

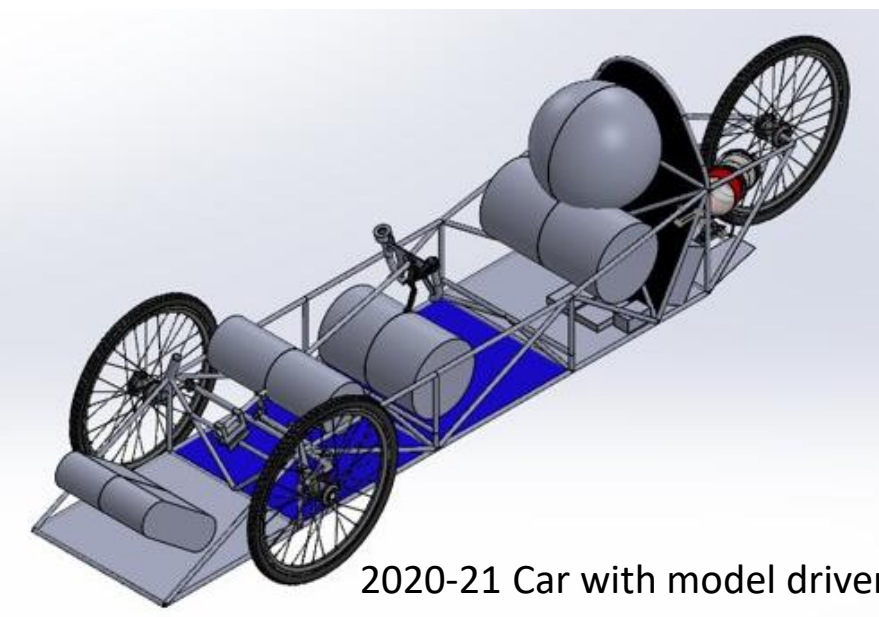
## Abstract

Shell Eco-Marathon is a competition that Trine University has been taking part in since 2014. Each year the task of the seniors on the team is to improve the car from previous year. The 2020-2021 team set out to innovate ideas that would improve the efficiency of the 2019-2020 car. After doing some preliminary research, the team concluded to build a new frame and a body. Those two components of the car are the heaviest compared to the competition, so they needed to be redesigned to reduce weight. 2019-20 car weighs 138 lbs and the goal was to get the 2020-21 car under 100 lbs. Along with building a new frame and body for the car, the team was also able to do some Dynamometer testing and writing a operational manual for it. This was done to capture the drivetrain losses that occur in-between the engine producing power to the wheels translating that power to motion. The report that has been written will offer greater detail to all the mention work.

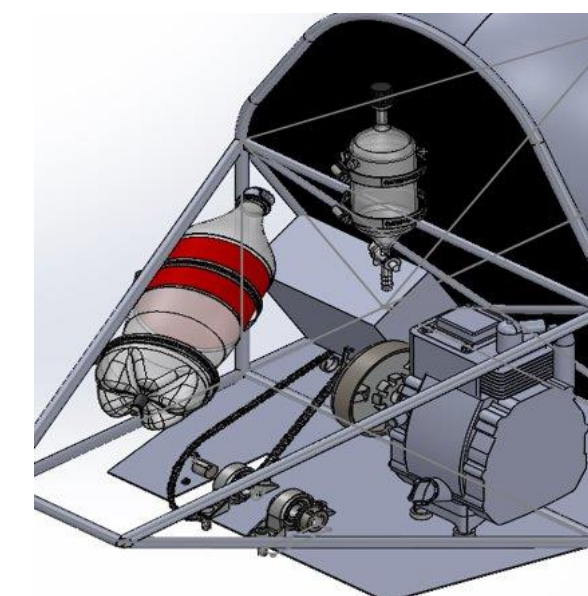
2021 Race was cancelled due to COVID-19 pandemic.

