

University of Wales Trinity Saint David

Wales Institute of Science and Art



Prifysgol Cymru

Y Drindod Dewi Sant

University of Wales

Trinity Saint David

Soap Fury

Integrating Project (ACHA 4008)

Luke Jacobs, Liam Evans, Dafydd Pughe, Daniel Burden

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1. Introduction

Soap Fury comprises of 4 members, each of which have different roles within the team's function, we have decided to keep ourselves flexible and assist between assigned key roles.

Team roles as following:

Team Leader – Luke Jacobs

Chief Designer – Daniel Burden

Finance Manager – Liam Evans

Dafydd Pughe – Materials Research & Time projection

These roles were decided between three of our members with consideration to the unavailable member, these main roles stayed throughout the project however the workload was divided between members as the project continued.

Moving through the project the tasks developed and were assigned as the following:

Luke Jacobs - Report writing & work collation, meeting minutes, Steering Mechanism, Time Projection Assistant.

Liam Evans – Costing & materials research.

Daniel Burden – initial and final designs, Kart Geometry, materials.

Dafydd Pughe – Materials Research, Time Projection.

2. Meeting Minutes

28/11/2024

Meeting Minutes

Call to order

A meeting of Soap to Glory was held at UWTSD Community Area on 28/11/2024.

Attendees

Attendees included Luke Jacobs, Liam Evans, Dafydd Pughe

Apologies

Members not in attendance included Daniel Burden.

Approval of minutes

First meeting no previous Minutes to Approve

Report of meeting minutes

Dafydd, Liam and Luke conducted the first meeting of soap to glory, initially setting out group roles, nominating the group lead as Luke Jacobs, chief designer as Daniel Burden, Liam Evans as Finance Manager and Dafydd Pughe as Material researcher and time projectionist.

Matters arising

Daniel Burden needs to be brought up to speed upon return.

Regular meetings to be Scheduled

Announcements

Date, time and location of next meeting:

02/12/2024 - UWTSD IQ Library Room 103 - 11:30 AM

Signed : L. Jacobs

Date of approval: 2 /12 /2024

2/12/2024

Meeting Minutes

Call to order

A meeting of Soap Fury was held at UWTSD Library room 103 on 2/12/2024.

Attendees

Attendees included Luke Jacobs, Liam Evans, Dafydd Pughe, Daniel Burden

Apologies

N/a

Approval of minutes

Previous meeting minutes were approved by Luke Jacobs and Seconded by Liam Evans.

Report of meeting minutes

The Group met in its entirety for the first time catching Daniel up on previous events, reviewing what each of the group needed to do to fulfill their role, research was started as well as designs discussed.

Matters arising

Team name & logo needed to be confirmed.

Announcements

Date, time and location of next meeting:

05/12/2024 - UWTSD IQ Library Room 103 - 09:00AM

Signed : L. Jacobs

Date of approval: 5 /12 /2024

5/12/2024

Meeting Minutes

Call to order

A meeting of Soap Fury was held at UWTSD Library room 103 on 5/12/2024.

Attendees

Attendees included Luke Jacobs, Liam Evans, Dafydd Pughe.

Apologies

Daniel Burden

Approval of minutes

Previous meeting minutes were approved by Luke Jacobs and Seconded by Liam Evans.

Report of meeting minutes

The three met, to discuss ongoing work to gauge where each other were and to voice their concerns, the team felt they were roughly on track discussing some extra parts that need to be done and happiness with the overall design.

The team decided to go forward with a chosen design

Matters arising

The steering mechanism needs to be done and was assigned to Luke Jacobs.

Announcements

Date, time and location of next meeting:

09/12/2024 - UWTSD IQ Library Room 103 - 11:00AM

Signed : L. Jacobs

Date of approval: 09/12/2024

5/12/2024

Meeting Minutes

Call to order

A meeting of Soap Fury was held at UWTSD Library room 103 on 5/12/2024.

Attendees

Attendees included Luke Jacobs, Liam Evans, Dafydd Pughe.

Apologies

Daniel Burden

Approval of minutes

Previous meeting minutes were approved by Luke Jacobs and Seconded by Liam Evans.

Report of meeting minutes

Three members of Soap Fury met for the final face to face meeting of 2024 before all staff members going on annual leave over the festive period.

Final tasks to be covered by members were discussed before annual leave

Matters arising

The steering mechanism needs to be done and was assigned to Luke Jacobs.

Announcements

Date, time and location of next meeting:

21/01/2025 -Teams Online - 11:00AM

Signed : L. Jacobs

Date of approval: 09/12/2024

21/01/2025

Meeting Minutes

Call to order

A meeting of Soap Fury was held at Teams Online on 21/01/2025.

