Presentation for FS 2008

Title:
State of the art – Carbon and aramid fibers in furniture

Description:
Composites have been used for years in boatbuilding, but in standalone furniture it is uncommon - no, even rare - that they are used outside of the major design and fabrication houses (think Aeron chair). This combination of talk, demonstration and workshop covers lots of material in a short time, starting with the basics of composite fabrication and continuing through examples of wood veneers around carbon cores, ultra-thin stairtreads, and even some strength of materials examples.

When a panel is flexed, the majority of the stresses are created at the outer surfaces of the panel. This is explained by engineering beam theory which shows the distribution of stress as a function of the distance from the center of the panel. It can be seen from the illustration that stresses drop off rapidly as one approaches the center of the beam. This is why I-beams have wide flanges and a thin center panel. It is why surf boards have a fiberglass skin and a foam core.

Texalium – product by Hexcel that is silver colored –alum vapor deposition on fiberglass cloth, as far as I can tell

Giovanni Pagnotta- carbon fiber furniture – Parsons grad 1986

Overview: Eames 1948, Castle 1969, Aeron 2002

Definitions of composites
- Carbons
  - Issues about corrosion – 316 stainless, etc
  - Brittleness
  - UV sensitivity
  - Can get very thin - tissue
- Kevlar and Aramids
  - Twice as strong as glass, also twice as stiff as carbon
  - UV sensitive
  - Not as brittle
  - Very tough
  - Not particularly good in compression
  - Always seen it woven
- Fiberglass
  - About as strong in tensile as carbon, but only 1/3 as stiff

Limits of talk

Wood and wood veneered furniture and parts

Discussion of why used

Increased toughness –
Increased strength
Increased rigidity
Decreased weight
Eliminate short grain issues

How to get those properties

Beams (illustration)
Lamination
Cantilevers

Shapes

Honeycomb
Plates
Tubes
Fabric
Prepreg
Bars – use for loose tenons
Tissue

Fabrication

Cutting fabric
- Special ceramic scissors
- Knife – olfa or similar
- Regular scissors
  - Grind roughly on grinding wheel,
  - Take off burr
  - Short life before re-sharpening, but inexpensive

Adhesives
- Epoxies
  - West System
  - 3M system epoxies
  - Two heads epoxies
  - REMEMBER – EXOTHERMAL

Vacuum bags
- Pre-bending veneers
- Kerfed core

Drilling and cutting
- No brad points – pickup
- Carbide or HSS, but dulls easily
- Watch for grab-back it up – nasty if you catch a piece of glue going around

Sawing

Very tough on blades
Sacrificial thin kerf blade
7.25 inches, Freud
NEVER cut unsupported fiber
Can also use an abrasive wheel

Sanding
Carbon or aramid fibers are bad – use respirator
Epoxy seems to be ok, but I still use respirator.
For good epoxy to epoxy bond, must sand roughly

Vac bag demo –
Start off with veneer – microwave prebend
Core – similar color or plug in end with proper shape
Kerfing
Taping and securing
Plastic or release spray (NON SILICONE) on form
Spray or roll on the epoxy – roll on easier and better
Coat all sides and fabric too (will have too much epoxy in sandwich, but will squeeze out with vacuum
Cover with release fabric
Cover that with air breather fabric
Bag it
LOW PRESSURE WITH TABLETOPS – 10-15 inches vacuum
Strip off release fabric and throw away
Trim carefully, and touch up color.

Resource List – Composites – FS 2008 Purchase

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Types of composite materials

- ***Carbons***
- ***Kevlar (aramid fibers)***
- ***Glass (fiberglass)***
- ***Paper (filled and unfilled)***
- ***Polyester***

Binders:

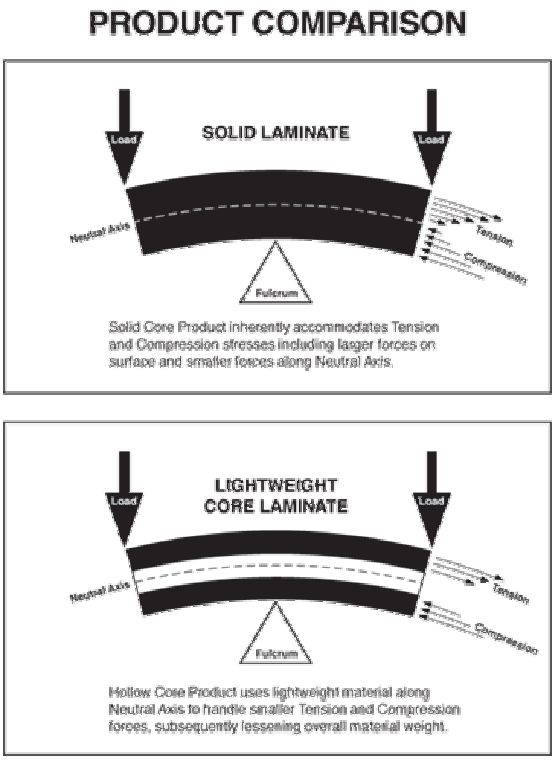
You need something to hold these fibers in position to give them strength
EPOXY is the word

ALL EPOXIES ARE EXOTHERMIC – THEY GIVE OFF LOTS OF HEAT

Flat pans preferred, no large mixing jars

Most common uses –

Honeycomb to reduce weight
Laminations to increase rigidity
Laminations to increase strength or toughness



My preferences:

For Epoxies – West System – easy to use, about the right consistency for my applications right out of the can. Also notable – 3M epoxy system. Only use their microballoons for fillers – introduce no water or ability to wick water.

For compression strength – carbon fiber alone

For toughness – aramid/carbon weave – 5.7 oz

For repairs/fairing – carbon tissue with microballoons and epoxy

For conference tabletops – epoxy impregnated paper with smooth surface material and carbon tissue.

For thin tabletops – NIDA type composite honeycomb

Sources:

NOTE: these suppliers may not be the least expensive, but they seem to me to combine good service with good product.

NIDA – From the manufacturer – www.nida-core.com

West System – your local marine supplier is best – will have the freshest product – West Marine is our local source. FRESH MATERIAL IS CRITICAL TO GOOD RESULTS www.westsystem.com

Another epoxy company – www.epoxyheads.com

Expensive scissors and shears – www.jaeberly.com

Paper honeycomb – Tricel Honeycomb – Gurnee IL www.tricelcorp.com

Carbon and aramid fibers and matting

The Composite Store – www.cstsales.com

TAP Plastics – www.tapplastics.com

Fibre Glast Developments – www.fibreglast.com (watch spelling)

Plates and tubes: www.dragonplate.com

Other: www.materialconnexion.com