

Aero CFD Flowchart

Tuesday, October 19, 2021 9:44 PM

Flowchart of what we are going to do in which order (old)

- Re-simulate front and rear wings and compare to Solidworks (in matching setups)
- Develop process for rolling road ground effect 3d sims
- Run wings with grounds effect (FW only)
- Create full car sim worthy cad model with tires and chassis
 - o With simplified suspension members as well????
 - o Maybe with radiator if the cad can work and not be too complicated
- Run wings in full car sims to see the differences
- Past undertray sims
- Design and sim new undertray design

2022-2023 flowchart

- Make separate CFD cad models of EV and IC
 - o The chassis should be made of solid bodies(preferably one solid body)
 - o CAD simplified suspension members and wheel
 - o CAD simplified parts for things like accumulator (EV), drivetrain(EV and IC), and things like the driver
 - o Make sure wings are solid bodies with preferably separate bodies for each wing element and endplate
- Establish base template for simulations (cell size, regions, parameters)
 - o Use parameters and functions to make automatic changes for design studies
 - o Make sure wings have similar mesh sizes for comparisons
- Simulate Test RW to select one for the final simulations
- Simulate Test FW to select one for final simulations
- Simulate semi-final FW and RW on full car minus suspension to decrease simulation time
 - o Add in undertray once FW and RW have been selected because under tray is lowest priority
- Add in suspension components for final FW, RW and, Undertray
- All of the previous simulations should have been in half car at selected stall speed
- Add an accel configuration of aero package
 - o Only run a velocity sweep and pitch sweep with positive values (this setup will only be used for excel so don't need to worry about negative pitch sensitivity just positive pitch)
- Half Car Comparison
 - o Run velocity sweep of the half car to determine downforce and drag at different speeds (Design Manager)
 - Sweep 10mph to 60 mph in 10 mph increments
 - o Run pitch sweep at stall speed (or average speed) to determine change in COP and downforce (Design Manager)
 - The pitch sweep will be done using a new polar coordinate system located at the pitch center of the car
 - The pitch range will set by recorded change in pitch under braking and acceleration (needs dat acc) but can be guesstimated for now
 - Cannot do pitch and velocity sweep at the same time would require 36 sims which would take 2-3 weeks
 - This will be used to measure the change in COP under breaking (COP moves forwards when breaking)

- Add in porous region (needed for full car simulation)
 - Add in porous region for radiator (both IC and EV)
 - Will require real life data for pressure/velocity change due to radiator
 - We can use a small radiator and pitot tubes or mount to the side of a vehicle with pitot tubes
 - <https://community.sw.siemens.com/s/article/How-to-simulate-radiator-fan-and-duct-in-STAR-CCM-and-design-suggestions>
 - Will enable to simulate down force and drag along with effect of the fan any sidepods/ducting
 - Can simulate mass flow rate through various radiators to select a different radiator
 - Add in porous region for intake filter with outlet beneath (IC specific)
 - Will simulate the effects of the air intake on the RW considering it sits in front of the RW
- Full car simulations (will require more ram and preferably more cpu cores)
 - Run yaw stability sweep (Design Manager)
 - This will be used to calculate side loads on mounts in cornering and in case of a spin
 - Run Roll stability sweep (Design Manager)
 - This will be used to calculate the roll sensitivity of the FW and Undertray as the forces will shift to to new height differences
 - Rotate the car through domain using polar coordinates to simulate downforce and COP through various radius corners
 - This will be used to calculate downforce at various corner radii and speeds
 - Will need real life maximum corner speeds to compare
- EV Specific parts
 - Thermal fluid simulation of accumulator
 - Using built in battery thermal models thermal simulation of the batteries can be added to a full car simulation
 - Will simulate effect of fans pulling in air from outside while the car is driving. This may affect any mid wing or possibly undertray depending on flow rate ad exhaust point of the accumulator

Star login and servers

Monday, October 24, 2022 5:17 PM

ksumotorsport@gmail.com -
Notkansas2022
Cent OS7 now running
Password 8768417069

athom455@students.kennesaw.edu



License
Setup

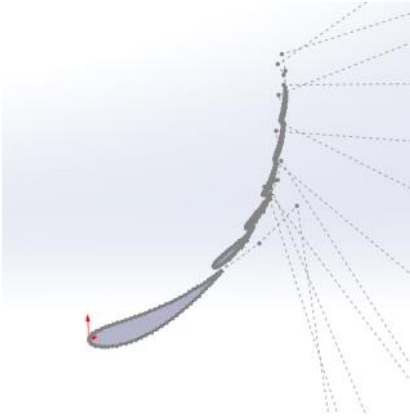
Servers username: KSUMOTORSPORT
Password: Galantvr4!

How to make a Final Wing (X)

Sunday, January 10, 2021 8:58 PM

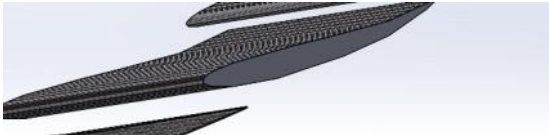
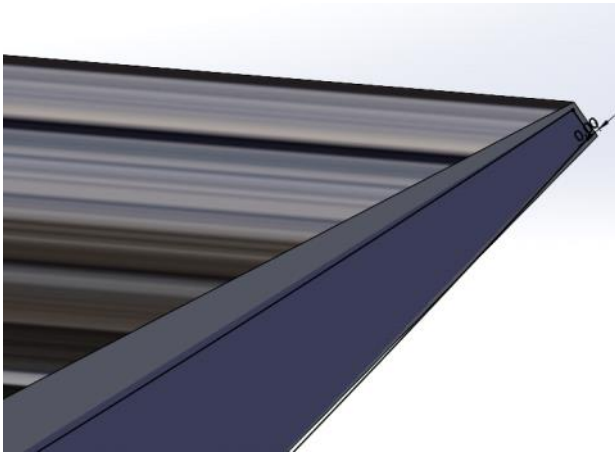
Make an assembly with the solid body:

Convert the sketch of the elements and main plane on to the mid plane of another part.



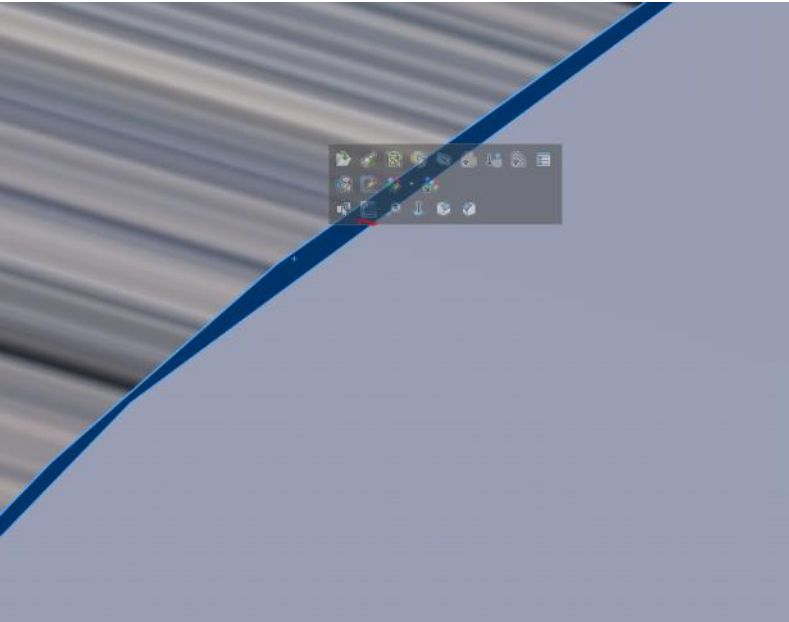
The main plane can be extruded as a thin feature but the upper elements need to be done as solids.

Hollow them out withan offentities off the solid (do not convert entities first)
If the trailing edge is square you may need to close it by hand prior to the extrusion

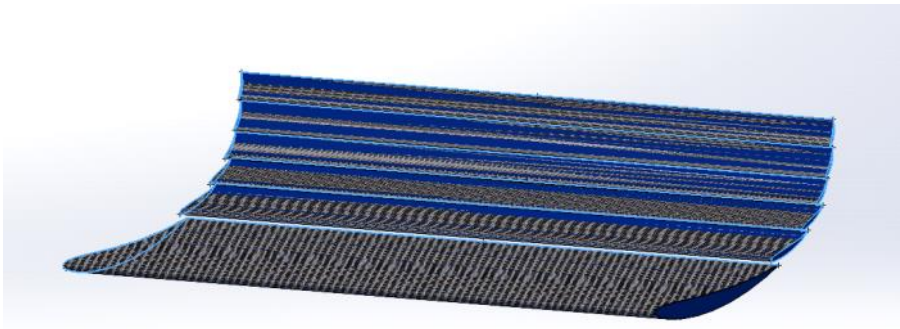


Foam inserts:

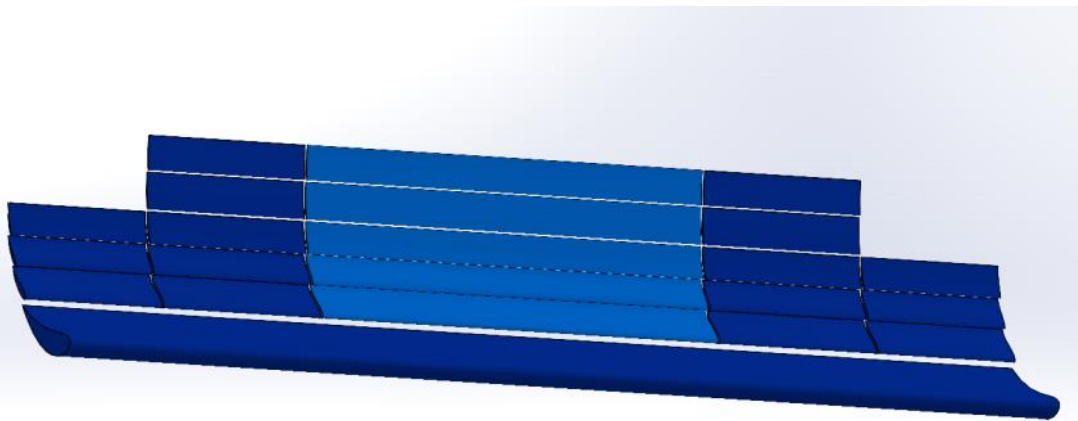
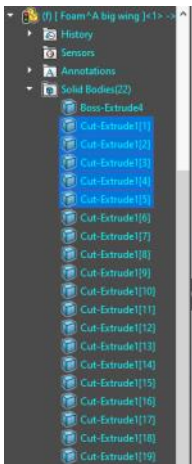
With the thinn carbon creat a skect on the edge of the plate. Convert the inter lines and extrude the foam ot the leanth of the element or plane.



Here is the carbon skin with the foam inserts



Using the endplates on as the cuts



End plates:

Setting up CentOS

Thursday, February 16, 2023 4:21 PM

- Download CentOS 7 2009 iso (2207 is only needed for newer hardware)
- Flash iso to flash drive using balena etcher or other software to make usb boot media
- Plug into and install centos
- To remake usb flash drive into windows

Aero-Daq-VD with Jonathan and Hopefully Brenden

Tuesday, February 07, 2023 8:05 PM

Meeting Goal
Create action plan that works for both VD and Aero for acquiring suspension data

Sammy Goals
Get dampening data (because you are measuring distance)
Load cells maybe for weight transfer, not necessarily desired

Nathan Goals
Measure Aero Loads to compare to CFD< within <.5 lbs
Fz per wheelj

Testing Issues Thus Far (using shock pots)
Lack of Stiffness in mount
Not necessarily linear with shock travel
EMI? Cuz EV
EV only rn – EnD scope – cruise control
EV cruise control was not the best but works? - little unsteady, still tuning pid, top speed?
Test conditions/test plan – flat ground, car setup, tire leaks, shock settings, spring stiffness? Etc.
Suspicious daq – need nodes?
Inverted data
+1 mph cruise control

Rediscuss timeline after car deadline

Points breakdown

-aero 2-3 points design prez + helps engineering
-suspension 3-4 points design

Hit list for leads
Define goals better
Narrow in on problems
Define desired hardware better (sensitivities, ranges etc.)

Goal: Have an actual plan that works for both VD and Aero for acquiring suspension data
Acquiring what data?
What makes an "actual" plan?
What is a working qualifier?

Subgoal:
Measure aero loads compared to the CFD models
What loads?
Placed where?

-Measuring Fz of wheel
-What resolution of Fz? Differences between packages, so thus- 1/2lb to 1/10lb to be able to determine the differences

Are these questions for the notetaker or the discussion on the meeting? I could infer, but mainly just writing stuff down lmao

Sammy is focused on damping data
Why?
What data?

Load cells are good for weight transfer across the car

Would this data come from shock dyno???

Shock dyno is live time of shock at potential points, instead of points at actual turns
Shock pot gives specific displacements for specific areas

If you had shock characterized, would you be able to use other sensors to get the displacements/info for dampening that sammy wants? What about accuracy?

Would load cells be beneficial for sammy?
-yes, but like don't necessarily need the data for what he wanna accomplish

What you tryin measure with load cells??