Attendees

Attendees included Luke Jacobs, Liam Evans, Dafydd Pughe, Daniel Burden

Apologies

N/a

Approval of minutes

Previous meeting minutes were approved by Luke Jacobs and Seconded by Liam Evans.

Report of meeting minutes

All members of Soap Fury met in an online meeting to review and discuss the final documentation for the first half of the soap fury project before submission of documents, making any desired amendments and conveying opinions for review

Matters arising

No matters arising, end of part 1

Announcements

N/A

Signed : L. Jacobs

Date of approval: 21/01/2025

3. Gantt Chart

Follow here for [Soap Fury Gantt Chart](#)

4. Team Aims & Goals

As a team during a meeting, we decided on some basic and realistic goals, the primary aim was to produce a safe and stable soap box kart that will complete any type of course that may be thrown at us at the event, after looking through the regulations we decided that stability would be the best focus. The team decided on an ultimate goal of a Top ten finish, we decided on this as a realistic achievement due to this being a new endeavour for every team member with no prior knowledge of producing a soapbox kart.

5. Initial Designs

Daniel produced 3 designs as the team made the decision that we would make 1 design and continually develop it until we achieved a finished product.

The basics of the design would have to comply to the provided regulations found in the supplied documentation, this results in a maximum length of 2500mm and maximum width of 1500mm. Regulations on roll bars state there must be 35 mm above the drivers head and another roll bar 25mm above the drivers hands whilst at 12 o'clock on the steering input (Richards Castle Soapbox Regulations, no date) Then the cockpit came into question, Daniel decided that as a starting point that the cockpit would be built around himself as he was a bigger member of the team, so that should allow enough tolerance a variety of team drivers so with that he produced the first draft.

