

University of Wales Trinity Saint David

School of Engineering



Technical Report

Integrating Project

Soap Box

Code: ACHA4008

(Done Individually)

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1 Introduction

From the report made in assignment one, its noted that the team had compiled some existing soapbox designs with some advantages and disadvantages to help them come up with ideas to be able to design a soapbox. This report will look at the process of designing the soapbox, the thought process, the dynamics and drivability of the soapbox, and the final designs of the soapbox. The final design will show all the features that the soapbox will contain for the derby.

2 Research

2.1 Design process

The design process started with the team picking the advantages they liked most from the existing designs they picked in the previous report. The criteria of the advantages chosen were that they had to contribute to helping the soapbox perform better in the derby in alignment with the rules and regulations set by the organisers of the derby. Below are the advantages that the team picked from each existing designs of the soapbox:

1. From the soapbox below the group liked how it was made out of galvanized steel which is the material they chose for their soapbox. This material is good as it is lightweight, forgable, and strong.



Figure 1: Soapbox existing design 1

2. The soapbox below caught the groups attention as it has a unique style. One of the groups aims was to build a unique looking soapbox. They liked this design because it has sharp edges and sharp body lines which bring out the nice style of the soapbox. This helps the soapbox stand out amongst the others and will allow for more recognition.



Figure 2: Soapbox existing design 2

3. The image below shows the 3rd design that the group chose under their existing designs. This design was a favourite due to the design which is quite aerodynamic. The aerodynamics of the soapbox are important as it will reduce the amount of wind resistance/ drag that will slow down the soapbox. The arrow and slanted shape allow it to cut through the air and allow it to glide off the body of the soapbox with ease.



Figure 3: Soapbox existing design 3

The group decided to adopt these liked advantages into their own soapbox design. They chose the galvanized steel from the 1st existing design, the unique look from the 2nd, and the aerodynamic shape from the 3rd. This will allow for rough sketches to be made as they decide towards the final design of the soapbox.

3 Design work

The group paired up and came up with three possible designs for the soapbox. This allowed for diversity and allowed for more open-minded designing. From these three designs the group shall pick the design they like best. Below are the designs with an explanation of their advantages and disadvantages:

1. The below image shows the first design that the group came up with. This design was hand drawn as the team believed in diversity in the designing methods that they used.

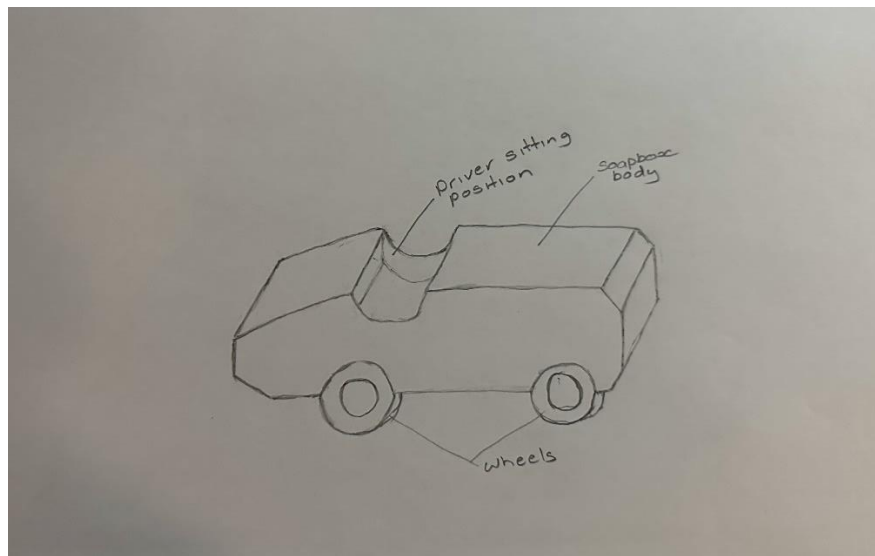


Figure 4: Soapbox possible design 1

Advantages:

- Has lots of space for the driver.

Disadvantages:

- It has no roll cage.
- This design is common among some viewed soapboxes.
- It is not aerodynamic.

