

Design Evaluation Report

Hamish Cranstone - 1801893

Module Code: M6X01244

Word Count: 3122

Executive Summary.

Vehicle safety technology is an extremely important feature in automotive design. Vehicles are equipped with safety devices and features not only to protect the vehicle and its user in the event of an emergency but also to prevent them from occurring in the first place.

This vehicle design demonstrates the futuristic concept of how vehicle safety could have an affect on exterior automotive design.

The main feature is the cockpit that is able to pivot from side to side, similar to how a motorcycle would when cornering. This movement would allow the weight to be distributed to maintain traction at the wheels that need it most to keep the vehicle in control.

The vehicle has been designed for drivers to experience track days in a safer manner and allows them to explore their limits and develop skills as a driver.

The concept's name is Concinnity.

“Concinnity” is defined as the skilful and harmonious arrangement or fitting together of the different parts of something. (CONCINNITY | Definition of CONCINNITY by Oxford Dictionary on Lexico.com also meaning of CONCINNITY, n.d.)

Detailed Description and Specification of Design Outcome

Concinnity is a concept vehicle designed for track use only. The design assists drivers to improve their driving skills by allowing them to make errors. If the driver starts to control the vehicle in a way that would induce an incident then the safety features will engage to prevent the incident from occurring. Gaining knowledge of these mistakes becomes an effective learning tool and aids competence in driving.

In a situation where the driver starts to lose control the cockpit will pivot to put weight over the tyres that need more traction and the motor will modulate the power output to the wheels in unison. Concinnity can be operated in a mode that allows the cockpit to pivot constantly to provide the most grip, allowing the driver to achieve faster lap times.

The outcome of this design could have many positive consequences once the vehicle is tested in the environment it was designed for.

Socially, it can improve people's enjoyment of track days as it starts to solve issues such as the accidental driver errors that cause possible injury to the driver and damage to the vehicle. Drivers will get pleasure learning in the vehicle as they rapidly develop their skills and driving technique in a more controlled environment. Drivers will gain more trust in the vehicle's ability as they use it, therefore gaining confidence and increasing user satisfaction.

Environmentally, vehicles with internal combustion engines are large factors in contributing to poor air quality. Numerous track days with a multitude of vehicles all operating at their

maximum output results in the production of many harmful gasses that pollute the surrounding environment. As this vehicle is fully electric, it doesn't release any harmful gases and allows the environmental impact to be controlled and made sustainable. The electricity could be generated in a sustainable way that has no negative effect.

Economically, this vehicle could be used by both private buyers or businesses. The initial cost of the vehicle will be far outweighed in the benefit of saving a car or potential life injury from an accident. Initial research into the problem showed how many vehicles have an incident on a track day which also puts into perspective how economic a vehicle that has a much lower risk of an incident could be.

Critical Evaluation

Upon clarifying the project direction in the first stage of this project the concept's design can now be focussed on. The design has to be futuristic as it is set to launch in 2050 and requires a cockpit that can pivot laterally.

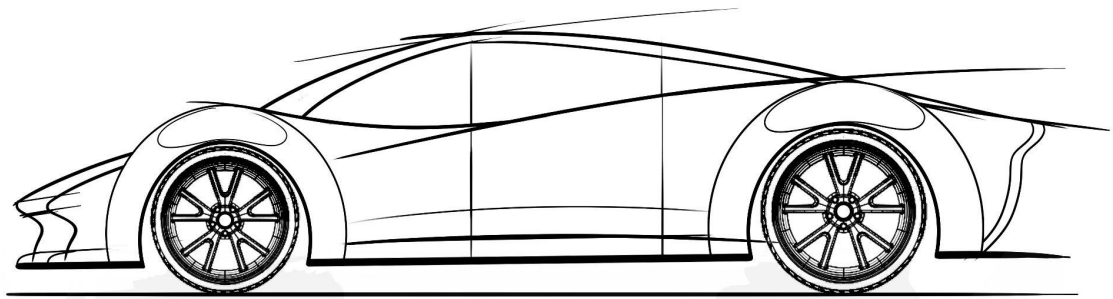


Figure 1: Initial Sketch before design development, Photoshop work over Alias wireframe (2020)

Photoshop was used to develop the design through the use of orthographic drawings to work from the side, front, rear and top views.

