ANALYSIS OF A DENSE TRIAXIAL WEAVE CARBON FIBER COMPOSITE UNDER COMPRESSIVE STRESS

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Composites

- Any type of material formed from two or more materials which remain physically distinct within the combined material
  - Concrete
  - Glass
  - Carbon Fiber

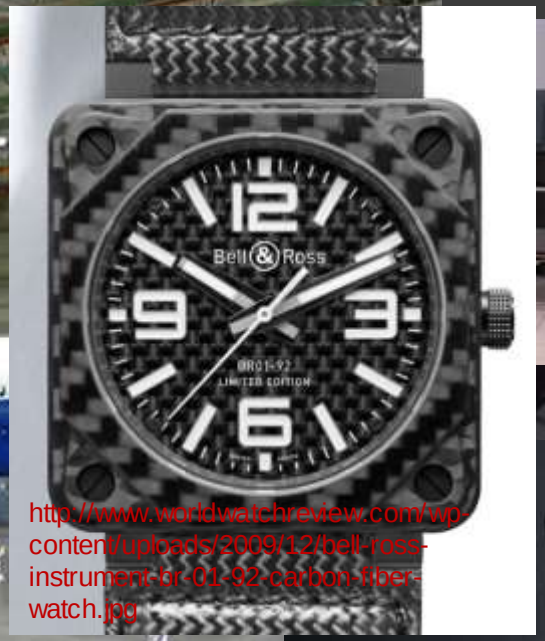
Carbon Fiber

- Brittle carbon based (Savage 2010)
- Often woven into patterns
- High tensile strength, lightweight, corrosion resistant
- Brittle, expensive, difficult to work with
- Small changes in composition can change how the material resists stress (Ghosh et al. 2011)

- Tends to crash unsafely (Savage 2010)
- Decreases in weight corresponding with increased performance and efficiency (Fuchs et al. 2008)

Applications

http://www.popsci.com/files/imagecache/article_image_large/articles/Boein



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http://puremetalcards.com/blog/wp-content/uploads/2011/12/iPad-2.jpg

http://www.carbonfibergear.com/wp-content/uploads/2009/04/1-carbon-mercedes-bicycle.jpg

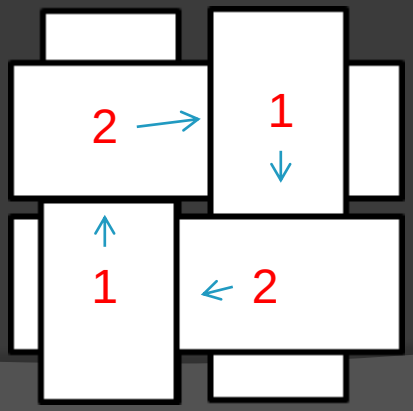
http://www.carbonfiberfilm.com/wp-content/themes/cff/images/featured_lightswitch.jpg

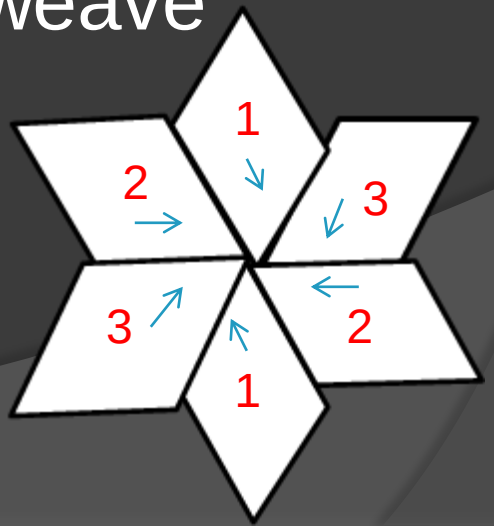
http://www.djc.com/stories/images/20111027/Backpack_Auburn_interior_big.jpg

Research Objective

The objective of this research is to determine the viability of a dense triaxial weave carbon fiber composite

