

University of Wales Trinity Saint David

Wales Institute of Science & Art

Project First Report

Design of a “Soap Box type of Car”

Integrating Project – ACHA4008

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Abstract

This project involves designing a soapbox type of car according to the Richard's Castle Derby regulations and restrictions. This project aims to design a fast enough soapbox type of car at the lowest cost to compete in Richard's castle derby safely. The associated engineering principles and various materials were considered in the design. The Richards Castle Soapbox Derby's previous timing record was a benchmark that was guiding this project. Three draft sketches were prepared, and the one with the smallest frontal area was selected. Great emphasis was given to minimize the soapbox car's drag and set the soapbox car's total weight to a reasonable value to enable the achievement of the set targets. Some assumptions were made regarding the soapbox car's drag coefficient, and calculations were carried out using a spreadsheet to estimate the expected timing of the soapbox car that it was designed for. To establish that the selected design of the soapbox car performs as it was estimated is required to carry out computer simulations, wind tunnel testing, and actual race has to be carried out to compare the expected results of the design with the actual results. This process will help in taking the required corrective measures and improve the original design. The present report is the first report of the soapbox car project, and a second report will follow with CAD drawings of the selected soapbox car design.

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1 Introduction

1.1 Scope of the project

This project involves designing a “Soapbox” style of car that will adhere to the regulations set by Richard’s castle soapbox car derby (*Richards Castle Soap Box Derby 2020 Notice to Builders and Entrants Rules and Regulations-2020*, no date). A team consisting of five persons was formed to tackle this aim. The Richards Castle soapbox derby’s regulations that involved the design of the soapbox-style car were studied carefully by all the team members.

1.2 The aims of the project

- a. To design a fast enough soapbox car for the Richards castle soapbox derby considering the Richards Castle Soapbox derby regulations, the racing track, and the previous records.
- b. Construct a safety-to-race soapbox car.
- c. Use the material effectively to achieve the first target at a minimum cost.

2 Methodology

It was necessary to establish first, under which class category stated in the Richards Castles Soapbox Derby regulations, the soapbox car will be designed. This issue was discussed among the team members, and it was agreed to design a 4-wheel soapbox car.

Before each team member proceeded with the design, it was necessary to study the Richards castle soapbox derby competition (*Richards Castle Soap Box Derby 2020 Notice to Builders and Entrants Rules and Regulations-2020*, no date). The race track and the previous records associated with this event were also considered. This study was necessary to decode the essential parameters to achieve the aims of this project. These parameters were identified by looking at the pictures of the soapbox car of the winner in 2019. (*Soap Box Derby | Richards Castle | Enter your cart and race*, no date) The timing of the winner in 2019 was also noted. (*Soap Box Derby | Richards Castle | Fastest carts down the hill*, no date)



Figure 1 –Photos of the 1st Winner of Richard’s Castle soapbox Derby 2019

From this research, the following information's were obtained from the above photos:

- a. The weight of the soapbox car is 163 kg (stated in the photo)
- b. The timing of this soapbox car is 44.033 secs (stated in the photo)
- c. The tires are relatively thin about, 0.08m in width and 60cm in diameter (estimated)
- d. The shape of the soapbox car has rounded edges
- e. The height of the soapbox car starting from the front is gradually increasing to about 1.4m where the driver's head is. (estimated from the photos)
- f. The width of the soapbox car is about 0.7m. (estimated from the photos)

Photos of various soapboxes were studied as well. This study was necessary to investigate how to beat the previous records.

Having the above information in mind, the various activities involved in preparing this design project were identified, and a Gantt Chart was prepared to split the work into various activities. (See Appendix B)

Each of the activities was assigned to a team member, and regular meetings were held on-line discussing the progress and the ideas and suggestions of the team members. Regardless that specific tasks were assigned to each team member, all the team members had their input in all the activities. This approach was followed to make all the team members aware of all the project activities. The subjects considered critical to the designed are listed below, and further investigation was carried out.

- Weight, size, and shape of the soapbox car
- Wheel and steering
- Braking system.
- Cost of the required materials.

3 Investigation, Analysis, and results of subject areas

3.1 Weight, size, and shape of the soapbox car

As the only power which will move and accelerate the soapbox is the gravity, the weight, the size, and the shape of the soapbox car are essential. Figure 2 shows the forces acting on the soapbox when the soapbox car is on an inclined plane.

The part of the weight of the soapbox car and the driver's weight, which acts on the soapbox parallel to the inclined plane, is given with equation 1.

As an initial guess, the total weight of the soapbox car was considered to be 163kg (the same weight as the weight of the soapbox car of the 2019 Winner of the Richards Castle Soapbox Derby), and the weight of the driver was assumed to be 70kg giving us a total weight of 233kg. The force F_w , which will accelerate the vehicle, was calculated to be 207N using equation 1. This force calculated was based on the race track's average gradient even though it varies.

