Composites System Requirements Review

7/20/2025

Feedback

Please give us any feedback!

Specifically on:

- Feasibility of projects
- Integrations with other systems
- Caveats that we will need to consider in decision matrix

LHRC


DOES ADVERTISING WORK?
104
TEXAS
The University of Texas at Austin
BODY:
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Overview

Agenda- Dhruv

High Level Goals

- System Level and Teamwide goals

Improvement from Last Year

High Level Timeline

Parts/Assemblies

- Assemblies
  - Part Descriptions
  - Graphs, Figures, Models

Research Projects

- Project:
  - Order of Operations
  - Logistics
  - Etc.

High Level Goals-

Teamwide Goal Overview

- Timeline, Manufacturing Goals
- 3- Timeline
- 2- Lapsim (Aerosim Val)
- 1- System Goals (Research Projects)
- System Level Goal Overview
- 1- System level goals
    - **Research** oriented system, focused on **delivering results-** Lower weight, more rigid structures
    - Front Wing **Compliance** with **Body** and **Aero**, increase accuracy to CFD, **generate a stiffness target** to reach
    - Ensure **design to manufacturing compliance**, increasing % of manufacturing that is **identical to 000**
    - Finish **Molds by End of February**, faster manufacturing timeline.

Improvement From Last Year

Manufacturing: Working with different suppliers for molds, making them in house, goal, **molds** complete **before March**, better compliances with other systems, **fit and finish**, focused on **90->100** instead of 0->90

Projects: More **research** and testing towards **projects**, heavily focused on deliverables, any way that it can help the car, ie: **lower weight, increased CFD Validation, more rigid structures**

- Undertray rigidity
- Front Wing Compliance
- Aero Mounting, more than zip ties
- 000 CAD to Mass Weight on manufactured part
- Manufacturing timeline
- Aero-Comp joint meetings and events
- Resin Infusion for body work

Overall Hi-Level Timeline

Sub System Slides Include Specific Timelines

By Aug 25:

- List of companies to reach out to
- design research projects (documentation, CAD, FEA), Decision Matrices on projects and assemblies

By End of Sept:

- New members onboarded,
- Assigned to sub-sys and projects

Fall 2025

Early Sept:

- Testing old components on Racoon
- Resin infusion tests, wing structures tests, new mold tests

By Halloween:

- Complete Projects and testing w/ previous design documentation.
- Validate findings on drive days, and with Instron and wind tunnel.
- **New Members Shop Certified (at latest)**

Overall Hi-Level Timeline cont.

Sub System Slides Include Specific Timelines

Before Winter:

- Manufacturing tests for wings
- Finalize manufacturing decisions based on testing data, certify with team and system leads
- Start manufacturing for ’26 Car

By March: Molds Manufactured, Begin final manufacturing stretch of body work and aero package

Spring 2026

May: Dominate at Comp

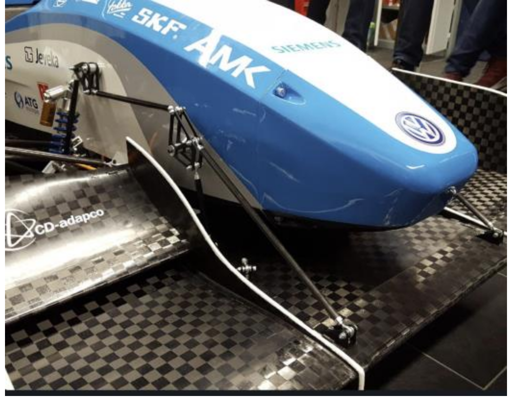
By Wheel's Down: Manufacture plates (close outs, fire walls, wing plates, etc) Start on molds and wing manufacturing

By Apr:

- All composites finalized,
- Validation with body and aero on drive days with ’26 car

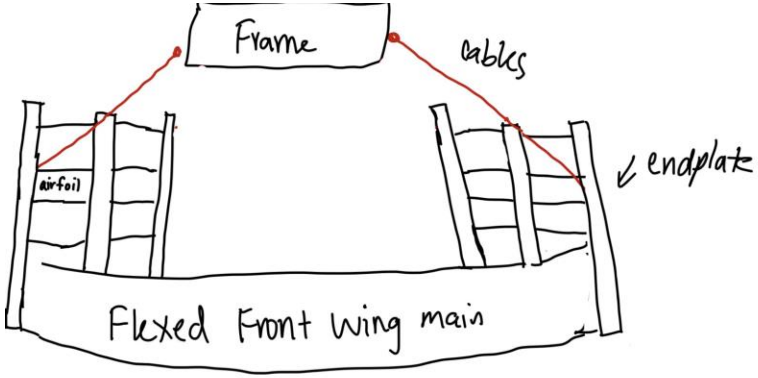
Aerodynamics

Front Wing (2 new members)



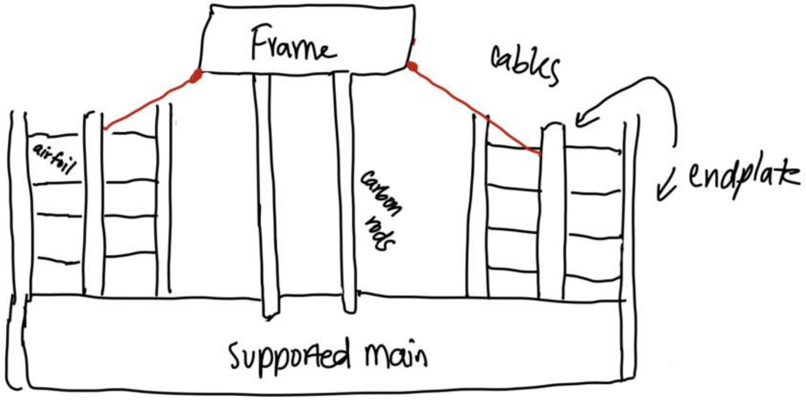
Description/Purpose:

- 55in x 23in x 11in
- Pre-preg airfoils and endplates w/ foam core.



Overview/Changes:

- Airfoil Manufacturing-
  - **3D printed** molds for **smaller airfoils** profiles
  - Better **airfoil** cutting **accuracy** to avoid unnecessary **flexures in structure**
  - **Test patch** ply testing with 3-point-bend (FEA or FSI) to generate a **target stiffness**
  - **Tooling board** w/ resin infusion (**uniform stiffness**)
- Mounting-
  - **Direct mounting** onto middle **front wing main element** to avoiding flexural deformation **(tie rod mounting or swan neck)**

