CO-WRITTEN BY GEORGE POULTER & ASHLEY DAVISON

MEET THE TEAM

SFR11B'S DESIGN TEAM

SAM WILLIAMS

TEAM PRINCIPAL

SOLOMON SMITH

TECHNICAL DIRECTOR

WILLS BLOOM

MANUFACTURING DIRECTOR

DANIEL WESTON

VEHICLE DYNAMICS

MAX POULTER
EDDIE WARDEN
ANTON PARKINSON
JAMES WELLS
ELEFTHERIOS KARAMANIS
OLIVER BUREAU
ISABELLE HUMPHREYS
ALEX SMITH

ED LAVERY HAPPE

AERODYNAMICS

SAM ROUND
DAN PATRICK
ASHLEY DAVISON
LOUIS WAN
JACOB BATES

SAM HARRIS

INTERNAL COMBUSTION POWERTRAIN

OLIVER TIMMS
BEN CLARKE
HARRY WILLIAMS

THOMAS NALSON

CHASSIS AND DRIVER ENVIRONMENT

MICHKA NETTING
JORDAN TURNER
PHOEBE TOLLIDAY
GEORGE POULTER
MATTHEW FARROW

ADAM LAURENCE

ELECTRONICS

AMI JERGER
ZOE PAPADAKOS

JOSH FLETCHER & JACK MISZEWSKI-WALL

VEHICLE OPERATIONS

ROSIE HURCOMBE
JAMES FERGUSON

JAMES WRIGHT

ELECTRIC VEHICLE POWERTRAIN

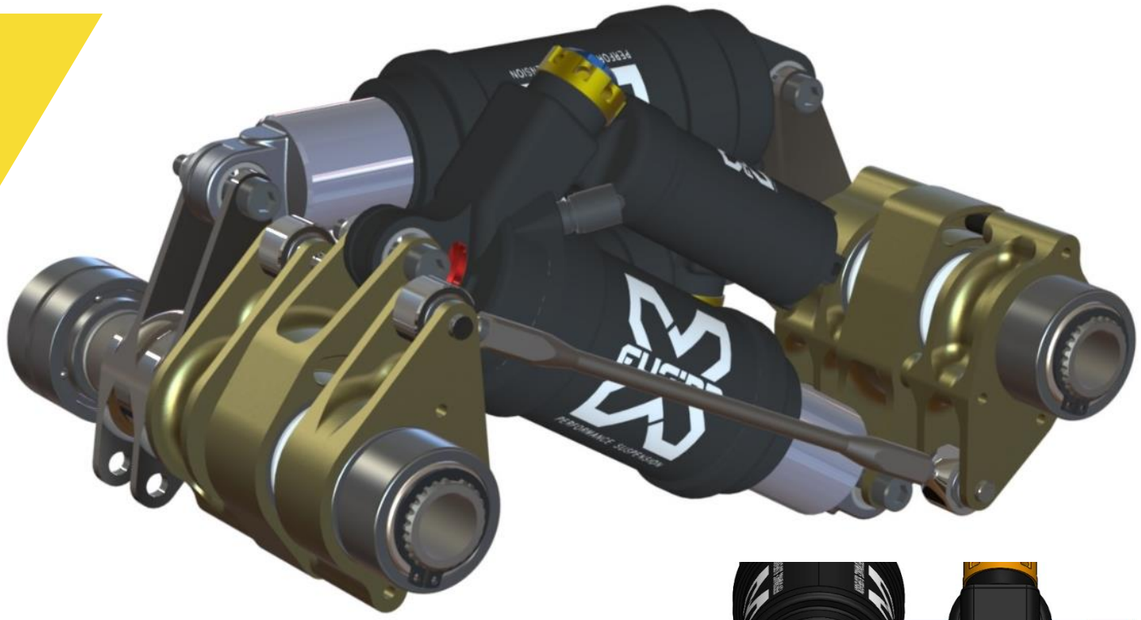
OLIVER PARNHAM
CIARAN BERRY
MATT BOLAND
DAN ELSEY
ABAYOMI OMOTOSHO – IKURU
BOON KEAN TEO

TECHNICAL INSIGHT

INBOARD SUSPENSION

TECHNICAL INSIGHT

INBOARD SUSPENSION



Why Decoupled?

