Design Portfolio

Orion Racing India (2014-2017):

Orion Racing India is a formula student team of K. J. Somaiya College of Engineering. It develops and manufactures a prototype formula-1 race car and takes part in international design competitions organized by Formula SAE.

(Website: http://orion-racing.com)

Roles and Responsibilities:

- Worked in Bodywork and Aerodynamics System for two years 2014-2016. System head of Bodyworks and Aerodynamics in final year (2017).
- Member of cost report team for two years 2016-2017.
- Presented Design Report and Cost Report at Formula Student Germany 2017 and Formula Society of Automotive Engineers Italy 2017.

Design Portfolio

Projects:

1. **Molds design and manufacturing**:

Designed and manufactured cost-effective molds which can be used for manufacturing carbon fiber parts by resin infusion process and autoclave curing process.

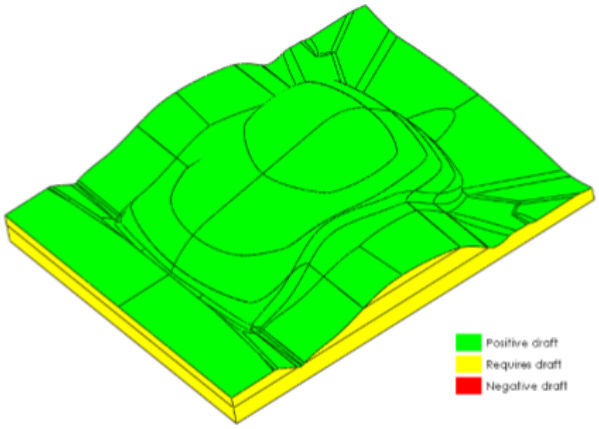
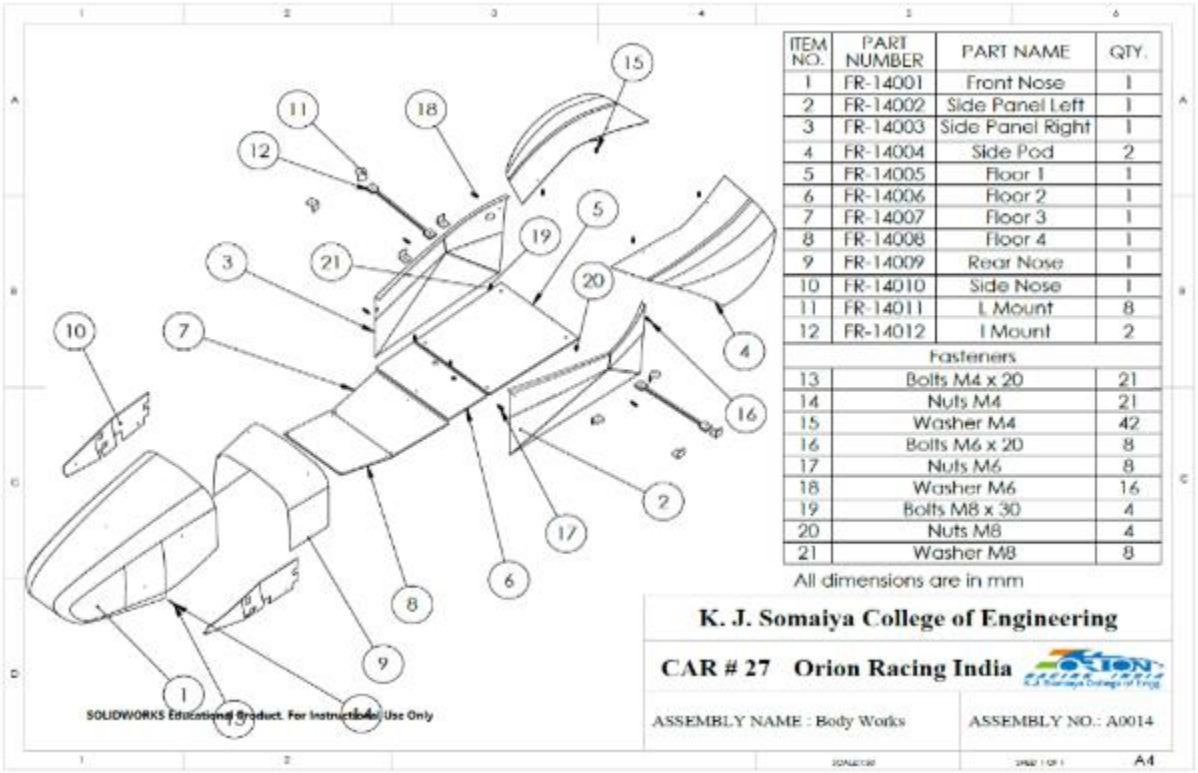


Figure: Draft analysis of seat mould

Figure: Seat Mould

2. **Bodyworks design, analysis and manufacturing**:
    a. Increased the strength to weight ratio in the structural composite parts.
    b. Achieved finest finish to reflect the aerodynamic considerations and aesthetics.
    c. Reduced weight by achieving optimum fiber to weight ratio.



