Front Wing Struts 2025-26

Project Name: Front Wing Struts	
RE	Advait Chordia
Priority	
Primary Subsystems	Aerodynamics
Secondary Subsystem(s)	Chassis

Introduction and Goals

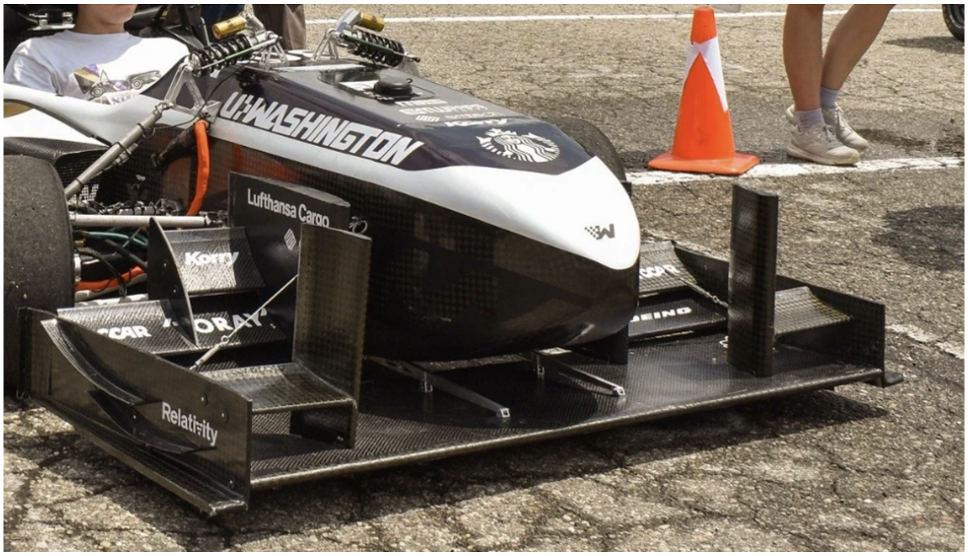
Relevant Rules

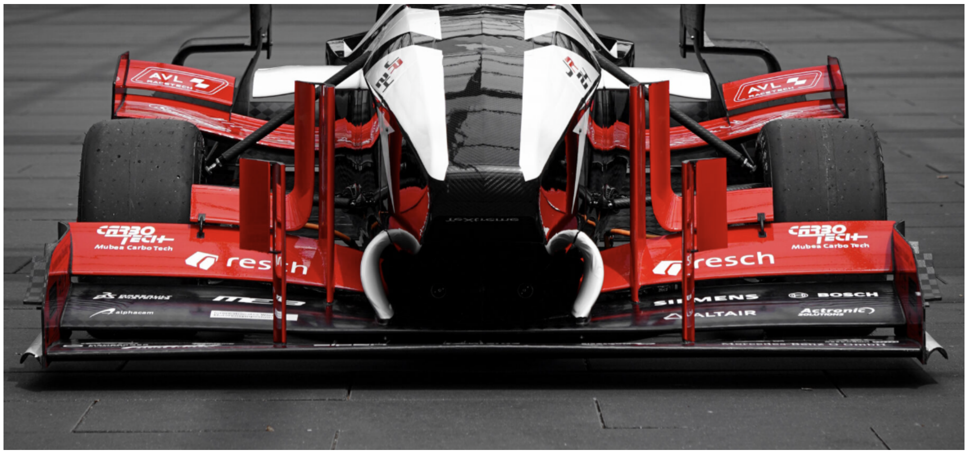
Notes on Previous Design

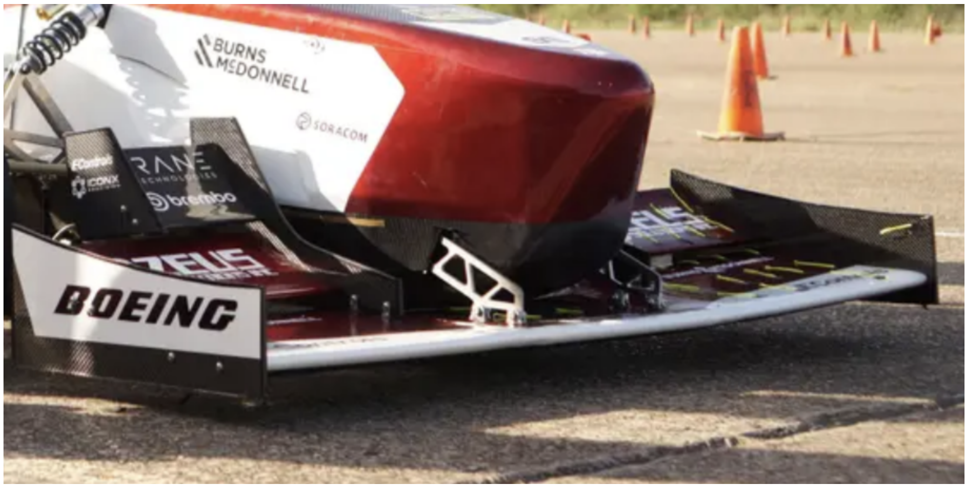
Year	Notes	Positives	Negatives
24-25	A lightweight design that was sandwich paneled core and carbon plies. Although, they didn't end up being manufactured well enough.	• A very lightweight design which was topology optimized and ended up being very light.	• During testing, they failed and the core sheared. • The biggest problem was with manufacturing tolerances causing misalignment of the mounting points post-manufacturing.

Market Research

Description	Image	Notes /Comments

UW (electric)		- Simple, effective design with a very small frontal surface area (probably produces lesser drag) - Mounted to the bottom of the monocoque which likely has a much simpler geometry, reducing tolerance issues. - Aluminum built part which might add a little weight but looking at how small its profile is, I doubt weight addition was a drawback. - Looks like its bolted on - can be changed my having grooves in the FW MP inserts. - Manufacturing looks very doable as the geometry of the strut itself seems very simple.
UMich (electric)		- Tubular strut framework - huge weight savings. - Side mounted, which I don't think is the way to go from a manufacturing point of view. Another concern I have is how it deals with horizontal movement. - Bolted on again but easy to manufacture considering geometry.

JR24		• Curved struts that possibly guide air towards the undertray and has aerodynamic advantages instead of just trying to keep drag low. • Looks like the manufacturing method is different and the struts are fused /mounted to the body and wings in a very clean way, possibly helping aero but making manufacturing different to what we've done before. • Curved profile adds to more manufacturing feasibility considerations with tolerances and more.

Texas A & M (electric)		• Strut mounting integrated into nosecone with a housing slit in the nosecone itself for this. Removes /reduces the impact of the complex/non-linear geometry of the nosecone which would be tough to mount on. • Skeletonized struts for weight saving and complete aluminum part. I think the possibility for manufacturing errors becomes much lower with a material choice like this. • Bolted on to ribs on to ribs on the mainplane. Maybe integrating these ribs into the inserts of the mainplane to reduce the error of mounting spots.
		• Looking for a car that has stay rods and to see if they're feasible to implement.

How much do we care about the ease of taking the front wing off?

- If somehow manufactured with the front wing, the bolting position (or whatever form of mounting used) will need to be easily accessible and replaceable.
- Consider how many bolts/whatever mounting method used would be needed to maintain the required FS.

How feasible is it to create a more complex geometry? What are the other possible methods of manufacturing it?

Aluminum vs Sandwich Panels?

