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Soap Daddy Inc.

Integrating Project – ACHA4008

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1 Introduction

In this report we will be discussing and analysing the soap box our team designed for the Richard Castle Soap Box Derby. Expanding from the initial drawings, the goal was to create a full cad model of the soap box, analyse the design, and talk about why certain aspects have been chosen. This report will focus on discussing the design process. Analytics have also been calculated to evaluate forces acting on the soap box when on a run. We will also investigate how we can improve in future projects.

2 CAD Drawings

The assignment of producing CAD drawings was split between four members. Oliver Gillson took on the role of producing a chassis model that would be used as a base model to build from. Oliver Wilson took on the role of producing a steering assembly, Liam Davidson designed the wheels and Harry Rogers took on design of the body.

2.1 Chassis

The chassis design changed slightly from the original drawings, removing upper supporting beams to reduce weight as shown in figure 2.

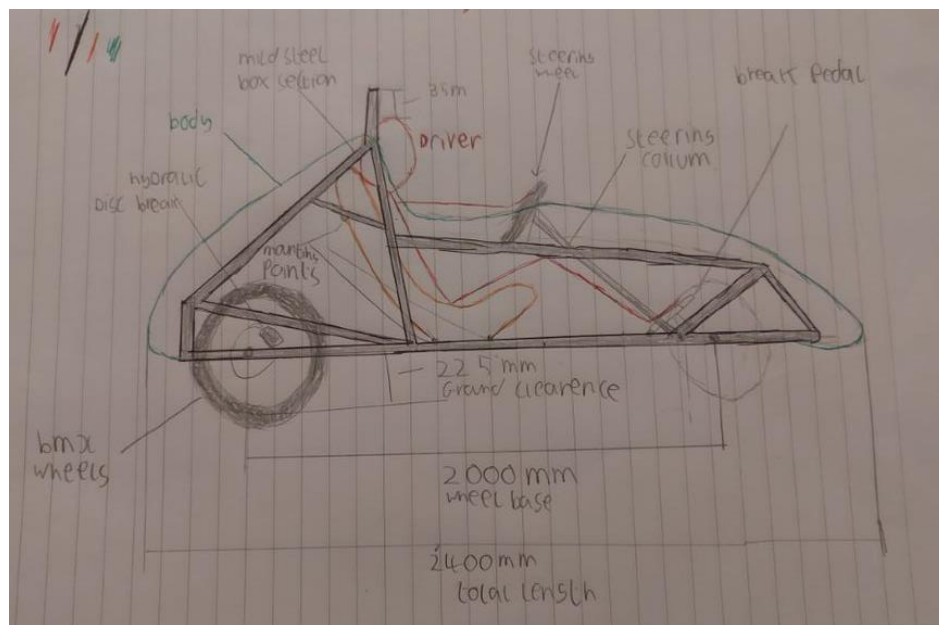


Figure 1: Original design drawing.

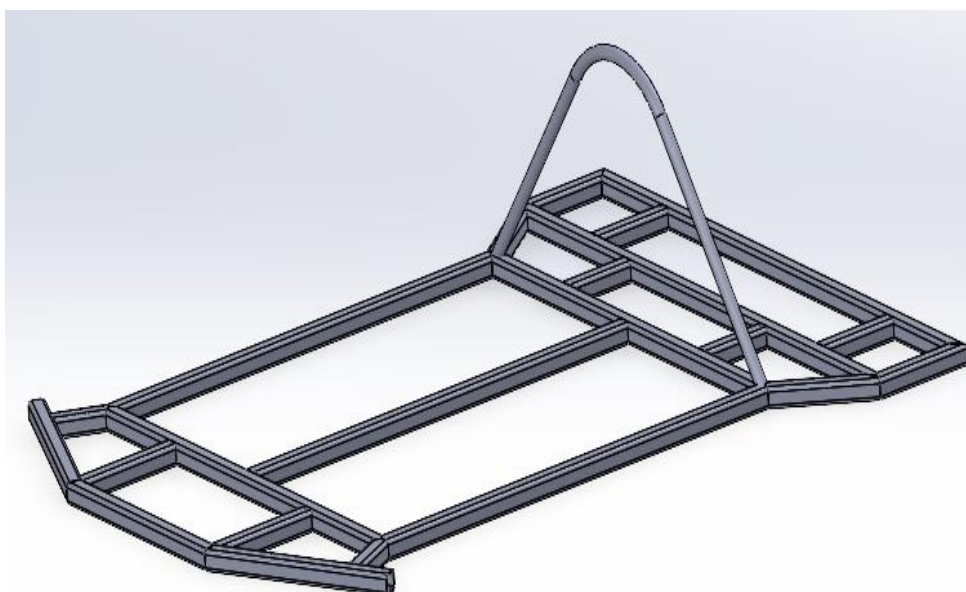


Figure 2: CAD designed chassis.