2. The design below is the second design that the group designed. This design was also designed on paper.

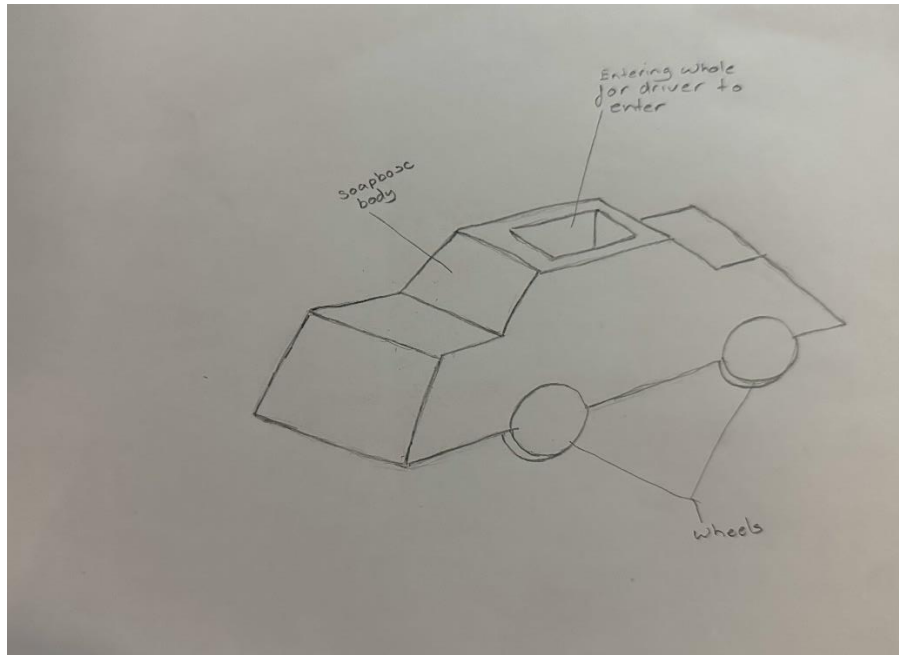


Figure 5: Soapbox possible design 2

Advantages:

- Unique design.

Disadvantages:

- Not aerodynamic
- Has no roll cages so cannot apply with rules and regulations.

3. The image bellow shows the third design that the group came up with. This design was designed using Computer Aided Design (CAD).

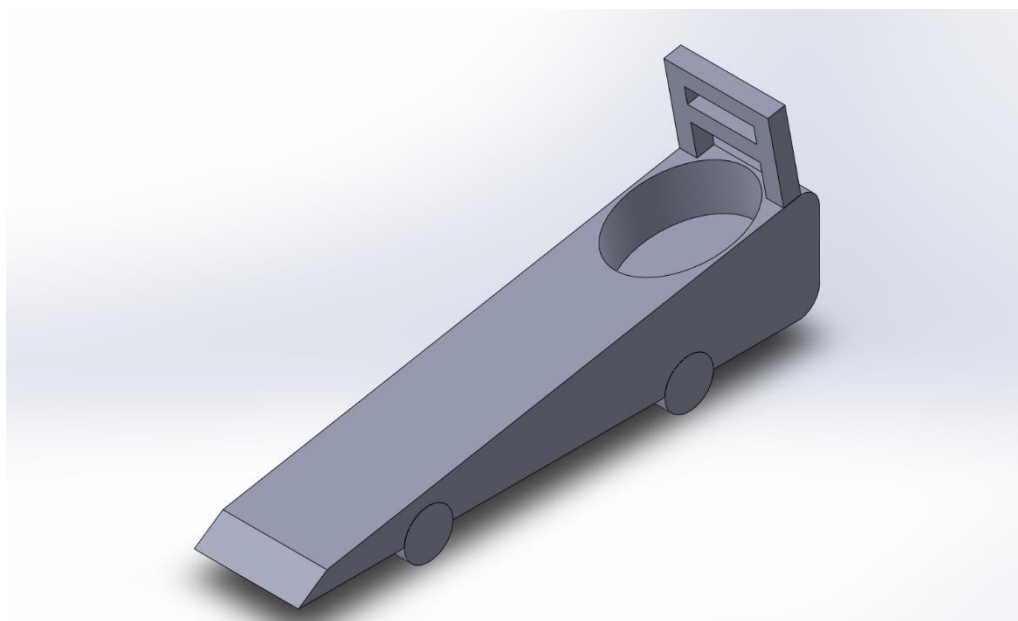


Figure 6: Soapbox possible design 3

Advantages:

- The design shows good aerodynamics.
- It is a simple and unique design.
- Has a good roll cage.

Disadvantages:

- It is quite long.

The group made time to sit and look at the three designs to pick the one they saw as the best for their soapbox design. The group considered all the advantages and disadvantages and concluded that the 3rd design that was made in CAD is their go to design for their soapbox. The 3rd design is the groups chosen design for the soapbox.

4 Dynamics/Drivability

The dynamics/drivability will look at why the soapbox has been designed the way it is, why the chosen steering solution was used, and why the chosen braking system was used.

