

Why does composites exist

Thursday, May 22, 2025

8:33 PM

The Good

- Strength: Weight over typical engineering materials such as steel and aluminum
 - Imagine the aero replaced with aluminum
- Shave weight where not needed such as boxes and low stress items
- Flexibility with material choice
- Carbon = Stiff, FG = Strong

The Bad

- Cannot reasonably predict when it will fail sometimes
 - Bad for high stress components like A-Arms or Pushrods
 - Shit just fails sometimes when not done correctly
- Math is AIDS
- It's dirty
- It's expensive

How does this help the team achieve its car related goals

- Reduce weight while keeping things strong (Hopefully)

How should I manage composites projects. (Design and Fabrication)

High Impact-Med Effort = 3/4-1 season. I.e: Aero Package

Low Impact-High Effort = Considered but justify why you didn't.

High Impact-High Effort = 1 season, preferably managed by someone not in Day-Day affairs of the team. I.e: Monocoque, Composite Accumulator

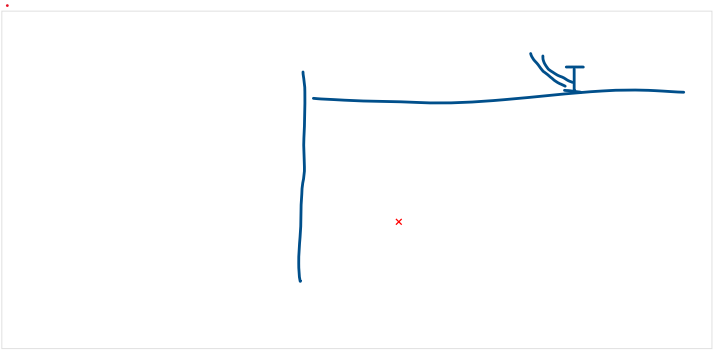
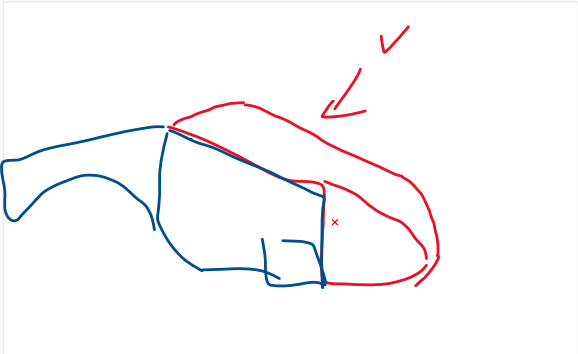
Low impact - Med Effort = 1/2 Season. I.e: Composite Boxes, miscellaneous panels

Agenda:

Meeting Time: 7/9/25, 6-8

- Future Leadership Discussion (30 min)
 - Reach resolution from the board meeting
 - Composites only Preferred
- KS8 Debrief (Tentative; 30 min)
- Proposed Architecture (5 min)
- Aero's Items (30 min)
- Member Dump and discussion (1 hour)
- Hand out tasks (10 min)

- Aero's Items:
- What molds are for sure good to re-use?
 - Bad
 - FW Mainplane
 - Element 3
 - What supplies and materials do we need for a full pack?
 - Wet layup again?
 - Talk about structures design



Meeting Notes

Wednesday, July 9, 2025 6:20 PM

- Weekly Meetings no matter what
 - Find something to talk about
 - Plan availability per week
- Revise Labs for new members
- Drop lead if not present for whole season

KS8 Debrief

- People management issue bc did not feel like there was enough to hand out
- UT installation sucks
- FG Sidepanels for EV
 - Aircraft Fabric
- New mold process
 - Fiberglass molds are good
 - Introduce 3D printed Molds for prep ease
- Rib alignment was really nice to have and install
- Endplate routing was a success
 - Talk with Arch about machining on 5 axis for trimming parts
 - Delta for tools
 - Epoxy for flat edges
 - Look at different ways, no more tape.
 - Look at Min radius rules and such
- Updates prior to workday helpful
- Wish we could get money sooner
 - Felt like we could start earlier but we were bound by when we get access to our money
- Mold tolerancing emphasis.
- Introduction of Resin infusion for higher quality parts
 - Calculate cost difference between Wet Layup v. Infusion
- Design lead POV
 - Design event
 - Get asked why things are composite?
 - Have data and testing to reinforce

Architecture Notes

- Composites isn't a design group
 - "Advisory" Group more than anything
- Things we have been asked for
 - Testing to supplement

Aero Notes

- Seth will be gone September to Spring
 - Will not check out and help as much as he can

- 9/8 Design Deadline
- Aero has all the outsides
- Comp had the insides
- Design theoretical structure prior to design
 - Data, Calcs, etc
 - ARCT Help?
- Composites free reign until there is a change to the aero design
- Whole Aero Package
 - 3-2 Element RW
 - SAME Size front wing with less elements
 - UT Between the wheels, maybe a diffuser
- Simplicity and Quality

Action Items

- Material Calculation (David)
- Beginning Structure Design (Everyone)
- Vacuum Pumps (Alexander and Tyler)
 - Resin Infusion Items
 - Cost
 - Compare against Wet Layup
- Chematix Items (Whenever we get a chance)

CMP's Season Architecture

Monday, July 7, 2025 10:14 PM

Philosophy: "Everything but the Kitchen Sink"

Reduce weight around the Whole Vehicle through replacing low-medium impact components with composite components and build on improved processes for lower weight and increased reliability.

Spitball:

Carbon Toe Rods
LV Box Replacements
Composite Swan Neck
Wing Structure
Footwell covers
Composite Steering Rack
Seat insert(s) Assist
Aero Package
Bodywork
Adhesive Research
Tooling Research
Process Research

Risk Breakdown:

High Risk

- Steering Rack
 - Med effort
- Carbon Toe Rods
 - Med Effort

High Risk: Items that will put the driver/vehicle in danger. Done by someone confident in their engineering design and manufacturing skills and some type of verification in manufacturing

Med Risk

- Swan Neck
 - Med-High Effort
- Aero Package
 - High Effort
- Body Work
 - High Effort

Med Risk: Items that when broken may cause a risk to the driver/vehicle. Ideally done by someone who has experienced the Composites process and understands the impact of the part

Low Risk

- Wing Structure
 - Low Effort
- Footwell Covers
 - Low Effort
- Seat Insert Assist
 - Low Effort
- Research Items

Low risk: Items that will not cause another part failure or put the driver in risk if it were to fail. Items that do not need a lot of knowledge to pursue. Ideal for a someone new to the composites process.

Timeline items:

- Internal Drop Dead
 - 1 week before vehicle drop dead
- Timeline alarm
 - 3 weeks before drop dead and not at least started manufacturing
 - Need more people to do small tasks? Need to talk to board? Need to order something?
- Design deadline
 - With the teams design deadline
 - Nothing above Low Risk gets done without PP
- Ordering deadline
 - Order general items as soon as we get money access.
 - Have specialty items ready to order

Member Dump

Tuesday, July 8, 2025 8:37 PM

Seth on CMP Architecture

- Composites is a manufacturing group, not a design group.
- Looking at things like LV boxes, footwell covers, steering rack/toe rod material changes as composite design projects is nuking the scope of members of composites.
- Members of composites should seek projects in other subgroups, maybe projects that would most likely use carbon, and design that, then return to help manufacture.
 - Members/Lead could also provide advice on design for carbon fiber
- Bottom line: Don't separate everything carbon fiber into its own group.
 - For example: Footwell covers. Yes it's needed, but an ergo member should design this and not hand it off for a composites member to do cause "that's their thing".
 - Instead, think of going into a design group and doing a design, then manufacturing it in composites later. For example: Aero Structures. You design the internal structure, doing hand analysis, maybe FEA, and lost of good CAD work. Then you take that and manufacture your design which just happens to be a composite material
- The point is, I think that every composite member shouldn't look at the car and say what can I make that's a composite part, but instead looks at bigger design projects that may or may not be a composite part and putting effort there
- I am saying this because I have heard that most composites members feel like they haven't gotten to do real design, which I have also heard from members in manufacturing.
- There obviously still needs to be a wealth of knowledge retained in composites, and someone or a group need to maintain the workspace and workflow, but I think that instead of increasing scope of what composites is to try and get more design work, I think composite members should transition to other groups before manufacturing season and then transition back at the end. That is, if they want to do more design work and not just various composite tasks
- **I apologize if this rubs anyone the wrong way.**

Composites Lab info

Monday, July 7, 2025 8:19 PM

[Composites Information.xlsx](#)

From <https://kennesawedu.sharepoint.com/sites/Team-KS6-C/_layouts/15/sharedialog.aspx?crossdomain=true&migratedhosting=true&clientId=excel&clickTime=1751934778996&sharingCorrelationId=6E08791C-1E1F-47E3-9B6B-7C5FFA035725>

All composites information from 2024-202x is located here

The Freezer

Monday, July 7, 2025 7:59 PM

Inventory:

Syensqo / Solvay Fiberglass Pre-Preg: ~12 rolls

Pre-preg CF: Not sure, maybe 4 small rolls and a bunch of scraps
3 indiscriminate tin bottles (Frekote? iirc)

Freezer Maintenance:

- If it is not getting cold, please dust off the radiator looking thing that is located on the top and the left of the unit
 - Add pic here
- Every 3 months the ice buildup should be cleared to prevent leakage into room with breakers to the whole building right behind it
 - A drain should be added to the unit at some point.
 - To do a drain, Locate the nipple to the left of the refrigeration unit located inside the unit. Add a threaded insert to make connection and add copper tubing to the system like an AC unit. Solder or crimp can work, dealers choice. The copper line is then taken outside into a drain/bucket. The walls of the unit are simply insulation foam, simply drill hole as close to the diameter to the tubing and fill in the hole. Tada
- Put a wet rag to it every once in a while to get it clean.
 - Should probably strip and Paint

8/18/25

Monday, August 18, 2025 6:01 PM

KS8

Monday, August 18, 2025 6:00 PM

24-25 Wants and Needs

Tuesday, June 25, 2024 6:28 PM

Topics:

- Projects
 - What projects do you want to do?
- Summer testing/Research
 - What testing and research do you want to do?
- Final Project
 - What projects do you want to do?
- TODO
- How can we do better going forward?
- What changes are going to happen this year?

