

SAE Mini Baja

Frame Team

Engineering Analysis

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Overview

- Introduction
- SolidWorks Designs
- Scenario Testing
- Simulation Results
- Conclusion

Introduction

- Competing in the SAE Mini Baja Competition
- Design a manufacturable frame that will last through the SAE Competition Dynamic events
- Frame needs to be lighter and smaller
- Frame must aid in outperforming last year's baja vehicle

SolidWorks Analysis

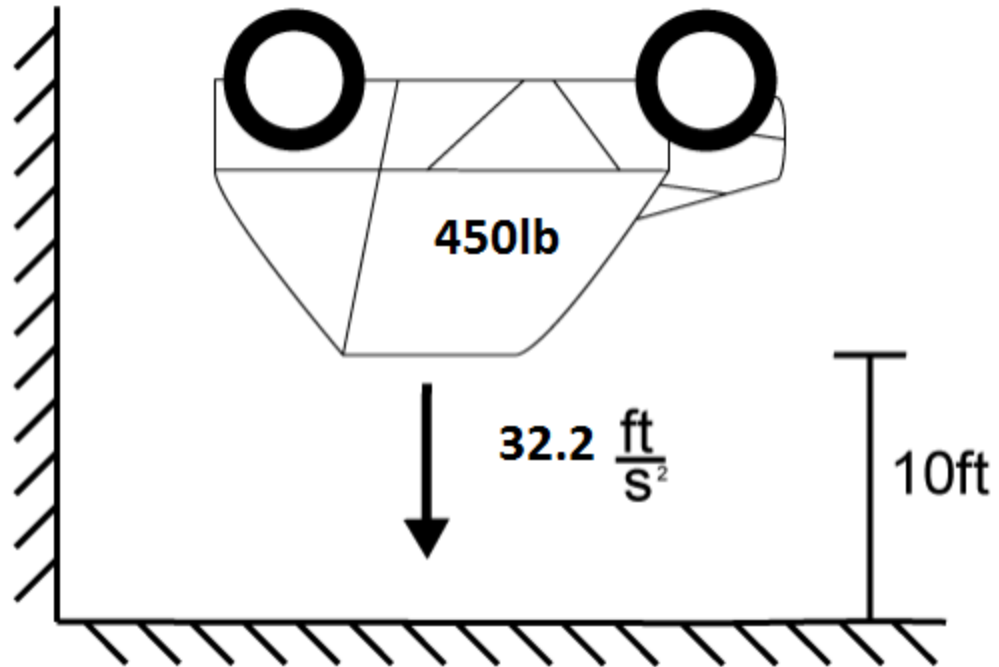
- Four Simulation Studies:

1. Rollover Test
2. Front Impact
3. Rear Impact
4. Side Impact

- Test Assumptions:

1. Drop height of 10 ft
2. Impact velocity of 25 mph
3. 0.1 and 0.2 second drop and impact impulse times, respectively

Drop Test



Drop Test Calculations

- Applied Equation:

$$F = m \cdot \frac{\sqrt{2gh}}{t} = 2507.752 \text{ lbf}$$

$$F_a = \frac{F}{l}$$

where,

F = total force,

F_a = applied force,

m = mass,

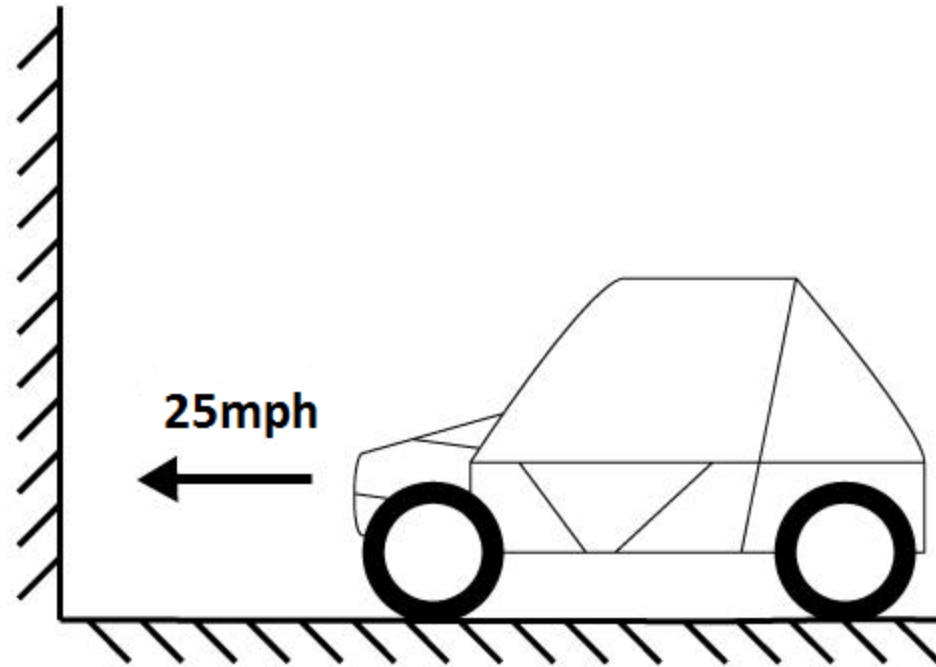
g = acceleration of gravity,

h = drop height,

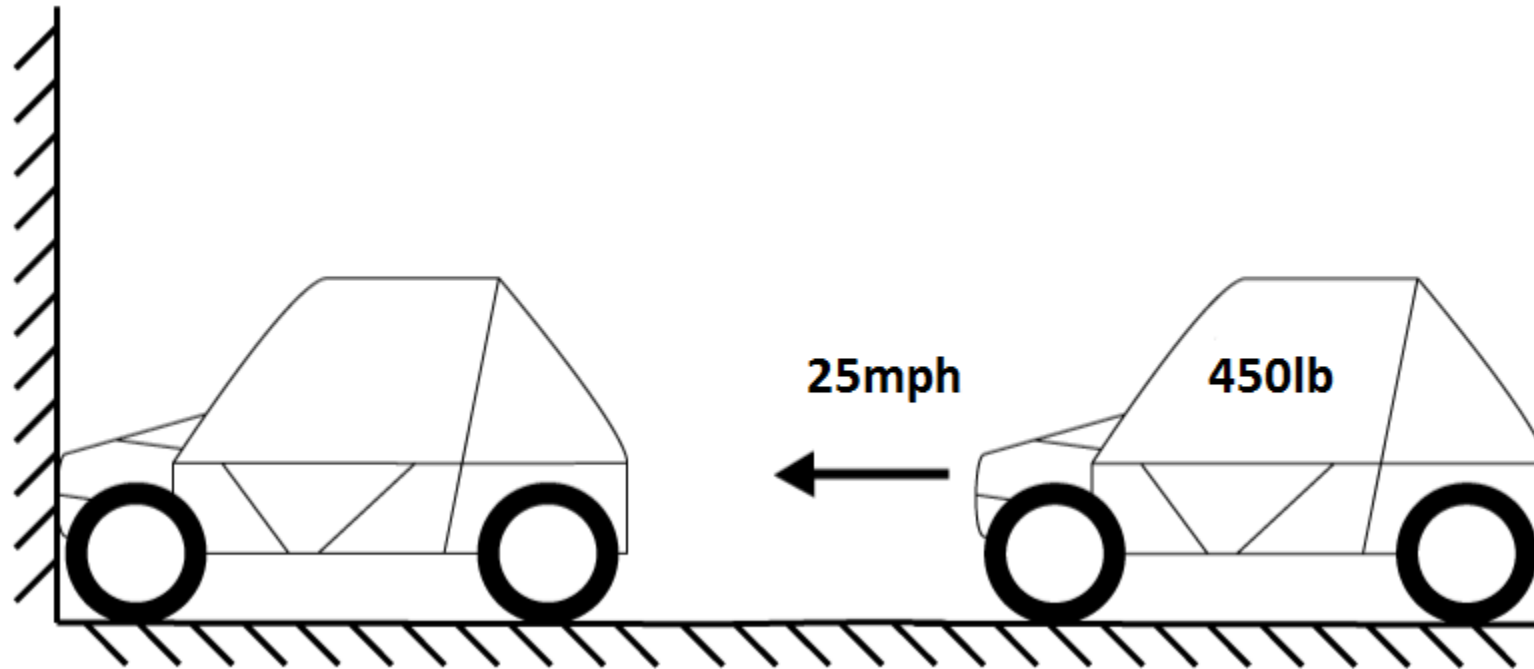
t = impulse drop test time,

l = total length of members force is applied to.