- Hypothesized to be more resistant to compression than a biaxial weave





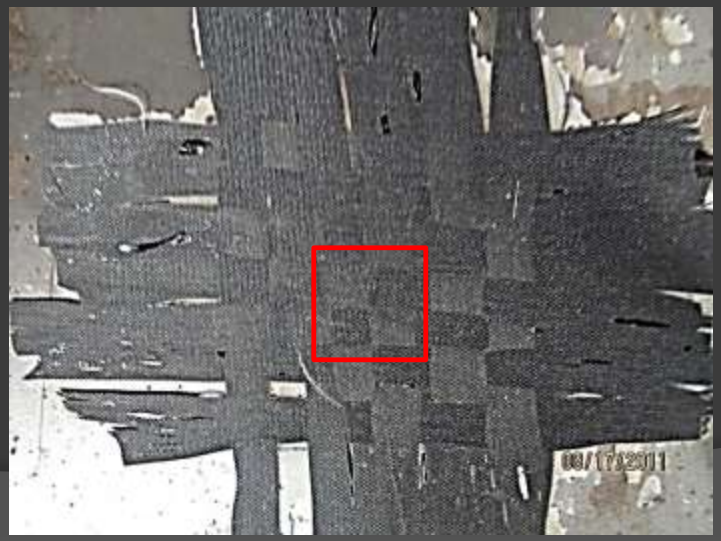
Biaxial and Triaxial Weaves

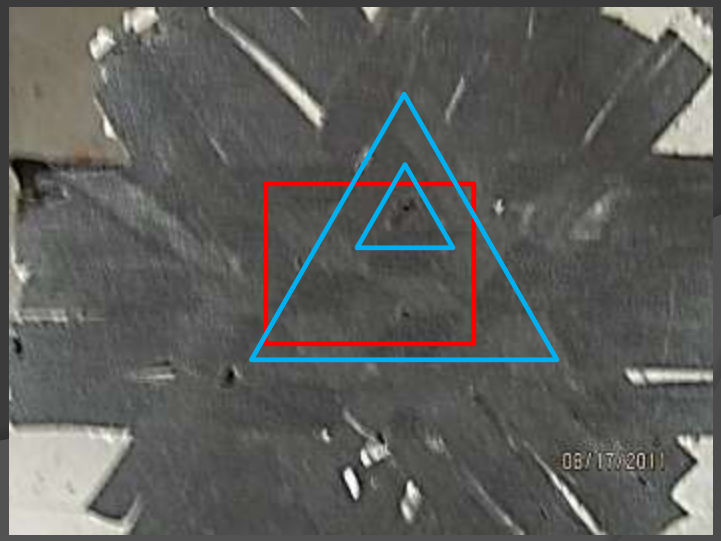
Biaxial

- Two axes
- Two layers of fiber at any point in the weave

Triaxial

- Three axes
- Three layers of fiber at any point in the weave





Methods: Samples

Control

- Biaxial 1x1 twill
- 6 strands per axis
- Two layers
- 10 samples

Experimental

- Dense triaxial weave
- 5 strands per axis
- Two layers
- 10 samples

Methods: Sample Creation

- Each sample was woven and then wrapped for storage
- Once at the shop, the samples are unwrapped and epoxy is applied
- Pressure is applied to the composites to remove air and epoxy pockets from the samples

Test 1: Deflection Test

- How far can the material bend under a load
- Pressure applied until the composite is deemed structurally unstable

Test 2: Pressure Test

- How much pressure could be withstood
- Pressure applied until the composite fails and no more pressure can be applied

Results: Test 1

- Biaxial composites deflected more than Triaxial composites on average

Test	Centimeters of Deflection (Biaxial)	Centimeters of Deflection (Triaxial)
1	0.635	0.47625
2	0.47625	0.47625
3	0.47625	0.396875
4	0.47625	0.396875
5	0.714375	0.396875
Average Deflection	0.555625	0.428625

Results: Test 2

- Triaxial composites withstood more pressure than Biaxial composites on average

Test	Stress Endured (Biaxial)	Stress Endured (Triaxial)
1	40psi	290psi
2	110psi	280psi
3	90psi	210psi
4	200psi	120psi
5	170psi	180psi
Average	122psi	216psi

Conclusions

- The weave shows promise

Future Research

1. Machine woven composites
2. Other properties (e.g. tensile strength, torsion resistance, ease of use,)
3. Cost analysis

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http://files.conceptcarz.com/img/Lola/99-Lola-B2K40-DV-10-WG_03.jpg

Mentor: Tony Bright

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