ITEM NO.	PART NUMBER	PART NAME	QTY.
1	FR-14001	Front Nose	1
2	FR-14002	Side Panel Left	1
3	FR-14003	Side Panel Right	1
4	FR-14004	Side Pod	2
5	FR-14005	Floor 1	1
6	FR-14006	Floor 2	1
7	FR-14007	Floor 3	1
8	FR-14008	Floor 4	1
9	FR-14009	Rear Nose	1
10	FR-14010	Side Nose	1
11	FR-14011	L Mount	8
12	FR-14012	I Mount	2
Fasteners			
13	Bolts M4 x 20		21
14	Nuts M4		21
15	Washer M4		42
16	Bolts M6 x 20		8
17	Nuts M6		8
18	Washer M6		16
19	Bolts M8 x 30		4
20	Nuts M8		4
21	Washer M8		8

All dimensions are in mm

K. J. Somaiya College of Engineering

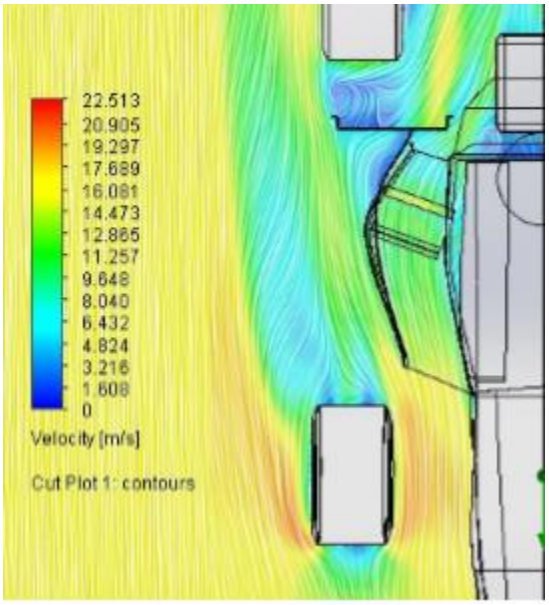
CAR # 27 Orion Racing India

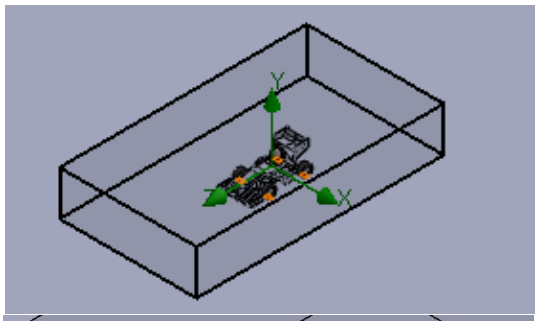
ASSEMBLY NAME : Body Works

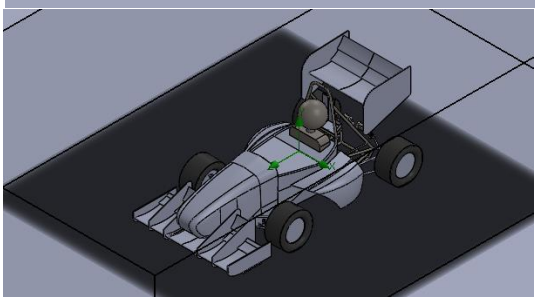
ASSEMBLY NO.: A0014

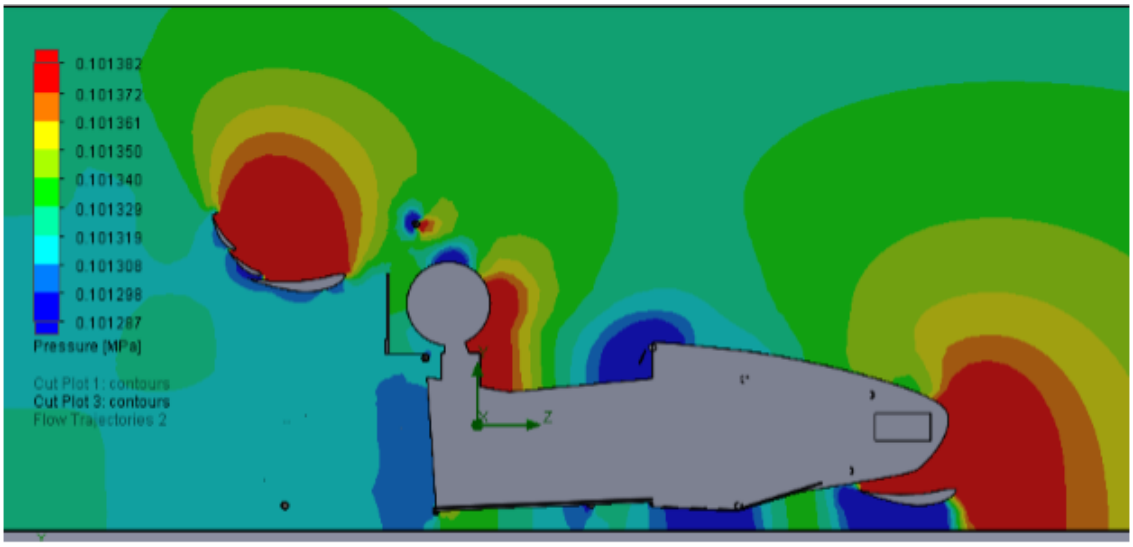
A4

3. **Aerodynamic package design, CFD simulation and manufacturing**:
   Designed the aerodynamic package to ensure sufficient amount of downforce and reduce lap times substantially.



