



The redesign of the UWTSD formula student chassis, to meet regulations and to optimise strength and rigidity.

Oliver Gordon

Andrew Harrison

School of Engineering

BSc Motorsport Engineering

Introduction

On this poster, there will be an other view of the entire project, to redesign the UWTSD formula student chassis to meet regulations and improve its strength and rigidity, by firstly redesigning it to meet the regulations and then secondly, change its materials to see how the redesign reacts in static analysis with said new materials. There shall also be a small section on the validation process for the CAD system used during this project.

Project Aims

The project aims were as follows:

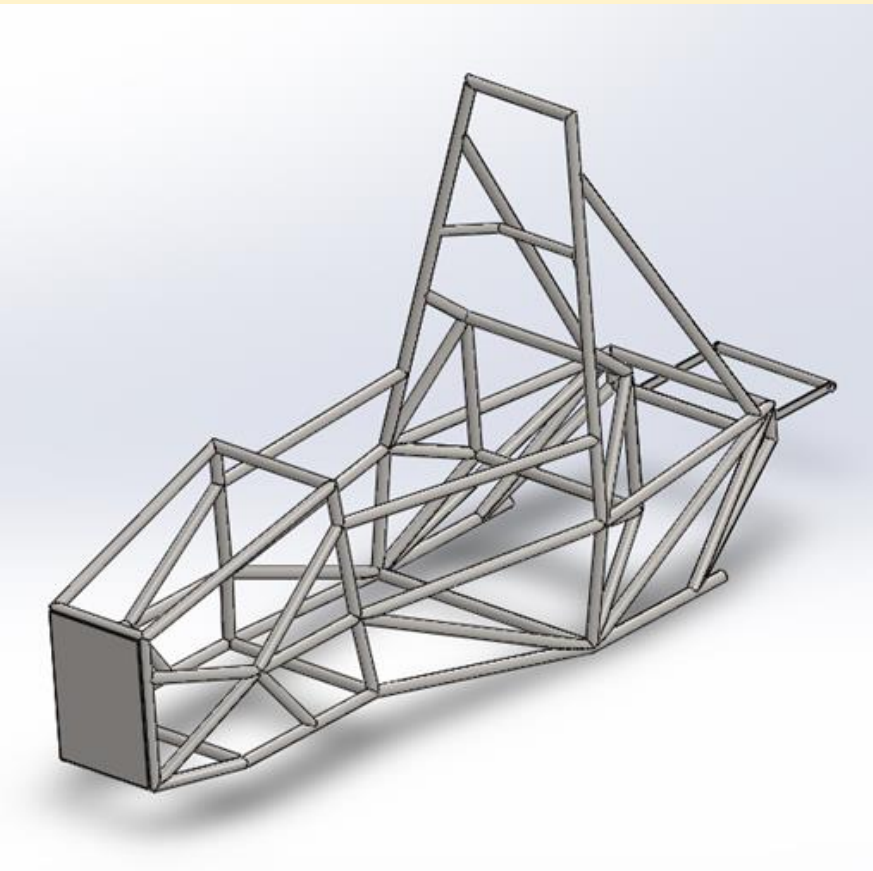
- Measure and model the current UWTSD formula student chassis to a high accuracy.
- To conduct a real-world test with a component and simulate in Solidworks to complete the validation process.
- To remodel the current chassis to meet 2019 FSAE regulations. And refine the design.

Chassis 1

On the right is a cad model of the original chassis from the UWTSD workshop, full spaceframe chassis with bulkhead and jacking point.

old chassis #1			
test no.	stress +	stress -	dispalcement
1	0.8074	3.948	0.5106
2	2.242	3.656	0.5394
3	11.22	9.962	26.89
	Mpa	Mpa	mm

- As results for the original chassis for all three test as seen to the left, the stresses experienced are a good basis to work from.
- Very little displacement being experienced apart from in test three, and the negative stress (stress acting in the opposite direction) of the load being much greater than the positive stress.

