	45.9	8.2	25.1	20.8	78,952
Wisconsin--hard maple	316	137,073	60.1	17.7	16.8	5.4	26,871
Georgia--redgum	280	107,769	27.5	30.8	20.1	21.6	78,295
Totals	1,094	321,703	----	----	----	----	210,987

'Includes an estimated 2,000 square feet of residue green veneer. Actual measurements were not possible.

The yields by company grades and FPL grades are shown in table 2.

Wisconsin Study (Hard Maple).--Results of the Wisconsin hard maple study were based on 316 sampling units of veneer that contained 35,073 square feet of grades A, B, and C quality veneer. At least an additional 2,000 square feet of green veneer in the units was residue. Actual measurement of this residue could not always be made due to the veneer being torn and piled from the lathe. The 37,073 square feet was segregated by the FPL grades into 60.1 percent grade A, 17.7 percent grade B, 16.8 percent grade C, and 5.4 percent residue. The plant recovered 26,871 square feet of dry usable veneer. The yields by company grades and FPL grades are shown in table 3.

Georgia Study (Redgum) .--Results of the Georgia redgum study were based on 280 sampling units of veneer containing 107,769 square feet of green veneer. This veneer was segregated by the FPL grades into 27.5 percent grade A, 30.8 percent grade B, 20.1 percent grade C, and 21.6 percent residue. A total of 78,295 square feet of dry usable veneer was obtained. Representative dry yields by company grades and FPL grades are shown in table 4.

Table 4 is based on the dry veneer that was selected by the company graders for cutting back and trimming to raise grade. This is approximately one-third (22,934 square feet) of the total dry veneer from this study. The veneer was therefore given only one Forest Products Laboratory grade per piece of veneer, i.e., no additional cutting back or trimming was done by the FPL graders to upgrade a piece.

Table 2.--Yields of dry veneer by Forest Products Laboratory grades and company grades. (Wisconsin--yellow birch study)

FPL grade	Company grade							Value (Dollars per 1,000 sq. ft.)
	(5) Select reds	(6) Select whites	(1) No. 1 faces	(2) No. 2 sound	(3) No, 3 utility	(4) No. 4 rejected	Total	
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	
A	12.06	10.07	33.02	6.66	0.08	0.08	61.97	50.01
B	1.07	.35	1.84	10.83	.56	.85	15.50	26.34
C	.27	.07	2.33	9.73	1.68	8.06	22.14	22.15
Residue	____	____	____	.04	____	.35	.39	13.31
Total	13.40	10.49	37.19	27.26	2.32	9434	100.00	40.03

Table 3.--Yields of dry veneer by Forest Products Laboratory grades and company grades (Wisconsin--hard maple study)

FPL grade	Company grade				Value (Dollars Per 1,000 sq. ft.)
	White	Naturals	Centers	Total	
	Pct.	Pct.	Pct.	Pct.	
A	34.67	0.67	1.58	36.92	66.58
B	11.53	6.67	11.12	29.32	46.13
C	.97	3.81	28.98	33.76	26.49
Total	47.17	11.15	41.68	100.00	47.05

Table 4.--Yields of dry veneer by Forest Products Laboratory grades and company grades (Georgia--redgum study)[1]

FPL grade	Company grade					Value (Dollars per 1,000 sq. ft.)
	(1) Clear finish	(2) Paint grade	(3) utillty grade	(4) Back grade	Total	
	Pct.	Pct.	Pct.	Pct.	Pct.	
A	2.46	2.02	1.94	0.20	6.62	30.21
B	1.84	10.33	11.81	2.73	26.71	24.22
C	.68	4.79	20.14	38.54	64.15	14.95
Residue	.07	.23	.42	1.80	2.52	14.28
Total	5.05	17.37	34.31	43.27	100.00	18.42

[1]Percentages are based on about one-third of the study veneer at this mill and are expected to be representative of the entire volume peeled.

Analysis

The regression and correlation values for comparison of green grade yields for each study are shown in tables 5 to 8. These results indicate that the recommended Forest Products Laboratory hardwood veneer grades, when compared with the plant grades, segregate veneer in the green condition into groups that reflect the utility of the veneer in the dry condition.

