

TECHNICAL NOTE NUMBER 131

UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

FOREST PRODUCTS LABORATORY

MADISON 5, WISCONSIN

REVISED

December 1952

PROPERTIES OF ORDINARY WOOD COMPARED WITH PLYWOOD

Because wood is made up essentially of hollow fibers the longer dimension of which runs lengthwise of the tree, it has widely different properties in the various directions relative to the fiber direction, or grain. These differences must be recognized in all wood construction in order to obtain satisfactory service and to make effective use of wood. Significant among the differences is the fact that tensile strength, compressive strength, bending strength, and stiffness are 20 times or more as high parallel to the grain of the wood as perpendicular to the grain. The shrinking and swelling of wood across the grain with changing moisture conditions is much greater than along the grain; in fact, for many uses, the change in dimension of normal wood along the grain with change in its moisture content is so small as to be negligible.

Plywood consists of thin sheets, or plies, of wood placed together with the grain of adjacent plies at right angles. Hence, in building up plywood a step is made in obtaining equality of properties in the two directions, parallel and perpendicular to the edge of a board. The greater the number of plies used for a given panel thickness, the more evenly is the material distributed, and the more nearly equal is the strength of the panel in the two directions.

The following tabulation of approximate values for two strength properties gives a specific example that will better illustrate how the redistribution of material in making plywood results in a change in properties:

	<u>ORDINARY WOOD</u>		<u>3-PLY PLYWOOD</u>	
	<u>Grain</u> <u>lengthwise</u>	<u>Grain</u> <u>crosswise</u>	<u>Grain of</u> <u>outer plies</u> <u>lengthwise</u>	<u>Grain of</u> <u>outer plies</u> <u>crosswise</u>
	<u>(Percent)</u>	<u>(Percent)</u>	<u>(Percent)</u>	<u>(Percent)</u>
Bending strength	100	8	82	17
Stiffness	100	4	96	9

It will be noted that at the expense of reducing by about 18 percent the bending strength of ordinary wood with the grain lengthwise, the bending strength of 3-ply plywood with the grain of the outer plies crosswise was doubled over that of ordinary wood.

It cannot be said, however, that plywood is stronger than ordinary wood, or vice versa, unless the statement is specific as to the grain directions and particular properties referred to.

Because the properties of plywood in the two major panel directions are more nearly equal than in lumber, it is possible to make panels of considerable width as well as length. The shrinkage and swelling of plywood in length or width with moisture content changes are very much less than those of solid wood across the grain. Because it is more resistant to splitting than ordinary wood, plywood panels may often be used in thinner dimensions than lumber, and may be readily nailed or fastened with screws near the edges without injury to the panel.

Plywood made with durable exterior-type glues may be used outdoors without danger of delamination. Plywood made with less durable glues is somewhat limited in the exposure conditions under which it may be used, depending on the particular type of glue used.