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Aprilia RS660 Group Project

Group Design Project (ACHA5014)

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Table of Abbreviations

Abbreviation	Meaning
CAD	Computer Aided Design
FEA	Finite Element Analysis
mm	Millimetres
CFD	Computational Fluid Dynamics

1 Introduction

This report outlines the design and development process undertaken by our team as part of a collaborative engineering project. The primary objective was to enhance the performance, efficiency, and ergonomics of a high-performance motorcycle, focusing on the Aprilia RS660 platform. The RS660 is a middleweight sportbike known for its balance of power, agility, and advanced electronics, making it a popular choice for both road and track use. However, there is significant potential to further optimise its performance for competitive track riding.

This project concentrates on key areas that directly impact track performance: reducing overall weight, improving rider ergonomics, and enhancing engine efficiency. By redesigning the prototype frame to be lighter and more adjustable, refining the self-supporting seat unit for improved rider positioning and reduced tail section weight, and developing a variable inlet stack to optimise torque delivery, this project aims to create a machine better suited to the demands of the racetrack. This report details the roles within the team, the design considerations, and the engineering solutions implemented to achieve these improvements.

2 Project Organisation

Group Member	Role	Project Responsibilities
Brody Crockford	Project Manager Prototype Frame Design	- Meeting organisation & running - Timeline management - Increase adjustability of the frame - Decrease weight of the frame
Jay Wexler	Self-Supporting Seat Unit Design	- Improve rider ergonomics - Reduce weight of the tail section
Sam Stainsby	Variable Inlet Stack Design	- Optimise torque delivery of the RS660

Our project team has taken a structured and collaborative approach, with each member focusing on a specific area to enhance performance, weight reduction, and rider experience. Brody Crockford leads as Project Manager and oversees prototype frame design, ensuring clear communication, effective timeline management, and delivering a lightweight, highly adjustable frame. Jay Wexler focuses on the self-supporting seat unit, improving rider ergonomics and reducing the weight of the tail section. Sam Stainsby is responsible for the variable inlet stack design, working to optimise torque delivery for the RS660 engine. This division of roles allows us to efficiently leverage each member's expertise to meet the project's performance goals.

3 Contribution to the Project – Brody Crockford

3.1 Introduction

Prototype motorcycles, like those found in the MotoGP World Championship, use many design strategies which are not adopted by road-going vehicles. This is due to differing requirements and the endless search for less weight and more performance. Recent developments in chassis design have led towards optimising the flexural characteristics to improve rider feel and cornering performance. These developments have not made their way to middleweight road bikes yet, due to increased costs, unpredictable road conditions and it being surplus to the normal rider's requirements. To build the Aprilia RS660 into a true racing motorcycle it would need a revised frame with geometry adjustment, optimised chassis flex and lower mass. This part of the group project sets out to do that, using SolidWorks tools to design a completely new frame for the RS660 platform.

3.2 Validation

3.2.1 FEA Validation

FEA was used for this project to conduct the stress analysis of CAD models; however, validation must be done to make sure that the computer simulation matches expected results. This is done by doing manual calculations and replicating it in FEA with the same conditions to compare, ensuring that the simulations calculations align with those expected in manual calculation. Details of my validation tests can be found in Appendix 1.

	Calculated Stress	FEA Stress	% Difference
Tension	1×10^7	1.07×10^7	7%
Compression	-1×10^7	1.07×10^7	7%
Bending	6×10^8	5.97×10^8	3%

The comparison between the manual calculations and FEA results demonstrates good agreement across all test cases. The differences observed are minimal and fall within an acceptable range, confirming the accuracy of the FEA model. Minor variations can be attributed to factors such as mesh density and numerical approximation inherent in the simulation process. Overall, the results validate the reliability of the FEA setup for predicting the structural behaviour of the model under the given loading conditions.

3.3 Measurements & Calculations

3.3.1 Manual Chassis Measurement

3.3.1.1 Laser Measuring

To take initial measurements of the bike's overall geometry and mounting locations, manual measurement was done using a laser. A coordinate system was used in millimetres and recorded in Excel for later replication in SolidWorks. This required the basis for chassis modelling alongside the depth measurement covered in 4.1.2.

To do this measurement, the bike was put onto a level surface and placed on stands to fully top-out the suspension. Great care was taken to ensure the bike was level and parallel to the edge of the platform, allowing the measurements to be more accurate. When measuring the laser was also made perpendicular to the bike using a square on the edge of the platform.



Figure 1 - Laser measurement of the Aprilia RS660.

The swingarm pivot was chosen as a 'zero' location as it is the separation between the frame and swingarm, with anything right (towards the back of the bike) of that point made positive to reflect the coordinate system in SolidWorks. All mounting locations were recorded for future reference, alongside the key points of the engine mounting and suspension.

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Table 1 - All measurements taken in Excel using the laser method.

Location	X	Y
Front Wheel	-845	-141
Rear Wheel	541	-121
Lower Shock	218	102
Upper Shock	-46	269.5
Swingarm Pivot	0	0
Rearset Lower	-81	-83
Side stand (L/H Only)	-122	-69
Front Sprocket	-8.5	2
Lower Sub Frame	-25.5	161
Upper Sub Frame	-101	281
Rear Engine	-46	135
Mid-Engine	-249	237
Front Engine	-438	168
Fork Top	-565	520
Pinch Bolt Front Top	-524	440
Pinch Bolt Front Bottom	-573	326
Pinch Bolt Shock	-79	259
Radiator Mount Top	-530	298

3.3.1.2 Height Gauge

To gather depth data from the frame, it was removed from the bike and split into two halves. This allowed each half to be placed on a level granite table and a height gauge used to measure the distance between the centre plane and various points, including engine mount positions, material thickness at mounting points and overall depth of external mounts such as the radiator mount.

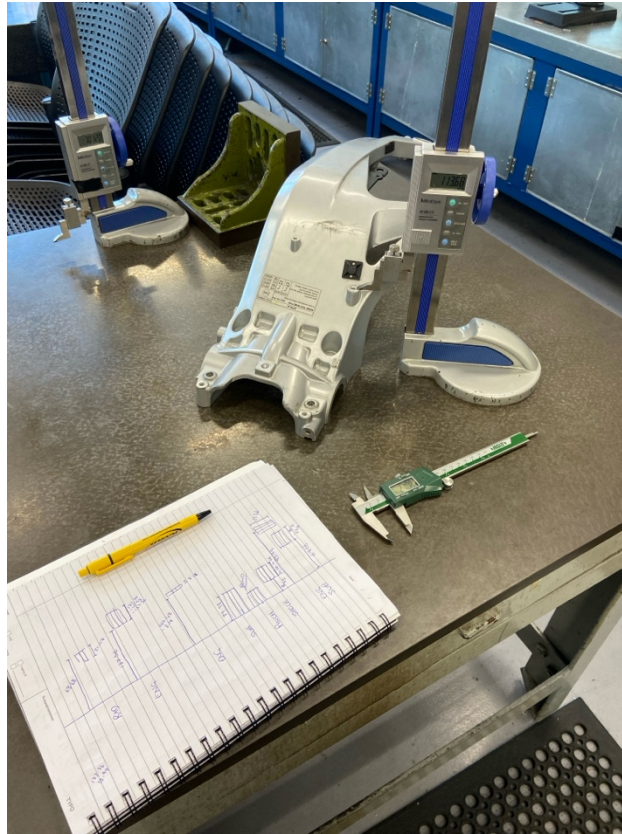


Figure 2 - Setup of the height gauge on the granite table.

Table 2 - Lateral measurements of the RS660 frame.

Location	Dist. from Centre Plane		Thickness
	R/H	L/H	Both
-	0	0	25.5
Clamp Bolts	0	0	25.5
Engine Mount Rear	65.9	67.16	24.7
Engine Mount Mid	132.4	137.3	3
Engine Mount Front	132.25	137.55	25.25
Sub Frame Mount Side	89.8	89.9	N/A
Sub Frame Mount Back	96.9	95.75	25.75
Radiator Mount	113.3	113.7	N/A
Shock Mount	14.65	14.65	19.2

3.3.2 3D Scanning

To ensure accuracy of the manual measurements, a scan of the RS660 engine was taken, due to this being the only part that the frame bolts onto. Please refer to Appendix 2 for details on the entire process.

Once the scan was taken, planes and axis of the of the mounting locations were exported and brought into a SolidWorks assembly with the manually measured points to check for any discrepancies. As the accuracy of the scan is $\pm 0.05\text{mm}$, it was perceived as more accurate

than the manual measurement and corrections were made to the measured dimensions before modelling. (Peel 3D, 2025)

3.3.3 Force Calculations

Before modelling, force calculations were made to feed generative-AI studies, and then later FEA simulations. To do this, multiple techniques were put into place.

2D data acquisition had been fitted to the bike prior to this project commencing, with data recorded at Castle Combe, Oulton Park and Pembrey circuits. From this, decelerations could be calculated for manual force calculations, based on simply supported beam equations.

$$Force = Mass \times Acceleration$$

$$Force = Spring\ Constant \times Displacement$$

$$Bending\ Moment = Force \times Distance$$

To calculate lateral forces at the front tyre, an equation was used to find the reaction force from a 10mm sinusoidal bump, and tests could be conducted in SolidWorks using a remote force at the contact patch. (Foale, 2002)

3.4 Modelling & Development

3.4.1 Engine Hanger Investigation

The front engine mount, often referred to as the engine hanger, or front engine suspension, has a large amount of influence over the lateral deflection of the frame when experiencing bumps at lean. This is due to it being the first 'fixed point' from the headstock. For this reason, prototype motorcycles often have very low front engine mounts, increasing the leverage that the headstock has and therefore the lateral displacement achievable, this is shown in Figure 3.

Engine hangers also influence longitudinal strength, alongside the beam shape. Using a curved shape is very strong laterally but can squash longitudinally, increasing deflection in this direction and decreasing braking efficiency. For this reason, racing manufacturers often use a flat engine hanger which is parallel to the centre plane of the bike. The flat hanger increases longitudinal stiffness while decreasing lateral stiffness, helping towards the lateral displacement goals.



Figure 3 - 2024 Ducati MotoGP Bike, notice the long and thin front engine hanger which is parallel to the centre plane. (Oxley, 2024)

3.4.2 Geometry Adjustability

Before starting the design, the adjustability of the frame had to be decided. The target was to introduce as much adjustment as possible to understand the effect of all extremities on the RS660, as this type of geometry analysis has not been done on this bike. While other factors may introduce a mechanical limit on the adjustment, such as the radiator positioning, this can be accounted for after the frame's manufacture.

For the headstock, it was decided that a 20mm slot would be introduced, allowing either $\pm 10\text{mm}$ of offset adjustment or ± 6.5 degrees of rake angle change in each direction, including any option between them. This will allow a test team to try multiple extremities using replaceable bearing cups to find the optimal trail value and wheelbase.

For the rear, the standard bike runs a directly mounted shock which doesn't allow for changes to the link ratio. To counteract this, multiple top shock mounts could be brought in, with varying heights from the swingarm pivot, changing the link ratio. For this design, a total of three mounting positions were chosen, a standard, higher and lower mount.

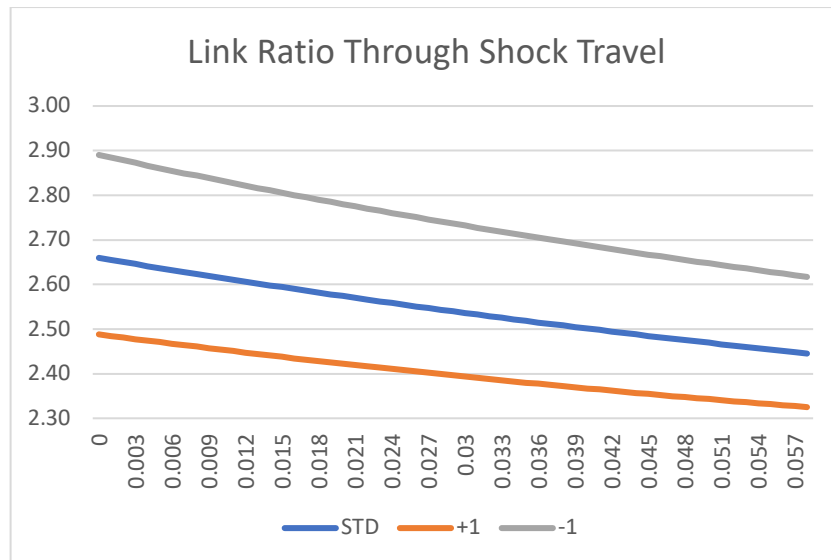


Figure 4 - The difference in the linkage curves available with this chassis adjustment.