Dump:

- James
- Improving the shop for next season (permanent/quick setups for PVA and such)
 - More consistent worktimes/meetings
 - Maybe a shop camera 24/7 for timelapses and security

Matt

- how to better keep the space clean during layups.
- if there will be other teams using the space we need to find a way to keep our stuff separate/ organized. (perhaps sign in sheet for other teams)
- Not killing members through their circadian rethemes
- Make Ehs leave us alone
- new member friendly

Grayson:

Testing:

- Pushrod MTS testing
 - Compression
 - Tensile
 - 3 point bend
 - Torsion
- Carbon Sample
 - Compression
 - Tensile
 - 3 point bend
 - Torsion
- Carbon Electrical Testing
 - Grounding
- Intake Deflection Data
 - Apparently we already have this

Research:

- Dissolvable Molds
- Heat resistant Molds
- Multi-Piece Molds
- Compression Molds
- Grounding
- Carbon Structural Testing
- Adhesives Properties
- Material Properties
- Fabrication Processes

Projects:

- Body
- Raised Dash
- Carbon Steering Wheel
- Raised Floorpans
- Wing structures
- Carbon Suspension
- Seat integration with firewall
- Engine cover/Engine cooling solutions
- Intake
- Gas & Brake Pedals
- Cockpit internal covers
- Carbon PW/RW Mounting
- Carbon Grounding
- MATLAB Composites Structure Analysis
- Detachable Side Wings
- Quick Assembly Wings
- Closed Edge Endplates
- Carbon Edge Cut Resistance
- Low Sitting Carbon Scraping Solutions
- Shop Layout

How can we do better?:

- Organization of the shop
 - Biweekly/Weekly Cleaning
 - Clean/Dirty room
- Scheduling
 - Consistent
 - Plan a day ahead
 - All-nighters NO
 - minimized
- Safety???
- Inventory
 - Binder?
 - Online Excel?
 - Ply schedules?
 - Easier with organization
 - SDS Sheets
- Communication
 - Keep main up to date
 - O to Q
 - 2 slides at main...lol
 - Pictures
 - Details
 - Plans
 - Testing
 - Set meeting dates
 - Have everyone input that
 - Aero and composites meeting
- Progress Log
 - Notebook/Binder
 - in one spot
- Shared Excel**
 - OneNote?
 - Put note on door that says to update it
 - Put together before fabrication season
- Computer in composites
- Maybe use the TV for something like a countdown, schedule, etc...

Research/Processes:

- Resin Infusion
- Prepreg
- Compression Molds
- In-laid Aluminum/3d print
 - Complex cores
- 3D-print materials
- Mold materials
- Core materials
- Filament Winder
- Adhesive Research
 - Physical Testing
- Matrix Research
- Grounding
- MATLAB Carbon Analysis
- Fibersin
- Sample Testing
- Machining Tolerance
 - Prep Time
 - Quality of part

Maintenance:

- Maintenance Schedule
- Air compressor
- Vacuum Pumps
- Extension Cords
- Air hoses
- Vacuum Press
- Sealable tables

Projects:

- Body
 - Aero Based
 - Collab
 - Whiskers
 - Side bodies = Composites maybe
- Raised Dash
 - Seth??? Sad he said no
- Carbon Steering Wheel
 - Britton & Grayson
 - Learn Scary MATH
- Raised Floorpans
 - Newbie
- Wing structures
 - Grayson
- Carbon Suspension
 - Matt
 - Talk to Sammy on doing some correlation to shock pot data
- Seat integration with firewall
 - Bray, Emil, Grayson, Anelia, Matt
- Engine cover/Engine cooling solutions
 - Britton
 - Research
 - Aero-Based
- Intake
 - Any log has pressure
 - Might find one with explosion
- Gas & Brake Pedals
 - Bray and Grayson or David
- Cockpit internal covers
 - Newbie
- Carbon PW/RW Mounting
 - Matt
- Carbon Grounding
 - TI PLEASE!!!
- MATLAB Composites Structure Analysis
 - Grayson, Britton, Anelia
- Detachable Side Wings
 - David
- Quick Assembly Wings
 - Britton
- Closed Edge Endplates
 - Grayson
- Carbon Edge Cut Resistance
 - Newbie
- Low Sitting Carbon Scraping Solutions
 - Matt
- Shop Layout
 - Anelia
- Multi Piece Undertray?
 - Aero Based
- Flat Bottom Car???
- Strakes???

24-25

Friday, August 2, 2024

7:11 PM

Projects:

-Body

- Aero Based
- Collab
- Whiskers
- Side bodies = Composites maybe

-Raised Dash

- Seth??? Sad he said no

-Carbon Steering Wheel

- Britton & Grayson
- Learn Scary MATH

-Raised Floorpans

- Newbie

-Wing structures

- Grayson

-Carbon Suspension

- Matt
- Talk to Sammy on doing some correlation to shock pot data

-Seat integration with firewall

- Bray, Emil, Grayson, Anelia, Matt

-Engine cover/Engine cooling solutions

- Britton
- Research
- Aero-Based

-Intake

- Any log has pressure
- Might find one with explosion

-Gas & Brake Pedals

- Bray and Grayson or David

-Cockpit internal covers

- Newbie

-Carbon FW/RW Mounting

- Matt

-Carbon Grounding

- TJ PLEASE!!!

-MATLAB Composites Structure Analysis

- Grayson, Britton, Anelia

-Detachable Side Wings

- David

-Quick Assembly Wings

- Britton

-Closed Edge Endplates

- Grayson

-Carbon Edge Cut Resistance

- Newbie

-Low Sitting Carbon Scraping Solutions

- Matt

-Shop Layout

Body Status

- Anelia
- Multi Piece Undertray?
- Aero Based
- Flat Bottom Car???
- Strakes???

Meeting notes 8/15

Thursday, August 15, 2024 6:11 PM

Potential Design

- **Wing Structures (D)**
 - David wants
- **Carbon Grounding but actually ground it this time**
 - Yes, its not that hard
 - Convince TJ to do again
- **MATLAB Analysis**
 - Status: Playing Around
 - Hopefully Grayson is doing it
- Detachable SW
 - Maybe Maybe not
- Closed Edge Endplate
 - Get rid of tape and rope
 - Britton
- Endplate Structure
 - Aero Collab possibly/Matt
- Rib Design
 - Internal structure Creep
 - David/ James /Garret
- Vac Pump Repair
 - Britton will work on own time
- Carbon Alum bonding
 - James/Alexander
 - Desing prop needed
- CNC Trimming/interactions

8/22/24 Aero Design Meeting

Thursday, August 22, 2024 5:13 PM

Notes and questions

DRS

- Rib Design
 - ~~How does this affect it~~
 - Can it be assimilated with Garretts Stuff
 - Perchance Garrett can put input on this
 - Must fit in the aero box
 - Flap 1,2,3 Changes
 - Trailing-Edge hole closer to center
 - "Triangulation" hole on mainplane; between Leading and trailing hole
 - 2 rib designs
 - ◆ DRS
 - ◆ Standard Rib
 - Linkages mounted with shoulder bolts or bearings
- Endplate Structure
 - Need straight endplates this time
 - Increase Compressive Strength on mounting holes/areas
 - 3D Printed/Alum inserts or integrated/recessed into endplate

RW Mounting

- Strut mounting to endplate
 - Endplate structure
- THERE'S A DF AND DRAG DOC IN TEAMS

FW Mount

- Simming moment on fw
 - Since simming in the direction of the fibers, could be close

AOA Adjustment

- Adjustable wing placement
 - How does this interact with endplates

8/29 Aero notes

Friday, August 30, 2024 3:23 PM

RW Mounting

- Endplate mounting
 - Milled "L"/Insert with bent tab
 - More resources and harder to make
 - Look into endplate insert installation procedure
- CF "Swan Neck"
 - Don't necessarily need rod end, could machine piece to go between tabs
 - Need to test and solidify adhesive application to prevent pullout.
- Drag
 - If little to no impact, Why change?
 - CFD Lies
- CF Swan Neck Mentioned
- Budget
 - Carbon Tube
 - Alum inserts

Front Wing Mount

- Unrelated, need Marco to fill in holes in current mount
- Why not Tabs that go into a groove like Pedal Box
 - Fastening Issues

11/14/24

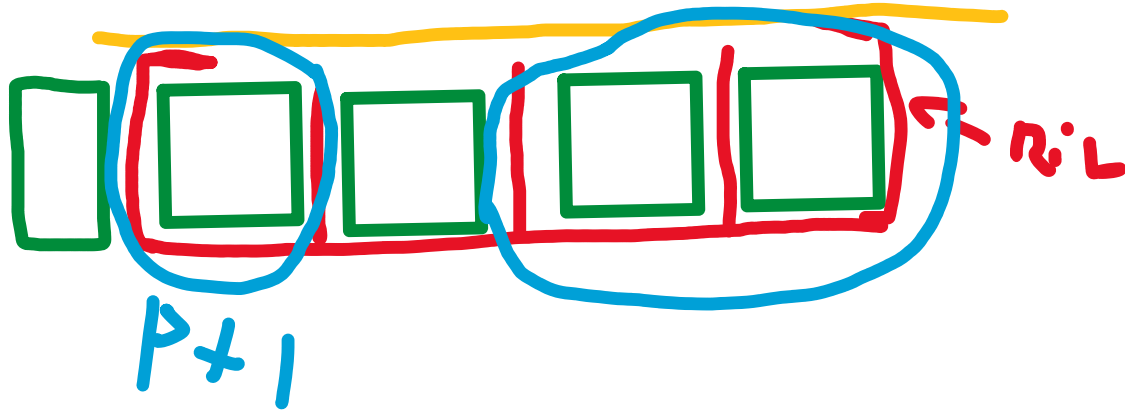
Thursday, November 14, 2024 7:01 PM

Spring 25 Fab season

- 4 endplates, 4 sidepanels
- Trim 7E RW .25"
- Get Aero done before car!