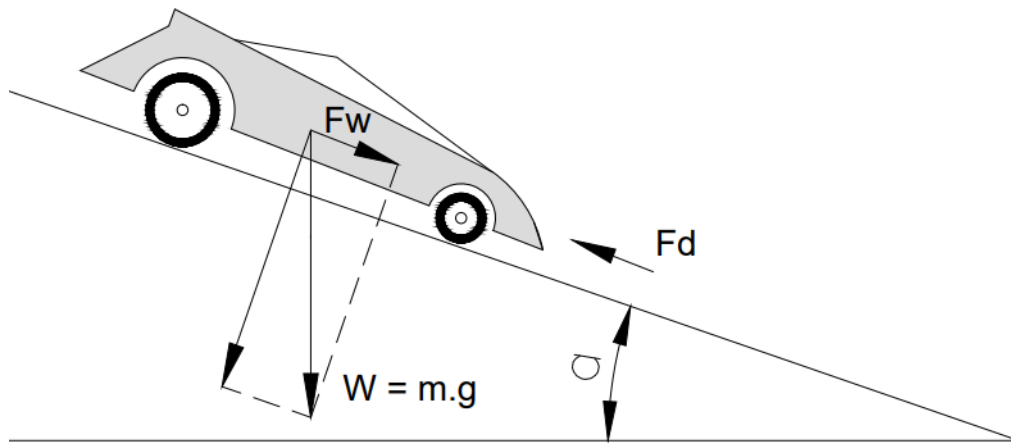


Figure 2 – Forces acting on an object on an inclined plane

$$F_w = mg \sin \alpha = 233\text{kg} * 9.81\text{m/s}^2 * \sin 5.19^\circ = 207\text{N} \quad \text{Equation 1}$$

Where:

F_w = component of the force due to the weight of the soapbox car and the driver parallel to the ramp/race track.

m = mass of the soapbox car and the mass of the driver

g = acceleration of gravity

α = the angle between the horizontal plane and the plane of the ramp / the race track

As the soapbox car will accelerate as it goes downhill, this will activate the drag force given by equation 2.

$$F_d = C_d \frac{1}{2} \rho V^2 A \quad \text{Equation 2}$$

Where:

F_d = Drag Force

C_d = Coefficient of drag

ρ = density of the fluid (in this case is air approx. 1.225kg/m^3)

V = speed of the object

A = Frontal area of the object

The soapbox car will continue to accelerate until the force (F_w), which activates the soapbox car's movement, becomes equal with the drag force (F_d). Considering the factors that affect the drag force to achieve higher speeds, the drag coefficient and the soapbox car's frontal area have to be minimized.

Having these factors in mind and considering the drag coefficient of various shapes (*Drag coefficients of various shapes : formula1, no date*) (*Shape Effects on Drag, no date*) and the shapes of various fishes, sketches were prepared to select the best shape and size of the soapbox car. It was noted that the Coefficient of the fastest fishes Sailfish and Swordfish are 0.0075 and 0.0091, respectively. (Sagong, Jeon and Choi, 2013) Empirically considering the shapes of living organisms with low drag coefficient, we can be in the right direction to achieve a soapbox car with a low drag coefficient.