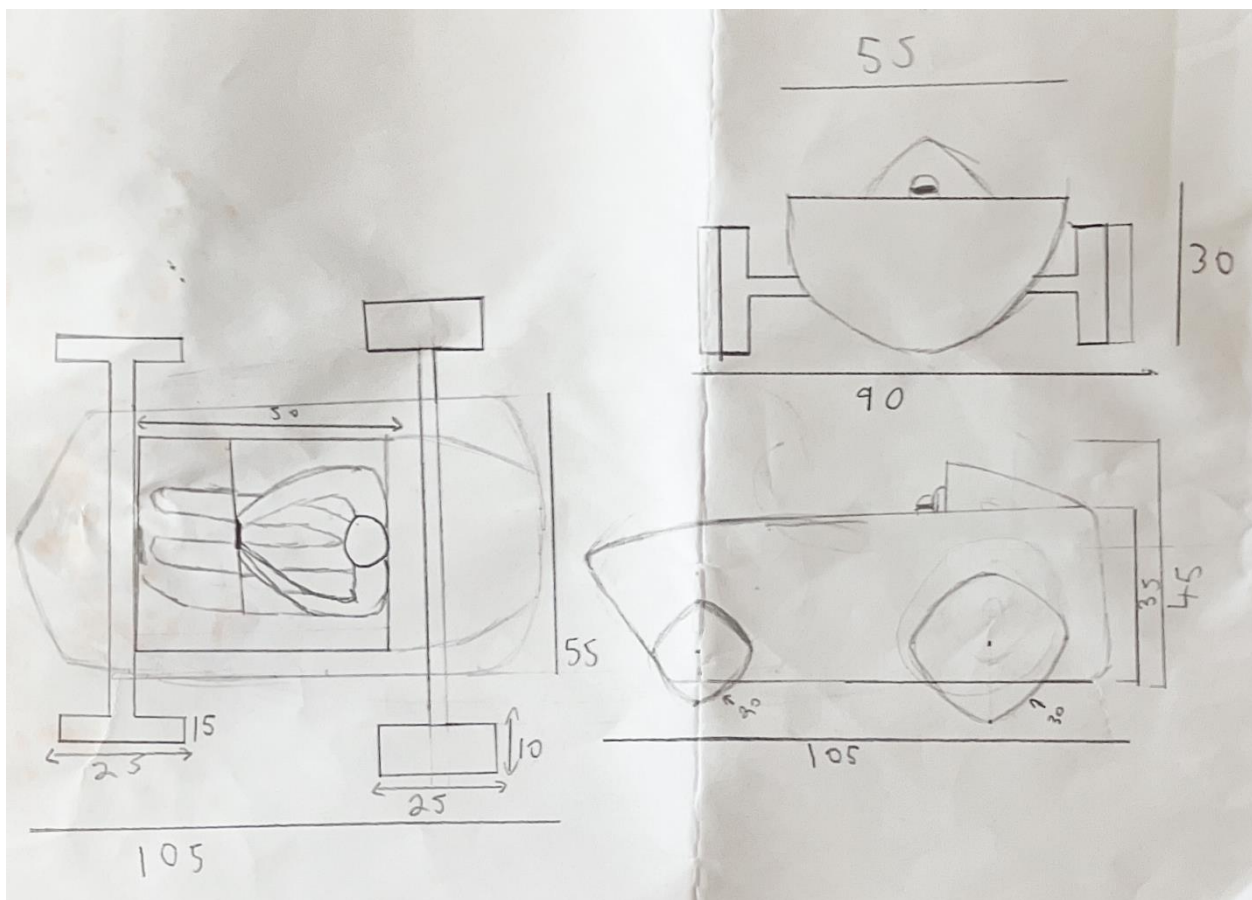


Figure 1- Initial Design (Daniel Burden)

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This first design was simply what the team think a soap box car should be after a brief team discussion, there was no inspiration other than what members had seen on red bull soap box, so this design was a bare bone. (Red Bull, no date)

This design didn't get far in the design phase, but this did bring up the question such as would we our soap box to be front wheel or rear wheel steering also what type of braking system would be suitable for the soap box.

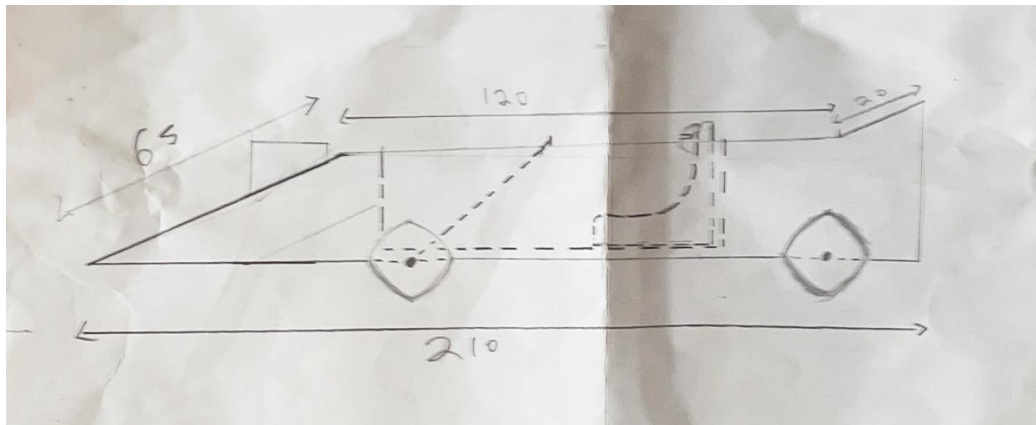


Figure 2 - Design 2 Side view (Daniel Burden)

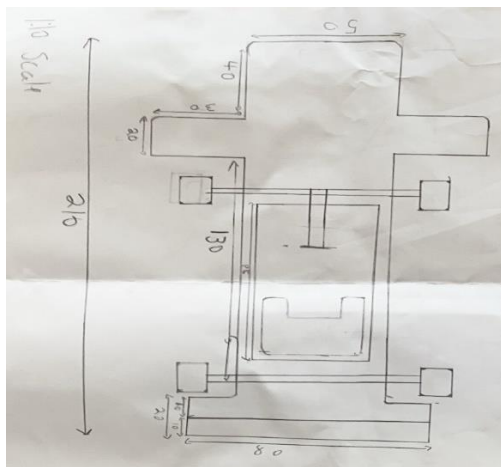


Figure 3 - Design 2 Top View (Daniel Burden)

The second design now was more thought out to include the driver, by this time the team had chosen Luke to pilot, part of this decision was because due to other hobbies he already owned the required and approved safety clothing allowing us to better allocate the budget.

We could now put thought to how the cockpit could be built accounting for the driver, for example the cock pit would be designed and built to include the driver's

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height and how far away the steering wheel would be and the seating position to fundamentally obtain a safe and efficient driving position.

Once that was sorted the design team went onto figuring how to incorporate front wheel steering and rear wheel braking ,once that was figured out then came the second design which was vaguely based on a 1980s era F1 car mostly taking cues from the lotus 98T, all of the inspirations came from one list made by Ben Miles for Goodwood ,this was a good overall design however it wasn't picked as we reviewed it we came to the realisation that it may be very difficult to produce with lots of parts and may have not allow the turning rate that was necessary.

