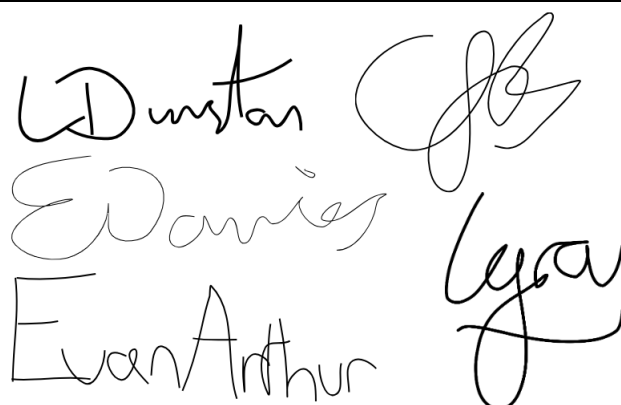


ASSIGNMENT SPECIFICATION

Student name:	Louis Dunstan, Ethan Davies, Evan Arthur, Callum Francis-Beck, Luca gray	Student P number:	2304942, 2304605, 2304962	2305338, 2312005,
Programme:	STEM Foundation year	School:	Engineering	
Module:	Integrating Project	Module Level (4, 5, 6):	4	
Module code:	ACHA4008	Contribution to Overall Module Assessment (%):	40	
Lecturer:	Richard Sutton	Internal Verifier:	A Noble	
Assignment Title:	Project second assignment	Assignment No (x of x):	2 of 2	
Hand Out Date:	16/02/24	Submission deadline:	10/05/24	

Referencing:	In the main body of your submission you must give credit to authors on whose research your work is based. Append to your submission a reference list that indicates the books, articles, etc. that you have read or quoted in order to complete this assignment (e.g. for books: surname of author and initials, year of publication, <u>title of book</u> , edition, publisher: place of publication).		
Disclosure:	I declare that this assignment is all my own work and that I have acknowledged all materials used from the published or unpublished works of other people. All references have been duly cited.		
Student's Signature:		Date:	10/05/24
Turnitin: Lecturer to tick to indicate if an electronic version of the assignment must be submitted to Turnitin. Note: the Turnitin version is the primary submission and acts as a receipt for the student. Both electronic and paper versions MUST be submitted by the same deadline. No marks will be released until both submissions are received. Late submission of either the electronic or paper version will result in a late penalty mark. Penalties for late submission: Up to one week late, maximum mark of 40%. Over one week late, Refer. Only Year Tutors and the Programme Director may grant an extension.		YES	☒
		NO	☐

Learning Outcomes tested (from module syllabus)	Assessment Criteria To achieve each outcome a student must demonstrate the ability to:
Technical knowledge/skill	Final CAD drawings of the part designed in assignment 1

Analytical skills	• Perform calculations to analyse forces (for example) that the part is going to endure
Quality of result and evaluation	• Comment on the suitability of the design

- Please submit the assignment parts in a suitable report folder– not in polypockets.
- This form (ALL PAGES) MUST be at the front of the paper submission. Assignments will not be accepted without this form as it is a requirement that you sign the disclosure regarding referencing convention.
- DO NOT put this form into Turnitin or it will match many similarities with other students' submissions.

TASK DESCRIPTION

The second part of this module is where you provide a technical report (1000 words) and a group presentation (10 mins max) to showcase your final designs.

GUIDANCE FOR STUDENTS IN THE COMPLETION OF TASKS

Your group must write a report (1000 words) that showcases your final designs that you researched on for assignment 1 of the module. Include CAD drawings and an evaluation on the process of designing the product. Comment on the suitability of the design, the quality of the result, as well as aspects that could be changed or improved on.

The report must also include some form of analytics/calculations based on the part you have designed. This could be, for example, the forces that the frame will need to endure to function safely.

To complement the report, you will have to do a 10 minute (max) presentation, where you will professionally explain how the project went, any stumbling blocks, why you designed the 'soapbox' the way that it turned out, what would you change, how the group worked together, etc. **The dates of these will be supplied on Teams in due course (they will take place in May).**

MARKING CRITERIA AND STUDENT FEEDBACK

This section details the assessment criteria. The *extent* to which these are demonstrated by you determines your mark. The marks available for each criterion are shown. Lecturers will use the space provided to comment on the achievement of the task(s), including those areas in which you have performed well and areas that would benefit from development/improvement.