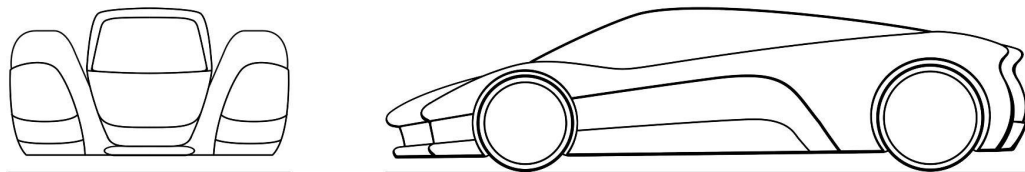


Figure 2: Initial Orthographic view, Photoshop (2021)

The first design iteration was aimed at fixing the extreme round arches in the side view to create a sleeker design. It was also an attempt to introduce some character through the use of the detail on the side. However, when translating the side view to a front view the look became far more comical than the serious appearance that was sought and lacked any kind of definition.

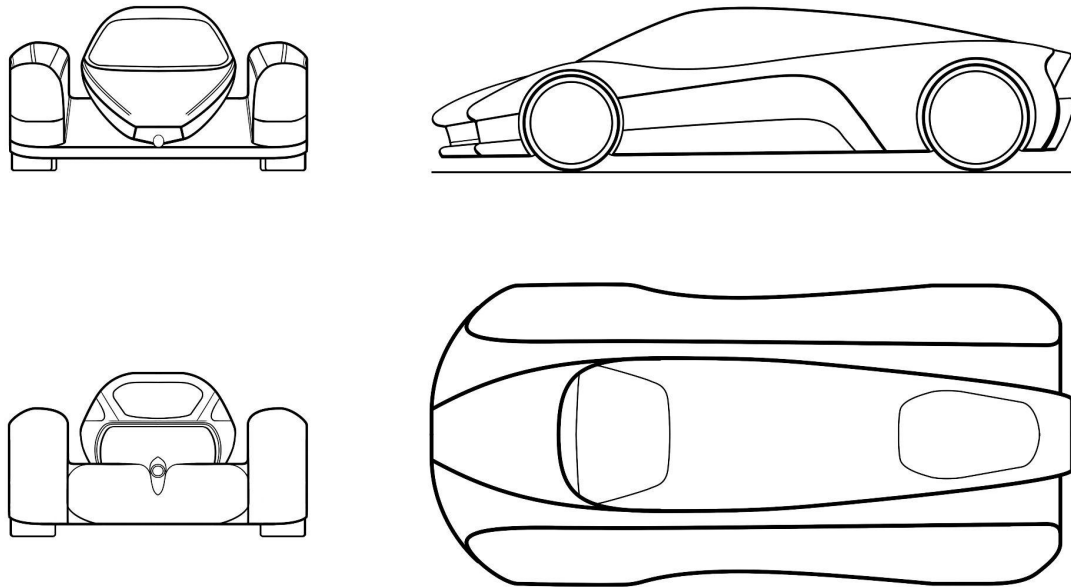


Figure 3: Second Orthographic Blueprint, Photoshop (2021)

The orthographic view was refined to create a sleeker design that more effectively shows how the concept works by adding definition.

