Improving Aerodynamics On The Framula E Car

The idea

Our car currently lacks aerodynamics, and this must be improved to make our finishing position lower in the F24 race league. The car's initial frame is quite boxy with sharp corners. This need to be improved so that these parts can direct air better and improve air flow over the car, increasing our efficiency so that we can race further and faster.

Things that could be improved:

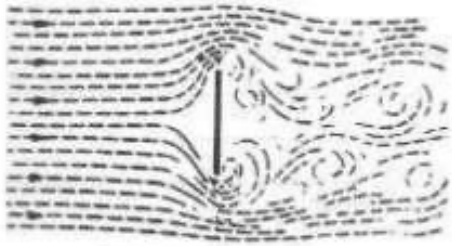
- Wing mirrors
- Rear of the car
- Front axles

The physics behind it:

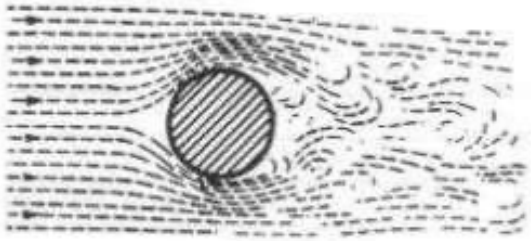
This project is centred around aerodynamics and how different shapes direct air around objects. The main principle is that a smoother shape will increase the efficiency of how the air goes around the car.

The image below shows the main principle of my idea and how different shapes affect the air resistance. The Lower the drag from the air, the more efficient our car will be, meaning that any flat shapes stop the air and creates a vacuum behind because of the low-pressure area that is formed. These flat shapes create a lot of drag behind and reduce the efficiency of the car, I want to reduce the drag, therefore I need to add smoother shapes to the car.

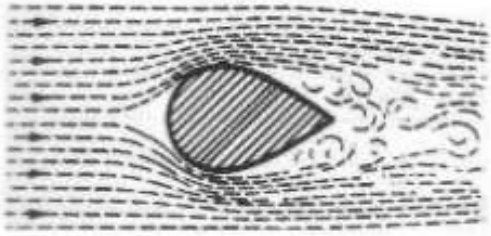
The smoothest shapes are longer with more flowing edges. If we want to increase the efficiency of our car, we want to use these shapes to help direct the air around with the smallest amount of resistance.