Common Assessment Criteria Applied	Marks available	Marks awarded
1. Quality of designs	30	
2. Analytical work	30	
3. Quality of report	10	
4. Quality of presentation	20	
5. Professionalism	10	

Assignment Mark (Assessment marks are subject to ratification at the Exam Board. These comments and marks are to give feedback on module work and are for guidance only until they are confirmed.)	Late Submission Penalties (tick if appropriate)		%
	Up to one-week late		
	Over one week late		

COMMON ASSESSMENT AND MARKING CRITERIA

	OUTRIGHT FAIL	UNSATISFACTORY	SATISFACTORY	GOOD	VERY GOOD	EXCELLENT	EXCEPTIONAL
Assessment Criteria	0-29%	30-39%*	40-49%	50-59%	60-69%	70-79%	80-100%
1. Research-informed Literature Extent of research and/or own reading, selection of credible sources, application of appropriate referencing conventions	Little or no evidence of reading. Views and findings unsupported and non-authoritative. Referencing conventions largely ignored.	Poor evidence of reading and/or of reliance on inappropriate sources, and/or indiscriminate use of sources. Referencing conventions used inconsistently.	References to a limited range of mostly relevant sources. Some omissions and minor errors. Referencing conventions evident though not always applied consistently.	Inclusion of a range of research-informed literature, including sources retrieved independently. Referencing conventions mostly consistently applied.	Inclusion of a wide range of research-informed literature, including sources retrieved independently. Selection of relevant and credible sources. Very good use of referencing conventions, consistently applied.	A comprehensive range of research informed literature embedded in the work. Excellent selection of relevant and credible sources. High-level referencing skills, consistently applied.	Outstanding knowledge of research-informed literature embedded in the work. Outstanding selection of relevant and credible sources. High-level referencing skills consistently and professionally applied.
2. Knowledge and Understanding of Subject Extent of knowledge and understanding of concepts and underlying principles associated with the discipline.	Major gaps in knowledge and understanding of material at this level. Substantial inaccuracies.	Gaps in knowledge, with only superficial understanding. Some significant inaccuracies.	Evidence of basic knowledge and understanding of the relevant concepts and underlying principles.	Knowledge is accurate with a good understanding of the field of study.	Knowledge is extensive. Exhibits understanding of the breadth and depth of established views.	Excellent knowledge and understanding of the main concepts and key theories. Clear awareness of challenges to established views and the limitations of the knowledge base.	Highly detailed knowledge and understanding of the main theories/concepts, and a critical awareness of the ambiguities and limitations of knowledge.
3. Analysis Analysis, evaluation and synthesis; logic, argument and judgement; analytical reflection; organisation of ideas and evidence	Unsubstantiated generalisations, made without use of any credible evidence. Lack of logic, leading to unsupported/missing conclusions. Lack of any attempt to analyse, synthesise or evaluate.	Some evidence of analytical intellectual skills, but for the most part descriptive. Ideas/findings sometimes illogical and contradictory. Generalised statements made with scant evidence. Conclusions lack relevance.	Evidence of some logical, analytical thinking and some attempts to synthesise, albeit with some weaknesses. Some evidence to support findings/views, but evidence not consistently interpreted. Some relevant conclusions and recommendations, where relevant	Evidence of some logical, analytical thinking and synthesis. Can analyse new and/or abstract data and situations without guidance. An emerging awareness of different stances and ability to use evidence to support the argument. Valid conclusions and recommendations, where relevant	Sound, logical, analytical thinking; synthesis and evaluation. Ability to devise and sustain persuasive arguments, and to review the reliability, validity & significance of evidence. Ability to communicate ideas and evidence accurately and convincingly. Sound, convincing conclusions / recommendations.	Thoroughly logical work, supported by evaluated evidence. High quality analysis, developed independently or through effective collaboration. Ability to investigate contradictory information and identify reasons for contradictions. Strong, persuasive, conclusions, justifiable recommendations.	Exceptional work; judiciously selected and evaluated evidence. Very high quality analysis, developed independently or through effective collaboration. Ability to investigate contradictory information and identify reasons for contradictions. Highly persuasive conclusions
4. Practical Application and Deployment Effective deployment of appropriate methods, materials, tools and techniques; extent of skill demonstrated in the application of concepts to a variety of processes and/or contexts; formulation of innovative and creative solutions to solve problems.	Limited or no use of methods, materials, tools and/or techniques. Little or no appreciation of the context of the application.	Rudimentary application of methods, materials, tools and/or techniques but without consideration and competence. Flawed appreciation of the context of the application.	An adequate awareness and mostly appropriate application of well established methods, materials, tools and/or techniques. Basic appreciation of the context of the application.	A good and appropriate application of standard methods, materials, tools and/or techniques. Good appreciation of the context of the application, with some use of examples, where relevant.	A very good application of a range of methods, materials, tools and/or techniques. Very good consideration of the context of the application, with perceptive use of examples, where relevant. Evidence of some innovation and creativity.	An advanced application of a range of methods, materials, tools and/or techniques. The context of the application is well considered, with extensive use of relevant examples. Application and deployment extend beyond established conventions. Innovation and creativity evident throughout.	Outstanding levels of application and deployment skills. Assimilation and development of cutting edge processes and techniques.
5. Skills for Professional Practice Demonstrates attributes expected in professional practice including: individual initiative and collaborative working; deployment of appropriate media to communicate (including written and oral); clarity and effectiveness in presentation and organisation.	Communication media is inappropriate or misapplied. Little or no evidence of autonomy in the completion of tasks. Work is poorly structured and/or largely incoherent.	Media is poorly designed and/or not suitable for the audience. Poor independent or collaborative initiative. Work lacks structure, organisation, and/or coherence	Can communicate in a suitable format but with some room for improvement. Can work as part of a team, but with limited involvement in group activities. Work lacks coherence in places and could be better structured.	Can communicate effectively in a suitable format, but may have minor errors. Can work effectively as part of a team, with clear contribution to group activities. Mostly coherent work and is in a suitable structure.	Can communicate well, confidently and consistently in a suitable format. Can work very well as part of a team, with very good contribution to group activities. Work is coherent and fluent and is well structured and organised.	Can communicate professionally and, confidently in a suitable format. Can work professionally within a team, showing leadership skills as appropriate, managing conflict and meeting obligations. Work is coherent, very fluent and is presented professionally.	Can communicate with an exceptionally high level of professionalism. Can work exceptionally well and professionally within a team, showing advanced leadership skills. Work is exceptionally coherent, very fluent and is presented professionally.

