



**FORMULA**  
**MANIPAL**

*Engineered with Passion*



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- Updates on Formula Manipal
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  - Our journey through Formula Bharat 2023

**FORMULA**  
**MONTHLY**

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January 2023

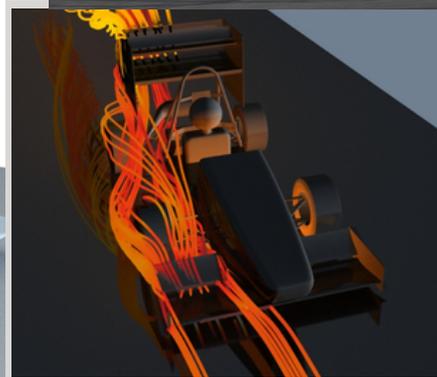
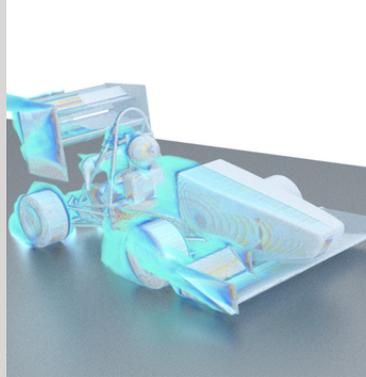
# KEEPING UP WITH FM

"Fast cars are my only vice" - Michael Bay. The first month of the new year has truly been eventful here at Formula Manipal. We participated in our first competition of the year that took place here in Coimbatore, India. We finally got to see our car on the racetrack. The brilliant performance of Formula Manipal at Formula Bharat 2023 has fueled the team's spirit to keep working hard, and come out with amazing, sleeker, faster, high-performance race cars built with each part designed and fabricated with passion up to perfection. We sincerely believe that this year is our year and we hope to bring great success and keep enriching the legacy of the team.

Along with working for the competition, our team has been also researching and experimenting to help improve the car. Here are some of the key updates that happened over the month.

## MECHANICAL

- We designed and ran simulations on a new undertray for the car.
- We also optimized a new aero package (increasing  $C_z$  from 2.6 to 2.8)
- We are also analyzing and testing Brake aerodynamics to determine convective heat loss.
- The primary firewall was modified to accommodate changes made for Technical inspection at FB23.
- Since a secondary firewall was required to protect the driver, an integrated design along with the head restraint was made from 4mm thick Aluminium sheet for which the bracket positions had to be changed.
- An integrated push-bar and quick-jack were manufactured as a more compact and/or efficient solution to the previous separate design.
- Mounting points for the new driver harnesses (FIA 8853/2016 specification) had to be altered.
- During the testing phase, it was observed that the car while downshifting from 2nd to first gear was constantly going into neutral. It was observed that this was due to faulty positioning of the shifter arm. The arm was re-positioned and the issue was fixed.
- A New bevel gear design for the custom open differential which will go in the upcoming EV has been designed. It weighs less and optimum load-bearing capacity was achieved.
- The team is working on designing Center locking wheels which will help reduce the unsprung weight of the car and improve performance.
- Our engine subsystem is closely working on designing a new intake manifold to improve the overall performance of the car.



## ELECTRICAL

- The entire electrical team has been working long nights in the workshop to perfect the design of the new Formula Manipal EV for the year 2023.
- We've completed the generative design of the battery pack segment.
- We've also completed the development of the HV battery pack, 400V 200A.
- The development of the thermal model of the battery pack is currently in progress
- The developments in powertrain cooling of the EV

## DRIVERLESS

- Formula Manipal is also designing its first driverless vehicle for the year 2023. From testing with new camera set-ups to programming and debugging 24/7 our team is confident that this year, our 3-year-long research phase will be fruitful.
- We've implemented real-time pose estimation for perception using the Zed2i camera development kit.
- Hardware-wise, we've also tested motors to help find the perfect solution.



