

Bridge #:  
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# The Second-Hand Span

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## PROBLEM STATEMENT

Design an I-beam using dry recycled carbon fiber fabric and infuse it with a two part epoxy resin through a wet lay-up technique to hold 7,200 lbs.

## DESIGN

There are three components to this beam:

- Two 2" x 3" x 30" tools were used to form the webs, with plies mostly oriented at 45° as well to counter shear stresses.
- One flat tool on the bottom that contains mostly full length plies to counter tension in the bottom and extra in the tabs to counter crushing from the load points.
- One flat tool on top that contains more material concentrated at the center and a few full length to help resist compressive forces.

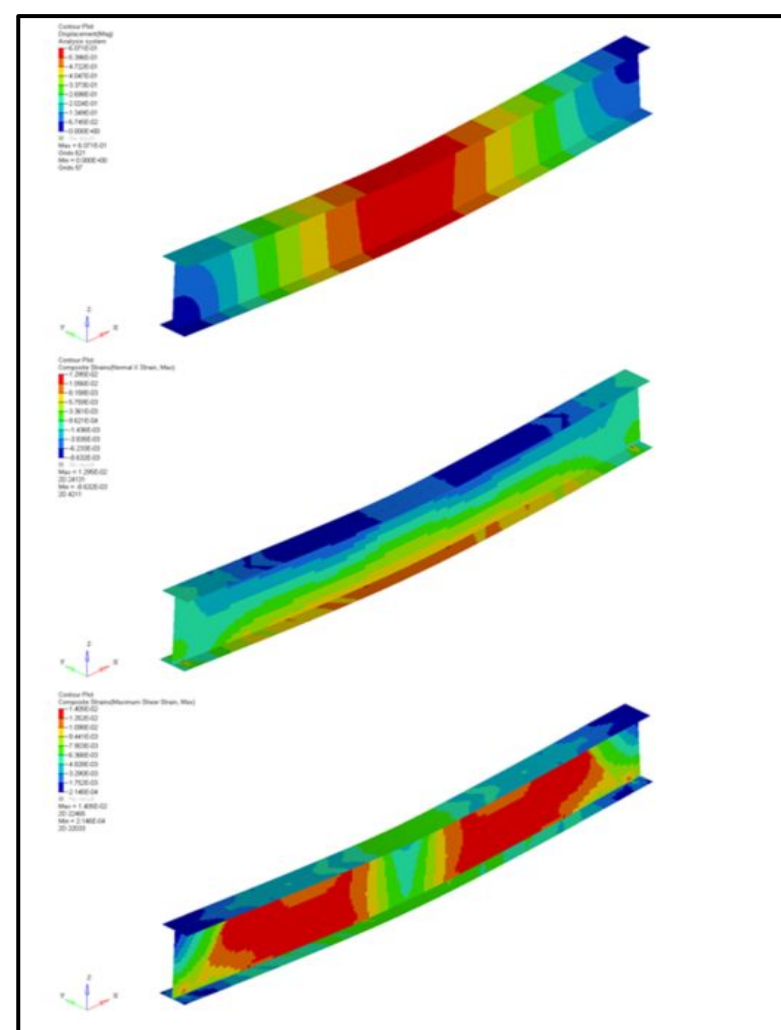


Figure 1. I-Beam finite analysis (displacement, normal strain, shear strain)

## MANUFACTURING

**Intro:** rCF (recycled Carbon Fiber) presents a unique design element at SAMPE, as the chopped mat creates a roughly isotropic material on the scale of a 24" beam, as opposed to the orthotropic properties of traditional fiber composites. rCF also remains a challenging material to work with. The lack of long-range order in the fiber drastically reduces the rate of infusion of wet resin into the plies.

**Prep:** Two 2" x 3" x 30" aluminum tools and two 7" x 30" aluminum caul plates were sanded (up to P400), cleaned with acetone and Isopropyl Alcohol, then wrapped in release film. rCF was pulled into small pieces to act as noodles to fill the void between the box tools and caul plates.