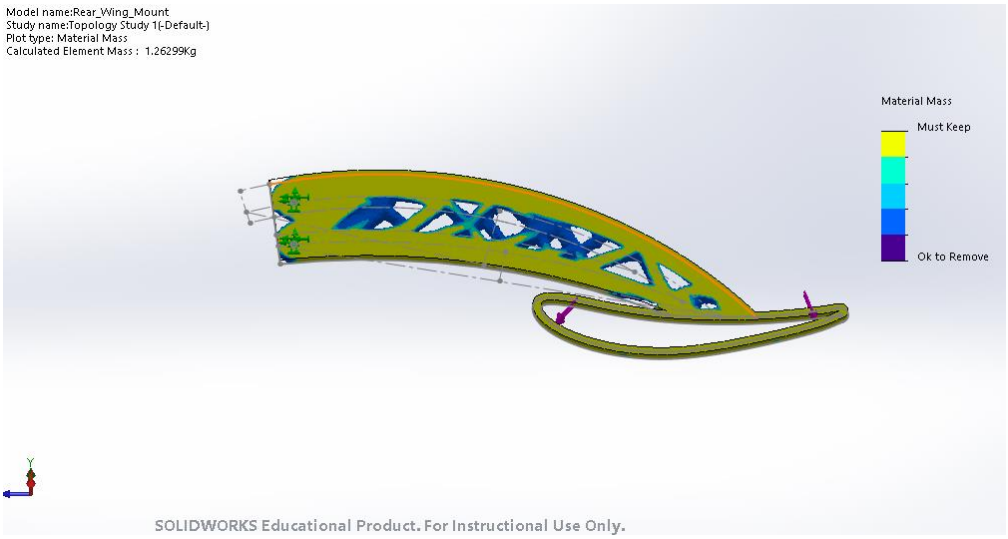






Pressure plot at the midplane of the car

Design Portfolio



Topology Optimization of Rear Wing Mount

4. **Cost and manufacturing report**:
   Prepared cost and manufacturing report performing cost analysis and preparing strategies for mass production of the car, securing first and third place in FS Germany 2016 and 2017 respectively.

Formula Student India 2016- Champion team

Formula Student Germany 2016 – Cost and Manufacturing Winner

U-farm (April – June 2018):

U-farm is a startup company, producing IoT powered modular indoor vertical farming equipment for Hotels, Restaurants and Cafes.

(Website: https://www.facebook.com/theufarm/)

Roles and Responsibilities:

- Performed CAD modeling, material selection and manufactured the pilot vertical farming appliance.
- Developed a prototype from scratch and decided the manufacturing processes with respect to budget and requirements.
- Held the position of Project Design Engineer for three months, gaining hands-on experience using the 3-axis milling machine, laser printer and 3d printer (from the university's maker lab) to create custom parts for the pilot project.

Design Portfolio

Divide by Zero Technologies (2018-2019):

Divide by Zero Technologies is 3D printing Original Equipment Manufacturer in India. It is one of the pioneer companies in India.

(Website: https://www.divbyz.com)

Roles and Responsibilities:

- Started as Design Intern in the Research and Development Department.
- Worked on structure and electro-mechanical systems and Performed CAD modeling, material selection, simulation and topology optimization using SolidWorks.
- Prepared 2D drawings, Bill of Material, and conducted cost analysis for the designed components.
- Developed and tested a beta prototype for one of India's first laser-based 3d printers from concept.
- Held the position of Design Engineer in the same department for six months.

Projects:

1. **Fused Filament Fabrication 3D printer**:
    - Designed a Fused Filament Fabrication 3D printer with increased bed size and functionality than its predecessor.

2. **Laser-based 3D printer**:
    - Designed and manufactured Optics Assembly, water cooling and gas purging systems of a prototype laser-based 3D printer.

Skills and Knowledge gained:

- Imbibed practical knowledge and exposure from my seniors and head of the department.
- Collaborated with embedder and engineers to develop Internet of Things enabled printers.
- Build interdepartmental rapport for smooth procurement of materials, quality control and production training requirements.
- Developed teamwork and cooperation skills at an industrial level.

