BAJA STUDENT INDIA 2017 Design Report

DATTA MEGHE COLLEGE OF ENGINEERING, NAVI MUMBAI

This is the team's second year in BSI competition and the goal was making a simple, robust, economical vehicle and Torrid Racing has made an attempt towards in achieving this goal. Following design report describes the design methodology followed by the team.

Primary aim of this year's vehicle design was to reduce the weight of the overall vehicle in order to improve the engine efficiency with maximum reaquired strength and safety.

Roll cage Design and Driver Ergonomics:

Design considerations:

The design considerations for chassis design are as follows:

1. Driver comfort
2. Optimum length and weight
3. Optimize packaging
4. Good Strength

Material size selection:

AISI 4130 CHROMOLY steel tube (1'' OD and 2mm thickness for primary members and 1.6mm thickness for secondary members) were chosen for fabricating the chassis in order to reduce the overall weight.

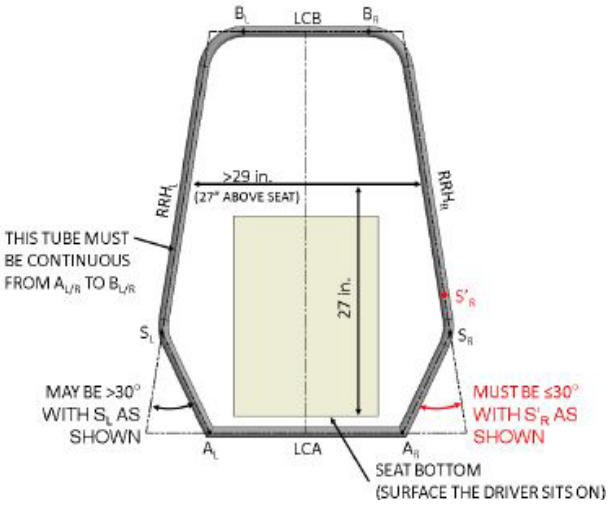
Selection criteria:

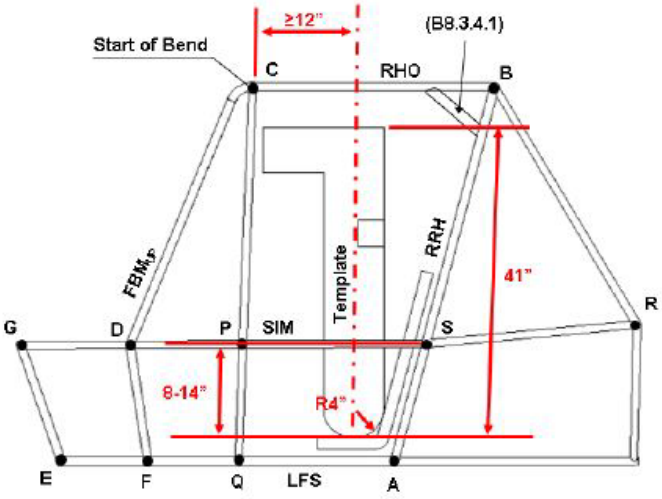
Sr. No	Material thickness	Bending strength (N.m)	Bending stiffness ($KN.m^2$)	Weight (Kg)	Cost/ m (Rs.)
1.	1'' OD (2mm primary &1mm secondary)	367.15 206.97	2078.03 1171.41	24.71	22200
2.	1'' OD (2mm primary & 1.5mm secondary)	367.15 292.41	2078.03 1655.03	29.13	23000
3.	1'' OD (2mm primary & 1.6mm secondary)	367.15 308.19	2078.03 1744.30	30.43	23340
4.	1'' OD (2mm primary & 2mm secondary)	367.15 367.15	2078.03 2078.03	35.54	25620
5.	1'' OD (2.5mm primary & 2mm secondary)	367.15 432.12	2078.03 2445.71	38.42	26130
6.	1'' OD (3mm primary & 2mm secondary)	367.15 488.20	2078.03 2763.11	41.16	29300

By considering the above factors, we have decided to choose material with 1'' OD & 2mm thickness for primary member & 1.6 mm for secondary member. As the thickness increases strength increases accordingly cost & weight increases. Thus our aim for this year's chassis was to reduce weight by getting maximum required strength which we have get after the results from analysis.