(Miles, 2021)

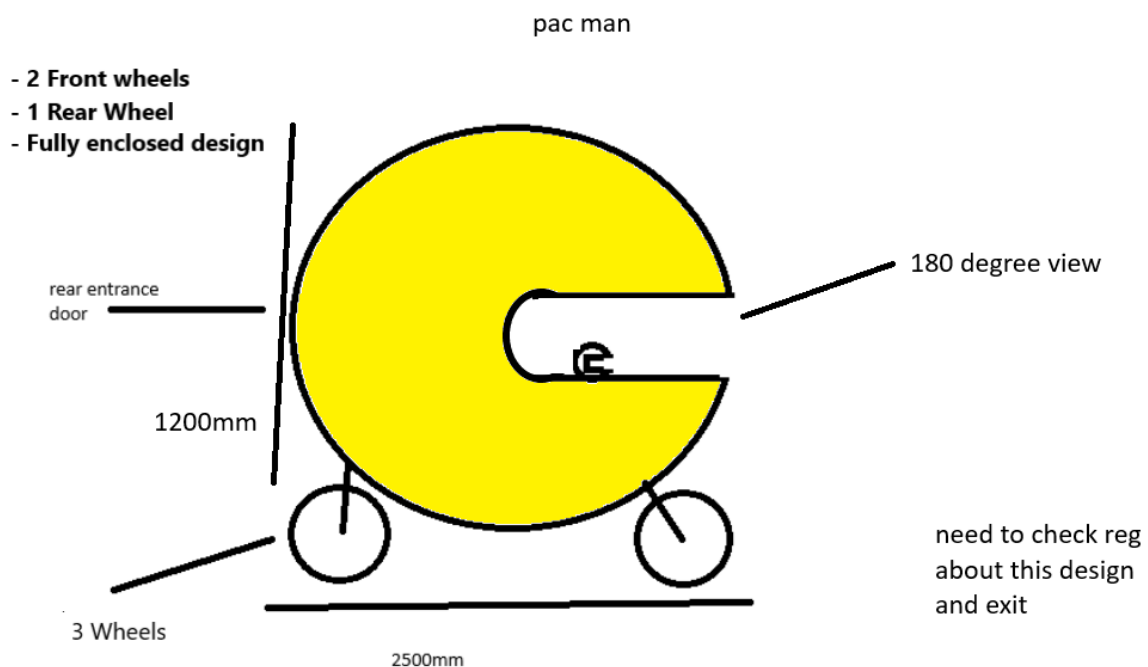


Figure 4 - Design 3 a less serious Design (Team Effort)

6. Final Design

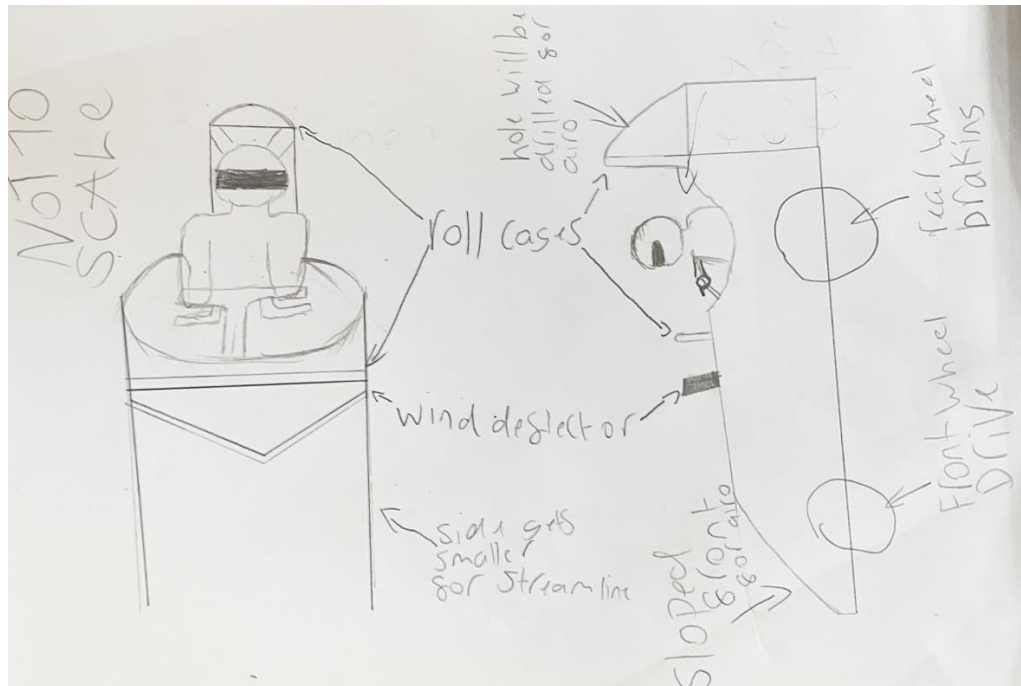


Figure 5 - Final Design overview (Daniel Burden)