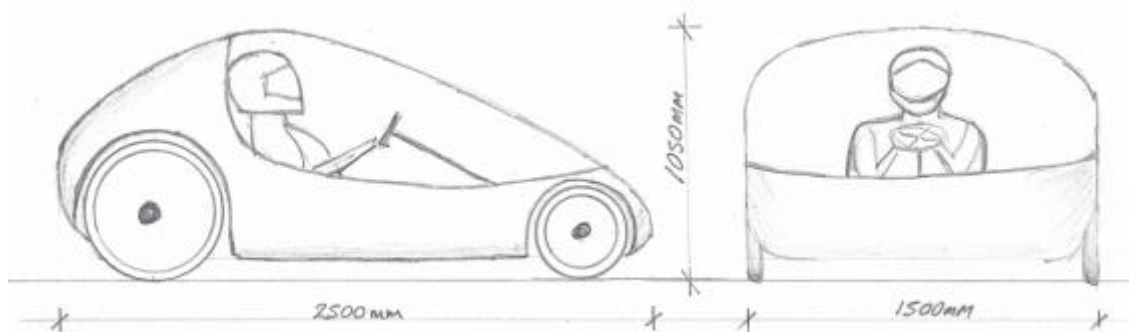


Figure 3 – Soapbox car - Option 1

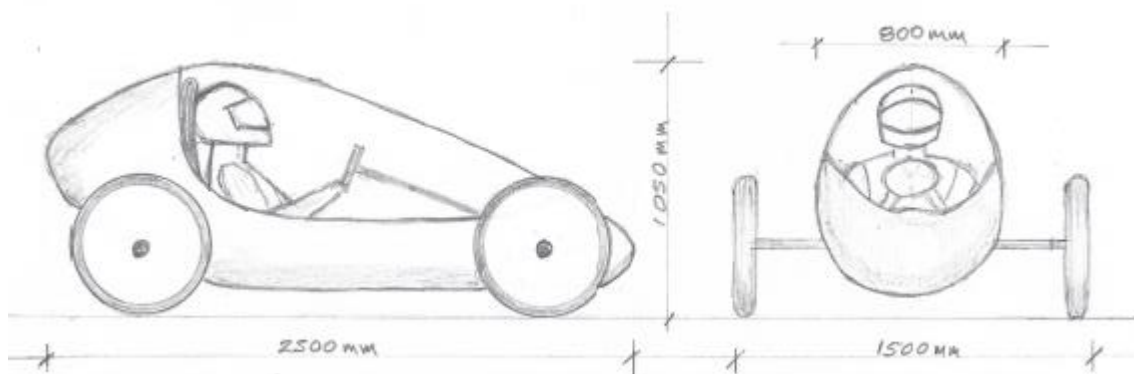


Figure 4 – Soapbox car - Option 2

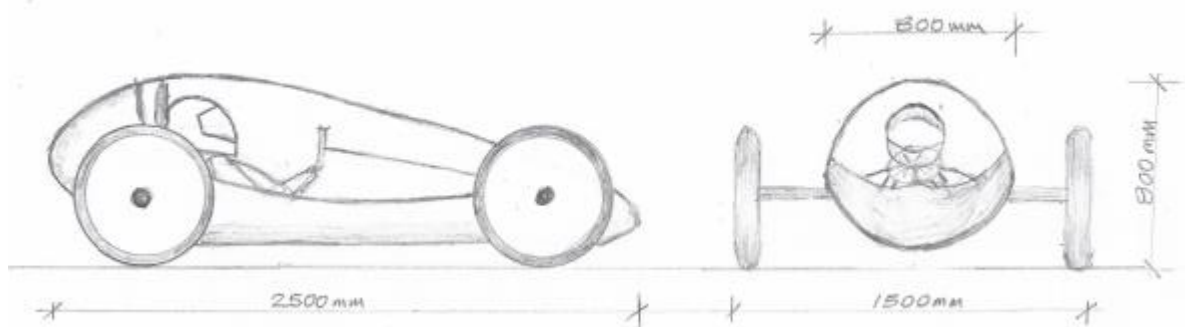


Figure 5 – Soapbox car – Option 3

The shape in figure 3 provides an aerodynamic shape, but it has a big frontal area. Also, the quantity of materials used is more because of the size of the main body.

The shape in figure 4 also has an aerodynamic shape, and its frontal area is less. This soapbox car's frontal area will result in less drag force than the soapbox car in figure 3. This shape also provides a comfortable driving position to the driver.

The shape in Figure 5 is more aerodynamic, and the frontal area is less than the soapbox cars in Figure 3 and Figure 4. This observation is because the soapbox car's body is lower, and the driver is sitting in an almost horizontal position. The driver's position is not comfortable, but considering that the race track is 550m, the driver will not be in this position for too long, and this the price that it has to be paid to have an advantage in the race.

Using the previously identified information about the soapbox car winner in the 2019 Richards Castle Soapbox car derby, a spreadsheet was prepared using engineering fundamentals. (Abi Summerfield, 2021) The Coefficient of drag of this soapbox car was determined by the trial and error method. This approach was necessary to add a reasonable value to the Coefficient of drag of the soapbox car designed under this project. Having a reasonable value for the drag coefficient and using the necessary values for the soapbox car, which is design under this project, then the soapbox car's timing was determined. The following table shows the values which were used in the calculations.

These values were used in calculating the acceleration, the speed, and the distance covered by the soapbox car at 0.5sec intervals using equations 3, 4, and 5.

Table 1– Design Parameters

Parameter	2019 Winner – Soapbox car	Project Soapbox car
Weight of soapbox car	163 kg	163kg
Mass of driver (s=assumed)	70kg	70kg
Height of soapbox car	1.4m	0.8m
Width of the soapbox car	0.7m	0.8m
Height of tyres	0.6m	0.6
Width of tyres	0.07m	0.07m
Coefficient of drag (estimated)	0.49 (Calculated)	0.49
Timing	44.003sec	41 secs (calculated)

$$dS = udt + \frac{adt^2}{2} \quad \text{Equation 3}$$

Where:

dS is the distance travel at a time interval dt

u = the speed of the soapbox car at time t

α = the acceleration of the soapbox car at time t

dt = is the time interval at which u & α are calculated

$$u = \alpha dt + u_0 \quad \text{Equation 4}$$

$$\alpha = \frac{F_w - F_d}{m} \quad \text{Equation 5}$$

Where:

α = acceleration soapbox car

F_w = force due to the weight of the soapbox car, including the weight of the driver (Eq. 1)

F_d = Force due to drag (Eq. 2)

m = mass of the soapbox car, including the weight of the driver

NOTE: In calculating ds, in equation 3, the average speed between the time intervals was used, and the acceleration in the previous time interval was used. This approach will cause some errors in the calculations, but these errors can be minimized if the calculations are made in smaller time intervals.