2.2 Steering Assembly

The steering assembly CAD was taken on by Oliver Wilson and followed the original design specification of a steering wheel assembly controlling both front wheels. The first revision met the requirements and fit the chassis well, however a vertical beam was added under the steering column to support the weight and mitigate any potential damage from lack of support (Figure 3).

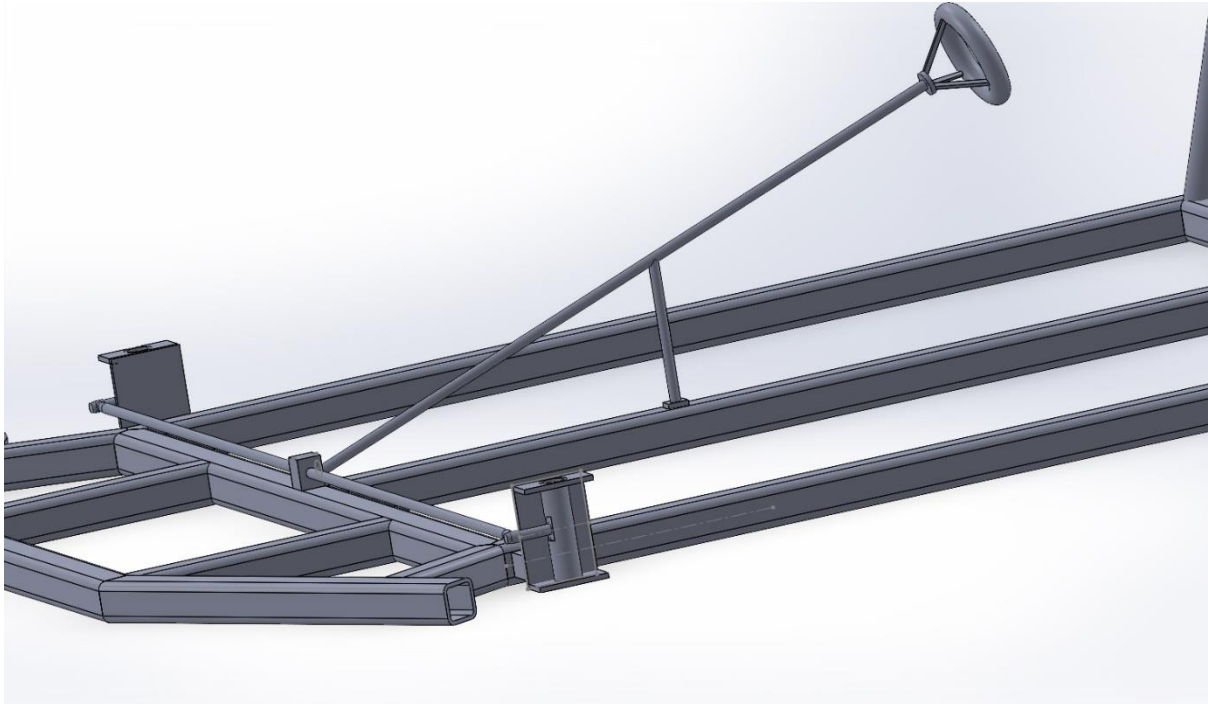


Figure 3: Steering assembly.

2.3 Wheels

The wheels, designed by Liam follow the original design spec of a solid spoke 18" BMX wheel with pneumatic tyre. 18" BMX were chosen as a baseline as they are strong, in-expensive and are a standard size. It is also possible to choose from many different tire options to further optimise performance.



Figure 4: BMX wheel.

2.4 Body

Attempts were made to match the original body design as closely as possible but gaps in SolidWorks knowledge proved this difficult. Harry took on the challenge and although the design differs it still provides the desired shape to improve aero efficiency.



Figure 5: CAD body design.

3 Analytics

SolidWorks allows users to assign materials to parts of assemblies, using this function has allowed us to estimate the overall weight of the soapbox. Figure 6 shows the estimated mass to be 69.28kg, for the purpose of the following analytics we will round this mass up to 70kg.

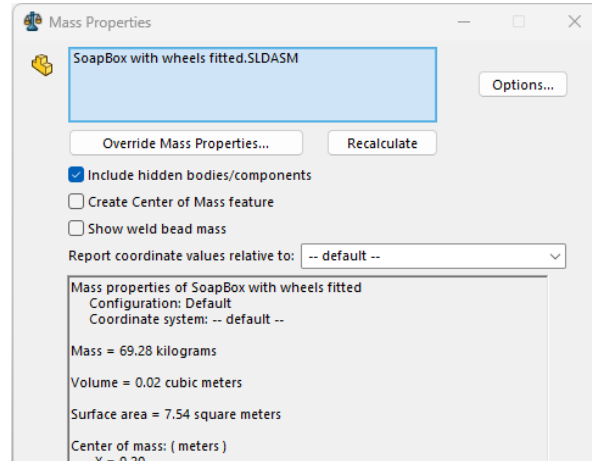


Figure 6: SolidWorks mass properties.