Please find the letter of recommendation here:
https://drive.google.com/open?id=113haEz2b0-aT0gmH6yx-JjmJSRt2OEZ8

CAD and Digital Manufacturing Specialization (2019):

CAD and Digital Manufacturing Specialization is offered online on Coursera by Autodesk. Through this specialization, we can learn the foundations of product innovation and digital manufacturing while developing the technical skills within Autodesk® Fusion 360™.
(Website: https://www.coursera.org/specializations/cad-design-digital-manufacturing)

Project:

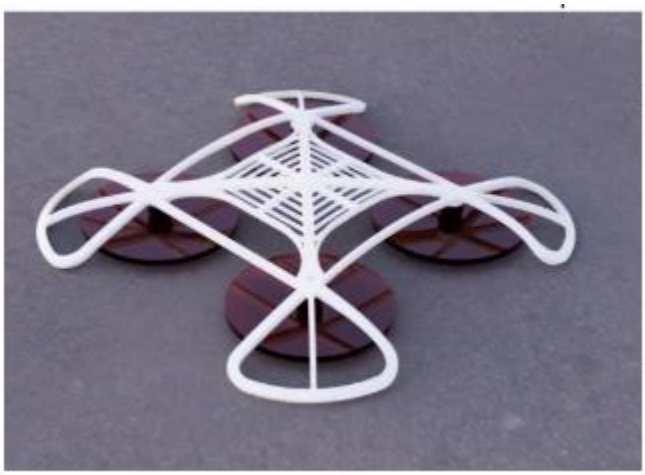
Designed and analyzed an Unmanned Aerial Vehicle (UAV) using Autodesk Fusion

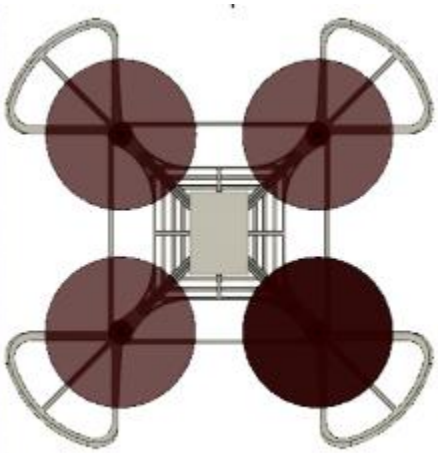
- Designed the chassis of an unmanned aerial vehicle (UAV), selecting the appropriate components as per requirement and performed simulated tests and analysis to validate the design.
- This project was modelled and analyzed using Autodesk Fusion.

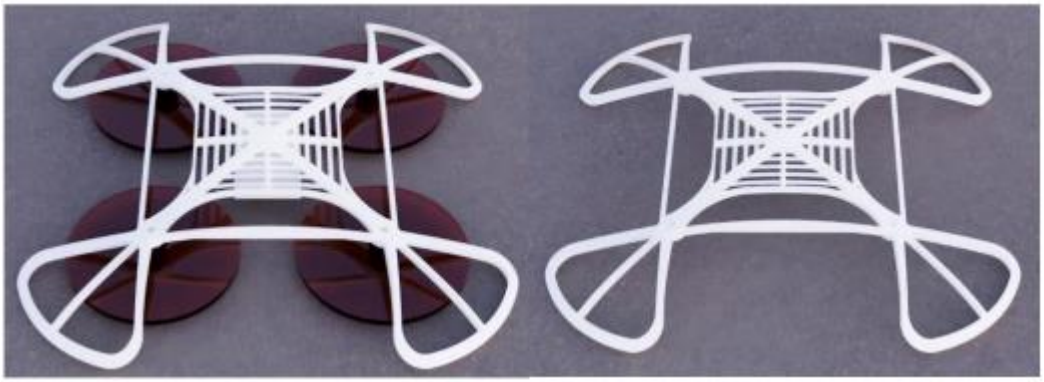
For agile UAV:

Design Portfolio

For Search and Rescue UAV:





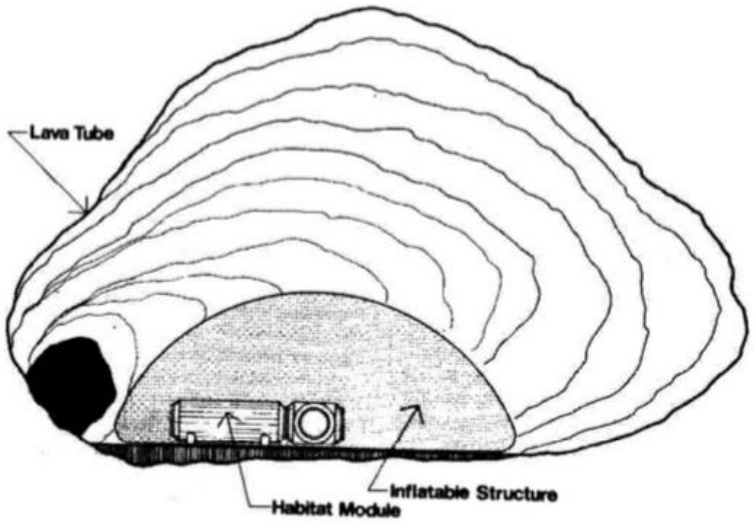


Please find the detailed report with component selection here:
https://drive.google.com/drive/folders/196YS0k2-lDR7KSbZix0bYxD-02sz9OBm

