Panel Design 101

FIBERGLASS

Ask anyone what the best boats are made of today and they will say “fiberglass”, and that is half right. When you look at a boat hull what you actually see is fiberglass reinforced resin. Dry fiberglass cloth or fabric is saturated with a liquid thermoset resin, such as polyester or epoxy, that hardens into a strong, rigid and waterproof composite laminate. The fiberglass reinforcement in resin performs the same way as steel rebar does in concrete. Now, suppose you put twice as much steel rebar in one direction in a concrete slab as you do in the other direction. What you get is a slab that is much stronger in the direction having the most steel; the same thing happens in a fiberglass laminate. And this is how the design and engineering of our panels start, with the fiberglass laminate skins.

Very few panels require the same exact strength in all directions. For example, a long span roof panel requires much greater stiffness and strength in the longitudinal or warp direction than it does from side to side (known as the weft direction). But a 8 foot by 40 foot wall panel for a house in Canada for example must be able to support a heavy snow load on the roof and that panel should have more strength (i.e. more fiberglass) in the up and down direction (weft) that it does lengthwise. When we design and build panels for any application, we optimize our laminates, especially the quantity and orientation of fiberglass, to meet required loads in any desired direction. We select from an infinite variety of custom fiberglass reinforcements, whether woven, knitted, unidirectional, or mat.

RESIN

Two of the most commonly used resins in the manufacture of fiberglass composites are polyester and epoxy, a resin not as commonly used is phenolic. These are excellent materials and all have specific properties that makes each more suitable for specific applications. At room or slightly elevated temperatures, the structural properties of laminates made with all three resins are all relatively similar but on exposure to fire or very high temperatures, there is a significant difference. DuraSip could use any of these resins in the skin laminate production of its panels, but it has elected to use phenolic for three important reasons 1. It has a much greater resistance to fire than either polyester or epoxy, 2. If all three resins are exposed to direct flame, phenolic produces less toxic fumes than either epoxy or polyester, and 3. At very high temperatures, phenolic resin maintains its strength better than either of the other two.

To understand the advantage of fire resistant phenolic/fiberglass composites, red oak wood is 20 times more flammable than a fiberglass reinforced phenolic laminate and burning wood produces substantially more smoke and toxic fumes as well. For the most safety critical composite applications in military, aerospace, and commercial products, phenolic are the preferred resin. That is why DuraSip uses phenolic exclusively for laminate skins in the production of their panel products.

CORE MATERIALS

There are two other variables in our panels that we control to optimize performance at the least weight and cost, 1. panel thickness (determined by the thickness of the foam core), and 2. foam core density. In addition to the laminate skins’ contribution to panel stiffness and strength, panel thickness is equally important. In general, if you double the thickness of a panel, you increase its stiffness by a factor of four. At DuraSip, we have the ability to produce panels in any desired thickness from 1” to 10” resulting in an extraordinary range of panel stiffness. Finally, we select appropriate foam densities for our cores that also play an important part in the structural performance of our panels.

In addition, although expanded polystyrene foam (EPS) is the least expensive of the rigid foam materials and when used, results in the least expensive panels, DuraSip can use virtually any rigid foam or even honeycomb as a core in its panels. EPS, polyurethane (either isocyanate, known as PUR, or isocyanurate known as PIR), PVC, or very high performance polymethacrylimide (ROHACELL) foams can all be used as cores by DuraSip.

The two most common foams used by DuraSip are EPS and polyurethane. The difference between the two is mainly insulation or R value. Polyurethane, although not as versatile in fabrication, has almost twice the insulation or R value compared to EPS, but it is also more expensive.

STRUCTURAL

Structurally, there are three primary panel properties:

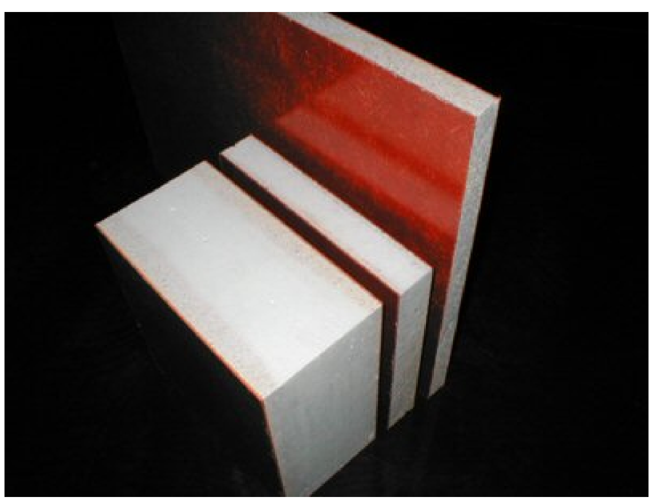
1. Flexural
2. In plane compression
3. Axial shear

DuraSip has in house 8’ x 8’ panel hydraulic testing capability to characterize structural properties of all its panel products, to determine both modulus and ultimate strength. In addition, we can conduct impact testing and if required, contract for tests we can not perform in-house. Third party testing will be performed when certified results are required.

With the ability to produce 8 foot wide panels in any continuous seamless length, DuraSip “joint less” Panels achieve excellent flexural and shear properties in addition to eliminating any possibility of cracking between joints.

FINALLY

Understanding the relationships between skin laminates, panel thickness, and core materials and density to optimize panel properties at the least weight and cost allows us to give our customers the best and lowest cost panel for their applications.



Core thickness can be changed to meet design needs.

Full size panels of various thickness.