3.4.3 Generative AI Results

To begin the modelling process, generative-AI was used to identify the load paths which required bracing. This was done in SolidWorks, which requires an oversized model to be made for material to be removed from. 6061 Aluminium was chosen at this early stage as it gives balanced mechanical properties of Aluminium (Maisonnette, et al., 2011). Studies were conducted with peak forces applied at both the front and rear, signifying the worst-case scenario from a longitudinal standpoint.

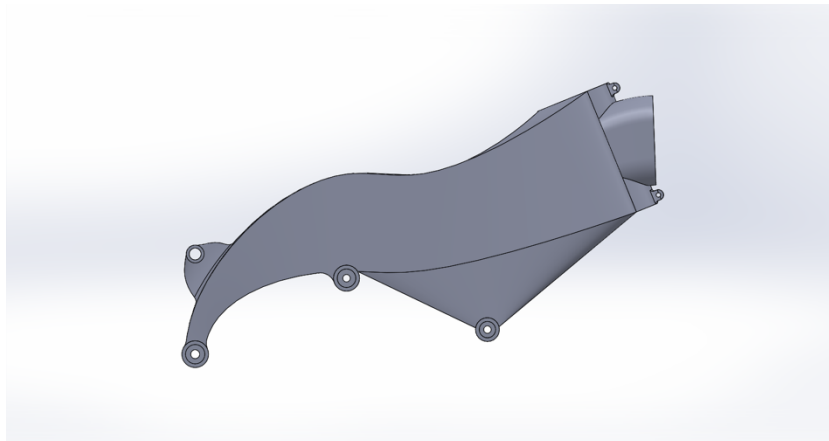


Figure 5 - This is the model that was used for generative AI studies.

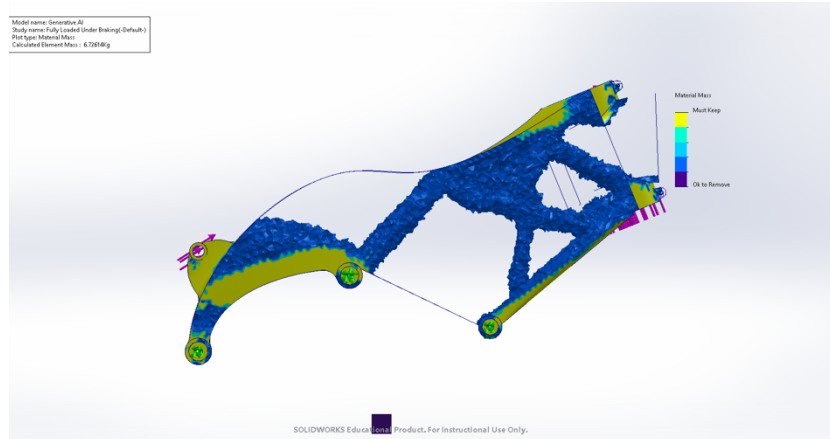


Figure 6 - The result of the 'fully loaded' topology study.

3.4.4 Initial Concepts

3.4.4.1 Engine Hanger Mounting

As mentioned previously, engine hanger design is key for front wheel deflection laterally as well as longitudinal stiffness of the steering head. For this reason, great care was taken to get the design of this mounting correct. Inspiration was taken from the Suzuki GSX-RR MotoGP chassis along with other Grand Prix motorcycles. (Kawata, 2015)

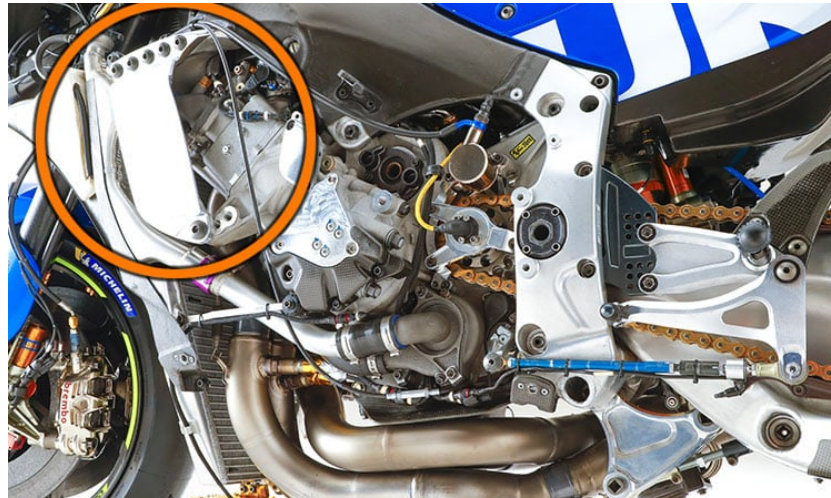


Figure 7 - The 2022 Suzuki GSX-RR MotoGP bike, using bolt-on engine hangers (Paddock GP, 2020)

3.4.4.1.1 Concept 1 – Lugs Under Beam

The first concept of the removable engine hanger used lugs underneath the curved beam and followed the same contour. While this aesthetically looked good, the curved engine hanger would have poor longitudinal rigidity based on (Vanslager, 1968). This, on top of the small amount of engagement between the two parts would result in poor flex qualities and stress concentration.

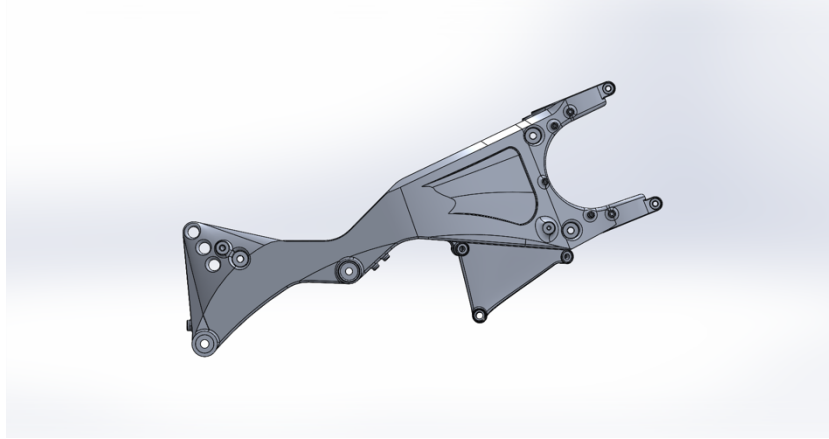


Figure 8 - The first model design with bolt-on engine hangers, using lugs under the beam.

3.4.4.1.2 Concept 2 – Flat Side, Bubble Beam

To counteract the low engagement between the parts, mounting was moved upwards to the lower section of the beam, as this gave more mating surface for stress to dissipate between. On top of this, a flat surface was introduced parallel to the centre plane for the hanger to mount to. This made the engine hanger completely flat and in line to the longitudinal force, making it very stiff in this direction. Having the engine hanger in this orientation also gives good lateral flex properties due to a straight beam being able to withstand higher bending moments before buckling (Vanslager, 1968). The issue with this design is the poor aesthetics due to the bulbous structure on the beam, which also makes the internal pockets more complex and limited the minimum mass of the parts.

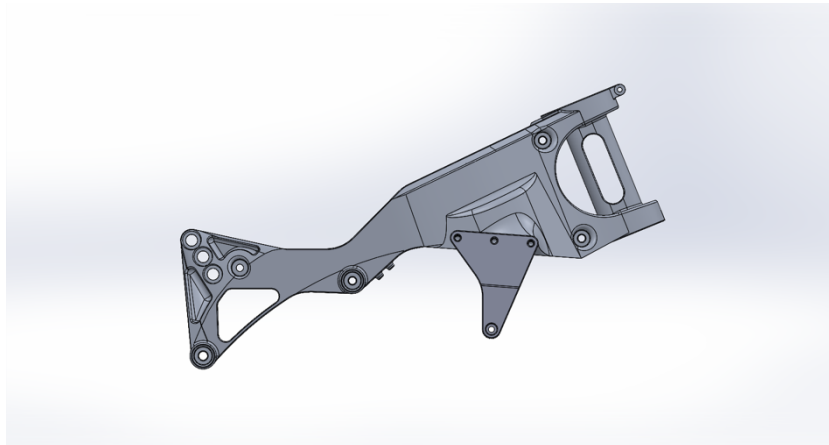


Figure 9 - The second engine hanger concept, with an extrusion on the beam to mount against.

3.4.4.1.3 Concept 3 – Flat Side Only

The engine hanger mounting design which was decided integrated the parallel mounting face into the beam shape and removed the bulbous extrusion. This simplified geometry allowed for increased pocketing to be brought in on the underside of the mounting points. The mounting

points also saw revision, with counterbores introduced to increase engagement between the parts. This design carries over the benefits from previous and simplifies it for additional gains.

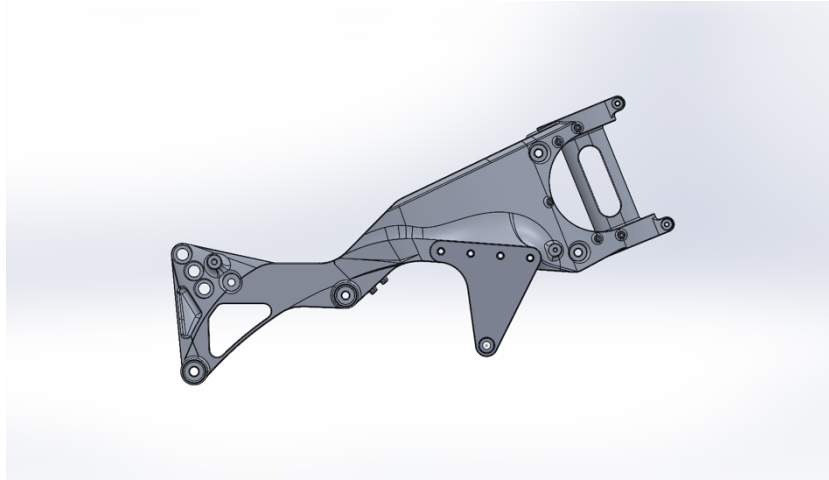


Figure 10 - The final engine hanger solution, with a smaller extrusion blended into the beam and counterbores for increased engagement.

3.4.4.2 Beam Design

Initial designs of the frame were based on the standard part, with inspiration also taken from existing Grand Prix machines, before further topology studies were run to understand what parts of the beam were not required. Following on from these, two main alterations were made to the external appearance of the beam with assistance from FEA studies.

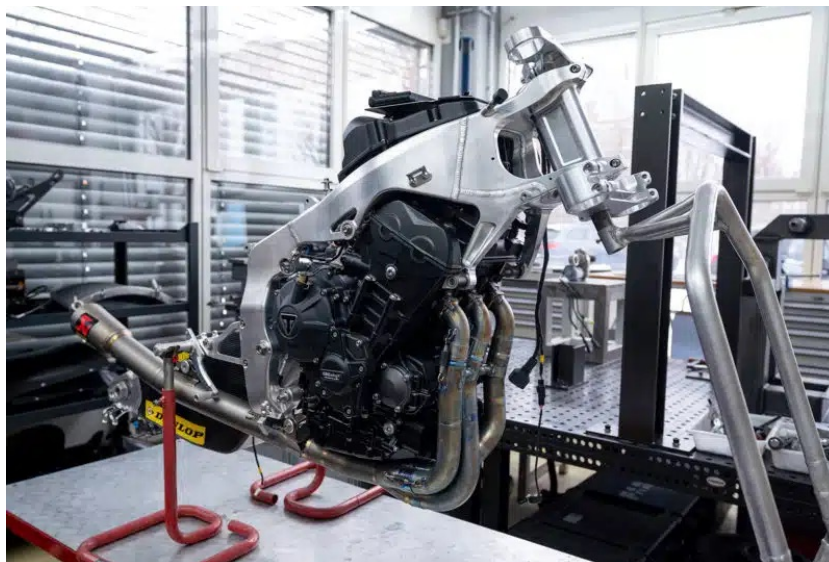


Figure 11 - 2023 Kalex Moto2 Bike (Oxley, 2023)

Around the middle engine mount the topology study showed a divide between the stresses introduced by the front and rear suspension. This can be simplified to lines signifying the compressive and tensile forces within the frame, as shown in Figure 12. The point at which the front and rear forces meet is the centre engine mount, which has very little stress above it

due to the crankcases absorbing these forces. Using this theory, the centre of the rear section experiences very little stress, with one side experiencing tension and the other compression, also shown in Figure 12. These results were reflected in FEA simulations and meant a significant amount of material could be removed from the design, further reducing the mass of the part.