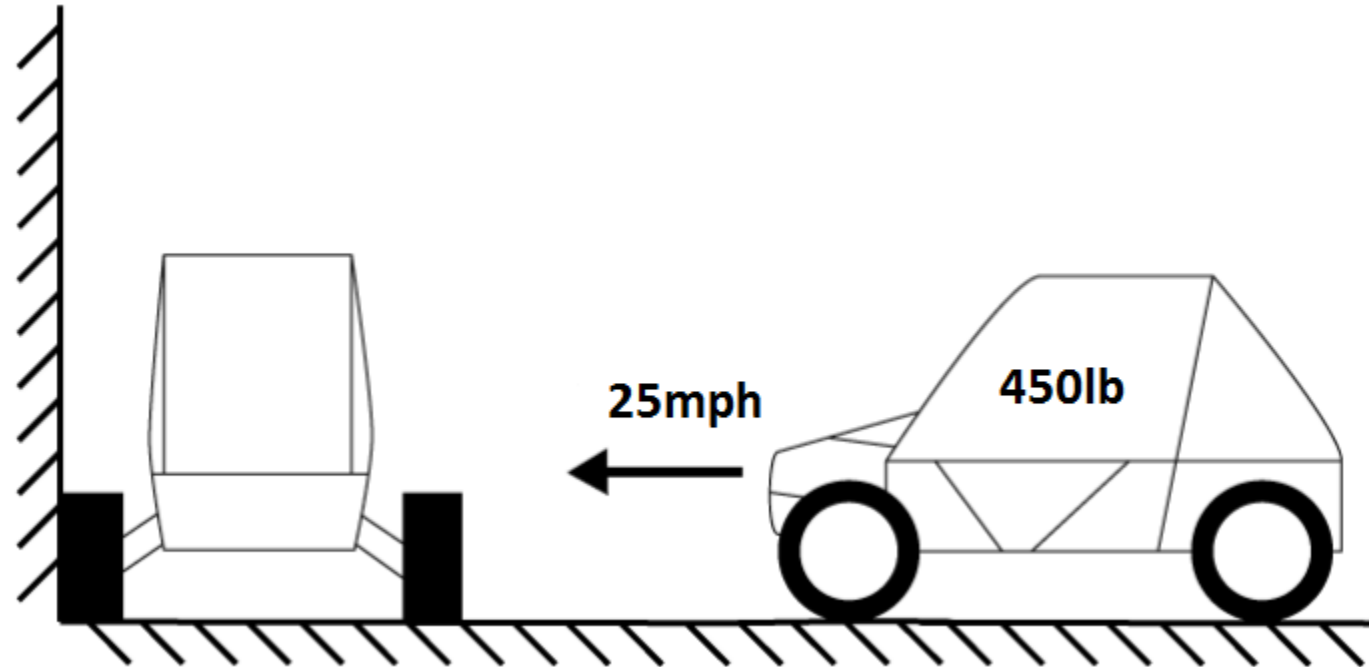
Front Impact Scenario



Rear Impact Scenario



Side Impact Scenario



Impact Tests' Calculations

- Applied Equations:

$$F = \frac{V_0}{t} m = 1192.175 \text{ lbf} \qquad F_a = \frac{F}{l}$$

where,

F = total force,

F_a = applied force,

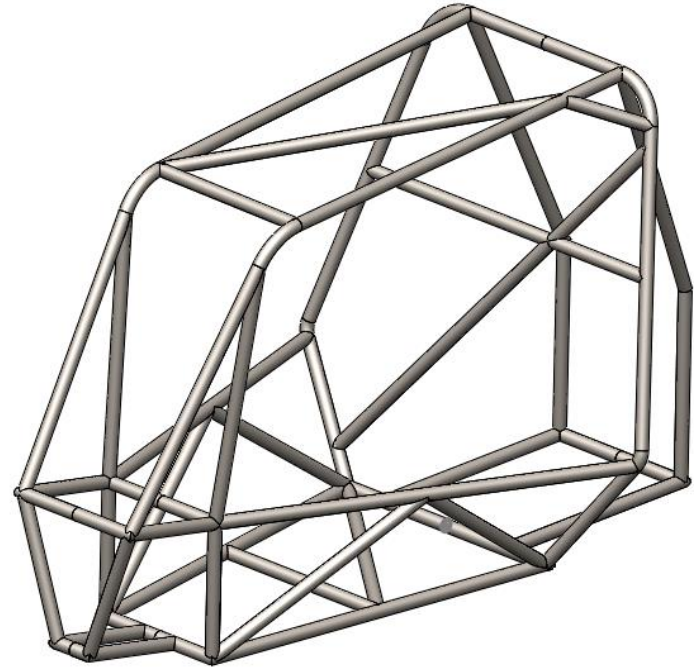
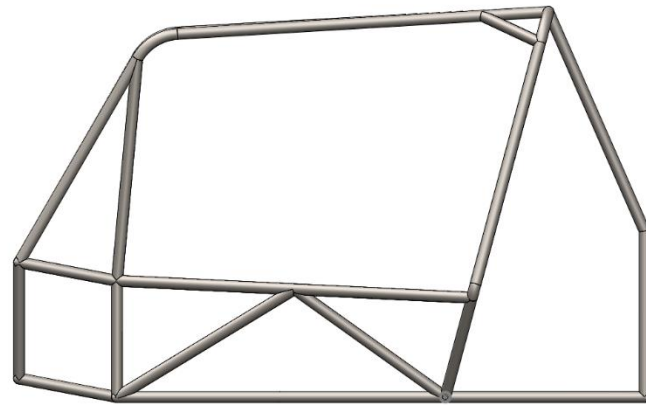
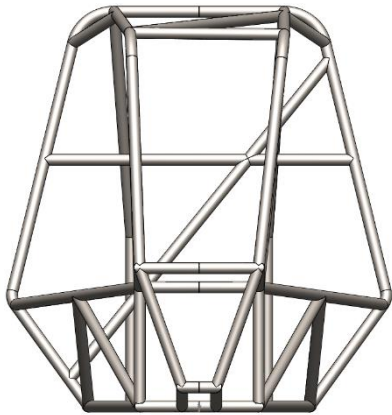
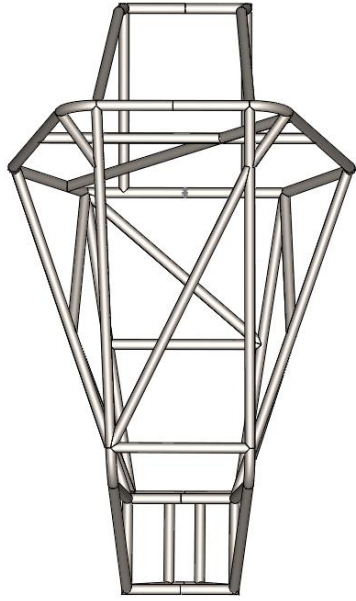
m = mass,

V_0 = impact velocity,

t = impulse impact test time,

l = total length of members force is applied to.