The recommended grades are to be applied to the green unclipped veneer produced from a bolt. These green yields give the most accurate measure of

Table 5.--Regressionand correlation values for grade yield comparisons (Vermont--yellowbirch study)

Dependentvariable (Y) yield in square feet (Companygrades)	Independent variable (X) yield in square feet (FPL grades)	Estimating equation (Y = a + bX) values		Correlation coefficient (r)	(Y) Mean value	(X) Mean value
		a	b			
					Sq. ft.	Sq. ft.
Faces	A + B	16.92504	0.57297	0.80959**	127.27	192.59
Backs	C	33.88819	.27854	.51905**	67.43	120.41

Table 6.--Regression and correlation values for grade yield comparisons (Wisconsin--yellow birch study)

Dependent variable (Y) yield in square feet (Company grades)—	Independent variable (X) yield in square feet (FPL grades)	Estimating equation (Y = a + bX) values		Correlation coefficient (r)	(Y) Mean value	(X) Mean value
		a	b			
					Sq. ft.	Sq. ft.
	Dry					
5 + 6 + 1	A	5.69	0.94271	0.93517**	133.95	136.06
2	B	27.32	.95528	.66908**	59.78	33.98
3 + 4	C	.35	.52091	.73561**	25.58	48.43
	Green					
5 + 6 + 1	A	46.98	.52378	.70345**	133.95	166.05
2	B	48.05	.39517	.29609**	59.78	29.67
3 + 4	C	11.65	.15340	.43926**	25.58	90.78

[1]Company grades are as follows: 5--select reds; 6--select whites; 1--No. 1 faces; 2--No. 2 sound; 3--No. 3 utility; 4--No. 4 rejected.

**Denotes significance at 1 percent level.

Table 7.--Regression and correlation values for grade yield comparisons (Wisconsin--hard maple study)

Dependent variable (Y) yield in square feet (Company grades)	Independent Variable (X) yield in square feet (FPL grades)	Estimating equation (Y = a + bX) values		Correlation coefficient (r)	(Y) Mean value	(X) Mean value
		a	b			
					Sq. ft.	Sq. ft.
	Dry					
White	A	7.12	1.05044	0.87222—	40.10	31.40
Naturals	B	-0.27	.39133	.48553**	9.49	24.93
Centers	C	12.15	.81128	.80067**	35.44	28.71
	Green					
White	A	3.89	.51425	.72245**	40.10	70.42
Naturals	B	3.93	.26740	.37045**	9.49	20.79
Centers	C	26.02	.47653	.57688**	35.44	19.78

**Denotes significance at 1 percent level.

Table 8.--Regression and correlation values for grade yield comparisons (Georgia--red gum study)

Dependent variable (Y) yield in square feet (Company grades)[1]	Independent variable (X) yield in square feet (FPL grades)	Estimating equation (Y = a + bX) values		Correlation coefficient (r)	(Y) Mean value	(X) Mean value
		a	b			
					Sq. ft.	Sq. ft.
	Green					
1 + 2	A	26.9128	0.3152	0.4530**	64.09	117.95
3	B	53.7885	.1438	.2325**	71.78	125.30
4	C	93.2403	.7043	.5947**	143.74	71.71

[1]Company grades are as follows: 1--clear finish; 2--paint grade; 3--utility grade; 4--back grade.

**Denotes significance at 1 percent level.

veneer bolt quality or potential yield. The grades can, of course, be used to grade dry veneer, but it must be recognized that the plant clipping pattern will affect the yield of veneer from a bolt or log.

The regression and correlation values for comparisons of total green Forest Products Laboratory grade yields with the mill recovery of total dry veneer are shown for the four studies in table 9. The correlations are significant and indicate that green veneer yields can be used to estimate total dry recovery.

The estimating equations in tables 5 to 9 apply only to a mill and its conditions

at the time of the study. Any change in veneer grading or mill manufacturing practices would undoubtedly change the equations.

Table 9.--Regression and correlation values for comparison of total yields

(Y) Dependent variable total dry veneer yields (Company grades)	Independent variable (X) total green veneer yields (FPL grades)	Estimating equation (Y = a + bX) values		Correlation coefficient (r)	(Y) Mean value	(X) Mean value	Number of samples (n)
		a	b				
					Sq. ft.	sq. ft.	
Vermont--yellow birch Faces and backs	A + B + C	56.60	0.44123	0.56886**	194.70	313	138
Wisconsin--yellow birch[1] 5 + 6 + 1 + 2 + 3 + 4	A + B + C	61.08	0.55283	0.74421**	219.38	286.50	360
Wiscons in--hard maple Whites and naturals and centers	A + B + C	16.50	0.62062	0.88580**	85.03	110.99	316
Georgia --red gum[2] 1 + 2 + 3 + 4	A + B + C	21.82	1.0236	0.9441**	279.62	251.84	280

**Denotes significance at 1 percent level.

[1]Grade numbers signify the following: 5--select reds; 6--select whites; 1--No. 1 sound; 2--No. 2 sound; 3--No. 3 utility; 4--No. 4 rejected. (Wisconsin--yellow birch study.)

[2]Grade numbers signify the following: 1--clear finish; 2--paint grade; 3--utility grade; 4--back grade. (Georgia--redgum study.)

CONCLUSIONS

From the results of these four studies it is concluded that the Forest Products Laboratory hardwood veneer grades can be used to develop hardwood veneer log grades. This is shown by the significant relationship between the recommended grades and plant grades with which they were compared. For developing veneer log and bolt grades, the Forest Products Laboratory grades should be applied to the green unclipped veneer produced from a bolt.

• • •