Shock pot issues
-lack of stiffness in mount? Ehhhh maybe? Not actually seen
-not linear..... Funky mount tbh
Why is non linear an issue?
It's not necessarily an issue, but if aero plans on interpreting the data as linear we will have to characterize the curve and adjust based on that- which may be tricky

-EMI? Bc EV? Is data good?
-EV only? Would like to do IC but like IC will be hard to implement in a steady state...
-Test conditions/test plan
-flat ground, car setup, tire leaks, shock settings, spring stiffness? And so on
-debate on the grading on the lot and if it's actually level, and how that affects the readings

Cost:
Load cells
-New pushrods
-4? New load cells with higher weights
-New amplifiers bc current ones are shit? Talk to Noah
-Code for tensy
-Board for tensy
-Wiring harness

Shock pots
-Would be nice to have new shock pots
-Would be nice to have new mounts
-Board may work? Needs diag. bc noisy data
-not measuring- drag, lift, center of pressure, etc
-measuring the combination of Resultant load on the tires and calculate that on the load

-Measuring dampening
-viable range of data?
-

Shock Pot- Displacement in difference scenarios
Have to have characterized springs to derive loads

Issues- No mount stiffness, Not linear to shock travel
Sensitive? What displacement reads what?
Shock pots on IC?
Need cruise control for IC + No ETB
No good cruise control for IC

Ev cruise control scuffed but better than attempt at cruise control

Need to 0 out car?

Angle does not change downforce produced but will effect measurement

Measure gradient and Difference in runs

Quantify slope/ Air

Load Cell- Good to have for weight transfer (For Y?)

Is there a Test Plan/ Conditions? Will require car setup
Why Load cell
Get rid of dampening

No Lag?

Hit rock ur data scuffed- More noise

Weight transfer from Load Cell

Data aqq issues

Voltage wasn't right

Front Shonk had long wires

Node system implementation?

Ease of implementation

Data points vs relation

Load cell better at data points but Shonks do relations

FW Tester has Load cell Setup

Needs to be on table?

Who to do?

Commitment to projects?

Timeline and Investment

Load Cell Implementation
New Load Cells
New Boards Maybe?
New Pushrods
New Code

Shonk Ponts
New mounts that don't deflect (Larry Mounts)
Needs better Code
Needs Diagnosing
Shock Tab Intervention

LV Can't do until car can run

Summary- Discuss after Deadline/ Built Car/ Flushed out car

Looking for resultant load on tire as seen in cfd to compare to previous cars

What resolution are we looking for

Differences measured in 1/2 to 1/10 of a Lb for areo comparison

What area do we need for Dampening Data in terms of hertz and Displacement

Find range for Cruise Control

What conditions for Test plan

Characterize EMI

Need to flush out the plan for Data Aqq

What is the SMART criteria?

S	Specific	What will be accomplished? What actions will you take?
M	Measurable	What data will measure the goal? (How much? How well?
A	Achievable	Is the goal doable? Do you have the necessary skills and resources?
R	Relevant	How does the goal align with broader goals? Why is the result important?
T	Time-Bound	What is the time frame for accomplishing the goal?

Aero/Comp 1/11/2023

Wednesday, January 11, 2023 9:24 PM

john

grayson

joey

nathan

andrew

Body 1 – layed up but needs prep – patches, wrinkles need to be chiseled and sanded – then clear coat and finishing

Body 2 – 1 week+ for layup – then body 1's steps, using weaved trips on corners

Have 3 wing molds for MPs, need RW lower machined, john needs to solve cam problem – add mdf under (2 layers)

Need RW 3,4 u&l machined

Need spar inserts machined x8

Pushrod inserts

Etching

Muriatic acid? concentration + base or NaOH + acid

Hold off on FW uppers stil everything else layed up so we can use the scraps, doubled check lengths with cad

Endplates ready to be layed up

3hc3 for rw 2hc2 for fw

Circle inserts made, oval not

Quadruple check orientation when bonding the inserts

UT – need to acquire 3x2" sheets foam + spray adhesive

Heat up resin, weigh resin drum

Resurface swiss cheese (1 at a time)

IC floor waiting on seatbelt tabs & pedal box

Need tube stock

Resin pump

Vacuum pumps

Trim body

End plate trim

Vinyl subgroup

Aj fix mount

Aero Meeting 1/26/23 Manufacturing Timeline

Thursday, January 26, 2023 10:28 PM

Attendance

Nate
Andrew
Joey
Willian
Aj
Sam

Tardy

Heily
Grayson

Nate
Feb 28 for FW & RW on car – ambitious – march 15 realistic

Waiting on for FW RW
-inserts
-6061 plate
-rw elements machined

Feb 3

9 days of layups

Feb 12

3 days of trimming

4 days of finishing

Feb 19

Bonding – 4 days
Inserts in endplates
All upper ribs
Upper ribs
Upper skin
3 days for MPs

Feb 23

5 days to spare

2 days of assembly and fitting to car

Feb 25

3 days to spare

Rw mp upper

rw 3 upper and lower

Rw 4 upper and lower

ut

Aero Meeting 1/22/23

Sunday, January 22, 2023 1:27 PM

Desired PC Specs

4+gb/core ram

4cores/channel of ram

32 gb ram for half car, 64/128 minimum for full car

Master Plan

Attitude sensitivities – pitch-we can do in half car(need centers), roll (need centers), yaw

Establish real attitudes and speeds – daq – 3+ laser or ultrasonic sensors

For df testing – load cells + test plan

Camera footage (yarn tuff) Velocity correlation with df, attitude

Design Event

Buzz word characterization

Basic sensitivities

Start with pitch

Yaw

Then roll

Ride height sweep

Then velocity sweep at flat attitude

7E-car

Finish model

-cfd body

-solid tubes

-suspension

-kill switches?

-double check wheelbase

-yoke

-firewall

-tsal

priority

-UT

-RW redesign

-FW redesign

-downwash?

-side wing?

STAR lessons

Upload vids

Come up with lesson date – 2/3/23

Shock pot problems

Deflection in the mounts – right length problem

Flat ground

Level car

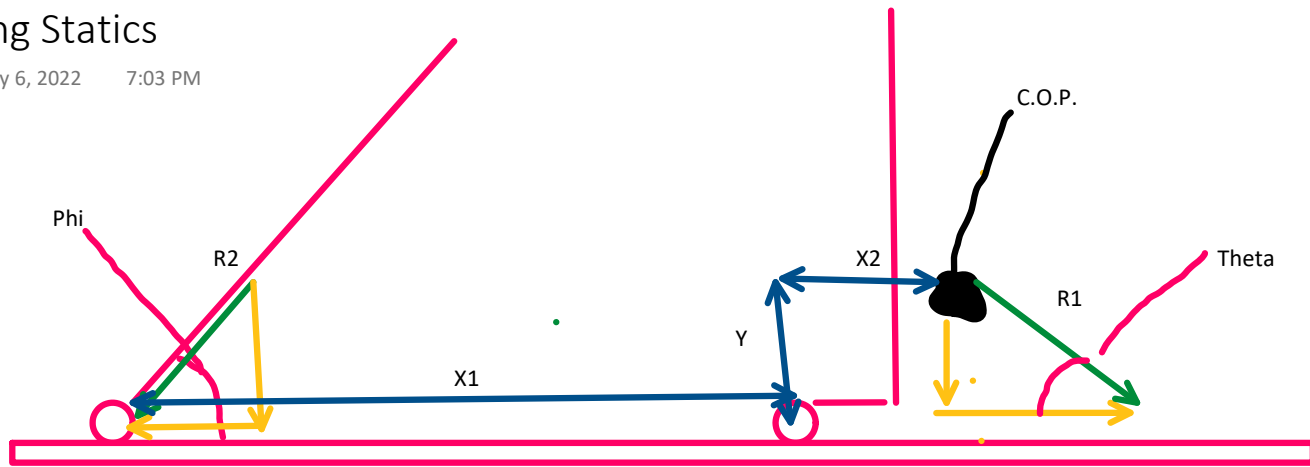
try soft and stiff springs for testing – minimum damping – load cells be better (300 lbs)

Establish corner speed average – output shaft
Voltage equalizing across long line – daq nodes to minimize line distance
EMI from tractive system?

Sponsors

Test Wing Statics

Sunday, February 6, 2022 7:03 PM



R2= Force load cell sees
R1=Downforce and drag resultant vector

Assumptions:

- Relationship between drag and downforce are the same as the sim
- Location of C.O.P. is the same as the sim
- Pinned connection at the rear has no frictional force

$$R2 = [R1\sin(\theta)X2 + R1\cos(\theta)Y] / [\sin(\phi)X1]$$

$$R1 = [R2\sin(\phi)X1] / [\sin(\theta)X2 + \cos(\theta)Y]$$

-Use sine and cosine to find downforce/drag

For current FW:

Phi = 54.568 degrees

Theta = 60 degrees (assumed)

X1= 5 inches

X2= 7 inches(assumed)

Y=2.25 inches(assumed)

R1=

2021 Flowchart

Friday, August 13, 2021 7:24 PM

Hotwire Cutter Things

Thursday, December 9, 2021 3:50 PM

Rails

<https://www.amazon.com/1000mm-Linear-Guide-Rail%EF%BC%8CMGN12H-Length/dp/B07NZZ2ZM2> (\$350)

https://www.vevor.com/products/2x-linear-rail-hgr20-1000mm-4x-blocks-ball-screw-rm1605-1000mm-bf12-bk12-cnc-set?_pos=1&_sid=65736e0a5&_ss=r (\$240)

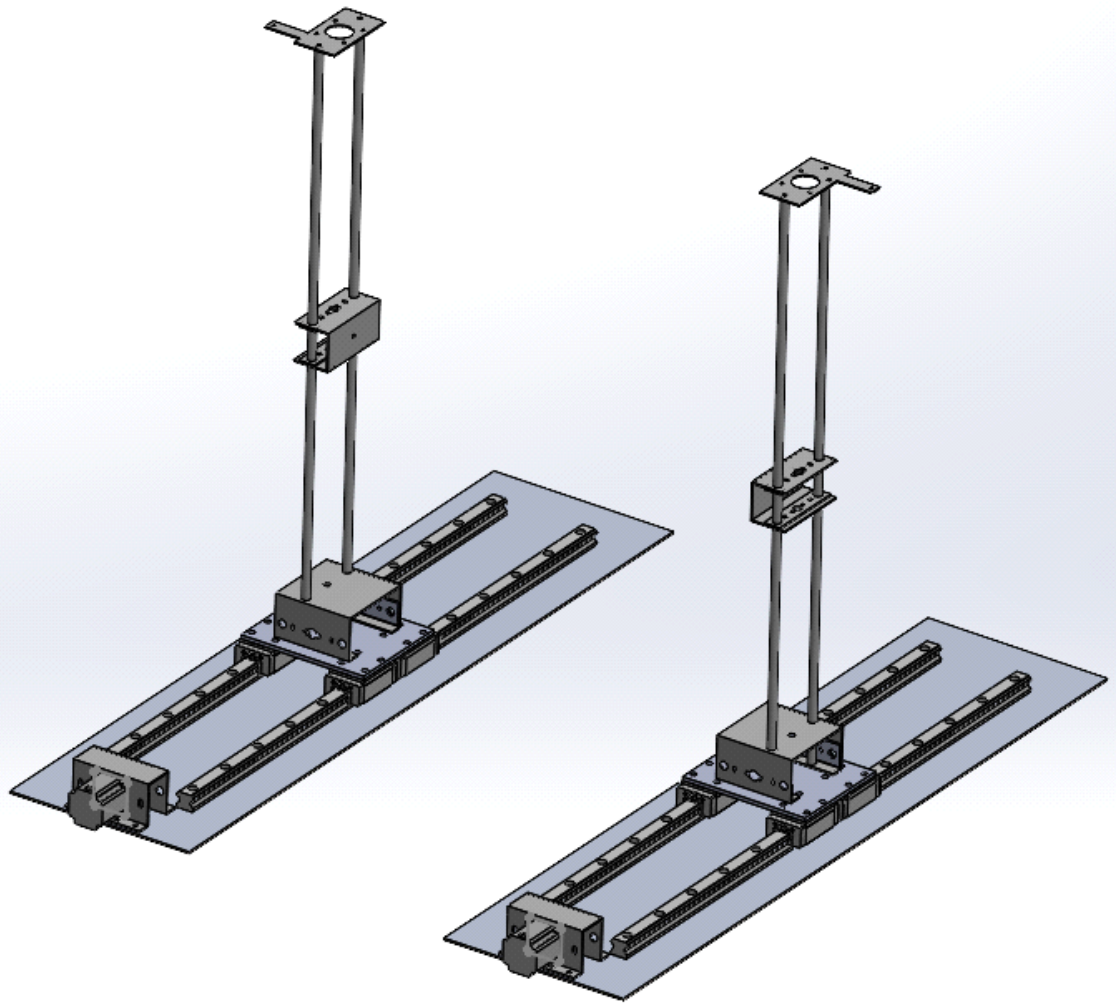
Steel for plate is expensive. Maybe consider 1/8" aluminum instead. (\$128 vs \$376)

We can remake motor mount plate to get correct height
Could use standoffs if it's stiff enough

Should probably remake the Delrin bushings for the ACME thread rod
Maybe do square since round is shitty. SHOULD have some already
Need custom tool for this or buy expensive tap (\$93)
<https://www.mcmaster.com/taps/thread-type~acme/thread-size~3-8-12/>

Could also get new lead screws since they're a bit wonky (Less than \$15 on mcmaster)
<https://www.mcmaster.com/98935A217/>

Do we need to provide nicrome wire?? (24 gauge) (\$15)
<https://www.mcmaster.com/8880K77/>



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 and explain them.