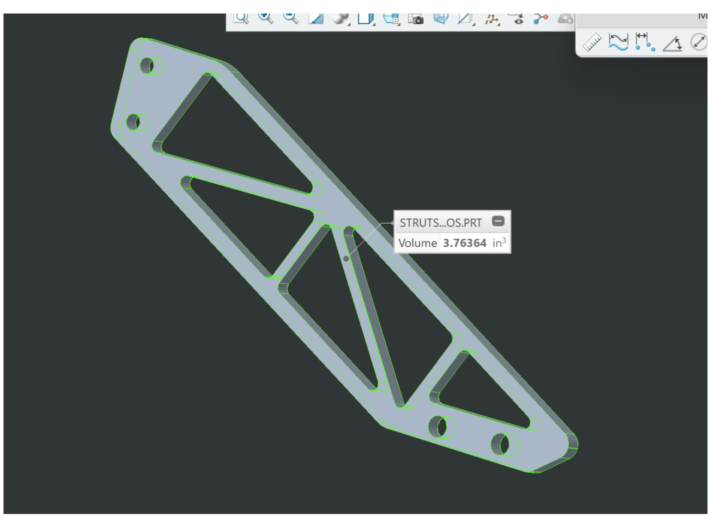
- Manufacturing possibilities
- Weight differences
- Potential structural difference

DCR

Requirement	Description	Design Implementation	Validation Method
1. Rule Compliance			
V.1.4.1	Ground clearance must be sufficient to prevent any portion of the vehicle except the tires from touching the ground during dynamic events	Rule	Front wing doesn't get scraped during pre-comp testing
T.7.1.3	All aerodynamic devices must be rigidly mounted to ensure they remain stable and do not oscillate or flex excessively while the vehicle is in motion.	Rule	Pre-comp testing
T.7.1.4	All forward facing edges that could contact a pedestrian (wings, end plates, and undertrays) must have a minimum radius of 5 mm for all horizontal edges and 3 mm for vertical edges.	Rule	Mock Tech
IN.6.6.2	If any deflection is significant, then a force of approximately 200 N may be applied. In this situation, loaded deflection should be no more than 25 mm and permanent deflection should be less than 5 mm.	Rule	Mock Tech
2. Structural Requirements			
SR.1	The front wing struts shall maintain a positive margin to yield and ultimate under all specified loading conditions (aero loads + cone strike + inertial loads)	FEA	Proof Load
SR.2	Struts shall have no negative (almost) on the aerodynamic purposes of the front wing	CFD	Wind Tunnel
SR.3	First natural frequency of the front wing assembly shall be at least three times the dominant road input frequency (4-5Hz).	FEA	Pre-comp testing
SR.4	Deflection under static loads should be less than 0.125"	FEA/ Hand calc	Assembly
3. Mass			
M.1	Struts (and all accessory parts) should be within 0.7 lbs (close to last year's strut, a marginal increase included for the possibility of a non-sandwich panel construction)	CAD	Weigh final product
3. Serviceability			
SV.1	Tool clearance given, fasteners in accessible parts without having to waste much time	CAD/use of standard hardware	Assembly
SV.2	+/-0.125" positional tolerance on mounting points to account for manufacturing and assembly variances.	CAD	Assembly
SV.3	Front wing system shall be assembled and mounted by 2 people in 15 minutes	Thought out fastener placement	Test time
4. Manufacturability			
MF.1	Struts and accessory parts should be manufactured within 2 weeks.	DFM and detailed production outline	Time