Figure 6 shows the distance travelled with the time shows that the soapbox car can reach the finish line in 41 secs.

As it can be seen from Figure 6, due to the fact the frontal area was reduced, this resulted in having a faster soapbox car than the year 2019 soapbox car winner. It was assumed that the soapbox car weight and the drag coefficient would be 233kg and 0,49, respectively. It is believed that the soapbox car that was considered in this project has a better drag coefficient, and the fact that additional fixed weights can be added to the soapbox car, it is believed that the soapbox car can perform better. It has to be noted that some assumptions were made in producing these results. One assumption is that the driver will not apply the brakes. Some inaccuracies in the assumed values and calculated values might cause some deviations from the racing results. That is why before the competition, it is required to carry test runs.



Figure 6 – Distance Vs. time - Comparison between Project soapbox car and 2019 winner Soapbox Car

The maximum that is expected from the design this soap to reach is approx. 78.6km/hr when the F_d reaches the F_w . As shown in Figure 7, this will not occur before the end of the race, and the top speed that this soapbox will reach during the race is 73km/hr if no brakes are applied and if the wind speed is zero.



Figure 7 – Distance travelled / speed Vs. Time

3.2 Wheels and Steering

For the selection of the wheels, two factors were considered. The wheels provide the required stability to the soapbox car and reduce the resistance to its motion.

The following equation gives the torque T that has to be applied for the wheel to rotate

$$T = mk^2a = m \frac{d^2}{dt^2} \frac{a}{r} = m \frac{r^2}{2} \frac{a}{r} = m \frac{r}{2} \alpha$$

Where:

T is the torque that is required to turn a wheel a certain angular acceleration

m = is the mass of the wheel

k = is the radius of gyration

a = the angular acceleration of the wheel

α = tangential acceleration

Looking at the above equation at a given tangential acceleration, as the wheel's radius increases and as the mass of the wheel increases, the torque increases as well. Considering the size of the wheels the 2019 winner of the Richard Castle soapbox Derby used, (*Soap Box Derby / Richards Castle / Fastest carts down the hill*, no date), and also the size of wheels the other competitors used, it was decided to use 60cm wheels in diameter and approximately 7cm wide. This decision was taken for three reasons:

- a. Bigger wheels will increase the torque but will give more stability to the soapbox car because the wheels can go over small stones/gravel, which are on the race track easy without causing imbalance to the soapbox car,
- b. Wider wheels provide a smoother ride,
- c. This torque will decrease considerably as the soapbox car reaches a constant speed.

Another essential factor that affects the torque is the mass of the wheel. Wheels with spokes or aluminum wheels are lighter need to be selected. Keeping in mind the accidents that occurred with wheels with spokes during soapbox car races and the speed the is expected the soapbox car to reach, it was decided to use aluminum wheels. With aluminum wheels, the wheels' mass is lighter than the wheels' mass made of steel, resulting in reduced torque. Reducing the torque will help the soapbox car accelerate quicker. The torque caused by the wheels is a factor that was not considered in the calculations of determining the timing of the soapbox car since this factor decreases as the soapbox car runs in the race because the linear acceleration of the soapbox car decreases.

The tires' inflation and the type of the tires and the wheel bearings are also significant because they create friction and provide resistance to the motion. These factors were also not considered in determining the soapbox car's timing since it is hard to value these friction forces. Still, these factors' contribution to the motion of the soapbox car can be assessed during test runs, and corrective measures can be taken where is necessary.

The steering of the soapbox car can be done with a steering wheel that is connected rods to the front wheels. The steering does not affect the soapbox car's performance, and it is not advisable to go for expensive options. It contributes to the stability and the safety of the soapbox car. Therefore, the steering must not have "excessive free play" as per the Richards castle soapbox derby regulations. (*Richards Castle Soap Box Derby 2020 Notice to Builders and Entrants Rules and Regulations-2020*, no date)

3.3 Brakes and suspension

The brakes are an essential part of the design of the soapbox car. One of the Richards Castles' soapbox derby regulation requirements is that the soapbox car's brakes can hold the soapbox car in a steady position placed on the start ramp with a gradient of 1:8. Considering the mass of the soapbox car and the driver's mass, which was sent to be 233kg, it was calculated that the brake should hold a force of 284N using the equation below.

The value is not so great. The bicycle breaks can handle this force. Considering though that this soapbox will reach a speed of 73km/hr during the race and assuming that it has to stop in 5 secs the force that has to be applied to stop the soapbox car in 5 secs was calculated using the equation below:

$$F_b = \frac{dv}{dt}m = \frac{73*1000/3600}{5} * 233 = 945N \quad \text{Equation 6}$$

Where:

F_b = breaking force

$\frac{dv}{dt}$ = deceleration of the soapbox car

m = mass of the soapbox car and the driver

This value is significant and cannot be taken by bicycle brakes. It has to be distributed to all four wheels. Considering that the braking system has to be more than adequate to handle this force, it was decided to use disk brakes on all four wheels the same as those used in quad bikes.

