

Soapbox Group Project



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Module: Integrating Project

Module Code: ACHA4008

Assignment 2 of 2

Team Name: Crash Test Dummies

Team Members:

Jaydan Carter 2305706

Suphakit Pratt 2203284

Odin Robinson 2306128

Niall Hindmarch 2316600

Dan Morris 2317275

Contents

1	Introduction.....	1
1.1	Aims & Objectives.....	1
2	Design.....	2
3	Analysis & Calculations.....	3
4	Conclusion	6
4.1	Evaluation	6

1 Introduction

This is a report on the final design of our soapbox project. It will include how the idea was conceptualised, a detailed CAD drawing and some calculations about the soapbox that could replicate real life performance.

1.1 Aims & Objectives

We aim to design a safe and secure soapbox.

- To establish what are and are not suitable materials to use on the soapbox.
- To exhibit good safety features such as seat belts and a roll cage for example

We aim to adhere to the Richard's Castle Soapbox Regulations

- To demonstrate that we have read the regulations thoroughly.
- To assemble a soapbox that incorporates the regulations.

We aim to make a cost-effective soapbox.

- To fabricate a soapbox with a lower budget
- To outperform other soapboxes with a higher budget

2 Design

After doing a vast amount of research, which includes viewing YouTube videos such as the Red Bull Soapbox videos. The most appealing Soapbox design that was seen was the rocket design. From this, all that had to be done was converting it so it would adhere to the Richard's Castle Soapbox Derby. The next step of the design process was to do multiple sketches so that an understanding of the dimensions of the vehicle would be gained. The shape of the soapbox is to minimise drag and maximise aerodynamic efficiency. Unlike the image below, the soapbox has one winglet on top and two just above both rear wheels like the wheel brows on modern F1 cars.



Figure 1 shows the inspiration of our design.

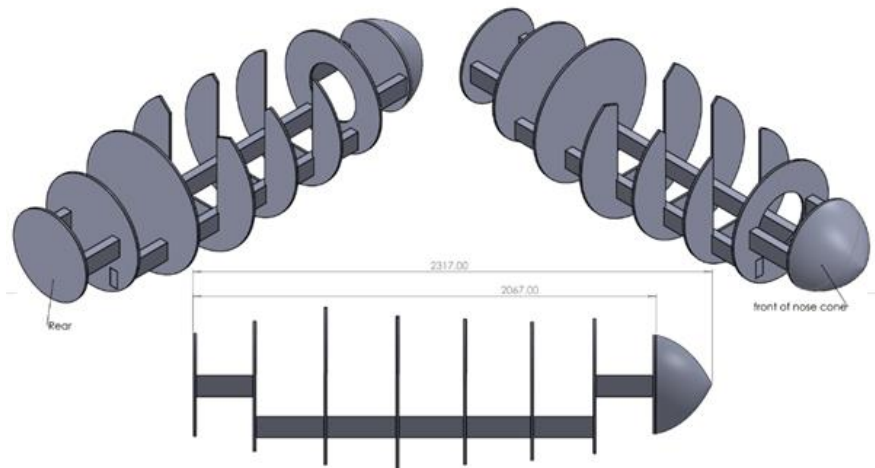


Figure 2 shows chassis of our soapbox in CAD.

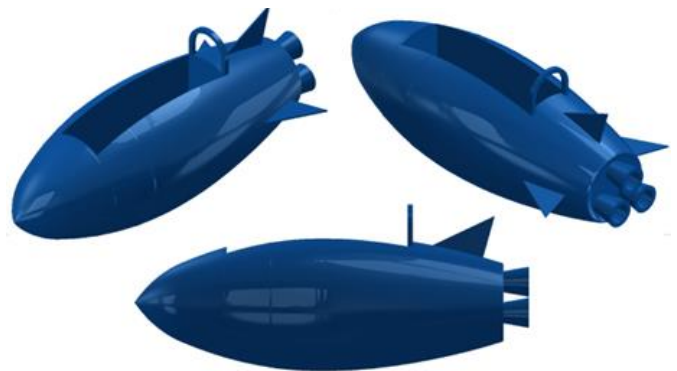


Figure 3 shows the body of our soapbox in CAD.

The soapbox has been fitted with a roll hoop as per regulations, it is design to withstand a severe impact with its semi-circular design. Furthermore, the driving position is situated as low as possible lowering the centre of gravity and improving handling.

The soapbox is fitted without suspension as this would add extra weight impeding the handling, whilst drastically increasing cost. The rear axle is a solid axle, the brakes are situated near the middle again keeping the centre of gravity low and less weight by the wheel. The steering design has taken inspiration from that of a go kart, where the column suspended by bearings, uses a tie rod attached to the hub of the wheel, this design can provide some mechanical advantage, lightweight and cost very little.

