To-Do List

Monday, May 20, 2024 11:34 AM

High Level To-Do List for Aero

1. Recruitment/retainment systems and tools

Low Level To-Do List

1. By Friday, July 5th: Have a sufficient understanding of Aero limitations based on past CFD data, Nathan and Joey's ideas, and reading archived design proposals.
2. By Tuesday July 2nd: Be able to decide if it is possible to have a 2nd iteration of DRS ready for manufacturing by Friday.

Quick Thoughts

Wednesday, May 29, 2024 11:34

Problems:

- Firefighting: Poor communication when firefighting errors
    - How do we ensure proper communication/channels so mistakes aren't made?

How to make design decisions that result in a good design score:

- Reasoning/Team Goal Alignment (e.g. reduce drag to reduce energy consumption)
- Simulation/Data Confirmation (Confirm if change will make an impact. E.g. how much energy expected to be saved by DRS?)
- Thorough Design Considerations (Wholistic Car Impact, load cases, manufacturing restraints, serviceability)
- Thorough Manufacturing Instructions and Tools
- Comparison to prior iteration
- Verification

Sponsors

- Reach out to 3M for PPE
- Reach out to aerospace companies
- Search for student sponsorship areas
-

2024-2025 Brainstorm

Sunday, April 21, 2024 11:21 AM

Projects:

1. EV RW DRS
2. EV/IC High Nose Body
3. IC/EV Undertray Strakes
4. EV/IC Whiskers
5. EV/IC FW Mounting for Rigidity
6. EV/IC RW Mounting for Weight Reduction
7. EV/IC FW Element Adjustment

Wholistic Car Impacts:

1. Suspension stiffness (Roll/Pitch)
    a. This will impact FW Design
2. Accumulator Architecture
    a. This will impact drag reduction
3. Acc package and Chassis Change
    a. Opens room for undertray change

Design Principles - How to make design decisions that result in a good design score:

- Reasoning/Team Goal Alignment (e.g. reduce drag to reduce energy consumption)
- Simulation/Data Confirmation (Confirm if change will make an impact. E.g. how much energy expected to be saved by DRS?)
- Thorough Design Considerations (Wholistic Car Impact, load cases, manufacturing restraints, serviceability)
- Thorough Manufacturing Instructions and Tools
- Comparison to prior iteration
- Verification

KS8 Design Approach

With two experienced members transitioning out, the first priority regarding the KS8's design will be to understand the limitations of each package. This will be done through reviewing CFD, discussing with Nathan and Joey, and reviewing archived design proposals and info dumps.

Following a sufficient understanding of the limitations, arbitrary solutions will be identified. These solutions will then undergo priority ranking using OptimumLap and other simulations/calculations to define effectiveness relative to meeting team goals, and semi-objective risk/cost analysis.

From here, a ranked list will be available for project selection. Projects will be selected based on the subgroup's bandwidth with an emphasis on quality over quantity. This is to ensure that as aspiring engineers we have an opportunity to enrich our understanding by diving deeper into fewer but more valuable projects, rather than bulldozing through many.

KS8 Manufacturing Priorities

The FW on IC and EV and the RW on IC *must* be remade. Most likely, molds will be *re-used* for cost reduction, however internal wing structures are subject to change depending on composite's discretion.

The EV RW should be re-made but takes a secondary priority under the other items. It is possible for DRS to dictate an endplate and rib change, which will be determined after the 2nd iteration's testing.

Recruitment and Retainment

- Have very small/week long projects that have an impact on the car but with low risk of failure.

KS8 Problems and Suggestions

- Leading/Trailing edge finishes can be improve
- Fw mounting will need to be redesign, could incorporate some feature to adjust AoA and ride height of Fw on the mounting
- Rw lower support rod needs to be relocated instead of mounting to the underside of airfoil
- Adding strakes below the UT
- Dedicate side tunnel design if possible
- FW EP vortex generator needs to be larger to work effectively
- Rad can be mount in the rear to open space for side wing if the team decide to go that route

Archive

Saturday, May 11, 2024 10:54 AM

This includes all pages before May 11, 2024

STAR-CCM+ intro

Monday, December 13, 2021 5:28 PM

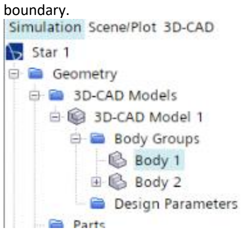
Getting Help:
If you don't know what something is press F1 to pull up the guide for the program which allows you to search up features ad explain them.

Prepping models:
To prepare for importing to solidworks ensure that the model does not has a lot of interference as this can cause problems with the mesh. Also check to make sure that parts are not disconnected as this will also cause problem when meshing. For tubes and parts with small internal volumes that we do not care about the flow around like the chassis tubes simply make them a solid body and merge them together. This will reduce the amount of cells required ad reduce the mesh complexity.

Importing models:
There are a few methods to import models. There are three different import options. Import in to 3d-CAD model, import mesh, and import CAE Model. Because we are using STAR CCM+ built in mesher and the CAE model import option is a Siemens exclusive file type the import that is being used is import CAD model into 3D-CAD. This setting can be found under File->Import->Import CAD Model into 3D-CAD. This import option can be found in the toolbar as well and is the isometric cube with a curved arrow coming out of the middle.

Importable files:
While STAR-CCM+ claims you can import Solidworks files whenever you try to use a solidworks part file or assembly it gives an error of no imported bodies. To get around this you should use a parasolid file. You can do this by saving the solidworks part or assembly as a parasolid file .x_t or .x_b.

Getting parts:
Under 3d cad models right click and select new parts to convert the cad model to a geometry part. Also the 3D CAD space should be when you add parameters any dimensions or mates(will be added when understood). A part that will need to be made is the box that will define the fluid domain. Under Geometry right click on parts and select New Shape Part>Block. If you are going to do a half car sim make one of the boxes sides cut the car model in half . Ensure that the front/inlet of the block is 2-4 times the length of the car from the front of the car while the rear/outlet is 5-10 times the car length behind it. If a reversed flow error occurs increase the distance between the outlet and the back of the car. The sides and top of the block should be 1-3 times their respective dimensions away from the car to ensure that any turbulance the car produces goes back to free stream before it encounters the outlet boundary.

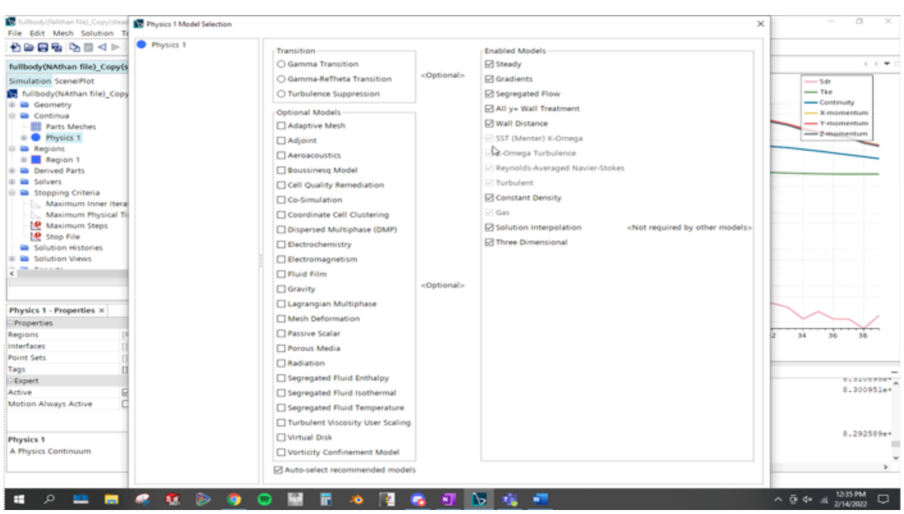


Regions:
Prior to meshing every part that you are going want a volume mesh for will have to be assigned to a region and then a boundary within in order for the automated mesher to work. Within the Regions create a boundary for each part of the simulation that will need different boundary conditions. So make boundary conditions for the inlet, outlet, symmetry plane, ground, and, car geometry with different boundaries for different parts.

