# Electric Vehicle Design Competition (EVDC)-2022 Final Report

Team sentinels

|  |  |  |
| --- | --- | --- |
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# Problems Identified for design

Before starting our design, we have done a small market survey and found the following problems in EV’s:

* EV cost and battery cost
* Beta version of vehicles
* Temperature Issues
* Charging time

We have seen that now-a-days many electric vehicles are catching fire.

These are the few important problems we have noticed.

We have decided to solve 2 of these problems:

1. EV cost and battery cost
2. Electric vehicles are catching fire

Solutions Chosen

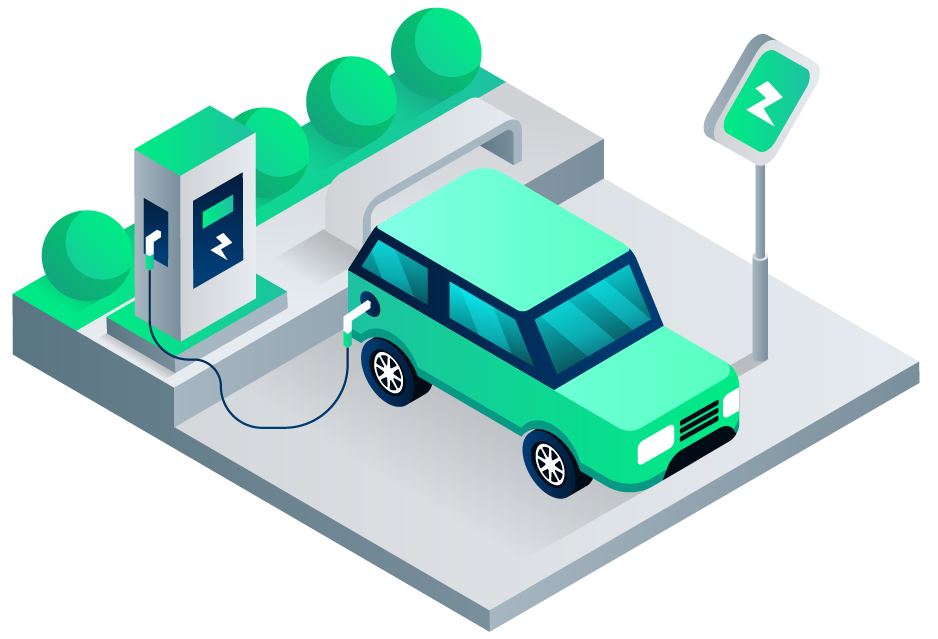
For solving each problem we have approached in a different manner

1. **EV cost and battery cost:**

To reduce cost of the vehicle we have used AISI 1018 as our chassis material. Because of which we had to compromise on our vehicle weight. We have decided to have some partnerships with Battery manufacturers and try to get batteries for a discounted price.

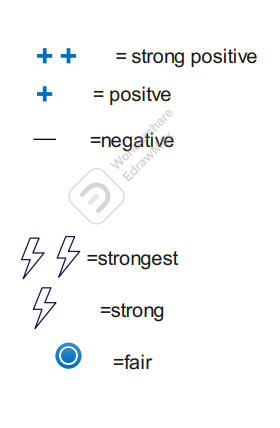
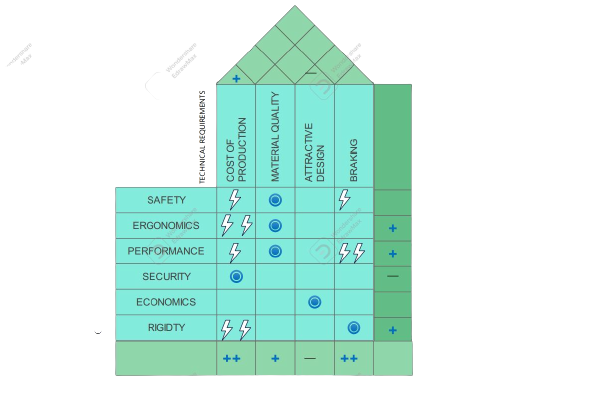
**2.Electric vehicles are catching fire:**

To overcome this we have installed a smart system which would detect if there is any smoke or temp rise in the battery and if the temperature exceeds the optimum value it will give a buzzer sound. Also it will send a message to the owners phone notifying him the same.