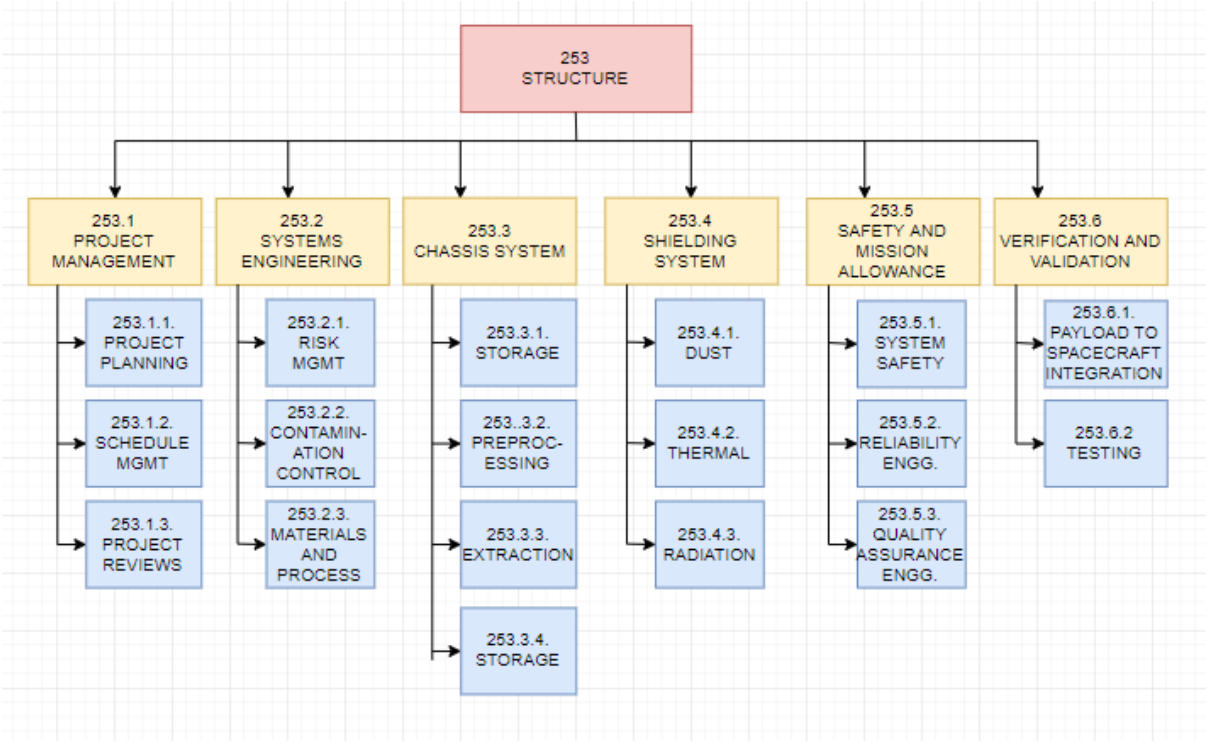
Clemson University - Academic Group Projects (Aug 2019 - Present):

1. Lunar Regolith processing module (Aug - Dec 2019)

- Designed a lunar regolith processing module for processing mined regolith to extract and store hydrogen, oxygen and He-3 for inter-terrestrial use.
- Worked in the structures team to minimize the risk to human life and to shield all other systems of the module from extreme temperatures, radiation, regolith and impacts from the micrometeoroids.

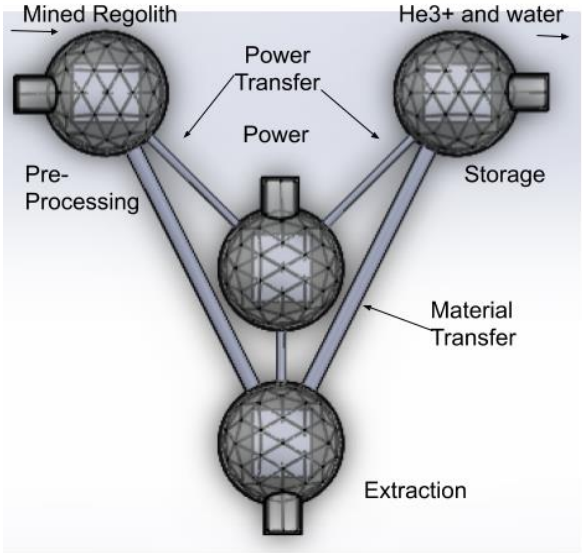


Inflatable Structure Habitat in a Lunar lava tube.