Prepping models:

To prepare for importing to solidworks ensure that the model does not have 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 problems 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 and reduce the mesh complexity.

Importing models:

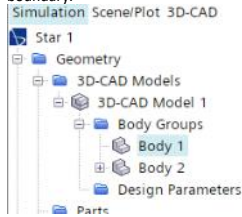
There are a few methods to import models. There are three different import options. Import into 3D-CAD model, import mesh, and import CAE Model. Because we are using STAR CCM+ built in mesher and the CAE model import option is a Siemens exclusive file type the import that is being used is import CAD 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 turbulence the car produces goes back to free stream before it encounters the outlet boundary.



Regions:

Prior to meshing every part that you are going to 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

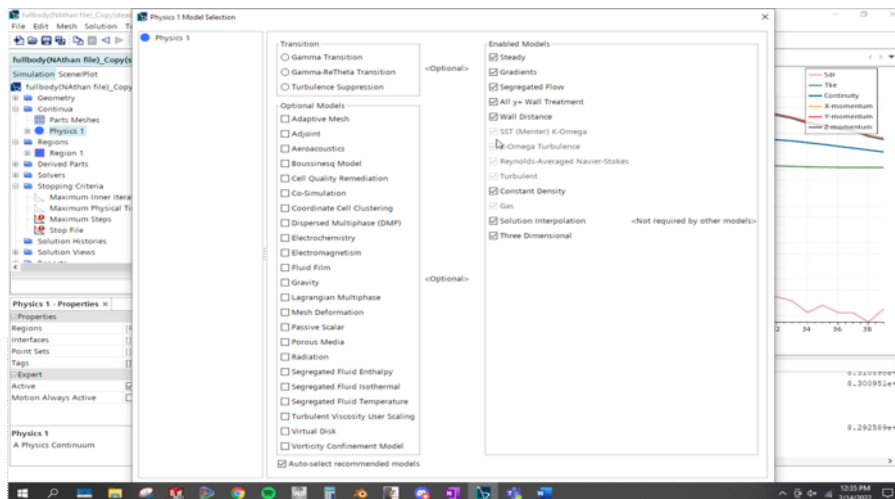
Meshing:

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 errors due to the way in which the chassis tubes are modeled with surfaces.

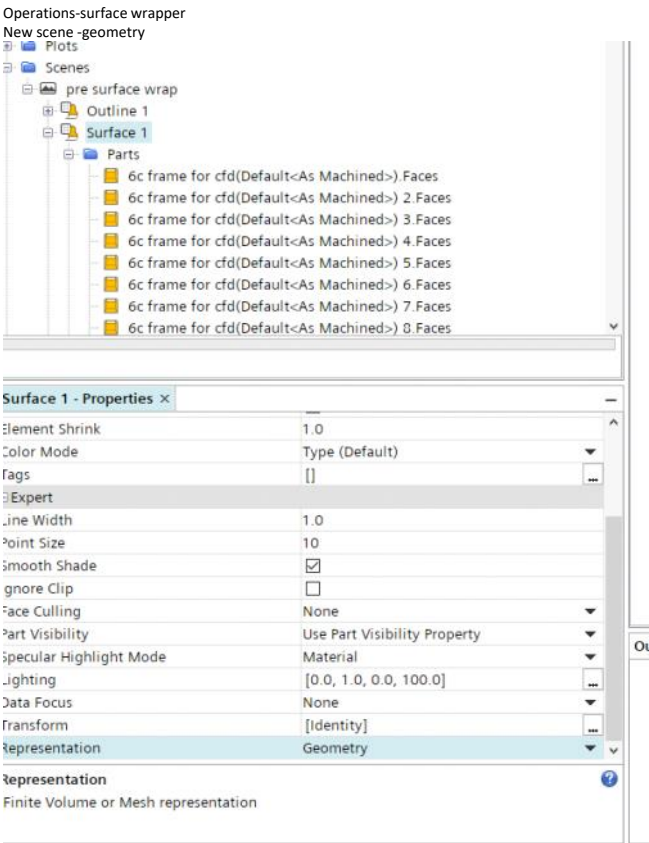
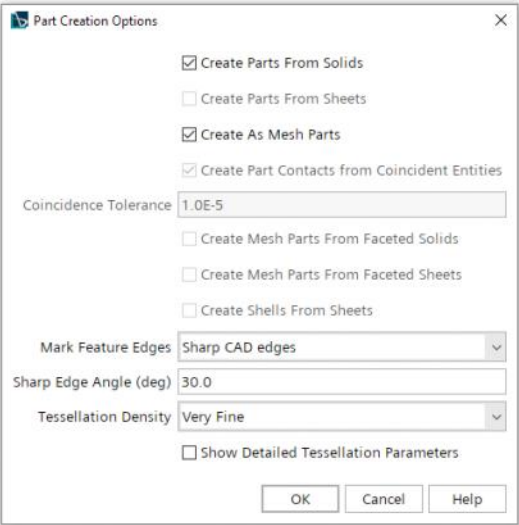
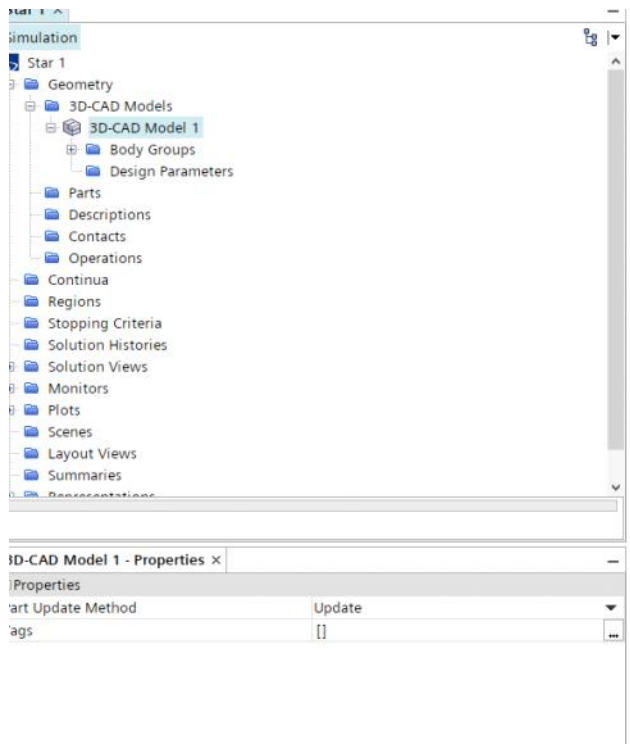
Physics Continua:

The physics continua is what determines the physics and solver for the simulation. For our situation. For the simulations you should select the following physics 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 are too 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.



Star 1 x

Simulation Scene/Plot Edit

Create Block Part

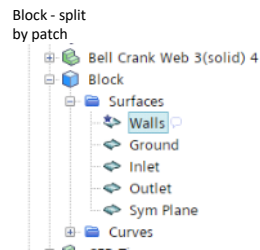
☐ Snap to Part

Maximum and Minimum Coordinates

	Corner 1	Corner 2
X	-1.9144426206012146 m	-0.10555737931070546 m
Y	0.0 m	3.6465573727261225 m
Z	-21.90737701135356 m	6.90737701135356 m

Coordinate System

Laboratory



Add block to surface wrapper in operations

Add proximity refinement
Mesher execution - serial

Base size = .05m
Disable cad projection

Target surface size .005m

Min surface size .001m

Surface curvature
72 points/circle

Surface proximity 8

Custom controls-surface control

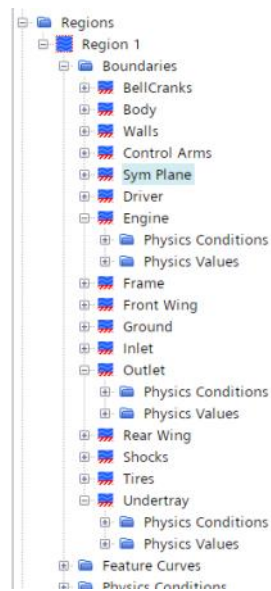
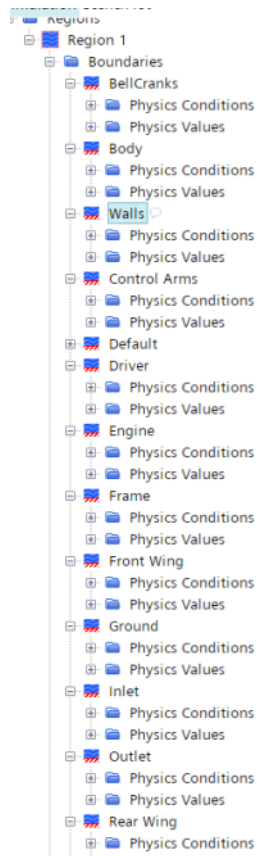
Assign surface wrapper bodies

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

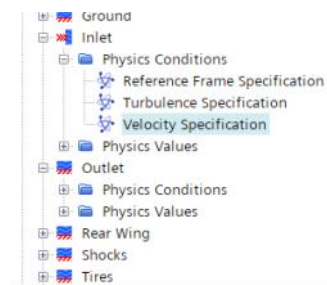
Input parts-surface wrapper

Continua-new-physicsmodels-select models-3d-gas-segregated flow-constant density-steady-turbulent-
komega

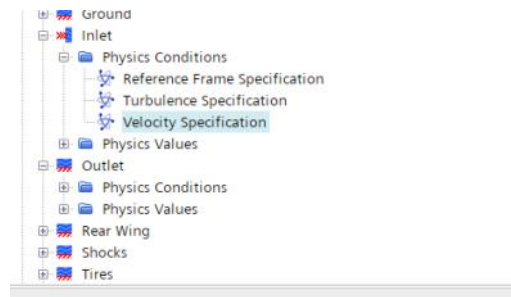
Regions-new region-new boundary- make a ton of them



Adding surface wrapper to region 1



city Specification - Properties x

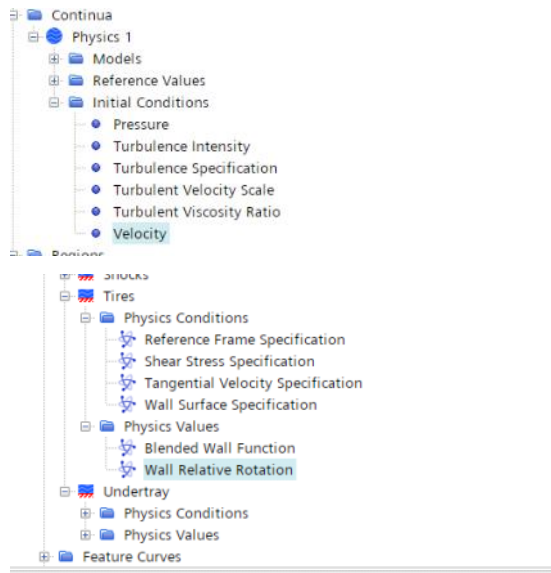


Velocity Specification - Properties	
Properties	
Method	Components



Velocity - Properties	
Properties	
Method	Constant
Value	[0.0, 0.0, -40.0] mph
Dimensions	Velocity
Coordinate System	Laboratory