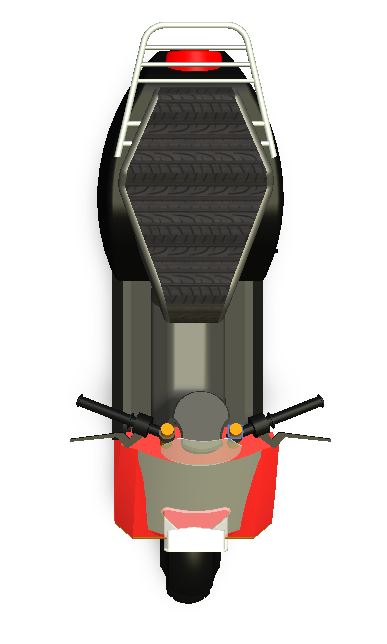




Quality Function Deployment (QFD)

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## Vehicle views

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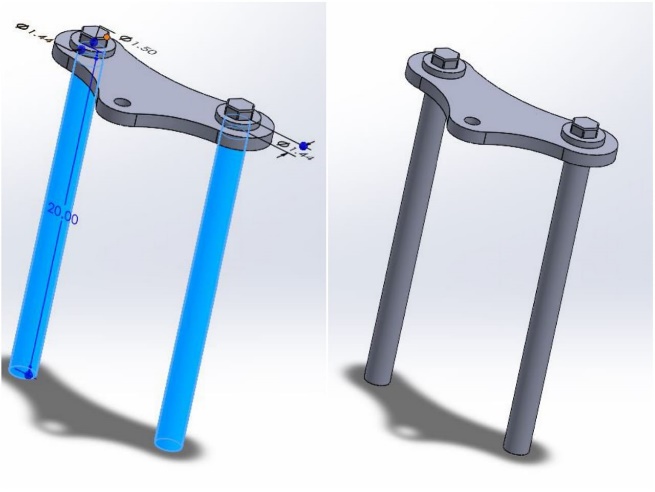