Inlet: for the inlet of the

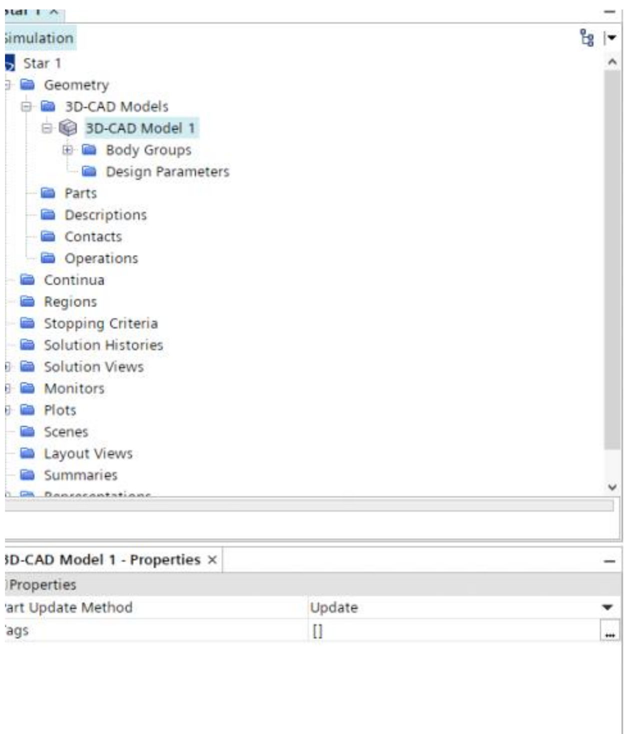
Meshing:
To mesh create a new operation under Geometry>Operations>Mesh>Automated Mesh. If not prompted to enter the meshing models select Surface remesher, Automatic Surface Repair, Polyhedral Mesher, and Prism Layer Mesher. After selecting the parts that the automated mesh will be applied to an exclamation point in a yellow triangle will be displayed on the symbol. This is not an error and simply means that the mesher has not been executed yet
Before adjusting anything to get a finer mesh run the automated mesh to check for any errors. If the Chassis tubes are not merged together or made to be one solid part then you may encounter an error regarding manifold vertices and faces or other errots due to the way in which the chassis tubes are modeled with surfaces.

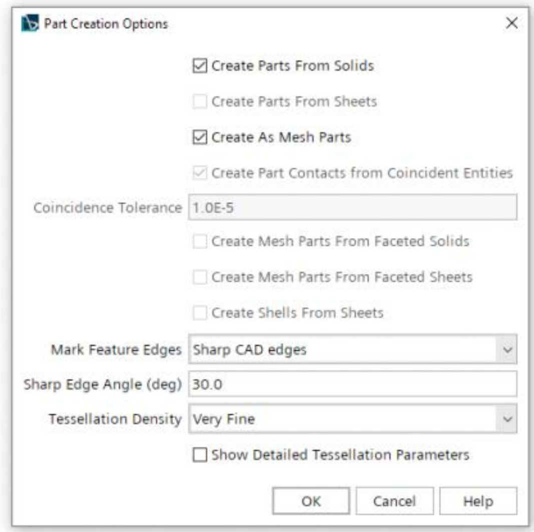
Physics Continua:
The physics continua is what determine the physics and solver for the simulation. For our situation. For the simulations you should elect the following physic models.



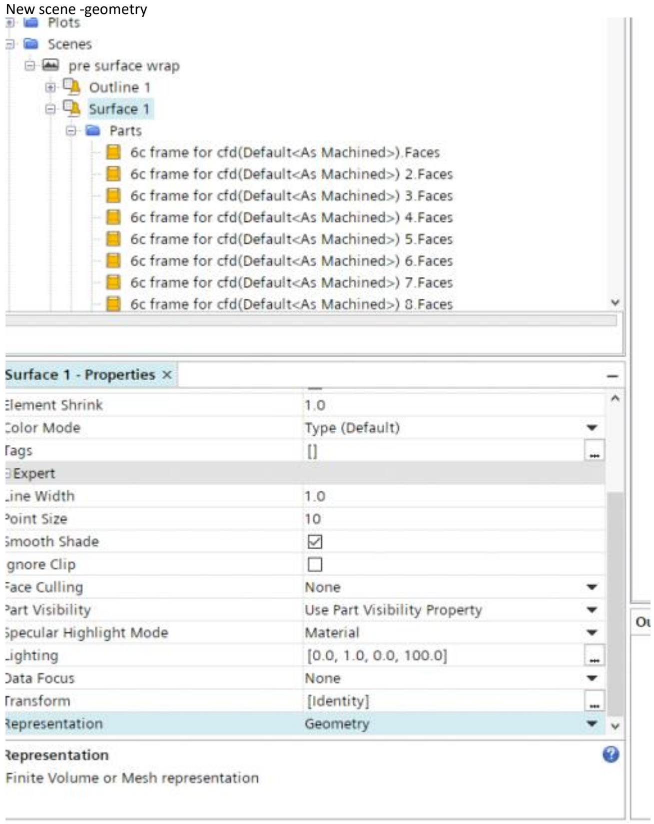
For regular runs Steady time is chosen due to the effects of unsteady flow characteristics such as vortex shedding being negligible. This small effect will be seen in minor oscillations of force and residuals graphs. If the oscillations is to great i.e. more than a few percent of variation then you should select unsteady time to better model those flow characteristics. The K omega Turbulence model is chosen

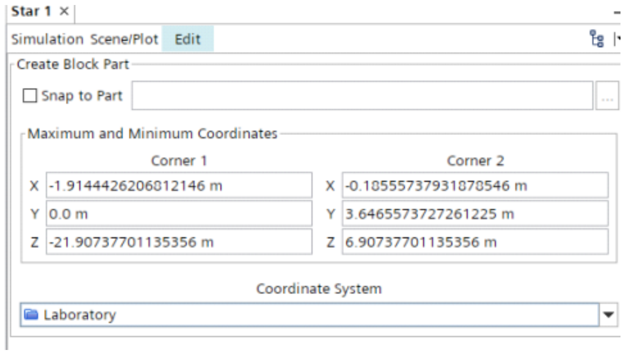
because it work best at modeling the turbulence that matter to us. Constant density is also chosen
because at the speeds we run air is assumed to be a constant density due to the low mach number.



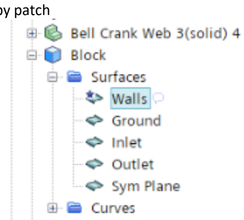


Operations-surface wrapper
New scene -geometry





Block - split
by patch



Add block to surface wrapper in operations

Add proxmity reinfment
Mesher execution - serial

Base size = .05m
Disable cad projection

Tagert surface size .005m

Min surface size .001m

Surface curvature
72 points/circle

Surfaxe priximity 8

Custom controls-surface control

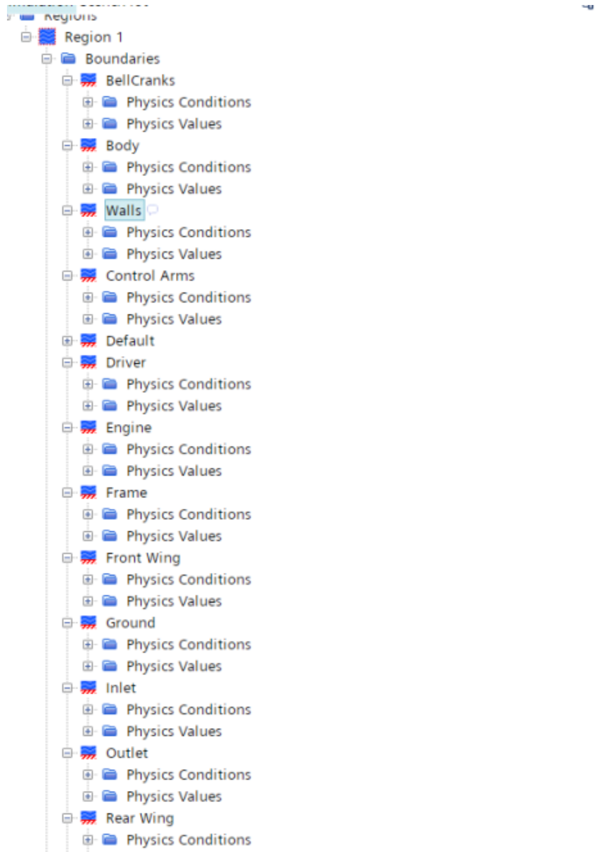
Assign surface wrapper bodies

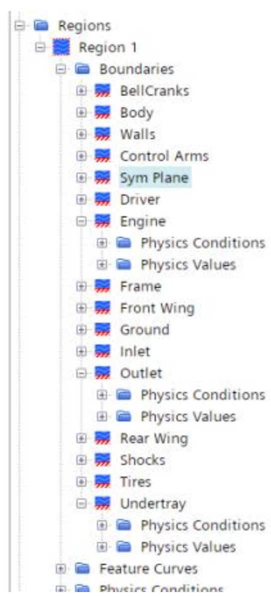
Operation-new-mech-automated mesh
Surface remseher
Automated surfacerepair
Trimmed cell mesher
Prism layer meseher

Input parts-surface wrapper

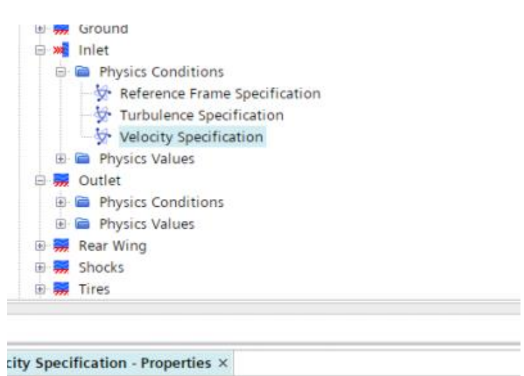
Continua-new-physicmodels-select moidels-3d-gas-segregarted flow-constant density-steady-turbulent-komega