3 Analysis & Calculations

After researching more about the Richard's Castle Soapbox Derby track. Discoveries were made that there are 2 gradients of the course. The first half of the course is at a 16% gradient, whereas the second half of the course is at a 10% gradient. Next a forces diagram was made for both the 16% gradient and the 10% gradient. From this, things such as normal reaction, forces acting downhill, coefficient of friction and the frictional forces can be calculated.

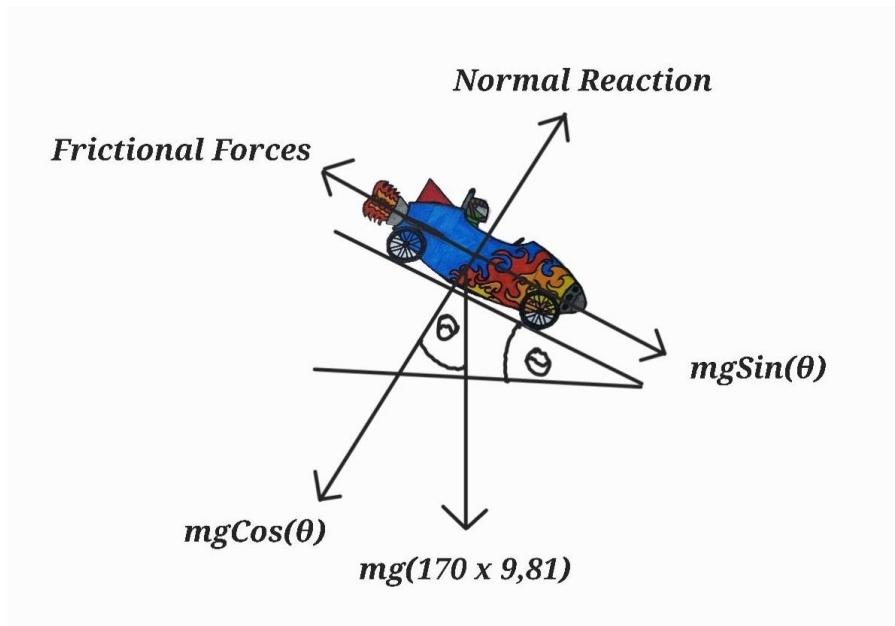


Figure 4 shows a forces diagram for the 16% gradient.

$$\tan \theta = \left(\frac{16}{100} \right)$$

$$\theta = \tan^{-1} (0.16)$$

$$\theta = 9.09^\circ$$

$$\text{Normal Reaction} = (170 \times 9.81) \times \cos (9.09)$$

$$\text{Normal Reaction} = 1,646.74\text{N}$$

$$\text{Forces acting Downhill} = (170 \times 9.81) \times \sin (9.09)$$

$$\text{Forces acting Downhill} = 263.47\text{N}$$

$$\text{Coefficient of Friction} = \mu = \frac{F}{N} = \frac{263.47}{1,646.76} = 0.16$$

$$\text{Frictional Force} = \mu R = 263.48\text{N}$$

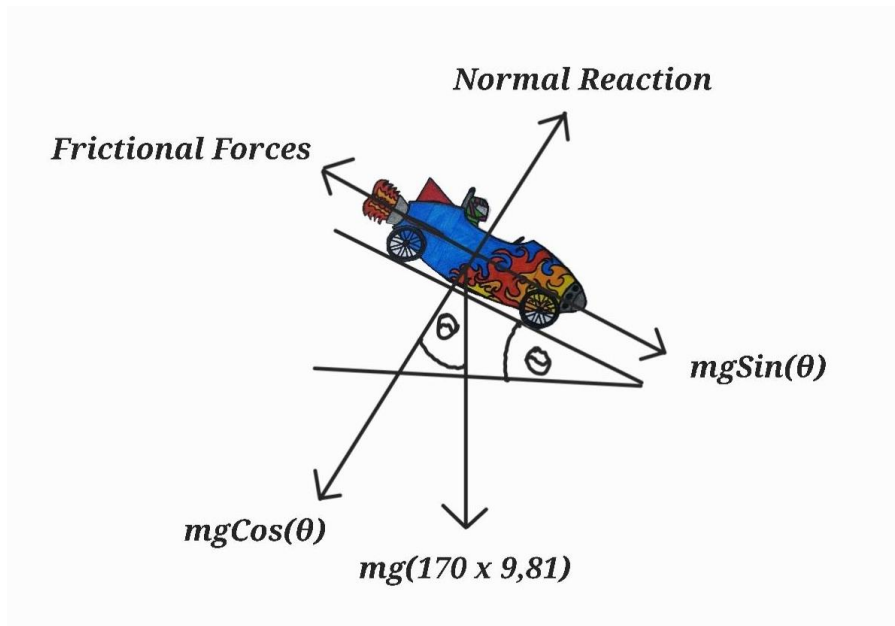


Figure 5 shows a forces diagram for the 10% gradient.