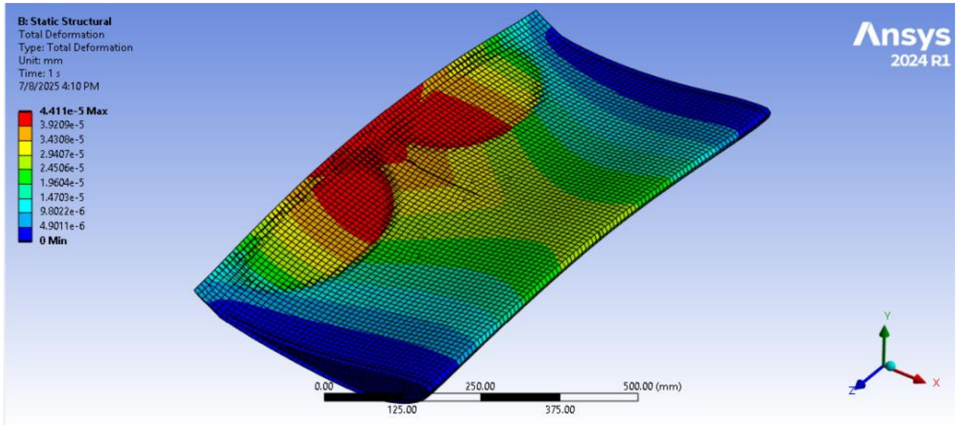


Important Considerations:

- Bounding Box-
  - Create molds that better reflect CAD sizes

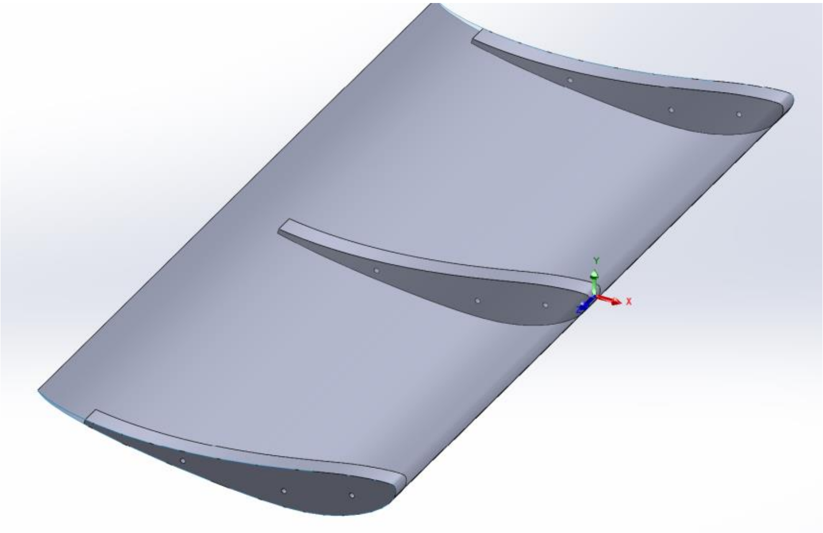
$$\text{Apparent Flexural Stiffness} = \frac{F}{\delta_{max}}$$

Rear Wing (2 additional members)



Description/Purpose:

- 40in x 38in x 32in
- Pre-preg airfoils and endplates w/ foam core



Overview/Changes:

- Internal Structure-
  - Aero judge was able to **press** on the airfoil and **bend it**
  - Generate a **target stiffness** through **FSI study** and **iterative process**
  - Explore **more ribs, core** as internal support, **increase** overall **ply** counts to see which **maximizes stiffness while minimizing weight**
- Mounting-
  - Mounting will stay relatively the same; good adjustability
  - Cognizant of bounding box to confirm legality.

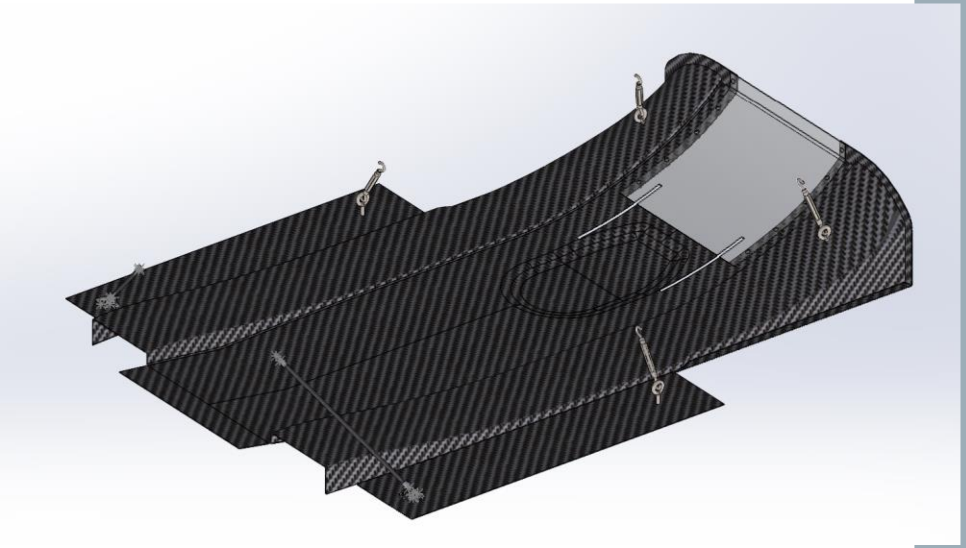
Important Considerations:

- Resources- With changes in rear wing airfoil geometry, new molds will have to be made- either 3D printed or tooling board (all elements)

Undertray (3 additional members)

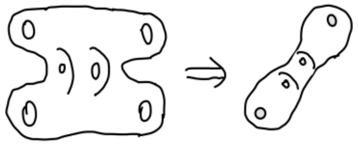
Description/Purpose:

- 75in x 55in x 13in Wet Layup/Resin Infusion
- possible Rohacell 51 Core.



Overview/Changes:

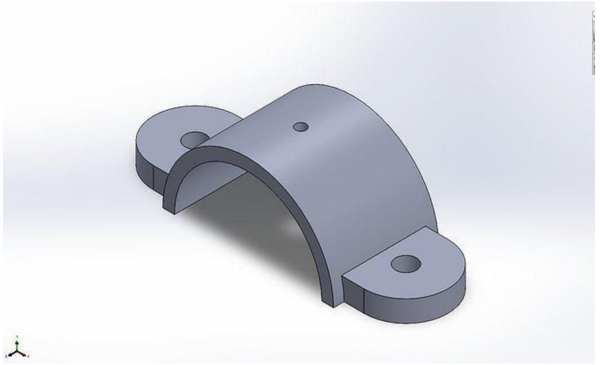
- <u>**Increase overall rigidity**</u>
  - **increase ply counts** and add **1/8"** foam **core** to reduce floppiness and compare to **targeted stiffness** (simulating aero loads and changing internal structure in certain regions
- <u>**Mounting**</u>
  - Mounting will relatively stay the same. **Turnbuckles** game good **adjustability** Carbon fiber tubes with rod ends to attach to frame. Implement Dzus fasteners for frame-to-undertray connection for easier mounting
  - Save weight by making **new** mounting **bracket**



Important Considerations:

- <u>**Resources**</u>- Undertray requires large amount of foam, epoxy, carbon, vacuum bag, and manpower. 3-4 people will be required for ensuring good layup quality of the undertray (long time commitment for layup

Bodywork/Sidepods (3 additional members)



Description/Purpose:

- Wet Layup/Resin Infusion for entire layup.