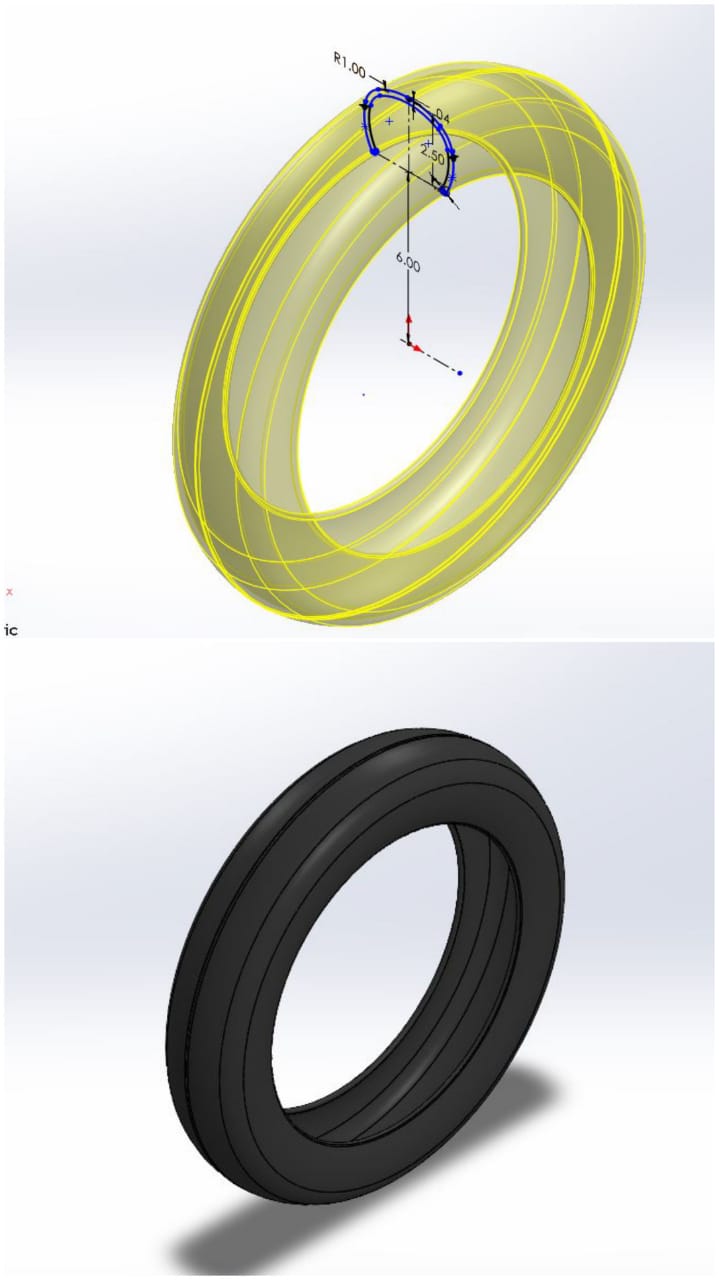
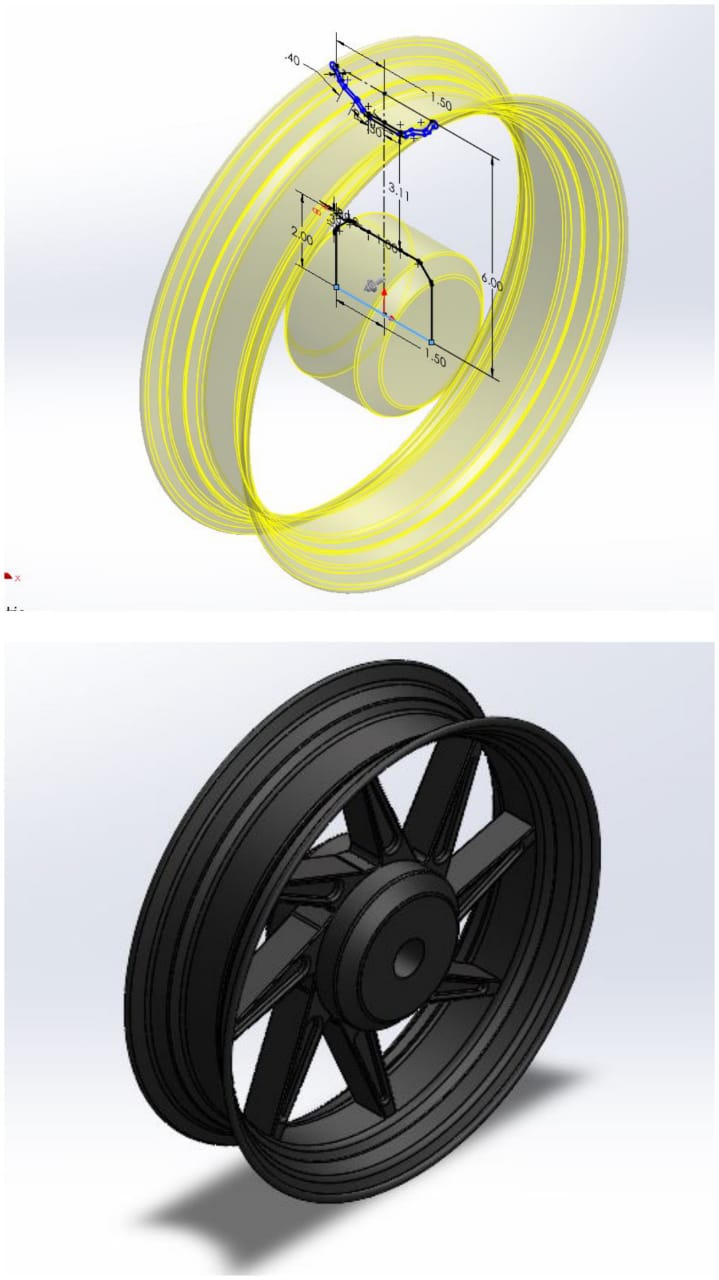
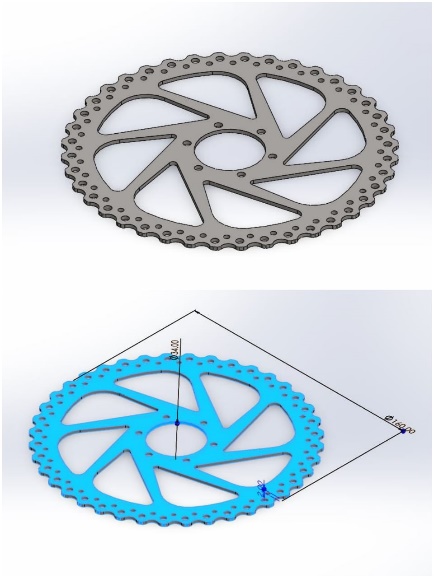
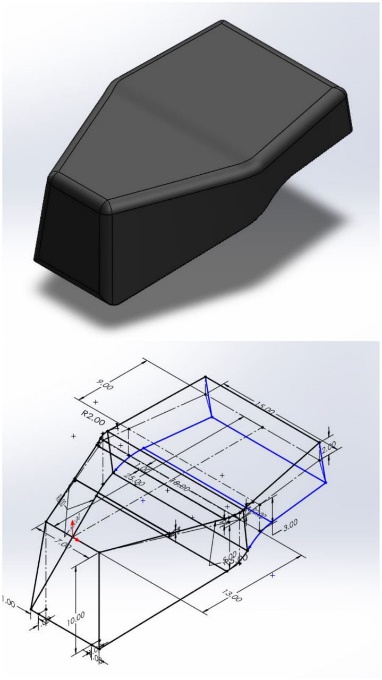
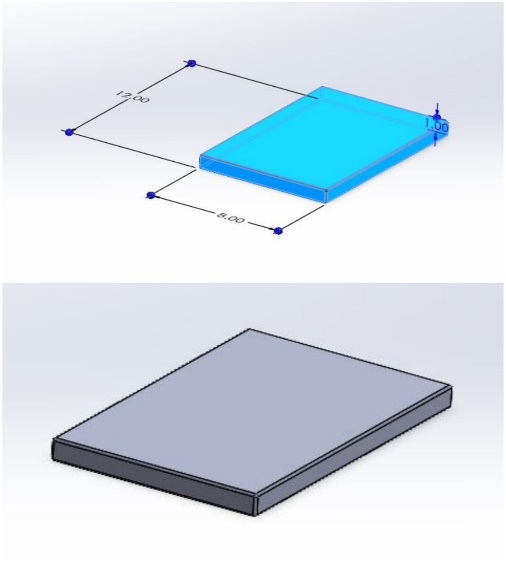
***Top View***