Considering the minimum ground clearance, the condition of the race track and the fact the racing time is less than a minute, it was decided not to use suspension system. This will also help in keeping the cost down.

3.4 Cost of the required materials

The research was carried out about the materials used for constructing the soapbox car, and a list with prices was prepared, as shown in Table 2. All the prices were obtained from the internet, and some of them include delivery charges. This fact increases the cost of the materials used for the construction of the soapbox car. As shown from this table, the highest cost is the extra weight required to make the car fast enough to win the race. Extra weight must be added during the test runs if the competition is high. These extra weights must be well secured to the soapbox car's body as per the Richards Castle soapbox car Derby requirements. (*Richards Castle Soap Box Derby 2020 Notice to Builders and Entrants Rules and Regulations-2020*, no date)

To provide an aerodynamic surface to the soapbox car custom-made fiberglass body was selected. This approach was necessary to provide a rounded, smooth surface to the soapbox car and reduce its drag coefficient.

Table 2 shows only the cost of the materials. The assembly of the soapbox car was considered the team members will do that. Emphasis was also given to the steering, brakes, and wheels selection because these contribute to the soapbox car's safety, considering the speed that the soapbox car is expected to reach during the race.

Table 2 – Costing of the materials to be used for the construction of the soapbox car

Item	Cost	Ref
The metal frame of soapbox car 10 No steel tubes 28mm x 2mm (31Kg)	£160	(MILD STEEL ERW ROUND TUBE 2.5 METER LENGTHS 26 DIFFERENT SIZES 10mm - 50.8mm eBay, no date)
Extra weight 11 No 50mm x 10mm flat bars 3m long (129.58kg)	£405.46	(3 metre lengths 10mm Flat Bar, no date)
Fiberglass kit (6 kg)	£111	(Fibreglass Repair Kit - Polyester Resin 1kg - Supplied with Hardner - 1 Sq M of Fibreglass Matt, Mixing Cups, Stirring Sticks & Disposable Brushes - Lloyds Approved: Amazon.co.uk: DIY & Tools, no date)
10 Panels polystyrene 100 X 50 cm 10mm thick to create a mould for the parts of the soapbox body, which will cover with fiberglass	£16.53	(Pack of 10 Polystyrene Panels 100 x 50 cm Density 20 kg/m3 (Polystyrene, Thickness 10 mm): Amazon.co.uk: DIY & Tools, no date)
Transparent rigid sheet cover 2m x 1.2m X 41.30	£82.60	(Clear PVC 3mm 1200mm wide, no date)
Wheels – 4 No 20"x2.5."	£181.81	(Aluminum Bicycle Front or Rear Wheel 20 X 1.75/2.125/2.5" eBike Chopper Nice eBay, no date)
Tire 4 No 20"	£240.15	
Steering System	£286.36	(Drift Trike Go Kart Rear Axle Kit, Sprocket Brake Assembly, Chain, Steering Wheel eBay, no date)
Braking System	£214.77	(Go Kart Cart Disc Brake Caliper Kit Wheel Hub Steering Knuckle Quad Drift Trike eBay, no date)
Driver seat	£17.48	(Plastic Bucket Seat For Drift Trike Go kart Cart Buggy DIY Build Custom Fitment eBay, no date)
Seatbelt	£22.99	(Universal 3 Point Inertia Seat Belt 3m 15cm Flat Buckle FREE NEXT DAY DELIVERY eBay, no date)
Paint -Multipurpose paint 750ml	£71.98	(Bedec MSP Multi Surface Paint for Wood Melamine Plastics Radiators *NO PRIMER* eBay, no date)
Contingencies/Miscellaneous	£181.11	10% of the other costs
Total	£1992.24	

4 Conclusions

The soapbox car's driving force is the weight of the soapbox car, and the forces that resist the motion of the soapbox car are the drag force the friction caused by the wheel bearing and the tires. In vehicles with an engine, the car's weight is a factor that needs to be reduced to increase the car's performance, especially when the car goes uphill. Our case is the opposite because the soapbox car's driving force is its weight and the driver's weight. With this design, efforts were made to reduce the drag force (by reducing the frontal area and selecting a shape of low Coefficient of friction) and reducing friction by using bearing to the wheels and inflating the types to an optimum type pressure. The weight of the soapbox car was to an optimum value that will enable achieving this project's set targets. The total weight of the car, including the driver, should be 233kg. Even though the soapbox car's timing during the race was estimated using a spreadsheet, this time has to be verified by computer simulation to make the required adjustment before building the soapbox car. Then a wind tunnel testing is required to fine-tune the shape of the soapbox car. Finally, on-track testing is required to make adjustments to the soapbox car, which cannot be simulated using the computer like the tire pressure and the race track conditions. The project team worked hard to produce this report, and there was good cooperation between the group members. The on-line meetings were held regularly, and this helped in the timely completion of the project. The next step is to produce CAD drawings for the design option selected and fine-tune the soapbox car's design.