With the soapbox weighing 70kg, our lightest driver weighing in at 70kg and having been provided the decent of the course of 50m (Richards Castle Regulations, 2022), we can calculate the potential energy of the soapbox at the start of the course using equation 1.

$$PE = mgh$$

$$PE = (driver\ mass + Soapbox\ mass)(Gravity)(Height)$$

$$PE = (70 + 70)(9.81)(50)$$

$$PE = 68670J$$

Equation 1: Potential Energy.

Regulations state the course is 550m long and that soapboxes should expect to reach up to 40mph (17.88m/s) (Richards Castle Regulations, 2022). Using this information, we can calculate the average acceleration of the soapbox and driver over the course using equation 2.

$$\frac{v^2 - u^2}{2(s)} = a$$

$$\frac{17.88^2 - 0^2}{2(550)} = 0.29m/s^2$$

Equation 2: Acceleration.

Using the sum of equation 2 for acceleration and a known mass of 140kg, we can calculate the force exerted on the soapbox and rider with equation 3.

$$F = ma$$

$$F = 140 \times 0.29$$

$$F = 40.6N$$

Equation 3: Force.

4 Design Evaluation

Overall, the team is happy with the final design on the soapbox. We have stayed close to the original drawing despite the difficulties faced caused by lack of exposure to SolidWorks. The main difference is the change in body shape which is reminiscent of the original design but lacks the curves, however, should provide a suitable amount of aerodynamics. All-in-all the team produced a high level of work, the CAD drawings are accurately sized and have been produced correctly.

In future projects it would be useful to break the original drawings down into subsections that can be assigned to team members producing CAD models. They would contain more detail and be easier to read than an overall general view of the design of the soapbox. Gaining more experience in CAD software is an obvious improvement but this comes with time and the team agrees that projects like this have increased their knowledge and understanding of SolidWorks as well as how teams might work together to produce products in real world situations.

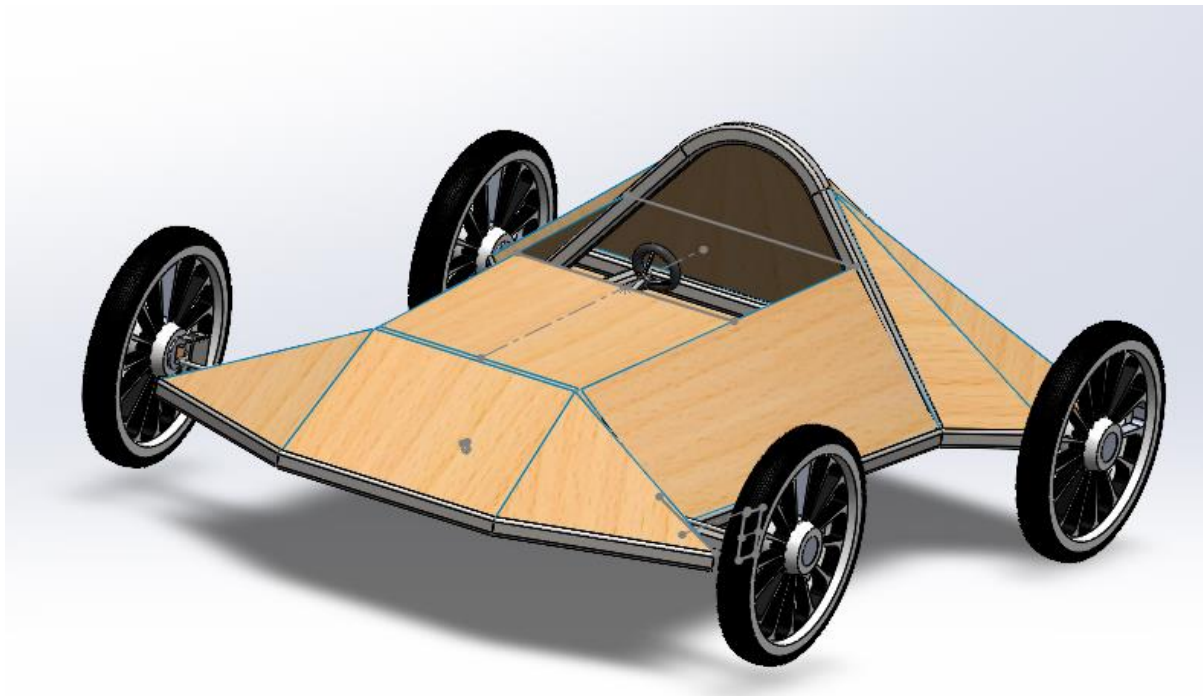


Figure 7: SoapDaddy Inc. Final CAD Design.

5 References

Richards Castle Soap Box Derby 2022 Notice to Builders and Entrants Rules and Regulations-2022. (n.d.).