Modeling:

Parameter	Required Dimension	Actual Dimension
Clearance from helmet to top	6 inch (min)	9 inch
Clearance to side surface(shoulder, hip, thigh, knee, arms, hand)	3 inch (min)	5 inch
Inclination of RRH from vertical	20 degree (max)	5 degree
Vertical height from above seat	41 inch (min)	51 inch
Width of RRH at height of 27 inch from above seat	29 inch (min)	47 inch
Height of Lateral diagonal bracing from top and bottom	5 inch (max)	5 inch
Forward end of RHO member from vertical line above seat	12 inch (min)	22 inch
Back and bottom intersection of set	4 inch radius (min)	5 inch radius
Height of SIM from above inside seat bottom	8-14 inch	12 inch
Position of LC above seat	> 41 inch	50 inch





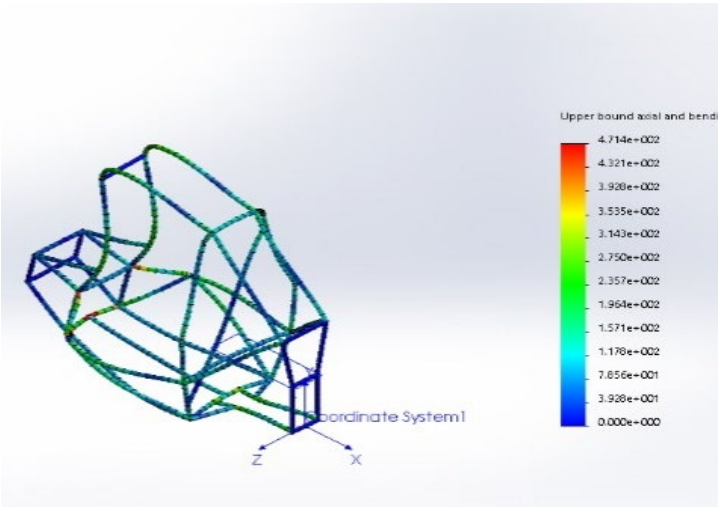
FEA Results:

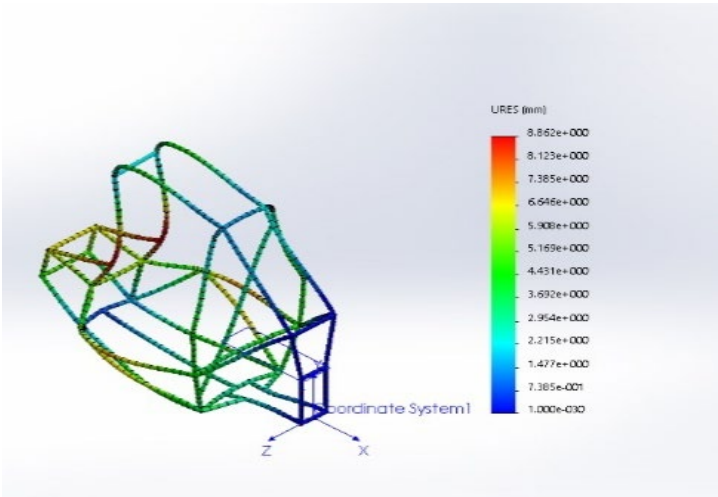
Tabulated Results:

Analysis Type	Deformation (mm)	Stress (MPa)	Factor of Safety
Front Impact	8.16	412.5	1.17
Rear Impact	6.47	171.16	2.69
Side Impact	6.38	406.96	1.16
Rollover Analysis	1.66	87.26	5.28
Torsion Test	14.14	337.32	1.36

Front Impact:

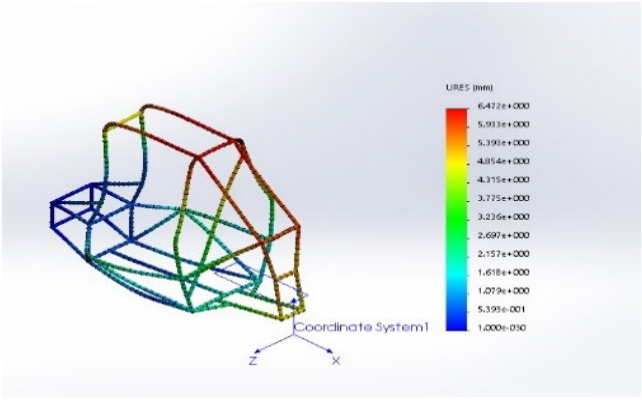
Force	**10G (22.56 KN)**
Impact time	0.169 sec
Stress Induced	412.5 MPa
Deformation	8.16 mm
FOS	1.17

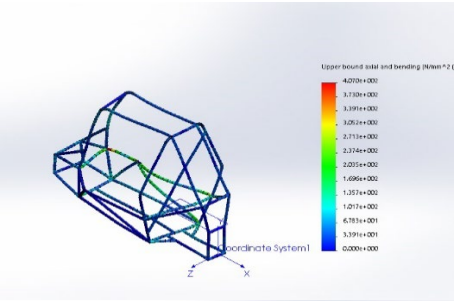


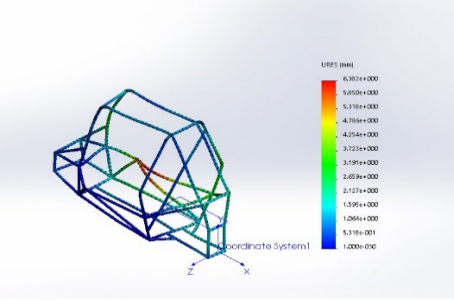


Side Impact:

Force	5G (11.2 KN)
Impact time	0.33 sec
Stress Induced	406.96 MPa
Deformation	6.38 mm
FOS	1.16





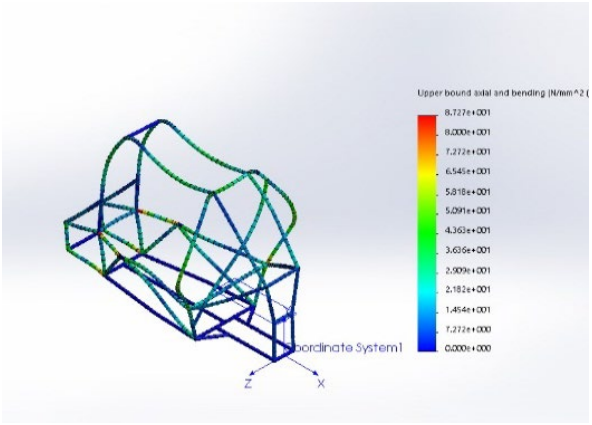


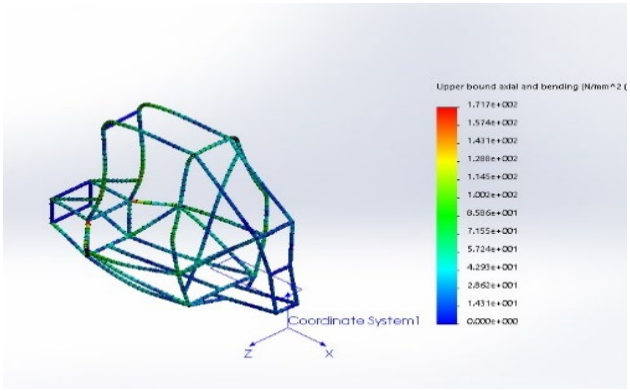
Rollover Analysis:

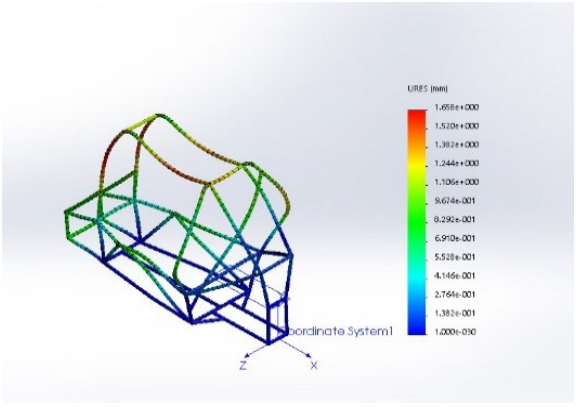
Force	3.5G (7.89 KN)
Impact time	0.48 sec
Stress Induced	87.26 MPa
Deformation	1.66mm
FOS	5.28