Overview/Changes:

- **<u>Continuity</u>**
  - The bodywork/side pods manufacturing will be similar to last year's
  - Potentially a better design for lip to duct mounting because it was a little difficult last year
  - **<u>Mounting</u>**
    - Mounting will require more attention- better finish and aesthetics. We will look into 3D printed mounts that wrap around the frame in a u-shape. Zip ties were effective but looked a little sloppy.

Important Considerations:

- **<u>Resources</u>**- Give enough time for post-processing. This means trimming the bodywork and nose cone to fit the rest of the car's components. Attaching radiator ducts to side pods. 2-3 people will be required for this project.

Aerodynamic Components Timeline

Front Wing and Rear Wing

Late Aug- September

- Mold manufacturing for wing elements (3D printed) for front wing main element and rear wing main element

October-November

- Wing Layups for individual airfoils, finalized assembly design, machining mounting hardware and finalized assembly

December-February

- Finished all layups and put start assembling structures, mounting components finished

March-April

- Fully complete

Body Panels, Sidepods, Nose Cone

September-November

- Have a reliable mold manufacturer chosen, finalize mounting and manufacturing processes/list of necessary resources

December-January

- Start making molds

January-February

- All molds should be manufactured and put together

March-April

- all layups and mounting completed

Aerodynamic Components Timeline

Undertray

Septemeber-November

- Finalize a mold manufacturer for undertray

October-November

- Figure out ply counts for undertray in specific regions- diffuser venturi tunnels, etc

December-January

- Begin mold production, finalizing layup elements (necessary chemicals, release agents, etc)

Febraury-April

- Finish putting together molds, finish layup and mounting

System Integration

Carbon Fiber Steering Wheel (Solid)

Description/Purpose:

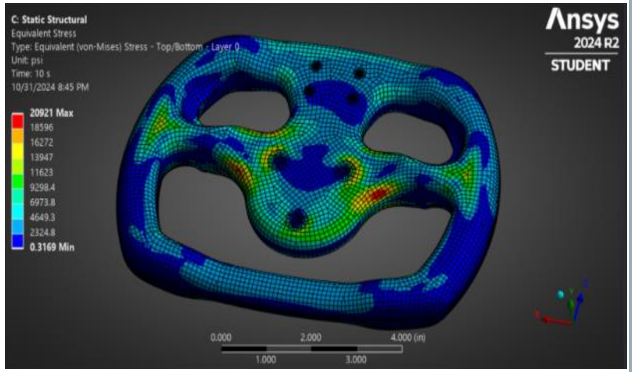
- A lightweight, high-strength steering wheel made from carbon fiber to enhance driver control, reduce weight, and improve ergonomics in high-performance applications. Designed for optimal stiffness and customization, it integrates easily with electronic controls and is tailored to the needs of drivers and ergonomics teams.

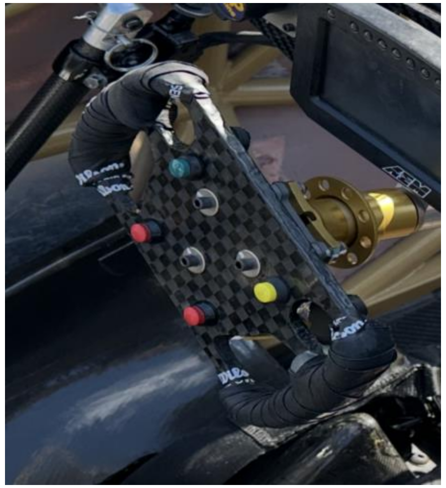
Overview/Changes:

- **<u>Requirements:</u>** More research, 3-Point Bend Testing, FSAE document for forces put on wheel
- **<u>Layup Processes:</u>**
  - Wet layup – Water-jet CF sandwich panel and creating custom grips out of 3DP PLA or grip tape
  - Prepreg – "
- **<u>Mold Manufacturing:</u>**
  - Metal plate/Mirror – Wet layup or Resin Infusion for a CF billet
- **<u>Sizing:</u>** Make Larger than last year dimensions: 8.5" x 5.6" x 1.5"

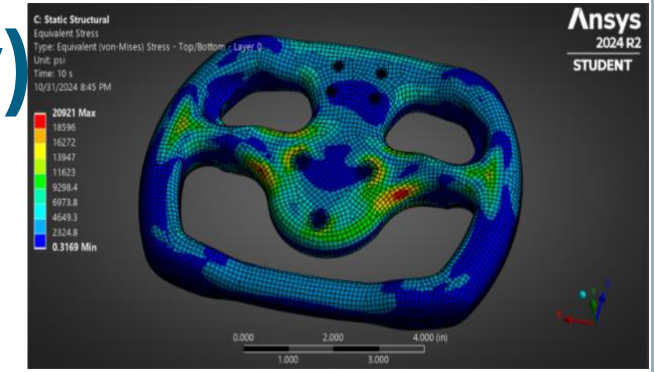
Important Considerations:

- **<u>Decisions:</u>** If shaving off time on an easier wheel design is necessary and risk with a new design.
- **<u>Last year Feedback:</u>** Wheel is tight with gloves on, TPU grips got mushy on Panda
- **<u>Prototyping Process:</u>** Lazer Cutting Wood, driver meeting
- **<u>Resources:</u>** SCS Waterjet, Prepreg CF or Dry CF, (Basics: Mold release ,Resin, Vac Bag, Peel Ply, Breather, Vacuum Pump, Sanding paper (Mold Preparation or Post-Process surface finishing), clearcoat.





Carbon Fiber Steering Wheel (Hollow)

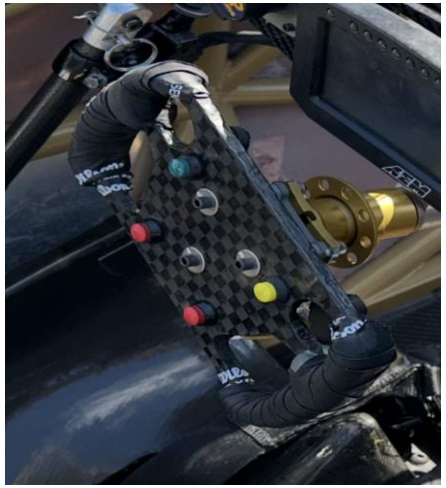


Description/Purpose:

- A lightweight, high-strength steering wheel made from carbon fiber to enhance driver control, reduce weight, and improve ergonomics in high-performance applications. Designed for optimal stiffness and customization, it integrates easily with electronic controls and is tailored to the needs of drivers and ergonomics teams.

Overview/Changes:

- **Requirements:** Claytons durability test 665lb, FSAE document for forces put on wheel
- **Layup Processes:**
  - Prepreg – Followed by post process surface treatment
- **Mold Manufacturing:**
  - Split mold – 3D Printed PA6-CF. Note: Also, Possibility to avoid epoxy bonding the two halves through a variation of compression molding.
- **Sizing:** Make Larger than last year dimensions: 8.5" x 5.6" x 1.5"



Important Considerations:

- **Decisions:** Hollow for electronics? If Improving upon last year's wheel design is worth it.
- **Last year Feedback:** Wheel is tight with gloves on
- **Prototyping Process:** 3D print PLA, driver meetings
- **Resources:** Enclosed 3D Printer, High Temp Filament, Prepreg CF or Dry CF, (Basics: Mold release ,Resin, Vac Bag, Peel Ply, Breather, Vacuum Pump, Sanding paper (Mold Preparation or Post-Process surface finishing), clearcoat.