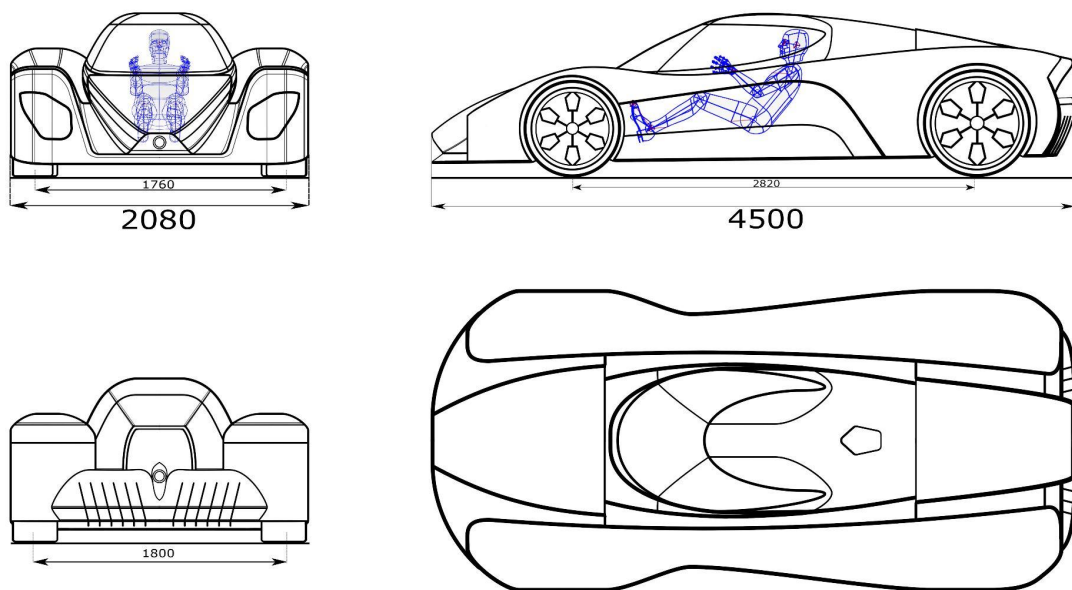


Figure 4: Third Orthographic Blueprint, Photoshop (2021)

A male ergonomic model was included in the third draft with measurements to show the scale of the design. It was developed to show how pieces of the design interact to make it more coherent. A directional shape of a pentagon was added to run throughout the design to highlight that the two sides of the shape resemble what can be seen in the detail on the side of the vehicle. It can be seen in the wheel design and in the headlights.

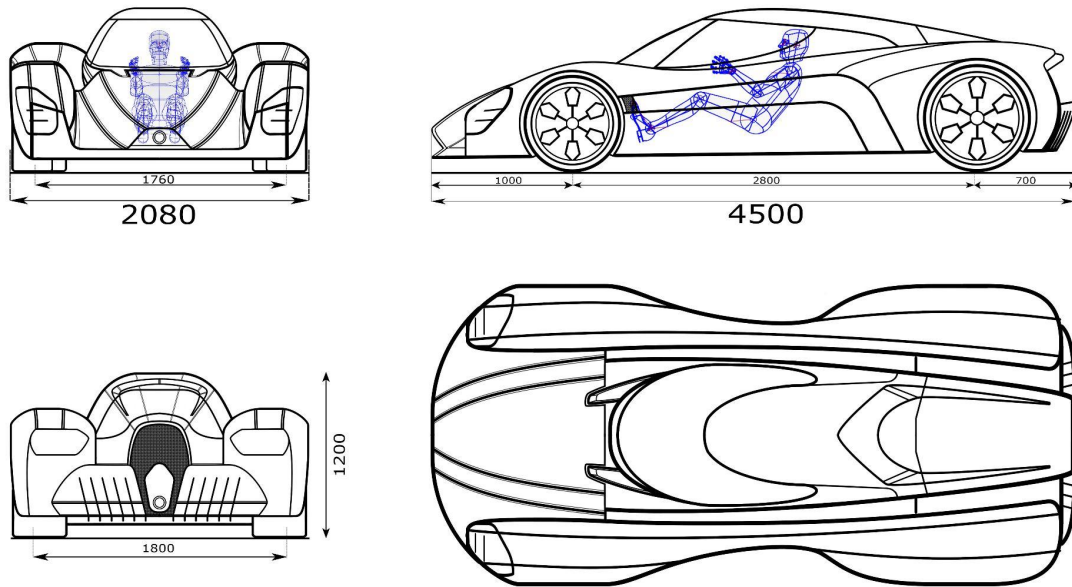
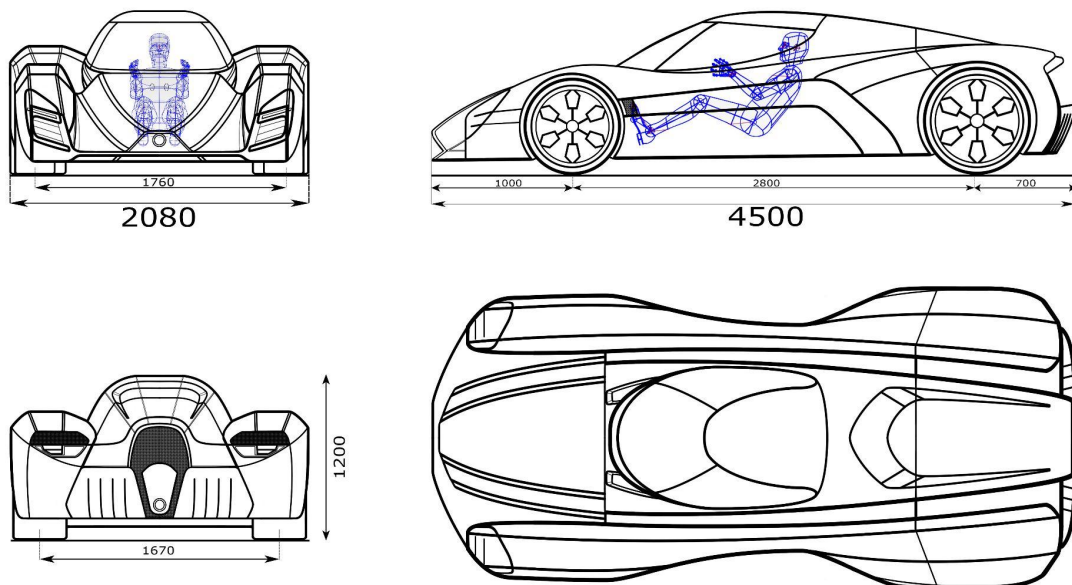