Rear Impact:

Force	5G (11.2 KN)
Impact time	0.33 sec
Stress Induced	412.5 MPa
Deformation	8.16 mm
FOS	2.69

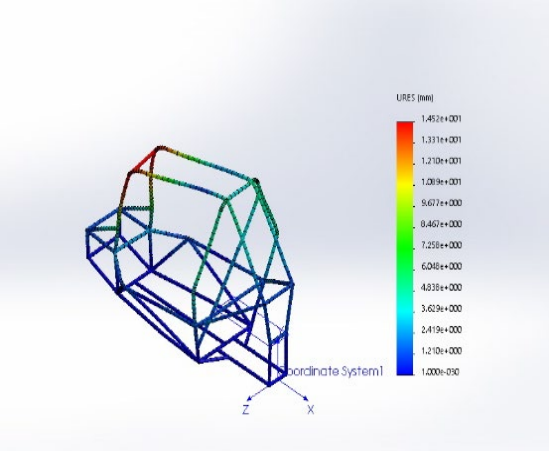


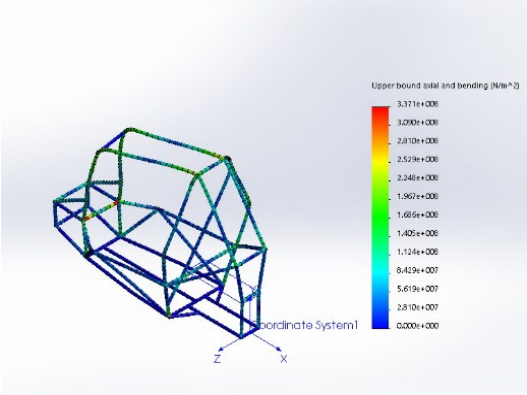




Torsional Analysis:

Force	**2.5G (5.6KN)**
Impact time	0.67 sec
Stress Induced	337.32 Mpa
Deformation	14.44mm
FOS	1.36



