

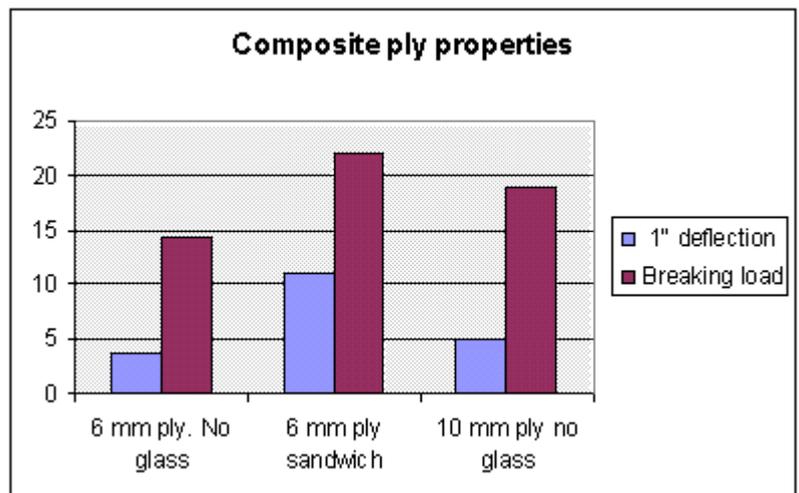
Plywood Composite Testing

Except for our very small boats, most of our designs use composite panels for the hull planking. Those panels are made of a plywood core sandwiched between layers of directional fiberglass in epoxy resin. While the boat is assembled like a plywood boat, the final product is a true sandwich composite hull, strong and lightweight. On this page, we show the difference in strength between those two materials. When building our boats, it is important to understand that difference. If not, the builder may focus on wooden boat building techniques and neglect the fiberglass work or worse, substitute inadequate materials. Our scantlings (material selection and size) are based on plywood-epoxy-fiberglass panels tested by a local laboratory in 1991. Those tests were made in accordance with ASTM standards and measured tensile, flexural strength, related moduli and resistance to shear. We do not have any pictures of those tests and materials evolved therefore, we ran a batch of simple tests on our home-made test bench. The purpose of the tests was to compare the properties of plywood with and without our fiberglass skins, not to extract absolute values.



Our samples were made of thin 6 mm (1/4") plywood with or without glass. For the sandwich panels, we used only one layer of glass but in many of our boats we use thicker plywood and several layers of glass. For example, 3 layers each side plus all the overlaps of stringers etc. can end up to a total of 12 layers.

We compared flexural and tensile strength by measuring the pressure needed to deflect the samples 1" and the pressure required to break the panels. We tested 10 samples of each type. The sandwich panel is in the sample in the middle. See the blue lines for flexion: the composite sandwich is around 3 times stiffer than the plywood and two times stiffer than thicker 10 mm (3/8") plywood. Previous tests have shown that it is stiffer than 1/2" plywood! The purple lines show the ultimate strength or more exactly, the pressure required to reach catastrophic failure. The composite sandwich is almost two times stronger than the plywood without glass and still significantly stronger than 3/8" plywood. The previous tests showed that it was equal or close to 1/2" plywood. We clearly see that our composite sandwich is very different from plywood and that comparisons based only on the plywood thickness make no sense. It must be noted that we tested samples with one layer of glass only and often, our plans specify several layers. Final notes: the type of resin and fiberglass is very important. A similar sandwich made with polyester resin would be much weaker because of the poor bonding properties of that resin. The type of fiberglass is also important. The designer must specify the appropriate fiber direction. In this case, the 45/45 fiberglass fibers complement the 0-90 fiber orientation of the plywood. A sandwich made with plain woven (0-90) fiberglass would be much weaker.



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