Things to do

- Rear wing trimming jig
 - o Britton



Research (End of fabrication into summer)

- PVA Molds
 - o Integrated ribs
 - Assigned to: Garret(if he wants),
- 3D Printed Mold Manufacturing Process
 - o Sandpaper expensive, consumables also
 - o Acetone misting for smoothing
 - o FOCUS ON PROCESS EFFICIENCIES!!!
 - Assigned to: Everyone/Newbies
- Filament Extruder
 - o Pretty expensive to buy
 - o Not bad to build
 - Assigned to: Alexander Jordan, Matt
- Andrews Carbon Suspension
 - o Dig up old senior design
 - Assigned to: David Olmo, James Moloney
- CF Intake
 - o Different Part, Different mold
 - o Dig up in drive
 - o PVA mold interaction?
 - Assigned to: Tyler Britton, James Moloney
- Cock (Pre-preg investigation)
 - o Test samples
 - MTS Data
 - Shear forces
 - o Infused coque v. preg coque
 - o Chassis development and learning

PLA in peel ply> test > Validate , PVA Pt1 >test> iterate > expand>Validate

All research to have a folder with documents and a "Report" summarizing.

Composites Alignment 10/2

Wednesday, October 2, 2024

7:04 PM

- Shop Update
 - Cleaned what we could
 - Materials are coated
 - Shower and Sink drain so that's goof
 - Email scarpi to say thank you
 - Look over zip vacs
 - Putting 3d printed jigs somewhere along with sink items
 - Take a look at mystery carbon
- Things to buy
 - Brushes for blanks
 - Bagging for blanks
 - Sandpaper
- Fabrication Update
 - New Side Panels
 - Baileys thing
 - New EV package
 - Resin:Fiber Calculation
 - TeXtreme Carbon Fiber Update
- Vibe Check Etc
 - They seem ok

I miss you guys :(

DO NOT DELETE ONLY STRIKETHROUGH (Ctrl + -)

☐ • Mold Prep on all current molds

- ~~Will be remaking EV Package, IC if time/budget allow~~
- Aero Still making plan

☐ • Reinforce 7E MP rib

- Done 8/16 - David
 - Needs Redesign so its not so jank
 - David to meet with Garret
- Delayed

☐ • Remake Flap 2(?) mold

- ~~Need Bagging for Blanks~~
- Possibly zip vac, maybe just weighed down

☒ • Resurface EV FW MP bottom mold

- ~~Abri Contacted, no response~~
- Abri saw, date tbd
 - Need CORRECT mold CAD
 - Need to sign into PDM on compooter
 - ~~How do I open the file now :skull:~~
- Attempted, failed due to layers debonding

☐ • Possibly layup winglets before Sep 9

- ~~Contingent on bagging~~
- Buying freeze
- Not Enough Time

☐ • Refresh class material, lab curriculum, and test

- Class 1 done
- Need ~~bondo, poly~~, gloves, and chip brushes for Labs

☒ • Spec Oven Dimensions for New building

- ~~For Scarpinato~~
- School to Spec

☒ • Spec Chest freezer new building

- ~~For Scarpinato~~
- School to Spec

☒ • \$ amount of material inside freezer

- For Scarpinato
- Working

☒ • Current 7E Aero trim and remake endplate

- ~~Get with Seth to redirect efforts~~
- ~~Contacted, answer next week~~
- No stock for ribs

☐ • Teach Marco and Seth emergency layup things

- Contacted

☐ • EV Aero Ready by 8/31

- Some holes may need to tapped
 - Holes tapped to 1/4-20
 - New Bolts Acquired
- Polishing wings
 - Flap 1 and 3 Complete

- Projected Week of 8/26
- Delayed

✓ • **Prep Composites kit for Pitt**

- ~~Asked Goons 8/23~~
- Assembled

Friday, April 25, 2025 8:20 PM

- Rib stabilizers
 - Overall good change, redo in the future
 - Print optimization to reduce weight
- Schedule changes would be better
 - More work sooner
 - Earlier times better
 - No more all nighters
- MDF > Foam Tooling
 - Foam and Fiberglass tooling superior
 - Is it cheaper?
- Shop/Process cleanliness
- Adhesion process changes
 - Seemed beneficial
- Knowledge Transfer and Member Retention (Kind of)
 - KS7 members stuck around, learned a lot and were autonomous
- CMP-Aero Communication improved
- Building management Communication
- Introduction of Chemical management
- Controlled our Volume Ratios

- **Timeline/Budget**
 - Underestimating budget to put project scope in check.
 - Early Ordering with previous year money
 - Semi 2 year Cycle
- **Member Retention**
 - No new KS8 CMP guys
 - Poor allocation of work
 - Lead gone for the fall/recruiting season
 - Classes and labs sucked balls
 - New Members join > School Picks Up > They Leave
 - Designate Workdays around peoples schedules
- **Labeling items in shop**
- **CAD/Structural Changes**
 - Reclarify Aero-CMP responsibilities
- **More "Standard Engineering" practice**
 - Sims, Calcs, etc
 - More design effort
 - Not necessarily PP, but a presentation regarding changes
- **Chemical Inventory**
 - Fire Cabinet is terrible
- **Shop junk**
 - How to dispose of big things
 - Big things Seat mold, UT, talk to school
- **Beware of design processes/ load**
 - How does work scale with more projects
- **Sponsors**
 - New and existing
 - Scraps, Consumables
 - Realistic Deliverables
- **CMP Design**
 - More involvement
-



Research

Sunday, January 19, 2025 4:14 PM

Garrett's Research

Sunday, January 19, 2025 4:15 PM

This can be moved at any time, just a big brain dump of total info, if you came for perfection, you will be disappointed

This is my research for composites starting Fall semester 2024. If clarification is needed send me something on discord Garrett Z on KSU formula SAE discord and main SAE discord

So lets start at the beginning. Aero super cool stuff but its hard to make exact stuff with tape measures and stuff because its kinda large. Then if Aero isn't manufactured as mega sim'ed over and over again, they don't have good representation and real world testing of their work (sad)

My own work started with the idea of 3d printing ribs which are the structures in an airfoil which are perpendicular to leading/trailing edge which are currently little metal aluminum parts within the wing to give it structure (in simple parts) (carbon holds shape and more but yeah)----->>> (image)

The original goal was to just remake these ribs in 3d prints, seen on right. These would be lower weight than the aluminum and be better for strength and stiffness. The main concerns within the project were 1) fatigue and shear systems As well as 2) bond strength

Image on the right is a meeting (after a aero meeting) with Seth and Nathan over this -->

This gave me a lot more feedback and learning opportunities within engineering because at this time I am a freshman (and at the time in over their head) so seeing how forces interact and push onto a part/system is super cool.

Fatigue is a much harder question to figure out because I am not good with the math yet And I do not know FEA (I need to learn)

What I can do much better in explaining is the bond systems from composites and I will This as simple as I can for people who have no idea what this is about

Okay, how strong a bond is within 2 parts is what is connected (area and material) and the adhesive With the KS7 this is from a piece of 1/8 in aluminum to resin the wing connected with Hysol

Hysol super strong, there's gonna be a link later to all of its numbers within strength and weight, for aluminum it has good surface energy after being cleaned but also kinda heavy.----->>>

So you look at this chart and be like oh Aluminum looks really good and it is but cleaning aluminum properly (chemically) is kinda hard and a art/ science, 3d printed materials also look really bad but that's where it gets fun

Edit: Properly etching/cleaning the aluminum has been an omitted step in our assembly process,

You can massively increase a surface area by roughing it up, as seen on grinding metal and more. But in the fact additive manufacturing acts as wood(in a sense) with a good sandpaper and cleaning can over double the surface energy So by doubling the thickness and roughing up the edges that are connected to the wing we can gain massive benefits and not add any weight if we lightweight the PETG properly (Bond strength=Surface area/failure load)

But if you remembered from the beginning of this section, what we bond to on the other side matters to which is resin, the part that will fail in this entire system first will be the Hysol-resin bond because of the material properties of resin (which we cannot really change)

This means the optimal way to reduce weight and not compromise on strength is get rid of the hysol and incorporate the PETG into the resin layup (incorporate structure into the layup)

Which now leads us into an another section

The layup process makes a good 2 piece airfoil, 2 pieces of an airfoil makes a bad leading edge and trailing edge which also double goofs aero (very sad) (Not necessarily, improperly assembled skins make a bad airfoil but it is a valid method given correct processes)

So in order to do both the incorporating PETG into the layup with resin, we now redo the way me wake layups, by making it a single layup, but now we get to the fun part of that.

By making a dissolvable system on the inside of the ribs we can make an entire layup using one piece of carbon fiber by reducing scraps and using a larger piece, which I have looked at a number of things from PVA (too expensive sadge) a project Britton worked on which is dissolvable salt molds(very cool but hard to manufacture in our scale (from my understanding) and the final bit. **GPS filament** [High Impact Polystyrene \(HIPS\) Dissolvable Filament - 1.75mm \(1kg\) | MatterHackers](#)

This is dissolved through citrus and works very well in tangent to ABS (which is decently similar to PETG (in my understanding))

So we 3d print a mold for the airfoils attached with ribs in a layup process that does everything

Issue is those would be 3d print really big ones that wouldn't fit on any printers

The fix, I make my own 3d printer with an inf z which is in the works as of today 1/19/25

I am gonna have to revisit this yap but here is a massive amount of links for parts and research

[Which LAYER HEIGHT gives you the STRONGEST 3D prints?](#)



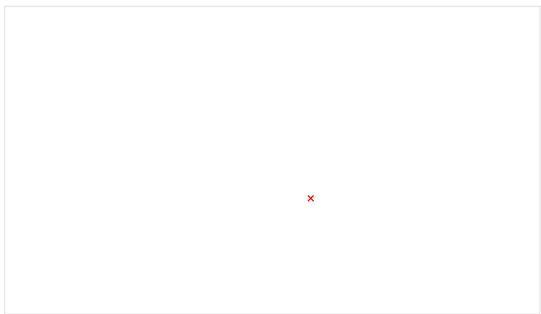
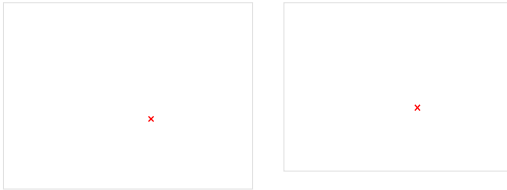
[The BEST 3D printing material? Comparing PLA, PETG & ASA \(ABS\) - feat. PRUSAMENT by Josef Prusa](#)



[Fatigue behaviour of FDM-3D printed polymers, polymeric composites and architected cellular materials - ScienceDirect](#)

[Young's Modulus, Tensile Strength and Yield Strength Values for some Materials](#)

[High Impact Polystyrene \(HIPS\) Dissolvable Filament - 1.75mm \(1kg\) | MatterHackers](#)

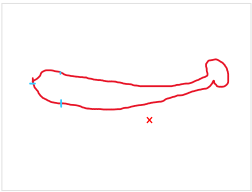


RW Trimming method, also my goober idea
If anything, using a CAD of our Aero element we can make a 3d printed jig that will hold one of our trimmers in the right spacing and distance. It would have some bearings in blue and a support guy on both sides with bearings to he can hold up, I can get a rough CAD but the hardest part will be proper alignment for the several 3d prints to connect

[Water Soluble Filament: Properties, How to Use, and Best Brands - 3D Insider](#)

[MechMaster Carr](#)

[Threaded Inserts in 3D Prints - How strong are they?](#)



Machining

Monday, July 7, 2025

7:55 PM

Onsrud Machining

Thursday, February 20, 2025 4:18 PM

CAM Settings

Adaptive to clear material

If staggered stock, set bottom height to lowest point of the staggered block

Tool: Foam 3/4" Ball End Mill

Min Cutting Radius: .075 in

Max Roughing Stepdown: 5 in

Fine roughing stepdown: .375in

Stock to leave: .02 in

Feed Rate: ~800 in/min (adjustable on machine)

Lead In/Out: .075

Copy and replace with this.