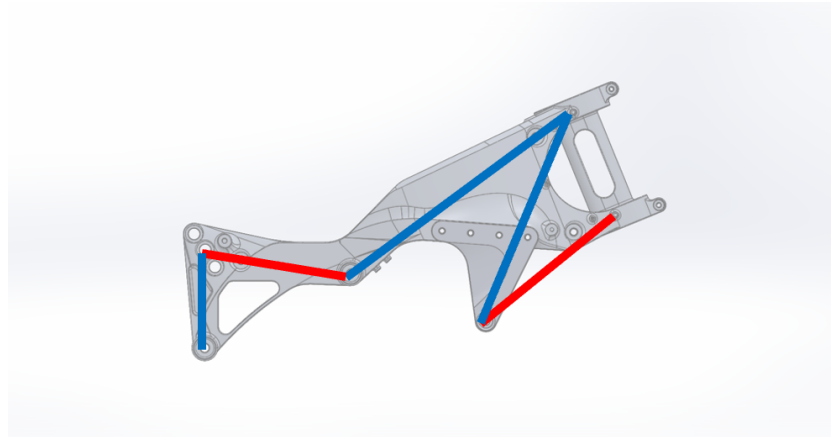


Figure 12 - Load path investigation with compressive (red) and tensile (blue) forces loading the engine mounts.

3.4.5 FEA Results & Further Development

3.4.5.1 Material Choice

Before proceeding with development and weight reduction, the manufacturing material was selected. An investigation in Ansys Granta assessed elastic modulus, yield strength, machinability, cost, and availability.

6061 Aluminium, specifically 6061-T6, was chosen for its balance of strength, machinability, availability, and affordability. While base 6061 has lower yield strength, the T6 temper improves this without compromising elasticity, providing a better safety margin. Its common use in engineering also reduces sourcing costs.

Although 2424 Aluminium offered higher elastic modulus and yield strength, its unpredictability, manufacturing challenges, and limited availability made it less practical.

Ultimately, 6061-T6 Aluminium was selected as the optimal material for the design.

3.4.5.2 Bracing Optimisation

When hollowing out the beam to reduce weight, bracing must be left in to dissipate the stresses previously shown in Figure 12. This was a constant process of modification and FEA testing, looking at the stress concentration and areas with little stress to determine places which should have additional bracing or areas which can have material removed to save weight.

Coming out of this process, the wall thickness throughout the beam was reduced to 1mm at the cutouts, with the load paths being braced at the full 15mm beam thickness at various widths. Radii are used at all edges to prevent stress concentration in these areas, with strategic external radii used to further decrease mass, as shown in Figure 13.

3.4.5.3 Stress Relieving Features

When dealing with multiple forces and braces, stress will concentrate at the weakest point along its path. To prevent this, radii can be used (as mentioned previously), but for more critical cases it was found that two methods could be used.

Adding material around the stressed point, especially joining braces together, can allow stress to dissipate away from its original pathing, spreading over a larger area and reducing peak values. This was used by the headstock to spread the load from the bearing cups, as shown in Figure 13. This method can also be used to reduce the displacement of a part, therefore reducing the stress that it is under.

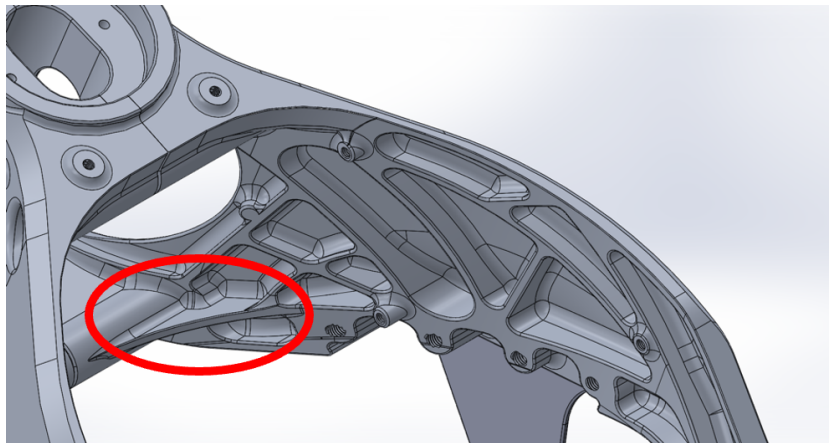


Figure 13 - Beam cutouts towards the front of the frame, with additional bracing for the lower head cup highlighted.

Another strategy used to reduce stress concentration was removing material in the braces to increase displacement along the stress path, dissipating the stress along its path and reducing the peak stress at the concentrated area. This was used along the compressive brace of the shock, where holes were introduced to absorb the reactive force from the shock. This reduced the peak stress at the joint between the brace and the main beam, as shown in Figure 14.

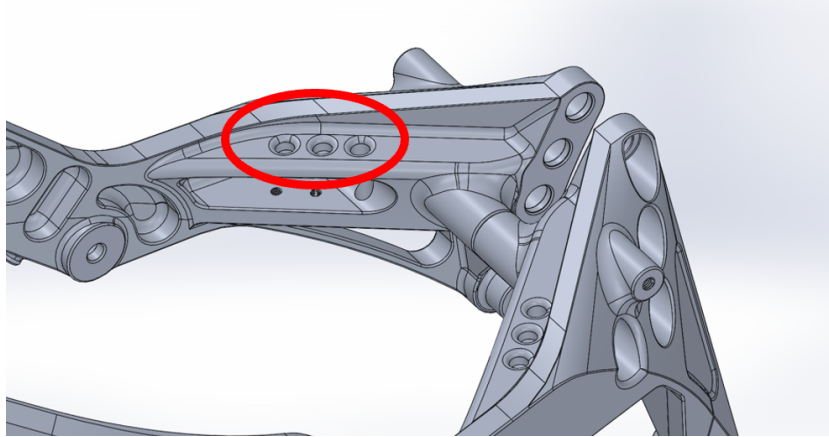


Figure 14 - The bracing around the shock mounts, with the stress-relieving holes highlighted.

3.5 Results & Analysis

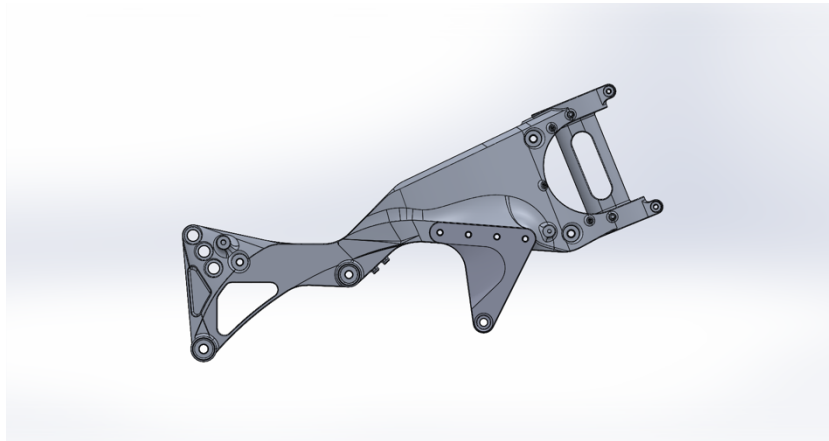


Figure 15 - Side view of the final frame model.

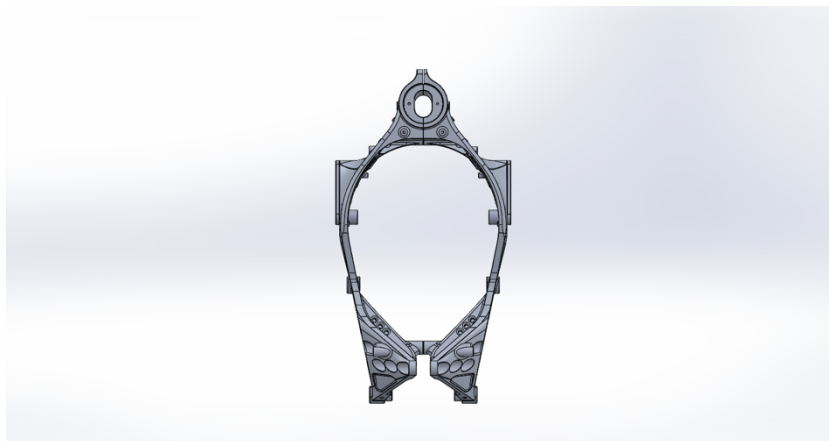


Figure 16 - Top view of the final frame model.

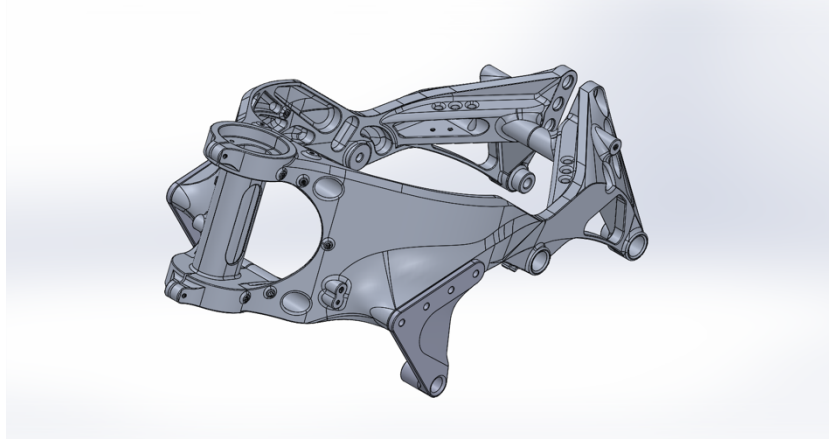


Figure 17 - Isometric view of the final frame model.

3.5.1 Mass Properties

SolidWorks predicts that the new frame assembly, made of 6061-T6 Aluminium, will weigh 6.8kg. With the standard part weighing 9kg this is a 24.4% decrease, reducing the overall bike mass by 1.375%.

3.5.2 Stress & Deflection Analysis

Conventional frames show similar stiffness values for longitudinal and lateral directions (Kawata, 2015), so the stiffness of the new design was calculated and plotted in comparison to a 1:1 stiffness, as shown in Figure 18. This plot shows that the new design offers much more longitudinal stiffness compared to lateral, with Table 3 showing that the frame is 2.81 times stronger in the longitudinal direction compared to the lateral. This should give great characteristics for on-track activity, while the option of replacing the engine hangers also allows this ratio to be altered to rider feel.

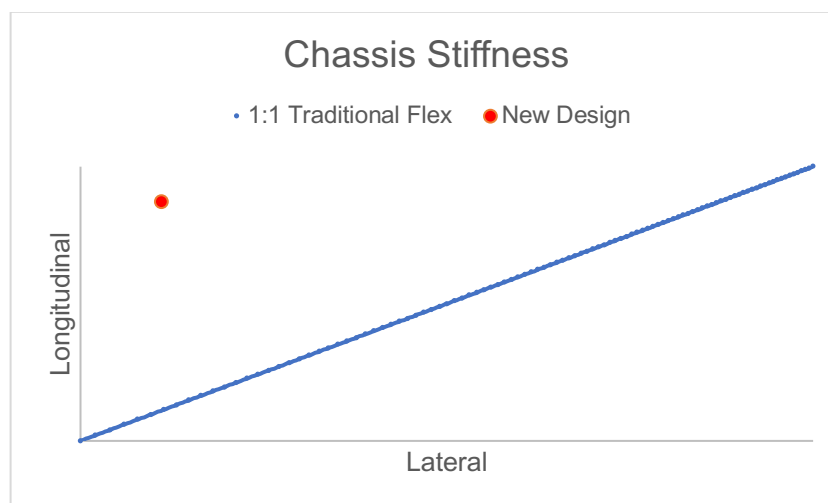


Figure 18 - A graph showing the new frame designs stiffness characteristics against traditional stiffness standards.

Table 3 - Maximum deflection and calculated stiffness for each direction, as seen during FEA testing with the latest design.