SFR10 saw the introduction of our first aerodynamic package - consisting of a front, rear and side wings. To maximise the aerodynamic downforce that these components produce, the ground effect phenomena is taken advantage of.

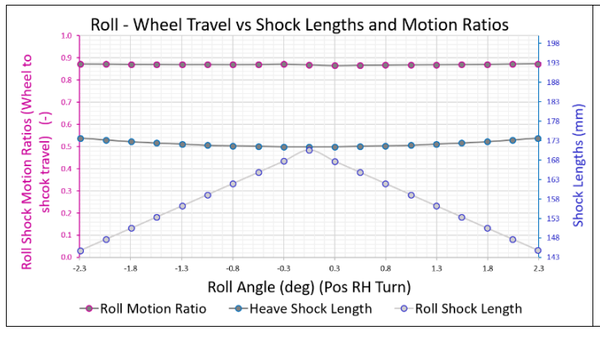
As the car rolls during cornering, or pitches under braking, the downforce generated can change significantly. The same also occurs with ride height. A trade-off between mechanical grip and the additional vertical tyre loads from downforce is required to maximise the vehicle performance.

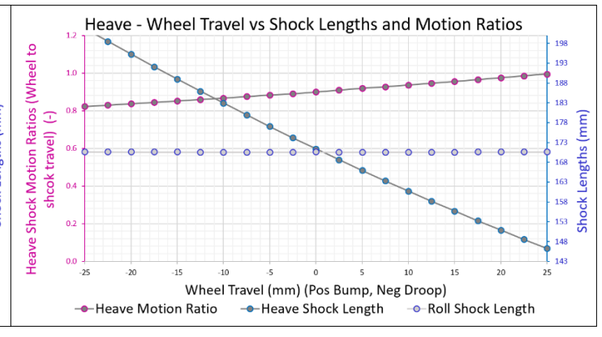
Traditional inboard suspension packages consist of corner springs and dampers and perhaps an anti-roll bar. This style of system can control individual wheel motion, however, chassis modes are all highly interconnected. The design process is therefore usually a compromise between the heave, roll and pitch modes.

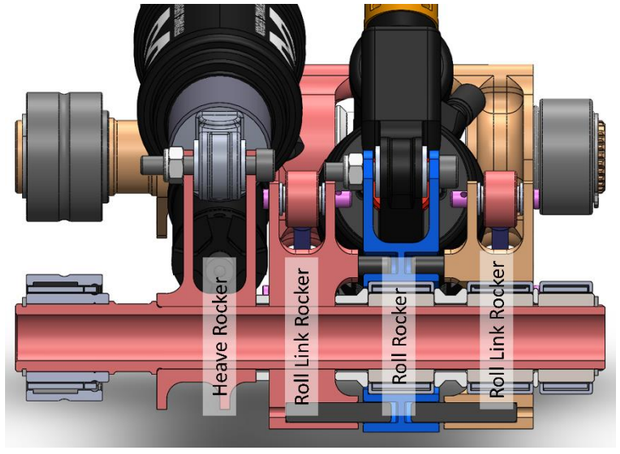
Our solution? A novel, decoupled architecture. A spring and damper unit for heave and roll on each axle has been developed. This has allowed us to independently control chassis heave, pitch and roll stiffness and damping.

"The use of X-Fusion air shocks has allowed us to create a lightweight and tunable package. These weigh just 430g which is about 50% of a conventional coilover. The spring rates can get easily adjusted without disassembly. This means we can extract maximum performance for different race events. They do however have a progressive spring rate which was accounted for in the motion ratio of the bell cranks. We are actively trying to improve of our models to account for thermal effects."

Max Poulter
2019-2020 Vehicle Dynamics Leader







Manufacture

SFR10's design exploited a wide range of manufacturing techniques such as 5-axis machining and electron beam melting. Design oversights meant that some components warped and a compromised steel design had to be used.