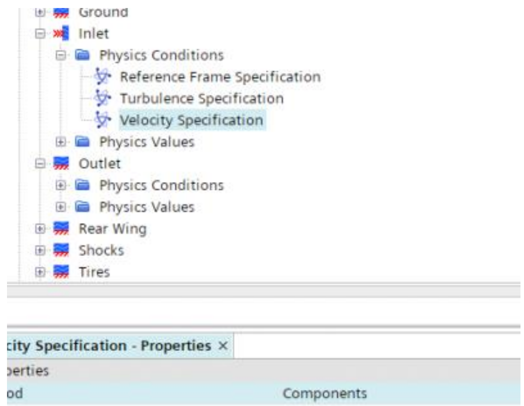
Regions-new region-new boundary- make a ton of them

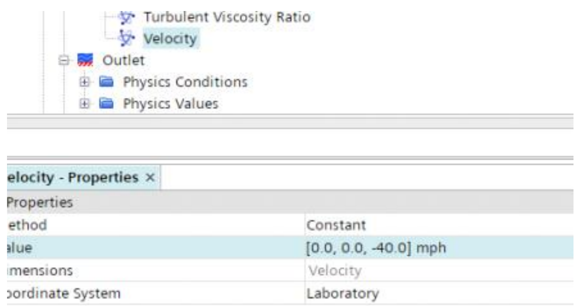




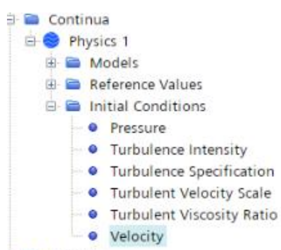
Adding surface wrapper to region 1

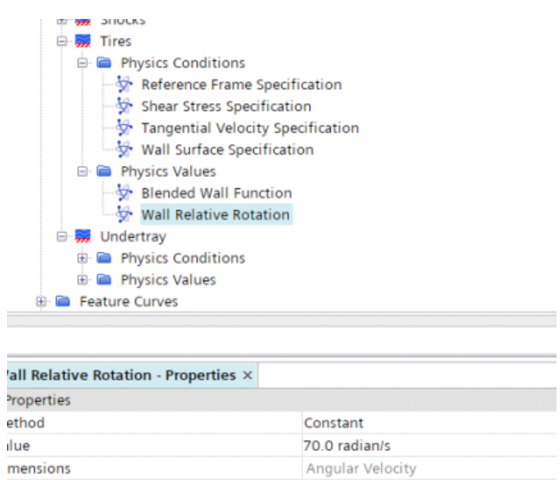






Outlet-pressure outlet





GENERATURE VOLUME MESH ONCE ALL BODIES ARE ASSIGNED TO A REGION

Goals 2023-2024

Thursday, June 29, 2023 7:02 PM

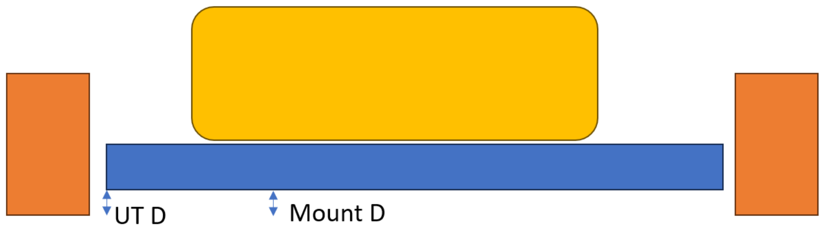
EV-Only focus (but fix any fundamental risky issues on IC)