Outlet-pressure outlet



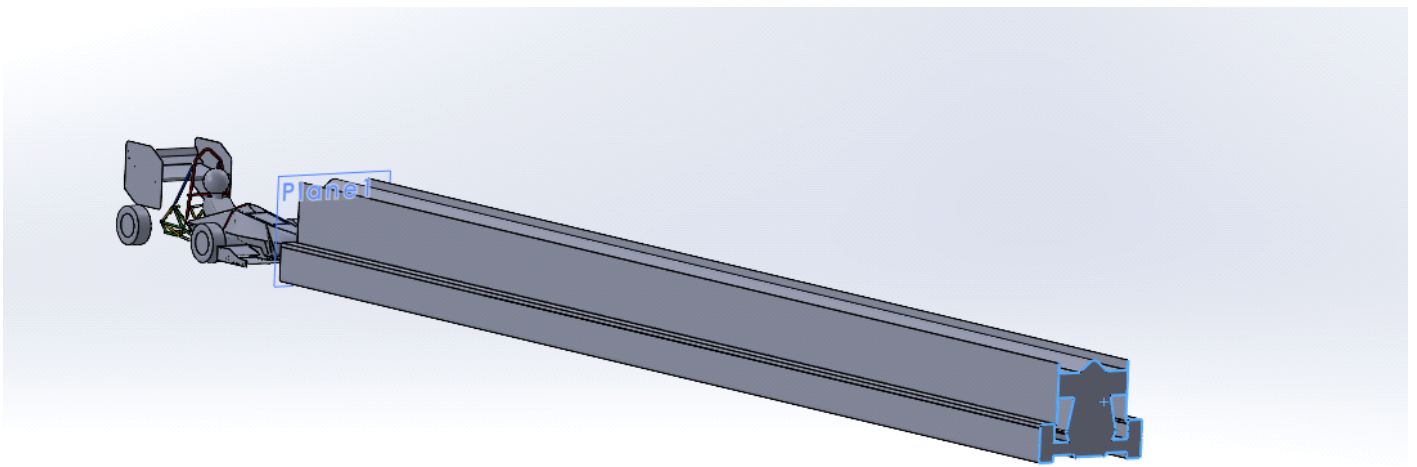
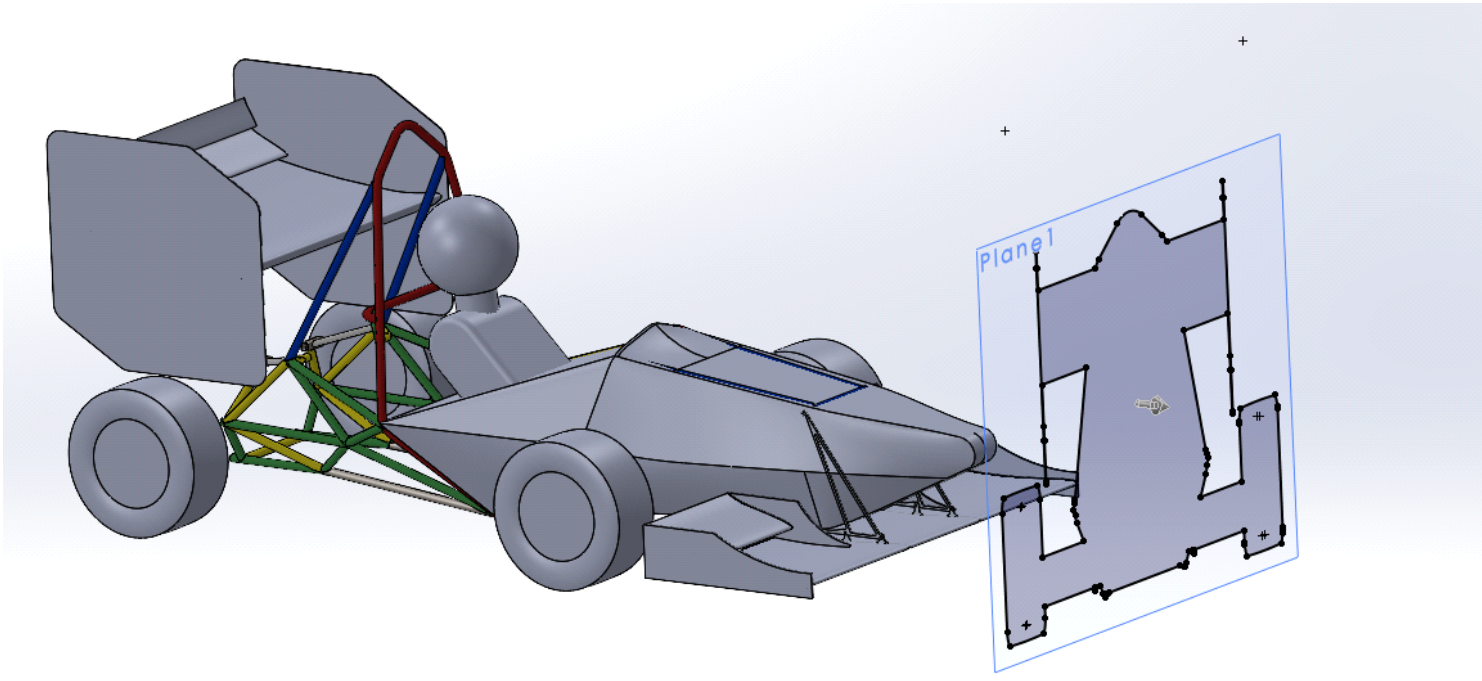
Wall Relative Rotation - Properties	
Properties	
Method	Constant
Value	70.0 radian/s
Dimensions	Angular Velocity

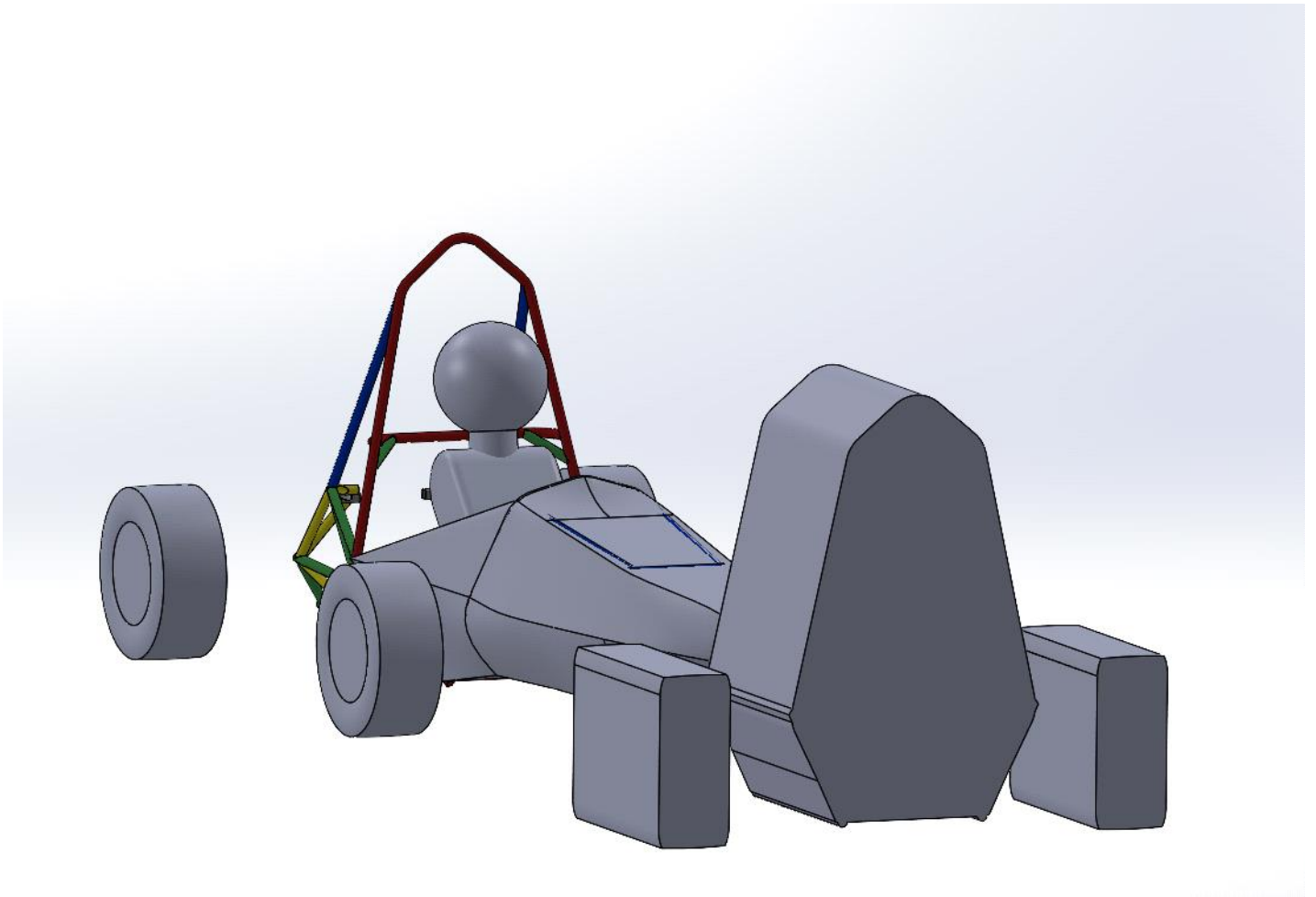
GENERATE VOLUME MESH ONCE ALL BODIES ARE ASSIGNED TO A REGION

How to: frontal area

Tuesday, June 28, 2022 7:12 PM

Make a plane off the front of the car of the front plane view
Get in a sketch on that plane
Go to tools and sketch tools then silhouette entities
Grab all bodies and solve the sketch entities
Extrude and use measure for the area of the face plane
This is an overestimation due to it being the outer area so holes don't get subtracted





Ks5
Aero-1581 sq in 1.02 square meter
1161 sq in .749 square meter

1/14/22 Wing Tester

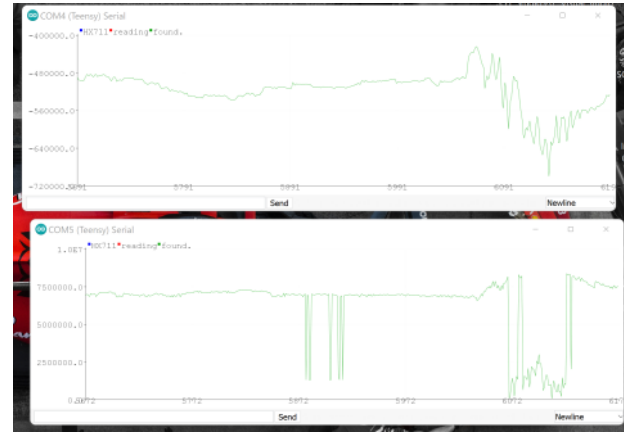
Monday, January 17, 2022 3:54 PM



WingTest
(2)



FW Test 1



Hotwire Cut Foam Core Pro-Con

Friday, January 21, 2022 2:56 PM

Pros:

Cheap
Process exists
Easy/not so time consuming

Cons:

2 Inch foam not thick enough for mainplanes
Pre made slices in stock (from manufacturer) show up in final part
Envelope bag creates bubble on front edge
Foam warps
No cut repeatability (high tolerance)
Waviness
Often lose foam when prepping the blocks to be cut (breaking the sheet into blocks and it doesn't cut clean)
Rib to foam bond fail
Male mold means poor surface finish relative to female
We have to schedule with aerial to use the cutter
Limit on trailing edge thinness

3d Print Pros/Cons

Pros:

Do female mold for good surface finish (Most imperfections will show up on the inside)
Hollow with bonded aluminum/carbon rib/spar structure so lighter
Better tolerances and repeatability will create better fit and finish
Allows thinner trailing edge
No special machining skills required

Cons:

More expensive
3D print take time
May need access to larger printer for larger parts (Same process if you did MDF though so that's a possibility for larger parts)
Low volume (not good for our 5 test wing plan but this should not be done again)
2 Layups instead of 1 per wing

Vinyl

Wednesday, January 26, 2022 11:52 AM



https://www.amazon.com/GLOSS-BLACK-Application-Vinyl-Vehicle/dp/B078X4JS4D?ref=ast_sto_dp&th=1 (Sterling Silver)

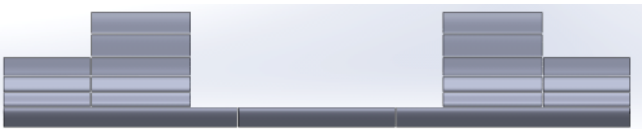
<https://www.rvinyl.com/3M-7125-Scotchcal-Electrocut-Graphic-Film-Bright-Yellow-15.html>

<https://www.rvinyl.com/3M-7125-Scotchcal-Electrocut-Graphic-Film-White-10.html>

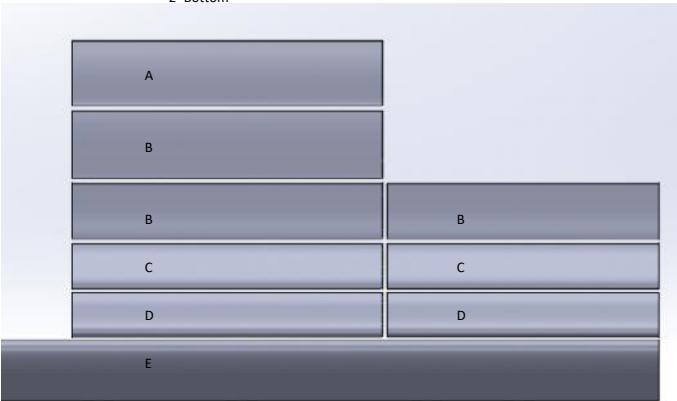
Swan necc

Wednesday, January 26, 2022 6:02 PM

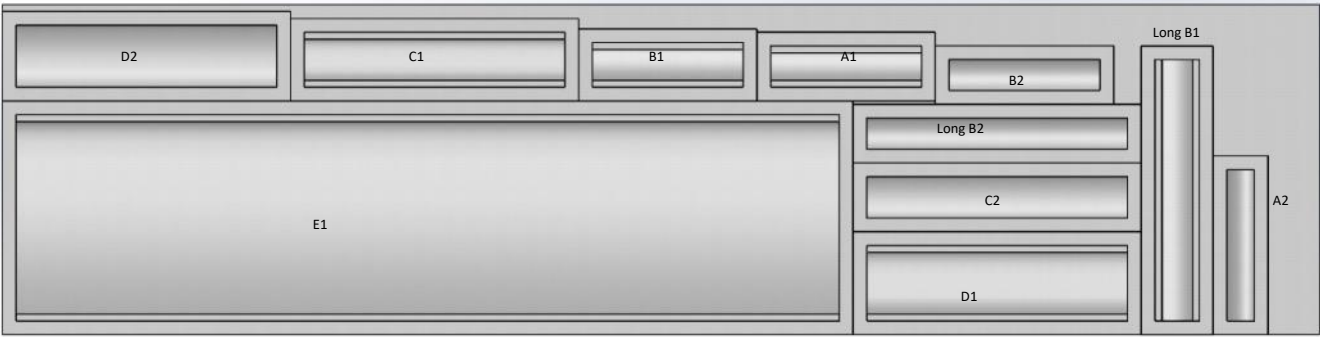
Ks5c swan neck 3.176 fos at .39" thick (1 mount full load) .817lbs per