Longitudinal	Lateral	Vertical
0.374mm	0.831mm	0.331mm
5882.35 N/mm	2091.02 N/mm	6525.68 N/mm

3.6 Further Work

3.6.1 Physical Testing

To understand the gains brought in by the new frame design, more physical testing could be done on both the standard part and the prototype. This can be done in jigs or on-track, with multiple methods able to be used.

Twist rig testing is used to understand the torsional deflection characteristics of a part, and this could be done on the standard part, replicated in FEA or done on the prototype part to compare between parts and find the advantages and disadvantages between them.

On track, strain gauge data could be found to look at real displacement values while riding to see if the theoretical gains have been realised in production. On top of this, as previously mentioned, a test team could conduct a geometry test to find the optimal setup window for this bike.

3.6.2 Additional Bracing

The design of this frame could be optimised further using bolt-on braces to further stiffen areas of the frame. Mounting locations have been added around the headstock for this type of investigation, although welding could also be introduced to do some more experimental bracing.

3.6.3 Engine Hanger Optimisation

Using the bolt-on engine hanger design, an investigation into the design of these could be conducted. Through FEA analysis, it was found that thinner hangers gave more displacement but exceeded yield strength, so there may be room for more complex bracing to reduce the mass of this part. The hangers could also be made using a different philosophy, potentially using 3D printing or trellis type hangers for different flexural characteristics.

3.6.4 Material Investigation

Finally, a more in-depth material investigation could be done to further optimise the strength to weight ratio. As mentioned previously, 2424 Aluminium could be used for chassis design due to its high elastic modulus. As well as this, the use of bonding or fasteners could be introduced to make a hybrid frame, incorporating other metals such as titanium for overall

strength or composites like carbon-fibre for more controlled directional flex. This alongside some more intricate topology could make for an interesting design and more complex characteristics for on track use.

4 Contribution to the Project – Jay Wexler

4.1 Research and Design Considerations

At this stage, the research conducted has been more limited than initially planned, largely due to the project's current focus on designing and developing the seat unit for eventual manufacture. Nevertheless, it has laid important groundwork for the design.

Research into production methods has offered valuable insight into what's required to produce a carbon fibre component, as originally intended. A key design focus has been optimising comfort and manoeuvrability to improve mobility and stability, particularly in corners and at high speeds. While rider preference remains central, a dissertation on motorcycle aerodynamics (Underland, 2017) provided unexpected but valuable guidance on improving comfort and safety—areas not originally prioritised.

This research clarified the link between aerodynamics, performance, and rider integration, influencing the ergonomic shaping of the tank and front seat area to aid rider stability and allow full tucking on straights.

Beyond design, production methods were explored, with group discussions helping to identify the most feasible manufacturing route—primarily the technique demonstrated by (Easy Composites Ltd, 2024). This was addressed during the interim viva in December, alongside initial constraints and process plans.

Existing Moto2 designs from teams like KALEX, NTS, and FTR have also served as practical references, shaping various elements of the design.

In summary, while research was less extensive than intended, it has meaningfully guided the design through insights into aerodynamics, ergonomics, and production strategies.



Figure 19 - Kalex Moto2 stripped.



Figure 20 - Full Kalex unit.



Figure 21 - NTS Moto2 without fairings.

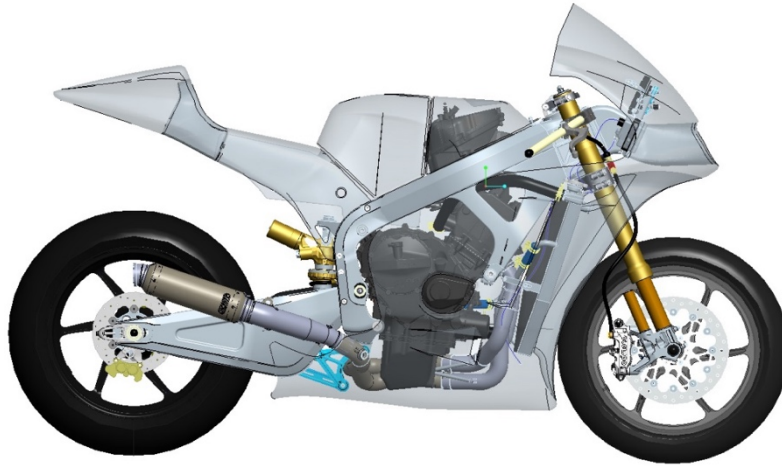


Figure 22 - FTR Moto2 full model.

4.2 Material Selection and Sustainability Considerations

From the outset of this project, carbon fibre has been the primary material choice for the final design. However, when viewed through the lens of sustainability, there are a few alternative materials that can be considered. With sustainability as a key focus, the upcoming months and continuation of this project into the final year will involve a detailed analysis of various carbon-dense, more sustainable materials, including recycled carbon fibre. The objective would be to assess their mechanical properties and applicability within a racing environment, ensuring a balance between performance, durability, and environmental responsibility.

A primary inspiration for this exploration is McLaren Racing, which has been actively researching and implementing natural fibre composites into their Formula 1 cars. This initiative was first introduced during the 2021 British Grand Prix, where McLaren incorporated a natural fibre composite seat (McLaren Racing, 2021). The adoption of such materials is driven by sustainability goals, with the added potential of reducing production costs for this project.

Following a similar approach, this project will explore alternative natural fibre composites that could serve as cost-effective yet high-performance solutions. While McLaren has primarily utilised flax fibres in their composites, further research will evaluate alternative materials, considering their plausibility, potential drawbacks, and overall effectiveness in a high-performance racing context. As well as potentially establishing the concept of added sustainability into motorcycle racing.

4.3 Design and Development

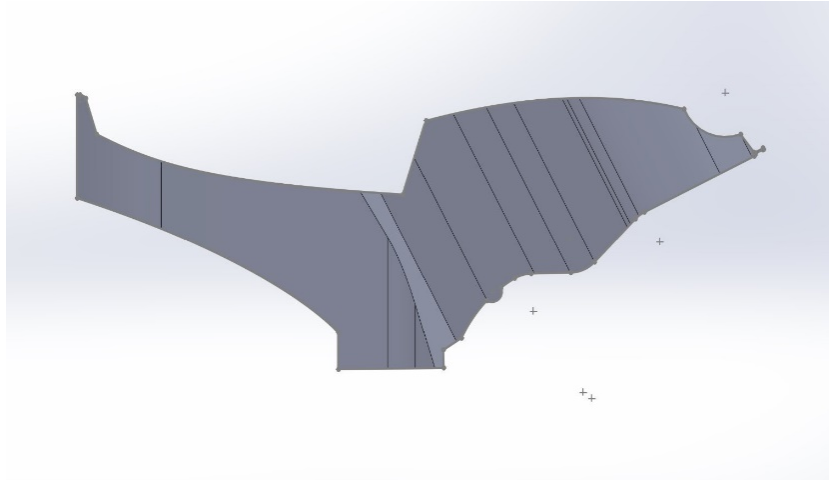


Figure 23 - Side view of initial body.

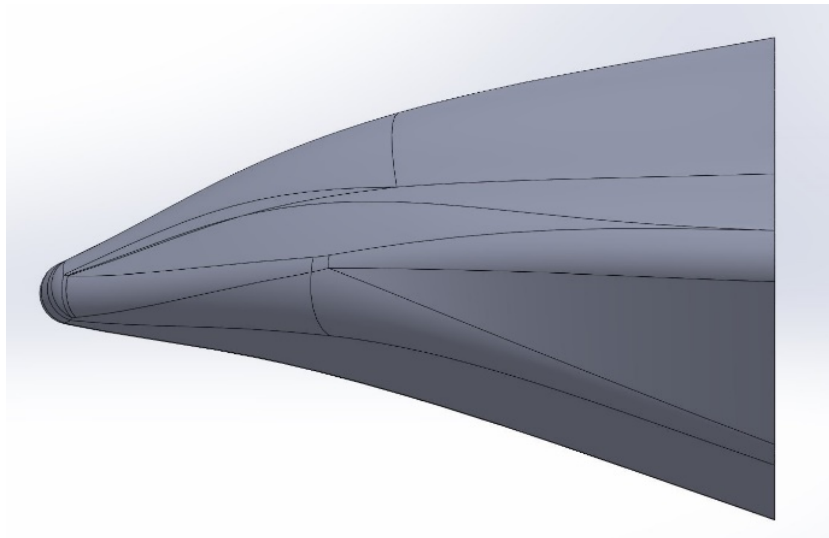


Figure 24 - Side view of tail section.

Initially, the plan focused on designing a simple body to replace the existing tank cover and rear section of the motorcycle, while enabling the complete elimination of the subframe to achieve the desired weight reduction. The original design followed a relatively basic structure, based on both the original design of the motorcycle's fairings, and the new frame designed as another section of this group project. developed further as more meetings and discussions covered additional design possibilities. Early iterations consisted of three primary components: the tank cover, main seat unit, and tail section. This modular approach remained largely consistent throughout the first phase of the project, up until the interim viva.

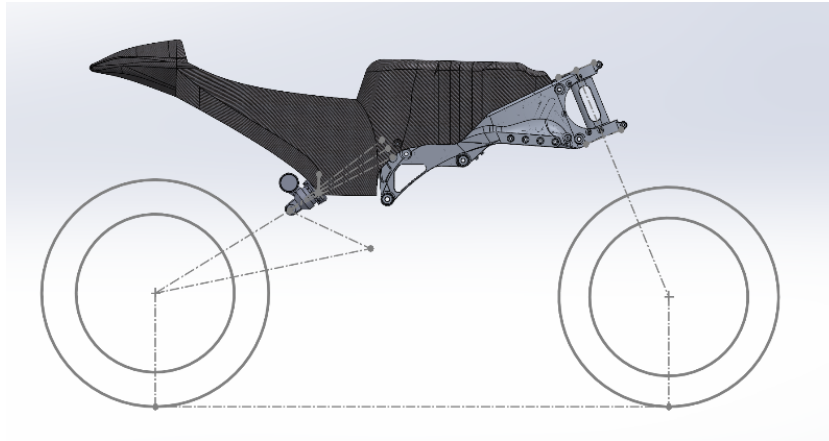


Figure 25 - Side view of current version

Following the conclusion of the first semester and the interim viva, changes were made to improve functionality. A key change included the introduction of a removable undertray, designed to improve accessibility to both the tail section, rear shock, and the option for storage in the area that also houses the shock. This adjustment is designed to allow for easier maintenance and component adjustments, further refining the overall practicality of the design and increasing potential trackside efficiency. This was partially a result of feedback from the interim viva about the idea to add extra panels for improved trackside efficiency. In the event of a crash that damaged a section of the body, this would allow for the production a replacement quicker than if it were a single body. A major fault of the first iterations would have been the inability to recover from even smaller crashes that may damage the body of the bike. This was due to the inability to produce a new part quickly enough, given the size of each section.

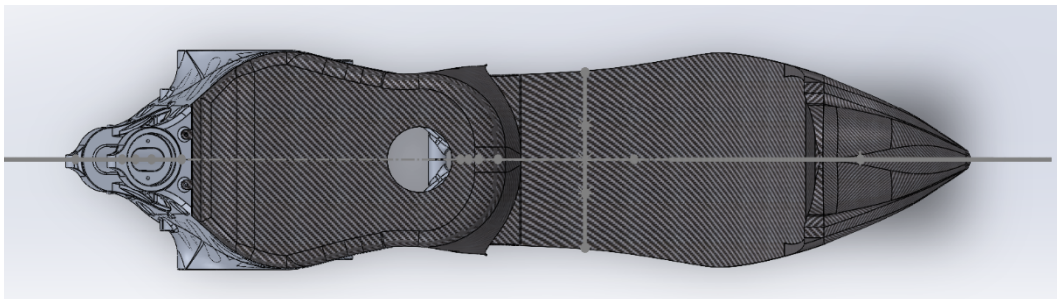


Figure 26 - Plan view of current model.

Another big focus has been the size and positioning of the seat, primarily focusing on its length and positioning as the rider has had the issue of not being able to get into a low enough tuck position and having extra space to manoeuvre at different stages of a race (see Figure 28 below). The main goal of this alteration is to enable the surrounding air to flow much smoother and reduce the number of zones that would create unnecessary downforce around him.