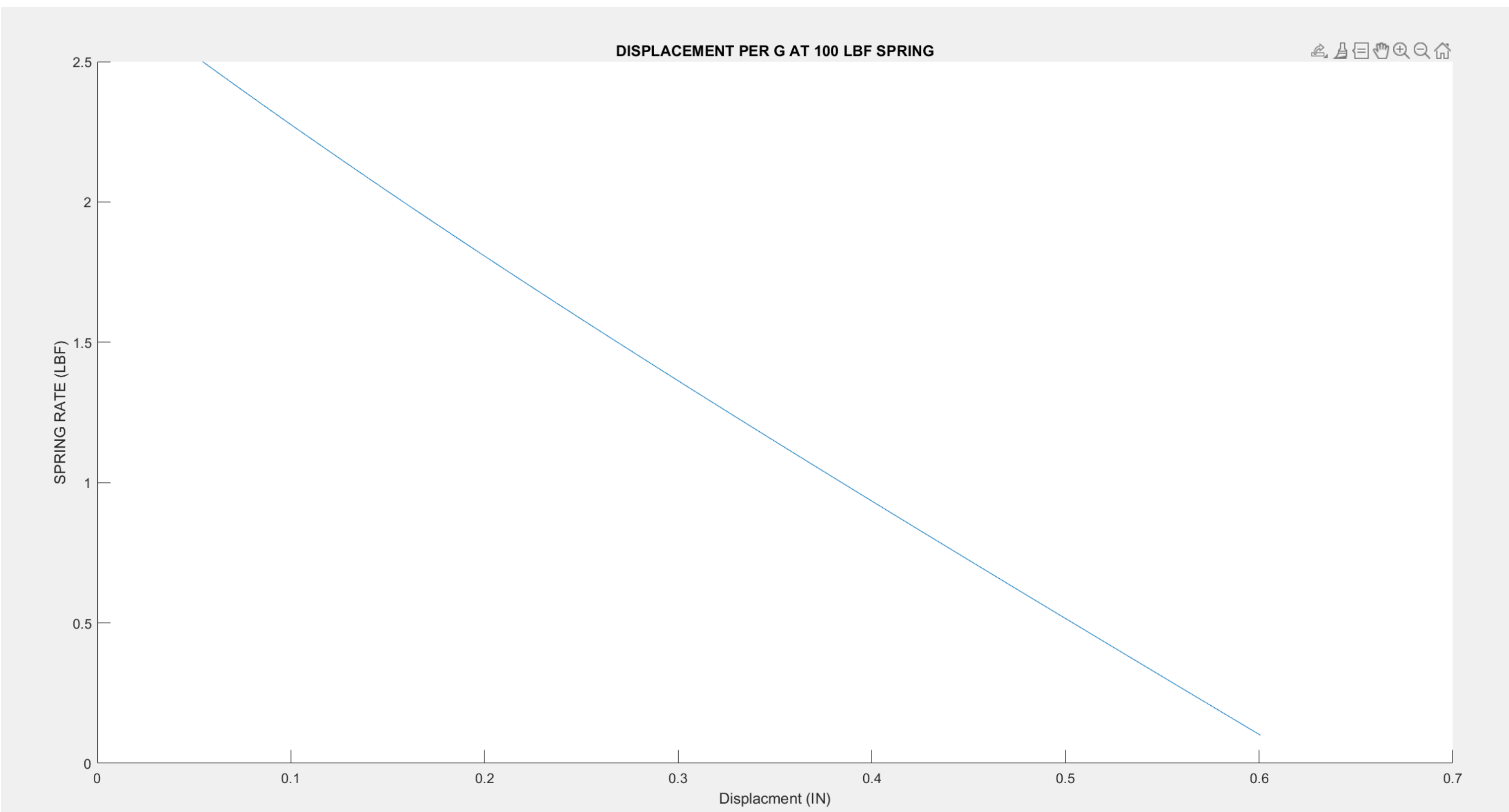
Use KS6-C as benchmark for improvement

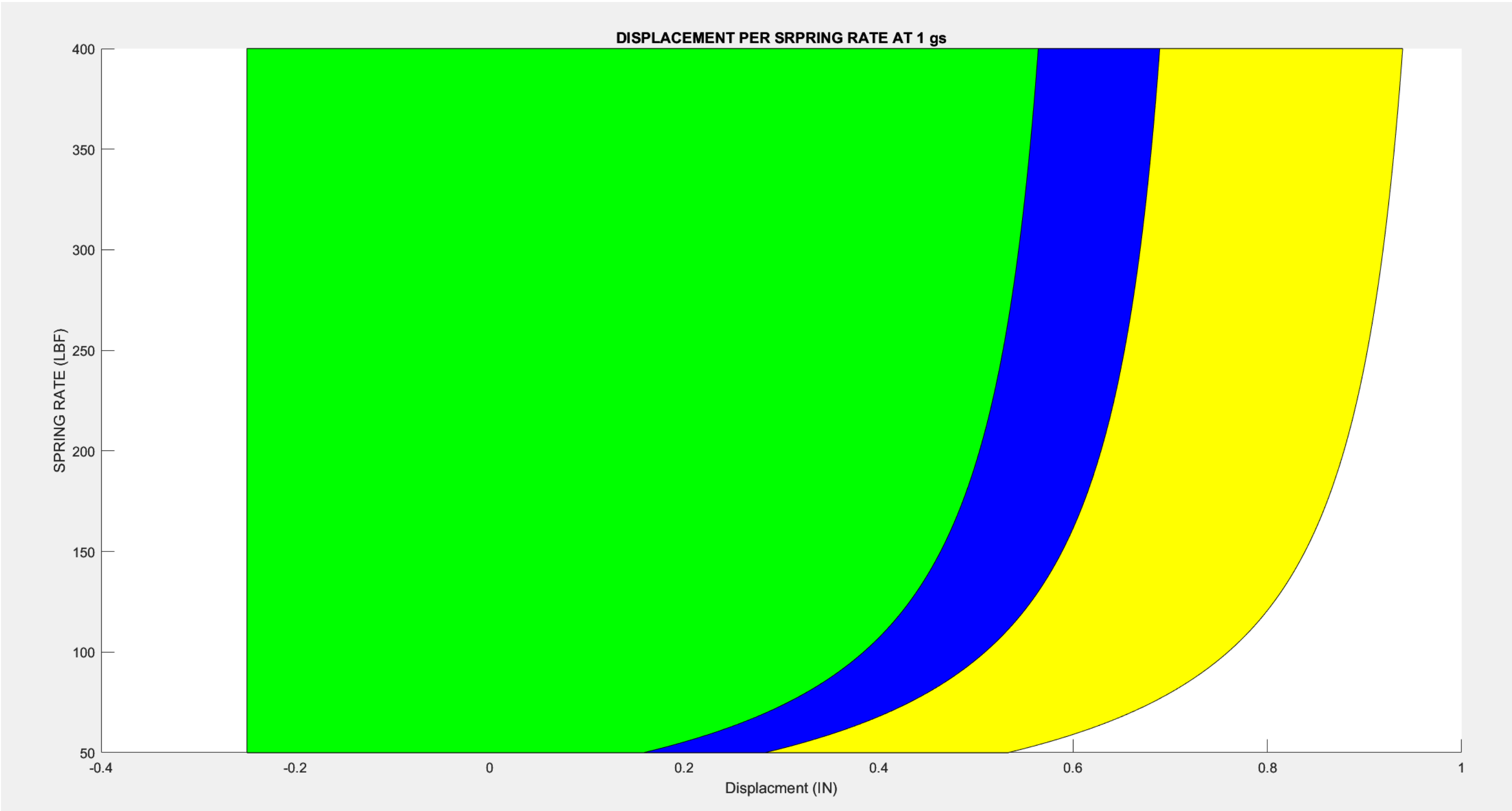
Collect DF data on car – DAQ does front end work
Improve downforce 10% (placeholder value)
Reduce drag 5% in accel config (placeholder value)
Weight increase of < 3 lbs
Explore attitude sensitivity
Match df transfer to within 10% of weight transfer? (arbitrary goal but lets go for it)
Stiffer skins
Less FW scrape
More stable RW mounting
FW not hitting ground and mount not breaking as it did last year
Remove body without removing FW
UT can be mounted in under 5 mins repeatably

Crack head moment

Friday, August 11, 2023 2:59 AM






DISPLACEMENT PER SRPRING RATE AT 1 gs
SPRING RATE (LBF)
Displacment (IN)
400
350
300
250
200
150
100
50
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1

FW Mount Concerns

Wednesday, October 4, 2023 11:10 PM

Bend radius of .029 is way too small for .1875 thick sheet
Will probably crack at bends

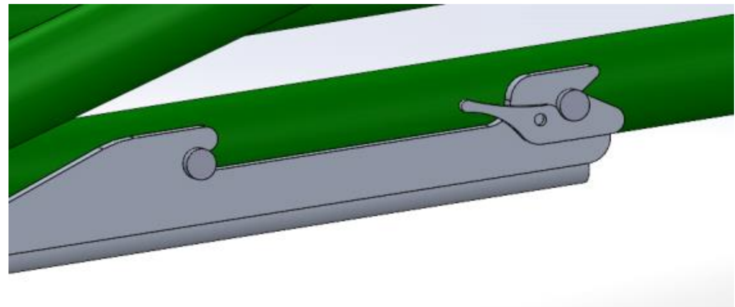
This is Just for the SolidWorks Model which for bend radius has never paid attention to. Bc we only have the one sheet metal brake and can't change the radius. Iv bent 5000 series .125 in aluminum very well. But your concern is valid. But we have no way to actually use the correct bend radius.

I'm confused by this. We can adjust the bend radius on the brake

We can not adjust the Bend on the brake. The adjustment you are thinking of adjusts for sheet metal thickness. The radius of the teeth that hold down the material is what make the radius. And we cannot change this.

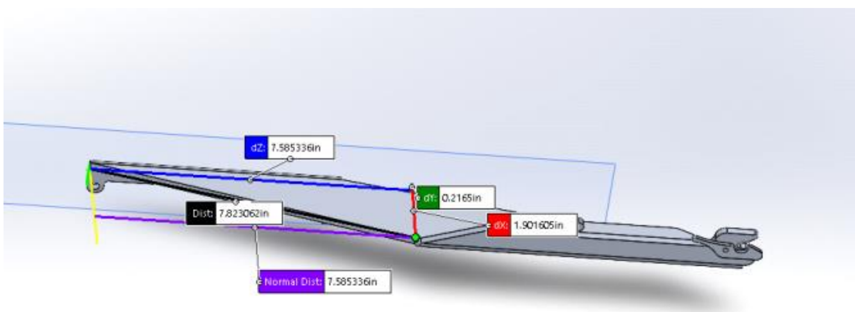
Entire mount is basically in bending
- Front view approx. 2 in unsupported
- Top view approx. 7.5 in unsupported

All valid and already contemplated points. Now that I have a final front wing rib from nathan with attachment point locations. I can FEA to see that adjustments are needed. To the shape and area in question.



Why not bolts? Or at least 1 pin and 1 bolt that way there is clamping force to help keep wing from moving

First off there is not a spring in the cad to lock the locking hook.
I have contemplated bolting, at least one. However the simplest method that does not include separate pieces that could be lost does not have enough for threads on the stud. Between the Aluminum mount and the frame. This is because moving the mount further from the frame cuts into vertical adjustment as the front of the mount start to interfere with wing. I can explain in person how the wing is captive in all axis.