***Isometric View***

***Front View***

***Side View***

## Details of individual components

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Disc

Seat

Wheel

Wheel

Suspension Telescopic Fork

Tyre

Tyre

Battery

# Details of design

**Suspension:**

**Front suspension:**

We have used telescopic front suspensionsTelescopic shock absorber is a mechanical or hydraulic device designed to absorb and damp shock impulses. Hydraulic shock absorbers are used in conjunction with cushions and springs. An automobile shock absorber contains spring-loaded check valves and orifices to control the flow of oil through an internal piston. Telescoping Shock Absorber is a type of Hydraulic shock absorber

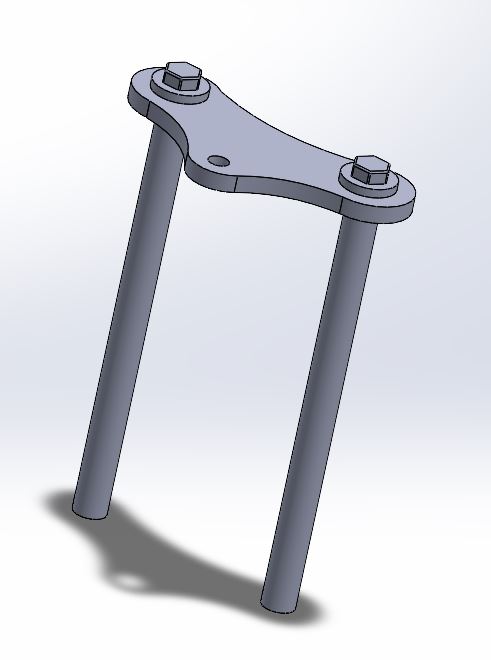
**Calculations:**

Bike weight = 80kg

2 persons weight = 200kg

Mass(m) = 280kg

Weight = 2744 N

Front suspension = 0.5 × 2744 =1372N

W = 1372×1.5 = 2058N

τ = 470 Mpa

G =72000 Mpa

C =7

δ =80 mm

K= w/δ =2058/80 =25.725 N/mm

Kw = (4c-1/4c+4) +0.615/C = 1.21285

τ =Kw(8wc/3.14×d²)

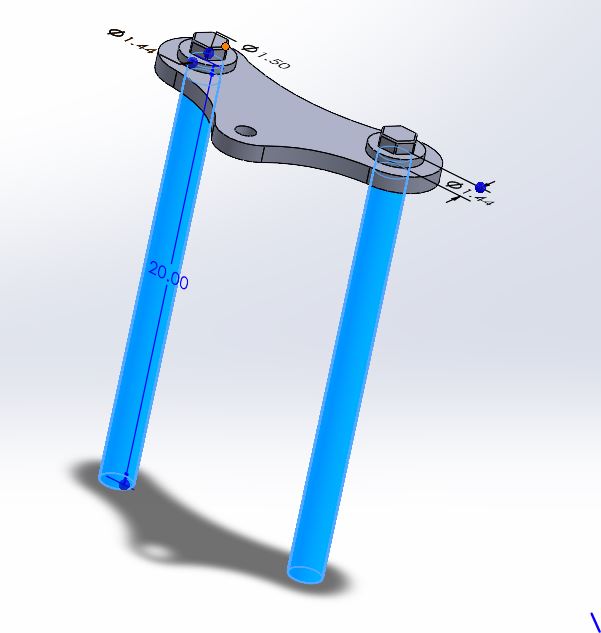
d² =94.71

d =9.73 mm

D =c×d =68.11mm

No.of turns

K= Gd⁴ / 8D³N = 25.725

N = 10

Total turns = n= 12

Lₛ =n ×d = 116.76

Lբ = free length = 116.76 +δ +δ×0.15 =208.76

Pitch = p= Lբ /n-1 = 18.97 mm

D (outer) = d+D =77.84 mm

D (inner) = d +D= 58.38 mm

**Rear Suspension:**

We could choose either a monoshock or a twin shock suspension system

1. When maneuvering is more convenient, because the focus is on a single point load, so when passing through ramps bend and swing hole softer springs. That's what makes the system more comfortable than double monoshock shock.