Figure 5: Fifth Orthographic Blueprint, Photoshop (2021)

Following the addition of more details in the previous variation of the design a rule could be created for all the design lines. The curves on the side now follow each other as they share the correct radius to keep them flowing together. Body lines were added to distinguish the shape of the arches. The body lines also saw some attention on the front due to some forward thinking into how the surfacing would be modelled in Alias. The adjustment also makes sense from a packaging perspective as a cover for the engineering components like the suspension and steering that would be hidden underneath the body surface. Thought was also given to how the cockpit would be accessed by the user with shut lines.



Scale 1:20

Figure 6: Final Orthographic Blueprint, Photoshop (2021)

Figure 6 is the final blueprint for the design that was created prior to moving away from Photoshop to start developing a model on Autodesk Alias Autostudio. Alias Autostudio is an automotive design and surface design software used within the industry to model detailed designs of vehicles with technical and accurate surfacing.

Details such as the lights were adjusted to fit within the shape of the bodywork. The headlights have been adjusted to look more futuristic and have helped make the front end look far more serious than before. The bodywork on the rearview has been given an arch that looks like an 'A frame' which makes the sides of the car appear planted to the ground. The diffuser was changed to fit into the rear bodywork and the cockpit has been changed so the greenhouse tilts forward for access.

The modeling process commenced once the orthographic drawing was finalised.

The blueprint was imported to Alias and scaled to the right dimensions.

A simple wire frame was created with minimal CV's. 'CV' stands for 'Control Vertices' and is what is controlled to give accurate curves and surfaces with Alias. CV's were added and adjusted to create curves whilst checking the curve quality to make sure that separate curves had a similar structure.

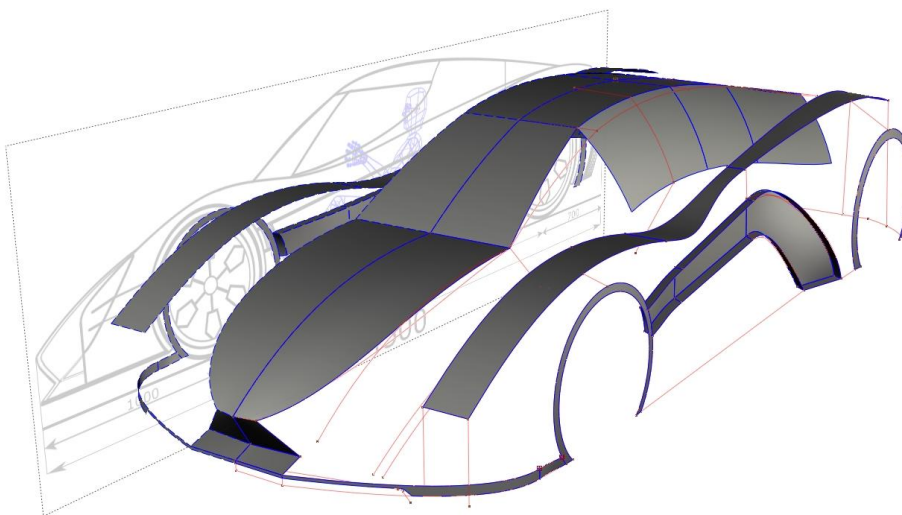


Figure 7: Incorrect Initial Surfacing Over Wireframe, Autodesk Alias (2021)