DRS Pseudo Code

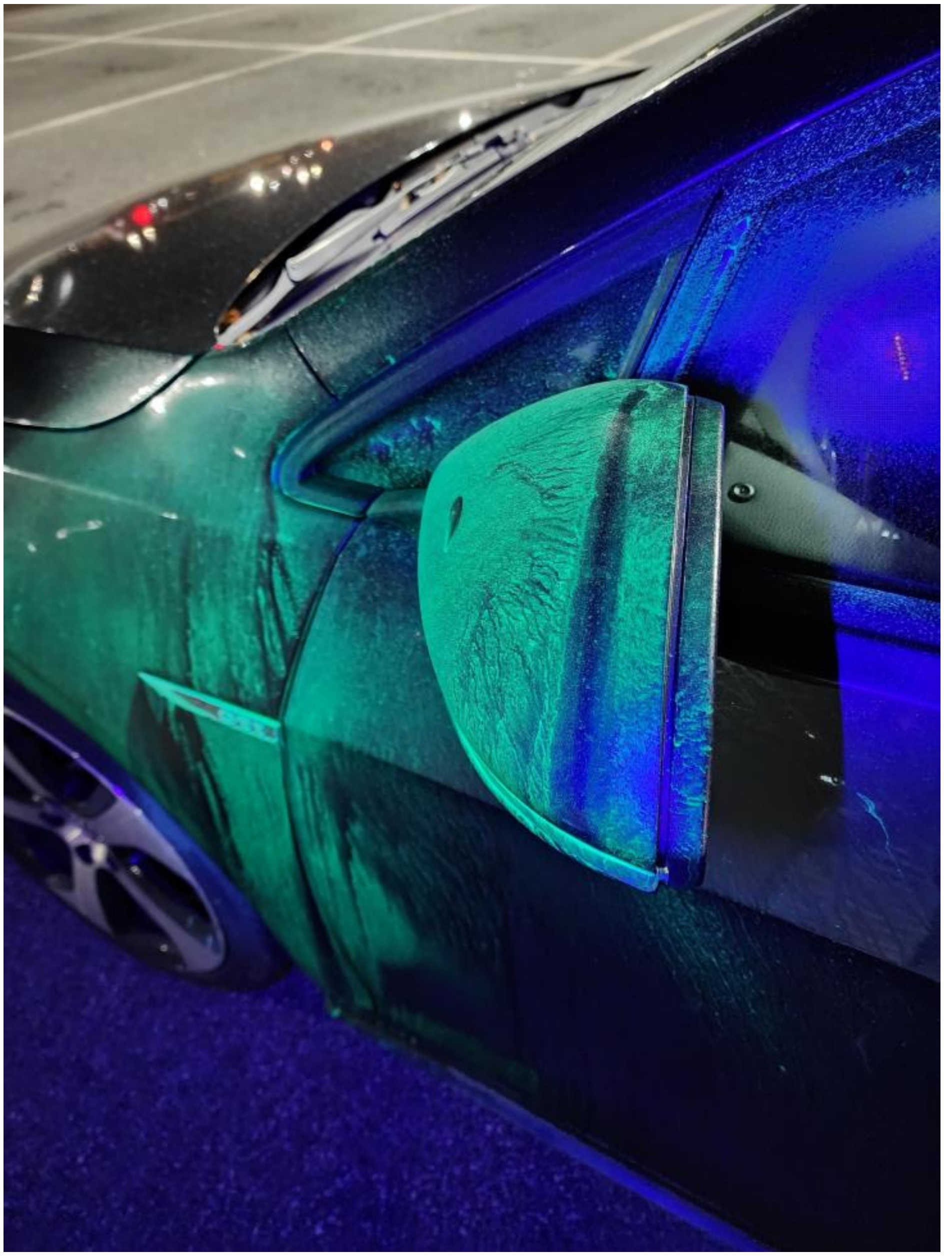
Wednesday, January 17, 2024 10:08 PM

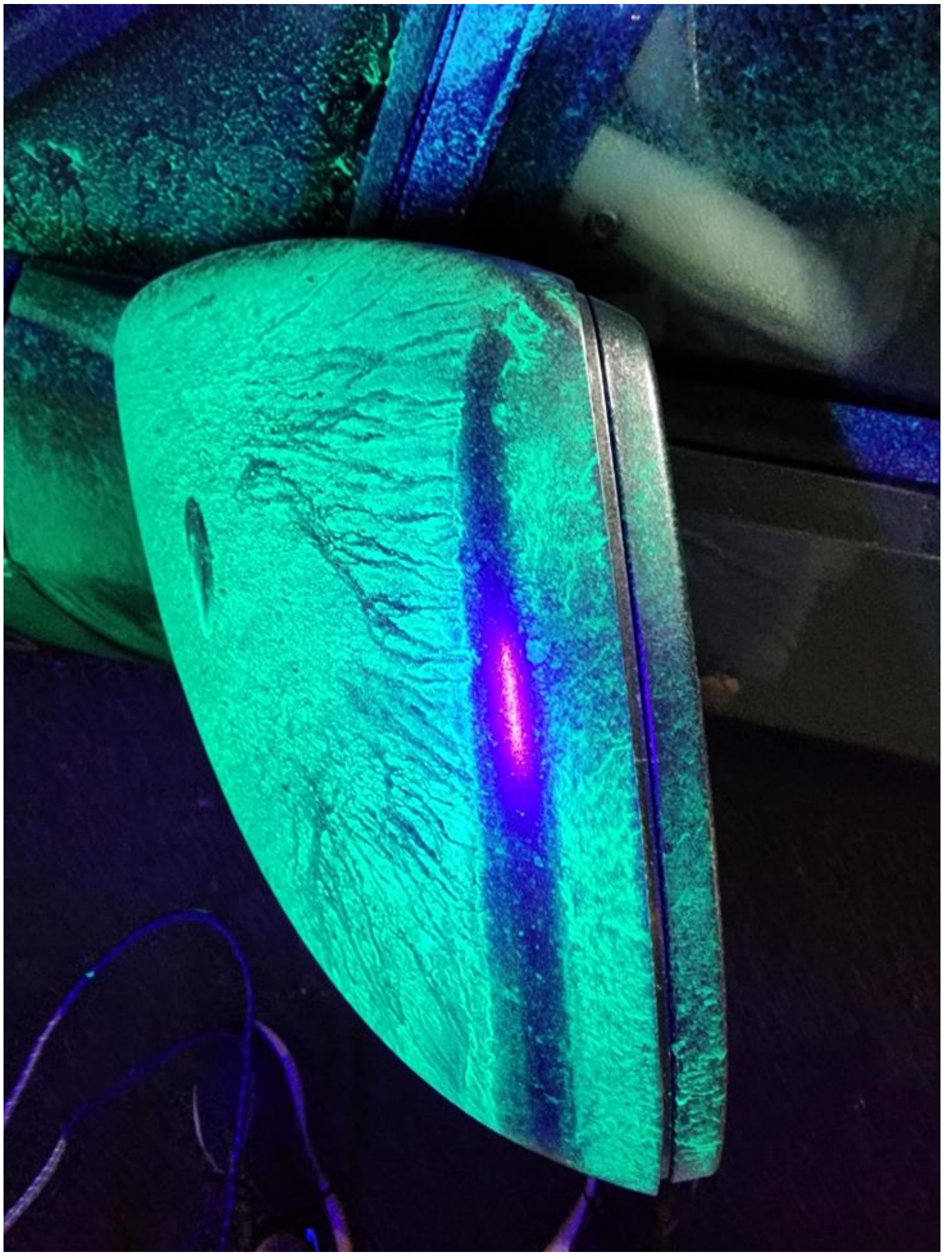
DRS servos have an encoder so we can choose the position
This means that there is a range of motion
For now lets assume 100% is open and 0% is closed

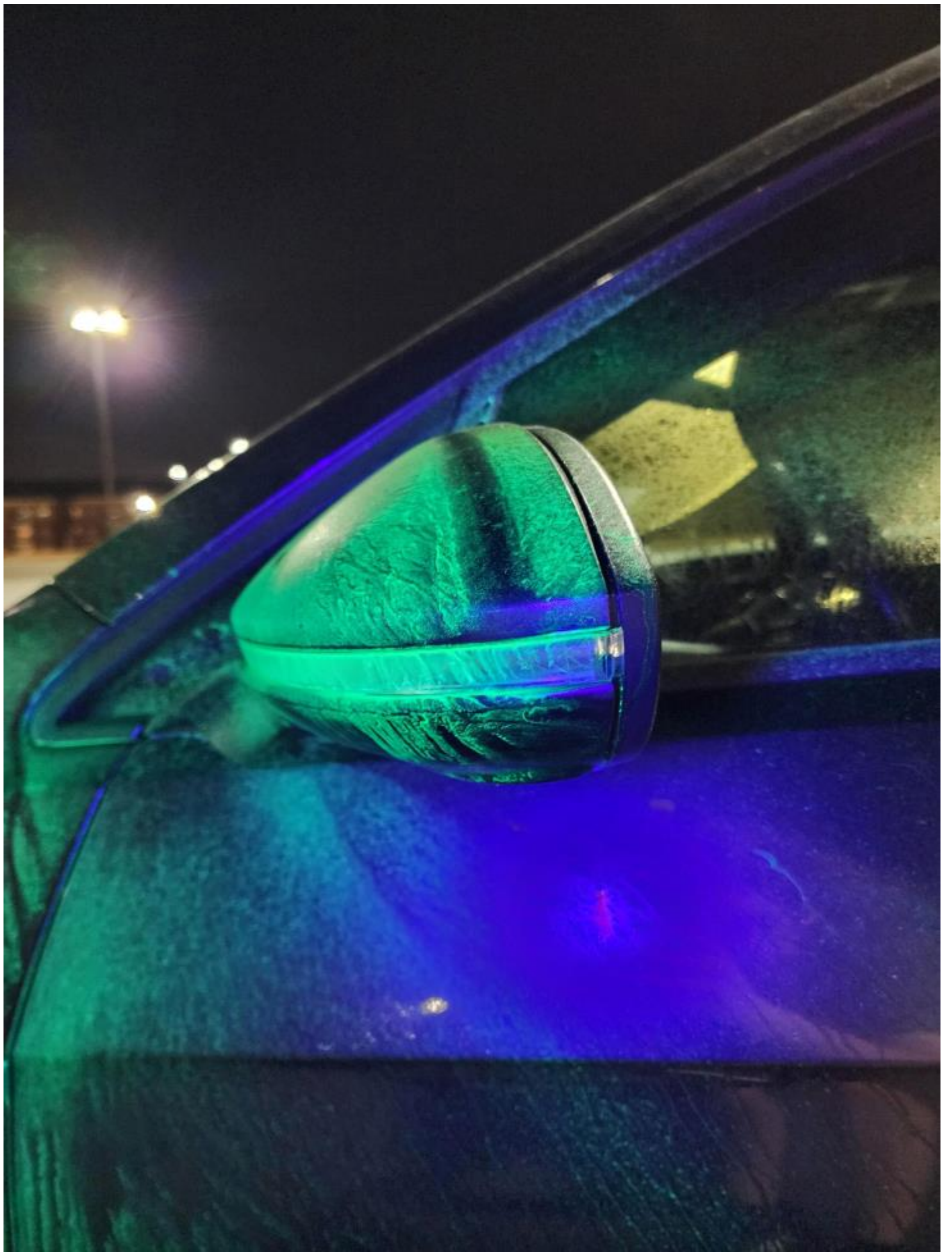
```
Function Car_startup()
	DRS_pos = 100
	DRS_pos = 0


Function drs(steering_angle, gas_pot, brake_pot)
	If(steering_angle <= 15 deg AND brake_pot <= 5% AND gas_pot => 5%){

	DRS_pos = 100

	}Else{

	DRS_pos = 0

	}
```