Counter sunk bolts/rivets

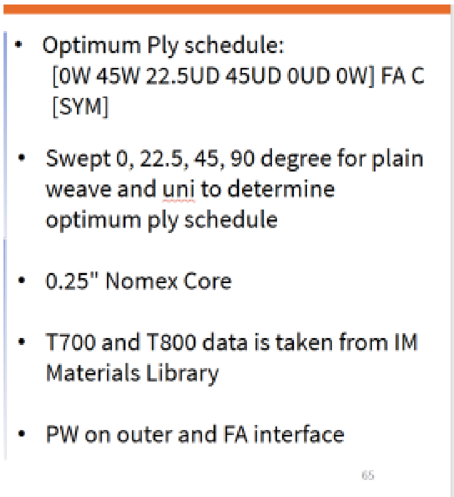
Initial Designs



Analysis

Material Choices

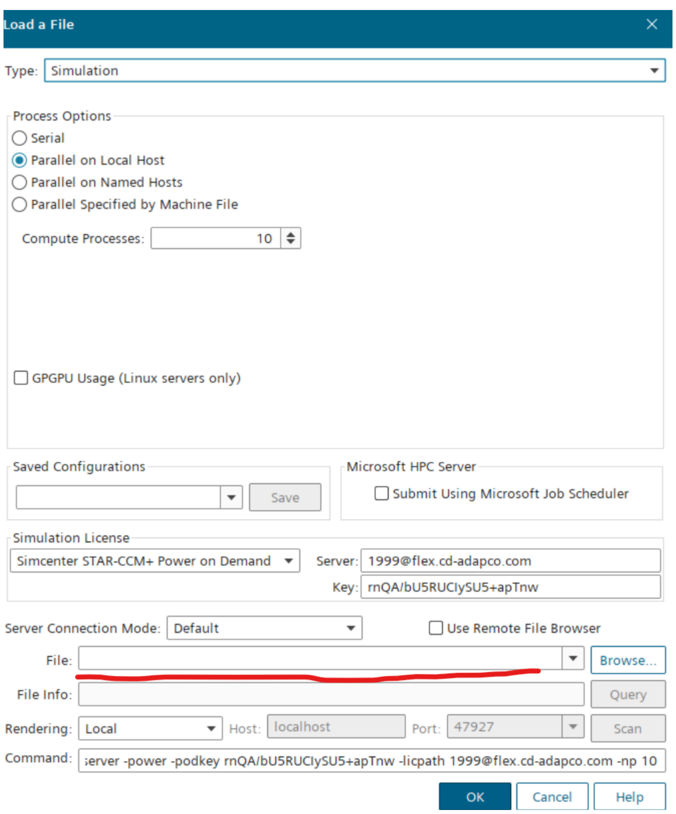
- 7075 Al
- 2021 Al
- 2014 Al
- 2024 Al
- CF sandwich



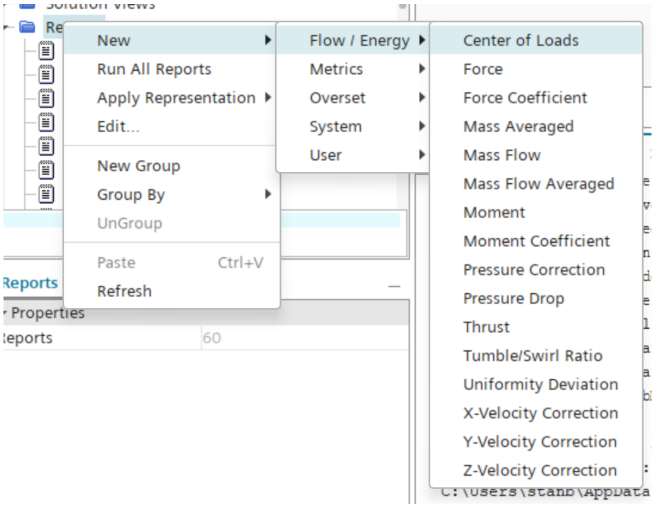
Generating Center of Pressure for individual load locations.

- When a run is finished, either on ncsa or locally, you will also have a .sim file. We can get the center of pressure to map loads on to in Ansys or other FEA software from this very file.