Delete all UIO and TCP commands

N120 G92Y(@YAXG92)

N125 G16XY

N130 G27

N135 G40

N140 G70

N145 G80

N150 G90

N155 G94

N160 G00 G79 Z(@ZPARKP1)

N165 G00 G79 A0. C0.

N170 (UAO,1)

N175 G70

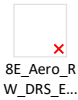
Reference for david pls ignore



CAM Master Router

Monday, March 31, 2025 7:56 AM

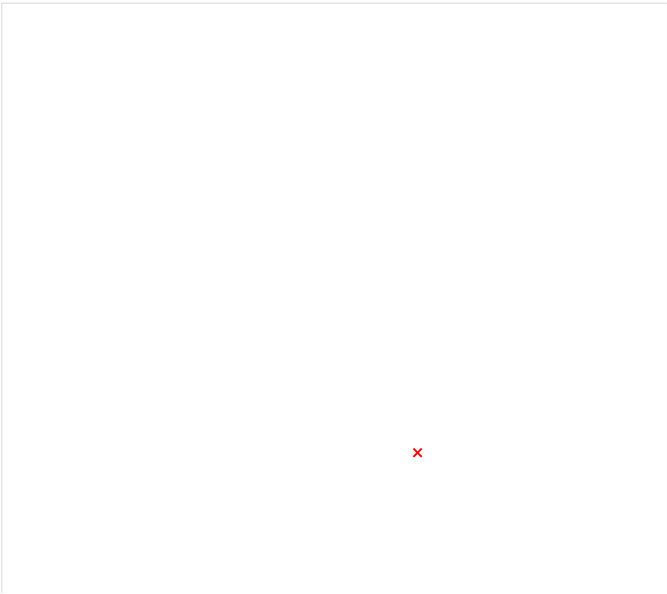
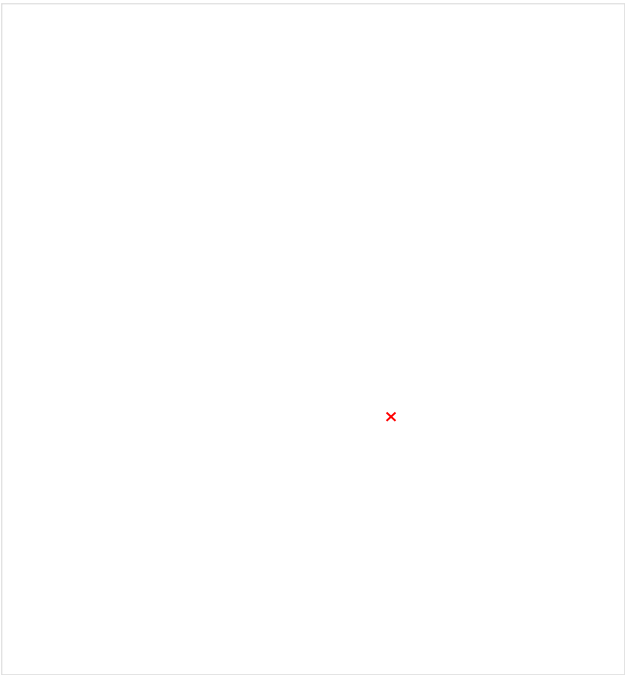
Post Processor for CAMaster Stinger



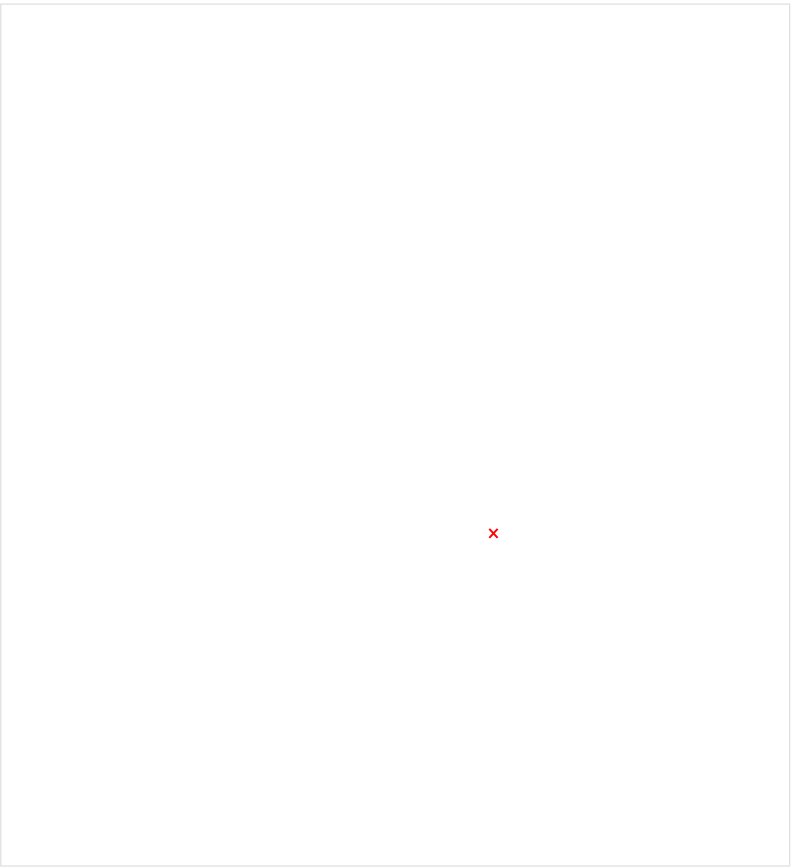
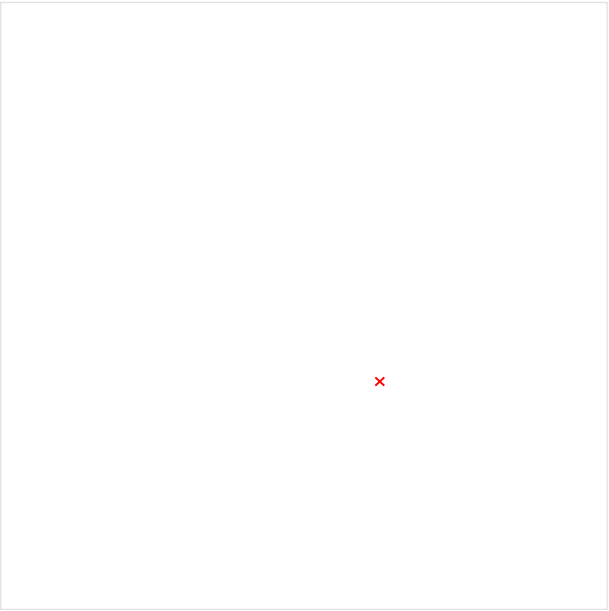
Current as of 3/31/25 (Seth's Revision)

Each operation is a separate file
Machine cannot do tool changes, will freak out if there are multiple tools in one program

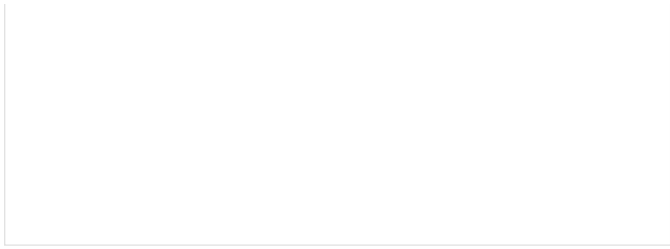
1/8" Diamond Cutter



3/8 End mill
Cutter



Cutting Data



Fabrication Process

Monday, July 7, 2025 7:57 PM

Everything needed to make a Composite part as efficiently as possible and the different methods to do it.

How to Clearcoat

Tuesday, May 27, 2025 8:02 PM

WHEN DELAING WITH CLEARCOAT SAFETY IS YOUR NUMBER ONE PRIORITY.

Please wear...