Surfacing could then be established using the curves once the wire frame was completed. Commencing with the cockpit of the model and then the side surfaces. It became apparent that the surfacing would not be possible as details were added too soon making it more difficult to achieve a correct surface layout. The side surfaces needed to be removed and started from scratch. The 'Circle Tool' was used to create the shape of the arch, before using the 'Curve Section Tool' to trim the bottom of the circle to create the wheel arch curve. The central surfaces that make up the side were then created using the 'Square Tool' to control the level of curvature more accurately. Straight curves were created and projected from the centre of the wheel arch, out onto the surrounding surfaces to create the correct surface patch layout. This allowed for the surfaces to be as even as possible to help create the curvature across the surface.

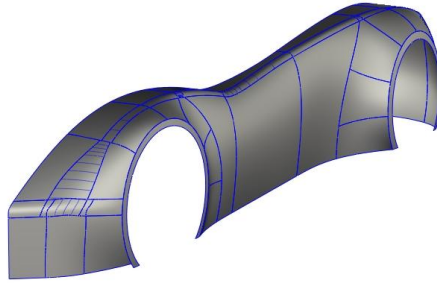


Figure 8: Side Surfacing, Autodesk Alias (2021)

The 'Square Tool' was used again to create the top surface on the side and then the hard edge was rounded by using the 'Surface Fillet Tool'. The 'Round Tool' was used to easily put a radius on the sharp corner of the arch and the 'Multi-Surface Draft Tool' was used to create the wheel arch liner.

A large side skirt was made to catch the light and to also tie in with the large splitter and diffuser on the vehicle.

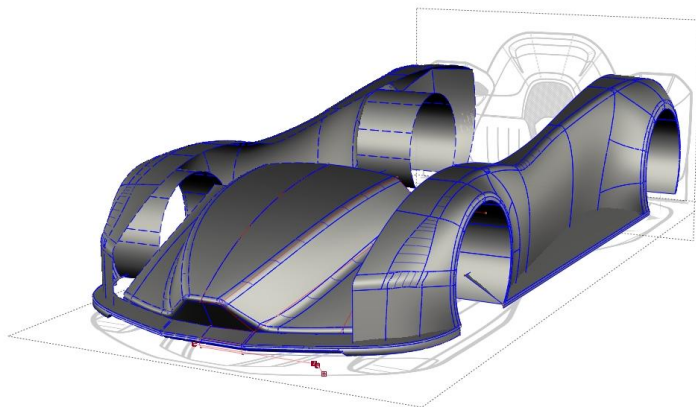


Figure 9: New Surfacing of Bonnet, Side Skirts and Splitter, Autodesk Alias (2021)

The wireframe was used with the 'Skin Tool' to make the top surface of the bonnet. The skin tool can select not only the edge and middle curves but also the mirrored curve, giving a nice surface with curvature. Once it was created, the surface, even though it had curvature, was very flat. This was amended by raising the CV's on the centre curve, this should now give some much nicer reflections when it comes to rendering the model later. The lower bonnet surface was created in the same way as the top, but extended so it was able to be intersected with the side surface. Once the surface was made, the 'Rail Tool' (set to one generation curve and one rail curve) was used to create the diagonal surface to join the top and lower surfaces. Then it was a simple case of trimming it so it was ready to add fillets.