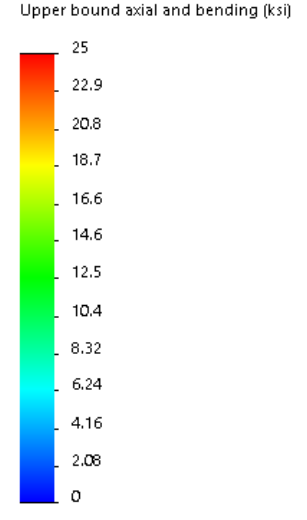
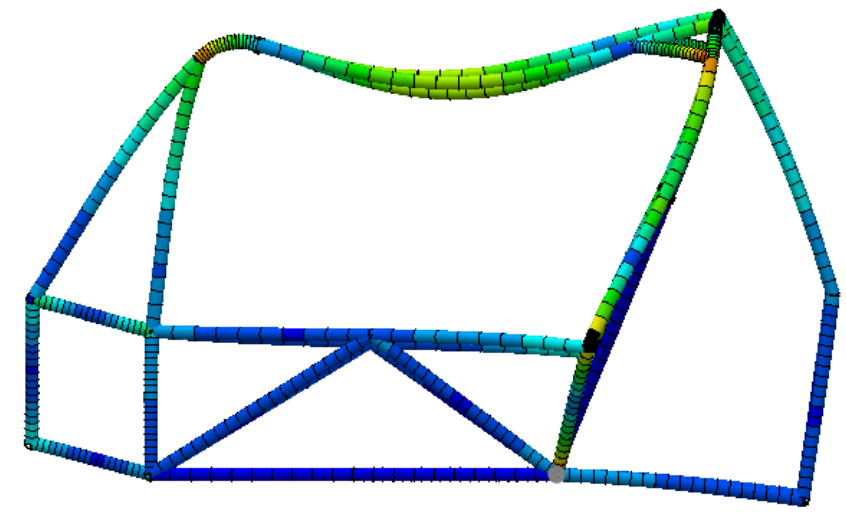
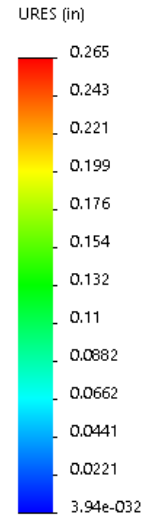
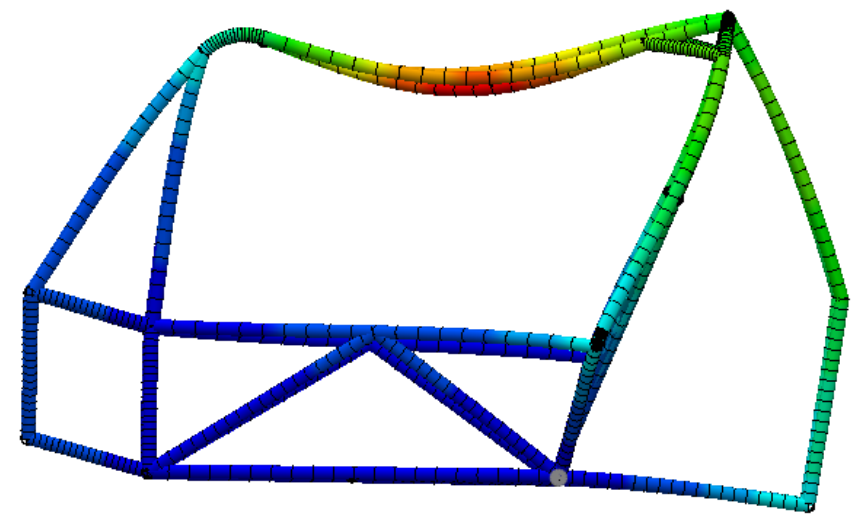
Front Supported Design



Design 1 Drop Test

Displacement

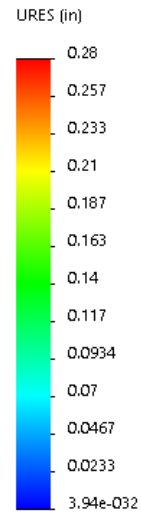
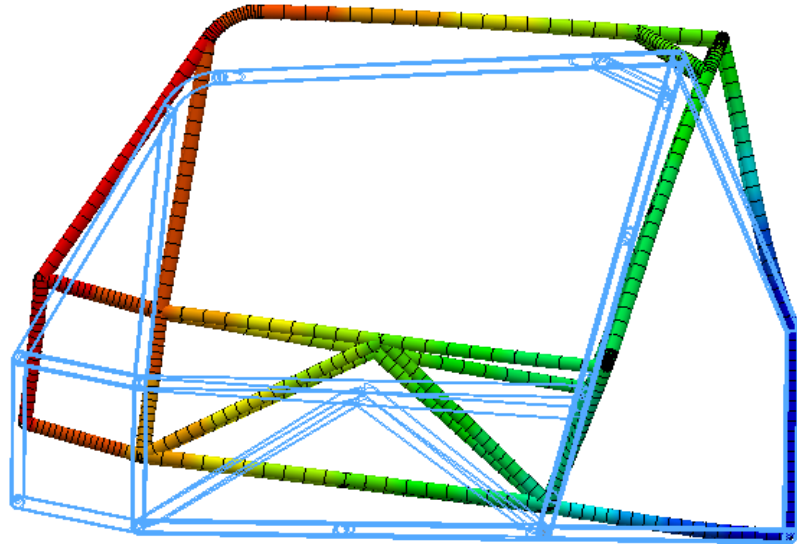
Stress



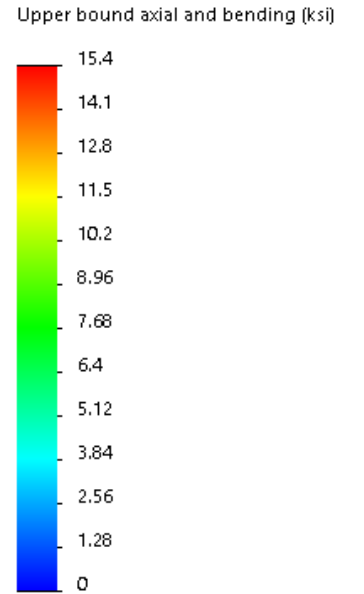
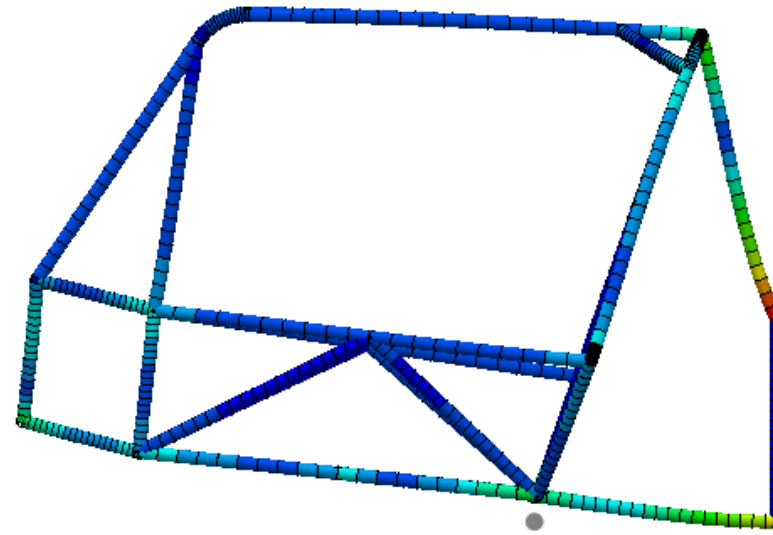
FOS: 2.7