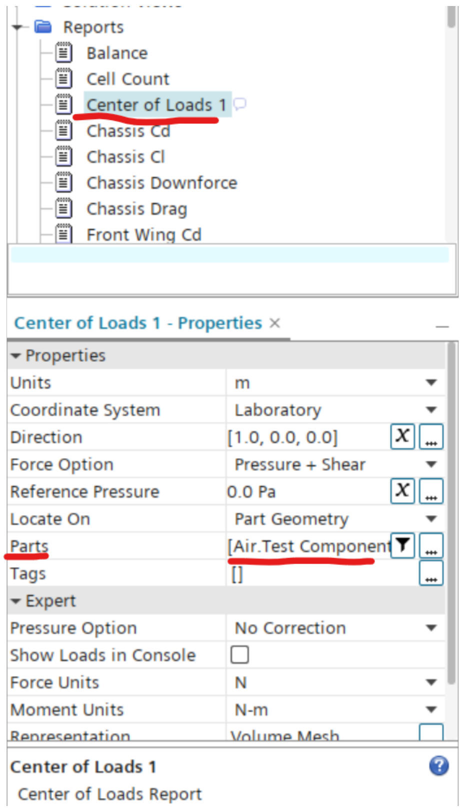
First, make sure to **load** your sim file, not make a new one.



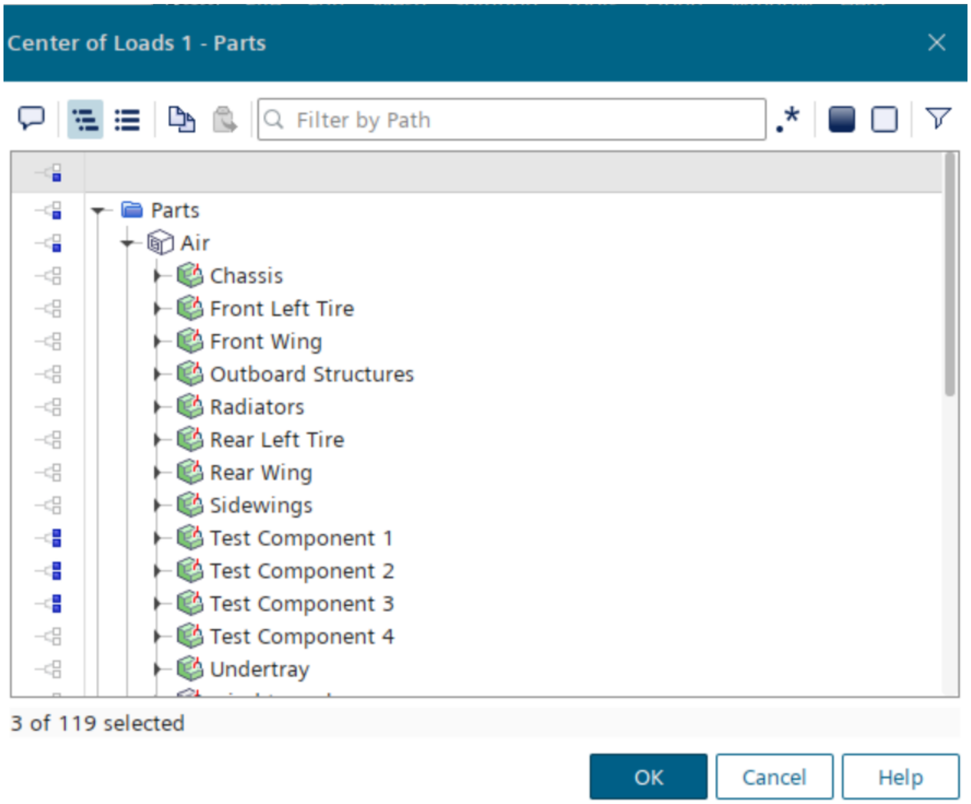
After the file is loaded, navigate to **reports** in the file structure folder. Right click, go to new Flow/Energy Center of Loads.