4.1 The soapbox designs.

To come up with the design of the soapbox, a lot of factors had to be considered to allow the group to have a maximum advantage in the soapbox derby. The factors that needed to be considered were aerodynamics, aesthetically pleasing and inclusion of a roll cage.

The aerodynamics of the soapbox is the most important factor when coming up with the design. This is because the soapbox has no engine and will need to go downhill as fast as possible. The more aerodynamic it is the faster it will move downhill. This is because it will reduce the amount of drag on the body of the soapbox. The wedge shape helps it be more aerodynamic as it allows the wind to glide of the body of the soapbox. The point where the most drag will be experienced will be the roll cage as it does not go hand in hand with the wedge shape.

4.2 Steering system

The steering system consists of a steering shaft and linkage to turn the wheels. This steering method was chosen as it is reliable and simple, which makes it easy to maintain and repair if there are any problems. This method was also chosen as it does not require many components meaning it will not add too much weight to the final weight of the soapbox.

Below is an image of the steering method used:



Figure 7: steering solution for soapbox

4.3 Braking system

The chosen braking system consists of the disk brakes found on mountain bicycles. This was chosen by the group as it is said to be very durable and efficient, as well as consists of very low maintenance. They have also been said to perform well compared to V-brakes. The group's decision to consider only bicycle brakes was factored by the issue of weight. Bicycle brakes are the lightest braking system that the group could find. The disk brakes are now the leading bicycle brakes that are on the market making them the chosen brakes for the soapbox, also due to the advantages mentioned above. Below is an image of the disk brakes that were used by the group:



Figure 8: Disc Brakes

5 Calculations

This section of the report will look at the testing results of the material and the safety of the soapbox. the most important testing results are of the forces that the frame of the soapbox can endure and the braking distance of the soapbox. The braking distance of the soapbox means the distance it takes for the soapbox to come to a full halt from a certain speed.

5.1 Frame force endurance

The force that the frame of the soapbox can endure is quite important to help ensure that the driver is always safe. This is in case of any accidental crashes. The method the group used to make the frame of the soapbox be able to withstand more force in the event of a crash was to make the galvanised steel sheet layered. The group used a triple layer as they found it to be able to withstand enough force. The test that the team used was making a small mock-up model of the soapbox using the triple layer from the galvanised steel sheet. After the mock-up model was made the group took the model to a hydraulic press to see how much force it can endure. The image below shows the type of hydraulic press the group used to test the mock-up model:



Figure 9: Hydraulic press

The group put the soapbox mock-up up model under the hydraulic press and calculated the amount of force it took for the hydraulic press to crush the frame of the model. The main soapbox design is 3 times bigger than the mock-up model. The result of the mock-up hydraulic press was 50 pounds to crush the model. This means that it takes 50×3 pounds to crush the original soapbox. It takes 150 pounds of force to crush the soapbox. this is generally in line with the average amount of force needed to crush a soapbox. This meets

the aim of the group to have the soapbox be safe enough for the driver in case of any accidental crashes.

5.2 Braking distance

The braking distance is the distance it takes for the soapbox to come to a stop from a certain speed. The braking distance is an important thing to ensure the safety of the driver and the safety of the other participants of the derby. The group came up with a method to test the braking distance of the soapbox. The method consists of finding a steep hill and getting the soapbox to roll from the top of the steep hill to the bottom and record the speed and the distance it takes for the soapbox to come to a stop. The speed will be recorded using a radar speed gun. To know where to measure from the group set out a cone 45 meters from the bottom of the hill to indicate where the driver is meant to start braking from. The results of the test came back positive, as the soapbox managed to come to a stop from a speed of 45mph in 43.3 meters. This meets the aims of the group in terms of safety.

6 Evaluation

The group was very pleased with their soapbox project and were happy with the standard of their work, but they felt like there are areas of the soapbox that they can improve on and make better or perfect. In testing the durability of the frame of the soapbox the group saw that they could have improved on the reinforcement of the front of the soapbox by adding mild steel rods in the front to help it have a better structure. They also felt like they could have improved on the design of the soapbox to make it more unique and extravagant. However, they were satisfied with the results that the soapbox yielded in their tests making it quite good for the derby.

7 Conclusion

In conclusion the second half of the project has looked at designing, dynamics, and the evaluation of the work that the group has managed to do. The group can say that the project has been a success as they managed to come up with a soapbox that fully functions. Although there is room for improvement for the soapbox to be improved, they were quite

satisfied with their work as it is said everything has room for improvement. The results also proved that the soapbox is ready for the derby.