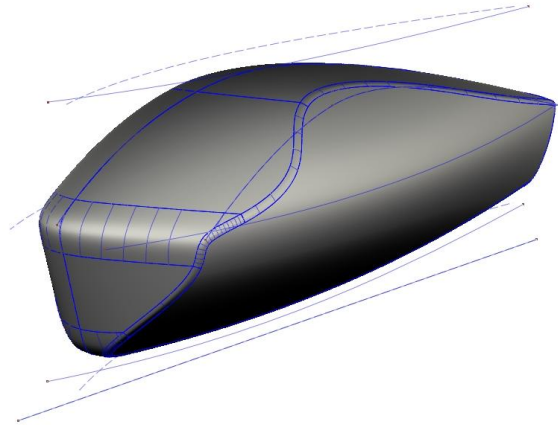


Figure 10: New Cockpit, Autodesk Alias (2021)

Difficulty was found in creating the surface of the cockpit as this cockpit does not join to the rest of the vehicle like a conventional car. By re-creating the top surfaces with the square tool and getting them to have curvature, the front and rear surfaces could be created by using a simple curve, then duplicating it to the edge of the surface to skin across it, similarly to the process used for the bonnet. The skin tool helped to bridge the gap underneath between the front and rear surface. The next step was to put a fillet around the cockpit. A discovery was made with the fillet tool, which is that if you make one radius on an edge, you cannot create another fillet that intersects it with an equal or larger radius. Therefore all of the fillets running around the cockpit were made as large as possible, whilst following the blueprint. The side surface was made using the 'Plane Tool' and intersecting it. A radius was then put on the edge of it that would smooth out the cockpit entirely. The manikin was then imported and to scale, so the proportions could be checked to make sure he would fit correctly.

The plane tool was used to create the splitter which was trimmed using a curve fitted to the front of the bonnet. The trimmed surface was duplicated and moved to the correct level.

They were then joined with the skin tool to give the splitter some depth.

The diffuser was created by following the curves on the blueprint then using the 'Offset Tool' to make the higher curve of the diffuser. The curves were then duplicated and scaled down, before moving them forward and skinning between the curves. The 'Surface Fillet Tool' was used to create the radius on all edges of these surfaces.

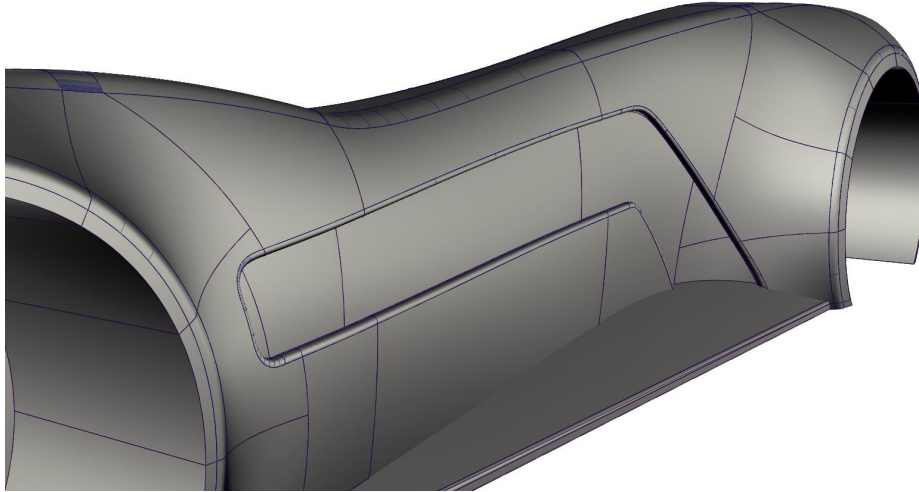


Figure 11: Side Detail, Autodesk Alias (2021)

After creating the main shape of the whole vehicle, it was time to add the details. The intake on the side of the vehicle was difficult to create. It was difficult to create the desired shape whilst making it still look functional. Eventually a solution was found. The shape was made out of curves which were then projected onto the side. The side surface was duplicated twice, to give 3 surfaces, before trimming 2 of the surfaces with the shape. Two of the surfaces were skinned across to make it look like the body surface had some thickness. The third surface was set further into the side to give the desired gap which looked perfect, albeit not what was originally planned with the arch. It doesn't exactly follow the blueprint, as the blueprint created earlier in the design process shows the rear arch being much more angular and prominent from the body.