Initial flow vis mix test

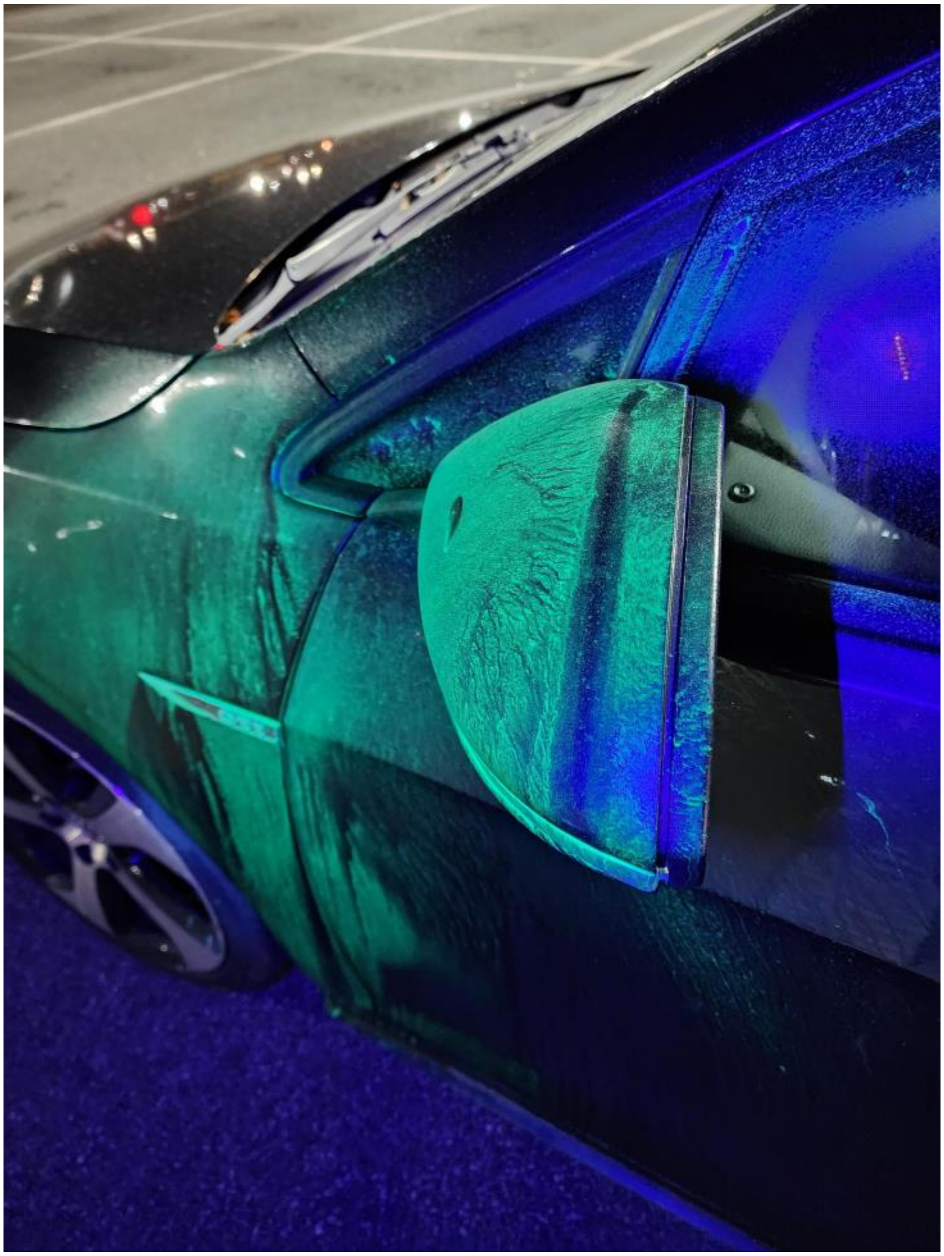
Monday, October 30, 2023 12:40 PM








G.T.I.



KS8 Undertray Diffuser Schizo Ramblings

Friday, January 26, 2024 4:35 PM

Ehirim, O. & Knowles, Kevin & Saddington, Alistair. (2018). A Review of Ground -Effect Diffuser Aerodynamics. Journal of Fluids Engineering. 141. 020801. 10.1115/1.4040501.
[Ground-effectDiffuserReview_r2.pdf]

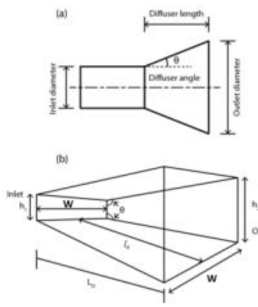


Fig. 1 : Schematics of (a) 2-D conical (b) 3-D plane-wall diffuser dimensional parameters

- Plane-wall diffuser area ratio: $\frac{h_2}{h_1}$
    - h_2 is 2 times the height between the top of the diffuser and the ground
    - h_1 is 2 times the height between the top of the inlet and the ground
- Plane-wall diffuser aspect ratio: $\frac{W}{h_1}$
    - W is the length of the inlet

- "optimum diffuser length reduces as area ratio decreases and optimum area ratio increases as ride height reduces" (page 22)

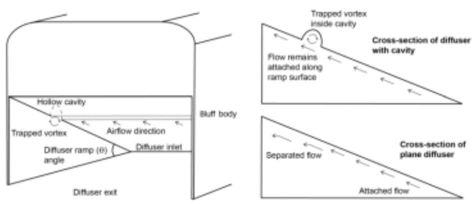


Fig. 33 : A schematic of a trapped-vortex cavity on a diffuser ramp surface

Based on some schizo math using the above tables and formulas, it looks like about 14 degrees is usually the optimal outlet angle, which is the same conclusion that was made in this article:
[Design and Analysis of Undertray Diffuser for a Formula Style Race Car.pdf]

Obviously this angle should only be used as a starting point, as the optimal angle changes varies based on inlet height and length, throat height and length, and outlet length.

Sovran, G. and Klomp, E. D., 1967, "Experimentally Determined Optimum Geometries for Rectilinear Diffusers with Rectangular Conical or Annular Cross-section", Fluid Mechanics of Internal Flow, ed. by G. Sovran, Elsevier, Amsterdam, pp. 270–319.
[experimentally-determined-optimum-geometries-for-rectilinear-diffussers-with-rectangular-conical-or-annular-cross-section.pdf]

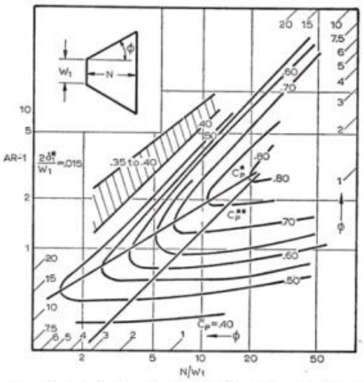


Figure 2. Performance chart for two-dimensional diffusers (Reneau, Johnston & Kline).

Two optimum diffuser lines that are very useful for design purposes have been added to the figure. One of them (line C_p^*) is the locus of points which define the diffuser area ratio producing maximum pressure recovery in a prescribed non-dimensional diffuser length. The other line (C_p^{**}) is the locus of points which define the diffuser non-dimensional length producing maximum pressure recovery at a prescribed area ratio. It can be shown that the C_p^{**} line must lie below line C_p^*. Although the diffuser angle varies along the C_p^* line, it is very nearly equal to 3.5° all along the C_p^{**} line. This provides a convenient method for defining the functional relationship between AR and N/W_1 that exists along the latter. However, the

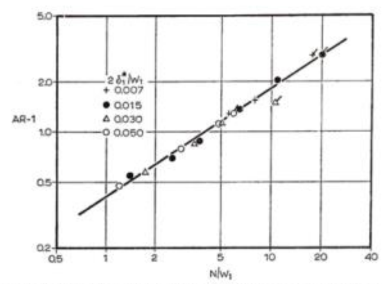


Figure 3. *Effect of inlet-boundary-layer thickness on optimum geometry for two-dimensional diffusers (Reneau, Johnston & Kline).*

Ruhrmann A. and Zhang X., 2003, "Influence of Diffuser Angle on a Bluff Body in Ground Effect", ASME Journal of Fluids Engineering, 125(2), pp. 332–338

Conductive Epoxy for UT GNDing

Tuesday, March 26, 2024 10:47 PM

https://phys.libretexts.org/Bookshelves/College_Physics/College_Physics_1e_(OpenStax)/20%3A_Electric_Current_Resistance_and_Ohm's_Law/20.03%3A_Resistance_and_Resistivity

Assuming:
4g volume epoxy usage per stud
~1cm length to conductive mesh
Target impact on resistance <0.1 ohms

Given:
Length to conductive mesh (cm)
Volume (cm)
Target impact (ohm)

Find:
Equivalent rectangular area of epoxy (cm^2)
4g = 64cm^3
64cm^3/1cm = 125cm^2 equivalent area

Resistivity threshold p (ohm-cm)
R = p(L/A)
p = (R*A)/L
p = (0.1*(64))/1 = 6.4 (ohm-cm)

Thus the epoxy must be rated for <6.4 ohm-cm

Here is a list of suitable epoxies ($ per 10g things)
https://atomadhesives.com/aa-duct-903-electrically-conductive-nickel-filled-epoxy-adhesives-room-temp-cure/
19.99

https://atomadhesives.com/aa-duct-gs1-silver-glass-sphere-coated-electrically-conductive-epoxy-adhesive/
38.99

https://atomadhesives.com/aa-duct-2924-2-part-electrically-conductive-heat-resistent-silver-epoxy-adhesive/
35.99

This guy probably best
https://atomadhesives.com/aa-duct-906-low-cost-low-volume-resist-electrically-conductive-silver-epoxy-adhesive/
18.99