Figure 27 - Image of rider in a full tuck

4.4 Further Developments

During the interim viva, a major focus was the tank's shape—specifically, its upper section, which obstructed the rider when tucking down (see Figure 27). In response, the top was redesigned to be lower and flatter (Figures 23 and 25), creating more space for the rider's chest and improving ergonomics.

The tank's sides were also revised. The original Aprilia design had a wider upper section that aided knee grip but restricted elbow movement, limiting a compact riding position. The new design offers a more consistent shape from bottom to top, reducing interference while retaining adequate knee support, thus enhancing both comfort and aerodynamics.

The design has evolved based on viva feedback, though with less emphasis on production efficiency compared to professional standards (e.g., Aprilia MotoGP). A new section was added, but full panel separation, as suggested during the viva, has been postponed until after prototype testing.

Recent refinements have focused on shaping for improved rider integration and comfort. Adjustments to the tank cover, such as a more rounded form, aim to better accommodate the rider in a racing position. These developments continue to align with aerodynamic and ergonomic goals based on rider input.

Space allocation for wiring, electronics, and optional internal mass has also been considered, allowing for fine-tuning of the bike's centre of mass to improve handling and balance.

The latest modification was an opening for the rear shock, needed for its wider range of motion due to a new frame design. While this required removing material from a key load-bearing

area of the seat, the issue was resolved by repositioning the main mounting points higher along the seat's sides, aligning with the tank-to-frame mounts. This change maintains structural integrity and effective load distribution.

4.5 Future Developments

Although significant progress has been made since the project's inception, the base CAD model is still undergoing refinement. Therefore, the main future developments will most likely be to ensure alignment between the body lines of each section, creating a more cohesive and aerodynamic flow from the front of the tank to the end of the tail. Key areas of this stage of development will include refining body contours, smoothing transitions between sections, and optimising the shape of the tail and undertray. These modifications will aim to align more closely with traditional design principles found in motorcycle racing, enhancing both aerodynamic efficiency and overall aesthetics.

On top of the above-mentioned plans, there are likely to be several optional modifications to the body currently designed. Key plans for this would be, the potential addition of panels to break down the tail or seat section even more, or removable window for extra convenience in the case of small changes needing to be made that would be more efficient to do without the need for removing an entire piece of the body. Many additional changes will likely be made in consideration to the plans for a final year project. With the current design as it is, the main developments are likely to take place with a physical body as that will allow for more visible detail work which can then be scanned into a CAD software in the case of further alterations needing to be made.

The final planned development, in alignment with current project goals, is the refinement of the mounting system. The full requirements for these adaptations will remain unclear until testing and analysis are completed. These evaluations will be essential in identifying any potential weaknesses in the existing mounting points. With the insights gained from testing, necessary adjustments can be made to optimise the mounting locations. Additionally, this analysis will help determine whether additional mounting points are required to achieve a more balanced and even load distribution, ultimately enhancing the structural integrity and performance of the design.

4.6 Testing, Analysis and Future Structural Analysis

Testing remains in its early stages, as many detailed evaluations will take place after the pre-mould model is fabricated using foam. With this it will be possible to collect any measurements and critical design details, which may require refinements. Consequently, extensive testing is

expected to continue as part of next year's individual project due to timing issues and knowledge.

In parallel, initial plans for Finite Element Analysis (FEA) are beginning to progress, due to recent lectures on the subject aiding understanding. At this stage, the focus will be on fundamentals of FEA principles to establish a foundational understanding of its application to the project. With this and access to more advanced software tools, more detailed and comprehensive analyses will be conducted in later phases to further refine the structural integrity and performance of the design.

The primary focus for future testing will be the mounting points between the main seat and the tank section, with additional evaluations potentially covering the mounting interface between the front of the tank and the top of the frame. Assessing these connection points will be critical in ensuring stability and structural integrity under operational conditions.

Following the assessment of the mounting structures, testing and analysis will shift to the primary load-bearing section of the body—the seating structure. Evaluations in this area will determine the distribution of forces across various directions, contact points and how the body responds in a wide range of situations it is likely to encounter, providing insight into how loads are transferred through the structure under different conditions. The results of these tests will be essential for the final stages of development. Without this data, reliance on assumed load distributions could prove ineffective and lead to inefficient production methods and unnecessary material usage, potentially resulting in the wastage of high-quality resources. By conducting thorough structural analysis, the design can be optimised for both performance, material efficiency and financial efficiency.

5 Contribution to the Project – Sam Stainsby

5.1 Introduction – Variable Intake Stacks

The development of a variable intake stack system presents a significant advancement in optimizing motorcycle performance by improving air intake efficiency. The first step in this process is measuring the existing stacks, as these measurements form the basis for accurate comparisons, calculations, and design iterations.

By analysing the characteristics of OEM stacks, such as their curved structure and varying heights, engineers can better understand their impact on airflow dynamics and engine performance. This part of the group project aims to explore design solutions for a telescopic variable intake stack system, using calculations and actuator technologies to improve the mid-to-high-end torque performance while addressing challenges like turbulence and flow separation.

5.2 Measurements

When creating the variable stack system, the first, and quite easily, most important step would be to measure existing stacks, which allows us to perform future comparisons and allows us to start calculations needed and take any other measurements that are also necessary for a final product.

Shown below are the OEM stacks (Figure 1, 2) that were measured and used as a basis for all calculations, here these stacks are curved, this could be to minimise friction and also any losses that could be caused by turbulence that would occur in a sharp angled system. It also shows that the stacks are different heights, this is because at certain rpm, the different heights of intake would be more optimal than the other, in this case the



Figure 28, Short intake stack



Figure 29, Long intake stack



Figure 30, Showing how each stack was measured

5.3 Initial Designs

5.3.1 Bell Mouth Design

When looking at different telescopic designs for the intake stacks, an idea was had for a curved system. This would allow for a higher level of air intake and have the advantage of increasing the stack length when taking into consideration the pulse tuning. However, this design has setbacks in terms of its difficulty to create its difficulty to calculate using the basic information

gathered, and the fact that the motor system that allowed the intake stacks to extend and retract would have taken up space in the airbox and added more weight.

Another option was to use a system that is like a variable intake found in a BMW 1000; where the base of the intake is fixed, as like the other systems, but actuators moving a separate part to provide a 2-step system.

Instead of opting for a curved telescopic intake stack design or the 2-step variable intake design, the choice was to use a straight telescopic system, that extends and retracts vertically. This would be powered by a motor (actuator) on the exterior of the airbox, connected to a bar/rod that will lift the intake stacks at the same level at the same time, thus allowing for improved airflow at our desired point.

5.3.2 Actuators

After finalising the design idea that would be put into use, the actuator used would be the next component needed.

There would be three different designs of actuator that could be used; Step motor linear actuators, which can provide good control for fine adjustments in the stack length, and can handle quick RPM changes; Servo-driven actuators, which can be programmed to allow for adjustments in the intake stacks based on parameters required, such as RPM and also throttle position; and finally is the high-speed linear actuator, which can handle moderate loads and (as implied by the name) can act at very high speeds and has a quick response time, allowing the stacks to adjust quickly under any sudden RPM changes.

5.3.3 Oils Resistance of Materials:

Carbon Fibre:

Carbon Fibre suffers from low vertical thermal conductivity, and poor oil resistance. In order to improve this, layer-by-layer plasma treatment with prepregs and high-pressure compression. Compared to conventional carbon fibre, this gives 135% enhancement after oil absorption and 240% improvement in oil resistance.

Nylon Sinter:

Nylon sinter has good chemical resistance as it is non-reactive to water, oils, fats and spirits. (3D People, 2025).

PLA Filament:

PLA filament has good resistance to a multitude of chemicals such as water resistant, salt resistant, UV resistant, and oil resistant (which is the most important one) however is not resistant to acids, base/alkalis, alcohol, or fuel resistant.

5.4 Calculations

The idea for these stacks is to improve overall efficiency in airflow to the engine but also to combat a dip in torque at around 60nm (shown in figure 4; the red lines indicate where the current stacks installed on the RS660 are pulse tuned for), and utilising the telescopic system will allow for correct adjustments and hopefully will allow for an increase in mid to high-end torque.

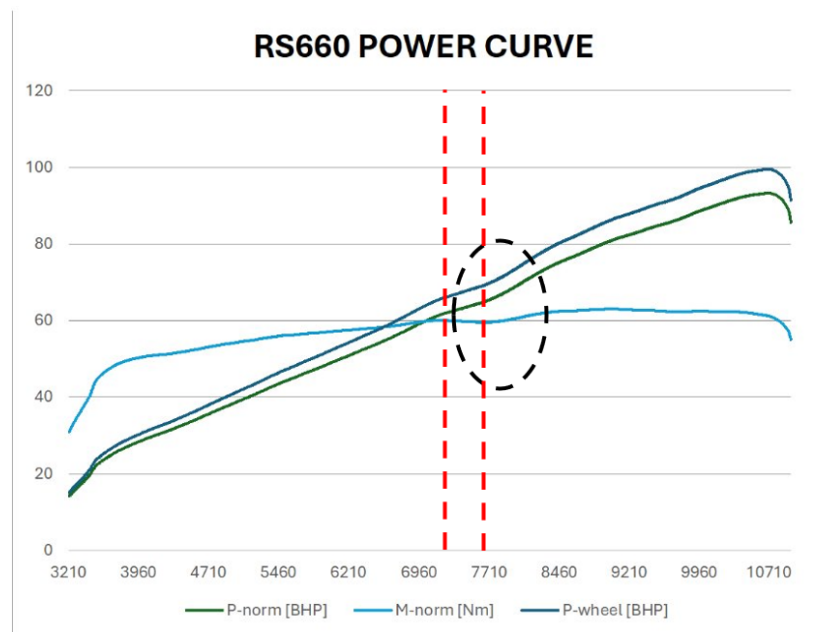
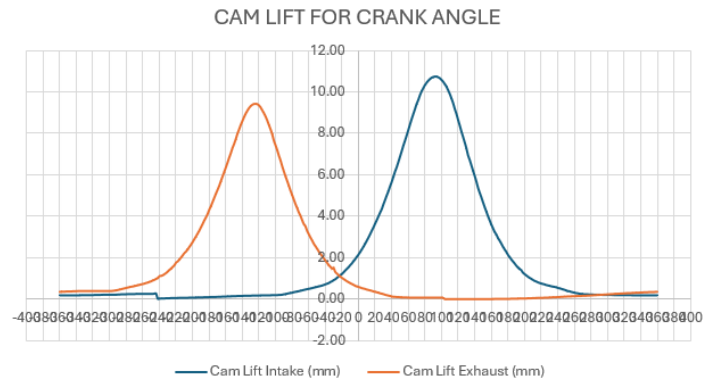


Figure 31, RS660 Power-Torque Curve

Shown in Figure 5 below is the calculations we used to find the desired height for the stacks, and what RPM they would be set at. Using the cam profile we measured the valve lift duration, which allowed us to find the pulse tuning duration (130deg), and using the calculation $L = \frac{330}{2n} * \frac{130}{360} * \frac{60}{RPM}$ we could find the ideal stack height, and using a rearranged formula; $RPM = \frac{330}{2nL} * \frac{130}{360} * 60$ we could see at what RPM the height would be equal to (The n in these calculations are replaced with the value of the harmonic: 1,2,3 etc).

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Pulse Tuning Duration = 130 degrees

$$L = \frac{330}{2n} \times \frac{130}{360} \times \frac{60}{RPM}$$

$$RPM = \frac{330}{2nL} \times \frac{130}{360} \times 60$$

Figure 32, Cam Profile Graph

As seen above the pulse starts at MOP (90deg) with our BDC (180deg) and closing (260deg); which gives us halfway the mark (where pulse ends = 220deg). Subtracting 90 from 220 will give 130deg, which means the pulse timing = time for 130deg crank rotation.