Particulate Mask

Safety Glasses

Long Sleeves

Pants Covering the legs

AT ALL TIMES OF WORK

PLEASE DO NOT BREATHE THIS IN

Instructions

- Prep your part
 - Get chunks out prior to doing anything
 - Bondo, Tooling material, excess resin, etc
 - Sand from 220 to 400 Dry
 - This is your time to eliminate high spots/rough areas
 - **Wet** sand 800-3000
 - These are you smoothing/polishing stages
 - Realistically you should not be spending too much time on either step.
 - Clean sandpaper is good sandpaper, don't waste time and energy with an old raggedy piece
- Clearcoat and hardener
 - Typically 1 gal and 1 qt cans
 - Using a mixing cup from the store, mix 4 parts CC to 1 part hardener (4:1)
 - No need for lacquer thinner or mineral spirits
 - Mix thoroughly
- Application
 - Apply in an area with little to no breeze
 - Supposedly it has been done inside composites with the garage slightly cracked open.
 - Do not spray during school operating hours or in view of cameras without full PPE
 - If spraying in a room, spray and then evacuate, do not return until an hour or so has passed, try not to unless you are respraying
 - Do not leave big vent on
 - Clean gun out with mineral spirits ensuring/verifying tip is spraying correctly
 - First coat is a "Flash Coat"
 - Adjust spray volume accordingly and apply a thin coat in a medium pace over the surface and allow dry for roughly 30 min
 - Second and so on
 - Increase spray volume by 1/2-3/4 revolution
 - Apply generously in a slow-medium pace, going along with all contours, filling all nooks

- and crannies
 - Allow 6 hours to dry
 - If you have excess in the container, pls dispose in the satellite waste container located in the corrosives cabinet.
 - **DO NOT POUR CHEMICALS DOWN THE SINK**
- Post-Processing
 - Buff and polish with a foam pad
 - Typically on a drill
 - Just like a car
 - David has used meguiars compound and polish, works like a charm
 - Wipe off excess and yer done