Design 1 Front Impact

Displacement



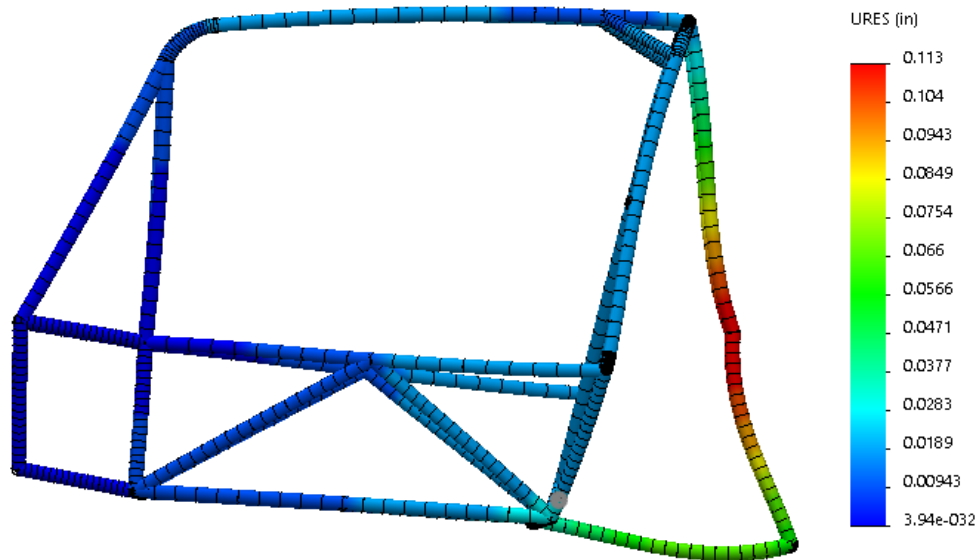
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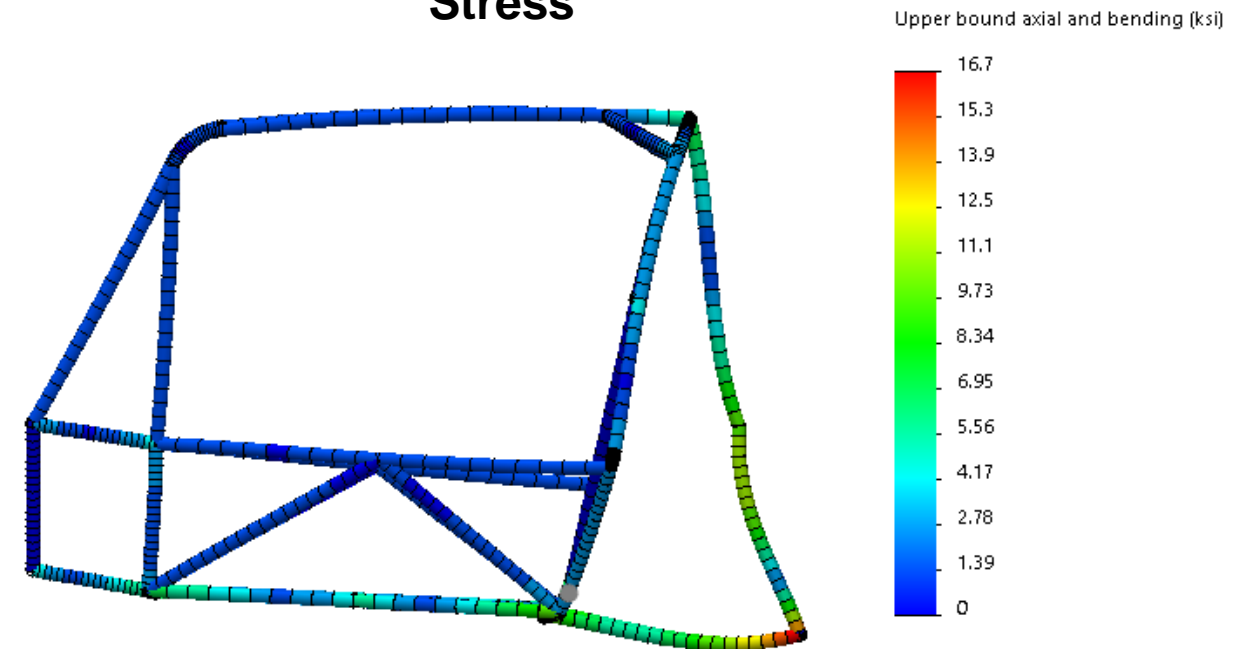
FOS: 4.7

Design 1 Rear Impact

Displacement



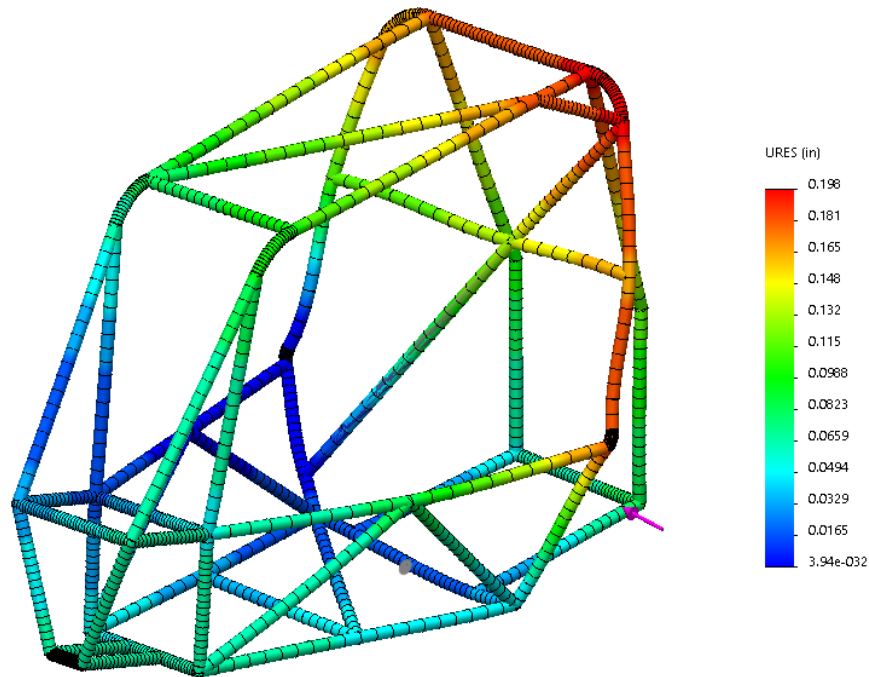
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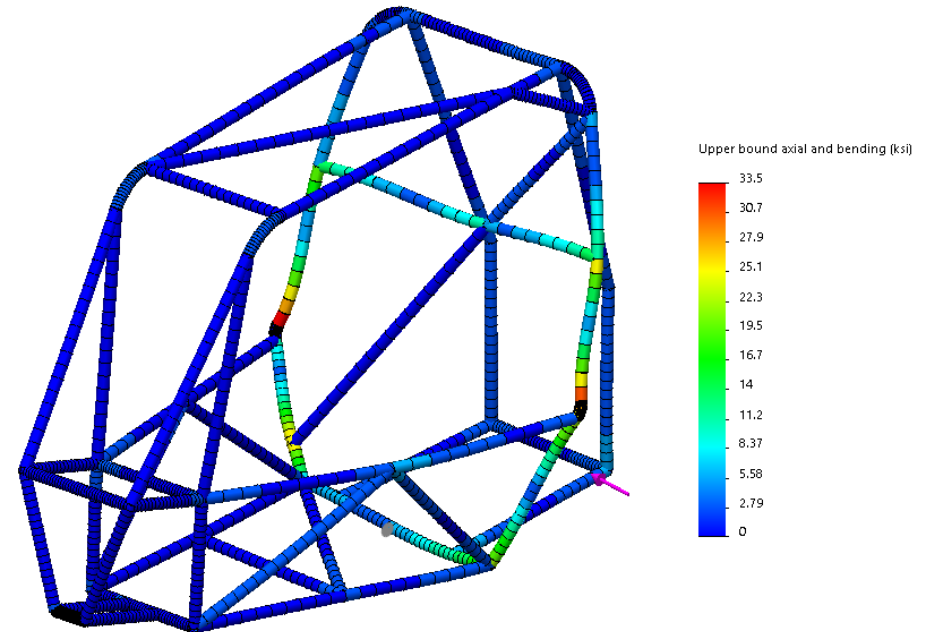
FOS: 4.0