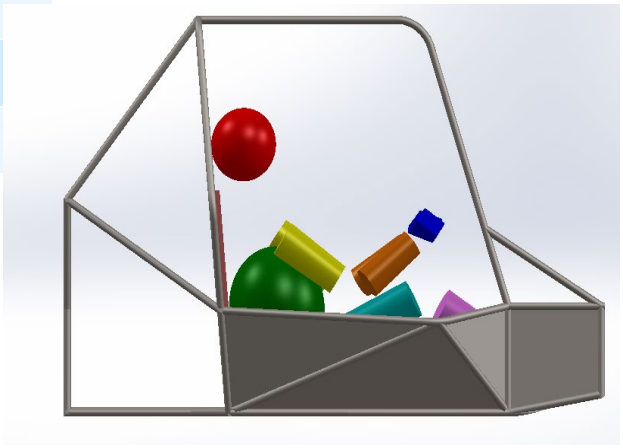


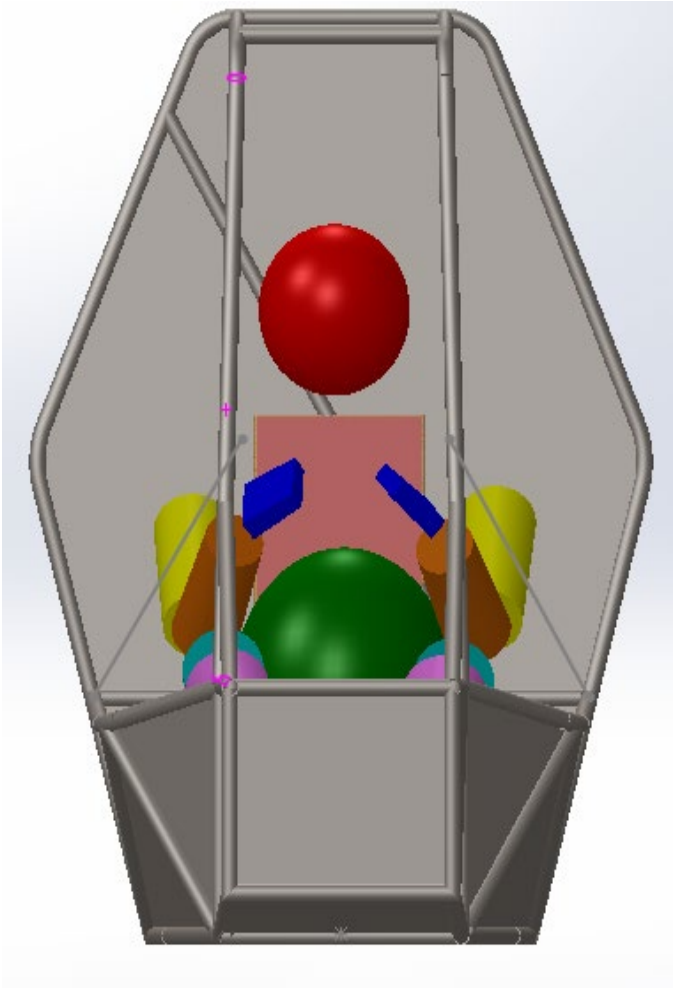
Driver Ergonomics:

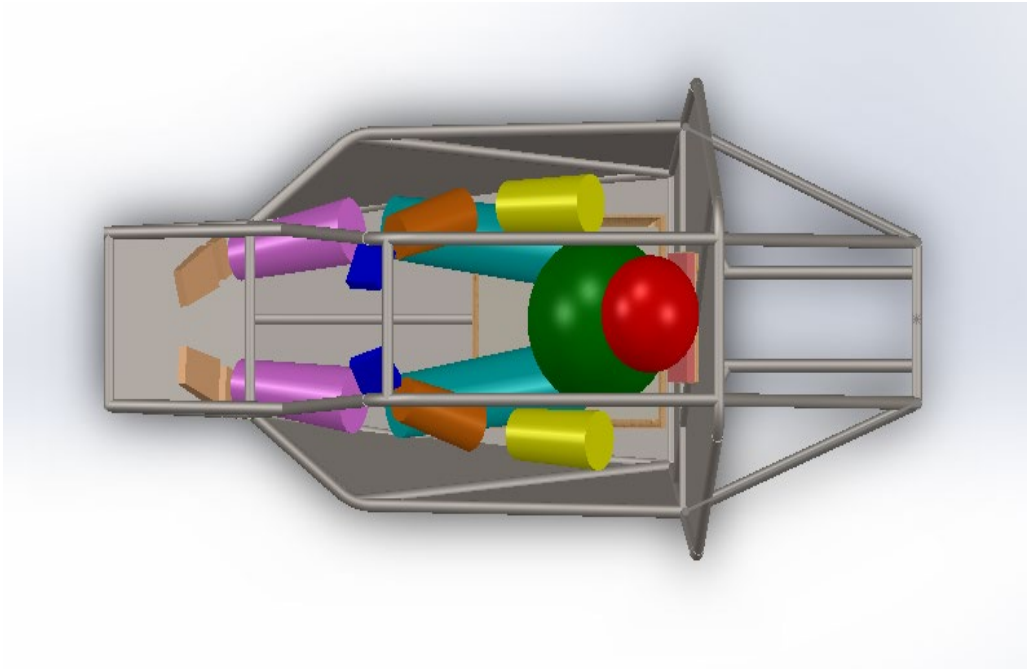
The ergonomics factors were analyzed by using Solid works. The model of Roll cage, Driver, Seat and Steering system were imported in Solid works and an assembly was made to check angle of limbs in normal condition.

Considerations:

1. Pedal and seat position for proper comfort.
2. As per rules, the condition for a clearance of three inches between the roll cage members and the body members of the driver and a clearance of six inches from the top of the driver's helmet to the Roll hoop overhead members were met for safety reasons. The actual clearance distances are three inches and eight inches respectively







Team Members:

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