The Design and Virtual Prototyping of a LEV

Group C1

TUS

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Project Aim

The Aim of the project is to make a new design or improve an already made design of a Light Electric Vehicle (LEV) and then carry out a simulation of this model. The LEV must be single seat preferably in the direct centre of the vehicle.

Objectives

- Design the overall concept of the Vehicle along with its accompanying subsystems.
- Create a 3C CAD model of the Vehicle both parts and an assembly.
- Conduct a CAE analysis of the vehicle structure as part of the virtual prototyping.
- Based on simulation results introduce some corrections and possible improvements to the CAD design.
- Prepare technical documentation of the project in the form of assembly drawings of the vehicle and its subsystems.

Background

The demand for electric vehicles that will be able to rival their combustion counter parts has only increased exponentially in recent years as the emphasis on environmental impact, sustainability and emissions has become more profound.

The main reason that LEVs would be used in most situations is to be able to reduce the emissions that a regular combustion vehicle would give off but there are other benefits such as the cost saving, now while the initial cost will be the same but then when it comes to the recharging of the vehicle, cost of the electricity it will be far less than that of a regular vehicle especially at night.

Safety of the user is of the upmost important in everything this LEV is no different, a roll cage made from welded steel tubing which will completely enclose the operator/driver providing maximum safety of the body of the operator.

Concepts

The design was kept with as little components as possible in order to reduce the risk of a failure Aswell as mechanical parts. The sketch below shows frame design of the LEV with little to no bodywork while the CAD model below has example shell design, both concepts were incorporated into the finial deign to make the finial model as efficient as possible.

With the frame design a lot of the important parts such as the battery/motor and steering system are exposed to the outside elements, further emphasizing the need of a shell/bodywork to protect these critical components

