



SHEFFIELD
FORMULA
RACING

DECEMBER NEWSLETTER

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Knowledge Transfer

Knowledge Transfer

Knowledge transfer has always been an issue which plagues student-led teams of any kind. As senior members leave, they often take invaluable information with them, leaving behind a blank space which can be quite the task to fill.

Fortunately for Sheffield Formula Racing, we only enrol students at the beginning of their University career, offering as much time as possible to absorb knowledge from those above and around them. We have also found that this pays dividends when our students apply for year in industry placements, as they have a wider knowledge of applying engineering theory into practise.

However, this is no normal year and I'm sure it comes as no surprise that knowledge transfer has been extremely difficult. We are currently in a position where only two out of the four years of the team have had the experience of taking a car through the whole build process - from designing, to build, then racing at Silverstone. It is this process which is key to our understanding of developing a better car each year.

At the end of this academic year, there could be as many as 30 people (over 50% of the team) leaving, again taking vital knowledge with them.

How Are We Overcoming This?

But anyway, enough of the problems. "How are you going to overcome this?" I hear you ask.

As a team, we've always tried to record as much of our process as possible, be this through technical reports or uploading into a shared online drive. However, this year there has been two new additions.

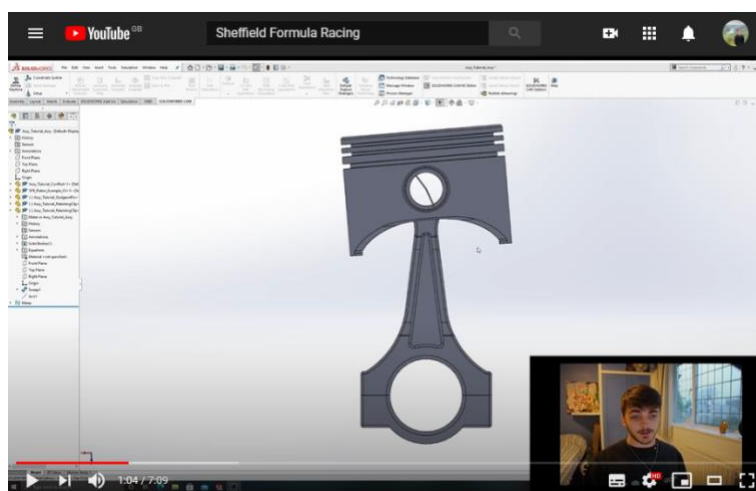
The first was the introduction of Discord as our meeting platform and the sole space for written conversations, rather than the usual Facebook, Facebook Messenger, WhatsApp and Instagram.



SFR have managed to create their own private community, broken down into the sub-teams and areas which reflect the team's function. It offers us the opportunity to carry out virtual meetings, contact specific people or groups within the team, host social events, and record streams of conversation in sections devoted to the topic. This has helped us tackle the communication issues which have arisen during COVID and will likely be a useful tool even after in-person meetings resume.

The second was the launch of a training program aimed at our first years. Its purpose is to equip them with the tools they need to hit the ground running once the building and testing of our car can resume. This includes teaching the basics of using CAD for design, CAM for manufacture, and some practical skills for producing composites and more.

Rather than relying on lecture-style teaching, members of the team have created detailed (and hopefully enjoyable) tutorials which have been uploaded to YouTube so they can be completed at their own pace. Furthermore, uploading to YouTube means these tutorials can be enjoyed by anyone in the wider engineering community.



Check out the videos we've uploaded so far and subscribe for future content coming soon by searching Sheffield Formula Racing on YouTube

Our New Recruits

This month welcomed SFR's new recruits for 2021! We are very excited to announce that 13 talented young engineers in their first year at The University of Sheffield are joining the team after a selection process starting with over 100 students. Although it will be difficult for our first years to develop their skills over the course of this year, the team are doing their best to get them involved as much as possible. Our CAD tutorial videos on YouTube and deep involvement in video calls during our weekly meetings are engaging the new recruits, and will prepare them for the year ahead.