# The Strength Behind the Wheel

## The challenges in F1

It's a debate that rages on among sports enthusiasts across the world - which sport is the hardest in the world? There are many difficult sports out there on a professional level, but there is one in particular that gets left out. In this opinion piece, we make the case for why Formula One racing is the hardest sport in the world. F1 drivers are some of the most elite in the entire world and many sports fans out there might be surprised to know the level of mental and physical strength needed to drive an F1 car, other than the awesome petrol heads reading this of course.

The most common misconception about F1 is that the "drivers are not athletes" and that they simply sit in a car and drive. It is the most ridiculous and frustrating misconception for us F1 fans and petrolheads. Although F1 drivers spend most of their time, sitting inside the restricted cockpit space, they are the most all-around athletes. The repetitive high G-forces that F1 drivers endure during the race are one of the biggest challenges they encounter. In a typical F1 race, the drivers commonly encounter up to 4-5 lateral G forces during braking, turning, or whenever the car accelerates or decelerates between zero and 330+ km/h. When the load is generated through a bend, increased G2-forces cause the driver's pulse rate to elevate and make breathing more difficult.

In order to withstand these forces, the neck, core, legs, arms and the heart are some of the most crucial physical areas developed when becoming an F1 driver. This is achieved through intense training. While other sports do not call for neck strength, it is a must for F1 drivers! Research shows that they have the strongest neck muscles and can shift up to 39 kg, using their necks alone.

A crucial component of a driver's fitness is his core strength. A driver's core strength not only enables him to withstand the high G-forces but also allows the driver to concentrate on corner apexes. A F1 driver must exert enormous pressure on the brakes to stop the car, the magnitude of this pressure is unbelievable! To fully depress the brake pedal, a pressure of 120 bar (122 kg/cm sq.) is required. The driver then gradually releases the pedal because F1 cars lack an anti-locking braking mechanism. Drivers will have to apply the brake pressure approximately 1200 times throughout a race, which is a significant test of leg strength. An F1 driver's fitness depends on his robust cardiovascular system. In contrast to the normal resting heart rate of 70 BPM, a driver's average heart rate during a race is 170 BPM. Grand Prix drivers train vigorously to perform under high cardiac levels. An unprepared driver risks performance loss, which is a very costly mistake for the team. In addition, the driver has to fulfill all these criteria while maintaining his weight on the scale. More weight adds more weight to the car, which results in a loss in lap time.

F1 drivers have a lethal combination of brains and physical fitness. They have the ability to make decisions in split seconds on the race track, while driving at 170mph. A wrong decision can cost them their life. It gives them that edge over other athletes in other sports which people don't realize. The brain is very active throughout the race and gets into gear even before the car does. The driver focuses on their perfect start, the perfect lap. He visualizes his route around the circuit, the corners, the apex at every corner. A lot of things are running through his brain while sitting at his wheel. He has digital displays on his wheel showing everything he needs to see from the cockpit. He has guys in front and back. He is thinking about the braking points, apexes and acceleration points on the track. He is thinking about his strategy. He is thinking about his rivals' strategies. He has his team in his ears constantly voicing times, positions, strategies, speeds and instructions. He carries the weight of expectations of all the people rooting for him to finish first. It is impressive how they comprehend, compute, and respond to so many different factors in less than two minutes, let alone under such pressure. F1 races can be devastating for even a split-second break in concentration. When you make errors in any other sport, you normally get benched, but in Formula One, you risk not just your own life but also the lives of track marshals and spectators. How can we forget about the engineers who work hard on the vehicle, continuously computing, manufacturing, and testing it before it shows up on the race track. On average, Mercedes reportedly employs 1500 people to work on their car each season.

Even though the struggles of the Formula Manipal team are in no way comparable to that of F1 drivers, we can draw lines of similarity between the two, putting into perspective the passion, dedication, discipline and work ethics in the same industry. Formula Manipal members face hurdles of all kinds everyday trying to achieve perfection while balancing academics outside the workshop as well. But the idea that brought together a group of enthusiastic, passionate, disciplined students who share their love for the same goal, bond, and become a family. Not one good deed goes unrewarded, and in this case, being a part of this family and the experience is the biggest reward one can ask for. It is not always about winning, it is the knowledge, the thrill, the legacy, and the entire experience that one gets to be a part of, which is fueled by the passion in us everyday.