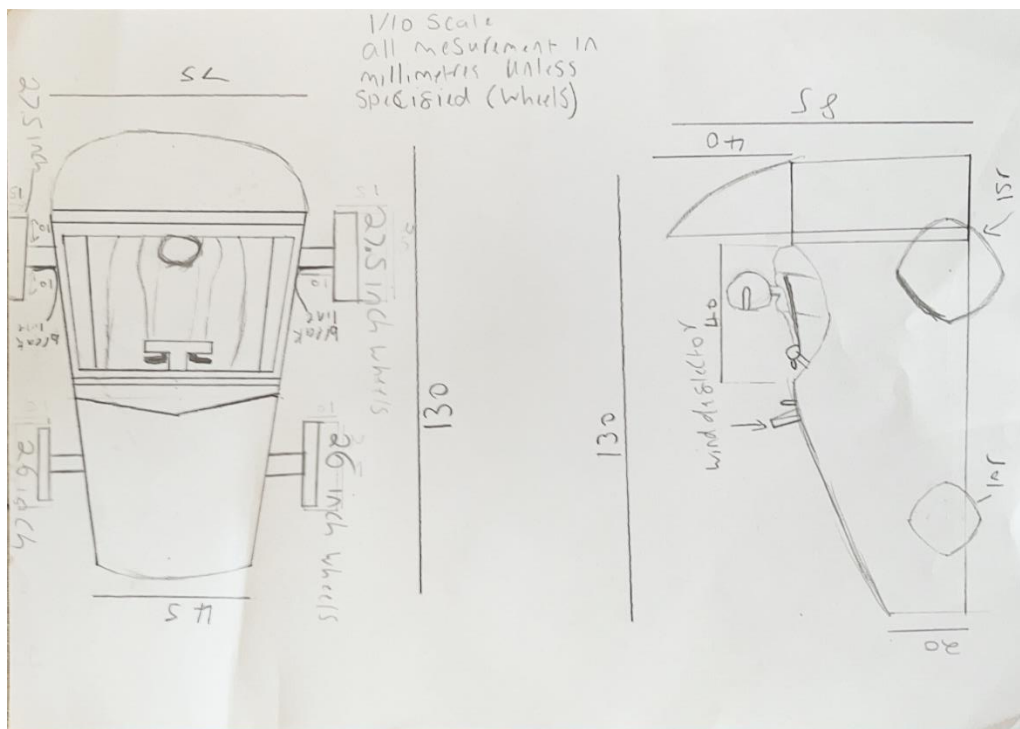


Figure 6 - Final Design Technical Measurements (Daniel Burden)

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For the final design the team had come together in a formal meeting so Daniel did not have to make the final design himself without external consideration, the lead designer was more than happy to listen to and take onboard concerns and ideas from the remainder of the Soap Fury team, this lead to a simplified but more practical design.

In one of the team meetings, we researched the course to obtain an idea of the course and found a video that provided a clear idea of what Soap Fury were up against.(Shropshire Starr, 2014).

Soap Fury had decided that since there were going to be no jumps in the course that it was a better decision to put focus on stability and simplicity as to gain downhill speed as efficiently as possibly aiming for the suggested speed of 30-40mph (Richards Castle Soapbox Regulations, no date) .

This lead to a thin curved body that extended as one from front to back, the drivers seating position also got altered to have the driver knees pulled backwards aiming to more centre balance the car, we also went more into the braking system as we used a hydraulic mountain bike brakes to enable easy routing and compatibility with the wheels, following the regulations we also made sure both roll bars would be possible with the layout and adhere to regulation, little details such as making holes behind the rear roll bar for extra aerodynamic efficiency were added and the wind deflector was used for the same purpose and the steering had also changed between models as we had made the decision as a group to make the cars steering from a conventional wheel to handle bars as they were in the regulation and made more sense for our car, track layout and braking system all the changes made were a culmination of team ideas to increase efficiency and simplicity.

7. Materials

There are many different materials needed to produce Soap Fury's kart, for the structure and body of the kart the materials need to be light but also durable to hold shape through the run, keeping the driver safe in the event of a crash on the course.

7.1 Body and Chassis

The main structure of the kart is going to be made from aluminium due to its sturdiness when hit and the lightness of the material relative to the sizes we will be using.

A popular material for go karting is AISI 4130 or AISI 1018 alloy steel (Best Material for Go-Kart Frames and Chassis | GoKartGuide, no date) , steel such as these are quite expensive which isn't ideal for this project since we want to make the kart in an affordable manor.