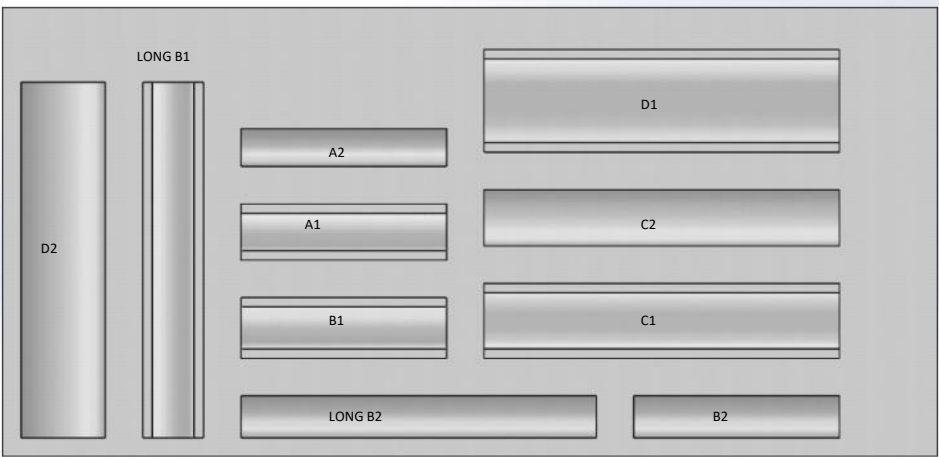
1=Top
2=Bottom



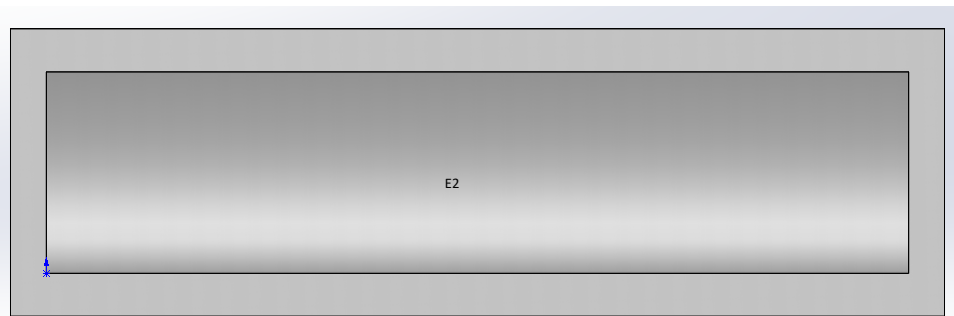
12



24"x96"x0.75"
(Full sheet)



24"x50"x0.75"



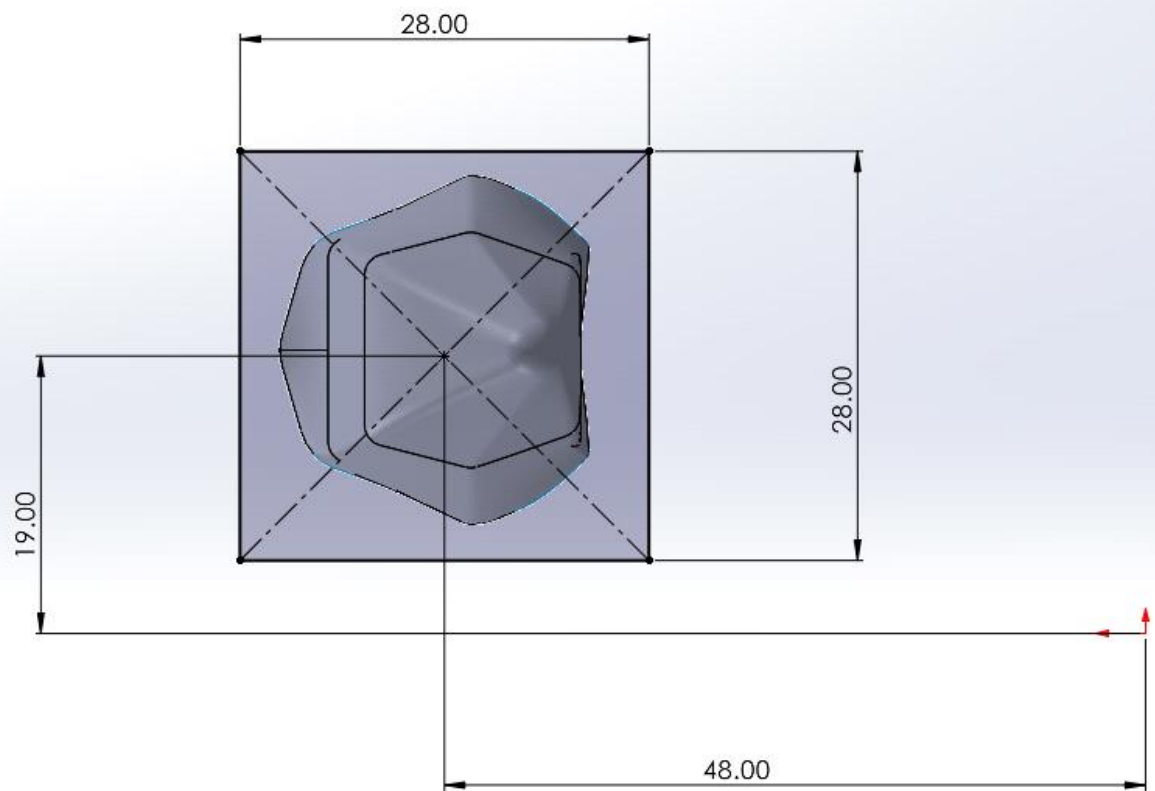
65"x20"2.25"

3 sheets thick

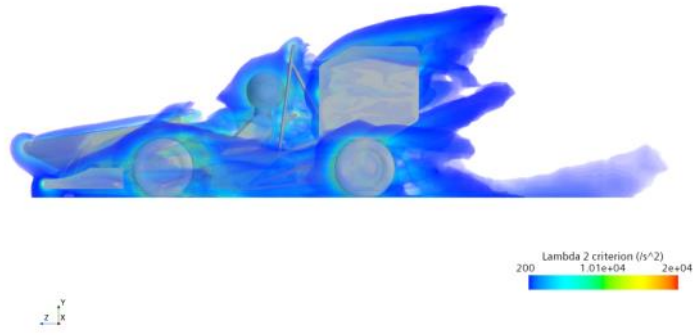
Expected weight: No less than 5.265 lbs

Fall2022 Body Mold

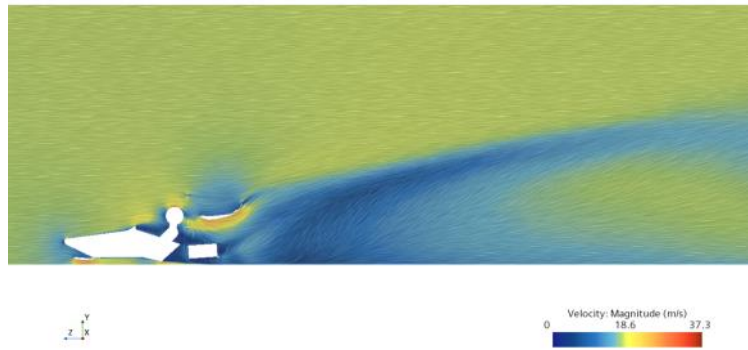
Friday, July 29, 2022 1:44 PM



StarCCM+ 12.02.0000



Simcenter STAR-CCM+



Vinyl Order

Monday, January 31, 2022 11:06 AM

<https://www.rvinyl.com/3M-7125-Scotchcal-Electrocut-Graphic-Film-Medium-Gray-31.html> (24" x 84") \$49.99

<https://www.rvinyl.com/3M-7125-Scotchcal-Electrocut-Graphic-Film-White-10.html> (24" x 120") \$70.99

<https://www.rvinyl.com/3M-7125-Scotchcal-Electrocut-Graphic-Film-Bright-Yellow-15.html> (24" x 84") \$49.99

(\$170.97)

(May also be enough for both cars. Probably will need more white)

Wing construction

Tuesday, March 1, 2022 9:31 PM

Exp: current baggin near hard corners creates bubbles and creases creating issues on foam core wings.

Reasons for endeavors:

Regarding hollow

Remove cresses and marks on air touch surfaces. And reputability.

More design fredom

Look for sharper trailing edges

Make wings with less man hours

- To prve we log foam wing man hours
- Log current test wing hallow89

Tested 5% and 10% infill pla with 2 walls, not very different stiffness in any mode

Made mandrel 3 walls 25% infill, sanded to smooth, very good success, 10 minutes of work. Use tamiya modeling putty on surface