Kai Damani
Mechanical Engineering



Guy Darby
Mechanical Engineering



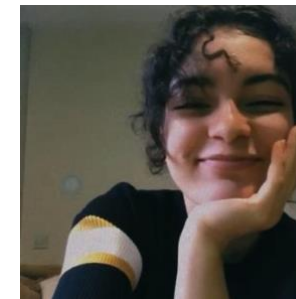
Sameer Malik
Aerospace Engineering



James Cheng
Mechanical Engineering



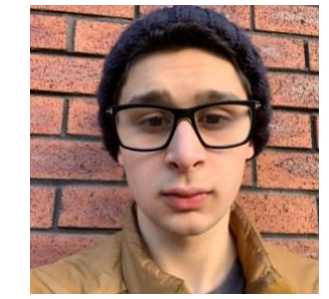
Morgan Manly
Mechatronic and Robotic Engineering



Lara Abouelnour
Mechatronics and Robotics Engineering



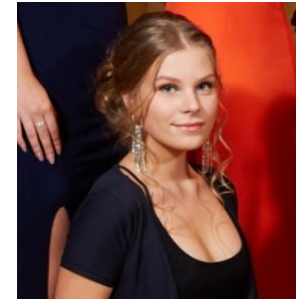
Rahman Pervaiz
Bioengineering



Charlie de Beaux
Electronic and Electrical Engineering



Youssef Elessawy
Mechanical Engineering



Martyna Wisniewska
Aerospace Engineering



Alejandro Burg
Mechanical Engineering



Edward Barganksi
Mechanical Engineering

Ioan-Alexandru Herdea
Robotic and Mechatronic Engineering

TECHNICAL INSIGHT

CHASSIS



TECHNICAL INSIGHT

CHASSIS

What is the Purpose of the Chassis?

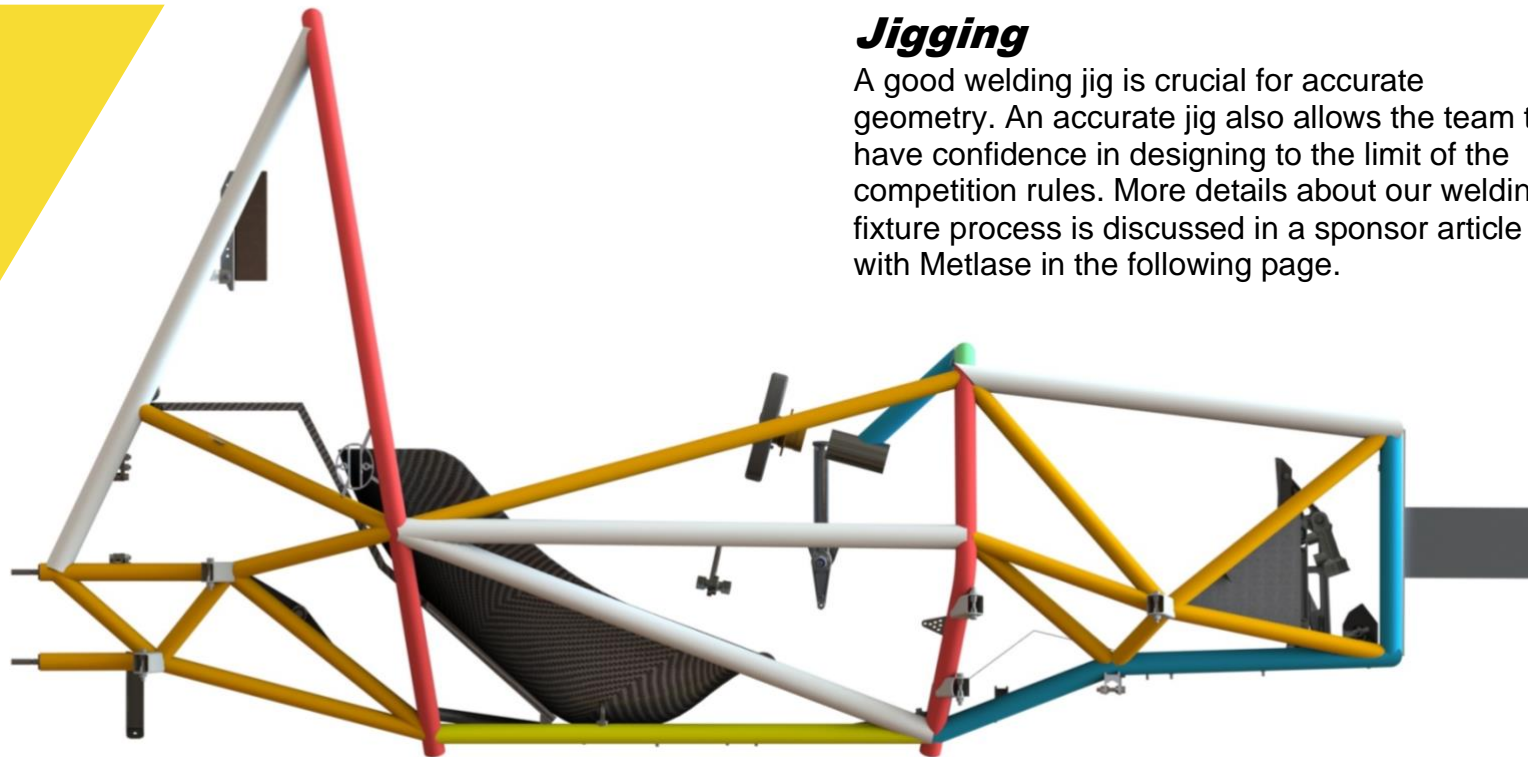
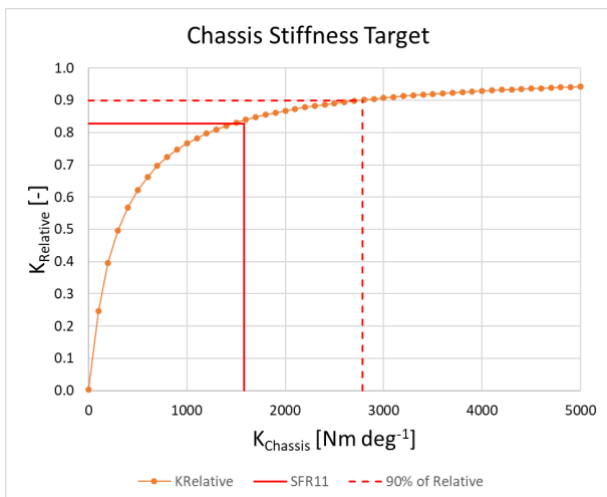
Simply put, the chassis is a subsystem of the vehicle that connects every other subsystem together; it is the vehicle's back bone.

