PROPERTIES OF ORDINARY WOOD COMPARED WITH PLYWOOD

Wood, as is well known, is a nonhomogeneous material, with widely different properties in the various directions relative to the grain. This difference must be recognized in all wood construction, and the size and form of parts and placement of wood should be such as to utilize to the best advantage the difference in properties along and across the grain. Were wood a homogeneous material such as cast iron, having the same strength properties in all directions that it has parallel to the grain, it would be unexcelled for all structural parts where strength with small weight is desired.

The Forest Products Laboratory has found that the tensile strength of wood may be 20 times as high parallel to the grain as perpendicular to the grain, and its modulus of elasticity from 15 to 20 times as high. In the case of shear the strength is reversed, the shearing strength perpendicular to the grain being much greater than parallel to the grain. The low parallel-to-the grain shearing strength makes the utilization of the tensile strength of wood along the grain difficult, since failure will usually occur through shear at the fastening before the maximum tensile strength of the member is reached.

The large shrinkage of wood across the grain with changing moisture content may introduce distortions in a board that decrease its use where a broad, flat surfaced is desired. The shrinkage from the green to the oven-dry condition across the grain for a flat-sawed board is about 8 per cent and for a quarter-sawed board about 4½ per cent, while the shrinkage parallel to the grain is practically negligible for most species.
It is not always possible to proportion a solid plank so as to develop the necessary strength in every direction and at the same time utilize the full strength of the wood in all directions of the grain. In such cases it is the purpose of plywood to meet this deficiency by cross banding, which results in a redistribution of the material.

In building up plywood a step is made in obtaining equality of properties in 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 homogeneous in properties is the finished panel. Broadly speaking, what is gained in one direction is lost in the other. For a very large number of plies it may be assumed that the tensile strength in two directions is the same and that it is equal to the average of the parallel-to-the-grain and perpendicular-to-the-grain values of an ordinary board.