AISI 1018 steel has a high tensile strength which is very good for safety when crashing, it also has a great balance between strength and weight.

Table 1- Strengths of steel alloys (Best Material for Go-Kart Frames and Chassis | GoKartGuide, no date)

Steel Alloy	AISI 4130	AISI 1018
Yield Strength	460 MPa	317 MPa
Tensile Strength	560 MPa	440 MPa
Hardness	217 HB	126 HB
Cost Per Meter	USD 12	USD 5

A material similar to steel but is much more cost effective is aluminium sheet metal for the body and aluminium round tube for the frame of the kart. This would help our costs since aluminium metal is a very cheap metal for the specifications that you get from the material the strengths of aluminium should cope with all the forces; that we will subject it to.

Aluminium is also a material that is easy to weld together which will also improve the strength of the joints which is an essential part of the structure. Due to AISI 1018 being a low carbon steel it makes welding various parts together very easy which is key for making the kart frame as strong as possible. (Kumar, 2023)

7.2 Braking system

For the braking system we decided to go with mountain bike hydraulic braking system due to its performance level, it is also a cost-effective braking system for the level of braking we need.

Another reason to use these mountain bike style brakes and master cylinder is the fact that we are using mountain bike style handlebars for our steering handle so these will easily bolt straight on to our steering system.

7.3 Steering system Materials

The steering system is going to be made out of aluminium tubing the same as the majority of the soap box, we are going to use a simple rope pulley system rotating around a central fulcrum point using rope connected to our steering bar to rotate the front axle, this is a similar set up to traditional soap boxes that use foot steering, to prevent over steering and oscillations we have decided to place 2 springs on the front axle to centre the steering these springs have adjustable tensions which will allow us to dial in the return rate inadvertently giving us a makeshift steering damper

(Wooden Go-Kart Plans :: How to build a wooden go kart, no date)

7.4 Seat

Dafydd and Liam researched different types of seat for the kart and decided to use a go karting seat for the soap box kart, this is due for the seat being lightweight and will also reduce the amount of movement of the driver while sitting and driving down the track therefore increasing stability. This type of seat is also very cost effective due to its low

price which means we could use the money on different parts and future development of the kart to make it more durable and efficient.

7.5 Wheels

The Soap Fury group decided that mountain bike wheels would be the best type to use for the kart. This is due to the mountain bike wheel having high impact load resistance which will be durable for the kart down the track. A key factor for using mountain bike wheels is that they are compatible with the braking system we've decided to use. We have designed the kart with 26-inch mountain bike wheels on the front of the kart and 27.5-inch wheels on the back to make the back of the kart more stable and stronger.

Putting more load on the front wheels via running the smaller wheels on the front should make our steering more sensitive and increase cornering grip on the steering axle.

7.6 Fasteners and Fixings

As a group we chose to use M8 bolts for everything because we will only need one sized tool to work on the whole kart and this is beneficial for practicality, also we thought that this kind of bolt will be strong enough for the frame of the kart and should cope with all the sheering forces experienced by the bolt together components.

8 Steering System

Through personal interest Luke had some prior knowledge of steering systems and was appointed to be in charge and knew what direction would be best for the team.

It was decided that the most basic steering system would be used, which was a direct pull system in which a rope attached to a set of pivoting handlebars pulls the front axle around a CenterPoint, steering the whole axle (shown in Figure 6) instead of Ackerman style in which the axle stays fixed but the wheels move, a benefit to this is that it is a lot lighter than rack and pinion style system, a lot less complex and much more cost efficient. (Nice, no date) (Vogel, 2021)

The return springs main purpose is to make the steering self-centring so that whilst turning the kart doesn't snap oversteer and veer off of the course, the chances of this happening can be reduced by installing lock stops to reduce the full lock of the vehicle, it will also increase the required force to turn the wheel either way and reduce turning speed inadvertently making a type of steering damper, which increases safety and stability.