2. Motorcycle performance using a mono shock suspension system is more stable than using a double shock. Because the focus is on a single point load in the middle of the swing arm, so that when the time passes embankment sharp, uneven roads and ramps, mono shock remains stable.

3. A twin shock suspension system if improperly tuned, can cause a torque to develop in the swingarm.

4. A monoshock weighs less than a twin shock system.

Therefore, taking into account, the above factors, along with cost, weight, availability, maintenance and complexity, we have decided to use the monoshock rear suspension

**Calculations:**

2 persons weight = 140kg

Load = 84 kg

Total load =84 +80 = 164kg

Load shared by 2 shock absorbers

So half of the above =82 kg

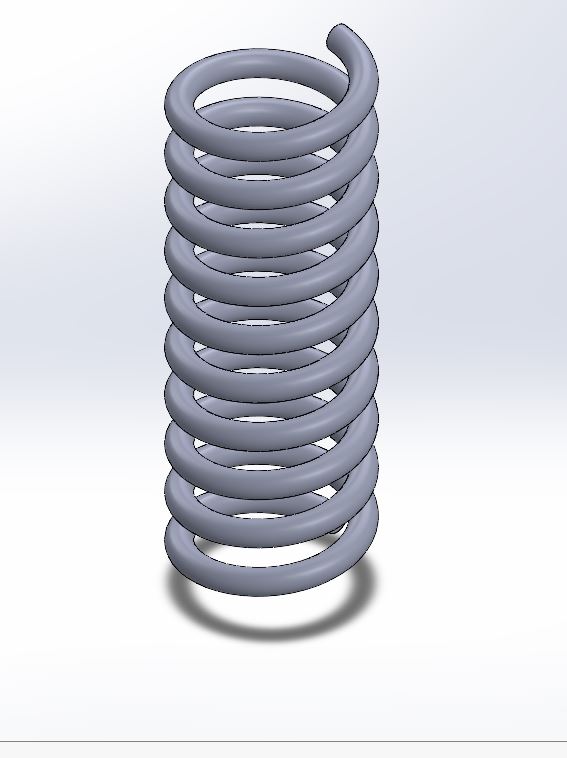
W =mg =803.6N

Material stainless spring

G=69000N/mm²

Dₘ = 46.25 mm

d = 8mm

****Dₒ =56 mm

nₜ = 14

n = 12

C= Dₘ/d = 5.7 mm

Lբ =200mm

Lₛ = 112mm

P= (Lբ-Lₛ/nₜ-1) +d =14.76mm

K= 1.2674

δ = 25.88 mm

τ = k8wD/πd³ = 283.6 Mpa

K =29.75 N/mm

**Braking:**

Mechanical disc brakes are being used on all motor vehicles. Pascal’s Law/ Principle of transmission of fluid pressure. Dual pull lever is used for the front wheels (one brake lever-dual cable pulls). They have high heat dissipation capacity as it has many holes on the disc.

**Brake specification:**

Independent disc with lever actuation.Disc brakes are used over cantilever brakes for the following reasons:

1. Disc brakes have much higher mechanical advantage. This makes it easier to stop with less hand effort.

2. Disc brakes even grab better in wet conditions.

3. Lighter and cheaper with added easy mounting and maintenance.

4. High durability.

5. Moreover, Rubber pads need frequent replacement.

6. Compared to drum brakes, disc brakes offer better stopping performance, because the disc is more readily cooled. Due to greater number of holes on the disc