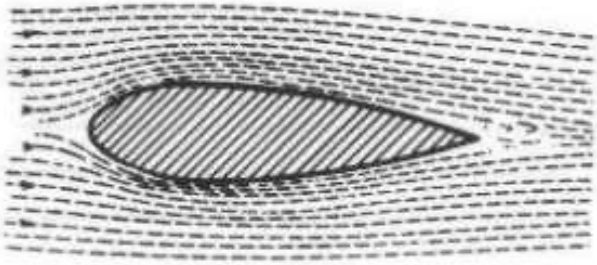
Resistance, 100%



Resistance, 50%



Resistance, 15%

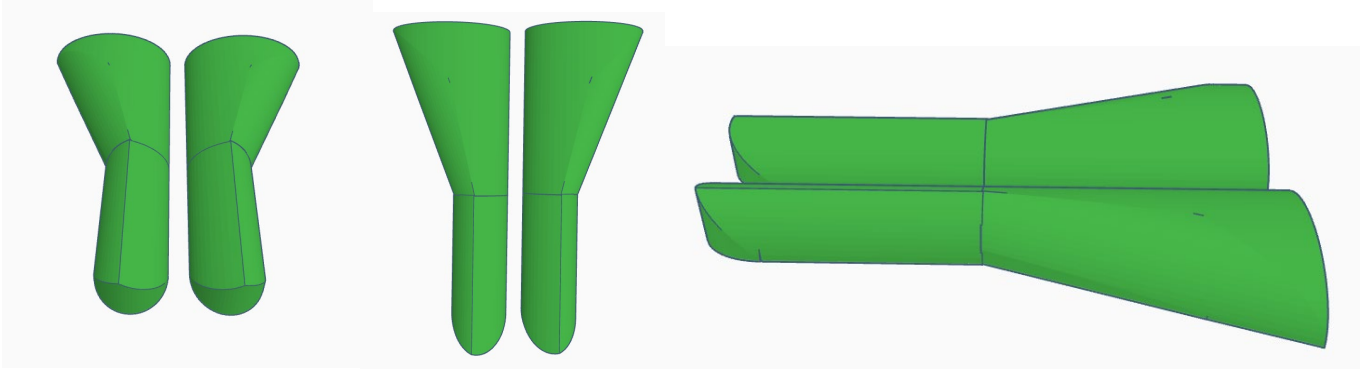


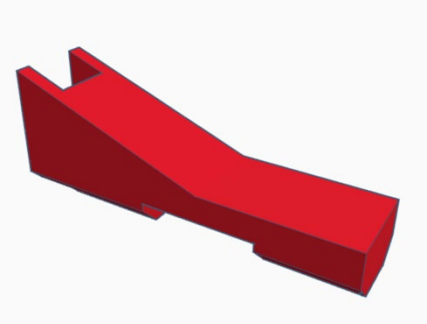
Resistance, 5%

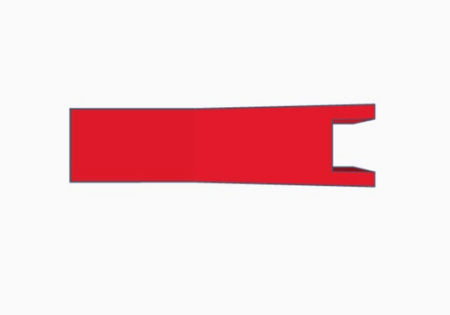
Front axles

Currently, the front axle has a flat spot on it, which wind gets stuck on, reducing the flow over it. This should be improved as this was recognised as one of the car's problem spots.

I designed two 3D printable parts for this area. One to go on the front and direct air around the axle. Also, I designed and printed a part for the inside as I recognised that this was also a point where air could get stuck, reducing the efficiency of the car.

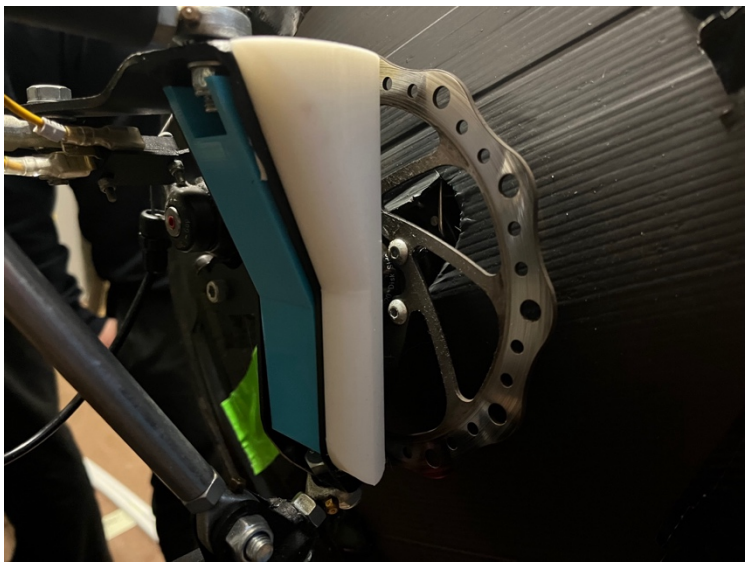






I had to design a few iterations of the front piece to make it fit properly and smoothly. This was needed to make sure that the air flowed over smoothly.

The inside part also had to go through around 3 iterations because the inside of the axle has bolts in it, one at the bottom and one at the top. This meant I had to redesign it multiple times until it fit correctly.



Some pictured of the finished design of the new front axle aerodynamics once they were attached. You can see that the wind can now flow around the front axle easier, meaning that efficiency is improved and none of the air is getting stuck on the axle.

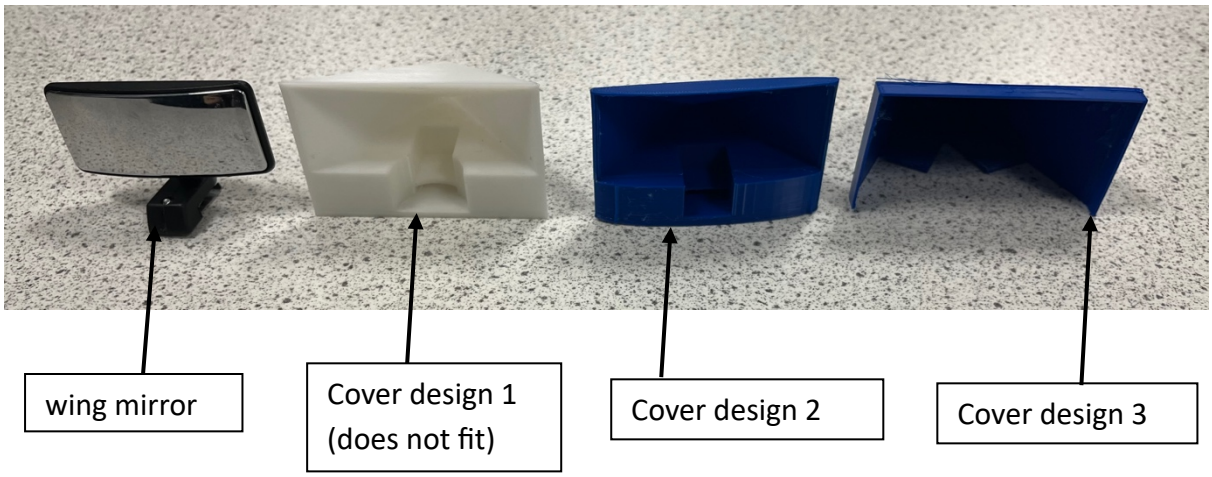
Wing mirrors

currently, our wing mirrors are not very aerodynamic, and this means that we have a slightly reduced efficiency. We can change this by making the air flow over these parts smoother. Having objects that stick out greatly reduce the efficiency and this means we will not go as fast and run out of battery quicker.