5 Acknowledgements

We would like to express our sincere appreciation to Odysseas Androutsos cousin Chrysanthos Christou who has proofread this report.

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[PRIMER/363035720010?_trkparms=ispr%3D1&hash=item54869d794a:g:eXkAAOSwsrhet1xa](https://www.ebay.co.uk/itm/Bedec-MSP-Multi-Surface-Paint-for-Wood-Melamine-Plastics-Radiators-NO-PRIMER/363035720010?_trkparms=ispr%3D1&hash=item54869d794a:g:eXkAAOSwsrhet1xa)
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bYuNWfK3AgWCDDeVAopFg0Cz2RaYGg7ICxH0w%253D%253D%7Ccksum%3A3630357200108

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APPENDIX A

Summary of the Richards Castle Soapbox Derby regulations 2020 that affect the design of the Soapbox car

Summary of the Richards Castle Soapbox Derby regulations 2020 that affect the design of the Soapbox car

- Classes: 3 No (2 Wheel Soapbox, 3 Wheel Soapbox and four-wheel Soapbox)
- Course details: Length = 550m – Descent = 50m (Slope varies and cars are expected to reach 30 to 40mph)
- The start is from a raised ramp, and no pushing is allowed.
- Maximum length of the soapbox car = 2500mm
- Maximum width of the soapbox car = 1500mm
- Type of Tyres: pneumatic (No more than two inline)
- Minimum Ground clearance = 50mm
- Gradient of ramp = 1 in 8
- Brake: Both wheels must be braked on 2-wheel soapboxes. Both wheels on an axle should be braked. The brakes should be able to hold the soapbox car on the starting ramp.
- Seat – must be well secured to the soapbox
- No of seats for the soapbox = 1 (feet first direction or upright position in case of 2 wheels soapboxes)
- Steering wheel column: Wheel/handlebar is recommended (to avoid/minimize puncture injuries)
- Steering: Not too excessive free play (Instability to be avoided)
- Bodywork: The driver should be able to exit the soapbox without help- Avoid sharp edges.
- Doors/Covers – To be openable from inside and outside the soapbox without the use of tools.
- No loose weights
- Gravity propulsion ONLY – No use of motors or pedals with chain
- Seatbelts – Are heavily recommended, especially on heavier soapboxes
- “Substantial” Roll Bar – To be fitted on all 3 & 4 wheel soapboxes
- Minimum Clearance of roll bar is 35mm above the driver’s helmet and 25mm from gloved hands when placed at 12 o’clock.
- Welding to be of a good standard.
- No glasses are allowed for the construction of the soapbox