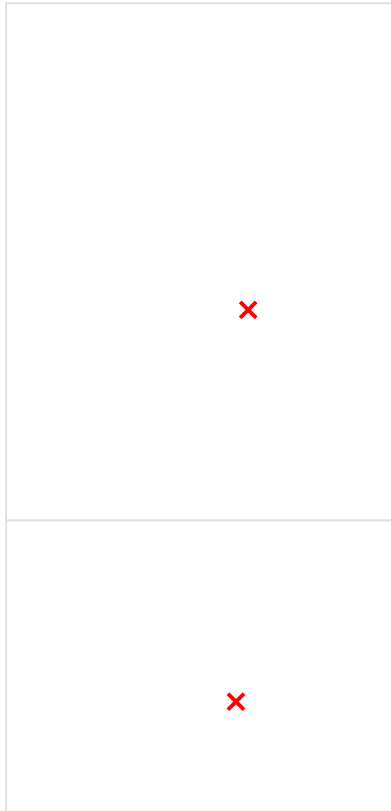
Composites Archive

Monday, August 19, 2024 1:28 PM

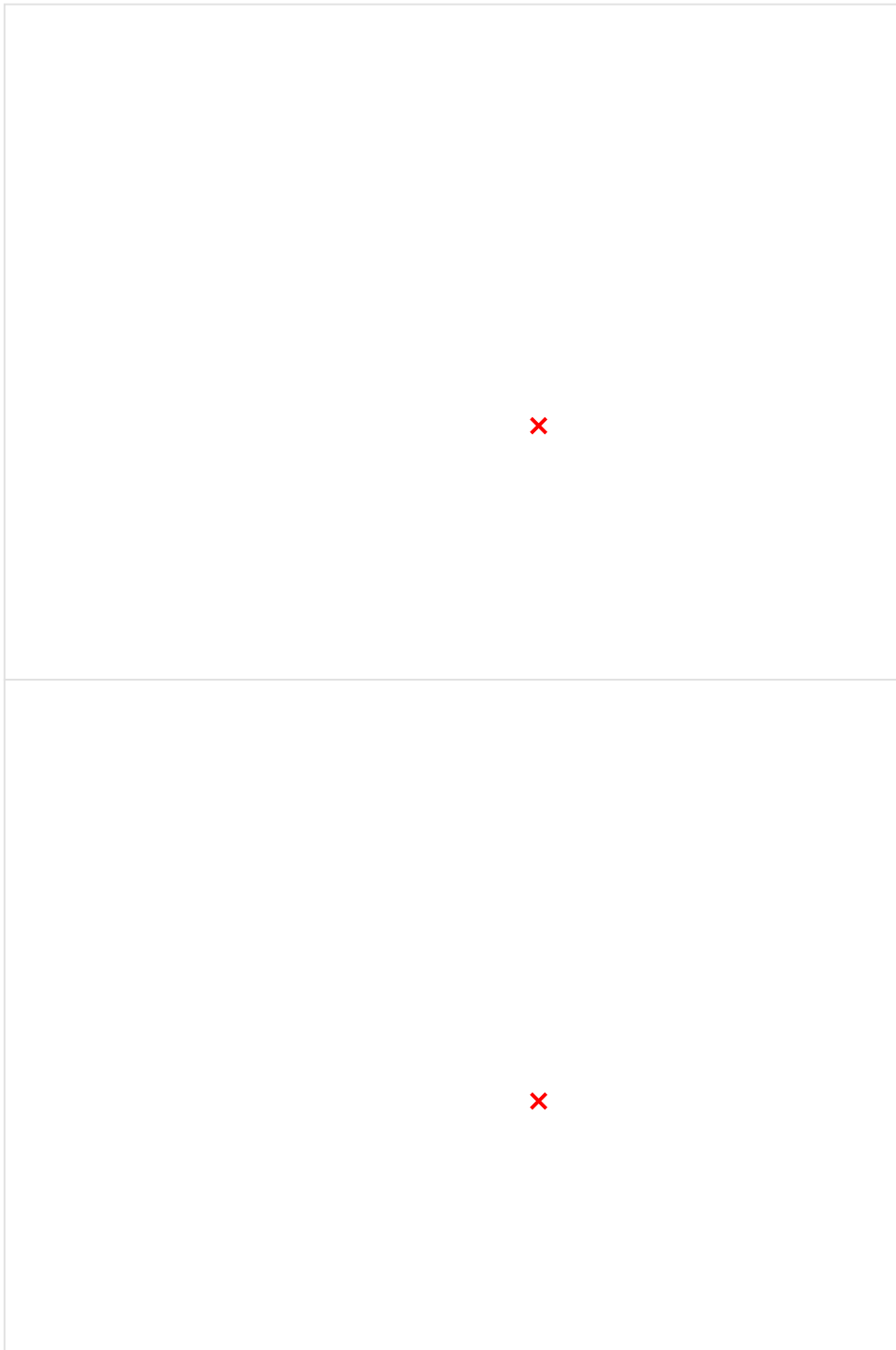
IC Package inspection

Wednesday, October 23, 2024

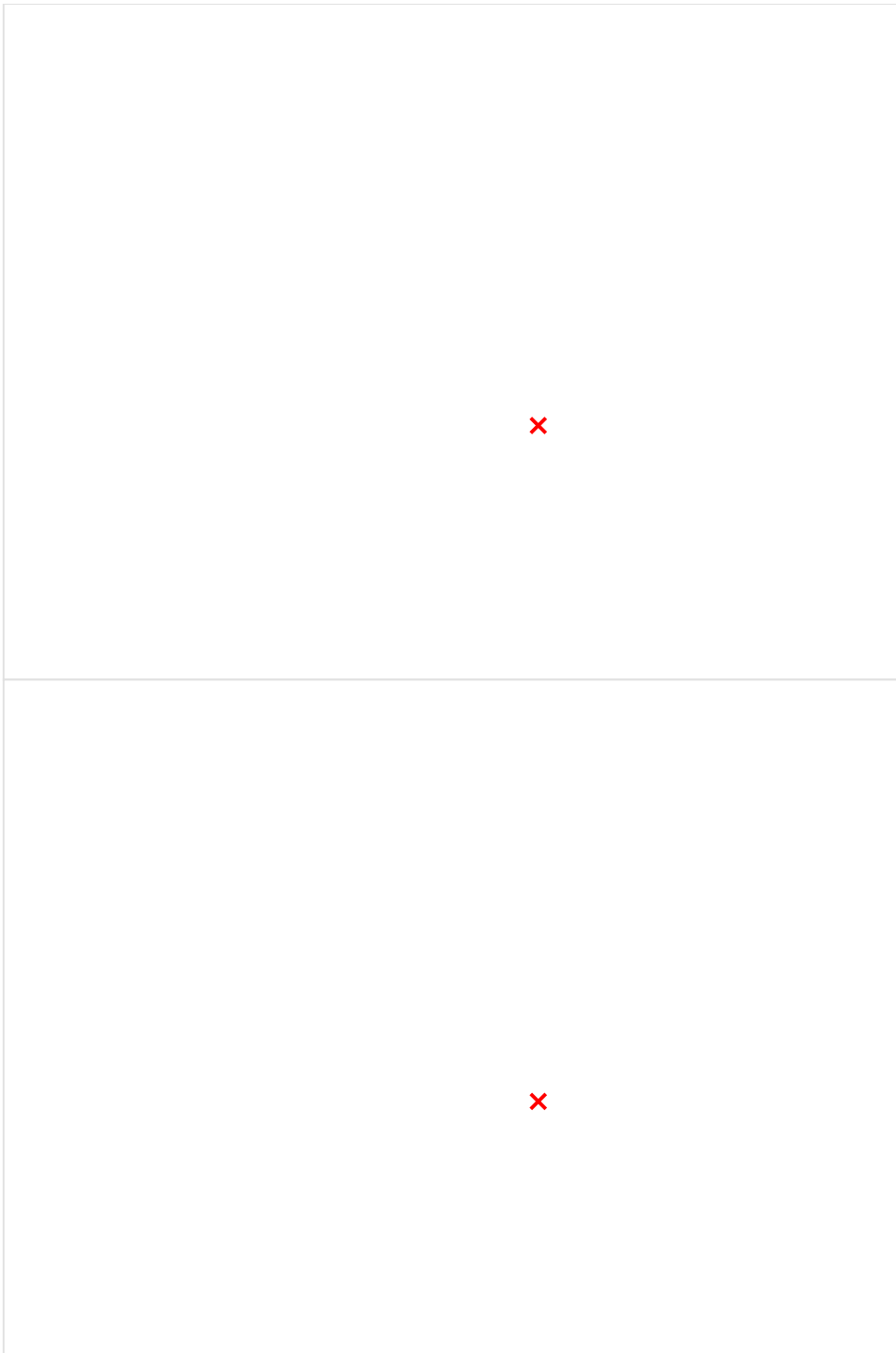
8:12 PM



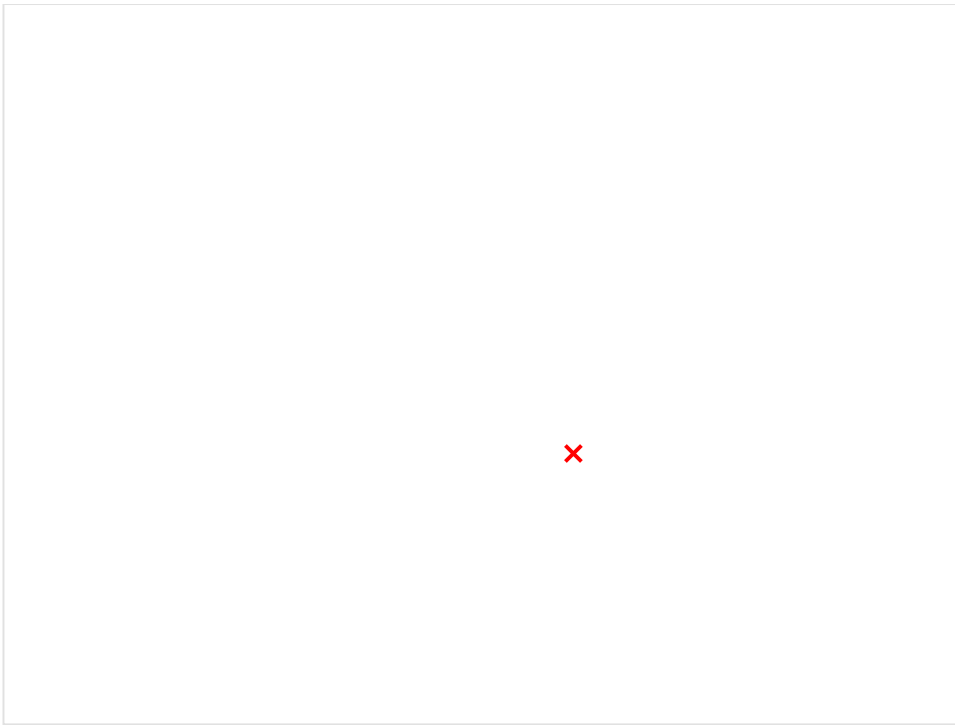
End plates for rear wing are debonded and the inner skin is damaged



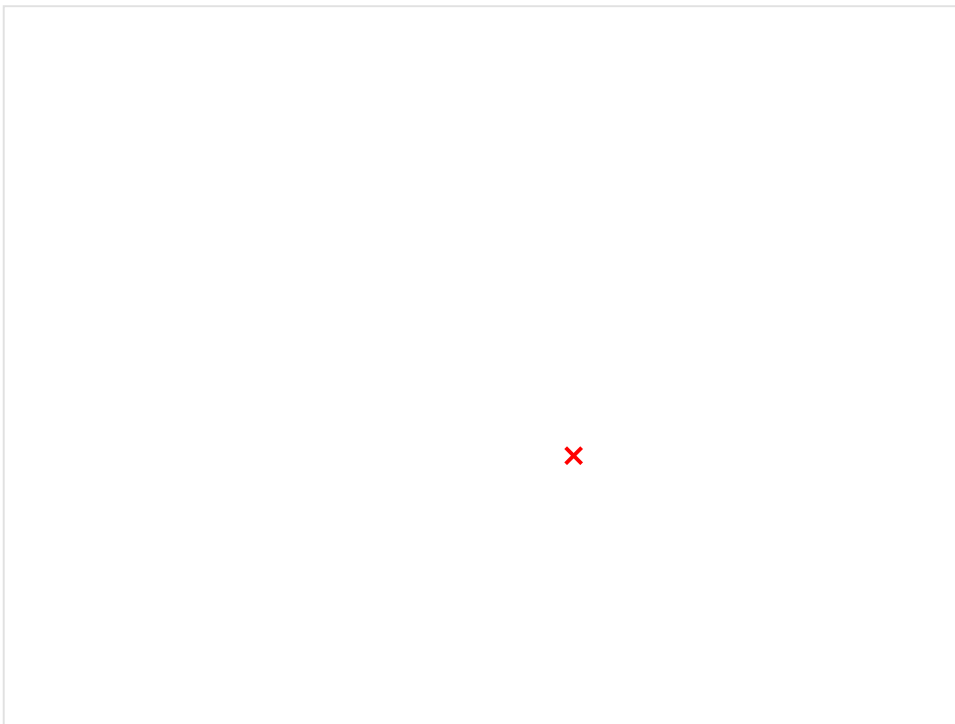
Rear wing mainplane skin can most likely be repaired with minor work (mainly sanding).



Front wing internal structure has multiple broken structural components (bottom pic is why mounting is not aligned)



Winglet rib debonded and bent. (we don't know how many are currently like this)



Front wing mainplane has one broken rib.

Mono Mansplain Manifesto - Nathan Fairlie 14 March 2024

Monday, January 08, 2024 4:41 PM

This document will serve the purpose of providing my opinion on guidance for if the team ever builds as monocoque as well as some pros and cons of different routes that can be taken.

Some of the original documentation (from my freshman year) is not great but it can be found in Teams under chassis > files > mono.

Some of the original data files for the testing can be found in Teams under Data Acquisition

Rule 1 for designing a monocoque: Don't be arrogant or in over your head. Being humble is the best way to avoid failure.

Coupon Testing/Jigs

When we first embarked on the project in 2020, the first thing we did was make A. the perimeter shear testing jig and B. the 3 point bend testing jig (we already had one so now we have two). I conceptualized but never built a seat-belt pullout testing jig. The design was to be adjustable as to change the angle that the bolt was pulled out as the geometry of this was uncertain. However, seatbelt pullout testing is not necessarily required as per rules if you connect the main hoop and front hoop with tubes on either side and weld the seatbelt mounting tabs to those. I might suggest purchasing a jig from another team if one is available.

The original perimeter shear testing seemed promising but we only tested 1 side (not a sandwich panel). After this, I made two 3-point bend samples and tested them. They were both comprised of .5" honeycomb, and varying skin thicknesses, layed up in one shot with adhesive sheet. All these original samples were pre-preg fabric. I am unsure on the exact fiber but I believe T300 3K PW or similar. In testing, one of these samples had a thinner delaminated and the other had a thicker skin and crushed the core. The thicker skinned-sample barely did not pass the required strength in the SES so the solution was to go to 1" honeycomb with the thicker skin. I am very confident that this one would pass. This sample was made but never tested due to constraints on being able to use the MTS lab.

Design Considerations

We originally set out to make a half-monocoque chassis for the IC car. The goal being that it would be cheap and simple to become a reality. The plan was to use expired fabric we had. We originally had no certainty on autoclave/oven time so one idea we had was to lay it up, freeze it under vacuum in the walk-in freezer we had acquired for \$100, then wait for autoclave/oven time. The idea was to do a uniform layup meaning one continuous ply schedule that would pass the strict rule for side-impact everywhere on the car. Based on my predictions, this conservative design would be within 4 lbs of one of our full-tube frames. (~ 60 lbs +/-4). This value was based off of the actual weight of a side impact 3-point bend sample that I thought would pass and the surface area of a working design. This design would likely be considerably stiffer than a tube frame though we never planned to do any simulation since we would be well-overbuilding it. One thing to note is that other teams have

published estimated for the point of torsional stiffness diminishing returns to be 2000 Nm/Deg (which a tube frame can achieve) but this does not account for local stiffness requirements. One of the main goals that this would achieve would be freedom of mounting items to anywhere on the car.

Pros

Mounting freedom

- Allows iteration from year to year
- Can drill a hole anywhere to mount
- Side wing mounting interface is easier

Reusability

- Mold Reusability
- In a half-monocoque design, the monocoque could be carried over while the rear tube-frame is reused

Weight loss after years of development

Stiffness

Safety

Do not have to manufacture a body, side-body, or floor

Should create less turbulence and drag having more of the car sealed off by a continuous smooth structure

Accu installation on hub motor full-monocoques

Cons

Initial Investment

Each additional monocoque from the same mold would still cost more than a tube frame

Design likely locked-in based on molds

Risk

- Mechanical failures
- Manufacturing failures

Time sink

Design and simulation difficulty

Yearly sample tests

No initial weight loss

Harder to service (working on brakes etc.)

Hard to repair (in event of failure, you cannot weld it back together)

Full vs Half

The original goal in 2020 (Pre-KS5-E (also called KS2-E)) was to develop a half monocoque for IC. It would be easier to design and build for the first iteration. (We would have also had enough expired carbon for this). In 2024, the IC is phasing out and the EV is phasing in. My opinion is that an EV would perhaps be easier to design for a monocoque since an accumulator would provide simpler geometry and more freedom for mounting than a combustion motor. This makes the idea of a full monocoque less daunting in my opinion. One thing I like about some of the full monocoques I have seen from other teams is how the teams with hub motors are able to dismount the accumulator out the back of the car as if it is rack-mounted on drawer slides. But this does not make sense for an inboard motor car. Regardless, the team should not bite off more than it can chew. The choice between full and half goes back to Rule 1.

Autoclave/Oven

In my opinion, an autoclave is not necessary and an oven will do just fine, given a good vacuum. One nuance to this might be if there is problems with adhesion to core material. Another difference between autoclave and oven might be the electrical resistance which would be required to be less than 5 Ohms to GLV for an EV as per the rules.

Some possible ovens are:

- Delta Flight Products
- Nor Ral
- GTRI-ATAS

Some possible autoclaves are:

- Delta Tech Ops
- Nor Ral
- Atomic 6 (promising)

1 Piece vs Multi-Piece

Many teams make the monocoque in one piece while others make it in multi-parts and bond it together. The ones where the monocoque is one piece will require multiple molds that mate together with a very small seam before being layed up on. This will usually create a 'flash line' where resin will fill. This can usually be easily knocked off. For a half-coque, this will usually mean 2 molds and for a full monocoque, it may be 3-5 molds (sometimes still 2). Another question that arises from this is "Where do I put the split?". My original answer was left and right because that is what I was recommended by my superior. My educated opinion is to split the monocoque top and bottom. This would allow the CNC router to make the bottom mold/part in one shot and maintain higher symmetry for the suspension. The top half of the monocoque would be less critical but still has to mate well with the bottom. For a pre-preg process, I would make the monocoque in one piece if the geometry is possible. This way you do not have to rely on a bond. However, for a resin infused process, 2 parts would be required to be bonded together.