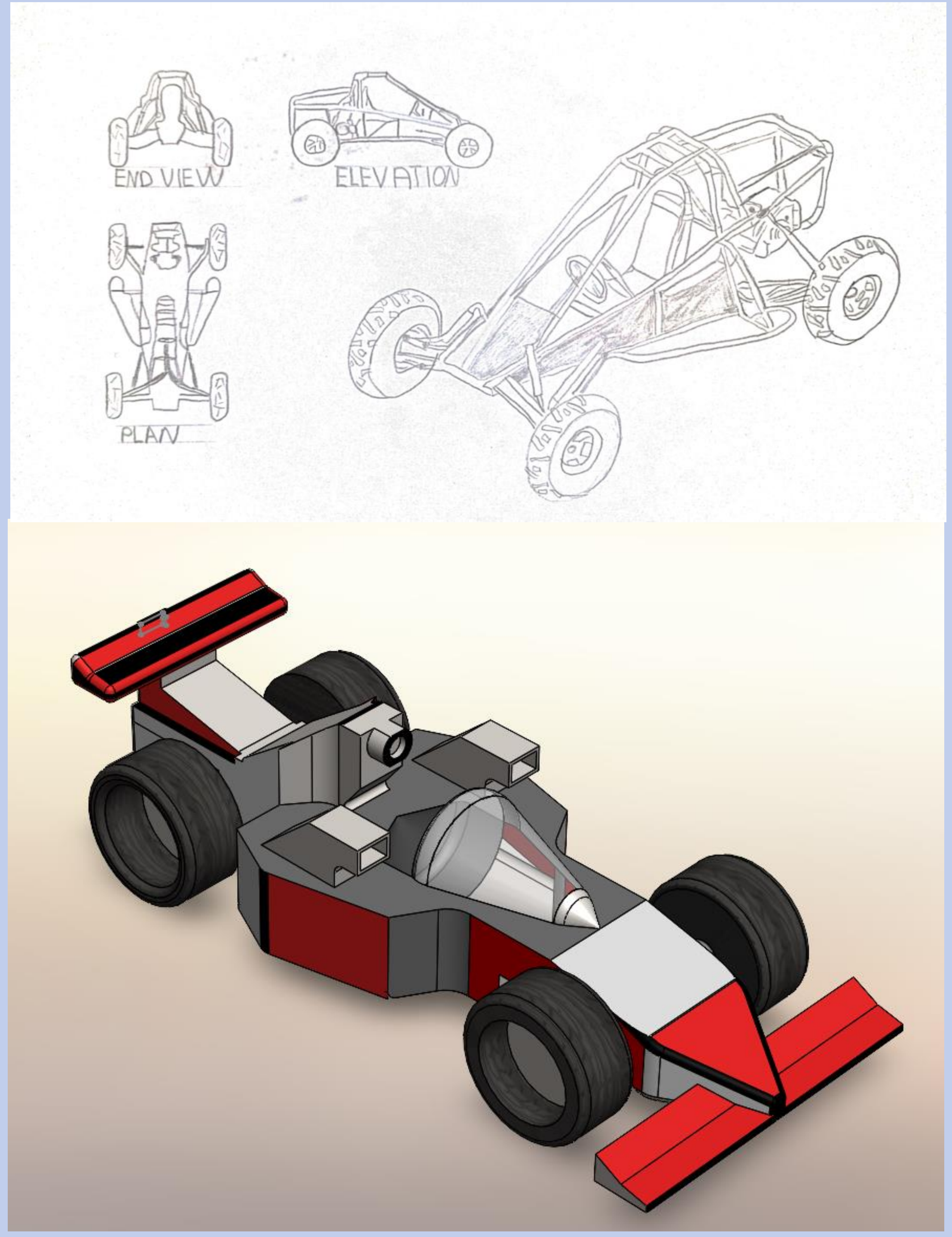

Figure 1: Concept Sketches/Design

In our finial design we decided to remove both the front and rear wing this was done reduce the total weight of the LEV so to increase the overall speed. Also, no windshield or front guard for the driver was implemented this was done for two reasons firstly to again remove weight and secondly to improve the vision of the driver.

Design

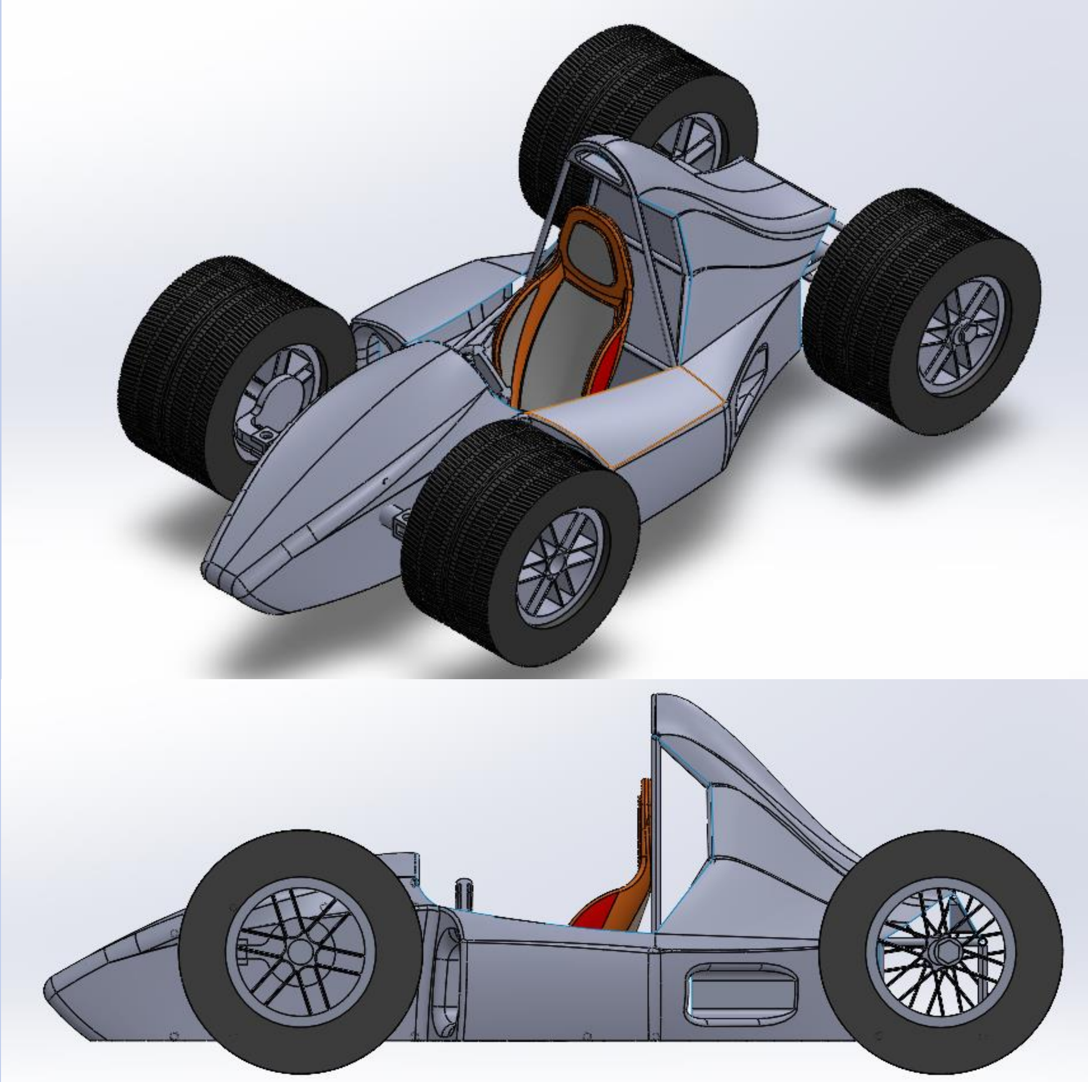

Figure 2: Completed CAD Model

A lot of research was needed before the modelling of the LEV could begin as there were many aspects that needed to be discussed and decided on, almost everything about the design needed to be decided about so that everything would fit and work properly together.