Design 1 Side Impact

Displacement

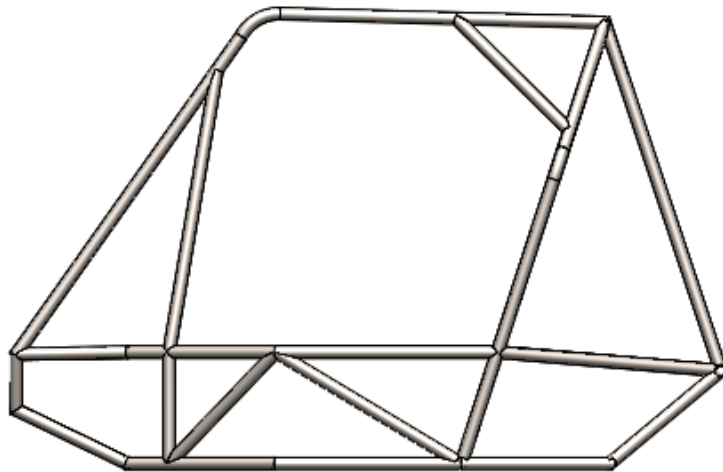
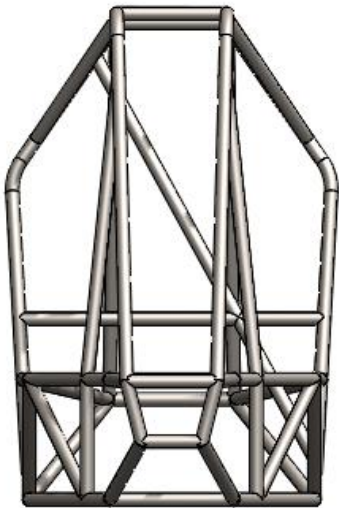
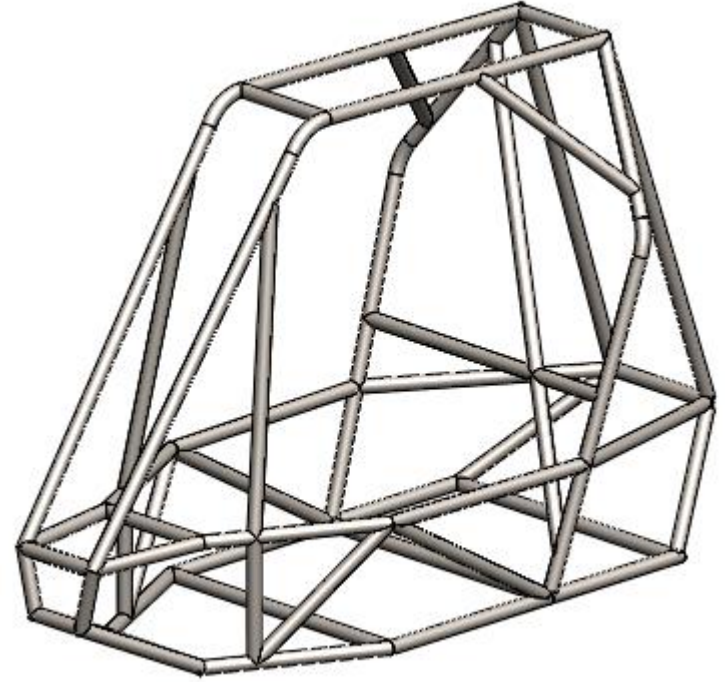
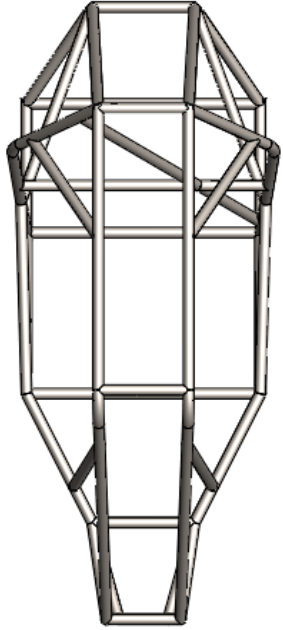


Stress



FOS: 2.0

Front Bracing Frame Update

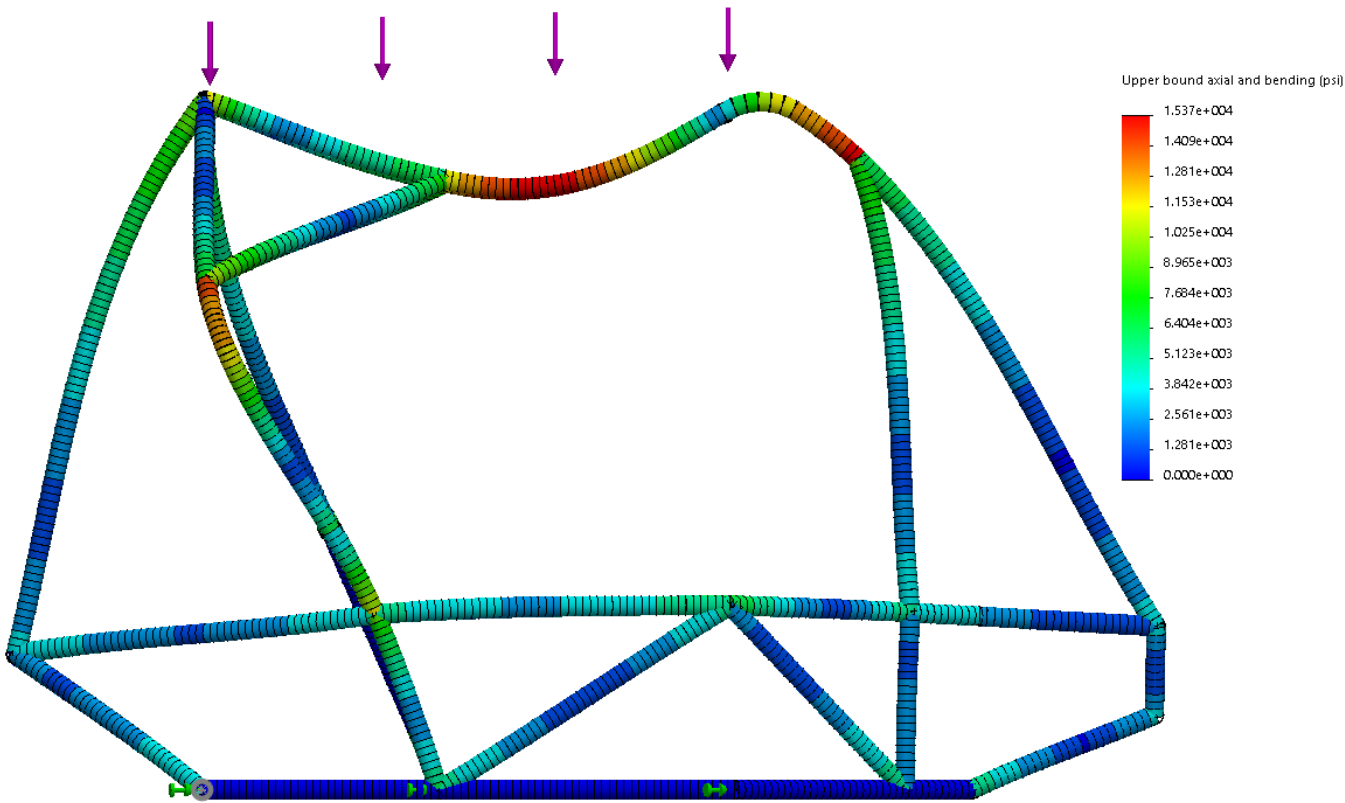
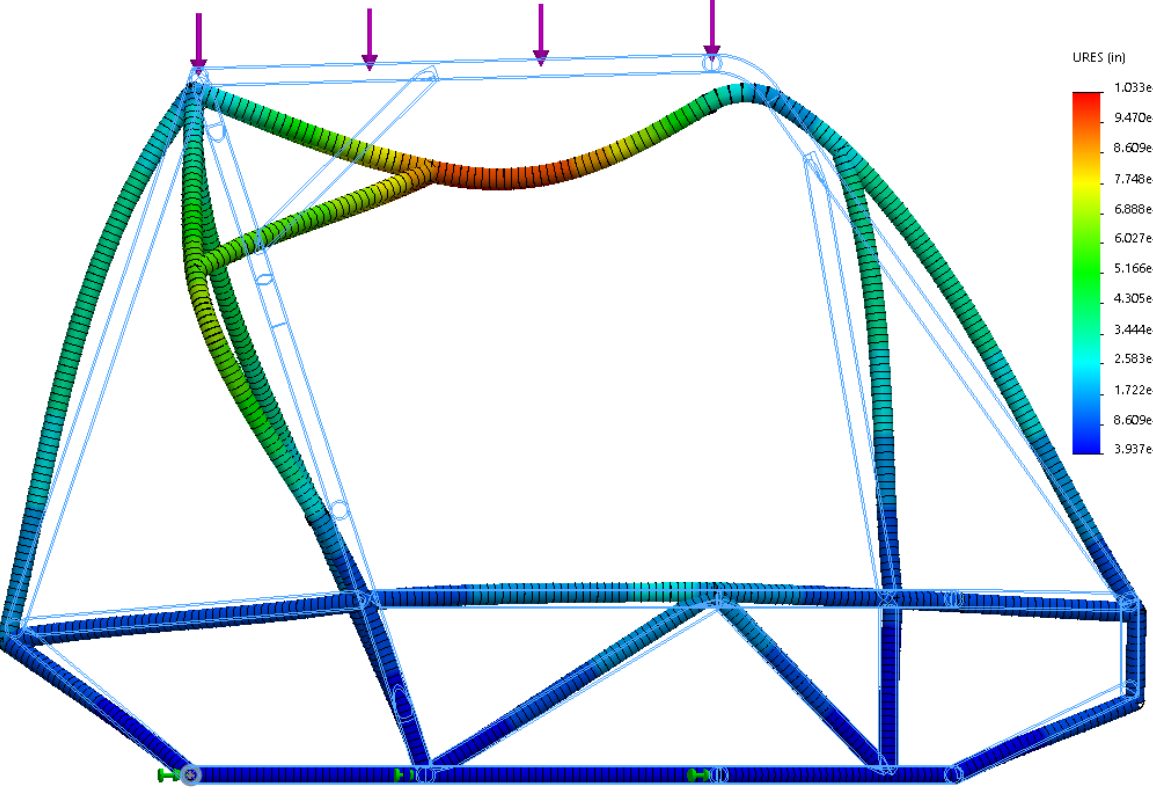