## Customer Needs and Requirements

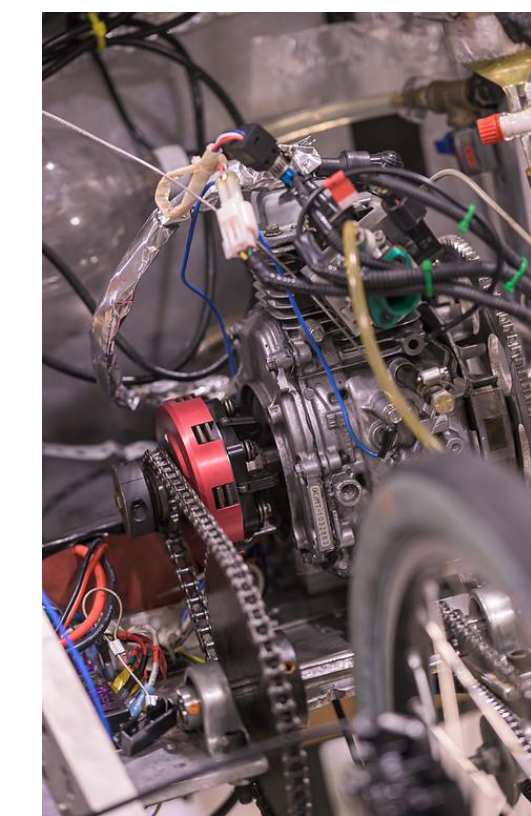
- Complete 6 miles under 25 mins
- A roll bar that can withstand a 700N force in all directions
- Car dimensions must be less than:
  - L: 3.5m x H: 1.3m x W: 1m
- Car must turn under 8m turning radius
- Build a complete car under 100lbs (Frame and subsystems included)
- Driver must exit the car in 10s or less