Vehicle Performance

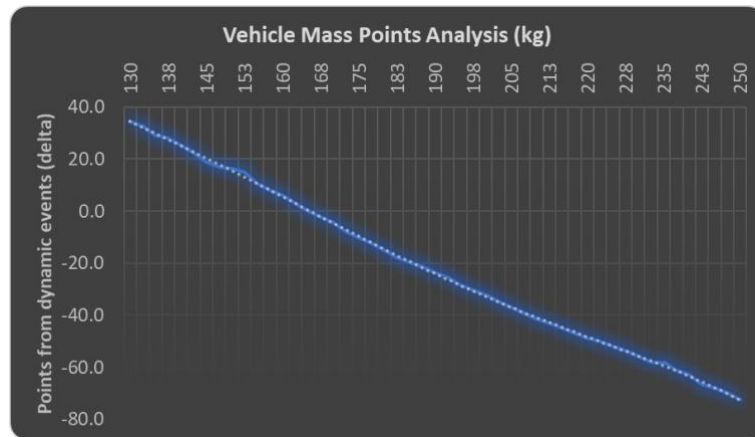
There are two critical parameters of a chassis that effect the performance of a race car. Firstly, its mass, and secondly its torsional stiffness.

Torsional stiffness is paramount to the handling of the vehicle. A compliant chassis will result in poor feedback from the tyres to the driver and unpredictable handling characteristics. However, we find that increasing the torsional stiffness beyond a certain value is not very effective.