Work Breakdown Structure

Design Portfolio



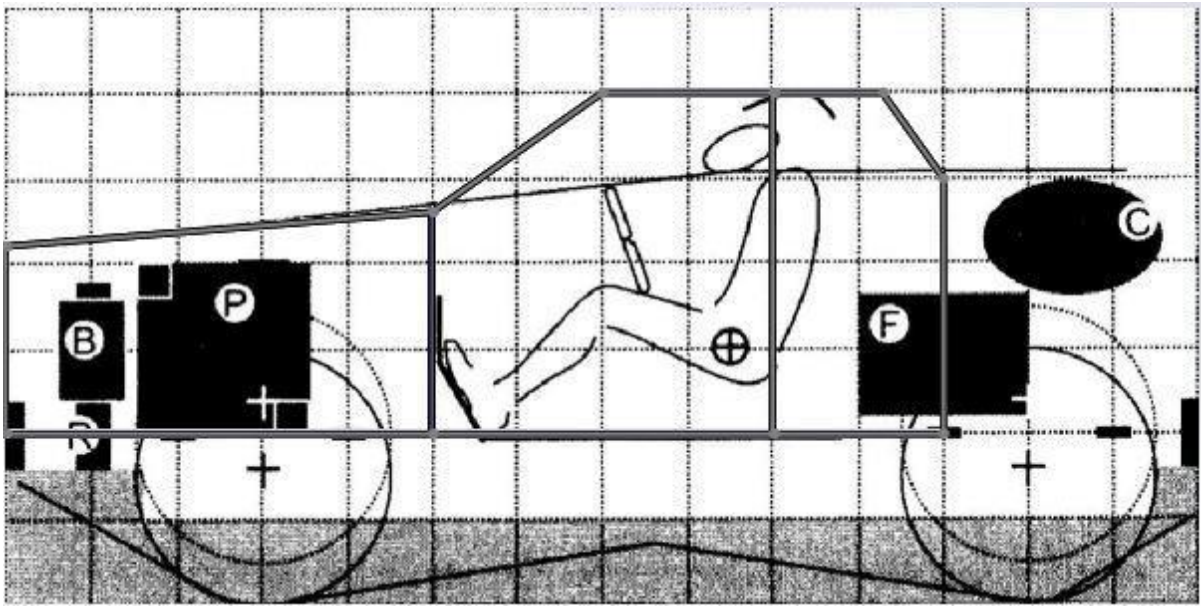
Proposed Layout of the LuRePm module

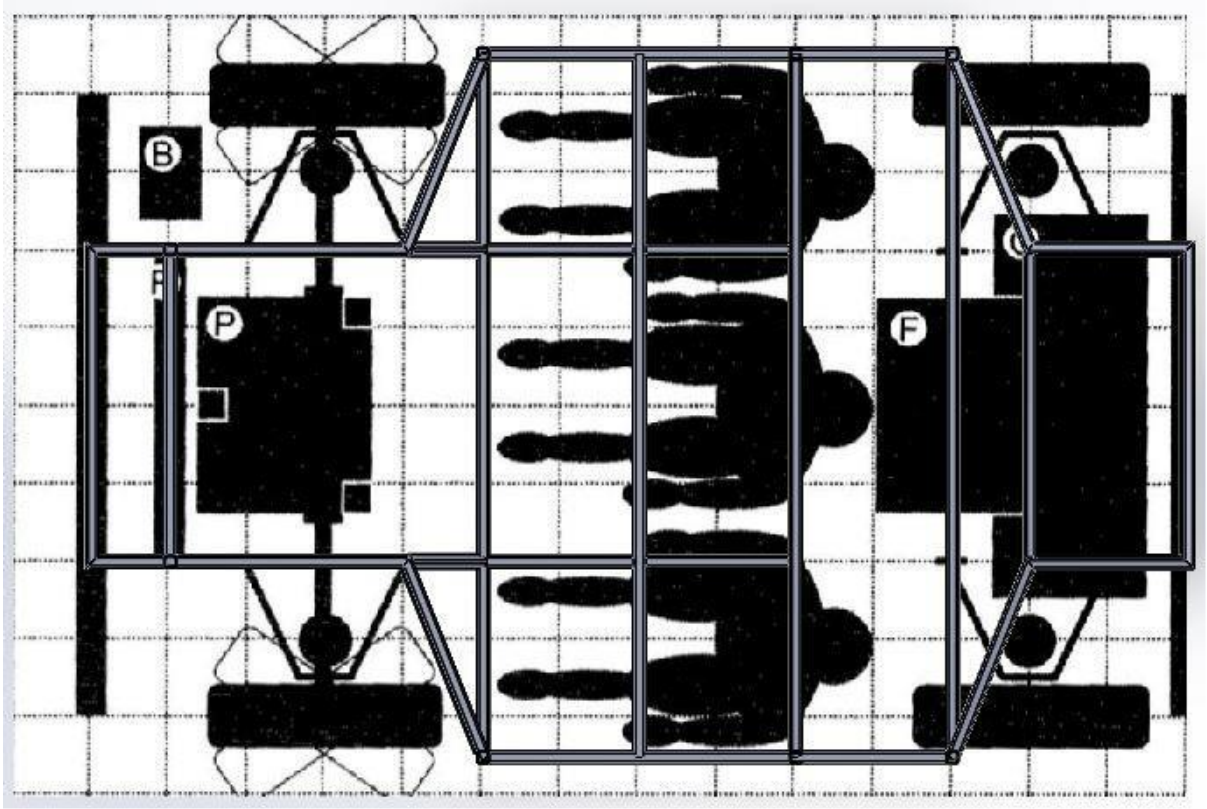
A Preliminary Design Report was prepared for this project which included:

- Users and Stakeholders
- Design Trade-offs
- Mission Justification and Objectives
- Conduct of Operations Plan (ConOps)
- Mission Architecture
- Project Breakdown Structure
- Work Breakdown Structure
- Feasible Design Concepts
- Concept Evaluation Study (FMEA, Decision Matrix, Severity Ranking Criteria)
- Verification and Validation test plan for subsystem level
- Program project plan
- Program budget proposal
- Proposed technology development program
- Evaluation of the concept with respect to MOE and MOP with engineering analysis

2. Structural & Thermal Analysis of Body in White (Jan - Apr 2020)

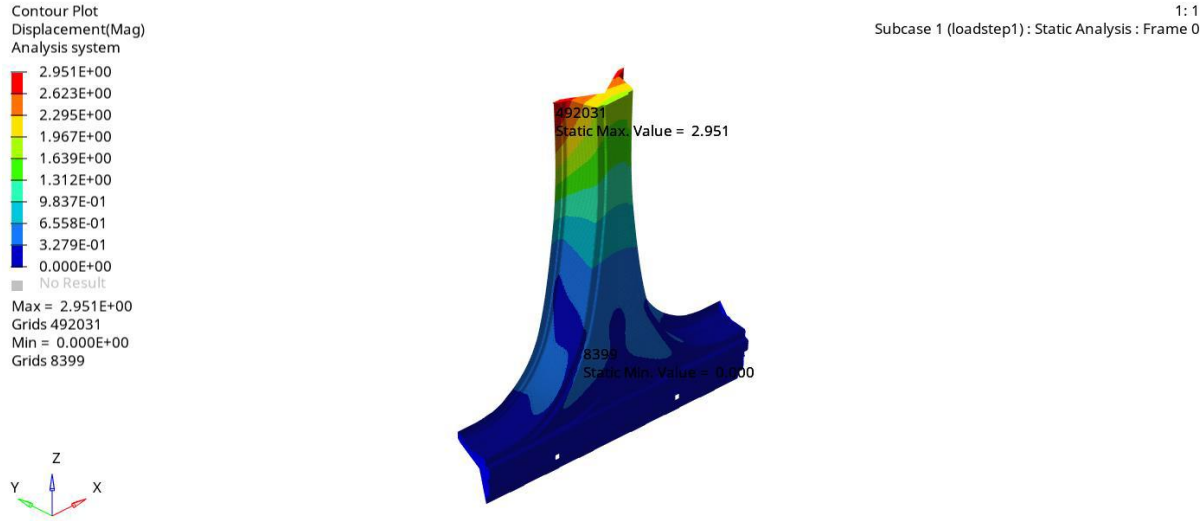
- Developed the body structure meeting the bending, torsion and crashworthiness and vibration with minimum possible weight.
- Optimized the geometry of the frame and the dimensions of tubes to minimize weight while satisfying constraints like Body Side-Frame Bending Stiffness, Body Structural Torsional Stiffness, Crashworthiness, Passenger compartment integrity, and Crash impact loads.

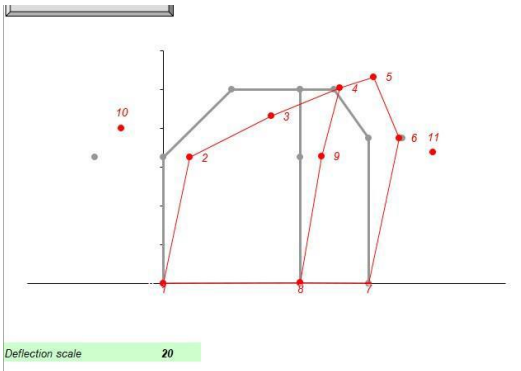




Design Portfolio

- Our team prepared the project report for this project containing:
    1. BIW Structural Lay-Out
    2. Body Side-Frame Design for Bending Stiffness
    3. Body Structural Torsional Stiffness Modeling and Development
    4. Design for Crashworthiness
    5. Design of BIW Structural Cross-Members to maintain passenger compartment integrity and to reach crash impact loads
    6. Total Vehicle Mass Compounding Estimate





	deflections (mm)	
	x	y
1	0.00	0.00
2	9.63	0.00
3	14.43	-6.80
4	14.45	0.32
5	14.44	3.22
6	11.19	-0.01
7	0.02	0.00
8	0.02	0.31
9	7.85	0.32
10	9.63	7.47
11	11.19	-3.75

	Bending Energy	% bending energy	Bending Stress		total stress	Cap buckling stress	Max moment	Moment of Inertia
	Nmm	%	N/mm²		N/mm²	N/mm²	Nmm	mm⁴
			end 1	end 2				
hinge pillar	290.6	1.5%	58	0	59	299	484,602	416,667
A pillar	145.3	0.8%	4	54	60	611	88,471	28,583
roof front	194.9	1.0%	70	73	78	468	87,726	15,104
roof rear	68.1	0.4%	33	70	86	468	84,195	15,104
C upper	44.3	0.2%	24	22	28	1197	89,380	140,625
C lower	686.9	3.6%	23	102	105	299	341,353	83,333
Rocker rear	37.9	0.2%	20	16	21	355	347,018	1,093,359
Rocker front	489.2	2.5%	54	28	58	355	940,769	1,093,359
B lower	4228.3	22.0%	198	56	199	299	1,213,607	245,333
B upper	490.9	2.6%	166	55	161	1197	346,322	52,083
Total beams		34.8%						
hinge-rocker	3407.5	17.8%						
hinge-A	0.3	0.0%						
A-roof	989.4	5.2%						
roof-C	991.4	5.2%						
C up-Clower	115.3	0.6%						
C-rocker	1692.4	8.8%						
B-rocker	3384.9	17.6%						
B-roof	1934.8	10.1%						
front end horiz	0.0	0.0%						
front end diag	0.0	0.0%						
rear end horiz	0.0	0.0%						
rear end diag	0.0	0.0%						
Total joints		65.2%						
Grand total	19192.3	100.0%						

