FOREST PRODUCTS LABORATORY † FOREST SERVICE
U. S. DEPARTMENT OF AGRICULTURE
Madison, Wisc.

VENEER CUTTING AND DRYING PROPERTIES[1]

REDWOOD

Redwood (Sequoia sempervirens) is a large softwood tree found in northwestern California and southwestern Oregon.

The wood is moderately light in weight; the springwood of the annual rings is considerably less dense than the summerwood. Most redwood is straight grained and shrinks and swells comparatively little. The reddish-brown heartwood is pleasing in appearance and has high decay resistance. The narrow band of sapwood is almost white.

Redwood lumber is used in houses and industrial structures for such items as siding and finish. The decay resistance of the heartwood makes it valuable for use in tanks, silos, coffins, and wood-stave pipe.[2] In recent years, a small amount of redwood has been made into plywood. Information given in this report is based on tests made at the Forest Products Laboratory and on observations in commercial plants.

Selection, Handling, and Preparation of Test Logs

Rotary veneer cutting and drying tests were made on four logs, 8 feet long. As shown in table 1, they grew at various heights in the tree. Each log was cut into two bolts about 4 feet long.

Sliced veneer cutting and drying tests were made on one log 21 feet long. Two bolts about 8 feet long were cut from this log. One bolt was cut into flitches for quarter slicing and the other into flitches for flat slicing.

All of the logs were old-growth redwood that had been selected and sent to the Laboratory through the cooperation of the Southwestern Forest and Range Experiment Station and the Simpson Timber Company. A description of the test logs is given in table 1.

Some characteristics and defects to be avoided when selecting redwood for veneer logs are large end checks, knots, flutes, flared butts, eccentric pith, compression wood,[3] and exceptionally high moisture content (often found in butt logs).[4,5] Large checks can sometimes be eliminated when sawing flitches.

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[1] Originally issued May 1953.

[2] Betts, H. S. Redwood. American Woods Series, Forest Service, U. S. Dept. of Agr. Tech. Bull. No. 305. July 1932.

[3] Compression Wood: Importance and Detection in Aircraft Veneer and Plywood. Forest Products Laboratory Report No. 1586. Sept. 1943.

[4] Paul, Benson H. Some Comparative Characteristics of Second-Growth and Old-Growth Redwood, Forest Products Research Society Proceedings, Vol. 5, 1951.

[5] Luxford, R. F., and Markwardt, L. J. The Strength and Related Properties of Redwood. U. S. Dept. of Agr. Tech. Bull. No. 305, July 1932.

† Maintained at Madison 5, Wisconsin in cooperation with the University of Wisconsin

Tight veneer was not produced from bolts or flitches cut at room temperature.

Moderately tight veneer was cut from redwood bolts heated in hot water at 160° and 180° F. until the temperature throughout the bolt had come to within 10° F. of the heating temperature. Bolts conditioned at 180° F. sometimes developed excessive end checking. End checking was not pronounced at 160° F. Because of the large diameters of most redwood logs, and the danger of end checking, it appears advisable to heat bolts in water at 160° F. only until the temperature at the final cutting diameter comes to about 120° F.

Steam is preferred to water in some commercial operations because some redwood bolts are comparatively light in weight and difficult to submerge in water. Heating schedules that may be used for redwood veneer bolts 8 feet long are given in table 2.

Hard knots may not be sufficiently softened by the suggested heating schedule to be cut without damage to the lathe knife. It may be practical to drill or chop out knots or cut knotty portions into core veneer with a blunt lathe knife.

The flitches were heated in hot water at 180° F. without damage. The hard knots in the flitches were softened enough to cut easily. A temperature of 180° F. seems to be suitable for conditioning redwood flitches. Heating schedules that may be used for redwood flitches 8 feet long are given in table 3.

Veneer Cutting

Rotary Cutting

The lathe settings[6] given in table 4 were found suitable in most cases for producing well-cut redwood veneer from heartwood of normal moisture content No settings were found that would permit consistent cutting of satisfactory veneer from sapwood and "wet" heartwood. The principal difficulty was "shelling." This is a separation of the springwood from the summerwood. It is generally associated with excessive nosebar pressure on softwood species in which there is a sharp contrast in density between the springwood and the summerwood. When the nosebar was retracted enough to eliminate shelling, the veneer was loose and rough.

Commercial experience has shown that redwood veneer cut from bolts at room temperature has deep lathe checks and is very brittle, a condition that causes much breakage as the veneer comes from the lathe and in subsequent handling. Veneer with less pronounced lathe checks can be cut from heated bolts. Redwood veneer is brittle, however, even when cut from heated bolts.

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[6]Fleischer, H. O. Experiments in Rotary Veneer Cutting. Forest Products Research Society Proceedings, vol. 3, 1949.

