UWFormula x Boeing Additive Manufacturing Tooling

Luciana Sobrino[1], Liam Gleeson[2] , Lucas Minet[1], Keith French, Nicholas Dethlefs
Boeing/UWFormula/Ashley Emery
[1] ME, [2] MSE

INTRODUCTION

- *UW Formula has historically used high density foam molds and jigs in order to make the front wing and all the aero components of the car.*
- *The process has over 10 steps with significant amounts of machining, sanding, and manual labor.*
- *Using additive manufacturing, we will be able to layup the carbon fiber directly on their internals, taking away the need for molds or jigs..*
- *Removing the labor-intensive aspects and using sacrificial material means the wing can be made faster and with less material waste.*

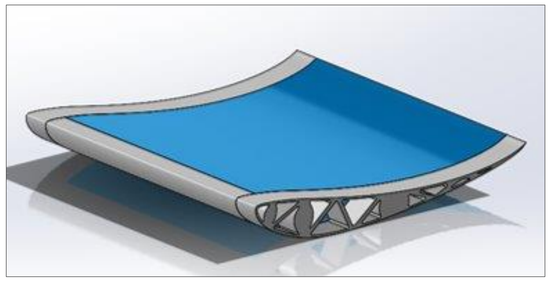
PROBLEM STATEMENT : Our project aims to create an improved design and manufacturing process for the front wing on next year's UWFSAE car. By removing the molding process, the manufacturing period will be much shorter and by using improved AM materials the wing will improve in performance and durability.

CORE FUNCTIONS

- *Provide stability and structure to the carbon fiber while staying lightweight.*
- *Cut down on labor and time spent during the manufacturing process to get more testing time.*
- *Paving the way for an eco-friendlier manufacturing approach with less material waste.*

MECHANICAL ENGINEERING
UNIVERSITY of WASHINGTON

DESIGN AND DEVELOPMENT



Prototype CAD Model

Prototype/Idea/Diagram

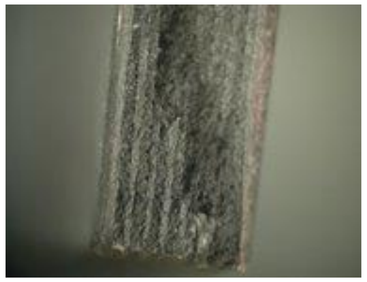
- *Truss structured ribs and a leading edge for mounting and impact support*
- *CF PEKK Ribs: incredibly strong, lightweight, can easily survive the temperatures/pressures of the autoclave*
- *Soluble Spar: Surface area for carbon fiber to lay on during layup and cure. Needed to avoid compression of carbon in the autoclave. Will be dissolved after cure*

Specimens for Instron Testing

Figures and technical work

- *Above are all our PETG baseline and CF PEKK test specimens, both laid up using prepreg carbon fiber.*
- *This project primarily involved 3D printing, destructive mechanical testing, material science, and composite manufacturing.*

RESULTS/VALIDATION



- *PETG (Baseline) vs CF PEKK (AM material) showed improved mechanical properties in three-point bend*
- *Microscopic inspection showed two distinct phases and poor bonding between layers*

3-Point Bend	Rate: 0.1 in/min	50kN load cell	
Specimen	Material	Failure Point (lbf)	Strain
1	PETG	210	0.02
2	PETG	405	0.027
3	PEKK	396	0.031
4	PEKK	456	0.027

CONCLUSION & FUTURE WORK

- This design reduces time spent, material waste and overall cost, although additive manufacturing has many quirks.
- For the future, we would recommend finding a more reliable soluble printing material that both dissolves and prints easily.
- One significant change to this project would be using the printers that the filament manufacturers recommend, as this would likely improve print performance.
- Potential applications are primarily automotive and aerospace

Acknowledgements

Evan Roberts
Troy Haworth
Ashley Emery
Boeing

Mechanical Engineering Capstone Exposition
May 30th, 2023, Husky Union Building, University of Washington, Seattle