Undertray

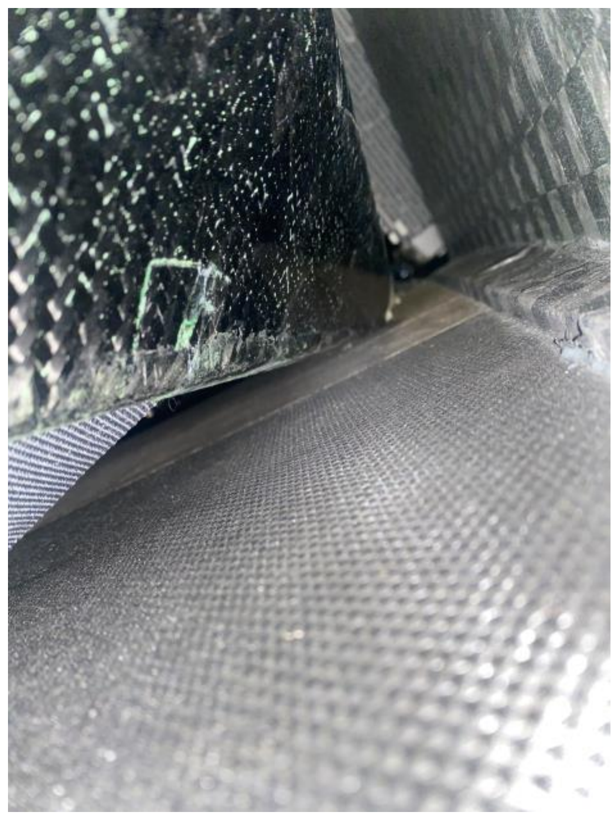
Tuesday, May 28, 2024 11:46 PM

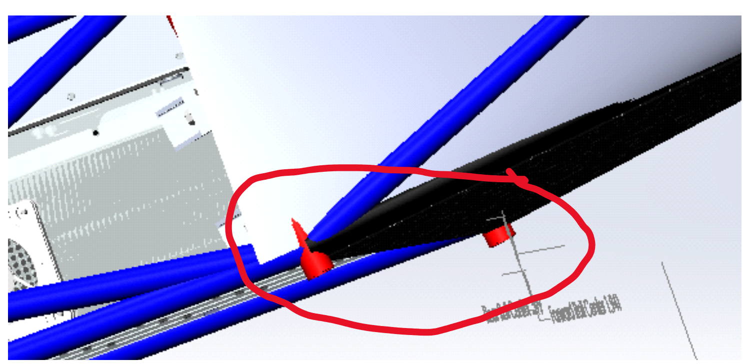
Driver front right is looking good

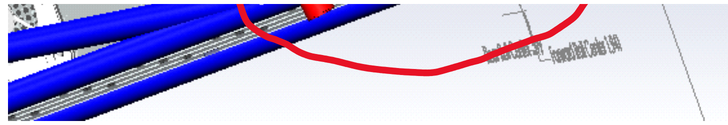
Driver front left

Rear right

Undertray hitting roll hoop chassie bars hitting on both side







Very bad picture but rear left tire hitting undertray

Jacking bar interactions

General Knowledge/Training

Saturday, May 11, 2024 10:55 AM

Section Contents:

1. Resources
2. Training Information
3. Standardized Documentation

Resources

Sunday, April 14, 2024 11:39 AM

General

1. *Low Speed Aerodynamics: From Wing Theory to Panel Methods.* Katz J. & Plotkin. A.
2. https://www.designjudges.com/articles/adding-aero-justifying-aero
   a. Basics considerations of designing an aero package. Incremental steps is key. Predicting, Testing and iterating is very important.
3. https://www.designjudges.com/articles/aero-placement-and-mounting
   a. Mounting basics
4. XFLR5

Diffusers

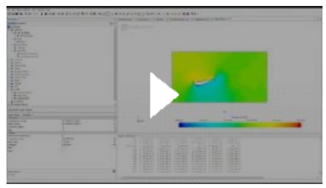
1. Ehirim, O. & Knowles, Kevin & Saddington, Alistair. (2018). A Review of Ground-Effect Diffuser Aerodynamics. Journal of Fluids Engineering. 141. 020801. 10.1115/1.4040501. Ground-effectDiffuserReview_r2.pdf
2. Sovran, G. and Klomp, E. D., 1967, "Experimentally Determined Optimum Geometries for Rectilinear Diffusers with Rectangular Conical or Annular Cross-section", Fluid Mechanics of Internal Flow, ed. by G. Sovran, Elsevier, Amsterdam, pp. 270–319.
3. Ruhrmann A. and Zhang X., 2003, "Influence of Diffuser Angle on a Bluff Body in Ground Effect", ASME Journal of Fluids Engineering, 125(2), pp. 332–338 experimentally-determined-optimum-geometries-for-rectilinear-diffussers-with-rectangular-conical-or-annular-cross-section.pdf

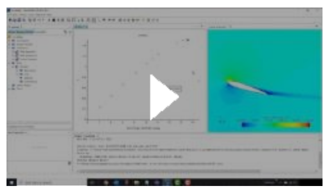
Testing

1. https://www.mathworks.com/help/sldo/ug/estimate-vehicle-drag-coefficients-by-coast-down-testing.html

CFD

1. STAR-CCM+ 2d wing build, mesh, run, validation, and automation
2. Star CCM+ 2D airfoil Simulation Tutorial
3. Y+ Value : https://resources.system-analysis.cadence.com/blog/msa2023-y-boundary-layer-thickness





High Nose

1. Enhancing formula student car performance: Nose shape optimization via adjoint method - ScienceDirect

Testing

Saturday, May 11, 2024 11:00 AM

Section Contents:

1. Pages dedicated to specific tests (e.g., shock pot, coast down, yarn tuft)

Test Log

Friday, July 5, 2024 11:18 PM

Shock Pot Verification Test

Friday, July 5, 2024 11:18 PM

Down Force Test

Friday, July 5, 2024   11:18 PM

Down Force Test Procedure:

Star CCM+ test validation.docx

From <https://kennesawedu.sharepoint.com/sites/Team-KS6-C/_layouts/15/sharedialog.aspx?listId=388a863b-355c-41f3-aee1-8db65f6ce0c2&listItemId=7416&clientId=sharePoint&policyTip=0&folderColor=undefined&scenarioId=MicrosoftTeamsFiles&clickTime=1720236184198&mode=copy&ma=0&fullScreenMode=true&itemName=Star%20CCM%2B%20test%20validation.docx&channelId=bd5f682d-021e-4dd6-8102-b22af7b3fb73&origin=https%3A%2F%2Fkennesawedu.sharepoint.com>

Drag Force Test

Friday, July 5, 2024 11:23 PM

Drag Force

From <https://kennesawedu.sharepoint.com/sites/Team-KS6-C/_layouts/15/sharedialog.aspx?listId=388a863b-355c-41f3-aee1-8db65f6ce0c2&listItemId=32033&clientId=sharePoint&policyTip=0&folderColor=9&scenarioId=MicrosoftTeamsFiles&clickTime=1720236238428&mode=copy&ma=0&fullScreenMode=true&itemName=Drag%20Force&channelId=1565c386-387c-4eda-868a-33f0a33f9e88&origin=https%3A%2F%2Fkennesawedu.sharepoint.com>

Summer Test Plan

Monday, June 24, 2024 8:17 PM

Priority

1. Force data for lift and drag
2. Deflection identification between FW and FW Mount

Testing Talks w/ Joey

Tuesday, June 25, 2024 12:52 PM

- Test Proposal for Star CCM Validation
- How much deflection is from FW and how much is from mount
    - Hard mount FW and do basic deflection and torsional testing

Component Notes

Tuesday, May 28, 2024 16:48

This section houses all of the main aero package components and subpages dedicated to lessons learned (problems we find or good things to continue) and resources related to the component.

DRS

Wednesday, June 26, 2024 8:19 PM

Things to Fix

1. Flap 1 leading edge match CAD
2. Indexing feature for ribs during layup
3. Linkage redesign between flap 2 spacer and link 8
4. Linkage and bolt wear. Use shoulder bolts
5. New bonded rib, rotation point near COP
6. Endplate lateral stiffness increase

Design Considerations

Summer Testing

- [ ] Aluminum Spacers and Linkages
- [ ] Code for servos
- [ ] Method for measuring LV draw

1st to 2nd Iteration To-Do

- Flap 3 Spacer CAD change to make space for articulation
  - Thicken middle hole wall thickness
- Re-make endplate attachment posts
- Make hole in bottom of spacer 1

Undertray

Sunday, July 7, 2024 2:33 PM

Failures/Shortcomings

Sunday, July 7, 2024 2:50 PM

Mounting

Problems	Causes
- Front UT must be bent to meet mounts, rear mounts had to be bent down to meet UT	
- Rear deflects significantly when pushed on. Possibly causes scraping from oscillation.	- Rear mounts are too far from the rear of the UT, so it is left unsupported

Meetings

Sunday, July 7, 2024 2:32 PM

Admin Meeting - June 24 - Problem Identification

Monday, June 24, 2024 4:51 PM

Meeting Purpose/Scope: Identify and align on issues with administration for Aero and Composite responsibilities

Deliverables:
1. Condensed Problem List
2. List of methods, systems, and solutions to condensed problems that will be used for KS8
3. Determine if there are steps to be taken from this meeting

Condensed Problem List/Solutions

CAD is Bad: What would help?
- Consistent Trailing Edge "Blocks"
- PDM Iteration Control
- Ply Schedule Included: Skin thickness, internal structure dependent on skin thickness
- Molds required in PDM and Project Proposals (Composites will put together, but in Aero Proposal)
- Actual drawings for all manufactured components
  - Tolerances, Abri will advise

Communication
- Weekly alignment meetings between aero and composites
  - Simple PowerPoints or show and tells
- Weekly Aero Design Meetings
  - Invested parties roped in at project discretion
- Monday Meeting: Update on past week's progress and this week's goals

Aero and Composite Responsibilities
- Revisit after role definition meeting

Manufacturing
- Checklist for mold prep

Action Items
- Create mold checklist
- Document that lists everything needed for a design (trailing edge consistency, tolerancing, drawings, etc.)
- Wednesday Aero/Composite Alignment Meeting
- High-level workflow/process steps (Like best practices during design)

Idea Parking Lot
- Change in mold material

Whiteboard

CAD is Bad: What would help?
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- PDM Iteration Control
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Manufacturing
- Checklist for mold prep

Meeting Summary:

This meeting was a follow-up from the previous design meeting that this is a sub-page to. It discussed similar themes surrounding administration and CAD iteration control.