Wheel Timeline

Late Aug- September

- CAD wheel designs and rapid prototype by Lazer cutting wood or 3D printing out of PLA/PETG. Finalize design(s)

October-Thanksgiving Break

- ANSYS simulation testing, and structural testing with Claytons Toyota Camry. Design/Manufacture molds
- Get access to Davies' Lab for 3Pt Bending testing on Plate)

December (Before Finals)-End of January

- 3D Print Molds (if applicable)
- Begin Layups (Hopefully Complete)
- 3D print/Create all Internal Bonding Components
- Bond Wheel (Maybe?)

Before Wheels Down

- Bond Wheel (if not done)
- Begin Final assembly of Steering Column
- Integrate Wheel w/ Finished Steering Column

Firewall

Description/Purpose:

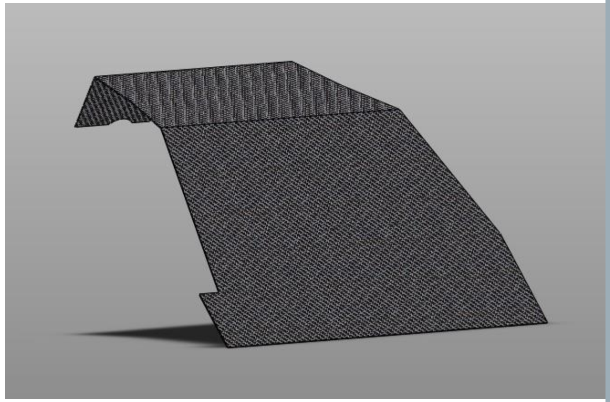
- Mounted behind the driver to provide safety, and thermal separation from the powertrain. Ideal for new team members, and contributes to overall performance and packaging efficiency.

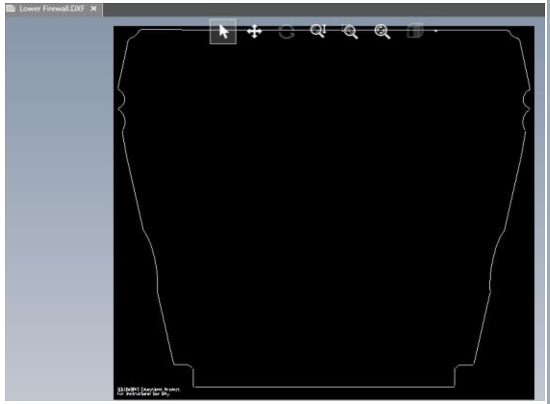
Overview/Changes:

- **Layup Processes:**
  - Prepreg – Followed by water jetting a CF sandwich panel
  - Wet layup – "
  - Resin Infusion – Potential project for testing resin infusion
- **Manufacturing:**
  - Metal plate/Mirror – (2D Lower Firewall)
  - Bent Metal plate – (3D Upper Firewall)
- **Sizing:** Dimensions TBD with Ergo after frame is developed
- **Mounting:** Explore better mounting options, quick-latches.

Important Considerations:

- **Decisions:** Deciding on 3 pieces, intake placement. Rule Book: Driver cannot have line of sight from engine. Consulting with Aero if optimizing.
- **Last year Feedback:** Tedious to remove/ install. "poor sealing' so had to use lots of speed tape, bad look.
- **Resources:** Metal Sheet/Mirror, SCS Waterjet, Prepreg CF or Dry CF, (Basics), clearcoat, Foam core (Roachell 51).





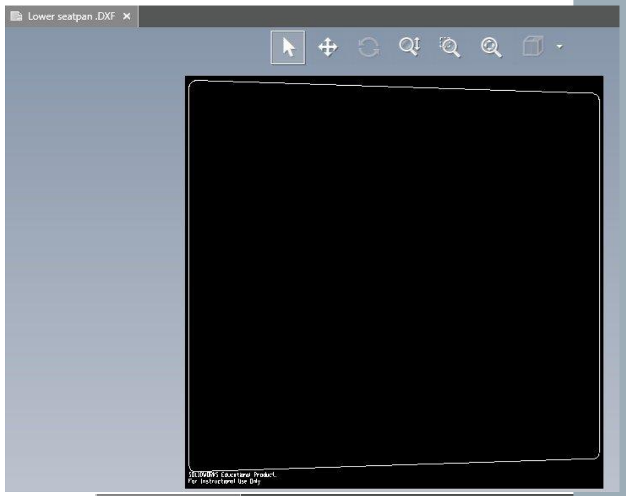
Seat Pans

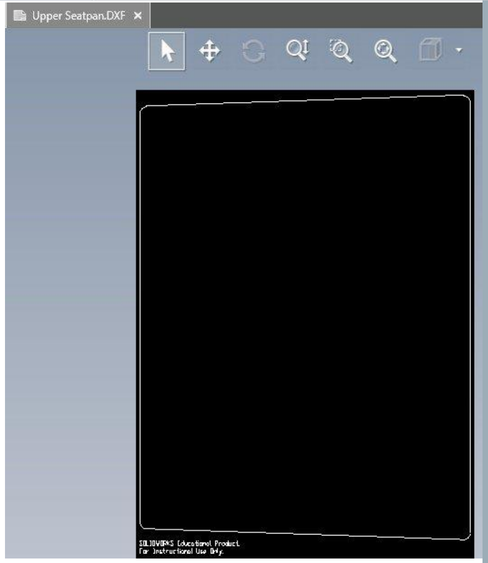
Description/Purpose:

- Flat carbon fiber panels mounted at the base of the cockpit to support the driver's weight and integrate with the frame. Simple, 2D component ideal for ANSYS simulation once the frame is finalized.

Overview/Changes:

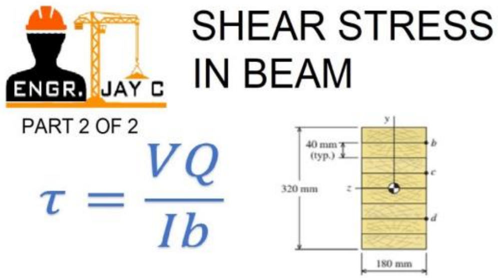
- **<u>Layup Processes:</u>**
  - Prepreg – Followed by water jetting a CF sandwich panel
  - Wet layup – "
  - Resin Infusion – Potential project for testing resin infusion
- **<u>Manufacturing:</u>**
  - Metal plate/Mirror – Wet layup or Resin Infusion for a CF panel (Similar to last year's 2D seat pans)
- **<u>Sizing:</u>** Dimensions will be constrained to bottom of the frames floor
- **<u>Foam Core:</u>** Switch from Roachell 51 to a more stiff Honeycomb in order to achieve a higher transverse shear resistance.
- **<u>Mounting:</u>** Explore better mounting options, quick-latches.





