FSAE Carbon Fibre Rim Design

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FUNDED BY LAB FUND ENGINEERING STUDENTS

Background and Problem Description

- Formula SAE is an intercollegiate engineering competition where teams design, build, and race open-wheel race cars. The Gryphon Racing team is currently downsizing to 10” rims in an effort to improve performance through reduction in CG, unsprung mass, rotational inertia, and overall vehicle weight.
- These reductions can be maximized through development of a custom carbon fibre rim. Carbon fibre is an ideal material for this design because its unique properties provide superior specific

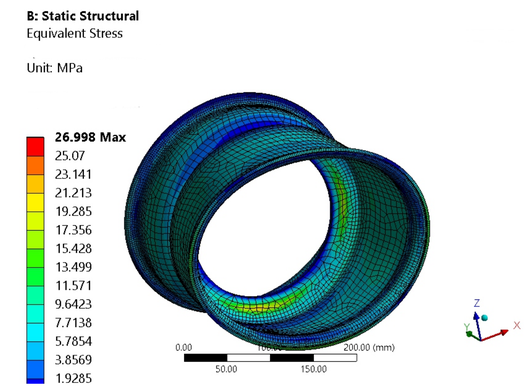

Figure 3 - Von Mises equivalent stress plot for final design

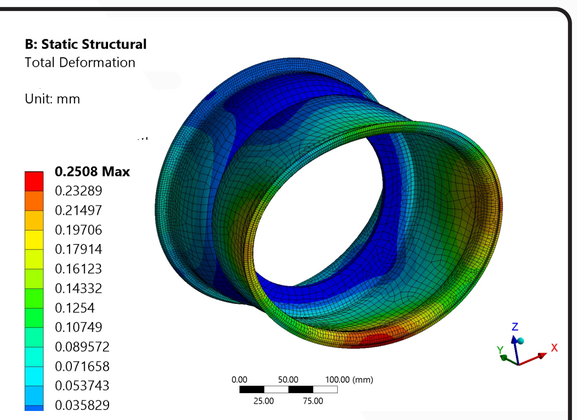

Figure 4 - Deformation plot for final design

Objectives

- Determine realistic design load cases through vehicle dynamics analysis.
- Perform materials research to select appropriate fabric and epoxy types.
- Develop a carbon fibre rim design to meet the requirements of at least 40% weight reduction with comparable stiffness.
- Design and manufacture the required aluminum molds.
- Build a completed prototype rim.

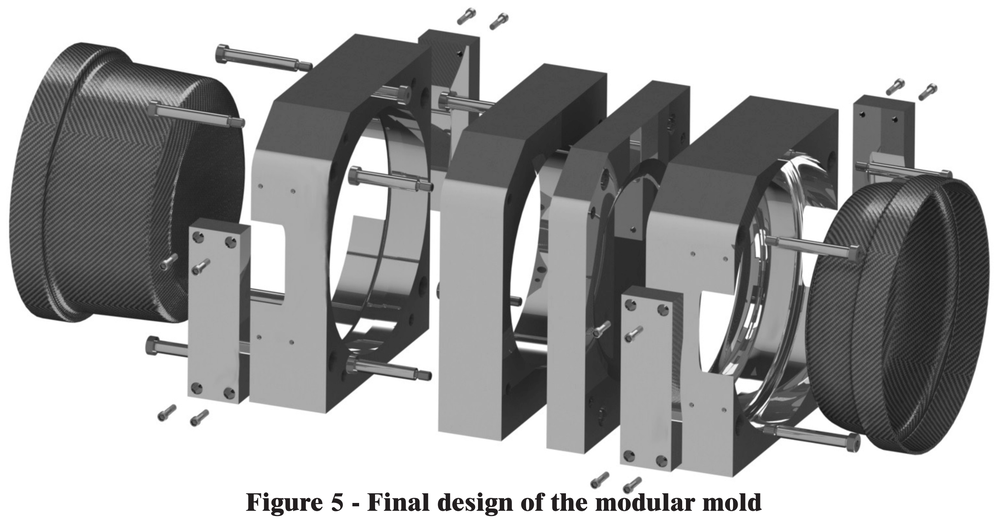

Figure 5 - Final design of the modular mold

Design Solution

- A custom rim profile was designed with consideration of suspension design criteria, ease of mold release, and minimization of stress concentrations.
- Structural analysis was completed to determine the required layering and orientations of the carbon lamina. Load cases for cornering, longitudinal acceleration, road bumps, and over-pressurized tires were considered. Tensile tests were performed on sample carbon fibre parts.
- A modular female aluminum mold was designed. This type of mold provides high dimensional accuracy on critical surfaces and can be feasibly machined using SOE facilities.
- 2x2 twill weave carbon fibre is layered on the mold using a high-

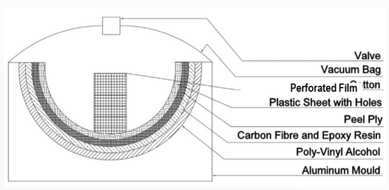

Figure 1 - Example layup for vacuum bagging

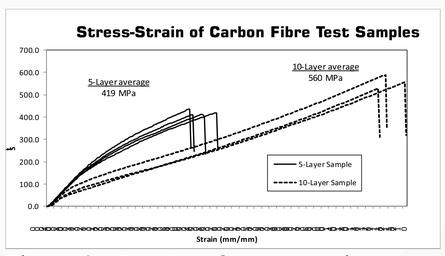

Figure 2 - Results of stress-strain tests

Conclusions

- A comprehensive rim design process was carried out and documented for future use.
- A fully functional aluminum mold assembly was designed and manufactured.
- A prototype rim was built as a proof of concept.
- 40% weight reduction was achieved while maintaining comparable stiffness and strength to original aluminum rims.

Figure 6 - Final carbon fibre rim render

Advisor: Dr. John Runciman, Ph.D, P.Eng.

Acknowledgements: Barry Verspagen, Ken Graham, Dave Wright, Anthony Meola, Gryphon Racing, Musashi Auto Parts

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