2020-21 Car with model driver

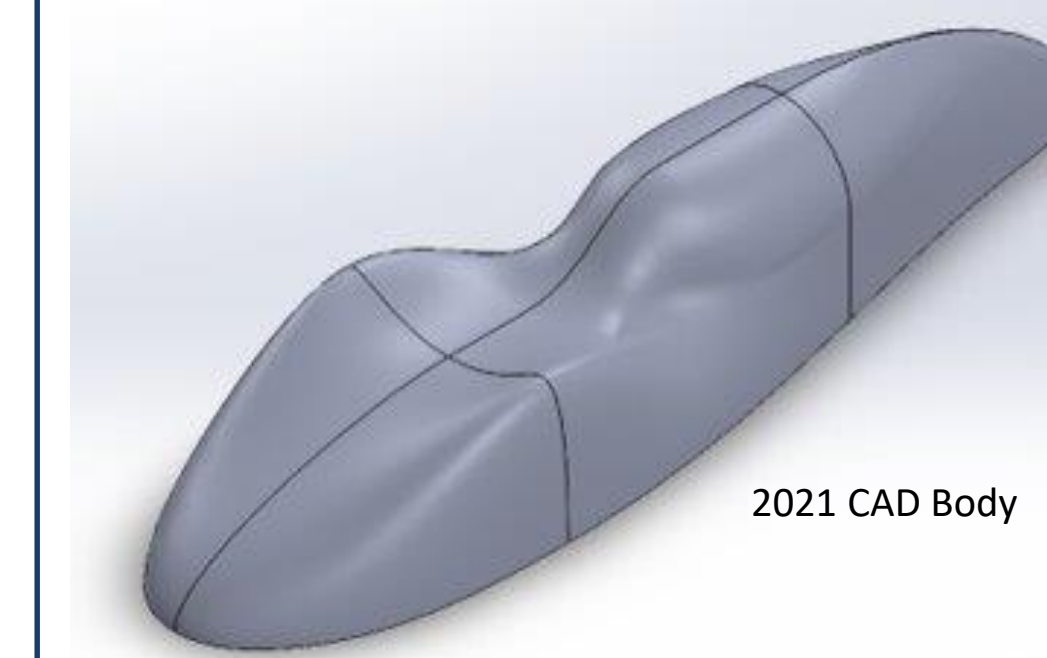


2020-21 CAD for engine compartment



Engine on 2019 car

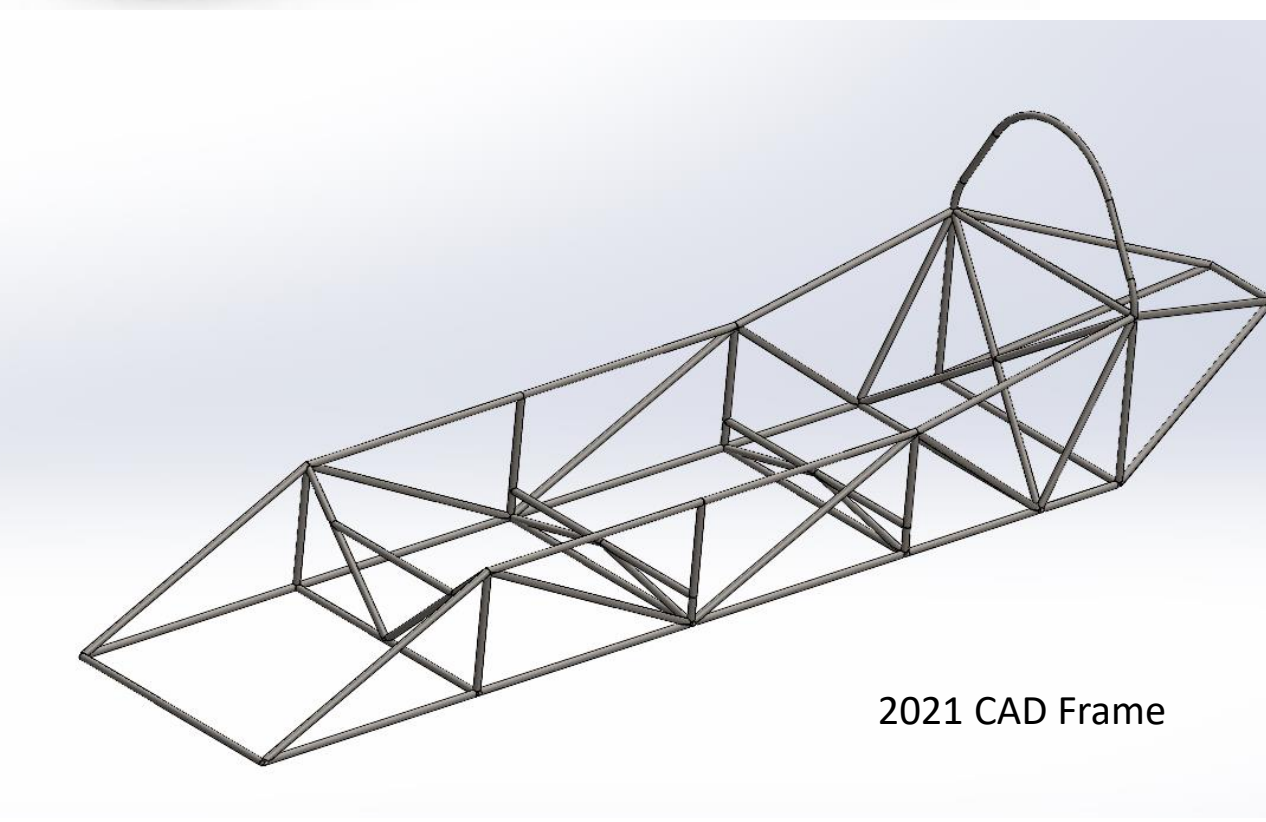
## Concept Selection



2021 CAD Body

### Body final design:

- Material:
  - 2oz Fiberglass fabric
  - 2mm Soric XF
- Predicted body weight:
  - 21.9 lbs