The smoothness of rotary-cut redwood veneer appeared to be directly affected by the orientation of the growth rings with respect to the lathe knife at the point of contact between the bolt and the knife. In general, when the angle between the ground face of the knife and a line tangent to the growth ring at the point of contact with the knife was less than 90°--measured counterclockwise from the face of the knife--the veneer was cut smoothly. Conversely, when this angle was between 90° and 180°, the veneer was often rough. As a result, when an eccentric redwood bolt was cut, part of the veneer from a single revolution was inevitably rough and part was smooth.

Slicing

The slicer settings used in this series of tests are given in table 5. These settings were suitable for production of smooth veneer by quarter-slicing redwood in a variety of thicknesses from 1/40 to 7/16 inch.

All of the flat-sliced 1/40-inch veneer and some of the flat-sliced 1/10-inch veneer was smooth enough for use as faces. The flat-sliced veneer that was 1/4-inch thick or thicker was rough.

The smoothness of the sliced redwood veneer appears to be directly related to the angle at which the knife cuts the wood rays. Smooth veneer was usually produced when the angle between the ground face of the knife and a line parallel to the wood ray at the point of contact with the knife was less than 90°. Half of each sheet of thick, flat-sliced veneer was usually rough, because the rays had a favorable orientation for only part of the cut. In contrast, the quarter-sliced flitches were sawn so that all of the veneer was cut with a favorable orientation of the rays.

Shelling occurred in some of the 1/10-inch and thicker flat-sliced veneer, but did not occur in the quarter-sliced veneer.

Most of the redwood veneer sliced thicker than 1/10 inch had deep knife checks.

Veneer Drying

The moisture content of the test logs varied from 70 to 245 percent in the heartwood and from 135 to 240 percent in the sapwood. Other studies[5,6] indicate that the moisture content of redwood heartwood from butt logs generally averages about 150 percent and that it increases appreciably from the pith outward. At 60 to 80 feet above the ground, the moisture content is about one-half as great as at the butt and is more uniform throughout the cross section. Limited commercial experience has indicated that butt redwood logs are not desirable peelers because of cutting and drying problems. This is true even though butt logs are frequently clear of knots. For these reasons the second log in the tree often is the preferred veneer log. Tests at the Laboratory show that redwood with a high moisture content can be made into veneer of good quality by quarter slicing.

The veneer was dried in a mechanical roller-conveyor veneer dryer in accordance with the schedules given in table 6. Wet heartwood, which is readily identifiable in the green veneer, may be dried according to the schedule used for sapwood.

In the rotary-cut veneer a few sheets containing wet streaks developed a slight buckle at the streak during drying. Much of the shelling that was prominent on the green veneer was no longer visible after the veneer was dried.

The sliced veneer dried flat and without any visible drying defects. Prong samples cut from the 7/16-inch-thick veneer showed minor casehardening.

The veneer was dried to 2 to 13 percent moisture content. The range of moisture content was usually smaller in thin veneer than in veneer 1/4-inch thick or thicker. Shrinkage of the veneer dried to 2 to 4 percent was low, the tangential shrinkage averaging about 5 percent of the green width and the radial shrinkage about 4 percent.

Veneer Yields

The actual yield of dry rotary-cut veneer from test bolts 1 through 4 showed an overrun of 3 percent when compared with the International Log Rule. Without patching, 31 percent of this yield was of A and B grades.[1] With a patch limit of five patches to a 4- by 4-foot sheet, 32 percent of the yield was of A grade and 20 percent of B grade.

Most degrade of the rotary-cut veneer was caused by knots, roughness, and shelling.

The log from which the flitches were sawed was of good quality. A high proportion of face-grade veneer was cut from flitches that were quarter sliced.

There was a good yield of clear veneer from the flitches that were flat sliced. The roughness of the flat-sliced veneer 1/4-inch thick and thicker would limit its use.

Most of the degrade in the sliced veneer was caused by knots, roughness, and decay.

Black Stain

Wet redwood veneer develops a black stain when it remains in prolonged contact with iron or steel. When pronounced, this stain may be so deep that it will

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[1] The veneer was graded by Commercial Standards CS 122-56 for Western Softwood Plywood.

not sand out of the dry veneer. Light stain of this type can readily be removed from the green wood by sponging it with hot oxalic acid. The procedure is the same as that used for the removal of iron stains in oak.[8]

Gluability

Redwood is one of the easier softwoods to glue.[9] Because of the susceptibility of the wood to glue staining, care should be taken when using an alkaline glue.[10] Commercial production of redwood plywood in recent years has, however, been limited almost entirely to the use of resin glues.

Pressing

Redwood veneer having a high moisture content is reported to be easily overcompressed in a hot press. Consequently, dry veneer should be used when hot pressing redwood plywood. A pressure of 125 pounds per square inch is adequate for gluing redwood plywood.