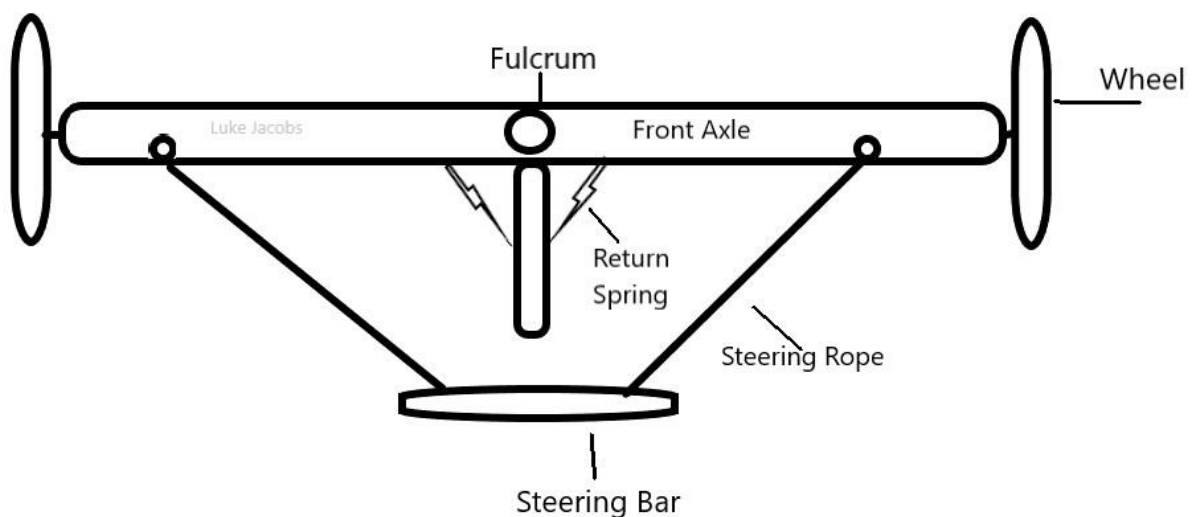


Figure 7 - Direct Pull Steering Simplified (Luke Jacobs)

9 Costing

This part of the document will have all the information on how much each material and part cost us and why we have justified the price. The document will also mention the other fees like entry fees.

9.1 Parts, Costs & Source

- **Foam – 12' x 12', 1' depth - £4.99**

[CUT TO SIZE UPHOLSTERY FOAM HIGH DENSITY ANY THICKNESS ANY SIZE OFF | eBay](#)

- **Aluminum Sheet Metal – 1300mm x 850mm x2 - £67.13**

<https://www.aluminiumwarehouse.co.uk>

- **Aluminum Sheet Metal – 1300mm x 750mm - £59.23**

<https://www.aluminiumwarehouse.co.uk>

- **Aluminum Round 12.7mm x 2mm Tube – 5,000mm x3 - £19.20**

<https://www.aluminiumwarehouse.co.uk>

- **Aluminum Round 12.7mm x 2mm Tube – 2,000mm - £11.60**

<https://www.aluminiumwarehouse.co.uk>

- **26' Mountain Bike Wheels x2 - £67.99**

[26" MTB BIKE WHEELS \(559 x 19c\) 8/9 SPEED CASSETTE HUBS BLACK DUAL WALL HP RIM : Amazon.co.uk: Sports & Outdoors](#)

- **27.5' Mountain Bike Wheels x2 - £102**

[QR 27.5" 650b \(ETRTO 584x19\) Mountain MTB Bike Wheel Set + 7 speed Freewheel \(14-28t\) – Rim & Disc Brake Compatible – Sealed Bearings Hubs \(Very Smooth Hubs\) – Double Wall – 32x Silver Spokes : Amazon.co.uk: Sports & Outdoors](#)

- **Mountain Bike Handlebars - £18.99**

https://www.amazon.co.uk/dp/B073JQPVSX?ref=cm_sw_r_cp_ud_dp_38D1CCC4RDG2XD01Y8YS&ref_=cm_sw_r_cp_ud_dp_38D1CCC4RDG2XD01Y8YS&social_share=cm_sw_r_cp_ud_dp_38D1CCC4RDG2XD01Y8YS&encoding=UTF8&newOGT=1&th=1

- **Mountain Bike Hydraulic Brake System - £39.99**

https://www.amazon.co.uk/dp/B0B65CJK3K?ref=cm_sw_r_cp_ud_dp_T4AX738955546Z5YFH2H&ref_=cm_sw_r_cp_ud_dp_T4AX738955546Z5YFH2H&social_share=cm_sw_r_cp_ud_dp_T4AX738955546Z5YFH2H&newOGT=1&th=1

- **Go-kart Seat - £65.72**

https://www.amazon.co.uk/dp/B0DFYLXV69?ref=cm_sw_r_cp_ud_dp_AGQH5DAB8F0MBJGE34KB&ref_=cm_sw_r_cp_ud_dp_AGQH5DAB8F0MBJGE34KB&social_share=cm_sw_r_cp_ud_dp_AGQH5DAB8F0MBJGE34KB&encoding=UTF8&psc=1&newOGT=1