The sloping body of the shell for the LEV will provide good aerodynamic which will give the LEV a low drag coefficient which will increase the downforce at high speeds. The material of the shell will be made from carbon-fibre which will be moulded into the correct shape which will reduce weight and increase speed.

The Frame as previously discussed will be made from welded steel tubing which is quite heavy having a density of approximately 8000Kg/m^3 so the frame will be the heaviest component of the LEV. But it will be the most important one too as every component will be attached to it, so it needs to be strong which it is having an ultimate tensile strength of 310MPa and a yield tensile strength of 276MPa. The axles will be made from some grade of SAE steel so that they can withstand be rotated at very high rpm. As for the rims they will be made from a cast aluminium alloy which is strong and light

Simulations

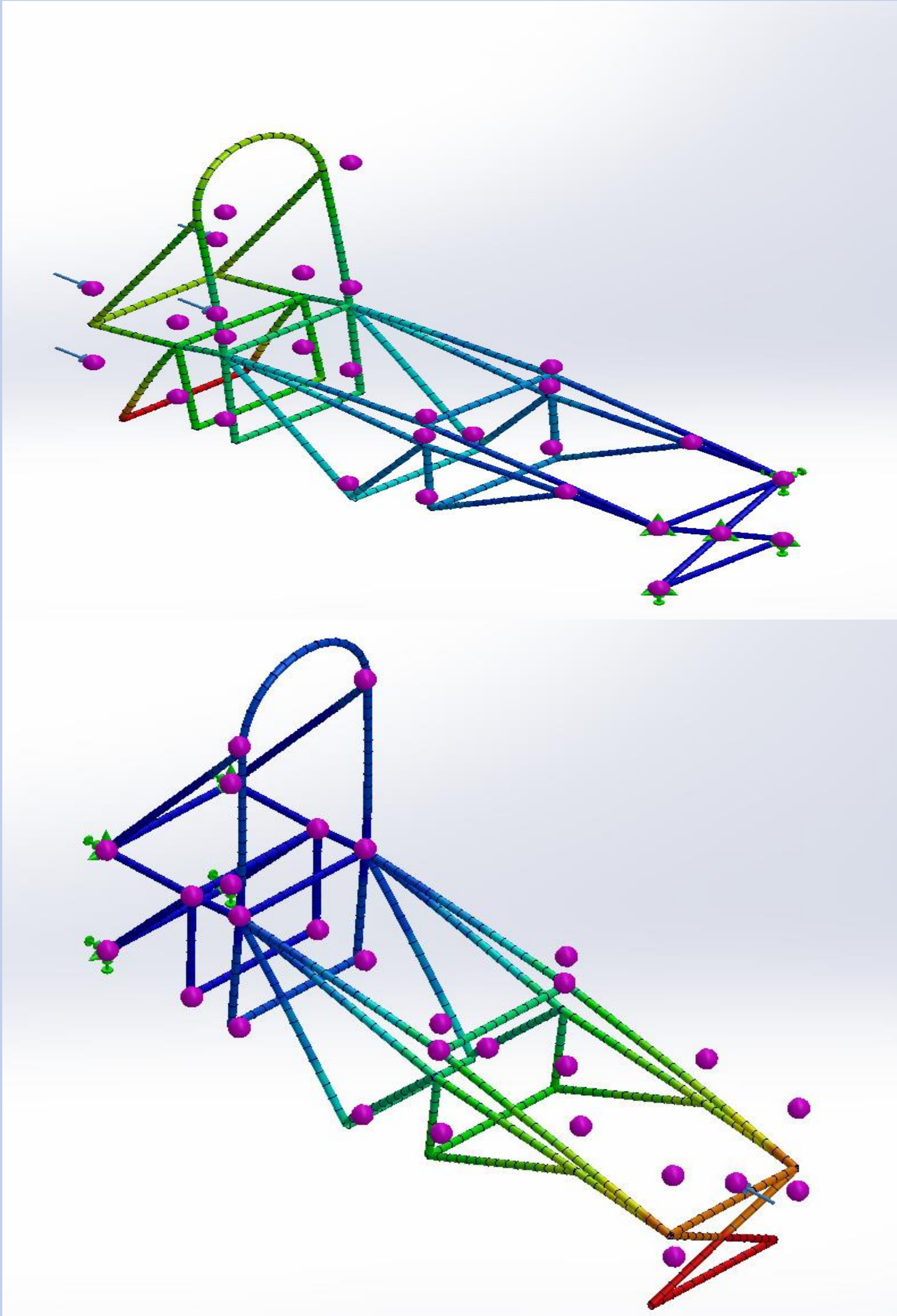

Figure 3: Displacement of frame after Rear and Front Impacts

Conclusion

With the use of solidworks the finial CAD model was created along with Solidworks simulations for an FEA of the frame of the LEV. A lot of research went into the design of the frame and body ensuring that a good design was finalized correctly. The modeling of the LEV in solidworks was quite time consuming which did make it difficult in the time leading up to the project deadline.

Acknowledgements

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