2021 CAD Frame

### Frame final design:

- Material
  - C1026 DOM Steel
  - ½" OD x .035 wall thickness

## Design Solution



Complete frame

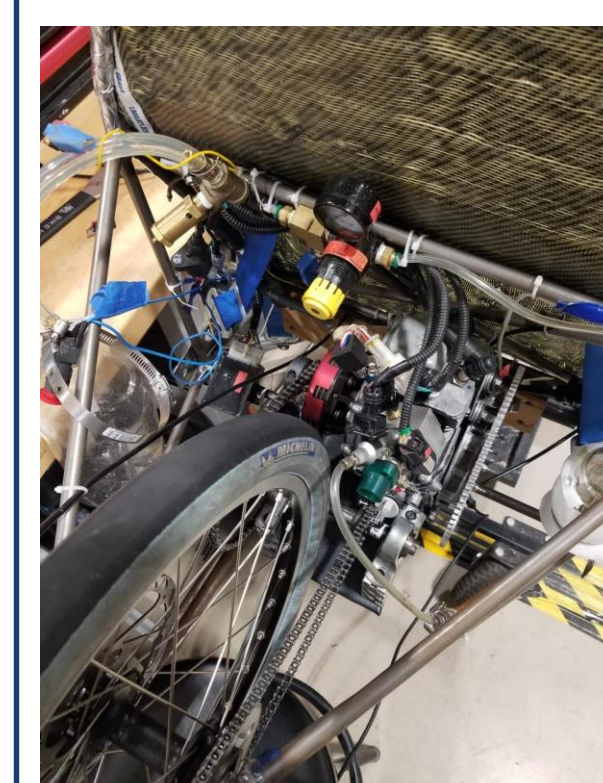
Driver seat with seatbelt and backrest



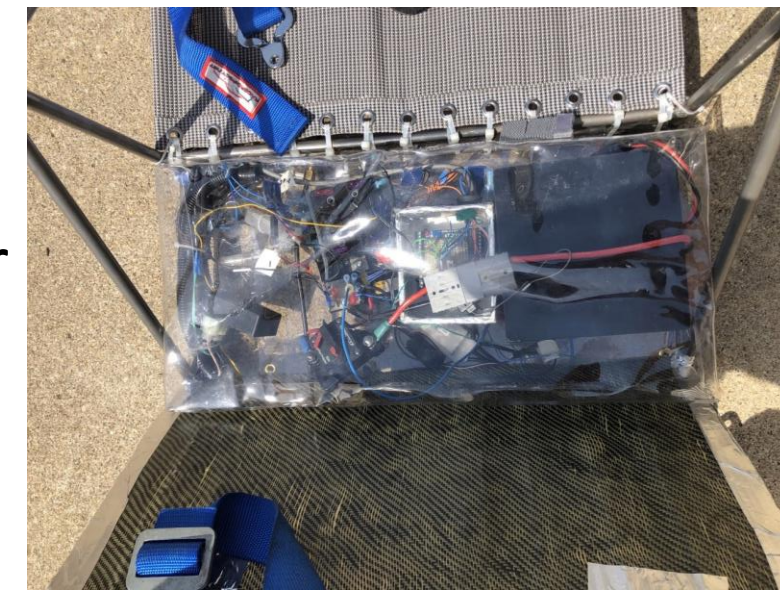
Finished body with some imperfections



Engine compartment



Electronics packaged under clear polycarbonate



## Manufacturing

### Frame Welding



Frame getting prepped before welding begins. This is done to ensure that the frame is level when welding.

### Body



Sanding the Bondo on the body. This is done so that we can achieve smooth surface finish.

### Laying Soric



Soric and fiberglass are being laid in the mold of the body. These materials will be turned into the final body after adding epoxy.

### Vacuum bagging



Taping the vacuum bag around the mold of the car to ensure there is no leakage. Once a vacuum was pulled, epoxy is fed in the mold to evenly coat the fiberglass and Soric. After drying for 48 hours the body is separated from the mold.