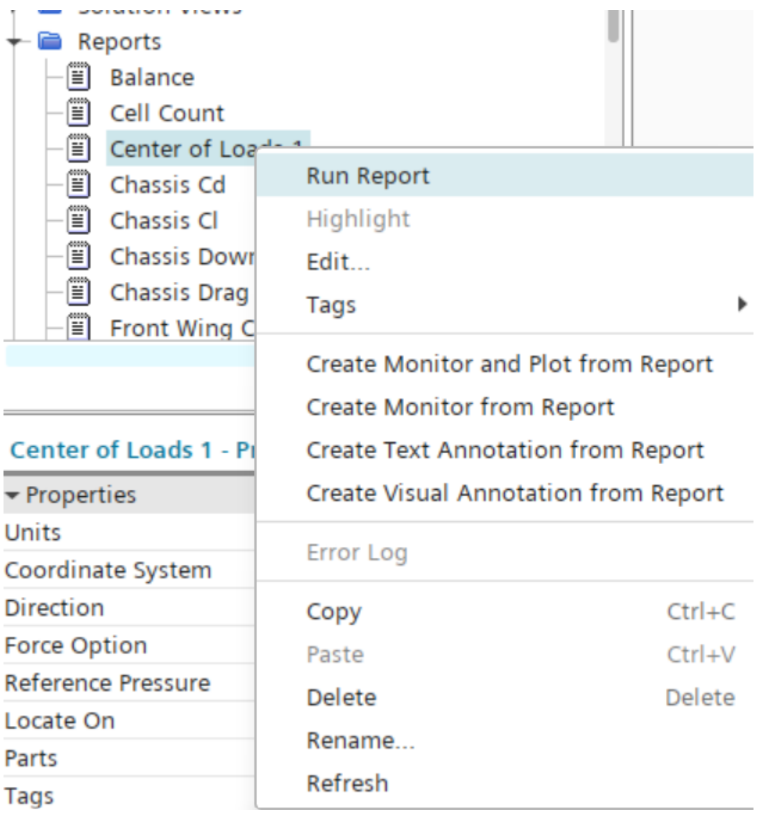
Click on Center of Loads, then navigate to parts, click on the array.



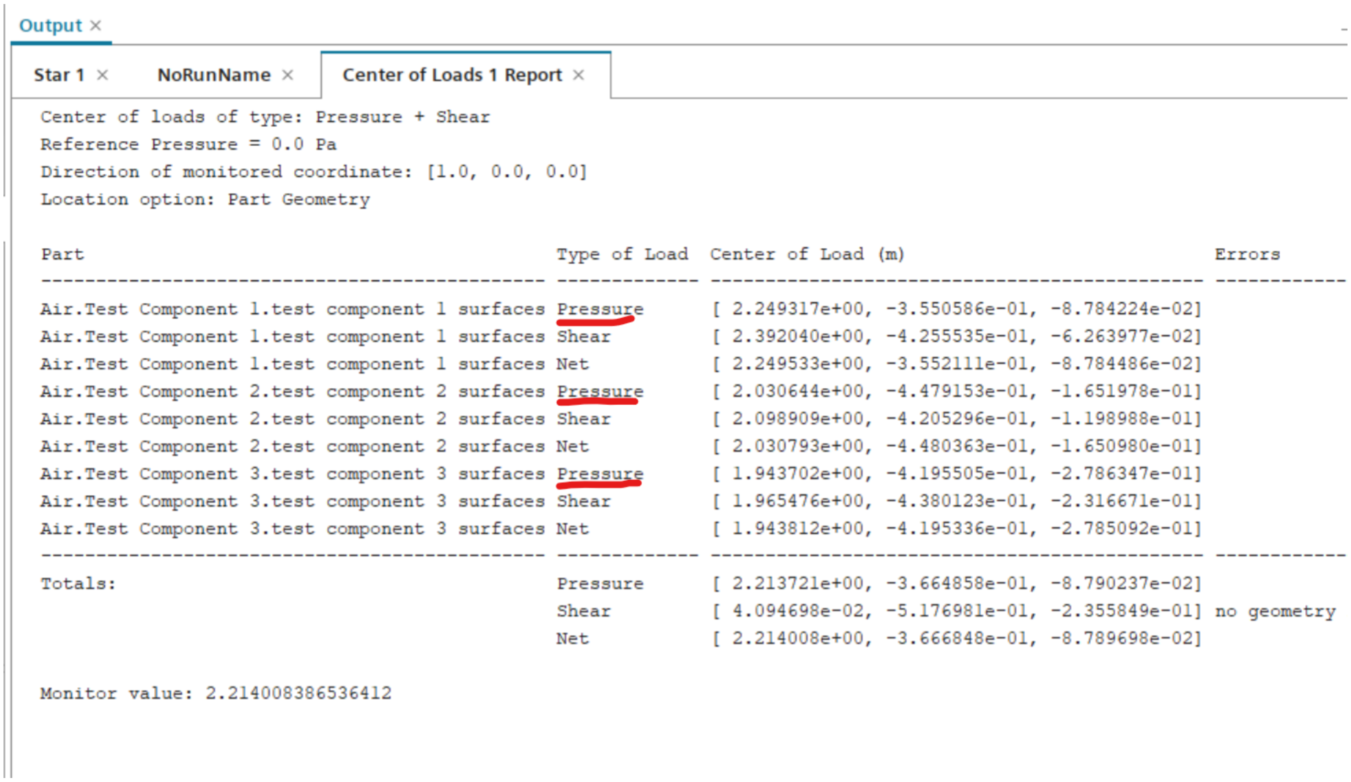
From Center of Loads, navigate to Parts, then Air. Make sure Test Component 1 - the # you are using are selected. Then, press ok.