# Formula Bharat 23

Formula Manipal put forward a significant amount of effort in the months leading up to Formula Bharat 2023, to get ready for this upcoming national race. In our team's pursuit of perfection, we made every effort, re-checked and tested every component over and over again both separately and together as a whole, and confirmed every bit of data in our presentations to guarantee that we gave both the static and dynamic events of the competition our best shot. Over the course of five days, Formula Bharat hosted participating teams from all over India. All the inspections, tests, and events were conducted during this time. Our team is proud of its achievements secured in Formula Bharat 2023 but there is always room for improvement, so taking in the learnings and knowledge we've received over the span of the competition, we believe that this year is the year FORMULA MANIPAL achieves heights like never before.

## DAY 0

We arrived in Coimbatore at 5:30am in the morning. After a quick breakfast, our team headed down to the competition site to complete on-site team registration for the Combustion team.



## DAY 1

Our combustion team started with the pre-technical inspection round of the competition where the tyres and the driver equipment were carefully examined by the technical judges. After clearing pre-technical inspection, our team started the mechanical inspection round where the inspectors examined the car and pointed out some major and a few minor changes in order to clear the inspection round. The rest of the day was spent in the pits working on the feedback provided after the first intense inspection round.

# Formula Bharat 23

## DAY 2

Our team arrived at the competition site at 0800 hours and started working intensely in the pits. After working on the feedback, our team tried our luck at the mechanical inspection again. This time the judges pointed out a few minor changes to be worked on the car. The rest of the day was spent in the pits to work on those minor changes and make sure that there are no other issues that can be raised on Day 3.



## DAY 3

Our team arrived at the competition site at 0800 hours and started working intensely in the pits. After working on the feedback, our team tried our luck at the mechanical inspection again. This time the judges pointed out a few minor changes to be worked on the car. The rest of the day was spent in the pits to work on those minor changes and make sure that there are no other issues that can be raised on Day 4.

# Formula Bharat 23

## DAY 4

Day 4 was one of the best days of the competition. The team arrived at the competition site at 0800hrs in the morning and the car was taken directly to the tilt test which was cleared! The car was then taken to the third round of technical inspection which was the noise test. The noise test was cleared the same day with our engine roaring at 105dB at 7500rpm. After clearing noise test we progressed to the last round of technical inspection before the much awaited dynamic events. The last test consisted of a brake test. This test required the car to come to a full halt after a small acceleration run, which was cleared the same day. Since the technical inspection didn't go as the team planned, we were unfortunate enough to miss one of the dynamic events that took place that day. After clearing break test and finishing all rounds of the technical inspection, our team was finally ready to face the dynamic events of the competition. Our first dynamic event was the acceleration event. Our team participated in all 4 rounds of the event. Our first round resulted in clocking the fastest time of the event till the end of the competition but resulted in a DNF due to a minor leakage spotted on the track. After a quick fix in the pits, our team re-entered the event and participated in the remaining 3 rounds where we clocked the 4th best time of the competition. The next dynamic event was the Autocross event where our team managed to compete in 2 rounds of the event and secure a podium by achieving a 3rd place in the event.



# Formula Bharat 23

## DAY 5

Day 5 consisted of the most difficult dynamic event in the competition- the Endurance Event where the team had to complete 22 laps(22 kilometers) around the track set up by the competition. The event started off great and our team drivers put great times lap after lap but after an unseen issue, one of the rear left rod ends broke and the car came to a stop. Even though we didnt achieve the results we wanted, the team was proud to come so far and was happy to clear all inspection rounds and compete in the dynamic events scoring a lot of points for the team. After the event, our team packed everything in the pits including tools and other equipment and got ready to leave the competition with a lot of knowledge and just as many memories. A few members stayed back to ensure everything gets shipped properly and later joined the team on it's journey back home.



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