**Calculations:**

Vehicle speed = 35kmph = 9.72 m/sec

Mass = 250kg

Rotor Radius (R)= 101.6mm

R (rear) = 152.4mm

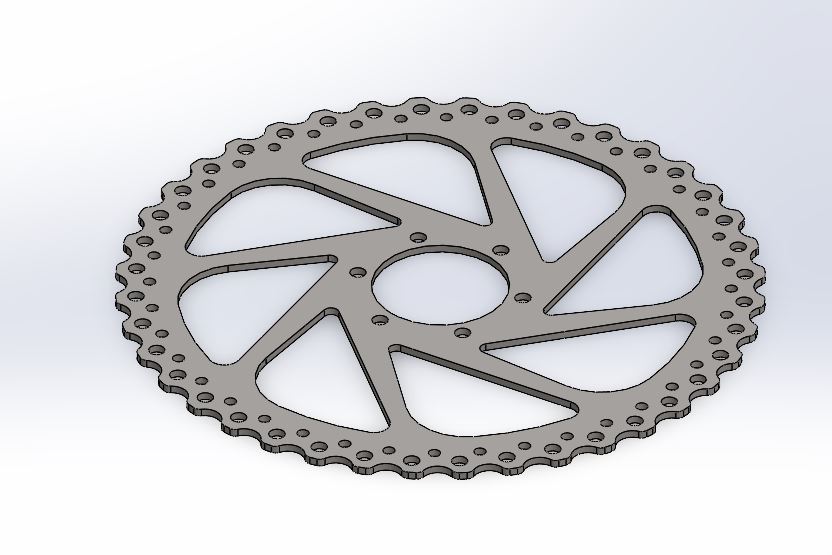
R( front) = 152.4mm

Area = 1000mm²

μ = 0.5

Pressure (p) = 3.5 Mpa

n = 2

Fᵣᵢ = (p/2) ×A

= 1750N

Ftᵣᵢ = μ × Fᵣᵢ

= 0.5 ×1750 = 875 N

Fc =2 (Ftᵣᵢ) = 1750 N

Tb = Fc × R

= 1750 × 101.6 = 177.8Nm

Fᵣ =177.8/0.152 = 2339.47 N

Wheel base (L) = 1.23 m

Ground clearance = 135mm

μ' = 0.7

Centre of gravity (x) =0.64m

Front axle (h) = 0.58 m

d =(L×μ' × Fբ)/m(Lx -μh)

= (1.23 ×0.7× 1169.73)/ 250(1.23×0.64-0.7 ×0.58)

d = 10.60

Stopping distance (s) = v²/2d = 9.72²/2 ×10.60

S = 4.45 m

**Disc dia** : 9.4 inch

**Disc thickness:**4mm

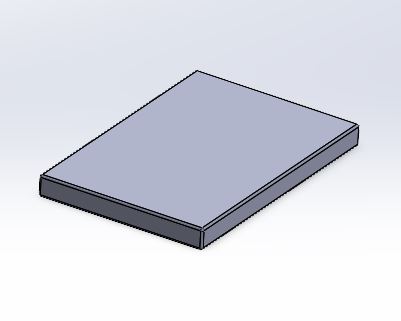
**Transmission system (Electric drive) :**

Transmission system is a battery powered drive train (rechargeable battery). The function of electric drive system is the conversion of electrical energy produced from the battery into mechanical energy to propel the vehicle using brushless DC motor.