Front Brace Top Impact

Displacement

Model name: Matthew's Frame
Study name: Drop Test(-Default<As Machined>-)
Plot type: Factor of Safety Factor of Safety1
Criterion : Automatic
Factor of safety distribution: Min FOS = 4.3

Stress

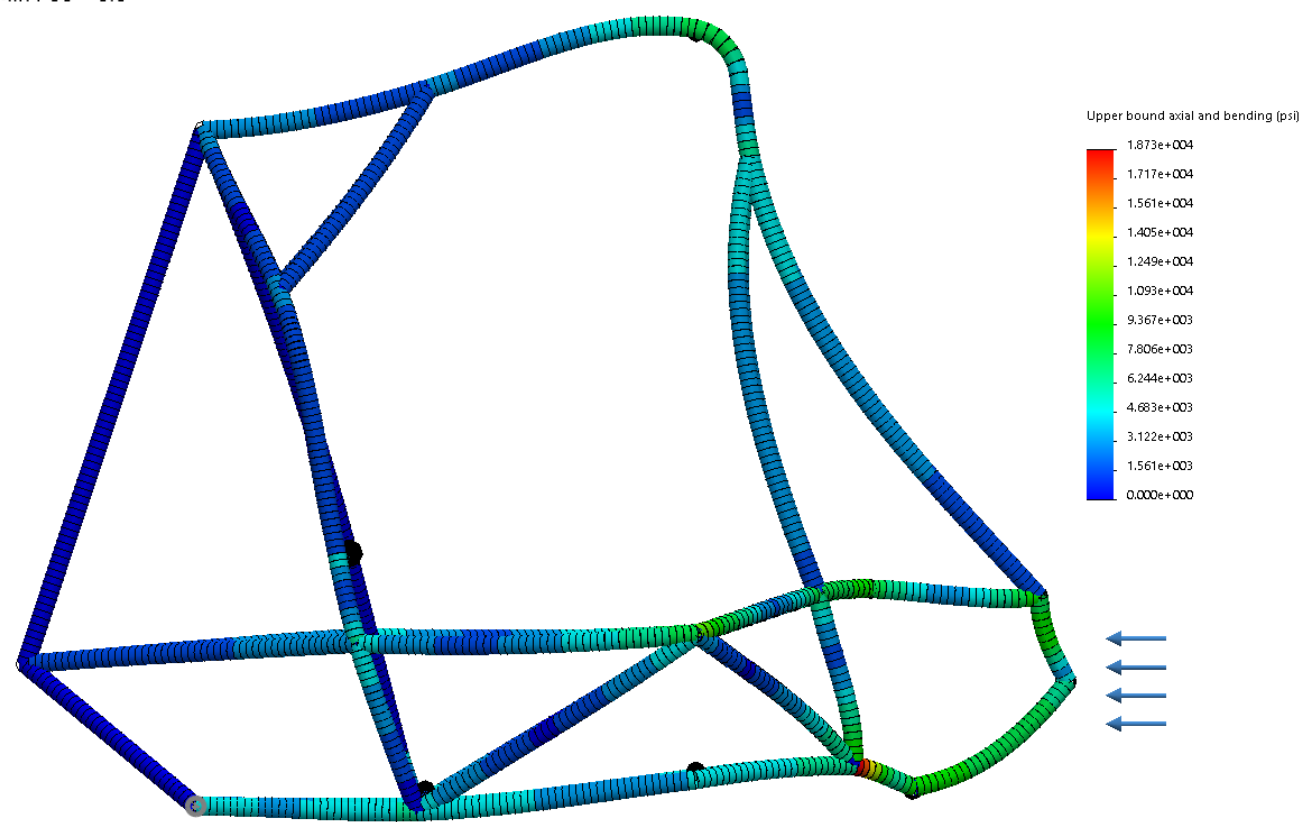
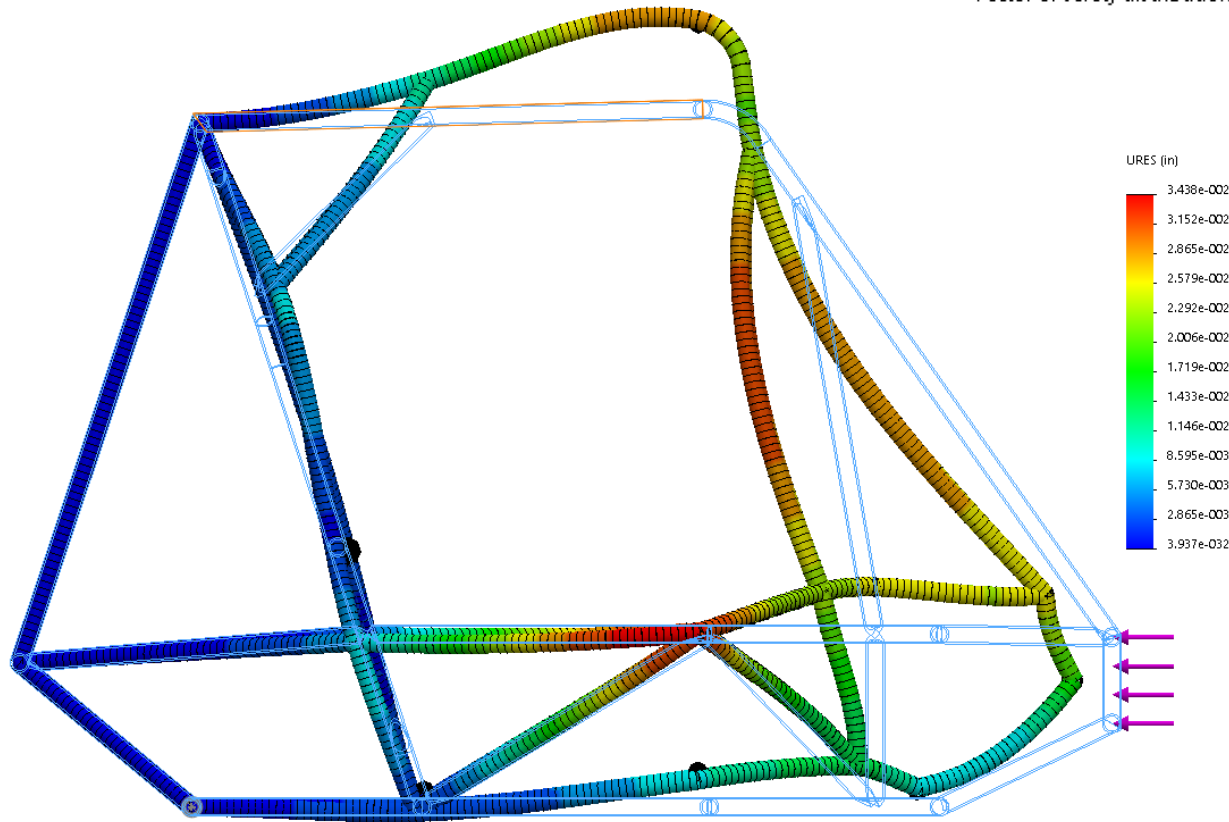


