

Bridge Number  
WJNCC9GRMVS

# Weird Flax, But Ok

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Category F



## PROBLEM STATEMENT

Design an I-beam using natural materials such as linen, and flax fiber that will hold a distributive load of 2400 lbf.

## BEAM DESIGN

There are three sections in this beam:

- Web created with 0° and 45° ply and balsa for shear stress
- Top created using mostly 0° ply and a few 45° ply for compressive stress
- Bottom created using mostly 0° ply and a few 45° ply for tensile stress

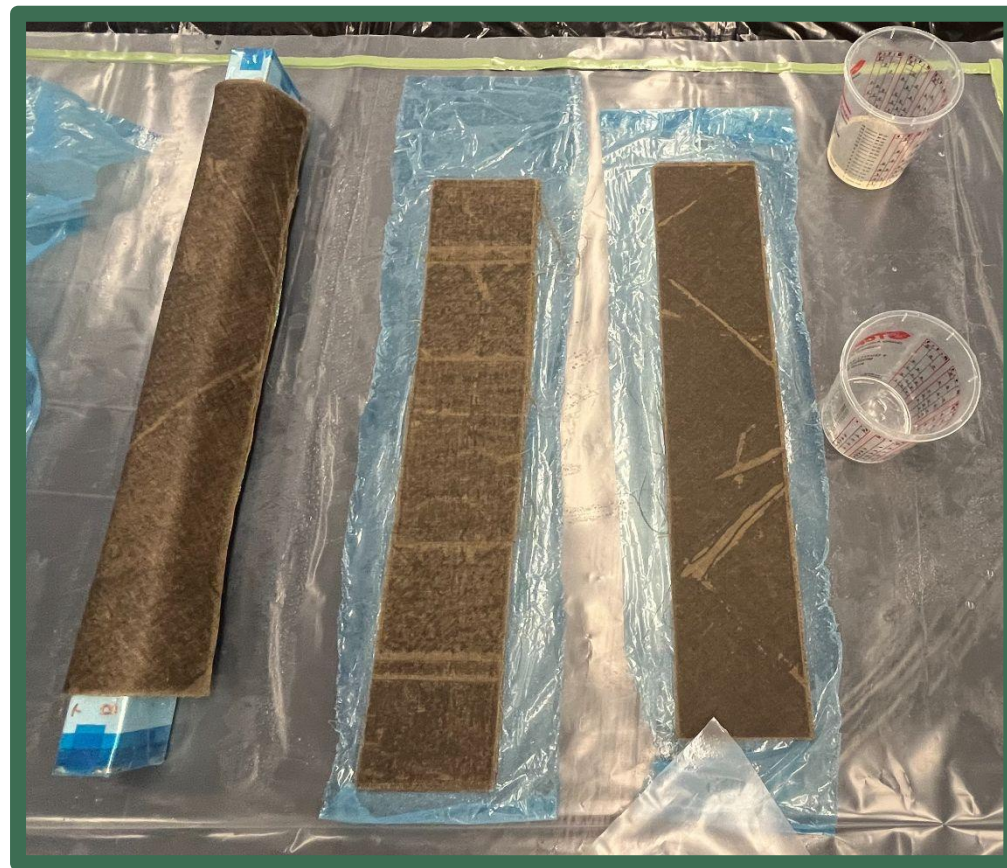


Figure 1 - Web, Top, and Bottom of Beam Impregnated with Resin

## ACKNOWLEDGEMENTS

- Faculty Advisor: Navid Zobeiry
- Alex Gray, Research Engineer - UW MSE
- UW SAMPE Officers & Members

## MANUFACTURING

Plies are designed and modeled in SolidWorks, then cut using a CNC fiber cutting table. A wet lay-up process is used to combine the dry linen, cotton, and flax fibers as well as the balsa wood. Pro-Set Inf-114 Infusion Resin is impregnated into individual plies, which are then laid in a predetermined order to optimize the overall strength of the beam.

The top and bottom flanges are laid flat on steel caul plates, while the two side channels are laid on the narrow side of a 2" x 3" aluminum tool. The top, bottom and C-channels are assembled around a balsa wood core, vacuum bagged, and placed into an autoclave. They are then cured in an autoclave at 150°F for 2-3 hours.