### Final body and frame

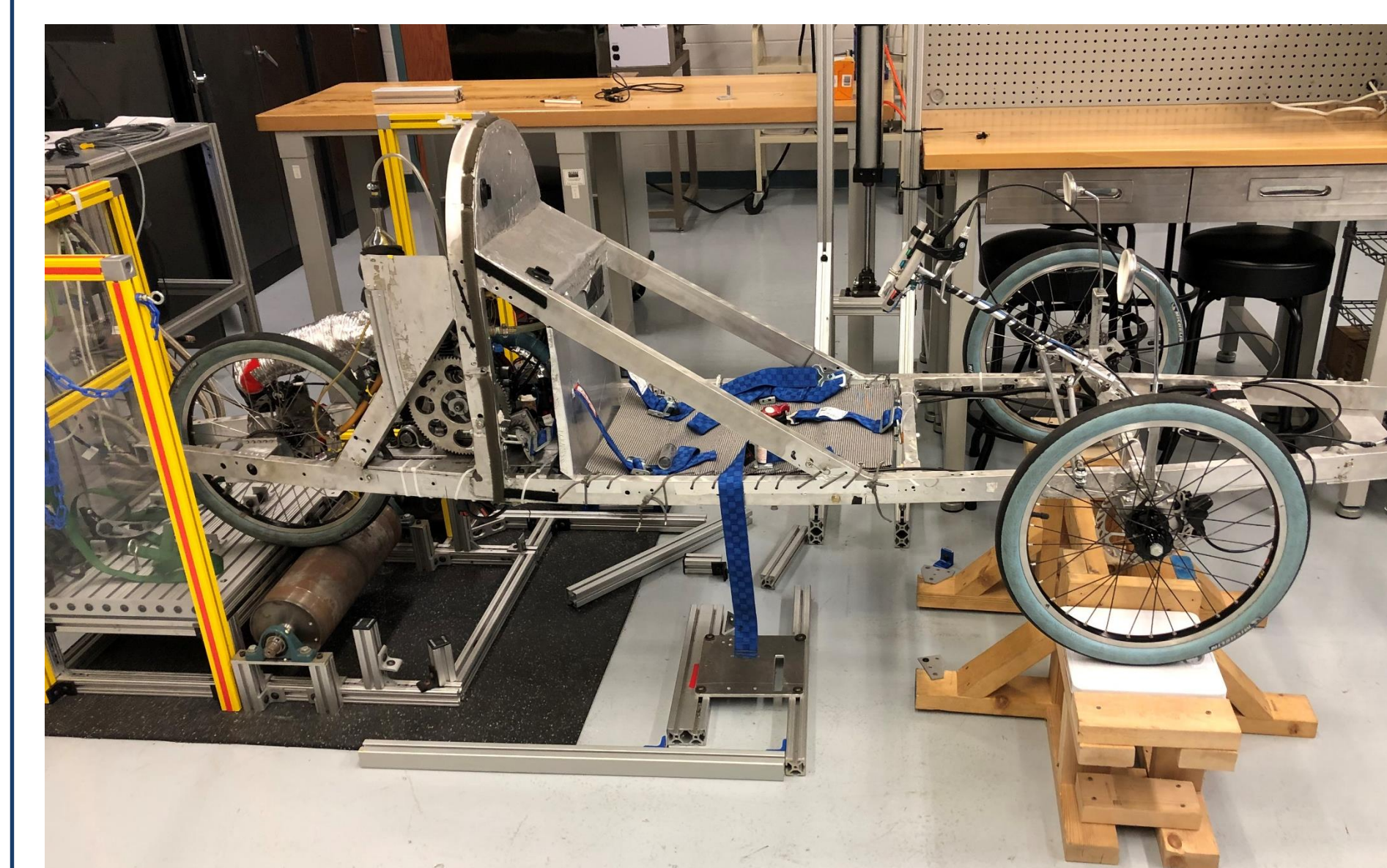


This the final body and the frame for the 2020-21 year, total weight of car 93 lbs. The body will be attached to the frame via plastic pushpin rivets. The body has imperfections that were caused due to some issues in vacuuming bagging.