Student Self Evaluation Form

Student name:	Louis Dunstan	Student P number:	2304942
Programme:	Stem foundation year	Year of programme	2024
Assignment Title:	Integrating project second assignment ACAH40008		

This section repeats in brief the common assessment criteria detailed on previous pages. The *extent* to which these are demonstrated by you determines your mark. Using these criteria, tick the box that best indicates the level of achievement you feel you have achieved with regard to each of them.

Common Assessment Criteria Applied	Level of Achievement						
	REFER		3 rd	2:2	2:1	1 st	1 st
	OUTRIGHT FAIL	UNSATISFACTORY	SATISFACTORY	GOOD	VERY GOOD	EXCELLENT	EXCEPTIONAL
1. Research-informed Literature	0-29% ☐	30-39% ☐	40-49% ☐	50-59% ☐	60-69% ☒	70-79% ☐	80-100% ☐
2. Knowledge and Understanding of Subject	0-29% ☐	30-39% ☐	40-49% ☐	50-59% ☐	60-69% ☐	70-79% ☒	80-100% ☐
3. Analysis	0-29% ☐	30-39% ☐	40-49% ☐	50-59% ☒	60-69% ☐	70-79% ☐	80-100% ☐
4. Practical Application and Deployment	0-29% ☐	30-39% ☐	40-49% ☐	50-59% ☒	60-69% ☐	70-79% ☐	80-100% ☐
5. Skills for Professional Practice	0-29% ☐	30-39% ☐	40-49% ☐	50-59% ☐	60-69% ☒	70-79% ☐	80-100% ☐

PLEASE COMMENT ON AREAS IN WHICH YOU FEEL THAT YOU HAVE PERFORMED WELL	PLEASE COMMENT ON AREAS YOU FEEL THAT YOU NEED TO DEVELOP
Leadership roles, motivating the rest of the group to get their jobs done, as well as organizing all of the meetings hosted to help us along with our project.	Time management is one area that needs to be improved.