- **M8 Nylon Locknuts x100 - £4.49**

<https://www.screwfix.com/p/easyfix-bzp-steel-nylon-lock-nuts-m8-100-pack/58418>

- **15mm thick by 2m length rope - £9.99**

https://www.amazon.co.uk/dp/B09TVKRBSH?ref=cm_sw_r_cp_ud_dp_NBJDBBWYX54D5K505X4N&ref_=cm_sw_r_cp_ud_dp_NBJDBBWYX54D5K505X4N&social_share=cm_sw_r_cp_ud_dp_NBJDBBWYX54D5K505X4N&encoding=UTF8&newOGT=1&th=1

- **RS PRO Steel Gate Spring, 200mm x 2 (£6.28) £12.56**

<https://uk.rs-online.com/web/p/extension-springs/8946806?gb=s>

- **M8 x18mm Full Thread Cap Head Screws x100 - £53**

<https://www.accu.co.uk/metric-cap-head-screws/615039-SSCF-M8-18-A4-80-BL>

9.2 Justification

Foam - The reason we chose this foam is because it's a great depth and size to protect the driver and comfy to be sat in for long periods of time. £5 is also a great price for these foam measurements. This is also a great price as based on my research foam this size has an average cost of £7.

Aluminium Sheet Metal and Aluminium Poles – The price for this sheet metal from aluminium warehouse is good as it allows us to cut to perfect size and is from a place which specializes in aluminium

(The price of sheet metal varies based on demand, At the time of writing, it costs the prices as previously mentioned.)

Mountain Bike 26.5 and 27' wheels – amazon is a reliable place to get any parts and the price they offer is justified due to the great quality. Based on my research we would be paying the average price for these wheels, and they are one of our more expensive purchases.

Braking System – this braking system was decided via a vote and is a reliable way to brake. We are paying slightly more than average for the brakes but that can be justified based on that its for the safety of the driver and needs a reliable system.

Go-kart seat – the seat is a great size for a great price. Will slot in perfectly

Fasteners & fixings - we chose to get 100 because we would rather have too much. It's also a cheap price where we can justify spending. The M8 bolts are used so we have a single size over the cart making it easier for maintenance

15mm thick by 2m length rope- we have opted to use a rope and handlebars pully system. This is an effective way to steer and is cost effective

RS pro steel gate spring – a cost-effective way for the steering to be self-centring, also with tension adjusters to allow for fine tuning.

9.3 Cost Table

The Below table encompasses all the expenditure Soap Fury has for build materials.

Table 2- Kart Build Materials Cost Table

Item	Quantity	Cost (£)	Average Cost (£)	Expenditure (£)
Foam	1	4.99	7	4.99
Aluminum Sheet 1300 x 850	2	67.13	34	134.26
Aluminum Sheet 1300 x 750	1	59.23	55	59.23
Aluminum Tube 12.7mm x 5m	3	19.20	20	57.60
Aluminum Tube 12.7mm x 2m	1	11.60	14	11.60
26' Wheels	2	67.99	63	135.98
27.5' Wheels	2	102	80	204
Handlebars	1	18.99	23.6	18.99
Hydraulic Brake	1	39.99	33	39.99
Go-kart Seat	1	65.72	50	65.72
M8 Nylocks	1	4.49	7.80	4.49
15mm X 2m rope	1	9.99	8.99	9.99
Steel Spring,	2	12.56	15	25.12
M8 bolts x100	1	53	55	53
Total				£824.96

The average price is based on both second-hand and brand-new prices as of 17/01/25.

9.4 Additional Costs

- Entrance Fee - £50
- X-lite 802rr Ultra Carbon Helmet – Already Owned (Luke Jacobs) value - £250
- DRC GP Evo Leather – Already Owned (Luke Jacobs) - value £800

The extra cost table shows we do not forecast any particular unexpected costs outside of the build.

10.0 Project Review

Soap Fury formed as a group with little effort with natural flowing conversation flowing indicating that we would be a good match for communication, upon the first meeting there was no clash between members on assigning roles each with their own interest the group formed a strong base.

Our team produced good information and research in their own areas, the initial designs were produced in a timely fashion with thought being paid to lots of aspect it didn't take long for all to contribute thoughts and set sights on how to move forward with a final design.

The communication and understanding took a slow and broken start however developed exponentially, with a lot of considerations given to other members ideas started to flow and fit fast, making it simple to combine research and work to support each other's areas and ideas.

This document contains enough information to move forward with a confidence in further developing and producing this soap box kart, moving forward we now need to pay attention to chassis geometry and stress forces being loaded through assembly to ensure the kart can cope with the speed and general wear and tear of the course ahead, as well as manufacturing methodologies.

11 References

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