Important Considerations:

- **<u>Decisions:</u>** New ply thickness and foam core to support higher impact loads.
- **<u>Last year Feedback:</u>** Roachell 51 Core was crushed after multiple impact loads were applied.
- **<u>Resources:</u>** Metal Sheet/Mirror, SCS Waterjet, Prepreg CF or Dry CF, (Basics), clearcoat, New foam core.



Headrest Back Plate

Description/Purpose:

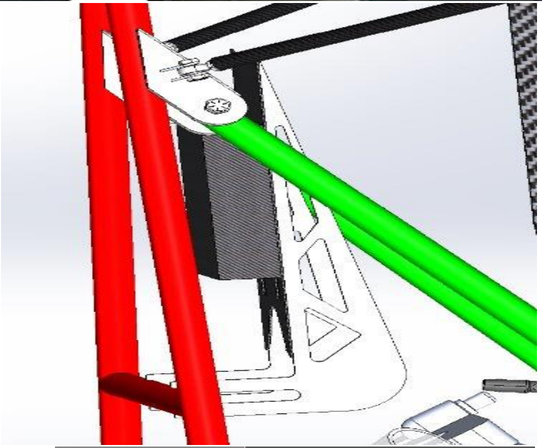
- A lightweight carbon fiber panel mounted behind the driver's head to provide structural support and impact protection. A great hands-on project for a new member once the design is finalized.

Overview/Changes:

- **<u>Layup Processes:</u>**
  - Prepreg – Followed by water jetting a CF sandwich panel
  - Wet layup – "
- **<u>Manufacturing:</u>**
  - Metal plate/Mirror – (Similar to last year's 2D panel)
- **<u>Sizing:</u>** Dimensions will be constrained to Ergo design
- **<u>Mounting:</u>** Explore better mounting options.

Important Considerations:

- **<u>Decisions:</u>** More research on attaching. Get official loadings from rulebook. Ply thickness.
- **<u>Last year Feedback:</u>** N/A
- **<u>Resources:</u>** Metal Sheet/Mirror, SCS Waterjet, Prepreg CF or Dry CF, (Basics), clearcoat, New foam core.



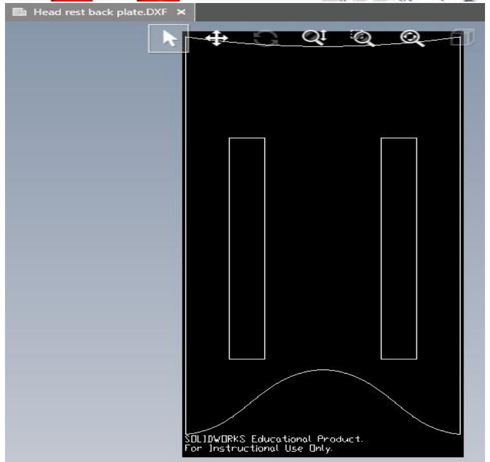


Plate Components Timelines

Late Aug- September

- ANSYS Simulation testing for loads (mainly seatpan)
- Ply count optimization based on simulation results
- CAD New Mounting (if applicable)

October-Thanksgiving Break

- Layup Stock for Firewall
- Layup Stock for Seatpan
- Layup Stock for Headrest
- Layup Stock for Upper Firewall/Engine Cover
- Ship out to SCS for Waterjet

December-Mid January

- Finalize Padded Headrest Assembly w/Ergo
- Finalize Integration w/ Welded Frame (Seatpan, Firewall, Engine Cover)

March

- Focus on Manufacturing

Carbon Fiber Control Arms

Description/Purpose:

- Lightweight, outsourced carbon fiber tubes designed to replace traditional metal CFCAs

Overview/Changes:

- **Manufacturing:** Outsource premade CF Twill weave tubes from Rockwest Composites: https://www.rockwestcomposites.com/45552.html
- **Sizing:** The sizing of machined aluminum inserts is a very critical part to ensure we achieve high adhesive strength between the CF tubes and inserts.
- **The Why:** We're following the same approach as last year since it proved effective, particularly with the Adhesive testing procedures Johnny rigorously performed. The results exceeded performance in strength and meeting manufacturing timeframe by sand blasting the Al inserts, so there's a solid rationale to maintain consistency.

Important Considerations:

- **Decisions:** Need Numbers from Dynamics but will be manufactured and tested by Composites. Will want to possibly re-organize documentation process and procedure. Additionally, we want to ensure we are considering the temperature we work in, to ensure we achieve the same if not better results in strength.
- **Last year Feedback:** Being mindful of factors such as temperature because there was a significant decrease in strenth when s
- **Resources:** Outsourced CF tubes, saw, Strong Adhesive, inserts/ball joints.

Steering Column Tubes

Description/Purpose:

- Lightweight, outsourced carbon fiber tubes designed to replace traditional metal steering column shafts, reducing overall system weight while maintaining torsional stiffness. The design will focus on meeting strength requirements through targeted torsional FEA analysis. A straightforward, high-impact upgrade that contributes to performance gains with minimal in-house manufacturing effort.

Overview/Changes:

- **Manufacturing:** Outsource premade CF Twill weave tubes from Rockwest Composites: https://www.rockwestcomposites.com/carbon-fiber-tubes?sz=120&srule=inside_dimension_asc
- **Sizing:** Dimensions will be constrained to Ergo's design, Premade CF Tubes can be cut/sawed.

Important Considerations:

- **Decisions:** Will stay similar to 2025 tubes with changes happening to the connection points by U-Joint. Will need to run ANSYS torsional testing. Need to investigate more on implementing CF steering column supports, Last year they were sandwich panels which worked well.
- **Last year Feedback:** Don't use the same steering column that Nigel picked last year, Also, maybe switching to U-Joint.
- **Resources:** Outsourced CF tubes, saw, Strong Adhesive, inserts/linkages?

Carbon Fiber Clutch Tube Handle

Description/Purpose:

- A lightweight clutch actuation handle made from outsourced carbon fiber twill weave tubing, replacing the previous aluminum design. Sourced from Rock West Composites and cut to fit ergonomic constraints, it offers improved aesthetics and stiffness with potentially minor weight savings. A simple, low-effort upgrade that enhances the car’s overall refinement and is easily integrated before wheels down.

Overview/Changes:

- **Manufacturing:** Outsource premade CF Twill weave tubes from Rockwest Composites: https://www.rockwestcomposites.com/carbon-fiber-tubes?sz=120&srule=inside_dimension_asc
- **Sizing:** Dimensions will be constrained to Ergo's design, Premade CF Tubes can be cut/sawed.
- **The Why:** Small tubed part that can easily replace an Aluminum tube.

Important Considerations:

- **Decisions:** Will replace aluminum tube with premade CF tube from Rockwest composites, weight savings may be negligible
- **Resources:** Outsourced CF tubes, saw, Strong Adhesive, inserts/linkages?