APPENDIX B

Soapbox car Design Project - Gantt Chart

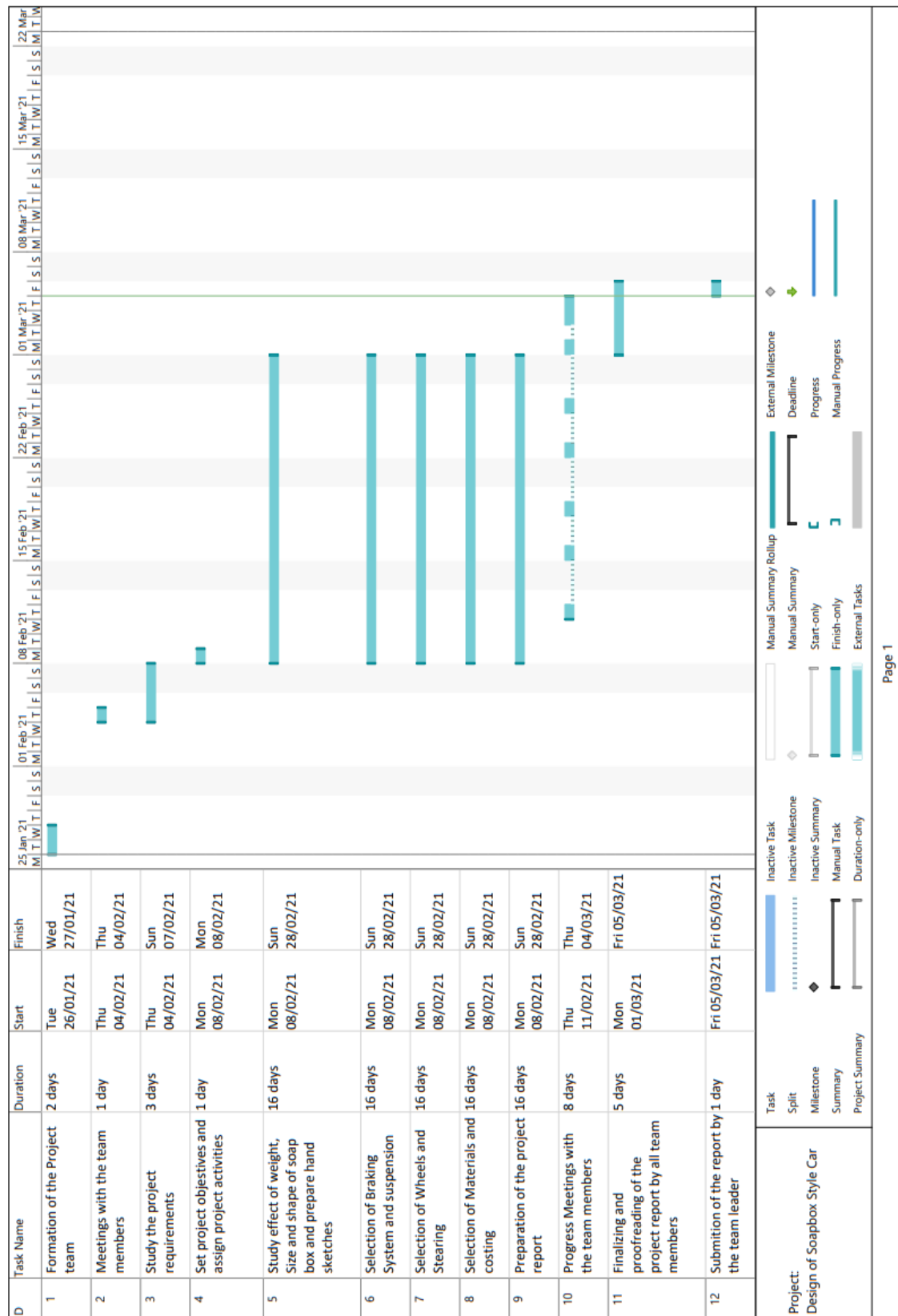


Figure 8 - Soapbox car project Gantt Chart

APPENDIX C

Minutes of Meetings

Minutes of Meeting

Team Name: **The cruel crusaders**

Meeting Date/time: **04/02/2021** at **16:30hrs**

Meeting Held at: **On Line**

	Present at Meeting:	Position	Contact No.
1	Odysseas Androutsos		
2	Drew Gilasbey		
3	Alexander Lewis		
4	Husain Al Humadi		
5	Abdulazim Mohammadain		

1) Project Brief

The project involves the design of a soap Box type of car which will comply with the rules set by Richards Castle Soap Box Derby.

2) Subjects discussed in the meeting:

- a) All members of the team introduced themselves and it was decided that it is important all members of the team to study carefully the objectives on the project and the rules that govern the Richards Castle Soap Box Derby.

- b) It was agreed to meet in a weeks' time in order to decide about the following:
The category under which this project will focused

Discuss and prepare a programme of works which will be present later in a Gantt chart.

Split the project in various activities.

Assign activities to each member of the team in order to complete this project successfully and on time.

3) Date and time of next meeting:

08/02/2021 at 15:00

Minutes of Meeting

Team Name: **The cruel crusaders**

Meeting Date/time: **08/02/2021** at **15:00hrs**

Meeting Held at: **On Line**

	Present at Meeting:	Position	Contact No.
1	Odysseas Androutsos	Designer and team leader	
2	Drew Gilasbey	Cost of Materials	
3	Alexander Lewis	Wheels and steering	
4	Husain Al Humadi	Preparation of the report	
5	Abdulazim Mohammadain	Research on brakes and suspension	

Subjects discussed in the meeting:

Team leader was voted.

It was decided that a 4-Wheel soapbox car will be designed.

These was a discussion about the splitting the project in various tasks.

Each member of the team was assigned with a task.

The tasks are shown on the above table.

Ideas were express about the production of the Gantt Chard in order to complete the project in the required time scale.

Date and time of next meeting:

11/02/2021 at16:30

Minutes of Meeting

Team Name: **The cruel crusaders**

Meeting Date/time: **11/02/2021** at **16:30hrs**

Meeting Held at: **On Line**

	Present at Meeting:	Position	Contact No.
1	Odysseas Androutsos	Designer and team leader	
2	Drew Gilasbey	Cost of Materials	
3	Alexander Lewis	Wheels and steering	
4	Husain Al Humadi	Preparation of the report	
5	Abdulazim Mohammadain	Research on brakes and suspension	

Subjects discussed in the meeting:

The Gantt chart for project was presented to the members of the team by the team leader.

Each member of the team presented their ideas and findings about the task they have been assigned to do.

It was stressed that the weight of the soapbox car is important because it is the driving force of the soapbox car. The importance of the shape of the soapbox car and the importance of the wheels were also discussed.

It was decided to prepare sketches for the proposed soapbox car and present them in the next meeting.