In cornering the vehicle can be considered as three torsion springs in series: the rear suspension roll stiffness, the chassis torsional stiffness and the front suspension roll stiffness. Their stiffnesses can be summed to estimate the total vehicle's resistance to torsional deflection. If this is then divided by the total suspension roll stiffness, we can plot the chassis stiffness against the relative stiffness for a rigid case. Here we see that there are diminishing returns after increasing the chassis stiffness, $K_{Chassis}$ beyond 2500Nm deg^{-1} .



Increasing stiffness is generally achieved by using larger and thicker tubes, resulting in increased mass. Using our quasi-steady-state lap time simulation tools, SFR are able to predict the effect mass has on the amount of points scored at competition. The resultant graph is of no surprise – reducing mass equates to a better performing car. Hence, there is fine balance between making a chassis light, yet stiff enough one.



The Tubular Space Frame

Chassis' can come in multiple forms, however, SFR have adopted a steel tubular space frame chassis since their inception 11 years ago. A space frame is constructed from multiple (generally straight) members. They are triangulated at nodes, similar to a truss style bridge, removing bending load which could account for a considerable amount of compliance. A space frame allows for a highly mass efficient structure that is also cost effective.

Jigging

A good welding jig is crucial for accurate geometry. An accurate jig also allows the team to have confidence in designing to the limit of the competition rules. More details about our welding fixture process is discussed in a sponsor article with Metlase in the following page.

SFR11 Aim and Objectives

Aim: Create a system that is suitable for all drivers.

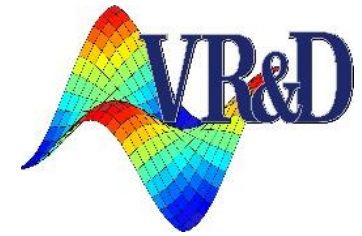
Objectives:

- Improve driver ergonomics by considering all driver heights
- Deliver a chassis earlier than before
- Increase engineering design and optimisation
- Increase the quality of CAD and drawings produced
- Increase the quality of manufactured parts
- Increase communication with other sub teams and aim to meet their requirements

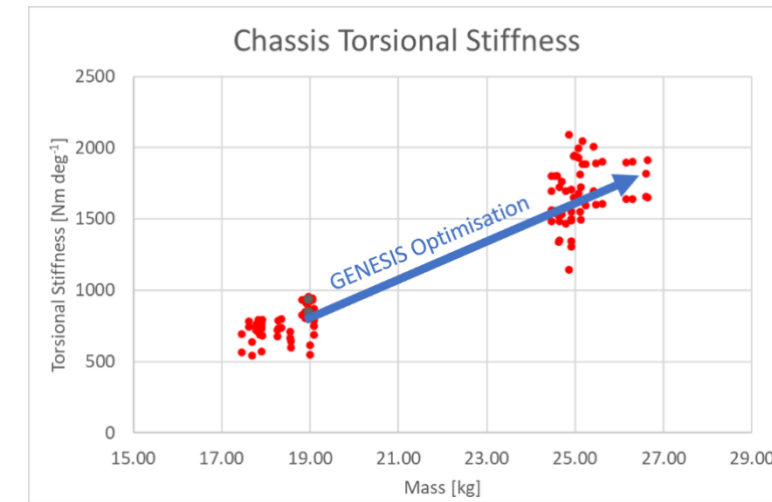
Structural Optimisation with GENESIS

An important stage during our design process is structural optimisation. Traditionally the team builds a finite element model using one-dimensional beam elements and iterates the design using engineering judgment and a trial and error approach. This process typically takes 6-10 weeks of manually adjusting geometry and tube sizes.

However, new for SFR11, a sizing optimisation procedure was performed using GENESIS, which was kindly supplied to us by two of our sponsors: GRM Consulting and VR&D. An objective function was set to reduce the structure's mass, whilst constraining a minimum torsional stiffness equal to 1600Nm deg^{-1} .



GENESIS halved our iteration period and yielded our lightest, yet stiffest chassis to date.



Impact Attenuator

An important safety aspect of the chassis is the frontal impact attenuator. SFR11 utilises a 5052 aluminium alloy honeycomb energy absorber. The structure weighs in at just 365g but is capable of absorbing 7350J of energy and safely decelerating a 300kg vehicle below an average acceleration of 20g. Improvements this year including hollowing the structure to reduce the average deceleration and mass; increasing safety and performance.