**Fibre:** Carbon Conversions RCF Phoenix RGSR 200, with and without Nylon stitching

**Resin:** Pro-Set LAM-125



Figure 2. Organizing Cut Plies



Figure 2. Vacuuming plies and resin to distribute resin evenly

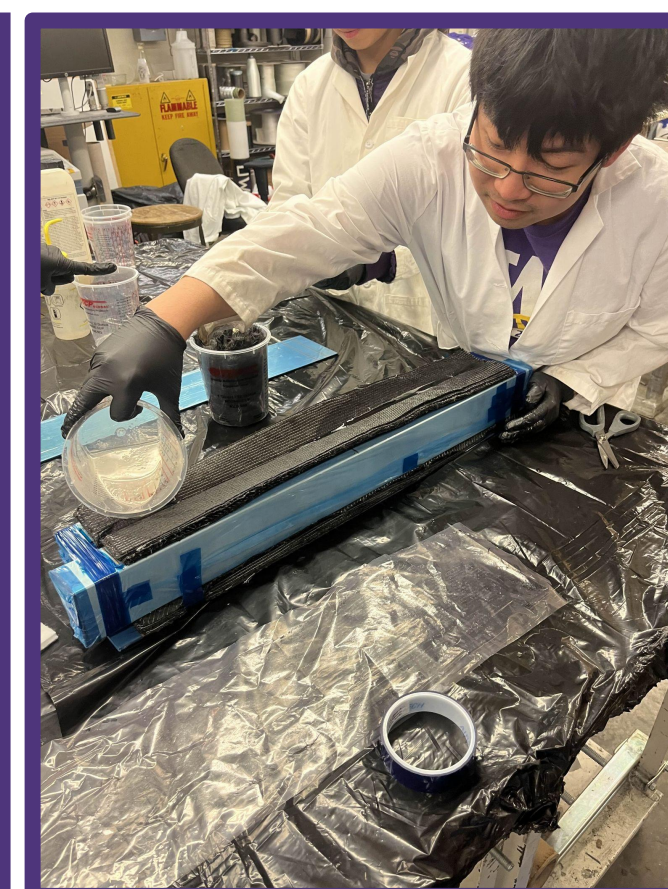
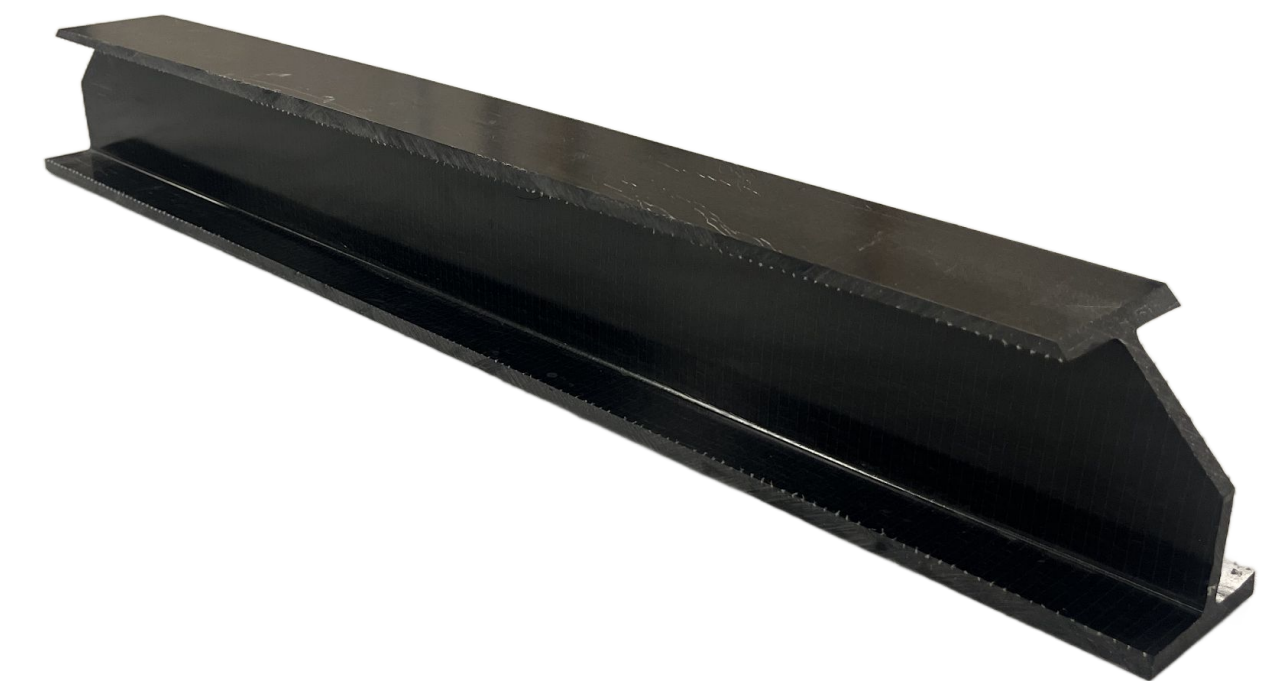


Figure 3. Constructing webs and pouring resin

## TESTING

The first two iterations of this beam failed very early in a crushing mode. Upon inspection, large voids and dry spots were found in the cross section of the beam.



## FUTURE IMPROVEMENTS

The infusion/laminating process is the most challenging portion of this beam. We've found that the plies have enough volume to them that it's challenging to tell how much is the right amount, since it doesn't visibly saturate similar to other materials at the right fiber/resin ratio. Therefore, a more robust infusion system is needed to ensure proper ratios.

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