$$\tan \theta = \left(\frac{10}{100} \right)$$

$$\theta = \tan^{-1} (0.10)$$

$$\theta = 5.71^\circ$$

$$\text{Normal Reaction} = (170 \times 9.81) \times \cos (5.71)$$

$$\text{Normal Reaction} = 1659.43 \text{ N}$$

$$\text{Forces acting Downhill} = (170 \times 9.81) \times \sin (5.71)$$

$$\text{Forces acting Downhill} = 165.93 \text{ N}$$

$$\text{Coefficient of Friction} = \mu = \frac{F}{N} = \frac{165.93}{1659.43} = 0.10$$

$$\text{Frictional Force} = \mu R = 105.943 \text{ N}$$

Integrating Project

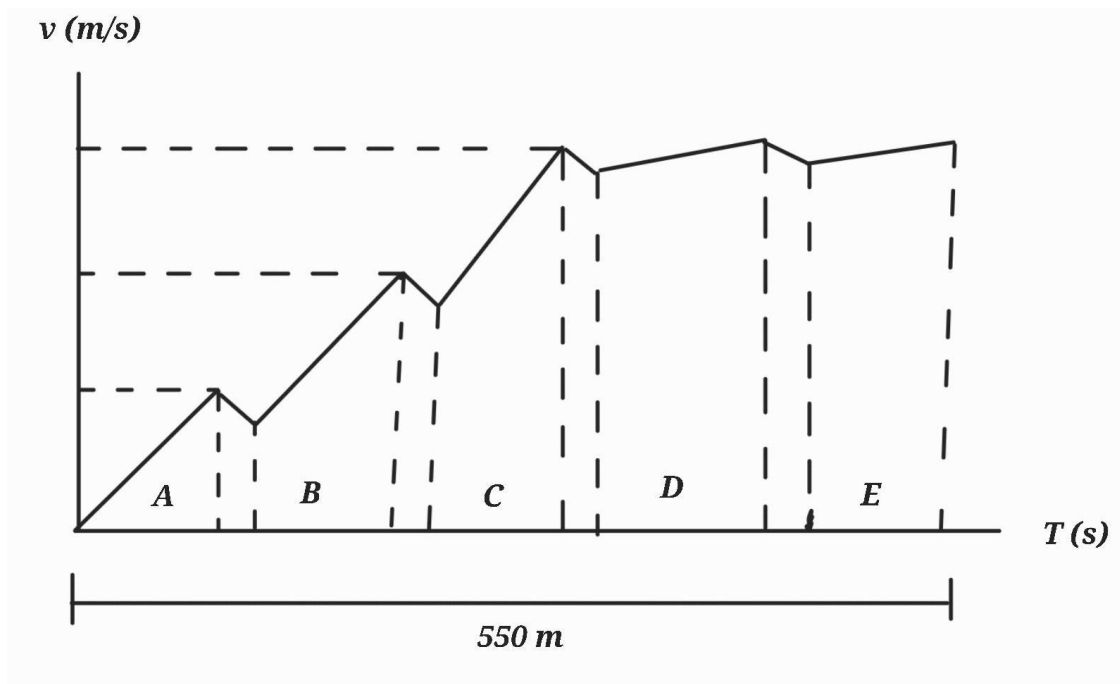


Figure 6 shows a velocity/time graph of the soapbox course.

Looking at A:

(u) Initial Velocity = 0m/s

(v) Final Velocity = 200m/s

(a) Acceleration = 2.74m/s²

$$a = \left(\frac{(2 \times s)}{t^2} \right) - (ut)$$

(t) Time = 7.3s

$$\left(\frac{\text{meters in A}}{\text{Total meters}} \right) \times 100 = \% \text{ of track in A}$$

(s) Displacement = 73m

$$\text{Average lap time} \times \% \text{ of track in A} = \text{Time in A}$$

Repeat calculations in each section.

4 Conclusion

In conclusion, the team has conceptualised a realistic and attainable design. The soapbox has met the target of upholding and respecting the Richard's Castle Soapbox Derby regulations. The materials used within the construction of the soapbox satisfies in terms of safety. But, with a large chunk of the soapbox being made up with wood, its eco-friendliness is improved as wood is biodegradable.

4.1 Evaluation

Upon reflection, the second half of this project went well. A variety of skills were displayed and gained such as planning skills, writing skills and research skills. Furthermore, presentational skills would be displayed, particularly in the second part of this project. However, like the first part of the project some members of the group were not pulling their weight. Dan and Niall have not put in a sufficient amount of effort throughout this project, including the first part. They have missed meetings, deadlines and have showed a poor amount commitment and communication throughout the course of the project. Overall, in the future more effort is needed to enhance our project.