Each year the team tests a representative front bullhead and impact attenuator at Cranfield Impact Centre. The assembly is mounted on a sledge before been launched into a hard wall to ensure it meets the requirements set out by the competition rules.



SPONSOR ARTICLE

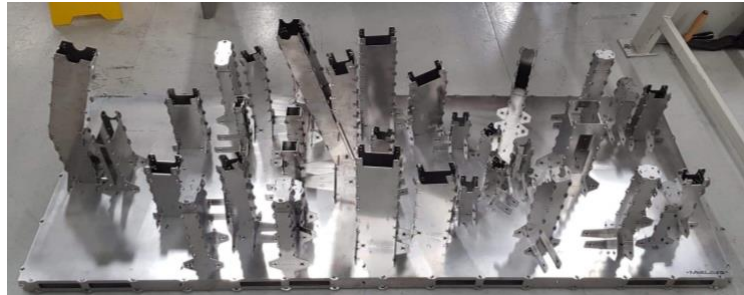
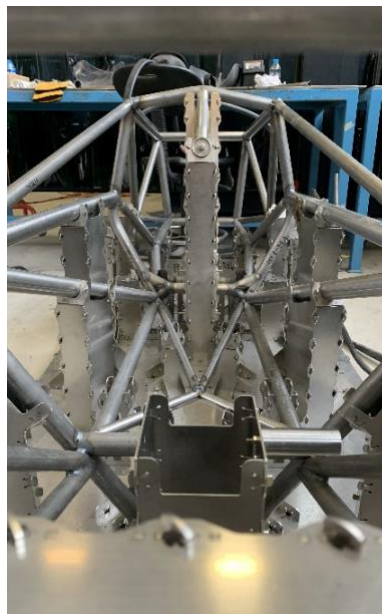
METLASE

SFR has a fantastic relationship with sponsor Metlase. Based at the Advanced Manufacturing Park Technology Centre, Metlase is a joint venture between Rolls-Royce and Unipart. The company utilises patented joining methods, precision laser cutting and press brake bending technologies to solve a vast range of engineering projects. With these available technologies, the company takes pride on being able to solve problems at amazing speed and precision

For the past four years, a handful of students have worked at Metlase to design and manufacture a variety of welding and bonding fixtures for the chassis, suspension, cooling and aerodynamic sub systems. These students are able to learn on the job directly from Metlase's experienced engineers and are quickly involved with the wonderful technologies they have to offer.

Our chassis welding jig is essentially formed from stainless steel towers that hold the tube members and critical bracketry in place for welding together. The laser cutting operation is able to provide an accuracy of less than 10microns, meaning the team is able to have great confidence in the precision of our products.

In previous years Metlase has also provided the team with last minute parts when things have gone wrong. In 2019 our rear wing mounts failed during testing just one month before competition at Silverstone race circuit. Metlase's fast-paced working environment meant that they were able to laser cut a titanium replacement part in just a few days.



The team is extremely grateful for the opportunities Metlase provides for our students. In return, our strong partnership has also seen a handful of team members work for Metlase full time, in the forms of summer placements, years in industry and graduate positions. Any team member who has worked with Metlase holds it in very high regard and Sheffield Formula Racing is very proud to have them as a team sponsor.

Richard Gould, Sales and Business Development Manager at Metlase said "We've really enjoyed working with the student team - the engineering world is desperately in need of new talent and it's great to be working with the best of the Sheffield students who have such a passion and enthusiasm for engineering. It's helpful for us, too, to be working on a project in Motor racing, and sharing our skills and knowledge in mechanical and digital engineering for such an exciting application, and seeing the students adapt their designs to absorb our technology and improve their designs is very rewarding for us. Go team Sheffield!"



"Working with Metlase is a great chance to develop our project working skills in a professional environment and get first-hand experience on how our partners operate in industry".
George Poulter
 2019-2020 Chassis and Driver Environment Leader

ALUMNI ARTICLE

Naomi joined the University of Sheffield in 2014 and was successful in applying to the team during our freshers intake that year. She wanted to join the team as she thought it would be a "great way to explore some hands-on engineering", something that, as academic students we don't always get that much exposure too.