**Battery specifications:**

Nominal capacity=65ah

Charging capacity =67.2v

Standard charging current= 5A-10 A

Maximum continuous discahrging current =50A

Weight=16 kg

Dimensions= 420×220×170mm

Cycle life=>800 times

**Motor specifications**

Rated power= 3000 w

Peak power= 3100 w

Peak current= 50 amp

Weight = 10 kg

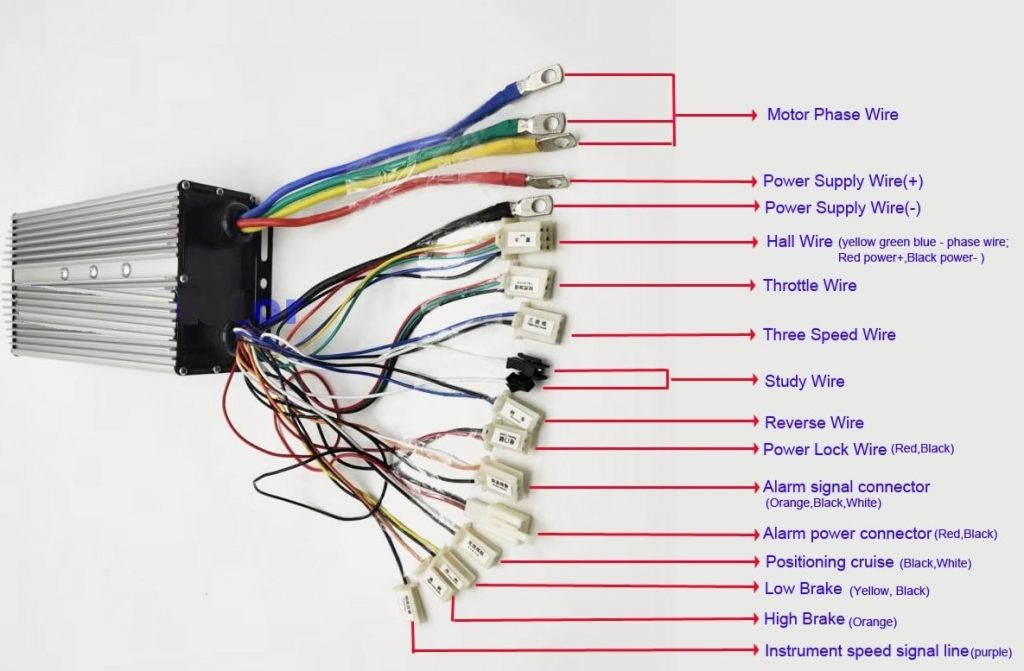
Maximum speed= 4200rpm

Rated speed= 65kmph

Top speed= 70kmph

**Controller specifications**

Rated voltage: DC60V

Rated current: 70A

Maximum power= 3000w

Low voltage

protection:DC50±0.5V

Maximum temperature(°c) = -20 to 50

Color: Silver

Cost: 11,989

Weight:2.753kg

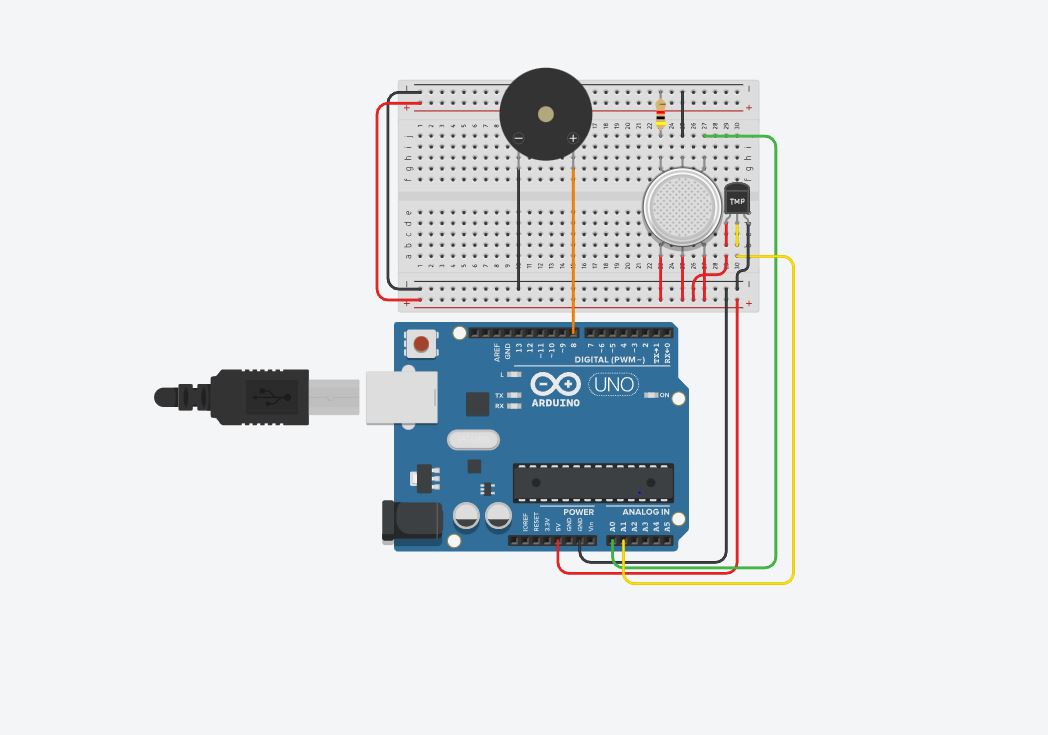
Dimensions=260×120×65 mm

# Innovation

Now a days most of the Electric vehicles are catching fire. To rescue this we came up with a small innovation. One temperature sensor and one gas sensor are placed near the battery. These are connected to Arduino via breadboard. A buzzer is also connected to Arduino. When there is temp rise in the battery, the temperature sensor senses it and sends a warning alarm. Similarly whenever the gas sensor senses any gas , it sends a warning alarm.

We have achieved this using Arduino as microcontroller.

**Schematic:**



**Code:**

int MQ2\_pin = A1;

float gas\_value;

int buzzer=8;

int sensePin = A0; //This is the Arduino Pin that will read the sensor output

int sensorInput; //The variable we will use to store the sensor input

double temp; //The variable we will use to store temperature in degrees.

void setup() {

// put your setup code here, to run once:

Serial.begin(9600); //Start the Serial Port at 9600 baud (default)

}

void loop() {

// put your main code here, to run repeatedly:

sensorInput = analogRead(A0); //read the analog sensor and store it

temp = (double)sensorInput / 1024; //find percentage of input reading

temp = temp \* 5; //multiply by 5V to get voltage

temp = temp-0.5; //Subtract the offset

temp = temp \* 100; //Convert to degrees

gas\_value=analogRead(MQ2\_pin);

if((50<temp<80) && (300<gas\_value<470)){

tone(buzzer,1000);

delay(1000);

noTone(buzzer);

}

else if(temp>80)

{

tone(buzzer,1000);

delay(1000);

noTone(buzzer);

}

else if(gas\_value>470){

tone(buzzer,1000);

delay(10000);