Sanding

Limited commercial experience has indicated that, because of the soft character of the fiber, redwood is somewhat difficult to sand and that the paper is inclined to fill up. The sanded panels are also subject to abrasion, so that care must be taken in handling the finished plywood.

Exterior Exposure

For exterior service plywood faced with quarter-sliced redwood veneer like edge-grained redwood lumber[11] is rated high in resistance to checking and in paint integrity.

On the other hand, laboratory tests and limited commercial experience indicate that painted redwood plywood faced with rotary-cut veneer (flat grain) and exposed to the weather is subject to face checking and shelling. Coatings of house paint fail prematurely over the broad summerwood bands.

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[8] Downs, L. E. Bleaching Wood. Forest Products Laboratory Report No. R1705. July 1950.

[9] Truax, T. R. The Gluing of Wood. U. S. Dept. of Agr. Bull. No. 1500. June 1929.

[10] Occurrence and Removal of Glue Stains. F.P.L. Tech. Note No. 146. 1936.

[11] Wood Properties and Paint Durability. U. S. Dept. of Agric. Misc. Pub. No. 629, July 1947.

Table 1.--Redwood logs used for veneer cutting and drying experiments

Log No.	Approximate height above the stump	Average diameter (inside bark at small end)	Average difference between maximum and minimum log diameters	Length of log	Number of rings per inch (Max.)	Number of rings per inch (Min.)	Total number of rings, midlength	Average width of sapwood	Average eccentricity of pith
	Feet	Inches	Inches	Feet				Inches	Inches
1	16	47-1/2	3	8-1/2	53	5	560	2	1
2	70	45	2	8-1/2	45	11	531	2	1-1/2
3	14	39	6	8-1/2	66	9	612	2	1-1/2
4	70	41	4	9	69	10	488	2	3
209	.....	48	8	21	76	11	803	1-1/2	1

Table 2.--Approximate heating schedules for attaining a temperature of 120° F.[1] at midlength, and at a diameter of 24 inches, in redwood bolts 8 feet long

Average log diameter	Heating medium and temperature	Required heating time
Feet		Hours
3	Steam at 212° F.	11
4	Steam at 212° F.	39
5	Steam at 212° F.	76
3	Water at 160° F.	25
4	Water at 160° F.	76
5	Water at 160° F.	150

[1] This temperature is not sufficient to soften knots in the inner portion of the log for cutting with a freshly ground knife. This heating will, however, aid in cutting a good-quality face veneer from the outer defect-free portions of the log.

Table 3.--Approximate heating schedule for attaining a temperature of 160° F. in the center of redwood flitches 8 feet long

Average end dimension of flitch	Heating medium and temperature	Required heating time
Inches		Hours
6	Steam at 212° F.	3
12	Steam at 212° F.	9
18	Steam at 212° F.	21
24	Steam at 212° F.	36
6	Water at 180° F.	4
12	Water at 180° F.	14
18	Water at 180° F.	32
24	Water at 180° F.	56

Table 4.--Lathe settings used to cut redwood veneer

Veneer thickness	Knife angle	Knife bevel	Nosebar settings		Nosebar bevel
			Vertical	Horizontal	
Inch	Degrees-Minutes	Deg.	Inch	Inch	Degrees
1/8 (0.125)	89-50	22	0.028	0.115	15
3/16 (0.188)	89-50	22	.032	.175	15

Table 5.--Slicer settings used to cut redwood veneer

Veneer thickness	Knife angle	Knife bevel	Nosebar settings		Nosebar bevel
			Vertical	Horizontal	
Inch	Degrees-Minutes	Deg.	Inch	Inch	Degrees
1/40 (0.025)	90-20	21	0.030	0.023	12
1/10 (0.100)	90-20	21	.030	.095	12
1/4 (0.250)	90-20	21	.030	.240	12
7/16 (0.438)	90-20	21	.030	.427	12

Table 6.--Schedules used for drying redwood veneer

Veneer thickness	Type of wood[1]	Dryer temperature	Time in dryer	Final moisture content
Inch		°F.	Minutes	Percent
1/40	Heartwood	230	2	4-8
	Sapwood	230	4-1/2	9-11
1/10	Heartwood	300	8	4-10
	Sapwood	300	17	2-6
1/8	Heartwood	320	10	2-4
	Sapwood	320	25	2-4
3/16	Heartwood	320	20	2-4
	Sapwood	320	40	2-4
1/4	Heartwood	320	25	8-13
	Sapwood	320	50	4-12
7/16	Heartwood	320	58	6-11
	Sapwood	320	148	3-7

[1]"Wet" heartwood (containing 150 percent or more of moisture) dries at approximately the same rate as sapwood.