Sharp trailing edges, good dimensional accuracy

Rear Wing Tester

Wednesday, March 2, 2022 5:34 PM

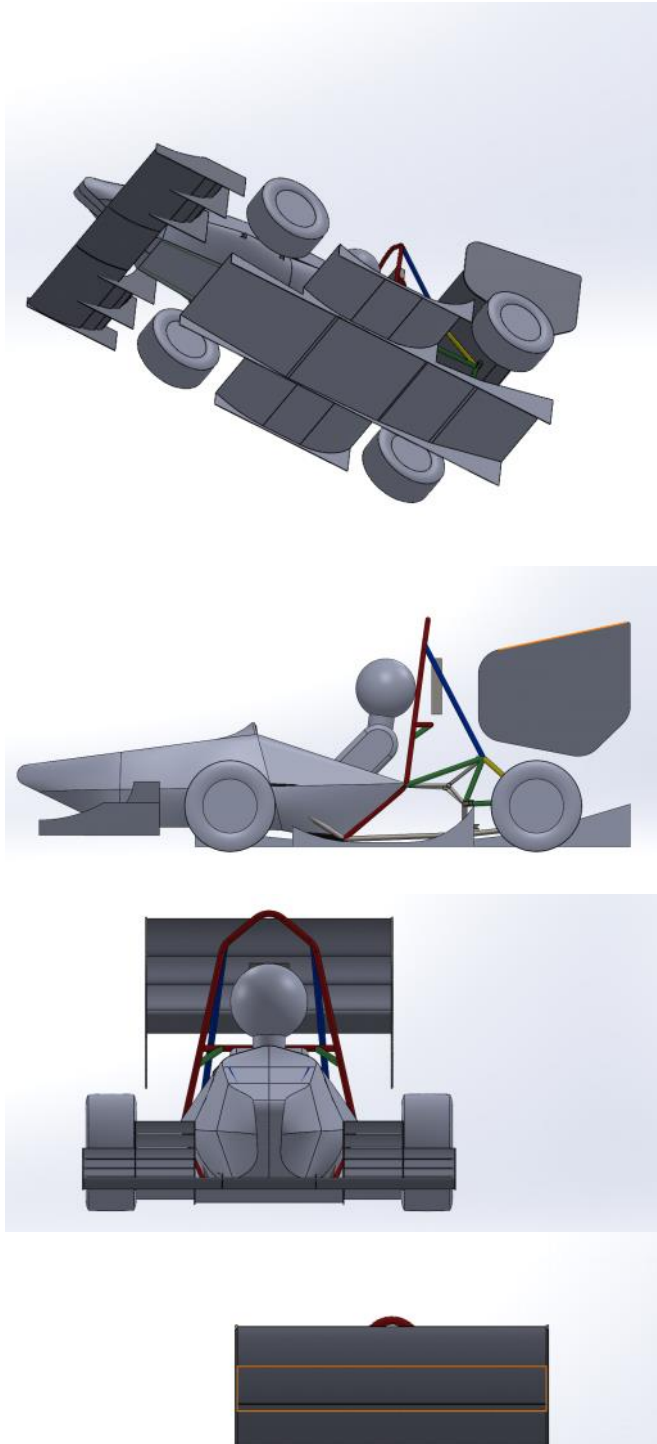
Undertray Design

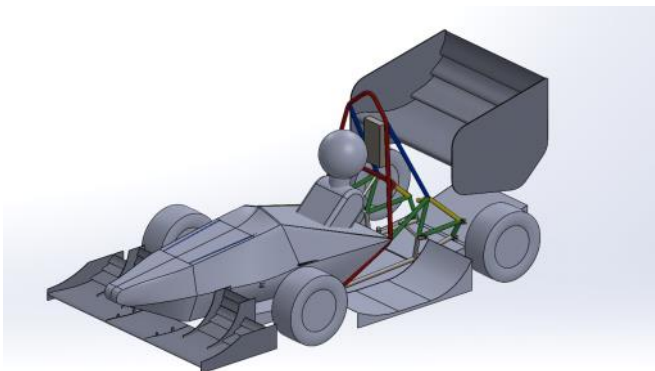
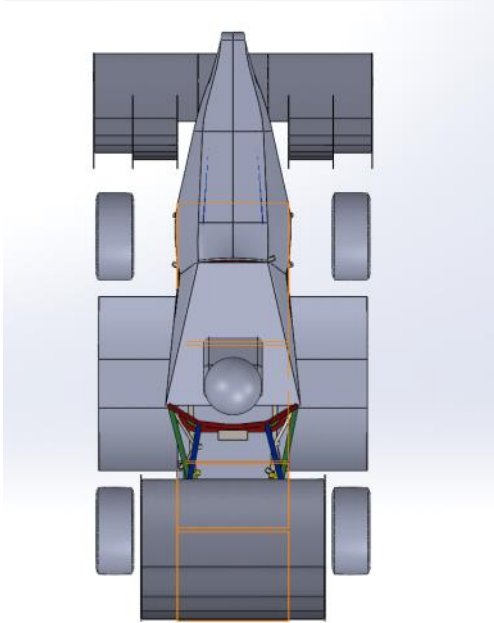
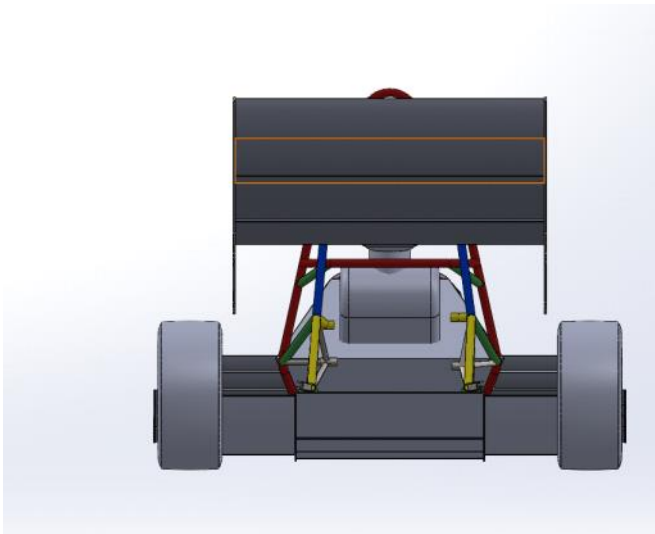
Monday, July 11, 2022 10:21 PM

First Concepts

Concept A

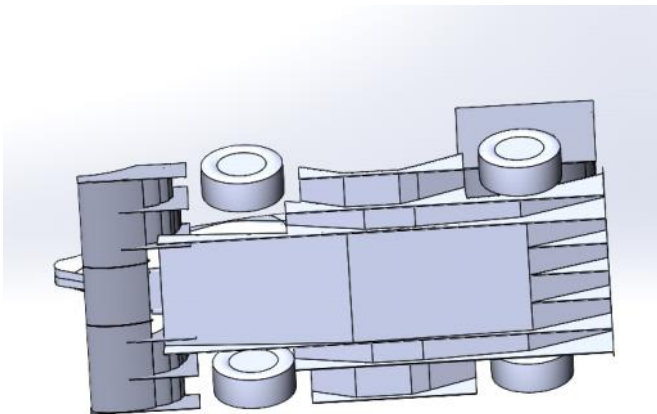
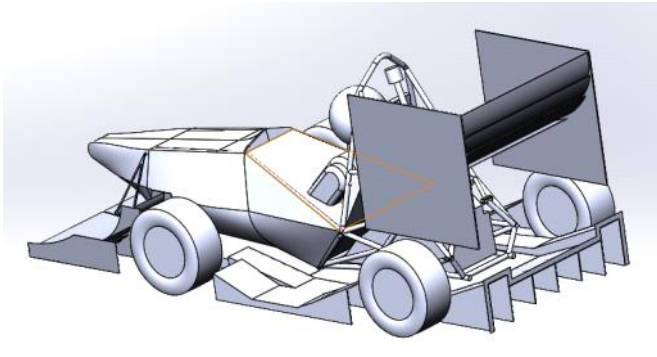
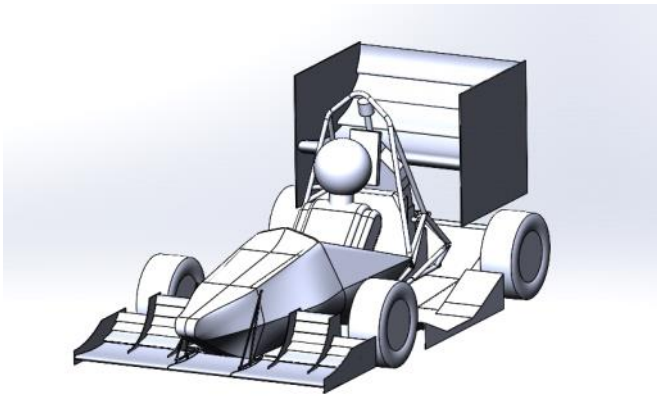
At this stage, this concept has not been in CFD but the basic idea was to have an inner section under the body and chassis that follows the constraints of it and an outer section that has more height freedom. The model is designed to fit in the aero box, avoid collisions with steering and control arm droop, allow some space for possible anti-roll bar(s), and allow iteration in CFD. This model needs ride height studies along with inlet/outlet studies. Another point of interest is feed and interaction from the front wing. One point of interest on this design is the theory that curvature might help allow a smoother flow but this is unproven. We are also interested in the possibility of adding winglets to the back of the diffuser as well as strakes underneath the car and the effect they would have. We will later consider studying the effects of front wing vortex generators and how they may help maintain undertray downforce. Other important studies might include roll, pitch, and yaw studies as the undertray is sensitive to all 3 of these conditions.

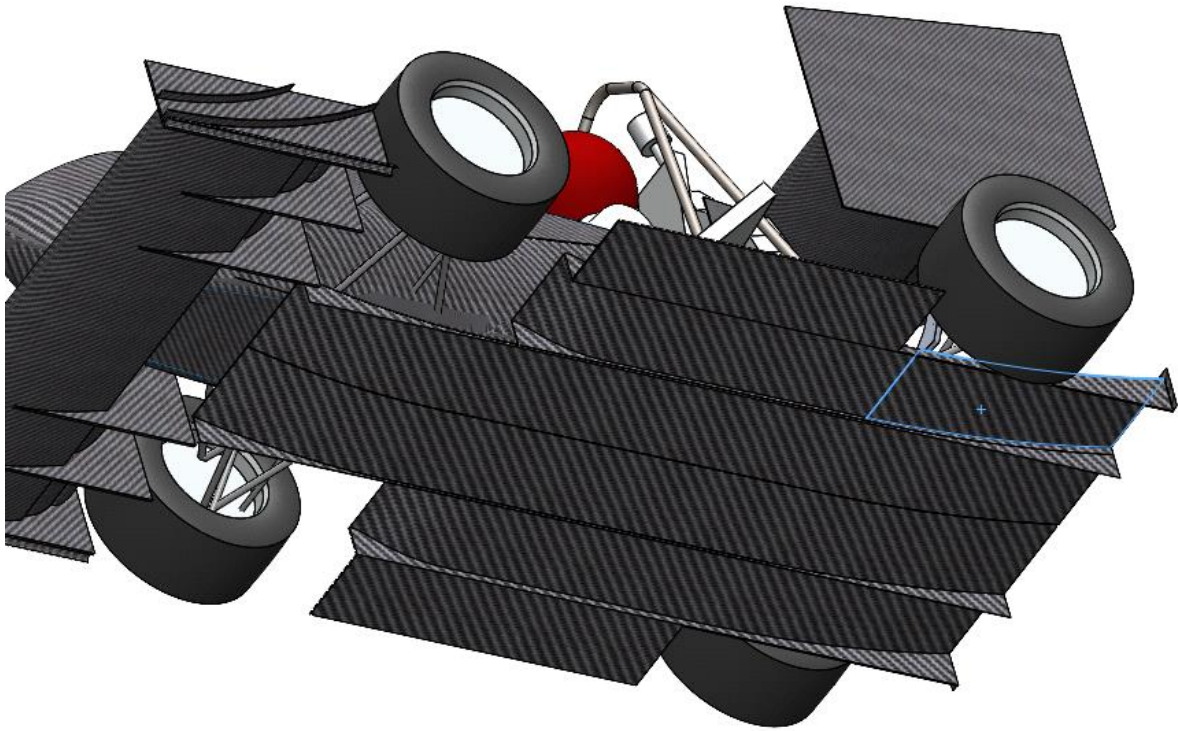




Concept B

This concept has similar design goals to concept A. It includes 3 sections but no curvature for more simplicity. It also includes strakes and a Nolder NX along the trailing edge of the diffuser section. One idea we had was to extend the section between the wheels and the chassis to have a 2nd smaller inlet that feeds from approximately where the front wing is through under the control arms and into the main undertray where its flow combines with the existing intake. One thing to note is we don't know if the outer section will see any air.





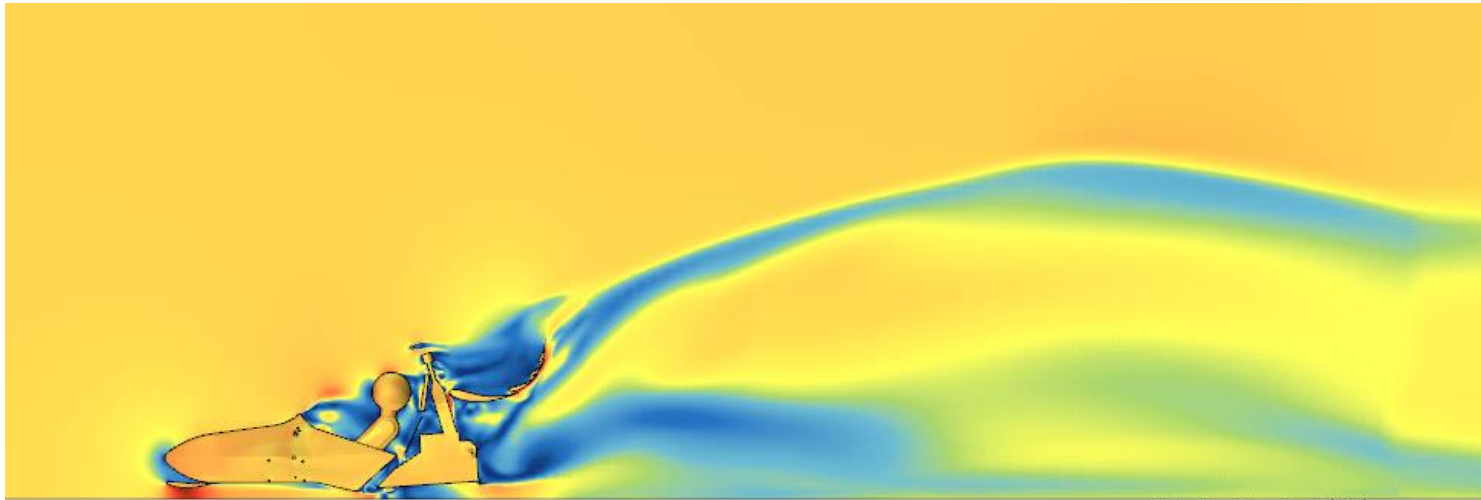
New Body Data

Thursday, August 18, 2022 10:51 AM

Body	Total CL	Total CD	Body CL	Body CD	Total Lift	Total Drag	Body Lift	Body Drag	
Old									
Low									
Mid	2.15	1.81	0.158	0.174	-96.2	68.6	-7.08	7.79	
Alt Mid	1.68	1.42	0.039	0.128	-77	64.2	-1.78	5.84	
High	1.76	1.54	0.044	0.137	-78.65	59.48	-1.99	6.13	
Alt High	1.63	1.40	0.008	0.120	-74.6	63	-0.373	5.48	

OG Goals:

Mid Nose



Mid Nose Alt

Vinyl Subgroup

Sunday, August 28, 2022 11:15 AM

<https://uscutt.com/24-oracal-651-intermediate-calendered-vinyl/>
<https://uscutt.com/GreenStar-Layflat-Classic-Transfer-Tape-Medium-Tack-Assorted-Widths/>
<https://uscutt.com/oracal-squeegee-w-felt-tip/>
https://www.amazon.com/3M-KTS-DL1-Design-Line-Knifeless/dp/B00UJ35G2/ref=sr_1_5?crid=19YATD9TZ8IQA&keywords=knifeless+tape&qid=1661806244&sprefix=knifeless+tap%2Caps%2C69&sr=8-5
https://www.amazon.com/3M-KTS-DL1-Design-Line-Knifeless/dp/B00UJ35G2/ref=sr_1_5?crid=1IZYKFBZNCDE&keywords=knifeless+tape&qid=1661713273&sprefix=knifeless+tap%2Caps%2C97&sr=8-5