After those parts are selected, right-click on center-of-loads and run the report. This will open a new 'output' window and run the report.



After the center of loads report has finished, we now have the Center of Pressure. Hooray!



Output ×

Star 1 × | NoRunName × | Center of Loads 1 Report ×

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Center of loads of type: Pressure + Shear
Reference Pressure = 0.0 Pa
Direction of monitored coordinate: [1.0, 0.0, 0.0]
Location option: Part Geometry

Part                                           Type of Load Center of Load (m)                                 Errors
---------------------------------------------- ------------ -------------------------------------------------- ------------
Air.Test Component 1.test component 1 surfaces Pressure     [ 2.249317e+00, -3.550586e-01, -8.784224e-02]
Air.Test Component 1.test component 1 surfaces Shear        [ 2.392040e+00, -4.255535e-01, -6.263977e-02]
Air.Test Component 1.test component 1 surfaces Net          [ 2.249533e+00, -3.552111e-01, -8.784486e-02]
Air.Test Component 2.test component 2 surfaces Pressure     [ 2.030644e+00, -4.479153e-01, -1.651978e-01]
Air.Test Component 2.test component 2 surfaces Shear        [ 2.098909e+00, -4.205296e-01, -1.198988e-01]
Air.Test Component 2.test component 2 surfaces Net          [ 2.030793e+00, -4.480363e-01, -1.650980e-01]
Air.Test Component 3.test component 3 surfaces Pressure     [ 1.943702e+00, -4.195505e-01, -2.786347e-01]
Air.Test Component 3.test component 3 surfaces Shear        [ 1.965476e+00, -4.380123e-01, -2.316671e-01]
Air.Test Component 3.test component 3 surfaces Net          [ 1.943812e+00, -4.195336e-01, -2.785092e-01]
---------------------------------------------- ------------ -------------------------------------------------- ------------
Totals:                                        Pressure     [ 2.213721e+00, -3.664858e-01, -8.790237e-02]
                                               Shear        [ 4.094698e-02, -5.176981e-01, -2.355849e-01] no geometry
                                               Net          [ 2.214008e+00, -3.666848e-01, -8.789698e-02]

Monitor value: 2.214008386536412
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Manufacturing

Testing

Deadlines

Timeline and Tasks

Deadline	Date	Deliverables