## Testing and Validation

### Test 1: Dyno Testing

- 2019-20 car was tested on the dyno to understand it's drivetrain losses
- A dyno operation manual was written for future students and professors



### Test 2: Vacuum Bagging Trial Run (Conducted 2 different trials)

- A plastic bucket was used to simulate high walls
- A flat curved piece was used to simulate curves on the body



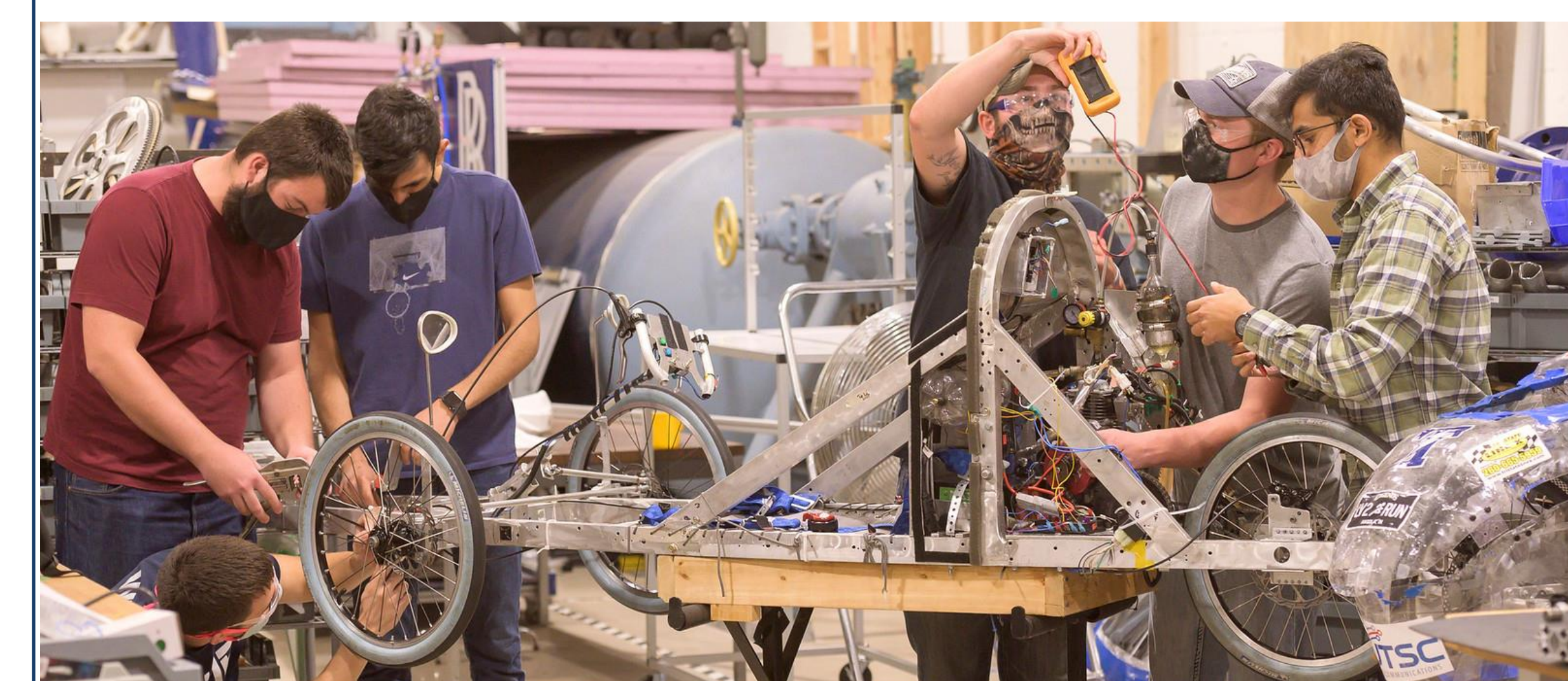
### Test 3: Testing a frame cross member

- Applying a 200lb force on the cross member to test it's strength
- Validation step to verify ANSYS simulation



## Acknowledgments

We would like to thank Dr. Jon Koch, Mr. Joe Thompson, along with the ME Department for their advice and providing assistance whenever needed.



Team working on 2019 car