Student's Name	Louis Dunstan	Date	10/05/2024
Student's Signature			

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CAD drawings

Computer Aided Design (CAD) was used to develop several components of the soapbox. Solidworks was the program of choice as it provides a great system to draw up 3-dimensional projects efficiently. A large motivation to using any type of CAD during the designing of the vehicle is the ease of iteration, meaning the initial design can be changed very quickly and easily to fit specifications or user needs.

One of these iterations was the addition of the rear quarter of the chassis. This is to reduce net weight of the whole chassis while still providing a stable base for the soapbox.

The roll hoop was added to abide by regulation, 2.14, which states that it must extend over the drivers head by 35mm. Figure 1.2 shows the improved finalised design including room for all 4 wheels, steering rack and room for a rotational shaft (with brake) at the rear. The other components of the vehicle have also been drawn using solidworks, as seen in Figure 1.4 which shows a basic representation of the rear wheel mounting points and on-shaft braking system.

The wheels chosen were modelled to get a better understanding of how the car will piece together as the rear axle and framework are custom meaning the wheels cannot be changed in any way.

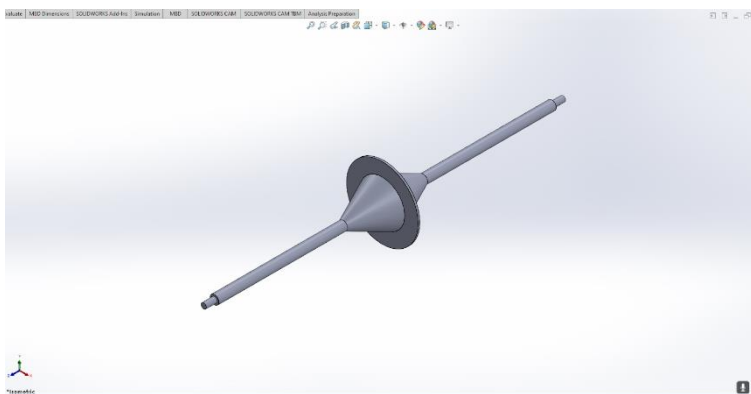


Figure 1.4 shows how the breaking system will mount to the driveshaft.

Figure 1.4 shows how the breaking system will mount to the driveshaft.

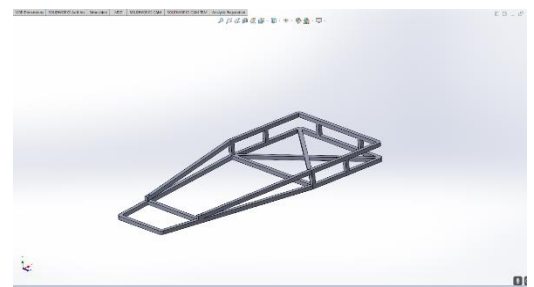


Figure 1.1 shows the initial design for the chassis.

Figure 2.1 shows the initial design for the chassis.

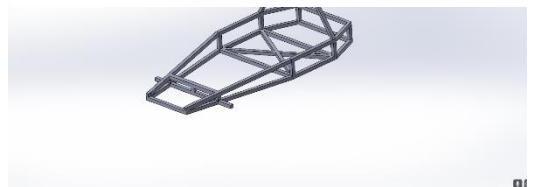


Figure 1.2 shows the final chassis design with mounts for the steering rack and the roll hoop.

Figure 1.2 shows the final chassis design with mounts for the steering rack and the roll hoop.



Figure 1.3 shows the wheel design for the Soapbox.

Figure 1.3 shows the wheel design for the Soapbox.

Evaluation of design process

During the design process the soapbox had to be kept at a heavier mass meaning that we would have a higher terminal velocity and with this we had to make sure to keep the weight at the tail end to give us increased acceleration (Scarcliffe Soapbox Derby, 2019)

The design for the bodywork was inspired by both the Toyota GT86 and Toyota MR-2 taking elements from both cars to create the first draft as seen below.