022 Yellow 24" x 50 yard (125.99)

072 Gray 24" x 50 yard (125.99)

010 White 24" x 50 yard (110.99)

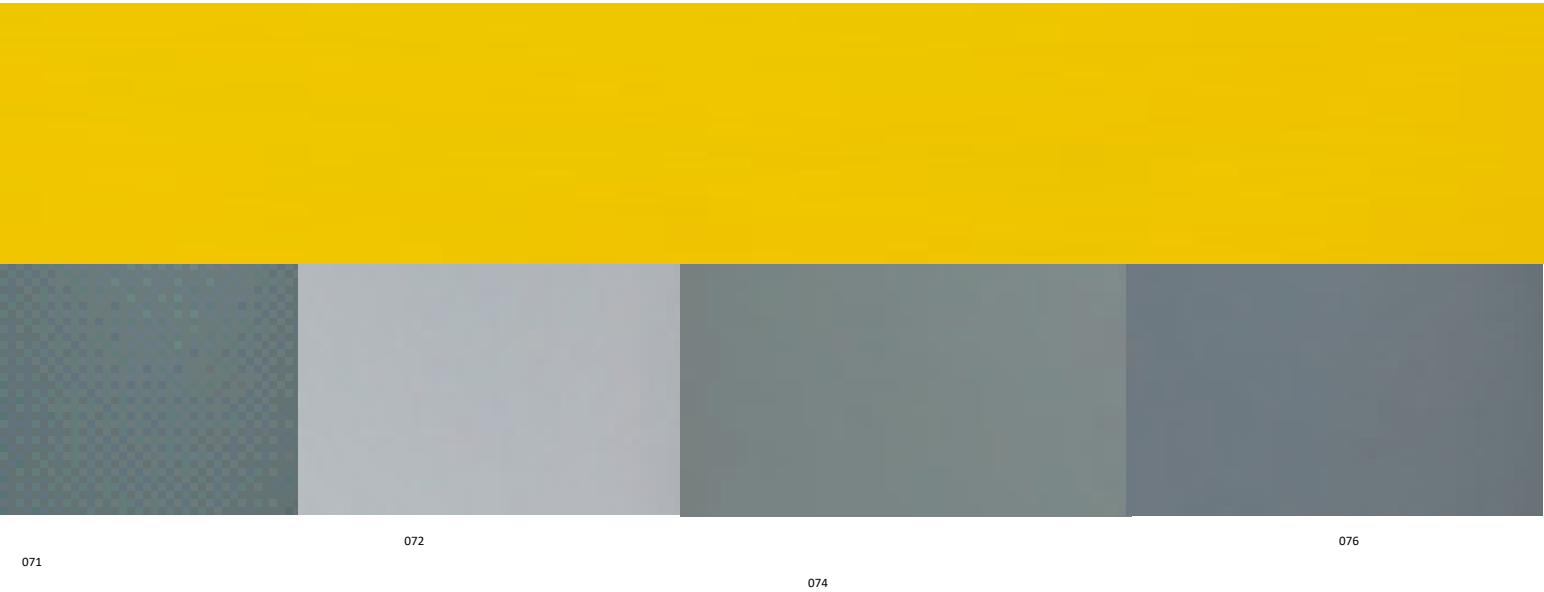
070 Black 24" x 10 yard (27.99)

031 Red 24" x 10 yard (30.99)

034 Orange 24" x 10 yard (30.99)

Transfer tape 20in x 100 yards x 2 rolls (114.18)

Total: 567.12



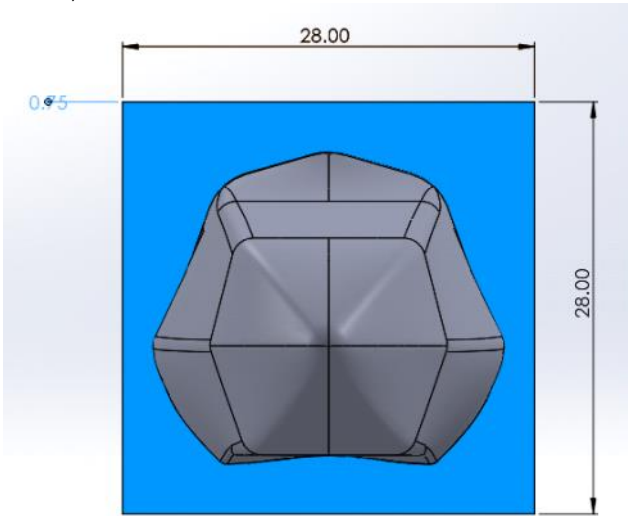
Body Stackup

Tuesday, September 6, 2022 10:02 PM

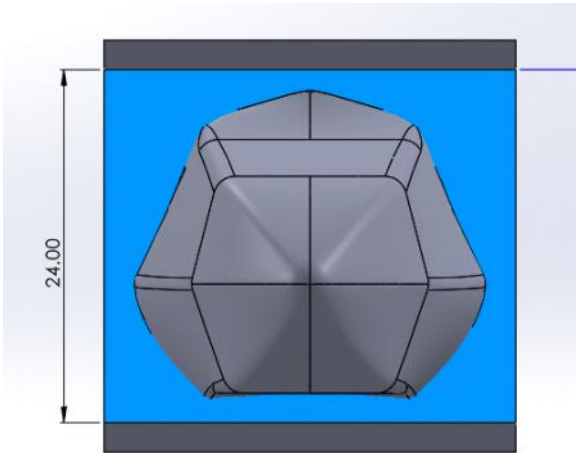
Layer	Size (in x in)		
Bottom	28x28		
1	24x24		
2	24x24		
3	22x24		
4	20x24		
5	18x22		
6	18x18		
7	12x14		

- All locations are either centered or coincident with obvious edge
- All blocks are 8" thick and machined down to 7". Stackup pictures and locations are of 7" tall pieces

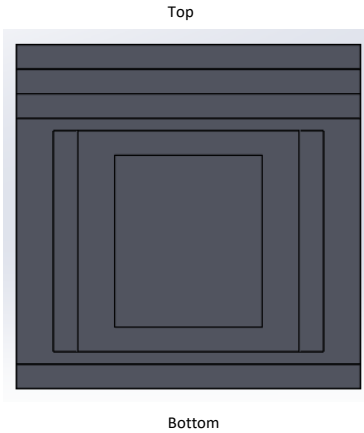
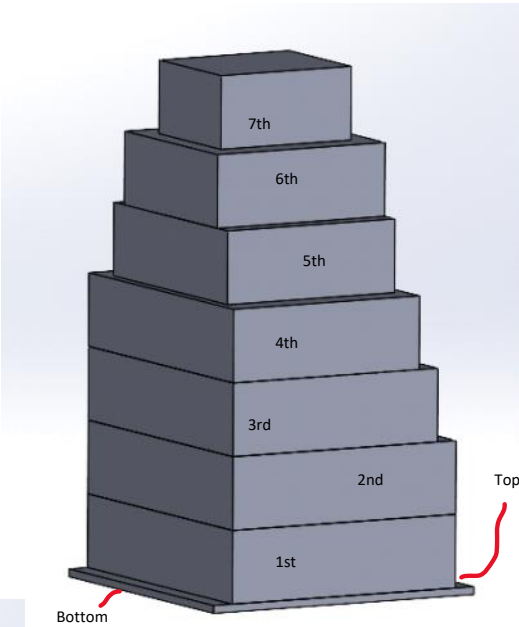
Bottom layer

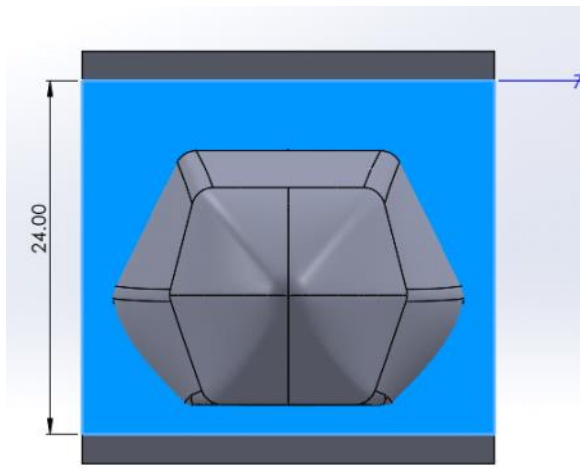


1st

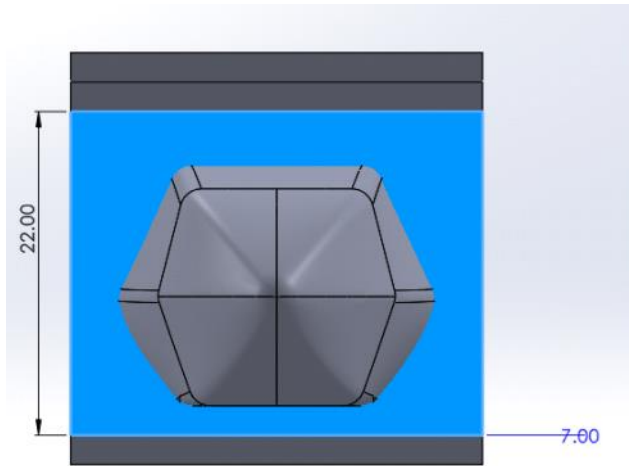


2nd

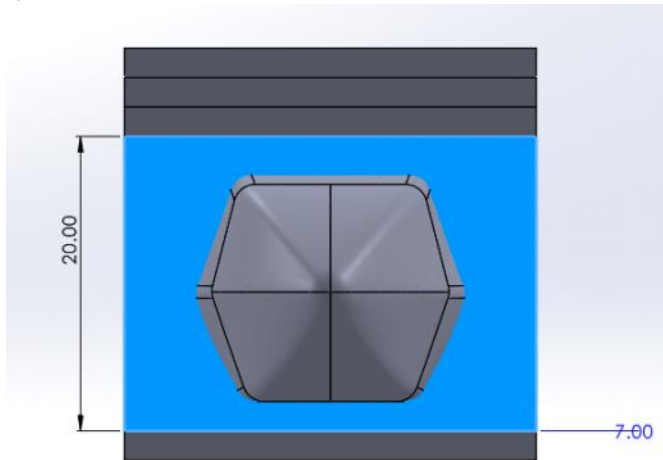




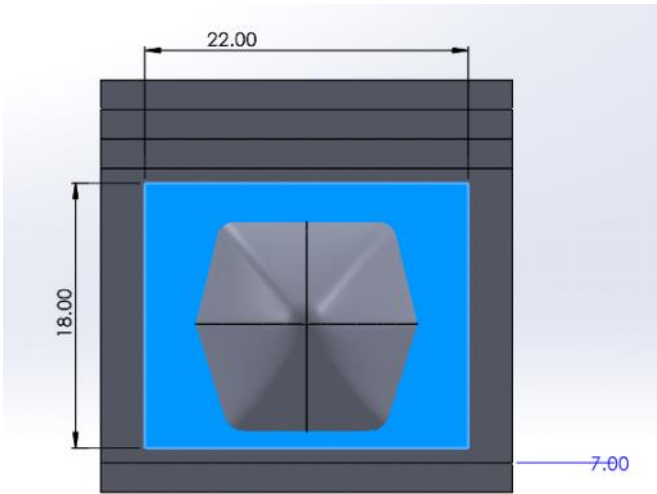
3rd



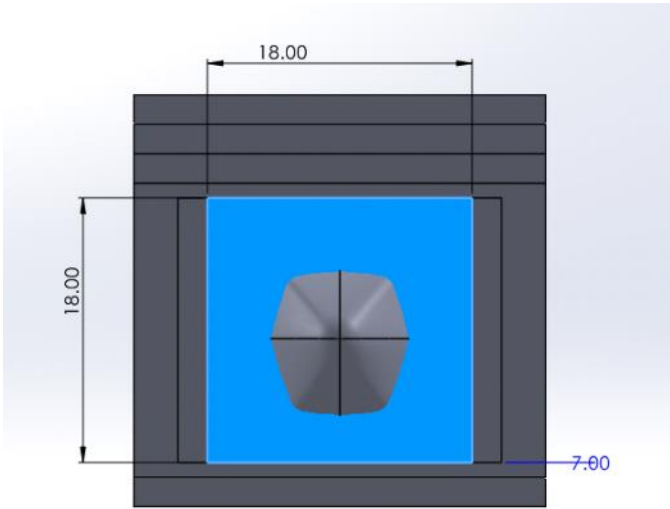
4th



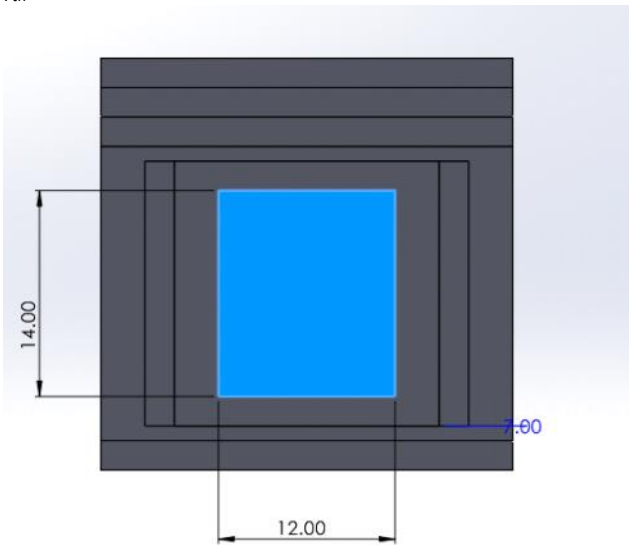
5th



6th



7th



Wing Structure

Tuesday, September 6, 2022

11:20 PM

Front Wing

Cone Hit Load Case

Assumption - Inelastic Collision

Car = 460 lbs

Car speed = 60 mph

Cone = 5 lbs

Collision = .005 seconds (arbitrary)