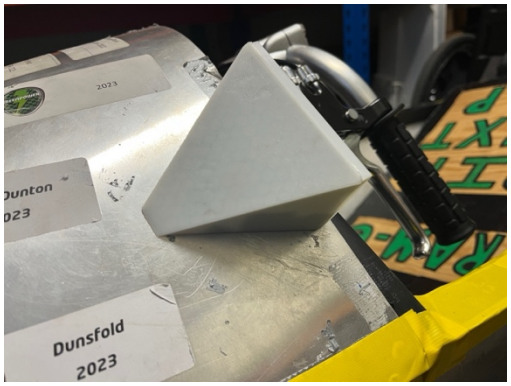
My first idea was to make a cover for the wingmirrors that attaches to the car. The wingmirror then stays in the cover so it can be easily removed.

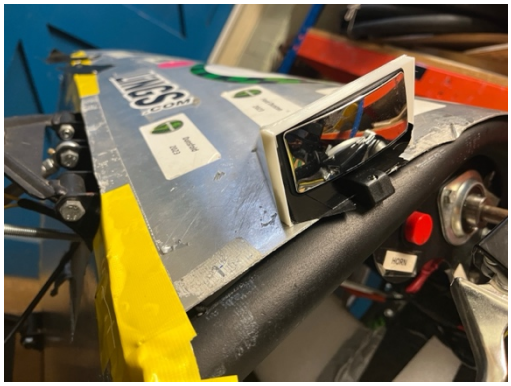
My first design did not fit as the dimensions were slightly off. I had to then change this for a second iteration to make the wingmirror fit. I also made some of the angles smoother so the air would flow better around it.

After this, I decided the weight of the cover was too much. I have now redesigned the wingmirror so that it has a reduced weight. The cover is also closer to the body of the car and does not stick out as much, this also increases aerodynamics. The slope on the back has also been made longer so that the air will flow better over the top.



overall, this improves the aerodynamics greatly. It makes the air flow better over the wingmirror as we are losing a lot of efficiency over it as it is quite a big part that sticks out.





Current wing mirror design:

As seen from the photos (left) my current design reduces the weight of the cover greatly and it also has a more gradual gradient, meaning that the wind can flow over the top of the wing mirrors better, making the efficiency of the car better.

Rear of the car

The rear of F24 cars are incredibly badly shaped in plain kit form. This is because it is boxy, and this increases the drag behind the car.

To decrease this drag, I came up with a design for a back nose cone, which directs the air around the back of the car smoothly, reducing the drag. This is a large area on the car so the improvements I make will make the car's efficiency much greater.

For this design, I first made the design with cardboard to come up with an initial look. After that, I used Correx, which is a lightweight plastic material, which has the same form as cardboard. I used this because it is easy to work with and is extremely lightweight, this means that the weight of the car is not increased by much, When designing this, I had to follow the regulations of the F24 races, which meant there was a limit to how long the back nose cone could be.

After some testing, I found out that I needed to make a hole in the back of the cone. This is because the air that flows into the back compartment of the car (where the motor and batteries are) will get stuck in this compartment and could cause the cone to rip off at high speed due to the pressure of the air. This also means that the motor can have a cooling flow of air as the air flows into the compartment, over the motor and out the hole in the cone.

Underneath, I have included some pictures of the cone. As you can see, it uses the aerodynamic shapes shown at the start. This means that resistance for the wind is reduced, and vacuums are not formed behind the car as this would increase the drag.

Unfortunately, this back nose cone creates a low-pressure zone underneath due to the shape of the bottom and how it goes up to meet the end. This means that air gets sucked into this area and it creates some drag in that area.

Overall, the improvements I have made to the aerodynamics of the car have increased the efficiency of our car. This has also reduced the resistance of the air, which has reduced drag behind the car. This means we can now go faster in races, and we are more likely to last until the end of the race.

In our most recent race, my improvements to the car, along with other improvements such as a new motor and heat sync have increased our position greatly. This meant we made it to the greeenpower F24 international final at Goodwood in early October and we finished 56th internationally and we are now the fastest state school in Norfolk!