Front Brace Front Impact

Displacement

Model name: Matthew's Frame
Study name: Front Impact(-Default<As Machined>-)
Plot type: Factor of Safety Factor of Safety1
Criterion : Automatic
Factor of safety distribution: Min FOS = 3.6

Stress

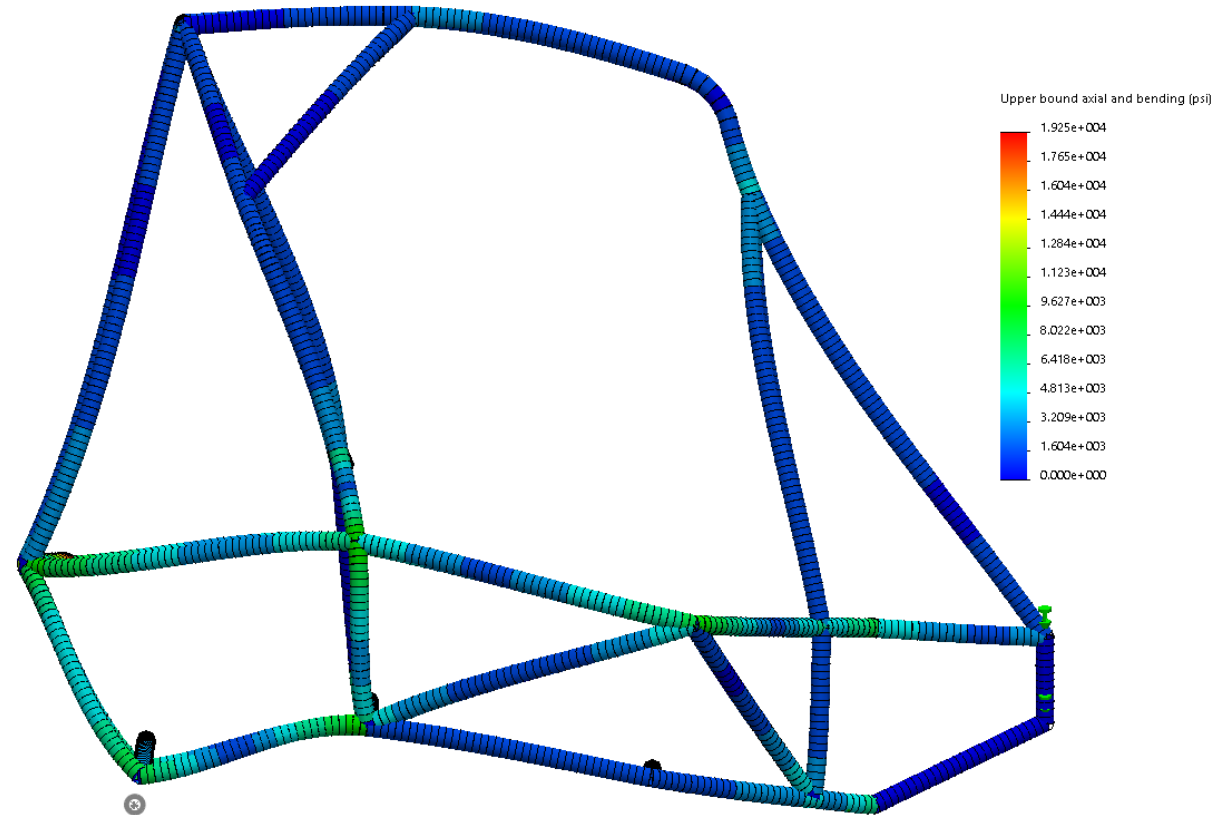
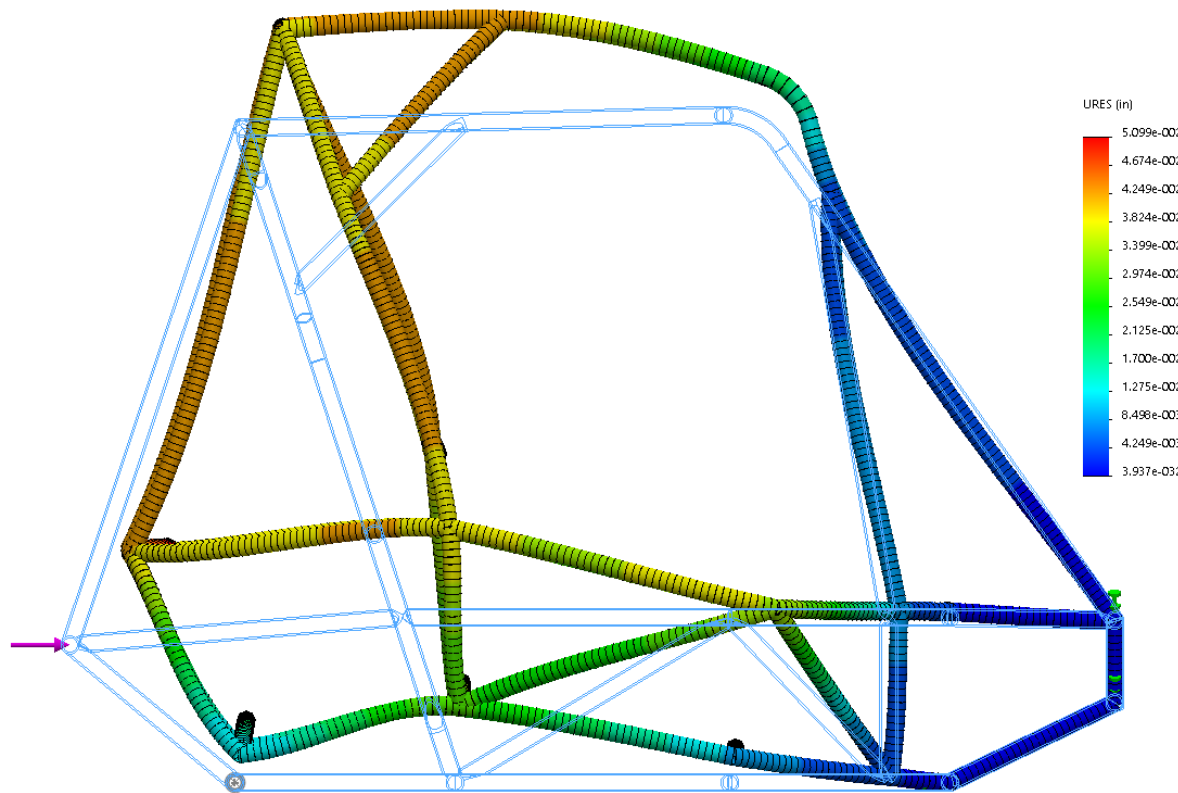