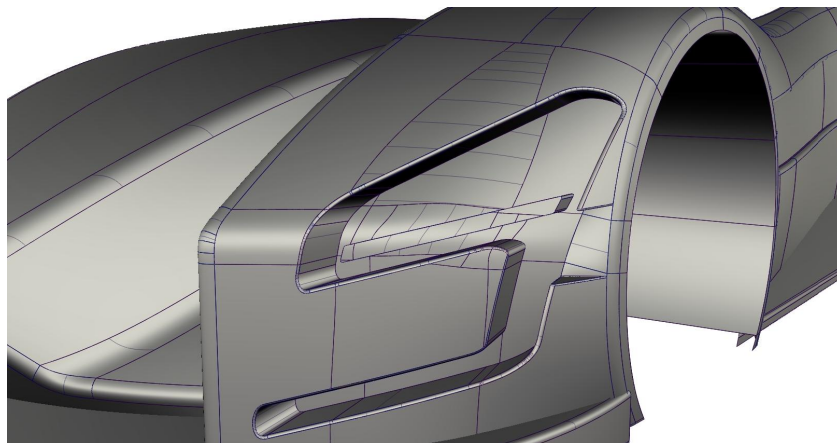


Figure 12: Headlight, Autodesk Alias (2021)

The next details to be created were the lights. The curves for them were made to shape, then the curves were projected onto the surfaces of the vehicle. The 'Trim Surface Tool' was used and the surfaces were divided. The divided surface was then set back to create a headlight and rear light surface. The LED strip was made by dividing part of the surface again with the trim tool and protruding it from the back of the headlight. The 'Skin Tool' was used to bridge between all the surfaces then the 'Surface Fillet Tool' to round off the edges. The last part of the light details was the small cutout to blend the detail from the side to the front to make the

details more of an all encompassing feature that does not start and end on the side. The headlight was very close to what was planned originally with the design of the vehicle, but the rear light was not satisfactory. The original design blended with the rear arch better. However, as the rear arch has changed a little from the original design, it has now made the rear light look a little dated. Graphically it has not changed from the original design.

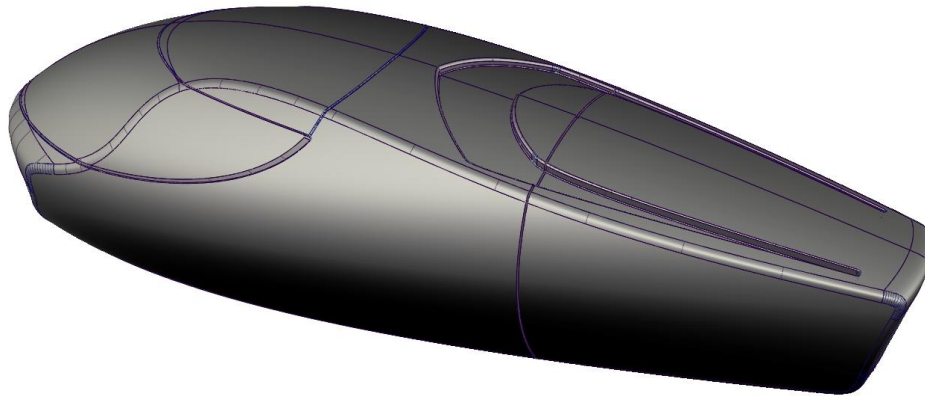


Figure 13: Cockpit Details, Autodesk Alias (2021)

The final details of the vehicle were on the cockpit. The windscreen and the detail on the back were both made with the 'Trim Divide Tool' then they were set into the cockpit before skinning between them and rounding the edges. Lastly some shut lines to show how the cockpit opens, and how the cockpit tilts from side to side were added.

The surfaces were grouped into the correct layers to make the modelling process easier as materials and different colours could then be added to each group and layer.

Experimentation with colours and rendering on Autodesk VRED could then begin. Initially by playing with colours of the designers preference, mainly consisting of deep blues and then using more colours that could contribute to the project. The earlier moodboard in the project suggested three words; Agility, Balance and Power. Green is thought of as the colour of balance and is associated with growth, safety and energy. All of these can be thought of as notions that can be paired with the vehicle. It balances the cockpit to help maintain traction which helps with safety as it prevents possible incidents when the vehicle is pushed to the limit, therefore protecting the driver. The vehicle also encourages the user to keep pushing their limits to increase their learning potential, leading to a positive growth in skill. The vehicle is fully electric leading to zero emissions resulting in less pollution of the environment in which the vehicle is being used in. The colour green should be the representative colour for this vehicle.