Resin Infused vs Pre-Preg vs Cut-and-Fold

With wet-layup not being possible, these are the three options. We initially set out to do pre-preg because that was the fabric we had, but that isnt necessarily the gospel. These are the existing processes because they are not very time constrained manufacturing wise like a 2-hour wet-layup is. Resin infusion was not considered since the team did not have experience in it however, resin infusion may be cheaper than pre-preg because pre-preg would require high-temp mold materials. The cut-and-fold process is the idea of using a pre-fabricated sandwich panel, routing contours in the flat sheet, folding it to the desired shape, and bonding it together. This could be reinforced with carbon fiber angle brackets bonded to the chassis. The limitations of this are many however: pre-fabricated flat panels of the required size are not something we could make in house, it would be hard-pressed to find a panel of the required dimensions and ply schedules, it would also heavily constrain geometry. I am also not sure if our required thicknesses would be too high for this process. Apart from this, I would say it is a tossup between infused and pre-preg. The team would have to do a cost analysis and have completed successful resin infusions first.

Mold Materials (Pre-Preg)

The pre-preg process will require a male 'plug' and then a female composite mold to be created off of that. This could be either fiberglass or carbon fiber but carbon is recommended because it will have a similar CTE to the final carbon part. These will require

expensive high-temp resins. Conversely, you could technically get away with committing to a multi-piece-bonded-together monocoque and use high-temp tooling block, but that is also crazy expensive. Another take is to do an aluminum sheet metal mold. This will require minimal surface prep (really nice) but will heavily constrain the design based on how sheet metal can be bent. You may be able to weld multiple pieces together. You will save time on the mold and might save money. It however be hard to hit the correct bending tolerances. For the 'plug', cheap foam or MDF may be used but MDF will likely have way more dimensional accuracy despite costing more. It will also be less fragile and have less mold-prep involved.

Core Materials

We went with Aramid-Nomex honeycomb because it was cheap and we also had it, I see no need to change this. The primary goal is to get thickness to the part without adding weight. If a higher adhesion between core and skin is required, a better adhesive sheet, or higher cell density may be useful. Foam cores will likely be expensive but will be stiffer and have a better bond. If resin infusion is the chosen route, a foam compatible with it will be required.

Shape

A more square XY profile (Cut section parallel with front plane) may be easier to layup however, a more round (octagonal, filleted, or circular) profile will be torsionally and locally stiffer. In general, keep the geometry simple to save manufacturing headache. Also, flatter regions are easier to mate to.

Consider constraints such as cockpit and foot templates, Percy, driver fit, steering wheel placement, steering rack, ergo, seat, firewall, hatches, AI plate, pedal box, suspension mounting, ARBs, aerodynamics and aerodynamic interfaces (ex: side wings, FW), roll bars, headrest bar, MHB, or almost any part of the car. The rules will be constraint #1, packaging #2. Work with the chassis, suspension, powertrain, and aero leads especially.

Inserts/Bolted Connections

I am no expert on this but a couple different options are hard aluminum or plastic inserts placed in the layup, thru hole with sized washers/nut plates, and potted inserts (such as a NAS-1834-4-1000). On non-torqued parts, it may be recommended to fill the surrounding honeycomb with epoxy or use a hard insert in case the bolt moves and damages the surrounding core.

Core Crushing

This is an issue I have read up on that teams experience where the edge of the honeycomb (rather than the face) is exposed to the wrath of the vacuum and the core crushes from the side. You should generally not be concerned about an autoclave crushing the face of the honeycomb.

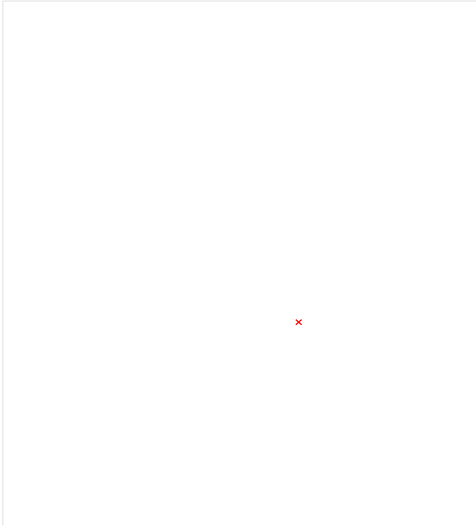
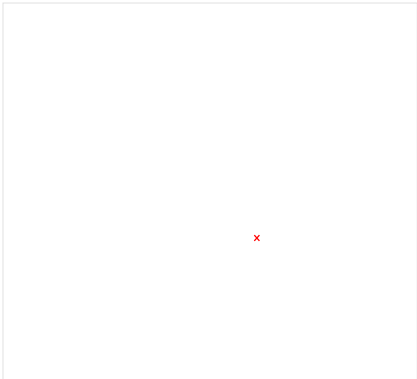
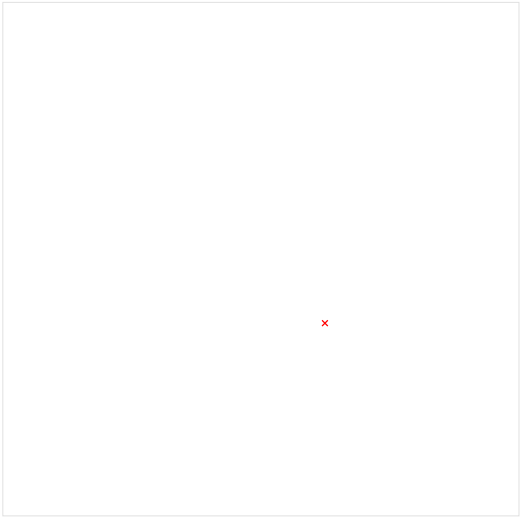
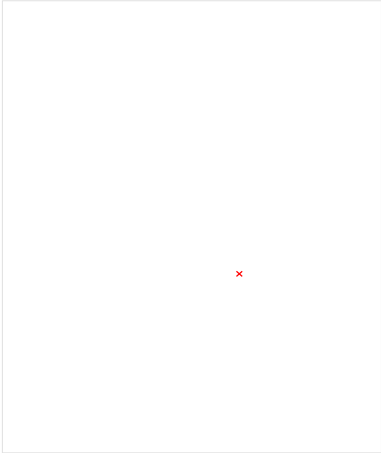
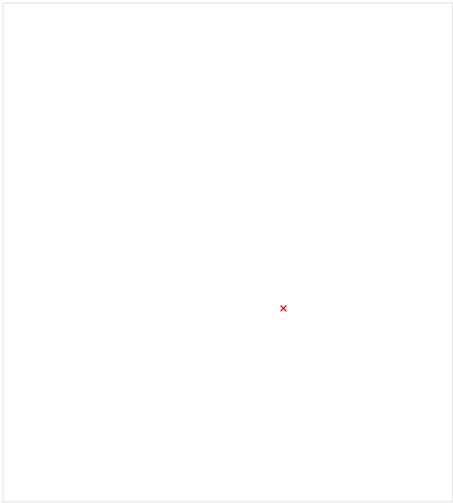
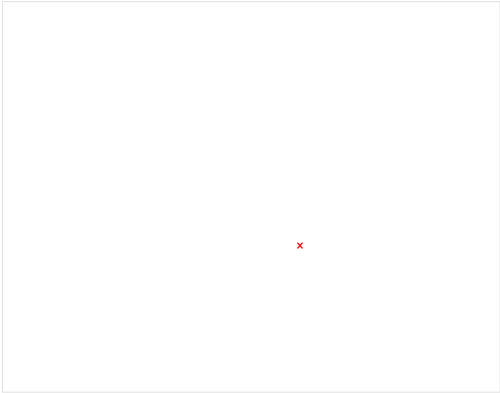
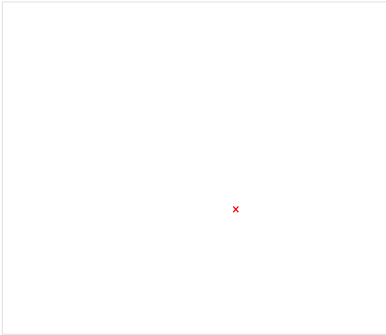
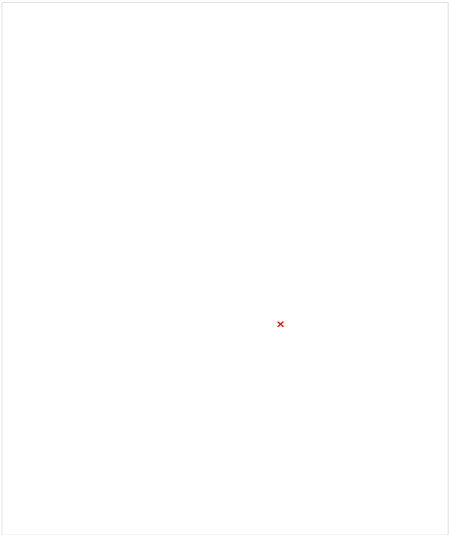
Cost