Front Brace Rear Impact

Displacement

Model name: Matthew's Frame
Study name: Rear Impact-(Default<As Machined>-)
Plot type: Factor of Safety Factor of Safety1
Criterion : Automatic
Factor of safety distribution: Min FOS = 3.5

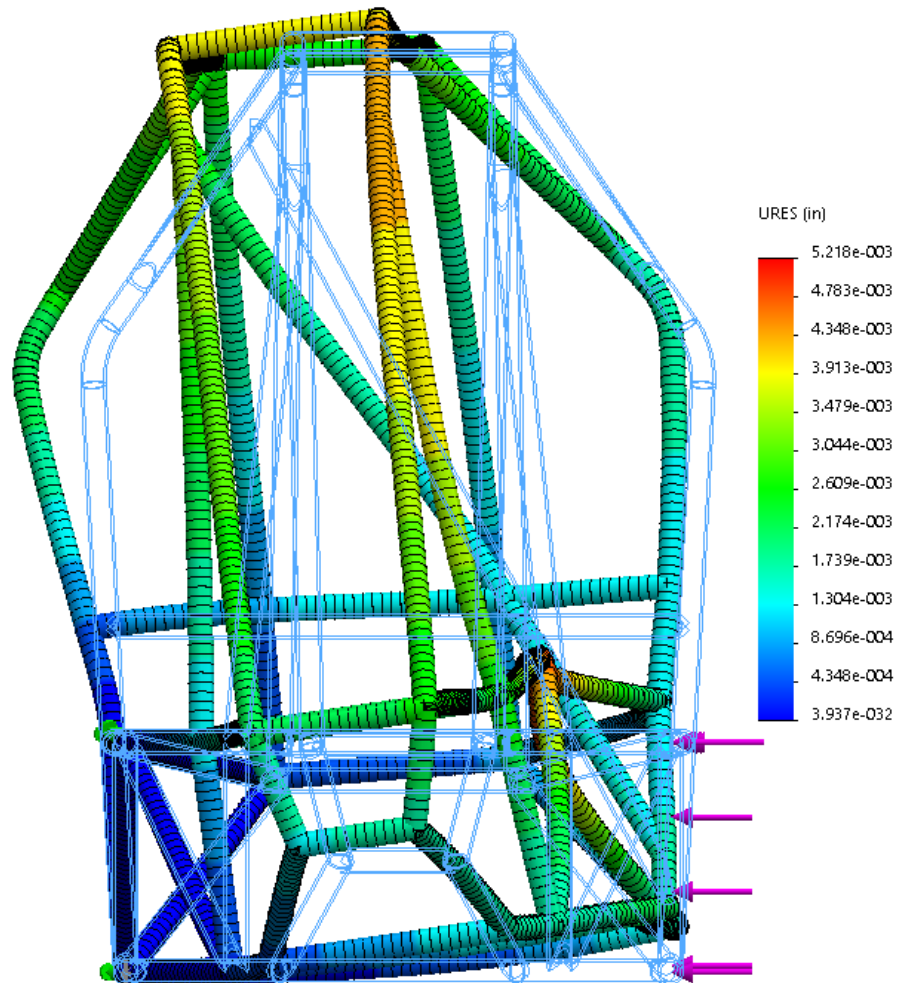
Stress



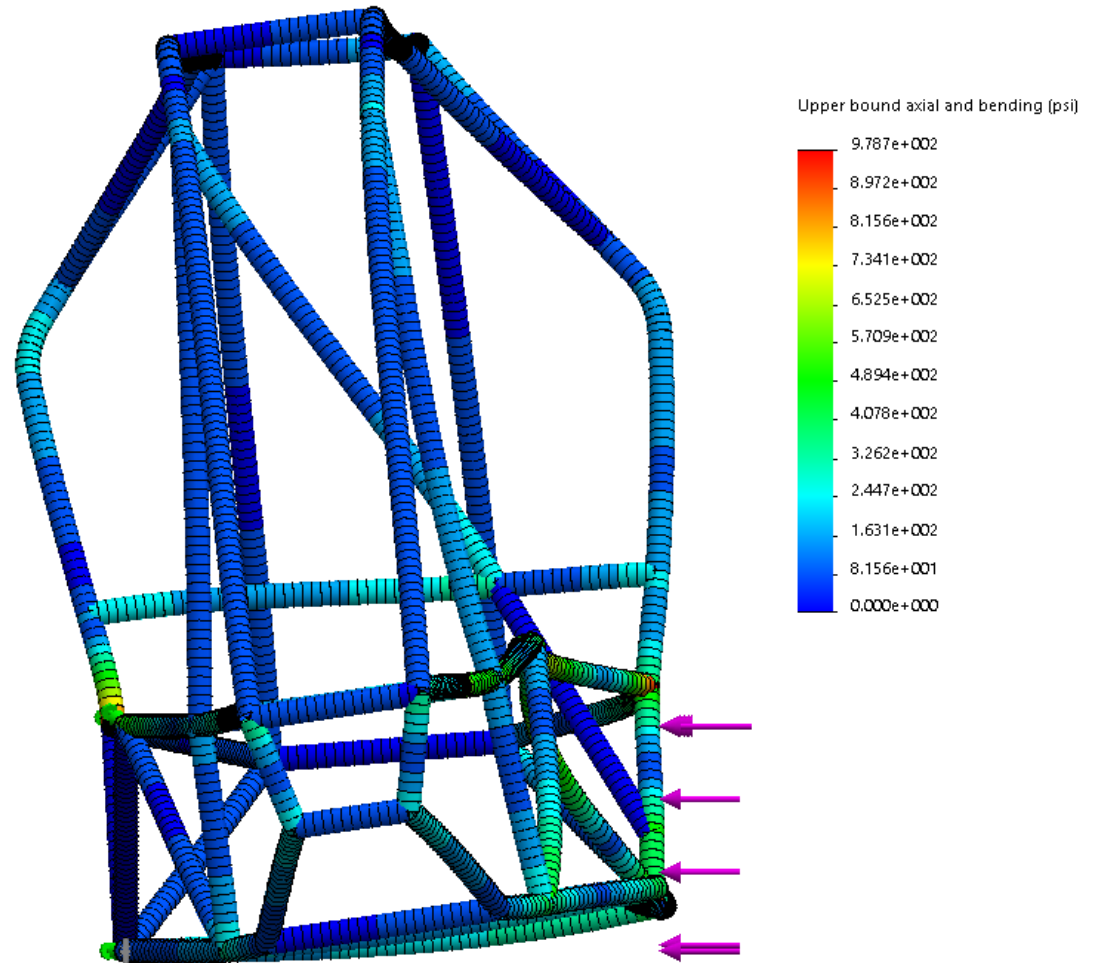
Front Brace Side Impact

Model name: Matthew's Frame
Study name: Side Impact(-Default<As Machined>-)
Plot type: Factor of Safety Factor of Safety1
Criterion : Automatic
Factor of safety distribution: Min FOS = 68

Displacement



Stress



Conclusion

- Possible Scenarios (Drop, Side, Front, and Rear Impact Tests)
- SolidWorks Analysis Completed and Acceptable
- Need to choose a final design

References

- <http://www.youtube.com/watch?v=gAwVya8AfyM>
- SAE Design and Analysis Project with SolidWorks Software

Questions?