During her time with the team she has held a variety of roles, progressing from Engineer, to Team Leader and finally Team Principal in her final year. Naomi was able to lead SFR to its highest ever scoring competition, where SFR9 came 2nd out of all UK teams at Silverstone in 2018.

The positions that Naomi took on enabled her to developed a variety of skills during her 4 years including: team work, project management, leadership, computer aided design and problem solving.

Naomi told us "SFR showed me that I could apply my theoretical engineering knowledge to a practical task and also gave me transferable soft skills that many companies look for in graduates".

After graduating, Naomi was successful at gaining a graduate scheme with Jaguar Land Rover. Here, she has been working for the Safety Components group on delivering side impact and pedestrian passive safety systems.



NAOMI BASHFORD

COURSE:

MEng Mechanical Engineering

DATE JOINED:

November 2014

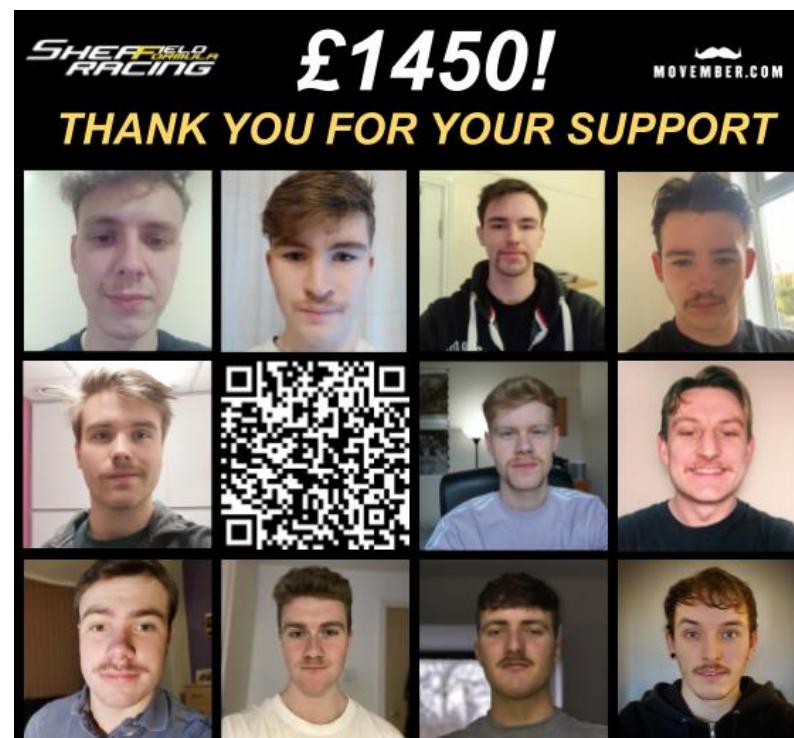
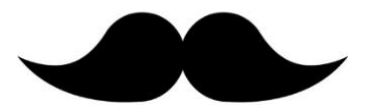
ROLES HELD:

Chassis and Vehicle Dynamics Engineer (2014-2016), Ergonomics Team Leader (2016-2017) and Team Principal (2017-2018)

CURRENT POSITION:

Graduate Engineer, Safety Components Group – Jaguar Land Rover

MOUSTACHES FOR MENTAL HEALTH



During November, 10 team member attempted to grow mustaches for the Movember Foundation.

We would like to take this opportunity to thank everyone that supported the team to raise £1491! Our original target was just £200 so we are overwhelmed by kindness of all of our friends.

The Movember Foundation is the leading charity attempting to tackle men's health. The money raised is used to support mental health and suicide prevention, prostate cancer and testicular cancer

By 2030, their aim is to reduce the number of men dying prematurely by 25%

MERRY CHRISTMAS & HAPPY NEW YEAR

From all of us at Sheffield Formula Racing, we hope you have a merry Christmas and happy new year. Our students will be completing their Autumn semester exams throughout January so our next issue will be during February. Stay tuned!

We are hoping that in the new year Sheffield Formula Racing will be able to return to our workshop and laboratory to bring SFR10 out of retirement for some testing and continue building our SFR11-B car.



SPONSORS