Force = 65 lbs

$M1v1 + m2v2 = m3v3$

Design for FOS: 2 (subject to change)

Apply as point load between ribs and at the most outboard part of the span

Deflection is acceptable so long as the wing does not impact the tire, or any other critical item

Aerodynamic Load Case

Assumption: 5 lb wing

60 lbs df

15 lbs drag

Assumption: equally distributed

.5" Max deflection from mid plane to end plate

FOS: 2

RW

Aerodynamic Load Case

Assumption: 8 lb wing

115 lbs df

40 lbs drag

Assumption: equally distributed

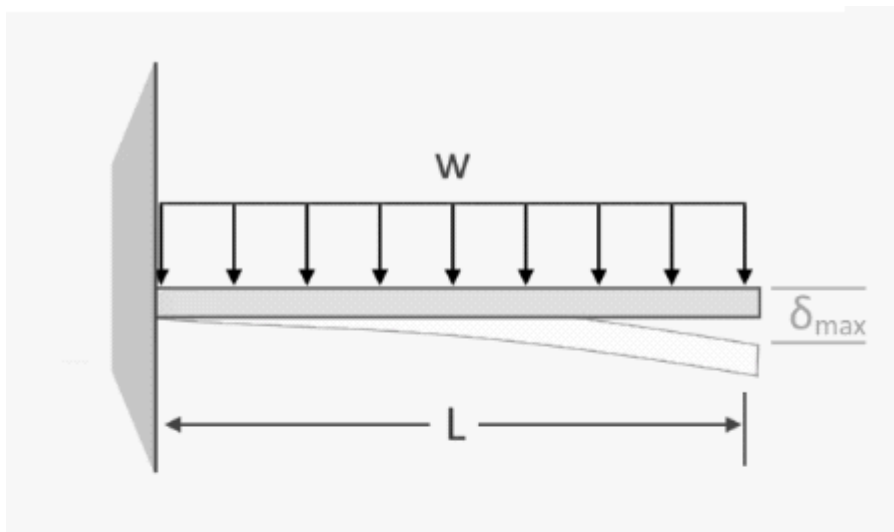
.5" Max deflection from mid plane to end plate

FOS: 2

For ribs

1- <https://www.rockwestcomposites.com/45419-dl-bto> best cheap tube

Calc for Fw mount to endplate half of wing df



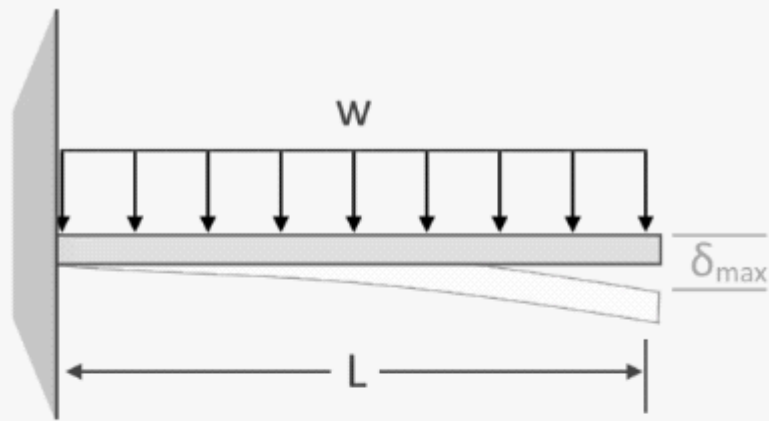
Input Values

Span length, L	1.7 ft ▼
Uniform load, w	17.6470588 lbf/ft ▼
Modulus of Elasticity, E	183 GPa ▼
Moment of Inertia, I_x	0.00288 in⁴ ▼
Stiffness of the beam, EI_x	219.37 N·m² ▼

Output value

Maximum deflection, δ_{\max}	0.41648 in ▼
-------------------------------------	------------------------------

Calc for Rw mount to endplate half of wing df



Input Values

Span length, L	1 ft ▼
Uniform load, w	58 lbf/ft ▼
Modulus of Elasticity, E	183 GPa ▼
Moment of Inertia, I_x	0.00288 in⁴ ▼
Stiffness of the beam, EI_x	219.37 N·m² ▼

Output value

Maximum deflection, δ_{\max}	0.16389 in ▼
-------------------------------------	------------------------------

Undertray
.5" deflection at highest deflection

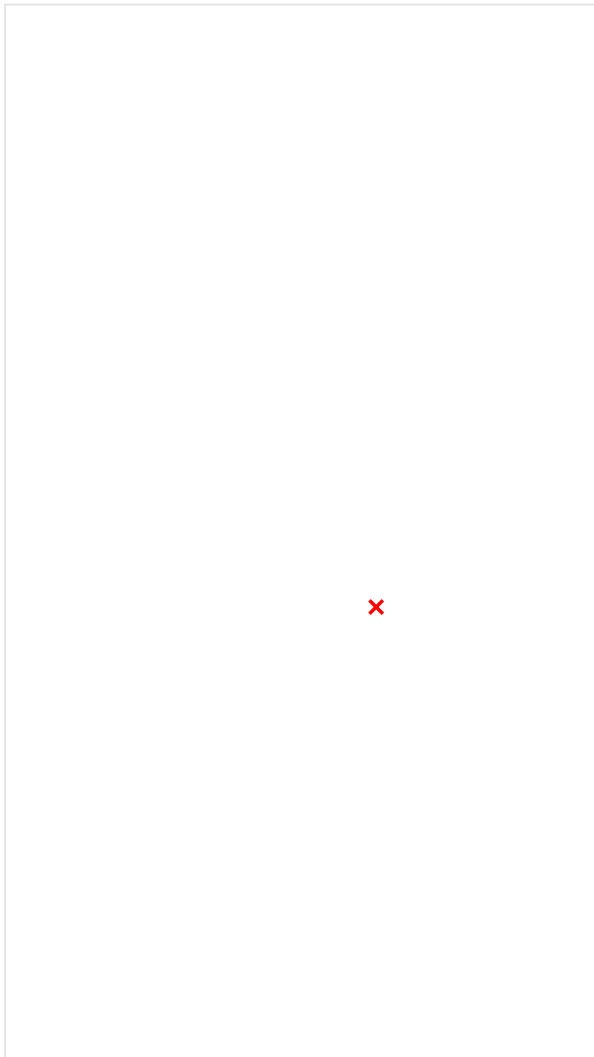
Foam wing failure and repair

Sunday, October 16, 2022 5:52 PM

By: Nathan Fairlie 10/16/22

FW fails by cracking on barnesville track at rib section resulting in ~2.125" deflection. Caused by deterioration of inner foam structure over time, bottoming out, deflection due to endplate scraping in roll/hitting kerbs at barnseville track

RW fails by rib pullout in travel back from event

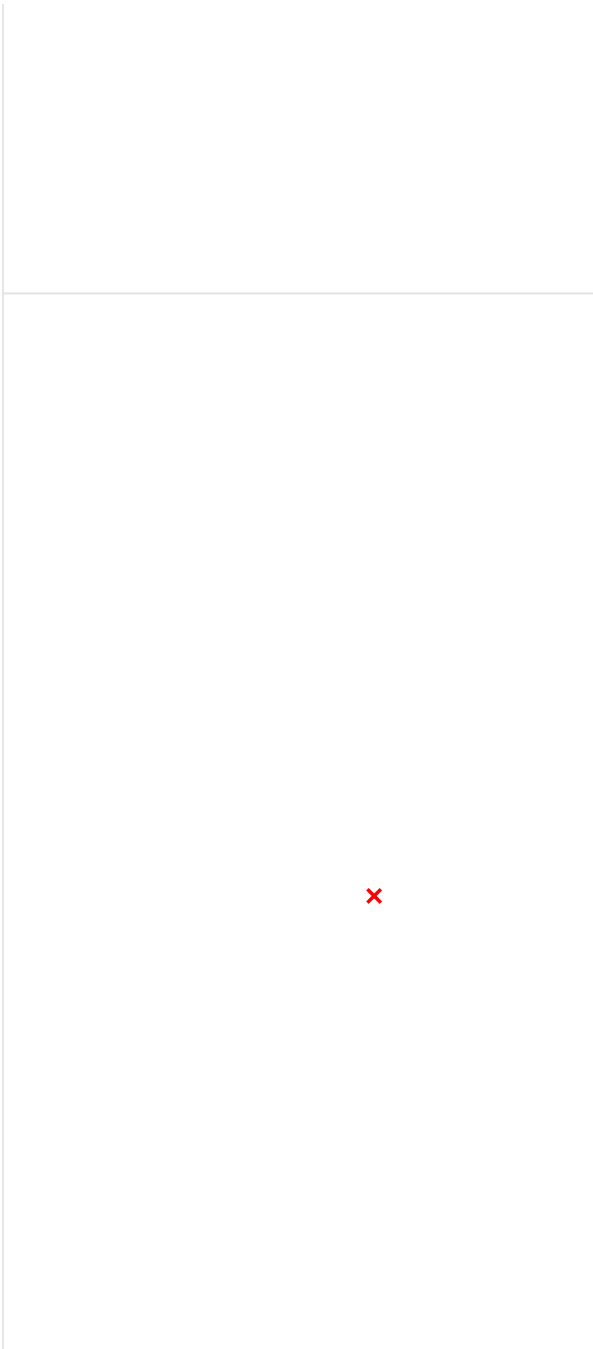


×

Pics of crack where the rib is, rib is loose due to dissolved foam due to brake clean or something

×

Pics of inner endplate delam due to scraping



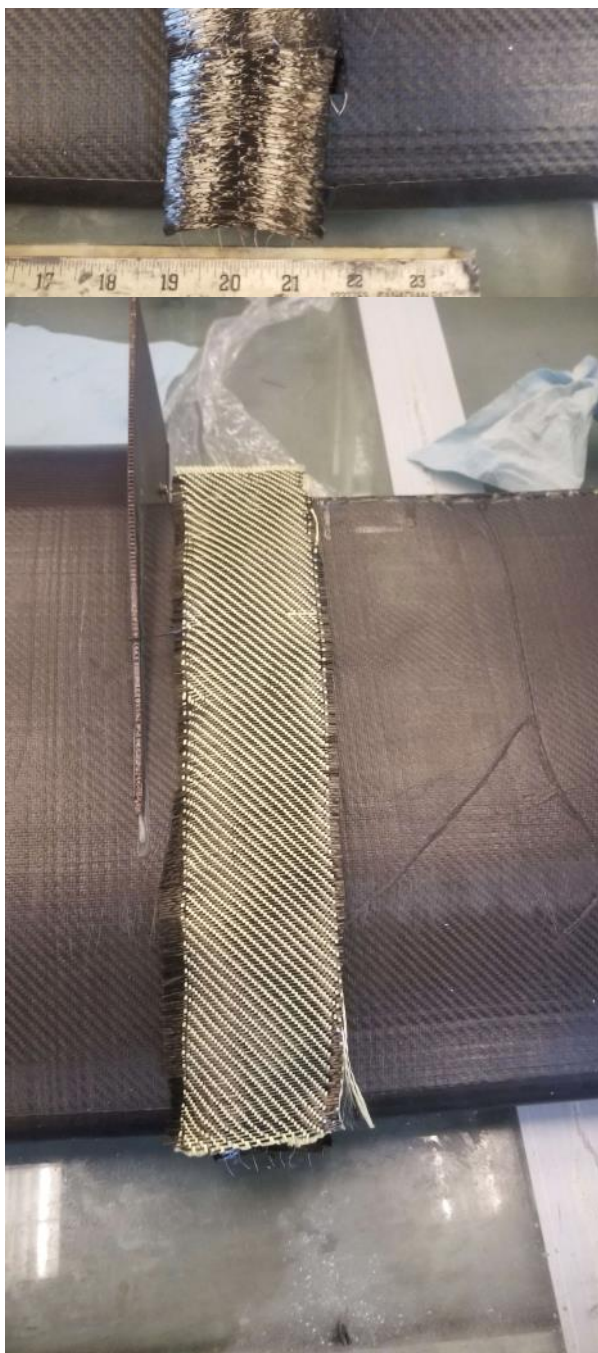
Pic showing amount of wear on endplate ~.25"

Scraping of mainplane over time

×



Uni tape on first layer of repair



Cf/kevlar 2nd layer of repair



Twill carbon 3rd layer repair



Twill carbon 3rd layer rerpair



Rw rib





Rib pullout