Tube Components Timelines

Late Aug- September

- Spec Tubes for all 3 Projects with given Loads/Requirements
- ANSYS ACP Validation on tubes

October-November

- Insert Machining (For CFCAs) & Adhesive Testing
- Adhesive testing for Clutch Handle
- Steering Assembly Insert Testing

Wheels Down

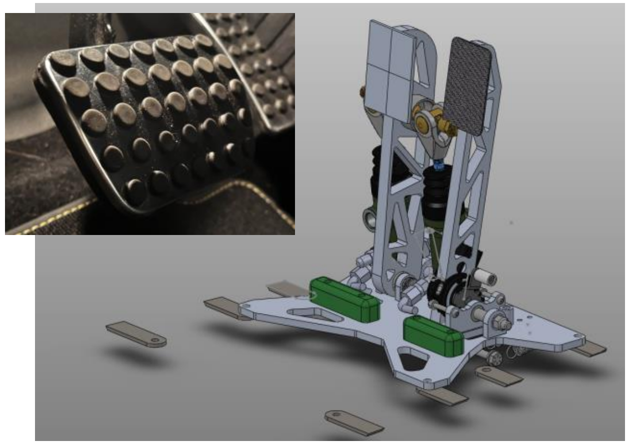
- Carbon Clutch Handle assembled + Integrated
- CFCAs Bonded + assembled + Integrated
- Steering Assembly Tubes Assembled + Integrated

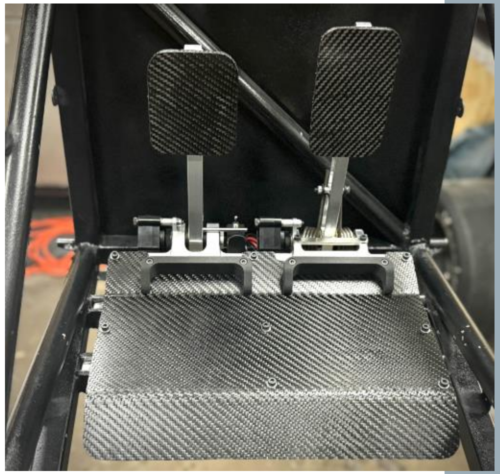
March

- Focus on Manufacturing

Decision Matrix Template

Pedal Box





Description/Purpose:

- CF Curved/ angled Pedal faces, CF heel rest plate, CF accelerator pedal arm

Overview/Changes:

- **<u>Layup Processes:</u>** Two possible approaches depending on each individual item
  - Prepreg – Depends on High Temp molds for oven curing
  - Forged Composites/ Carbon Fiber Sheet Molding Compound (SMC) – Depends on Compression Molding https://youtu.be/nhqAhYOdGNc?si=sYVZtOjpbg_3XKkw
- **<u>Manufacturing:</u>**
  - Split mold – (Similar to Hollow Steering Wheel)
  - Bent Metal plate – Compression Mold – Possible approach for creating angled/curved pedal faces instead of flat which were not as comfortable last year
- **<u>Sizing:</u>** Dimensions will be constrained to Ergo's design

Important Considerations:

- **<u>Decisions:</u>** If we want to try out compression molds for pedal face. Angled or curved pedal face design. If we can optimize a viable accelerator pedal made from CF. How much CF we want to implement into the Pedal Box Assembly.
- **<u>Last year Feedback:</u>** Couldn't produce an effective CF accelerator pedal with Al Split Mold (3D printed mold would be good here). Also did not have a CF heel rest plate.
- **<u>Resources:</u>** Enclosed 3D Printer with High Temp Filament or SCS Waterjet, Prepreg CF or Dry CF, (Basics), clearcoat. Forged Composites: Compression Molds (3D Print), CF Strands, Proper Resin Ratio supported through calculations (Refer to certain Easy Composites SMC video)

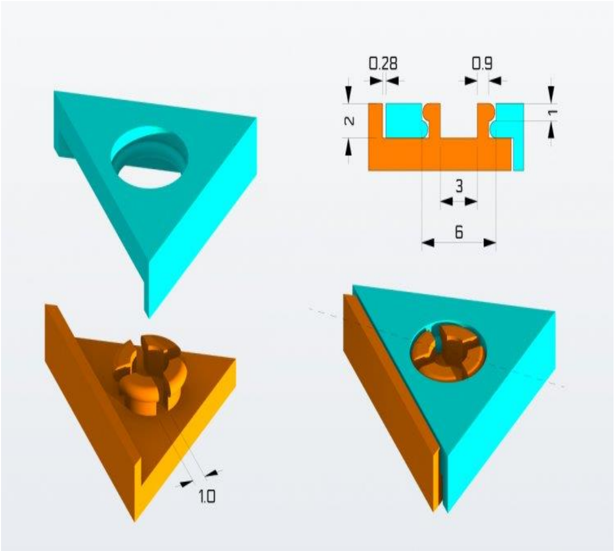
Closeouts

Description:

- Floor, under steering rack, interior and exterior, bell cranks have them too, look as

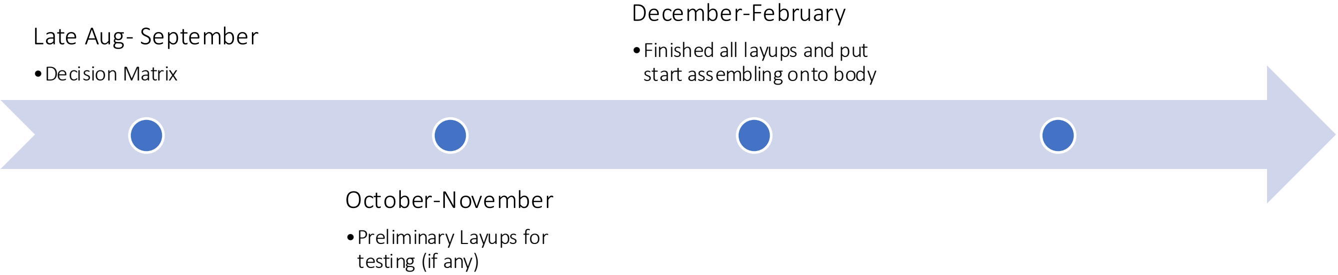
Changes/Areas of Focus:

- **Manufacturing**- Stronger, more rigid, foam or honeycomb core material with resin infusion.
- **Mounting**- New Mounting Methodology, 3D printed clasp on frame, similar to Lego hands
- https://cloud.wikis.utexas.edu/wiki/spaces/LHRC/pages/422085134/6+26+25+Composites+Body+Summer+Brainstorming
- **Ply Orientation:** 00 - 2ply



Important Considerations:

- **Timeline**-



Research Projects

Research Project Methodology

1. Idea
2. Constraints, Unknowns, Situations
3. Design, Model, Conceptualize
4. Simulate, Redesign, Optimize
5. Manufacturing: Machining, Printing, Layups
6. Testing: Mechanical, Fitment, Drive Day
7. Review, Reconsider, Reapproach
8. Finalize, Present to Leads
9. Manufacture for '26 Car

Priority Tag: 1- NEED to prove and produce, 2- Ideal but backups exist, 3- Essentially for fun

Culminated from all the input received about '25 car and recommendations for '26 car

Resin Infusion

General Description:

- Injecting resin-as opposed to lathering with a brush- into dry fiber for even epoxy distribution
- higher stiffness to weight ratio

Objectives of the project:

- The goal of testing resin infusion is to get familiar with the technique to then implement it on parts such as the undertray, bodywork, and front wing main.