RPM	Length	2nd	3rd	Actua Length	2nd Harmonic
6500	0.55	0.275	0.18333	0.355	0.080
6501	0.54992	0.27496	0.18331	0.355	0.080
6502	0.54983	0.27492	0.18328	0.354	0.080
6503	0.54975	0.27487	0.18325	0.354	0.079
6504	0.54966	0.27483	0.18322	0.354	0.079
6505	0.54958	0.27479	0.18319	0.354	0.079
6506	0.54949	0.27475	0.18316	0.354	0.079
6507	0.54941	0.2747	0.18314	0.354	0.079
6508	0.54932	0.27466	0.18311	0.354	0.079
6509	0.54924	0.27462	0.18308	0.354	0.079
6510	0.54916	0.27458	0.18305	0.354	0.079
6515	0.54873	0.27437	0.18291	0.353	0.079
6520	0.54831	0.27416	0.18277	0.353	0.079
7000	0.51071	0.25536	0.17024	0.315	0.060
7005	0.51035	0.25517	0.17012	0.315	0.060
7010	0.50999	0.25499	0.17	0.315	0.060
7015	0.50962	0.25481	0.16987	0.314	0.059
7020	0.50926	0.25463	0.16975	0.314	0.059
7500	0.47667	0.23833	0.15889	0.281	0.043
7505	0.47635	0.23817	0.15878	0.281	0.043
7510	0.47603	0.23802	0.15868	0.281	0.043
7515	0.47572	0.23786	0.15857	0.280	0.042
7520	0.4754	0.2377	0.15847	0.280	0.042
7550	0.47351	0.23675	0.15784	0.278	0.041
7600	0.47039	0.2352	0.1568	0.275	0.040

Figure 33, RPM values and stack length

Above is the length of the stacks at different RPM ranges, the length is not the actual length of the stack, it is the entire length from the top of the stack into the intake body, we found the actual length by measuring the length of the intake and subtracted it from the overall length, giving us the actual length of the intake stack.

We then found the 2nd and 3rd harmonic by using the equation shown in figure 5, and using the actual length, it shows that the 2nd harmonic is the most likely choice for the stacks to be tuned for, this is due to the restrictions in space that the airbox allows for, if the 1st harmonic would be used then the intake stacks would be far too tall, and risk restricting and choking the flow from the airbox.

5.5 Designs Created

In the images below are some of the designs created from the initial idea that was settled on; however during research it would show that having (as shown below) the base of intake situated on the inside would cause an aerodynamic effect called “flow separation” where air can flow through the intake, but after hitting a sharp edge would cause high turbulence and reduce efficiency of the intake system.

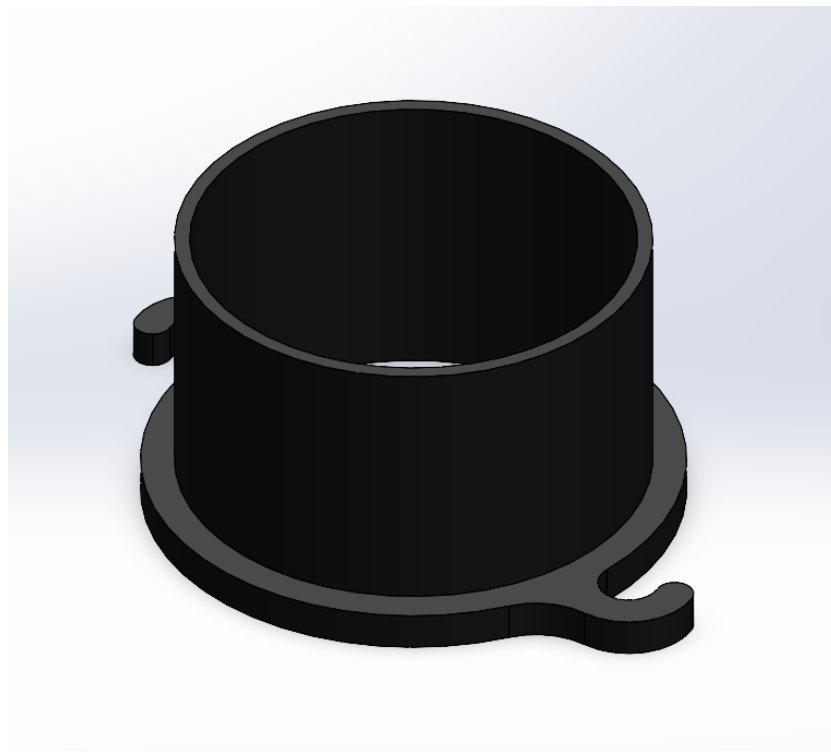


Figure 34, Base

Here in figure 7 is the base of all the designs created, the idea here is that the length of the base will stay the same, with a 2nd, separate part that will be part of the telescopic system, that will extend and retract along with the RPM of the engine.

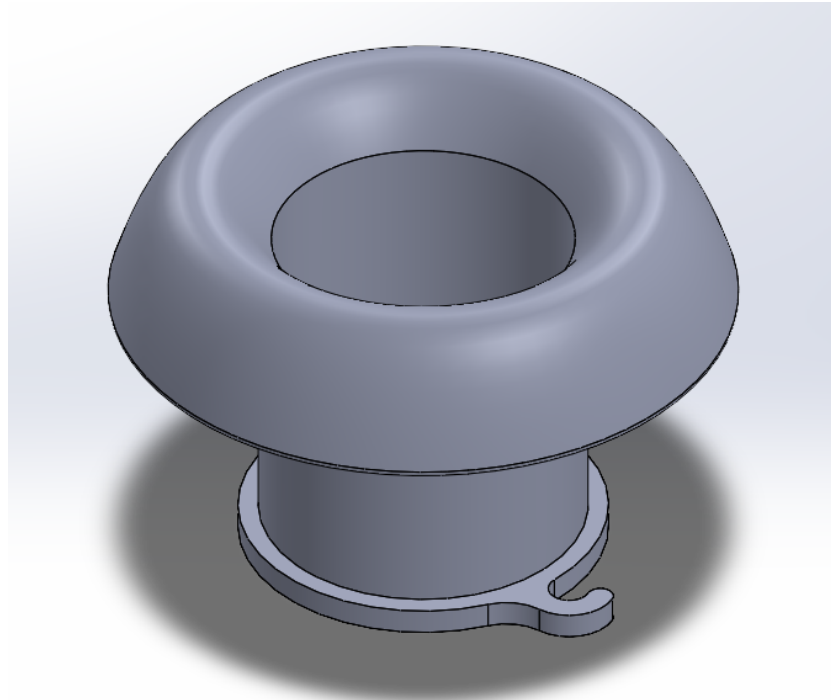


Figure 35, First idea

Here in figure 8 is the first idea of the bell, however without the previously mentioned telescopic system, this was made to have an early idea about the shape of the bell, which will be explained more in detail.

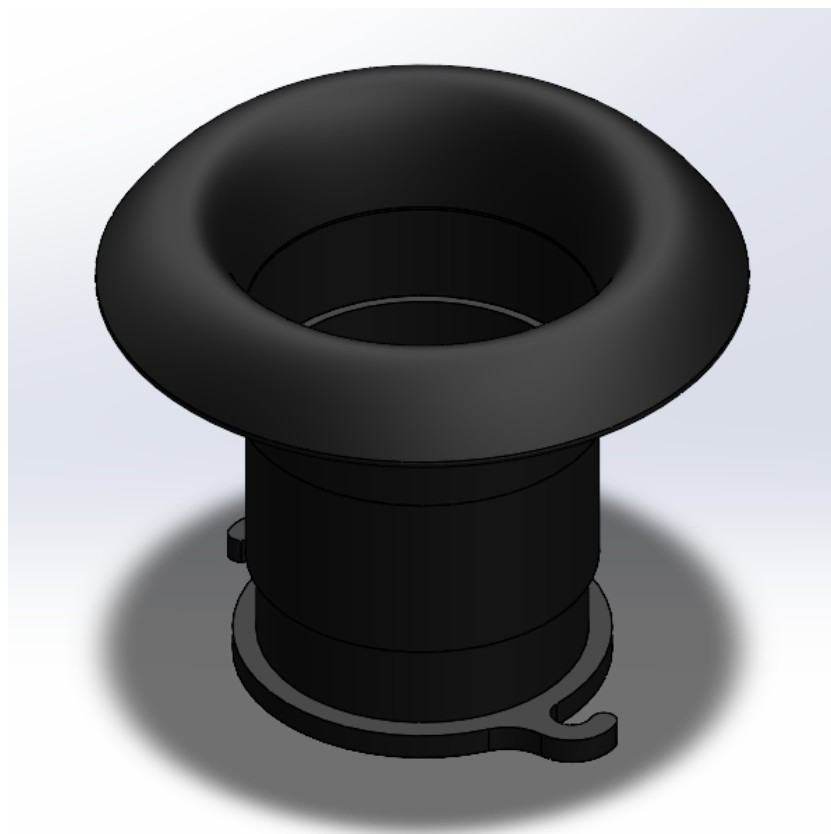


Figure 36, First telescopic idea

Shown in figure 9 above is the first telescopic shape made, although it doesn't function, it is made to use as a starting point for any future designs, future designs were made as separate from the base, allowing for actual practical 3D model assemblies. As explained previously, this design is what would cause a "flow separation" as the sharp edge on the interior of the model would disrupt the flow.

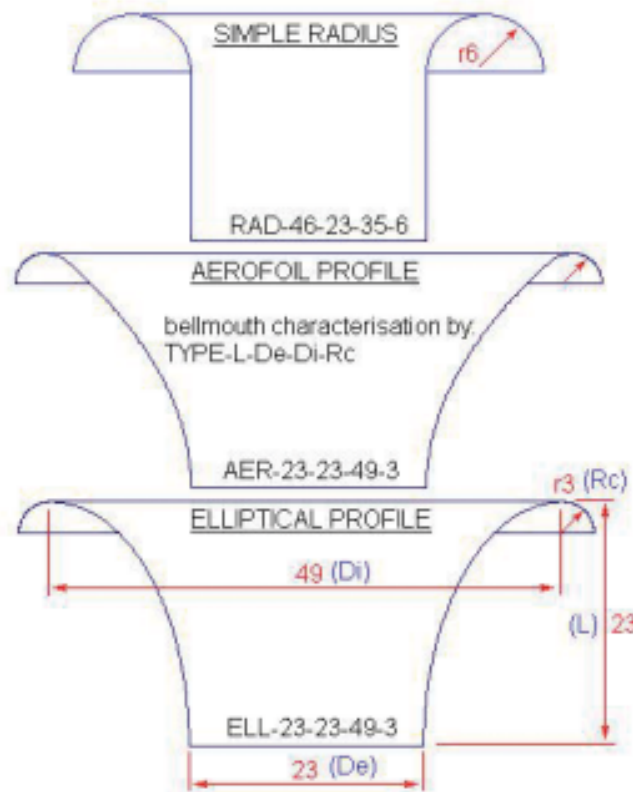


Figure 37, Various intake designs

I finalised a design for the bell, so that it is a separate part in SolidWorks and can be added to an assembly with the lower part. This final design has more of a aerofoil/elliptical bell mouth shape, instead of a simple bell mouth (see figure 10 below), this is because according to testing performed, these bell mouth shapes should provide for more efficient flow of air from the stacks.