Date and time of next meeting:

15/02/2021 at 15:00

Minutes of Meeting

Team Name: **The cruel crusaders**

Meeting Date/time: **15/02/2021** at **15:00hrs**

Meeting Held at: **On Line**

	Present at Meeting:	Position	Contact No.
1	Odysseas Androutsos	Designer and team leader	
2	Drew Gilasbey	Cost of Materials	
3	Alexander Lewis	Wheels and steering	
4	Husain Al Humadi	Preparation of the report	
5	Abdulazim Mohammadain	Research on brakes and suspension	

Subjects discussed in the meeting:

Three sketches of the proposed soapbox car were present and the one with the less frontal area was selected. Considering the competition and the time records in previous races it was decided that it is go prepare a spreadsheet that will predict the time of the soapbox car during the race applying our present knowledge. The timing of the 2019 Richards Castle Soapbox Derby winner was considered as bench mark that guided our design.

In the next meeting it was decided to prepare a spreadsheet that will estimate the timing of the soapbox car during the race.

Date and time of next meeting:

18/02/2021 at16:30

Minutes of Meeting

Team Name: **The cruel crusaders**

Meeting Date/time: **18/02/2021** at **16:30hrs**

Meeting Held at: **On Line**

	Present at Meeting:	Position	Contact No.
1	Odysseas Androutsos	Designer and team leader	
2	Drew Gilasbey	Cost of Materials	
3	Alexander Lewis	Wheels and steering	
4	Husain Al Humadi	Preparation of the report	
5	Abdulazim Mohammadain	Research on brakes and suspension	

The spreadsheet that calculated the timing of the soapbox car was prepared was present in this meeting.

The cost of various materials was also present.

In this meeting it was decided not to use suspension to the soapbox car because it does not contribute much to the performance and also to keep the cost down.

It was decided to use aluminium wheels instead of wheels with spokes because they are stronger. All the team members were requested to prepare sections for the report in order to pass them to the person that will put together the report.

Date and time of next meeting:

22/02/2021 at 15:00

Minutes of Meeting

Team Name: **The cruel crusaders**

Meeting Date/time: **22/02/2021** at **15:00hrs**

Meeting Held at: **On Line**

	Present at Meeting:	Position	Contact No.
1	Odysseas Androutsos	Designer and team leader	
2	Drew Gilasbey	Cost of Materials	
3	Alexander Lewis	Wheels and steering	
4	Husain Al Humadi	Preparation of the report	
5	Abdulazim Mohammadain	Research on brakes and suspension	

The various sections of the report were present by the respective member of the team and were forwarded to all the team members. The person in charge of putting together the report was requested to prepare a draft and present it in the next meeting.

Date and time of next meeting:

25/02/2021 at 16:30

Minutes of Meeting

Team Name: **The cruel crusaders**

Meeting Date/time: **25/02/2021** at **16:30hrs**

Meeting Held at: **On Line**

	Present at Meeting:	Position	Contact No.
1	Odysseas Androutsos	Designer and team leader	
2	Drew Gilasbey	Cost of Materials	
3	Alexander Lewis	Wheels and steering	
4	Husain Al Humadi	Preparation of the report	
5	Abdulazim Mohammadain	Research on brakes and suspension	

The person in charge of the report requested the team members to provide additional information in order to be able to complete the report, like photos, and sketches in PDF format.

Date and time of next meeting:

01/03/2021 at 15:00

Minutes of Meeting

Team Name: **The cruel crusaders**

Meeting Date/time: **01/03/2021** at **15:00hrs**

Meeting Held at: **On Line**

	Present at Meeting:	Position	Contact No.
1	Odysseas Androutsos	Designer and team leader	
2	Drew Gilasbey	Cost of Materials	
3	Alexander Lewis	Wheels and steering	
4	Husain Al Humadi	Preparation of the report	
5	Abdulazim Mohammadain	Research on brakes and suspension	

A draft copy of the report was given to all the team members with the request read the report and provided and provided their comments. Also, to provided their references in order to be included in the report.

Date and time of next meeting:

03/03/2021 at16:30

Minutes of Meeting

Team Name: **The cruel crusaders**

Meeting Date/time: **03/03/2021** at **16:00hrs**

Meeting Held at: **On Line**

	Present at Meeting:	Position	Contact No.
1	Odysseas Androutsos	Designer and team leader	
2	Drew Gilasbey	Cost of Materials	
3	Alexander Lewis	Wheels and steering	
4	Husain Al Humadi	Preparation of the report	
5	Abdulazim Mohammadain	Research on brakes and suspension	

A new draft copy of the report was given to all the team members with the request read the report and provided and provided their final comments in the next meeting.

Date and time of next meeting:

04/03/2021 at 18:30

Minutes of Meeting

Team Name: **The cruel crusaders**

Meeting Date/time: **04/03/2021** at **18:30hrs**

Meeting Held at: **On Line**

	Present at Meeting:	Position	Contact No.
1	Odysseas Androutsos	Designer and team leader	
2	Drew Gilasbey	Cost of Materials	
3	Alexander Lewis	Wheels and steering	
4	Husain Al Humadi	Preparation of the report	
5	Abdulazim Mohammadain	Research on brakes and suspension	

The final comments and correction were presented in this meeting and the person in charge of the report was tasked to finalize the report and submit it.

The team leader thanked all the team members for their cooperation and support.