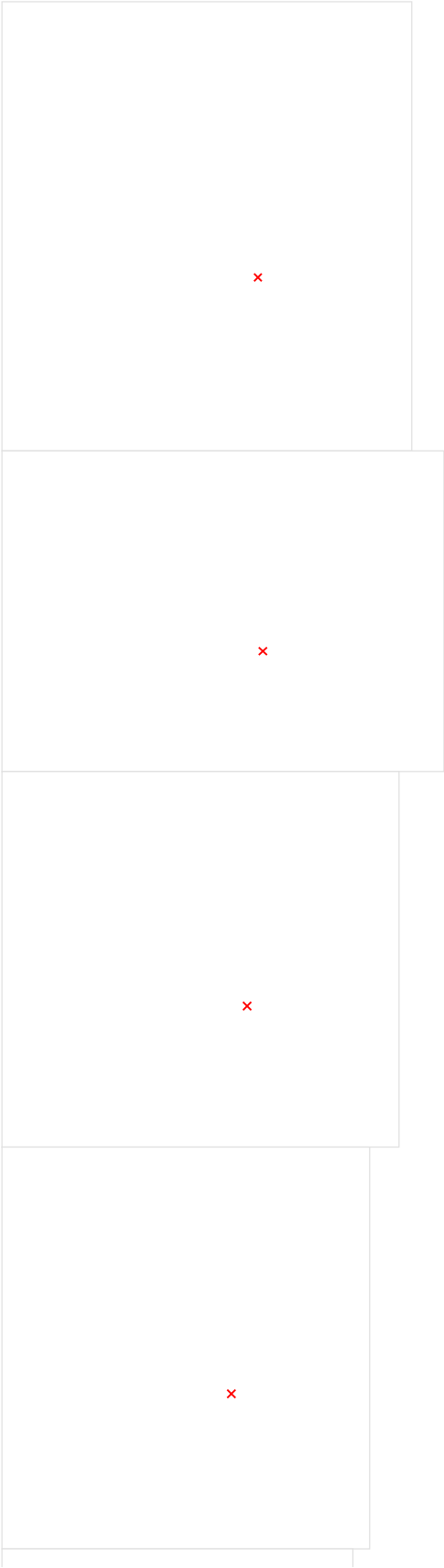
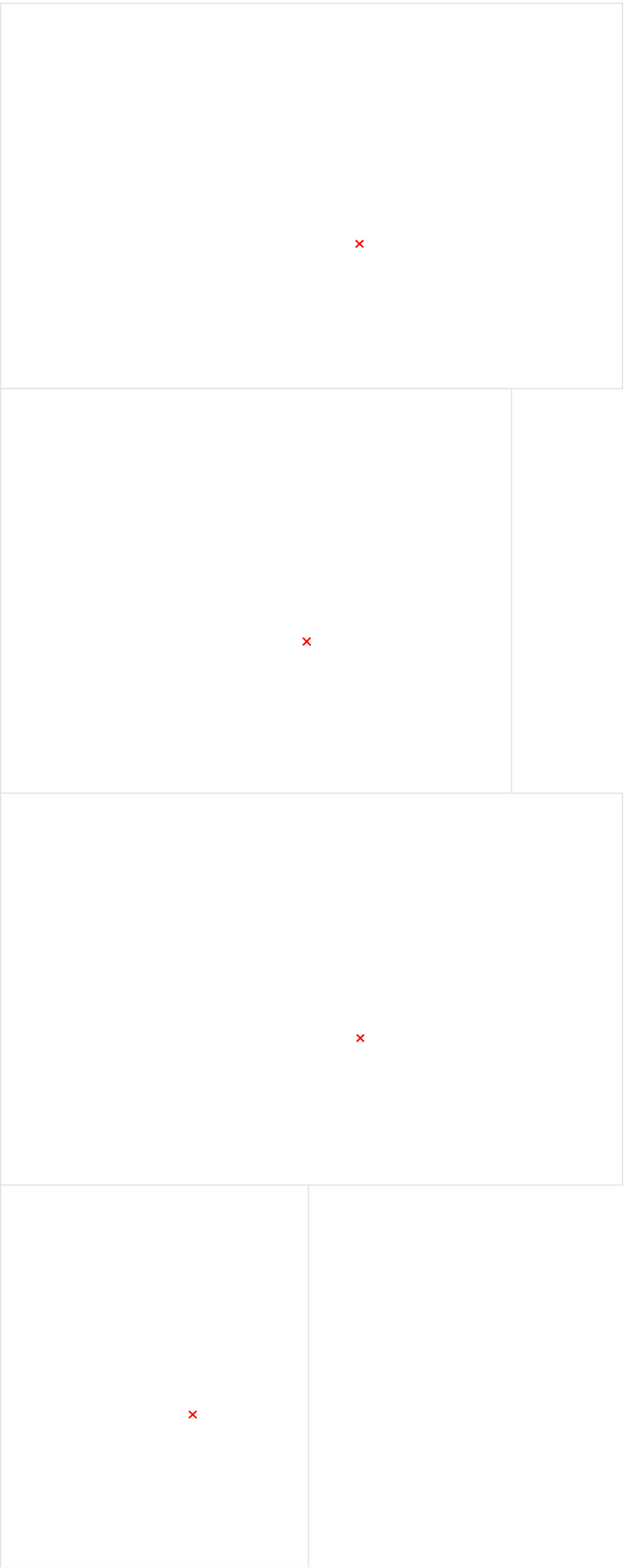
Yet to input the breakdown in a clean way but expect \$6-8k for a first iteration.

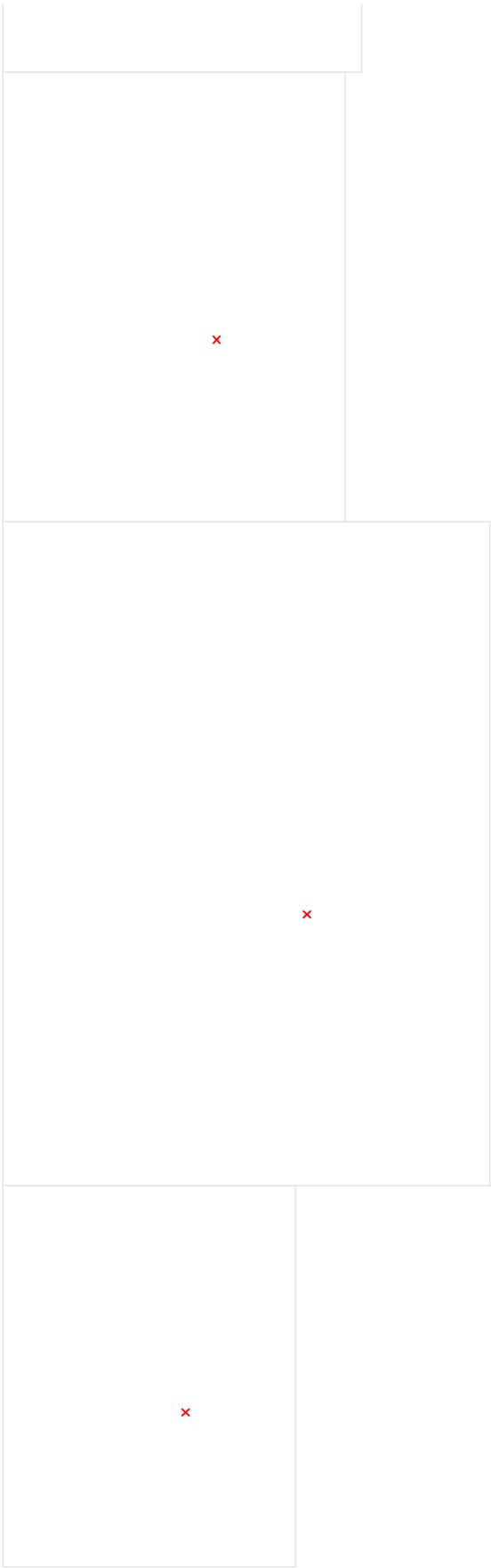
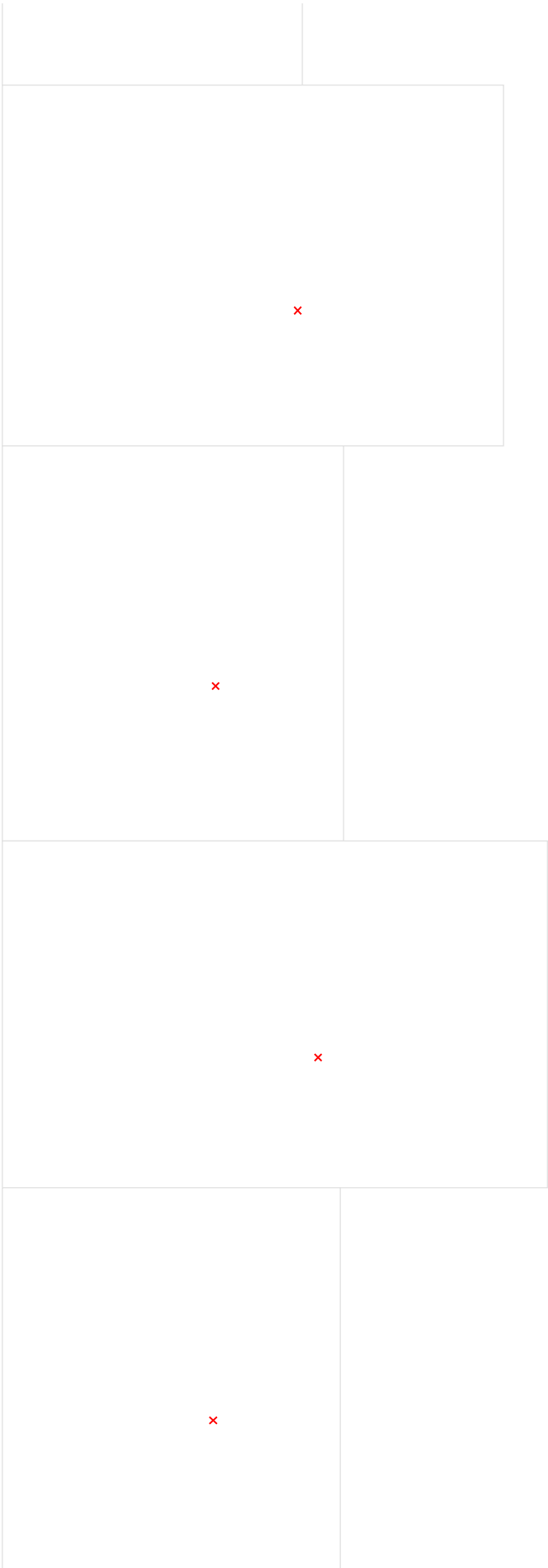
Maintenance

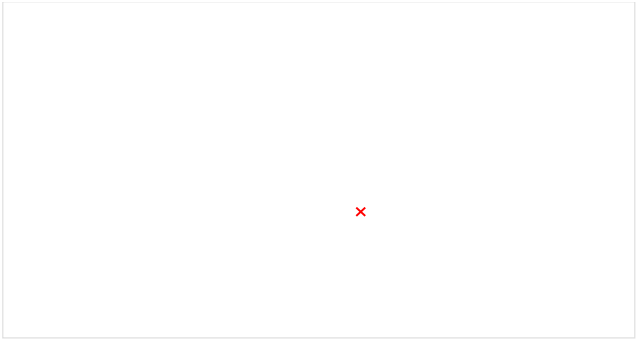
Tuesday, November 14, 2023 2:10 PM

Circuit breaker, 3rd panel, circuit 16 goes to O-101 outlets









Atomic six call notes

Wednesday, June 26, 2024 12:06 PM

Speaking with Dakota Ward Head of Business Relations

Where does Atomic-6 lie within team goals/What do we do

What is the Composites Process Look Like

Proprietary Mold Technology

Through mold reduce cure cycle

Where do we want to improve and what can Atomic-6 help with

Relationship with Material Provider