Figure 2 - Wet Layup Process

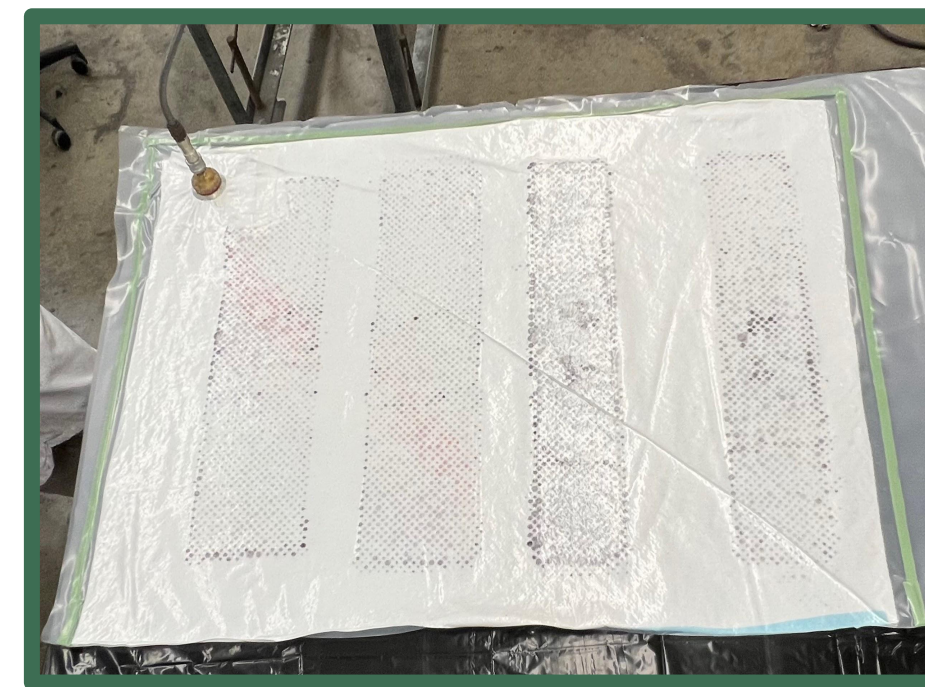


Figure 3 - Vacuuming Excess Resin From Plies



Figure 4 - Beam Layup on Tools in Autoclave

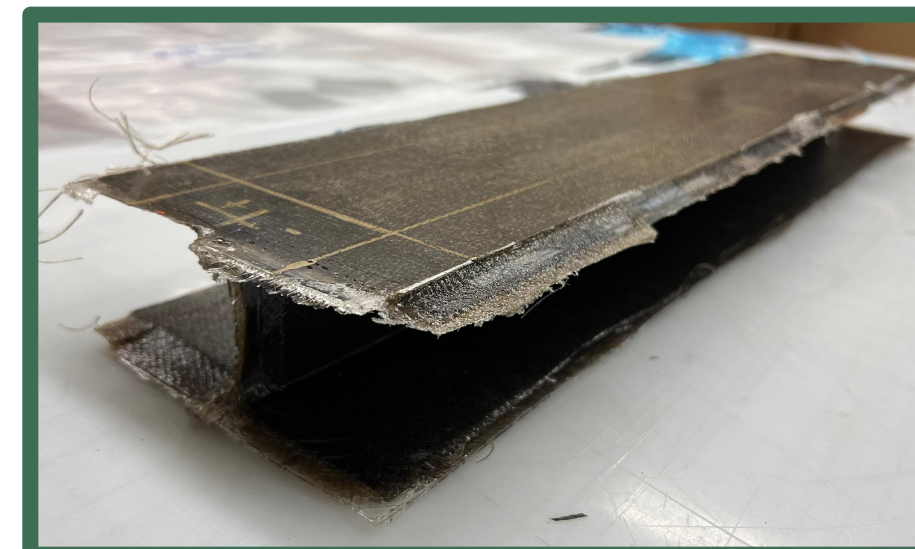


Figure 5 - Beam Removed From Tools

## TESTING

The initial design was overbuilt and held a load of 4000 lbf. To optimize the layup design, we removed the unnecessary  $\pm 45^\circ$  plies in the top, bottom, and web to balance the weight and the load-carrying capacity.



Figure 6 - First Iteration

## FUTURE IMPROVEMENTS

- Run a finite optimization analysis on the current beam to compare processing to theoretical performance and determine where mass can be further reduced
- Improve the wet layup process
- Investigate alternative resins and material treatments to improve adhesion between fibers and resin