Rough Timeline:

Mid-August

- Retrieve all supplies required for test layup (next slide)
- Prep any molds necessary for layup

Late august

- Perform layup on front wing using fiberglass mold from last season
- Also perform side by side layups of pre-preg, resin infusion, and wet layup
- Compare material quality of resin infusion with that of pre-preg as well as wet-layup (tensile testing, 3pb)
- Decide whether or not it's a viable option going forward

September

- Start manufacturing front wing for this season, mold manufacturing

Resin Infusion Needed Supplies

Quantity	Part	Cost	Link
1	Resin Catch Pot	$80	• EZ Composites • Amazon
1	Line Clamp	$5	• EZ Composites • Amazon
2	Silicon Connector	$8	• EZ Composites
2	Infusion Mesh	$24	• EZ Composites • Amazon
2	Feed Spiral	$7	• EZ Composites
1	Vacuum Hose	$15	• Amazon • EZ Composites
1	Infusion Epoxy	$80	• Rockwest • EZ Composites
Total		$219	
1	Resin Infusion Kit	$145	• https://www.easycomposites.co.uk/resin-infusion-starter-kit

Bucket Seat

Priority 3

- Making a bucket seat to be potentially reused every year
- Order of Operations
  - Work with Body and Ergo for Decision Matrix
  - Dependencies- Driver
  - Cutoff date/step – Complete by end of Fall
- Logistics
  - 1 new member from Body working with 1 new member from Composites

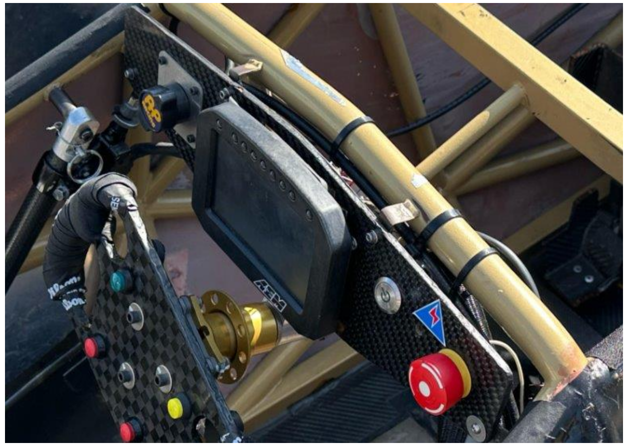
Dash/Gauge Cluster

Priority 2

- General description: In 2026, we're transitioning from **last year's hose-clamped** switches and display setup to a **fully integrated carbon fiber dashboard**. This upgrade aims to improve system organization, aesthetics, and driver usability by housing all key driver interfaces (AEM dash, switches, e-stop, key, brake bias) on a single clean panel.

- Objectives of the project:
  - **Eliminate** the **messy** and unprofessional look of last year's dashboard setup.
  - Provide a **rigid, ergonomic mount** for driver controls and display.
  - **Improve driver experience** with cleaner presentation and easier access.
  - Integrate all relevant electronics (DAQ, ECU access, display, switches) into one accessible area.
  - **Reduce risk** of twisting/failure due to unsecured components.

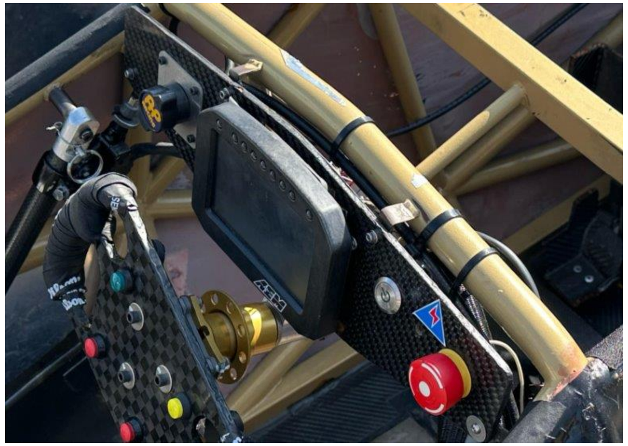
- Order of Operations
  - Finalize **Ergo fit** with jig or past frame data (ensure knee clearance).
  - Confirm **electronic component layout** and port access (DAQ, ECU, etc.).
  - **Design** 2D **CAD** profile of carbon fiber dash plate.
  - Source or **fabricate** the carbon fiber **panel** (in-house layup or outsource).
  - **Mount components** (AEM dash, switches, brake bias, e-stop, key).
  - **Install** into chassis before Powered Run.



Dash/Gauge Cluster

- Dependencies
  - Ergo: Provide **driver seating position** and clearance data.
  - Electronics: **Finalize AEM dash**, switch locations, DAQ/ECU port access.
  - Chassis: **Mounting locations** on frame must be confirmed.
  - ~1 week of design and fabrication time (outsourced or in-house layup).

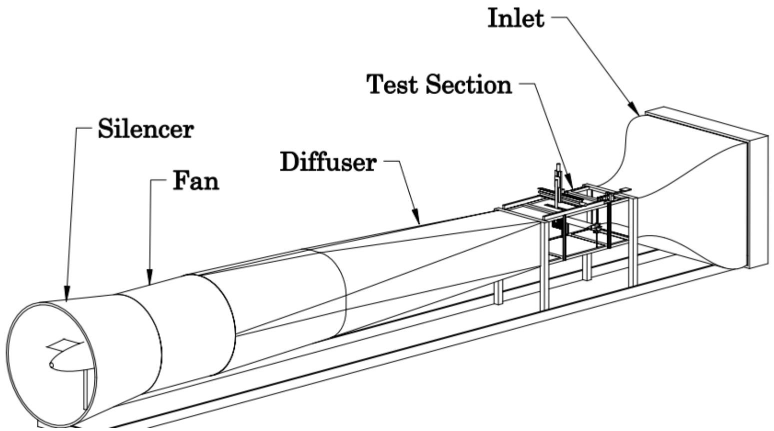
- Logistics
  - People Needed: **1–2 team members.**
  - Facilities: Access to **CAD** software, **composite layup** tools.
  - Special Equipment: Vacuum bag setup if laying up in-house; hole saw, drill, and mounting hardware for assembly.
  - Permissions/Circumstances: None unusual—must be coordinated with subsystems and scheduled to **finish by Powered Run**.