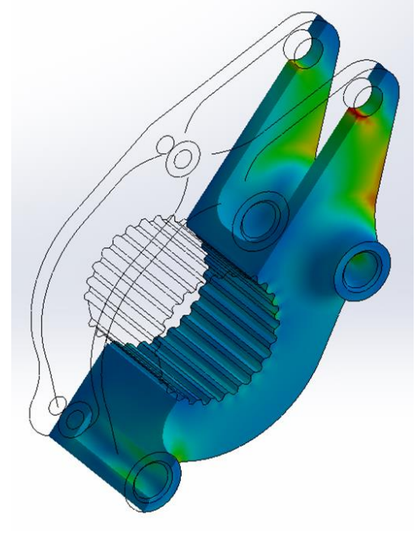
Part of the aim this year was to 'design for manufacture'. Splining was kindly out-sourced to one of sponsors, Agemaspark, whilst the bell cranks are CNC machined at The University of Sheffield's Advanced Manufacturing Research Centre (AMRC). Not only could the new components be manufactured quicker, but also tighter tolerance could be achieved using more traditional techniques.

SFR11 Design

Two horizontally mounted, titanium alloy shafts form the main structure. Torque is transferred from some of the bell cranks to the shafts using splined connections. Others are allowed to freely rotate using needle roller bearings and are connected to their parallel sisters using roll links and contacting dowels. This ensures that as the vehicle rolls in either direction, the roll shock is always compressed. Contacting dowels is a new feature from the previous year's concept; which instead used a 'dog leg' actuation method. The new concept sees improved fatigue life and reduced compliance.

The design process first started by optimising the kinematics in MSC Adams, a multi body dynamic simulation package. A variety of hand calculations were then computed to size initial components such as: bearings, number of dowels, thicknesses and shafts. Next a detailed design was developed in our 3D CAD package, Solidworks.

A mixture of materials are used in the design including: T45 steel, Ti-6Al-4V and 7075 aluminium alloy. This has allowed for a highly optimised construction weighing just 2.30kg per axle. Hand calculations and finite element analysis has been carried throughout the design process to minimise mass, whilst ensuring the required strength and stiffness targets are achieved.



SPONSOR ARTICLE

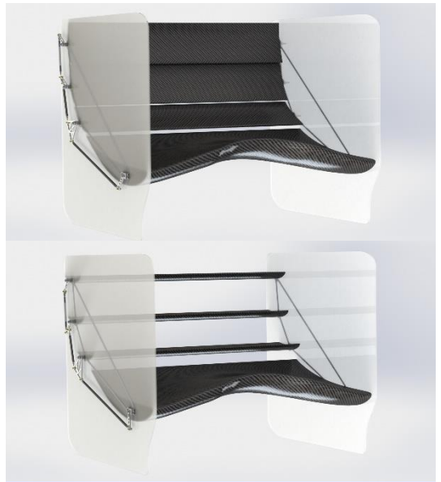
SIMSCALE

SFR are pleased to announce the continued support from SimScale for the 2020-2021 season. SimScale offer a cloud based computer aided engineering (CAE) simulation package to its customers. Their products include: computational fluid dynamics (CFD), structural mechanics, or finite element analysis (FEA) and thermal simulation. SimScale has moved high-fidelity physics simulation technology from a complex and cost-prohibitive desktop application, to a user-friendly cloud application accessible to over 150,000 customers worldwide.

Our partnership initiated during the first UK national lockdown in 2019, during which our third year students were completing a semester long group design project. The project aimed at exploring the benefits of a drag reduction system (DRS) and an un-sprung mounted front and rear wing.