Figure 38, Side view of bell mouth

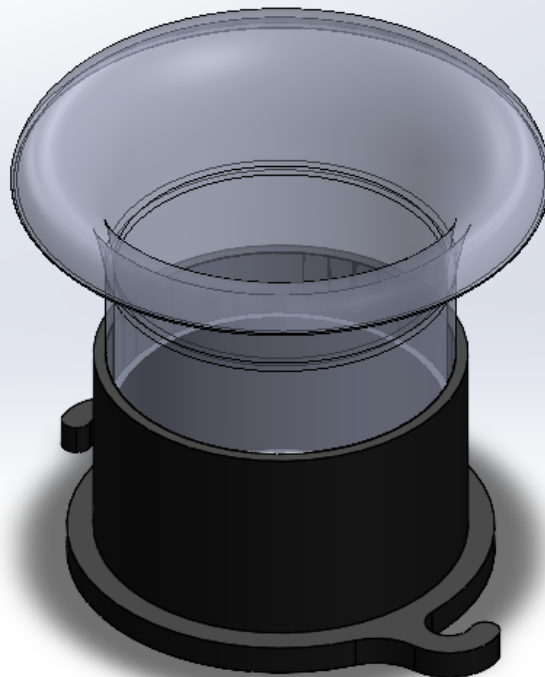


Figure 39, Bell mouth and base assembly

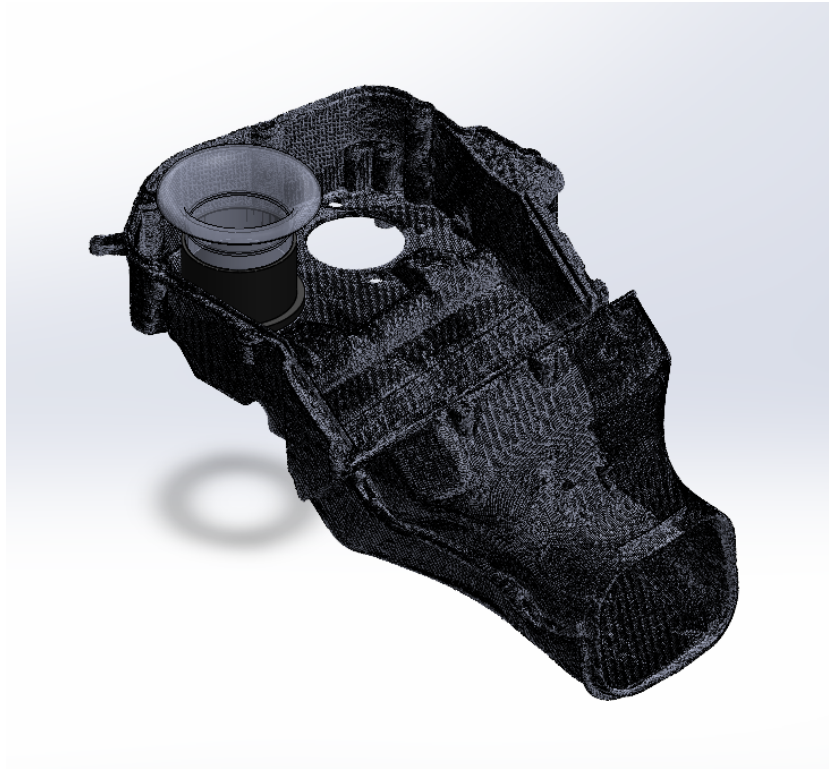


Figure 40, shows intake stack fitted into the airbox

Shown above here in figures 11/12, is the intake stack I have designed for the RS660, it is transparent to show the inside of the intake stack, and in figure 13 it shows how the stack would fit inside the airbox, all measurements were taken from OEM stacks and there is a possibility that some dimensions are subject to change. The stacks, as mentioned, would be controlled by a bar connecting the stacks, and moved by an actuator that would be installed on the exterior of the airbox, allowing for ease of accessibility and also negating risk of using up airbox space.

As for the choice of actuator, stepper motor linear actuators seem to be the most likely choice, and also is used most widely, this is because they are much more precise when it comes to the application requirements, and in comparison to other actuators, the stepper actuators are not reliant on brushes; which are a wear item that can degrade over time.

5.6 Testing

Although no physical testing has taken place during the development of the variable intake stacks, there will hopefully be future opportunities to either test the design in a controlled environment, for example on a dynamometer, or to have testing on the RS660 on the track, with feedback from possible sensors in the airbox.

There was also an attempt to run the inlet stacks through the SolidWorks flow dynamics feature, however to the fault of my own I was unable to perform any CFD testing with

meaningful outcomes due to inexperience of the software; in the foreseeable future, there will hopefully be more opportunities to learn and run CFD software, which will then allow me to possibly test these variable intake stacks.

5.7 Conclusion

The journey to developing an effective variable intake stack system involves very accurate measurements, some creative designs, and technical calculations. The finalized telescopic system, powered by stepper motor linear actuators, is an example of one solution to optimize airflow and address torque dips.

While physical testing and advanced simulations remain pending, the designs presented provide a strong base for any future improvements and performance evaluations that may be needed. With more opportunities to refine and test the system, this part of the project can have the potential to make contributions to motorcycle intake system engineering and performance optimization.

6 Progress Report

6.1 Brody Crockford

Table 4 - Comparison of planned and executed tasks for Brody Crockford.

Task	Description	Planned Dates	Executed Date
Initial CAD Model	Develop base CAD model for frame	Nov 1, 2024 - Dec 10, 2024	July, 2024
Data Collection	Gather twist rig data for chassis	Nov 4, 2024 - Dec 10, 2024	Not Completed
FEA & Design Iteration	Perform FEA analysis and update CAD models	Dec 10, 2024 - Jan 10, 2025	February, 2025
Prototype Development	Prototype manufacturing and iterations	Jan 10, 2025 - March 1, 2025	April, 2025
Parts Manufacturing	Manufacture components for the final build	March 1, 2025 - May 1, 2025	Not Completed

Table 4 provides a comparison between the planned and actual execution of key project tasks, highlighting several shifts in the original timeline.

The initial CAD model was completed ahead of schedule, due to the start time being brought forward and measurements being conducted early. However, data collection was not completed due to the unavailability of the twist rig and miscommunication with the individual operating it at the time.

FEA and design iteration, along with prototype development, were both completed later than originally planned. These delays stemmed from the FEA process and model development taking significantly longer than anticipated. The complexity and iterative nature of this phase extended the timeline and had a cascading effect on subsequent tasks.

Parts manufacturing remains incomplete, likely influenced by the earlier delays. While the project timeline shifted, substantial progress was made through the core development stages, and major deliverables were ultimately achieved.

6.2 Jay Wexler

Table 5 - Comparison of planned and executed tasks for Jay Wexler.

Task	Description	Planned Dates	Executed Date
Initial CAD Model	Develop base CAD model for seat/tank unit	Nov 1, 2024 - Dec 10, 2024	March, 2024
FEA & Design Iteration	Perform FEA analysis and update CAD models	Dec 10, 2024 - Jan 10, 2025	Not Completed
Prototype Development	Prototype manufacturing and iterations	Jan 10, 2025 - March 1, 2025	Not Completed
Parts Manufacturing	Manufacture components for the final build	March 1, 2025 - May 1, 2025	Not Completed

Table 5 compares the planned and actual execution of project tasks for Jay Wexler. While the project began with early signs of progress, several key phases were not completed due to delays in earlier stages.

The initial CAD model was completed in March 2025, significantly later than originally planned. This delay had a cascading effect on the rest of the project. Because the CAD model took much longer than anticipated, there was limited opportunity to begin the FEA and design iteration phase.

As a result, the FEA work was not completed, which in turn stalled both prototype development and parts manufacturing. These later stages remain uninitiated, as they depended on progress that had not yet been made.

Although the project saw a strong technical start, the extended time required to complete the CAD model ultimately delayed the workflow and prevented advancement into critical downstream phases.

6.3 Sam Stainsby

Table 6 - Comparison of planned and executed tasks for Sam Stainsby.

Task	Description	Planned Dates	Executed Date
Initial CAD Model	Develop base CAD model for stacks	Nov 1, 2024 - Dec 10, 2024	February, 2025
Data Collection	Gather pulse tuning data for engine	Nov 4, 2024 - Dec 10, 2024	November, 2024
Prototype Development	Prototype manufacturing and iterations	Jan 10, 2025 - March 1, 2025	Not Completed
Parts Manufacturing	Manufacture components for the final build	March 1, 2025 - May 1, 2025	Not Completed

During the group project there was a lot of new information to consider, and a lot of research needed. For the experience at hand, I do believe that I gave myself a very large task to undertake and would have done better if I split the project into separate pieces and worked toward individual goals, instead of one end component.

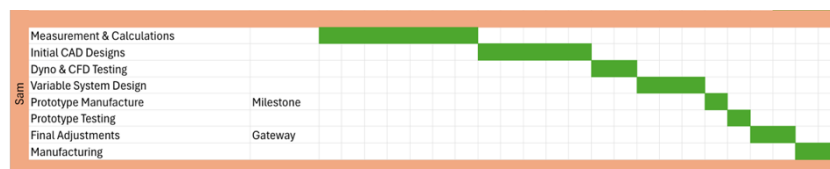


Figure 41, Gantt chart

Shown above in figure 13 is the Gantt chart that I was set to follow during this group project, however I fell behind after the first semester and sadly was not able to make up time after the fact, this is something I would want to improve greatly.

I would follow the Gantt chart closer, following the milestone and gateway more closely, and using them as a guide as should be done, instead of just focusing on the one final goal. I would also like to do more experiments and testing, CFD is one main, and very important, goal and also running the stacks on either a track or in a controlled environment.

I do however think I learnt a lot in the process, not only about the way that intake's function and what their designs can have effects on, but also on the 3D CAD side, using SolidWorks more and becoming more accustomed to the software is a vital skill to have.

7 Project Review

The Aprilia RS660 redesign project achieved several key successes, though not without its challenges. One of the most notable accomplishments was the development of a lightweight, highly adjustable prototype frame. By integrating SolidWorks, FEA analysis, and generative design tools, the team was able to create a structurally sound chassis with refined flex characteristics aimed at improving rider feel and cornering stability. The implementation of manual measurements alongside 3D scanning ensured accuracy in modelling, while material selection and iterative bracing design optimised weight without compromising strength.

The self-supporting seat unit also met its goal of reducing weight and enhancing rider ergonomics. Careful attention to aerodynamic shaping, comfort, and future carbon fibre manufacturing potential marked this aspect of the project as both functional and innovative. Similarly, the variable inlet stack work contributed to engine performance refinement, although further development is required to fully assess its impact.

However, some limitations emerged. Time constraints and the complexity of physical testing meant certain goals, such as strain gauge analysis and full geometry testing, remained incomplete. While the design prioritised performance and rider integration, production efficiency and modularity—particularly regarding separable body panels—were de-emphasised compared to professional racing standards.

Additionally, the project relied heavily on theoretical analysis and digital simulations, with limited prototype fabrication. While strong foundations were laid, real-world validation through track testing will be essential to confirm the effectiveness of the designs.

Overall, the project demonstrated solid teamwork, technical proficiency, and a clear vision for enhancing the RS660 platform. Despite some setbacks in scope and prototyping, the work provides a strong basis for future refinement and testing, with the potential to yield a high-performance motorcycle tailored to the demands of competitive track use.

8 References

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9 Appendices

9.1 Appendix 1 - FEA Validation

The FEA validation process involves comparing the results from finite element analysis simulations with manual calculations to ensure accuracy and reliability. In this study, both approaches use identical material properties, boundary conditions, and loading scenarios to maintain consistency. This ensures that the comparison focuses solely on verifying the accuracy of the simulation itself. Any discrepancies between the manual calculations and the FEA results can highlight potential issues in the modelling approach or underlying assumptions, helping to confirm that the simulation accurately reflects the physical behaviour of the system.

The model used for this validation is a square extrusion, as shown in Figure 19.

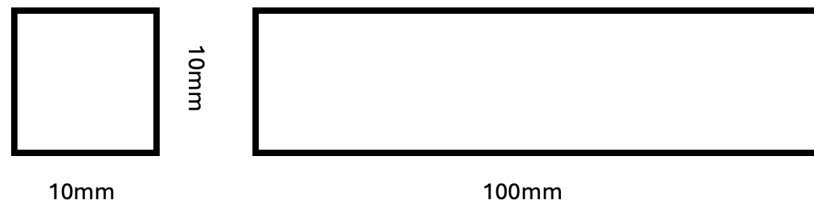


Figure 42 - 2D drawing of the validation model.

To validate the results, three tests were performed: Tension, Compression, and Bending.

The following equations were applied for the manual calculations:

Equation 1 - Stress equation

$$\sigma = \frac{F}{A}$$

Equation 2 - Strain equation

$$\varepsilon = \frac{x}{l}$$

Equation 3 - Young's Modulus equation

$$E = \frac{\sigma}{\varepsilon}$$

Equation 4 - Bending equation

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$$

A summary of the results is presented in Table 4.

Table 7 - Calculated maximum values

	Max Stress	Max Displacement
Tension	1×10^7	1.45×10^{-4}
Compression	-1×10^7	-1.45×10^{-4}
Bending	6×10^8	5.80

The finite element analysis was performed using SolidWorks. To ensure consistency with the manual calculations, the same material properties, boundary conditions, and loading scenarios were applied in the simulation.

Table 8 - Control Variables for both calculations and FEA simulations.

Young's Modulus	6.9×10^{10}
Applied Force	1000N

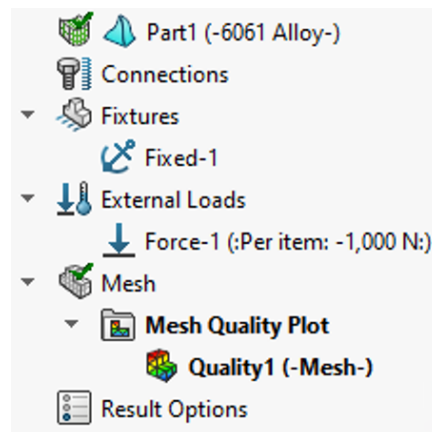


Figure 43 - FEA Simulation setup.