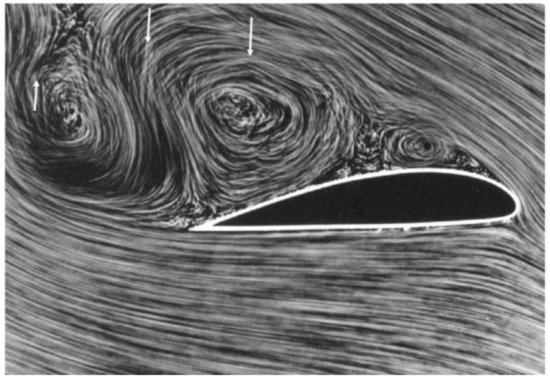


Aerodynamics Validation

- Overview/Dependencies
  - Work with aerodynamics to test deformation of airfoils made up of different ply counts and orientations
  - Utilize visual displacement method- track displacement of a marked spot (stickers) with camera recording
  - Must be done early (first semester) to get good ply counts for future layups

- Logistics
  - People Needed: 1–2 team members from both Aerodynamics and Composites
  - Equipment: wind tunnel, pitot-static pressure tubes, composite layup tools, high-speed high- resolution cameras, image processing software to convert pixel movement to length measurements.
  - Permissions/Circumstances: various facilities (?) for wind tunnel testing





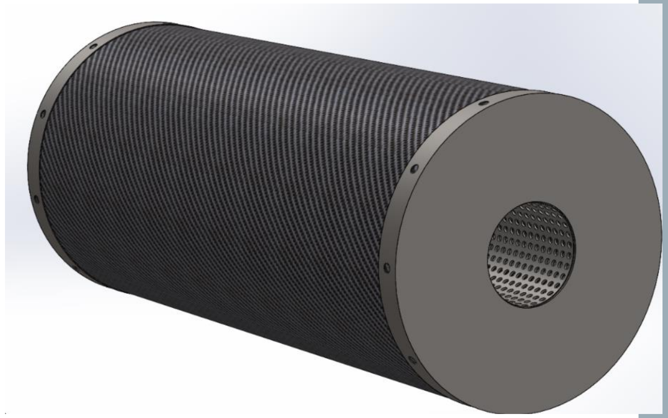
https://ntrs.nasa.gov/api/citations/20050050929/downloads/20050050929.pdf

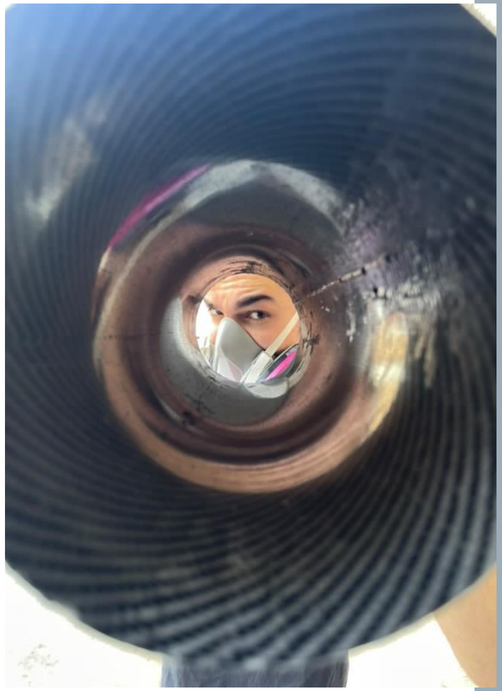
Optimized Cutting Jig, Dhruv, Ameya

- Freshman Project with lots of help from senior members!
- Utilize potential tile saw with Diamond cutting blade
- Exact Dimensions and Airfoils- 3D Printed profile ->
- Order of Operations
  - Decision Matrix on jig and cutting solutions
  - Dependencies- Aero Package
  - Cutoff date/step – Winter
- Logistics
  - 1 New member working with senior members

- Mockup of Airfoils with constrained base

Carbon Fiber Muffler Housing





Description/Purpose:

- A lightweight muffler that maintains structural integrity and heat resistance, contributing to overall performance and clean system packaging.

Overview/Changes:

- **Layup Processes:**
  - Prepreg –
- **Manufacturing:**
  - Roll Wrapping over a 5-inch metal mandrel
  - Split mold – Alternative if muffler is non-circular
- **Sizing:** Dimensions will be constrained to powertrains exhaust decisions.
- **Mounting:** May need to create CF pucks with holes inside in order to converge to smaller exhaust port tubing.

Important Considerations:

- **Decisions:** Will we have one on this year's car? -Probably not... Shape will determine manufacturing technique used. Acoustics.. Better at cutting out frequencies.
- **Last year Feedback:** N/A
- **Resources:** Metal Tube, Prepreg CF or Dry CF, (Basics: Mold release (Miracle Gloss?),Resin (If wet-layup),Vac Bag, Peel Ply, Breather, Vacuum Pump, Sanding paper (Mold Preparation or Post-Process surface finishing), clearcoat, New foam core.

Half Shafts- Johnny

Priority 2

- Replacing Steel Drive Half Shafts with CF
- Order of Operations
    - The Idea is we would be using the weldable spline from Taylor shave off a .001 of material with the lathe to meet our bond line expectations of .006-.007 in. The reason for this is because we are taking the same manufacturing process as the carbon fiber control arms, where we have a insert that goes into a carbon tube and we inject epoxy from two pre drill holes in the carbon
    - Based on the 4 splines and carbon tube the estimated weight is roughly 1.82lb

  •**Forces that we know** Nominal shaft torque; 419N.mCrank torque 65N.m we still need Brake torque and environmental conditions around the shaft

  •The Idea is to first experiment the possibility by using raccoon to for extreme torture testing. Then move to finalization for future cars

  - Cutoff date/step – January
- Dependencies; we would be working closely to powertrain to get as much data/ numbers to account for while doing trial runs
- Logistics
  - 2 extra people including myself to work on this project
  - We will have to make a jig in the garage to test for torsional failure for epoxy, and if possible tensile testing
  - Will reach out to Ben Hoff from Electric about this slide as well

Logistics

General Resource Costs

Quantity	Part	Cost	Link
1	Roll of Pre-preg	$3,000	• Rockwest- Mako CF Plain Weave • Rockwest- 250F T300 Twill • Hexcel- M77 CF Prepreg
1	Roll of Twill Weave	$2,000	• https://www.rockwestcomposites.com/on/demandware.static/-/Sites-rwc-master-catalog/default/dwffe40bab/wysiwyg/T300DataSheet_1.pdf
2	Extra Slow Hardener	$200	• https://www.rockwestcomposites.com/209-sa.html
2	Fast Hardener	$140	• https://www.rockwestcomposites.com/205-b.html
2	Base Epoxy	$200	• https://www.rockwestcomposites.com/105-a.html
1	Miscellaneous Mixing Supplies	$30	• Mixing Buckets • Mixing Sticks
1	Miscellaneous Adhesives	$60	• JB Weld Panel Bonder • Gorilla Two-Part Epoxy
9	Respirators	$180	• Respirators
1	Mold Prepping Agents	$200	• Partial Paste Wax • PVA • Duratec Polyester Primer
Total		$6010	

Recruitment

Potential Number of Members Recruited: 5 (some knowledge in CAD, interest in material science, okay with manual labor)

Breakdown: 2-3 for both aerodynamics and system integration