Figure 14: Final Render 13, Autodesk VRED (2021)

Materials to be used for each surface were explored and when found suitable the colour palette was chosen that would be used on the model. Test renders in a studio environment proved to give a satisfying appearance to the model bringing an image of how it would appear in reality. To portray the vehicle in the best way, various environments were researched to use as a showcase for the model. A suitable environment and backplates were found in the form of a small straight on a racetrack, complete with kerbs. After taking many shots of the vehicle in its natural habitat, playing with the camera settings and perspective a set of high quality renders could be produced. The renders were finished by utilising the animation feature on VRED to make the wheels blur as if they are in motion.

Designed Outcome in Relation to Brief and PDS.

Product Design Specification.

Target Customer: Track Driving Enthusiasts.

Aesthetics: Futuristic and Dynamic.

Ergonomics: Single Seater Vehicle.

Size: Length = 4480 Width = 1970 Height = 1120

Weight: 1750kg/3858lb

Performance: Scaling with Driver Capability.

Lowest Power Equal to 250hp per tonne. Highest Power Equal to 400hp per tonne.

Environment: Track Use Only.

Production Quantity: 50

Target Product Cost: £350,000

Launch Date: 2050

The personal brief of this project was to produce a design to illustrate how vehicle safety could have an affect on exterior design.

The purpose of this design was to establish a car that maintained traction and therefore safety. The whole concept of this design revolves around the cockpit tilting to provide an element of safety not encountered previously in the automotive scene. It needed to be aesthetically pleasing but functional, this has been achieved by using dynamic shapes and smooth lines. As a whole the vehicle looks futuristic and hits the target, however the rear lights are a let down for the rear view.

The size of the vehicle was determined by current track focussed vehicles and changed slightly on the modelling stage as it made the proportions of each piece more even. The length stayed almost the same, only decreasing by 8mm. However, the wheelbase was extended by 100mm making the lines from the cockpit nicely disappear as if the centre line of the vehicle runs down to the same axis as the centre of the front wheels. The overall height of the vehicle was lowered by 56mm and the overall width increased by 16mm.

Concinnity needs to be of a weight comparable to that of a GT3 track car to maintain compliance with rules and regulations of competitive events. This is to enable the vehicle to participate in the competitive nature of the racing sport.

The original intent and enthusiasm on starting this design project was to create a clay model to expand my skill set and to pursue an interest in this aspect of automotive design, however with the constraints of Covid-19 this became impossible and other design methods needed to be explored. Autodesk Alias was the alternative option to create a high quality model, I had concerns that my knowledge in this area was insufficient to create the desired model. Through perseverance and understanding of the application and all that it could offer I believe I have created a model of higher quality than first anticipated.

Table of Figures

Figure 1: Initial Sketch before design development, Photoshop (2020)	3
Figure 2: Initial Orthographic view, Photoshop (2021)	3
Figure 3: Second Orthographic Blueprint, Photoshop (2021)	4
Figure 4: Third Orthographic Blueprint, Photoshop (2021)	4
Figure 5: Fifth Orthographic Blueprint, Photoshop (2021)	5
Figure 6: Final Orthographic Blueprint, Photoshop (2021)	5
Figure 7: Incorrect Initial Surfacing Over Wireframe, Autodesk Alias (2021)	6
Figure 8: Side Surfacing, Autodesk Alias (2021)	7
Figure 9: New Surfacing of Bonnet, Side Skirts and Splitter, Autodesk Alias (2021)	7
Figure 10: New Cockpit, Autodesk Alias (2021)	8
Figure 11: Side Detail, Autodesk Alias (2021)	9
Figure 12: Headlight, Autodesk Alias (2021)	9
Figure 13: Cockpit Details, Autodesk Alias (2021)	10
Figure 14: Final Render 13, Autodesk VRED (2021)	11

Bibliography

Bourn, J., n.d. *Meaning of The Color Green* |. [online] Bourn Creative. Available at: <<https://www.bourncreative.com/meaning-of-the-color-green/>> [Accessed 20 May 2021].

Empowered By Color. 2018. *The Color Green*. [online] Available at: <<https://www.empower-yourself-with-color-psychology.com/color-green.html>> [Accessed 20 May 2021].

Lexico Dictionaries | English. n.d. *CONCINNITY* | *Definition of CONCINNITY by Oxford Dictionary on Lexico.com also meaning of CONCINNITY*. [online] Available at: <<https://www.lexico.com/definition/concinnity>> [Accessed 18 May 2021].