Please find the detailed reports here:
https://drive.google.com/drive/folders/10XUgQ1YZKPZibDcCoXUcw3YqOx13Obrz?usp=sharing

Hackathons:

With the onset of Covid-19, I participated in the following hackathons to help brainstorm solutions for controlling the pandemic and smooth transition to the normal.

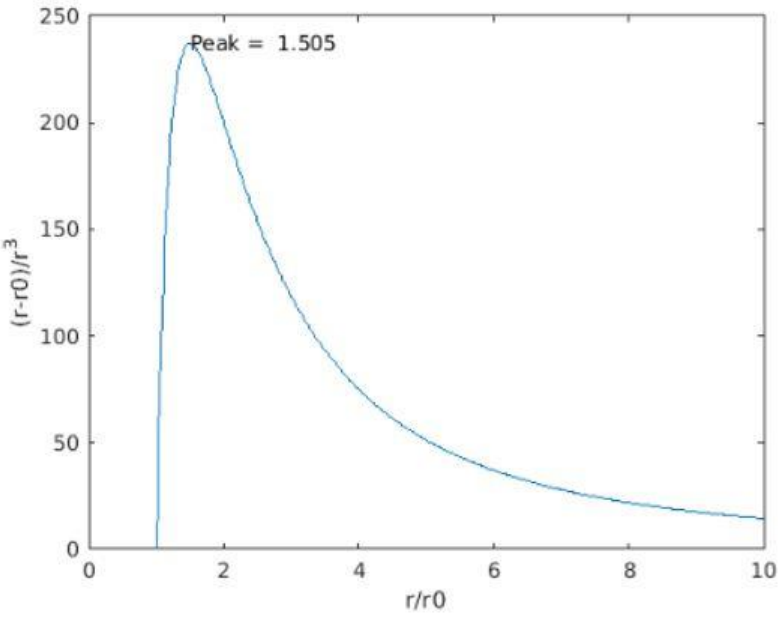
1. MIT COVID-19 Challenge Beat the Pandemic II (May 2020):

Conceptualized, designed and validated the prototype design using the simulations and simplified calculations.

Maximum Pressure calculations:

```
r0 = 0.025; %m
e = linspace(1,10,500);
r = e*r0;
m = (r-r0)./r.^3;
plot(e,m)
xlabel('r/r0');
ylabel('(r-r0)/r^3');
[Peak, PeakIdx] = findpe
Pk = e(PeakIdx);
text(e(PeakIdx), Peak, s
```

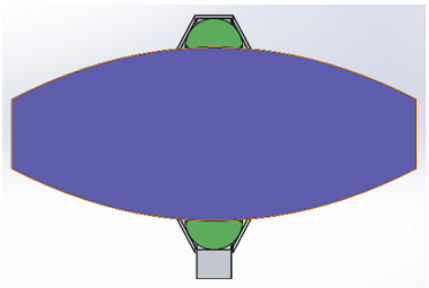
With reference to the graph, there is a maximum pressure after which it becomes easier and easier to inflate the tube.



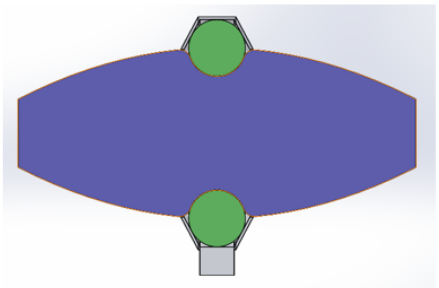
Validation:

After the maximum pressure was determined, the thickness of toroidal tube was fixed. The expansion of toroidal tube and displaced volume for ambu bag was calculated, after using appropriate factor of safety.

Calculation for size and number of toroidal vents:



The compression cycle of toroidal tube.
- Volume of ambu bag: 4.156 L



The expansion cycle of toroidal tube.
- Volume of compressed ambu bag: 3.753 L

Difference in volume = 0.403 L
Air intake in one breath or Tidal Volume (TV) = 0.5 L

2. Winner of MIT Challenge: India Turning the Tide (Aug 2020):

- Collaborated with a multi-disciplinary international team consisting of senior quality engineers and strategic experts from medical industries, along with computer science, machine learning engineers.
- Demonstrated a strong ability to analyze problems by proposing an automated quality inspection process using 3D scanners and virtual reality, RF id tags, and Remote visual inspection.