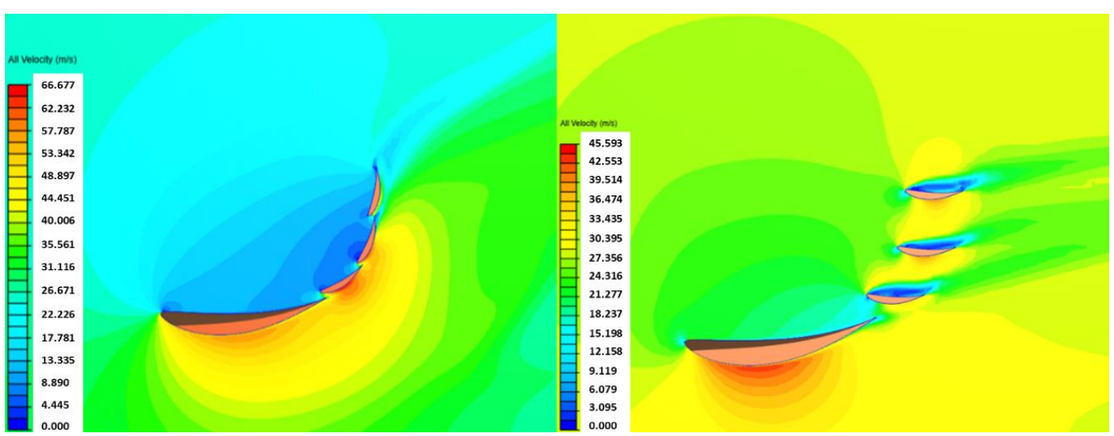
The aerodynamics of the wings were studied using CFD. Traditionally this would have been achieved using high specification computers on University campus. However, when lockdown struck, an alternative solution was required – SimScale.

SimScale allowed the team to complete simulations of the rear wing with 94 cores on their cloud application; using just their personal PC's. Not only did this mean a high amount of computing power could be utilised, but also other work can be completed in parallel as the demand is not coming from the users device. The team found the software intuitive and simple to use and yielded good results. SFR continues to use the software and hopes to expand its knowledge of the toolsets SimScale offers.



"The proposed design reduced the drag produced by the rear wing by 90%. Using lap time simulation tools, it was predicted this would result in a lap time reduction of 0.212s – equivalent to approximately 6.5 competition points."

George Poulter
2019-2020 Chassis and Driver Environment Lead



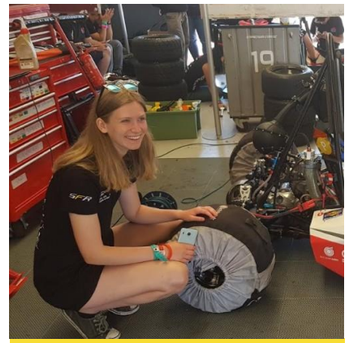
Velocity plots exported from SimScale's post processing lounge

ALUMNI ARTICLE

The first Alumni article in Sheffield Formula Racing's monthly newsletter is Elizabeth Jeffs!

Back in November of 2016, Lizzie joined the university's Formula Student team because it "sounded like a fun and interesting way" to apply the fundamental skills learned throughout her degree. During her time on the team, she has held multiple roles. These have seen her involved in the design and manufacture of composite components, such as the firewall and floor plates. Lizzie was also responsible for the product engineering of the steering system last year. These roles have helped Lizzie develop core engineering skills, such as: project management, professional communication, teamwork, and safety and risk management.

Lizzie graduated from the team this year and was successful in receiving a graduate job at bp as an Automotive Engineer. She believes that her involvement with Sheffield Formula Racing was fundamental towards securing the position. Her role currently involves investigating and developing lubricants for the automotive industry through testing and data analysis.



LIZZIE JEFFS

COURSE: MEng Mechanical Engineering (with a Year Abroad)
DATE JOINED: November 2016
ROLES HELD: Ergonomics Engineer (2017-2018), Vehicle Dynamics and Sponsor Liaison (2019-2020)
CURRENT POSITION: bp - Automotive Graduate Engineer

MOUSTACHES FOR MENTAL HEALTH

A number of the Sheffield Formula Racing crew have signed up to the great Movember challenge for the men's mental health charity.

12 team members are challenging themselves to grow a moustache for Movember to contribute towards a very worthy charity. Mental health, for both men and women, is extremely important, especially in the current circumstances of a national lockdown.

OVER £850 SO FAR!

A big thank you to Jacob Bates, Jordan Turner, Ashley Davison, James Wells, Jack Miszewski-Wall, Alex Smith, Ciaran Berry, Harry Williams, Sam Round and Matt Boland, and to everyone who has donated so far!

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