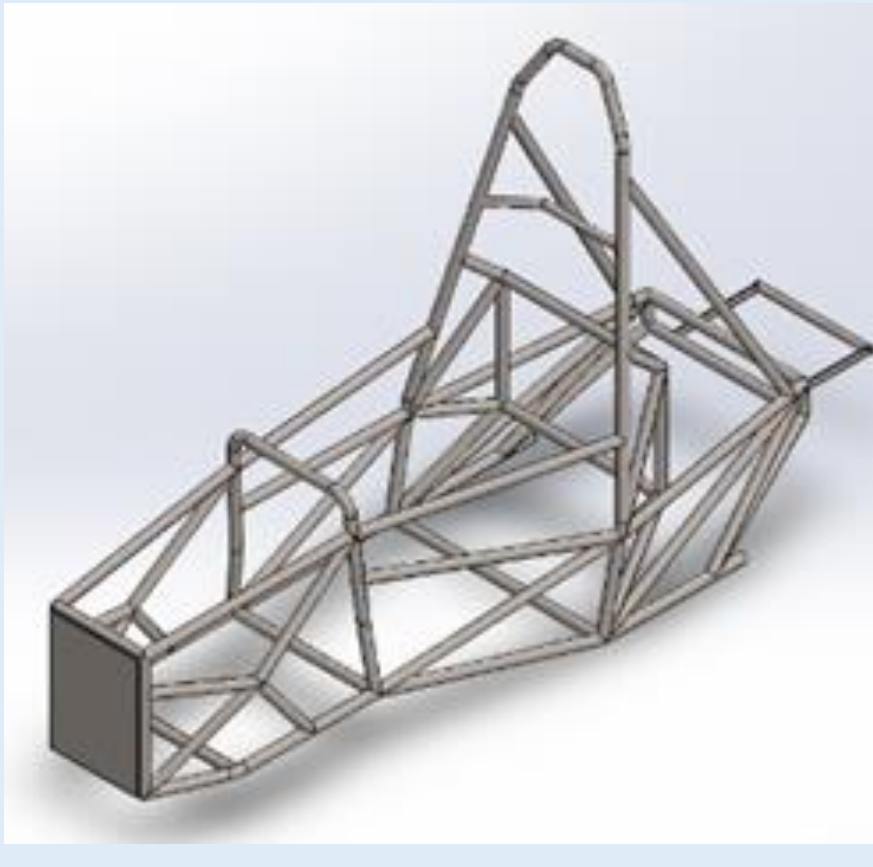


Chassis 2

On the right is a cad model of the redesigned chassis to meet all the regulations regarding spaceframe chassis. This includes a restructure of the side impact tubes. Along with radius changes made by myself.

new design old materials #2			
test no.	stress +	stress -	dispalcement
1	0.797	4.226	0.4516
2	2.43	3.195	0.5194
3	11.44	10.69	28.27
	Mpa	Mpa	mm

- In the table on the left shows that the redesign does have improvements in test one and two but fails to improve in test three.
- The displacement across test 1 and 2 see's overall improvement and in the stresses experienced it improves in some area's and fails to improve in some area's
- Test 3 see's no improvement.

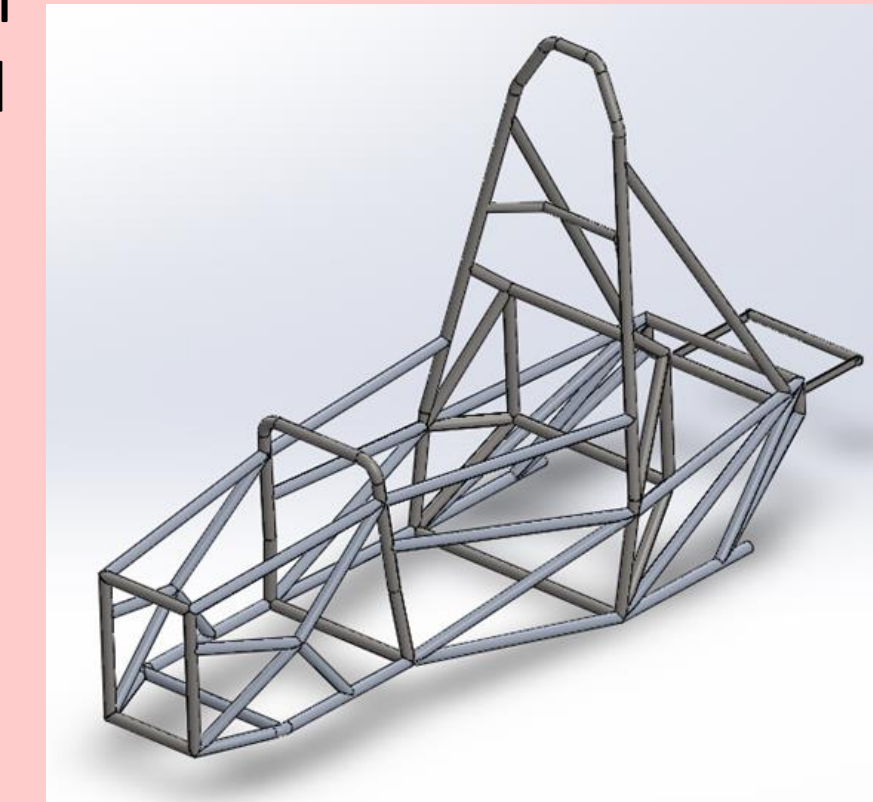


Chassis 3

On the right is a cad model of the redesigned chassis with updated materials, being 2014 alloy aluminium and plain carbon steel.

new design new materials #3			
test no.	stress +	stress -	dispalcement
1	0.9	4.196	0.6173
2	2.502	3.178	0.62
3	12.19	11.73	73.88
	Mpa	Mpa	mm

- In the table on the left shows that as expected the aluminium will experience more stress and displacement across the board.
- However although the chassis appears to have failed in comparison to the other chassis, is in facts shows that with very little compromise to the strength of the car a team could change the material of the chassis.



Validation

For the validation, two welded joints were made in the workshop, a 45° cut weld and a 90° butt weld, then put these components onto the Denison tensile strength tester and pull these components to breaking point, with the goal to simulate this in solidworks and have as small difference in results as possible.

Testing

During the chassis testing phase, three different static tests were conducted. A front-end collision test, a side impact test and a twist test. In test one the six-points at the front bulkhead were fixed. The loads applied at the engine bay are 708.555N per point (x4). This being the total weight of the car plus a driver. In test two the load of the weight of a formula student car and driver together equals 2834.22N, split across six points for the side structure is 472.37N. With the opposing points being fixed. In the third test The load is applied to the two points representing the front and rear corner on the right-hand side of the chassis is 1417.11N. With the left side corners being fixed.

Conclusion

To conclude, this poster shows an overview of the entire dissertation, with a showcase of the validation and testing and showing the three different chassis and an explanation of each different test. It also shows the different stages in redesign and a comparison of the testing results with positive & negative stresses and the displacements.

References

Solidworks, 2020. Why Choose SOLIDWORKS 3D CAD? <https://www.solidworks.com/product/solidworks-3d-cad>

IMECHE, 2018. Formula Student Rules 2019 s.l.: s.n.

Institution of Mechanical Engineers, 2020. FORMULA STUDENT. <https://www.imeche.org/events/formula-student>