3D spacer fabric

Introduction
3D Sandwich Material

Sandwich Structure

Para-girder Structure
Advantages

- High Cost Efficiency
- More Fiber Options
- Integrated Structure
- High Performance
- Design Versatility
Applications

1. Marine Market
2. Transport Market
3. Building & Construction Market
4. Corrosion Industry
5. Wind Energy Industry

FRP SERVICES & CO.(SHANGHAI) LTD.
(2) Research & Development

Typical Fabric Structure
Structure Design
1. Both deck layers bonded together by Z-piles from 2 to 25mm.
2) 3D Sandwich Fabrics made from carbon fibers, basalt fibers of other high performance fibers
3) S-glass and Basalf Sandwich Composite
4) 3D double-decker Fabric
5) Infused with PU
Infused with Phenolic Foam
Composites and Tests
Hand lay-up
Mechanical Tests

- Composite Tests
  - Tensile
  - Compression
  - Shear
  - Bending
- Fabric Test
- Tensile
Tensile Test
Composite Tests (ASTM)
PU Test
<table>
<thead>
<tr>
<th>Items</th>
<th>Stats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>E-glass(epoxy)</td>
</tr>
<tr>
<td>Fabric Hight(mm)</td>
<td>2~25</td>
</tr>
<tr>
<td>Tensile Strength (Mpa)</td>
<td>232<del>238/295</del>331</td>
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<tr>
<td>Tensile Modulus (Gpa)</td>
<td>12.1<del>14.8/18.2</del>19.7</td>
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<tr>
<td>Flatwise Compression (Mpa)</td>
<td>0.5~8.7</td>
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<tr>
<td>Flatwise Modulus(Mpa)</td>
<td>45.1~72.1</td>
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<tr>
<td>Shear Strength (Mpa)</td>
<td>1.1<del>1.5/2.8</del>3.5</td>
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<tr>
<td>Shear Modulus (Mpa)</td>
<td>21<del>33/51</del>75</td>
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<tr>
<td>Bending Strength (Mpa)</td>
<td>44<del>51/90</del>117</td>
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<tr>
<td>Bending Modulus(Gpa)</td>
<td>8<del>12/13</del>16</td>
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</table>
Findings of the Tests

1. Compared with traditional aluminum honeycomb material, composites made of 3D sandwich woven fabric performed better at tensile and shear strength.
2. Two materials performed almost the same in the flat wise compression and bending tests.
3. 3D sandwich composites can be the ideal substitute for traditional honeycombs.
Conclusions

1. The integrated structure of the fabric guarantees good physical properties of the composite. The cells between 2 deck layers can be filled with wires, bolts, foam and even sensors.

2. There are different ways to lay-up. The size of a single laminate can be made according to the customers’ needs.
Conclusions

3. The fabric has good design-versatility. The thickness of deck layers, roll width, density and height of vertical piles can be adjusted to meet certain requirements.

4. Composites made of 3D sandwich woven fabric boast excellent mechanical properties and resistance against delamination, which can be the ideal substitute for traditional honeycomb materials.