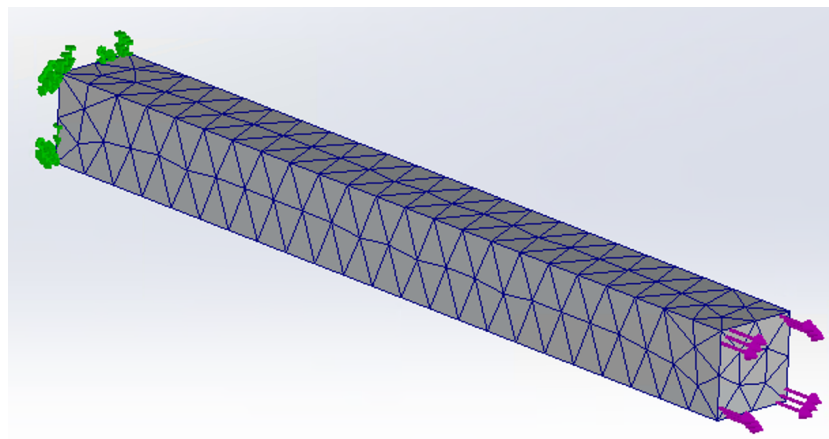


Figure 44 - Validation model, with fixed geometry and applied force for the tensile test. Also, with applied mesh.

The FEA simulations were run for each of the three test cases. The key results obtained from the analysis are summarised in Table 6.

Table 9 - FEA simulation results.

	Max Stress	Max Displacement
Tension	1.07×10^7	1.44×10^{-2}
Compression	1.07×10^7	1.44×10^{-2}
Bending	5.97×10^8	5.78

The results from the manual calculations and FEA simulations were compared to validate the accuracy of the model. The comparison is summarised in Table 7.

Table 10 - Error between calculations and FEA simulations.

	Calculated Stress	FEA Stress	% Difference
Tension	1×10^7	1.07×10^7	7%
Compression	-1×10^7	1.07×10^7	7%
Bending	6×10^8	5.97×10^8	3%

As shown in the table, the FEA results are in good agreement with the manual calculations, with differences falling within an acceptable range. These differences can be attributed to factors such as mesh discretization and numerical approximation inherent in finite element methods.

The validation of the FEA model demonstrates that the simulation results align closely with manual calculations for the square extrusion under Tension, Compression, and Bending loads. The use of consistent material properties, boundary conditions, and loading scenarios across both approaches ensures a reliable comparison. This validation provides confidence in the accuracy of the FEA model for further analysis and design applications.

9.2 Appendix 2 - 3D Scanning

The 3D scanning process of the RS660 engine was carried out using the Peel 3D structured light scanner in conjunction with Peel 3D's software suite. The objective of the scan was to quickly and efficiently capture the necessary geometric data to validate manual measurements and support future design considerations, without generating a full mesh model. The process began with preparation of the engine, including cleaning to remove dust and debris that could interfere with scan accuracy. Peel 3D retro-reflective markers were strategically placed on accessible surfaces of the engine, focusing on flat areas to ensure optimal tracking and

alignment. Particular attention was given to covering complex regions such as the cylinder head and mounting locations, where dimensional accuracy was most critical.

The scanning process consisted of two primary stages. First, the Peel 3D scanner was used to capture the positions of the scanning markers, establishing a stable reference frame for the subsequent surface scan. Once marker data was collected, the surface of the RS660 engine was scanned in multiple passes to ensure full coverage of key areas. Extra focus was placed on capturing mating surfaces and mounting features with enough detail to extract accurate reference geometry.

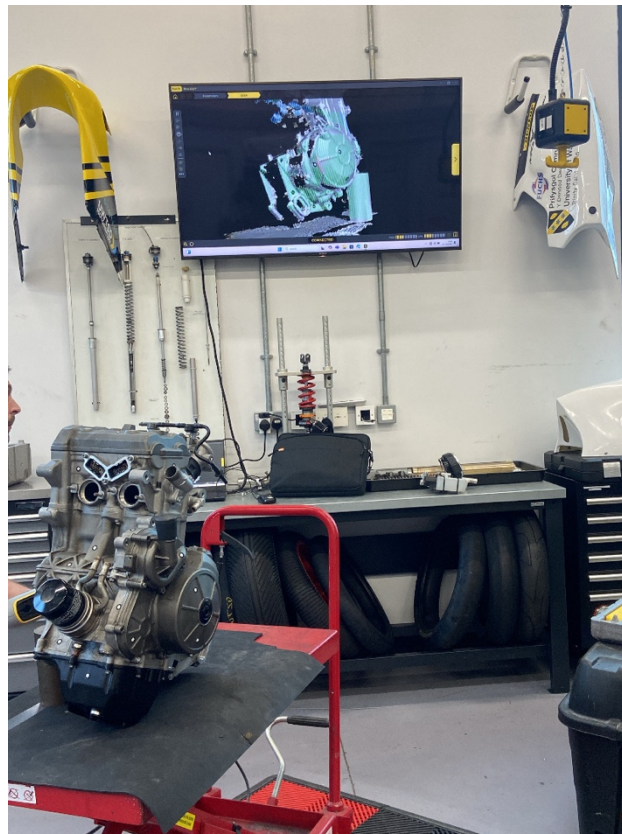


Figure 45 - The scan being done in the UWTSD motorcycle workshop.

Following this, the scan was post-processed using the Peel 3D software. Marker-based alignment techniques ensured that all scan data was properly registered. Noise reduction and data cleanup tools were used to refine the captured information, but rather than exporting a full mesh of the engine, only essential geometric features were extracted. Specifically, planes were created on mating surfaces and axes were defined at key mounting locations. These simplified geometric references were exported for use in validating manual measurements and ensuring alignment in future design work. This approach significantly streamlined the process by focusing only on the data required, reducing file size and post-processing time.

The extracted planes and axes provided the necessary dimensional information, particularly around the cylinder head and mounting points, to compare with and validate manual measurements. The simplified dataset served as an efficient and effective digital reference for reverse engineering tasks and custom component design. While the Peel 3D scanner offered sufficient accuracy for these applications, it is important to note that areas with deep cavities or complex internal geometries remained limited by the scanner's line of sight and resolution capabilities. For features requiring higher precision or tighter tolerances, additional measurement methods would be recommended.

9.3 Appendix 3 - Meeting Minutes

RS660 GROUP PROJECT MINUTES

ATTENDANCE	
BRODY CROCKFORD	Y
JAY WEXLER	Y
SAM STAINSBY	Y
ANDREW HARRISON	N

DATE: Tue 29th Oct

TIME: 13:00

MEETING #: 2

AGENDA:

- Check on work completed.
- Check if group PPTX and Gantt has been worked on.

COMMENTS:

- Jay with initial sketch and rear body based on Kalex Moto2 side profile. Comments given about measurements to reference, curvature to follow.
- Sam templated out viva slides – to catch up on work completed.
- Brody made a chassis program with adjustable geometry to compare setups.

ACTION:

- Jay working on revised side profile to fit 660 dimensions.
- Brody to make CAD model of swingarm, significant progress to be made by next meeting.
- Brody & Sam to measure Cams 4/5th November – Details TBC.
- Brody to get Flow Bench readings for head with different airbox configurations.
- Gantt chart and viva pptx to be filled out as work becomes completed.
- Sam making calculator for inlet length – needs to measure head and throttle bodies to get stack height.

RS660 GROUP PROJECT MINUTES

ATTENDANCE	
BRODY CROCKFORD	Y
JAY WEXLER	Y
SAM STAINSBY	Y
ANDREW HARRISON	N

DATE: 5/11/2024

TIME: 10:30

MEETING #: 3

AGENDA:

- Establish timescale for the project
- Establish milestones & gateways
- Understand group tasks for management assignment

COMMENTS:

- Timeline established – updated Gantt chart in teams to now reference
- Sam completed intake length calcs
- Need to work out potential gateway objectives for Sam

ACTION:

- Jay to gather more measurements to complete first CAD model
- Sam & Brody to flow bench with airbox
- All to complete Gantt Chart by next meeting

RS660 GROUP PROJECT MINUTES

ATTENDANCE	
BRODY CROCKFORD	Y
JAY WEXLER	Y
SAM STAINSBY	N
ANDREW HARRISON	N

DATE: 12/11/2024

TIME: 13:00

MEETING #: 4

AGENDA:

- Complete Tasks for project planning assignment.
- Go over plans before viva.

COMMENTS:

- Simplified Gantt chart made for the group, to be adjusted for dates and then used. Uploaded under “General – Files” in Teams.
- Table made for group tasks, screenshot in Teams under “General – Files – Management”.

ACTION:

- Enter these into the relevant sections of the project planning assignment.

RS660 GROUP PROJECT MINUTES

ATTENDANCE	
BRODY CROCKFORD	Y
JAY WEXLER	Y
SAM STAINSBY	Y
ANDREW HARRISON	N

DATE: 19/11/2024

TIME: 13:00

MEETING #: 5

AGENDA:

- Understand what is needed to move forward.
- First conversations about viva content, research & layout.

COMMENTS:

- Sam given assistance with CAD modelling.
- Jay continuing to work on initial CAD model & form.

ACTION:

- Sam to look at standard stacks to understand current pulse tuning alongside dyno results.
- Everyone on the same page with viva, show research and current solutions, then measurement, then design progress.

RS660 GROUP PROJECT MINUTES

ATTENDANCE	
BRODY CROCKFORD	Y
JAY WEXLER	Y
SAM STAINSBY	Y
ANDREW HARRISON	N

DATE: 26 Nov

TIME: 13:00

MEETING #: 6

AGENDA:

- Assist with final work before viva.
- Cover viva content and slide structure.

COMMENTS:

- Brody Viva Content:
 - Project Outline
 - Chassis flex research
 - Measuring
 - Chassis Model
 - Chassis Calculator
- Jay Viva Content:
 - Project Outline
 - Understanding of requirements (load, aero, ergonomics, regs)
 - Talk about ergonomics
 - Research about carbon manufacturing, design requirements
 - CAD Model
 - Moving forward – FEA
- Sam Viva Content:
 - Project Outline
 - Research & Calcs
 - Analysis of standard stacks
 - Current products available
 - Design Iterations (pros & cons)
 - Moving Forward: CAD & Testing (dyno)

ACTION:

- Sam to neaten calculations for viva, they are already complete
- Viva slide content to be finished by next week, to give time for run throughs and presentation prep.

RS660 GROUP PROJECT MINUTES

ATTENDANCE	
BRODY CROCKFORD	Y
JAY WEXLER	Y
SAM STAINSBY	Y
ANDREW HARRISON	N

DATE: 3/12/2024

TIME: 13:00

MEETING #: 7

AGENDA:

- Look at viva notes and begin compiling presentation

COMMENTS:

- Room booked for all day Friday
 - Final slide changes and notes written for talking
- Rehearsals to be done Monday & Tuesday for final changes before hand-in.

ACTION:

- Slides to be completed by Friday
- Brody to format everything

RS660 GROUP PROJECT MINUTES

ATTENDANCE	
BRODY CROCKFORD	Y
JAY WEXLER	Y
SAM STAINSBY	Y
ANDREW HARRISON	N

DATE: 3/12/2024

TIME: 13:00

MEETING #: 9

AGENDA:

- See where everyone is at
- Plan immediate work
- Look at timings for remainder of project

COMMENTS/ACTION:

- Sam to begin CAD modelling of stacks
- Model/Scan airbox to run CFD simulations
- Jay to work on final design, access etc
- Look into the process of FEA/testing
- Brody to begin twist rig testing when possible
- Frame sent for prototyping

RS660 GROUP PROJECT MINUTES

ATTENDANCE	
BRODY CROCKFORD	Y
JAY WEXLER	Y
SAM STAINSBY	Y
ANDREW HARRISON	Y

DATE: 18/02/2025

TIME: 13:00

MEETING #: 10

AGENDA:

- See where everyone is with work
- Plan for the next steps

COMMENTS:

- Jay still working on the model, making good progress
- Sam has initial model made, now looking at fixed prototypes

ACTION:

- Model to be finished in the next week or two, ready to begin the FEA process
- Sam to make fixed stacks to test, then develop telescopic system