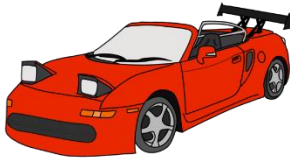


Figure 2.1 shows the initial car design.

Figure 2.1 shows the initial car design.



Figure 2.2 shows the smoothed front end.

Figure 2.2 shows the smoothed front end.



Figure 2.3 shows the rear of the car with the new improved front end.

Figure 2.3 shows the rear of the car with the new improved front end.



Figure 2.4 shows the rear 3/4 shot, showing the rear roll hoop as well as the new rear wing.

Figure 2.4 shows the rear 3/4 shot, showing the rear roll hoop as well as the new rear wing.



Figure 3.5 shows the front 3/4 with all the new designs together.

Due to regulation 3.3 The design had to be revised to remove sharp edges such as wing mirrors, rear wing, pop up headlights and any vents, this gives the final results as seen in the final draft images. The bodywork with removed complex items is now much easier to build and less dangerous to pedestrians if an accident was to occur

The overall dimensions of the soapbox are:

Width- 1000mm

Length- 2000mm

Height (to top of main body)-800mm

Roll hoop-600mm

Front "windshield"- 300mm

Rear wing- 300mm

The front windshield of the car is designed to be below the eyeline of the driver allowing them to have full vision of the road ahead.

Suitability of design

The design used for this project is suitable for the derby due to its bright colours. Due to the metal chassis used for this, the soapbox is heavier than most. This helps gain momentum when going down a slope. The design is within the size requirements due to its 1000mm width meaning it will be able to pass through all obstacles.

Quality of design

The quality of the soapbox comes down to the individual materials and parts used to piece this together. The custom chassis is purpose built to accommodate the parts purchased prior to chassis design. This gives security in knowing that all parts will be a perfect fit for the soapbox. The aluminium used for the chassis was handpicked as it is lightweight and durable. Cardboard being used for the bodywork is lightweight, malleable and cost effective. This is good as it creates an easy route into making the design reality. As previously mentioned the parts purchased were all picked from a handful of choices where only the best fit for the design was chosen. The smaller budget meant that the pool of choice for parts shrunk however with use of sites such as Ebay we found the same parts for less.

Improvements

An inclosed shell to improve aerodynamic structure hence reducing drag would be one improvement we could make however this may not fit within the rules and regulations. Another improvement would be to include the team name and livery on the drawings to show that that is the plan to include.

Analysis & Theory

Mass (soapbox) - 70kg
Mass (driver) - 80kg
Mass (total) - 150kg
Gradient of ramp - 1 in 8 - 12.5 deg
Track length - 550m
Decent - 50m
Estimate top speed - 30/40 mph
Initial velocity (u) - 0m/s
Estimate velocity (v) - 35mph - 15.65m/s

With all of this data we are able to take a look at the physics behind our soapbox. We can take a look an approximate time, the overall force, kinetic and potential energy,

$$s = \frac{u + v}{2} t$$

$$t = \frac{2s}{u + v}$$

$$t = \frac{2 * 550}{15.65}$$

$$t = 70.29s$$

$$v = u + at$$

$$a = \frac{v - u}{t}$$

$$a = \frac{15.65 - 0}{70.29}$$

$$a = 0.22ms^{-2}$$

$$KE = \frac{1}{2}mv^2$$

$$KE = \frac{1}{2} * 150 * 15.65^2$$

$$KE = 18369.19J$$

$$PE = mgh$$

$$PE = 150 * 9.81 * 50$$

$$PE = 73575J$$

$$F = ma$$

$$F = 150 * 0.22$$

$$F = 33N$$

All of these equations show that it is theoretically possible for the soapbox to compete in this derby. The time estimate being 70.3s puts the soapbox in the middle of the pack of last year's timings. High potential energy not transferring into high kinetic energy is due to other factors such as friction, air resistance, and momentum change. Having produced only a force of 33N is expected as the soapbox is not powered by a motor.

Bibliography

Scarcliffe Soapbox Derby, 2019. *The Laws of Physics*. [Online]

Available at: <http://www.scarcliffesoapboxderby.co.uk/event-photos-video/the-laws-of-physics/>