Moving forward, Aero will maintain a more transparent iteration control of it's development. This may be through PDM Iteration control or by just updating PDM regularly. Aero and composites will maintain regular communication through weekly meetings and standalone design meetings for project specifics. Composites will act as a standalone subgroup that provides structure solutions to Aer designs.

List of Problems

Grayson
- Positioning relative to CAD
- Shape tolerance
- Design CAD to Mold CAD
- Design iteration naming
- Communication between groups
- Ply schedule decisions not including composites group
- Composites manufacturing decisions made without the composites group
- Lack of planning in the fabrication of the parts

Abri
- Mold & Part CAD naming/revision scheme
  - In PDM
- Molds & blank dimensioning done for PPT
  - Stud finder to all molds
  - I would like to make a mold prep and making checklist (w/ grayson)
- Drawings need to be specific and accurate to tolerances
- Tolerance test
- Oct 23(started making mold) -Dec 22(Arch Closed, all molds were done)
- Undertray finished Nov 7th
- Feb 27 (started last two mold) - Mar 5 (finished last two molds)

David

<u>**Problems**</u>
1. Manufacturing happened too late. (I will beat this dead horse)
   a. Mold Prep finished too late (night of layup sometimes), volume of layups per night started to stack up, crammed months' worth of layups into weeks. Everything Snowballed
      i. 3D Printed Mandurels/ Wing Elements could have been done much earlier and as a "Hands on Lab" to teach newbies
2. Issues with facilities
   a. Had to Frankenstein the old compressors, facilities comes and turns off air while parts were curing, someone had cut off air that one time.
3. Sub group overstepping
   a. Aero does not curate ply schedules or structure. Composites does not change the design, goals, and intent of the aero package at a design level. (These are general examples, role definitions should hopefully help clear this up)
      i. <u>**THIS DOES NOT MEAN ONE CAN NOT HELP THE OTHER.**</u> Both groups should be encouraged to learn/help each other. (ie. Aero guys helping with a layup and getting a better understanding of what the manufacturing process is like and gain a greater knowledge of the capabilities of ***properly*** made composite parts. Composites guys learning/running CFD, aero theory and principles, the decision making process into the components they are making.)

<u>**Solutions**</u>
1. Bulk of Aero devices/ Composite components mostly finalized by mid-October (Absolute Latest)
   a. Gives enough time for materials to be ordered slightly beforehand and the opportunity to review what we are refurbishing/redoing, allowing time to fix mistakes and other issues.
   b. Ample time for mold manufacturing and prep to happen.
   c. Ability to do layups as we go instead of one big sweep.
2. No inherent solution besides leaving signs bc we're not their boss.
3. Understand where the line/ boundary is of overstepping

Composites need's to sign off on aero manufacturability (fabrication and assembly)

<u>**David's take on listed problems**</u> (Move if Needed)
- Positioning relative to CAD, Shape Tolerance
  - Unsure of what this means
- Design CAD to Mold CAD
  - Aero designs the part
  - Composites Designs the mold with Manufacturing Group "consultation"
- Design Iteration Naming
  - Use a <u>***system***</u>, we are not the only people in the engineering space to encounter this issue
- Communication, Ply sched, composites manu decisions, lack of plan
  - Already touched on
- Molds & Blank dimensioning for PPT
  - For Proposals?
  - Easy fix, just need to implement
- Stud Finder
  - I take blame for that Inner Endplate fiasco, desperate attempt to fix mistakes, under a lot of pressure at that time.
  - Also an easy fix
- Mold Prep checklist
  - Mold Prep Tracker?
  - Already have a system in place for it, just requires actually using it which proved to be difficult given the time crunch and timeline the last go around.
- Drawing Tolerance
  - Thumbs Up
- Tolerance Test
  - ???

Design Meeting - June 24 - Shortcomings/HL Goals

Tuesday, June 18, 2024 10:54 AM

Meeting Purpose/Scope: Decide on high level design goals for KS8 package. Focus on design goals only.

Meeting Deliverables:
1. KS8 Package Design Goals (High Level: Stiffer, more reliable, less drag, etc)
2. Ranked Design Matrix Template
3. Unanswered Questions

Agenda:
1. Align on failures of KS7 E Package
   a. 20 min.
2. Align on team goal constraints
   a. 20 min.
3. Decide KS8 package goals
   a. 60 min.
4. Introduce/Discuss/Finalize design matrix pillars
   a. 10 min.
5. Decide on Design matrix
   a. 10 min.

Meeting Summary:

After we started, it was quickly realized that the meeting surrounded problems with manufacturing and composite's area of responsibility, and not Aero design. The only action Aero is to take is to maintain clear CAD iterations and consistently communicate with composites regarding the current iteration and confirm if all iterations match each other.

We decided that composites would have full autonomy to make decisions and take measures they see fit to nullify these problems, both design related and admin related.

Composites will identify, design, and test solutions for structures over the 2024 summer design season. Furthermore, Aero and Composites will have weekly meetings to align on project statuses. This will open up opportunities for identifying errors in manufacturing early and maintain a healthy/communicative relationship between composites and aero.

Shortcomings/Failures:

These are **mechanical/performance/manufacturing** shortcomings/failures that occurred. Only list the problem, solutions will be discussed in the next meeting with design matrix rankings.

Seth
- FW Deflection/Oscillation
- Trailing/leading edge quality inconsistency

Grayson
- IC FW spar collapse
- IC RW adhesion Failures
- Wing skin deflection
- Ease of mounting
- Ease of assembly
- Impact with road
  - Self-clearancing
  - delaminations
  - Holes in bottom skin
- Ease of fabrication
- Cost
  - Is this something that could be brought down and how
- Rigidity of mounting

Team Goals that Directly Affect Aero

Please leave team goals that will directly affect Aero

Seth
- Efficiency/Drag Reduction
- Acc/Chassis Changes
- Pitch/Roll/Ride Height Changes & Aero Sensitivity
- Radiator airflow requirements

Grayson
- Decreased cost
- Decreased weight
- Decreased drag
- Increased downforce
- Increased cooling
- Increased rigidity
- Decreased Skin Deflection
- Increased Ease of Fabrication
- Decreased Time for fabrication
-

Failure/Shortcoming	Cause	Notes
EV FW Oscillation	- Debonding & crack propagation - Large clearance between skin and rib - EV FW Mount deflection - CAD/Manufacturing discrepancy • Ply schedule not in CAD	
EV RW Trailing Edge Inconsistency	- No template to trim around • No drawing	- "Wavy" pattern from rear view
EV FW Trailing Edge Inconsistency	- CAD discrepancy: Iterations were not tracked	- Gap between top and bottom of wing
IC RW Bond Failure	- Fatigue failure - Cracks were not addressed - No regular inspections - Fabrication mishaps	
IC FW Rib Collapse	- Cone impact	 - Design needs iteration for robustness, but inherently good
Wing Skin Deflection	- Internal structure placement not thorough	- Describe?
Assembly Difficulty	Admin topic	- What was difficult? - Was the difficulty unnecessary? - Does this affect serviceability?
EV RW Pushrod Tab Displacement	- Could be bent, or whole rib is not "upright" • Possible: Rib not adhered/jigged correctly	- Monitor this on KS7E during Testing
EV FW Mount Movement	- Possible: Bolt not tightened on left side - No jig for placement of tabs	
CF Pushrod Bond Failure	- CAD not sized correctly - Inserts not etched, CF not scored	- Test new ones by just running car - Current tubes in CAD are different size than IRL

KS8 Package Goals

Goal	Description
Reduce Overall Deflection or Increase Rigidity	Aero package deflection does not contribute to ground scraping
Robust package adhesion.	
Production accuracy to CAD	Reduce manufacturing inconsistencies that decrease wing performance.

Unanswered Questions

Question	Answer
How many packages will we be making? Remake E Car? New IC Package, or re-use?	