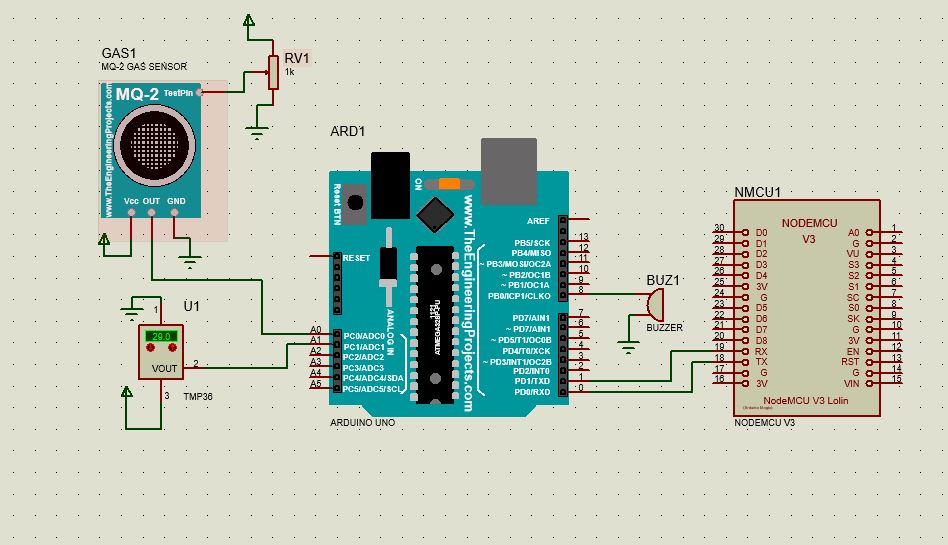
noTone(buzzer);

}

}

We can still devolop this innovation by sending a text message to the owner of the vehicle. This can be done using node-mcu and cloud platforms like IFTT,ThingSpeak.

**Schematic:**

****

**Code:**

**Arduino:**

int MQ2\_pin = A1;

float gas\_value;

int buzzer=8;

int sensePin = A0; //This is the Arduino Pin that will read the sensor output

int sensorInput; //The variable we will use to store the sensor input

double temp; //The variable we will use to store temperature in degrees.

char mystr[6];

void setup() {

// put your setup code here, to run once:

Serial.begin(9600); //Start the Serial Port at 9600 baud (default)

}

void loop() {

// put your main code here, to run repeatedly:

sensorInput = analogRead(A0); //read the analog sensor and store it

temp = (double)sensorInput / 1024; //find percentage of input reading

temp = temp \* 5; //multiply by 5V to get voltage

temp = temp-0.5; //Subtract the offset

temp = temp \* 100; //Convert to degrees

gas\_value=analogRead(MQ2\_pin);

if(50<temp<80 && 300<gas\_value<400){

tone(buzzer,1000);

delay(1000);

noTone(buzzer);

mystr="both";

Serial.write(mystr,5);

}

else if(temp>80)

{

tone(buzzer,1000);

delay(1000);

noTone(buzzer);

mystr="temp";

Serial.write(mystr,5);

}

else if(gas\_value>400){

tone(buzzer,1000);

delay(1000);

noTone(buzzer);

mystr="gas";

Serial.write(mystr,4);

}

}

**Nodemcu:**

#include <ESP8266WiFi.h>

#include<ThingSpeak.h>

#include<WiFiClient.h>

WiFiClient client;

const int httpPort = 80;

const char\* host = "maker.ifttt.com";

const char\* ssid = "abhi";

const char\* password = "abhi01234";

char bin[5];

void setup() {

// put your setup code here, to run once:

WiFi.begin(ssid,password);

Serial.begin(9600);

}

void loop() {

Serial.readBytes(bin,5);

// if stected waste has moisture content

if(bin=="temp"){

if (!client.connect(host, httpPort)) {

Serial.println("connection failed");

return;}

String url = "/trigger/BIN\_1/with/key/m7dMFf-5rWz8jfbbD1nx13g9qJYXAfOGonmhZWP2w7H";

Serial.print("Requesting URL: ");

Serial.println(url);

client.print(String("GET ") + url + " HTTP/1.1\r\n" + "Host: " + host + "\r\n" +"Connection: close\r\n\r\n");

Serial.write("f",1);

delay(10000);

}

else if(0.4<percentage<=0.85){

if (!client.connect(host, httpPort)) {

Serial.println("connection failed");

return;}

String url = "/trigger/BIN\_1/with/key/m7dMFf-5rWz8jfbbD1nx13g9qJYXAfOGonmhZWP2w7H";

Serial.print("Requesting URL: ");

Serial.println(url);

client.print(String("GET ") + url + " HTTP/1.1\r\n" + "Host: " + host + "\r\n" +"Connection: close\r\n\r\n");

Serial.write("f",1);

delay(10000);

}

else if(bin=="gas")

{

if (!client.connect(host, httpPort)) {

Serial.println("connection failed");

return;}

String url = "/trigger/BIN\_1/with/key/m7dMFf-5rWz8jfbbD1nx13g9qJYXAfOGonmhZWP2w7H";

Serial.print("Requesting URL: ");

Serial.println(url);

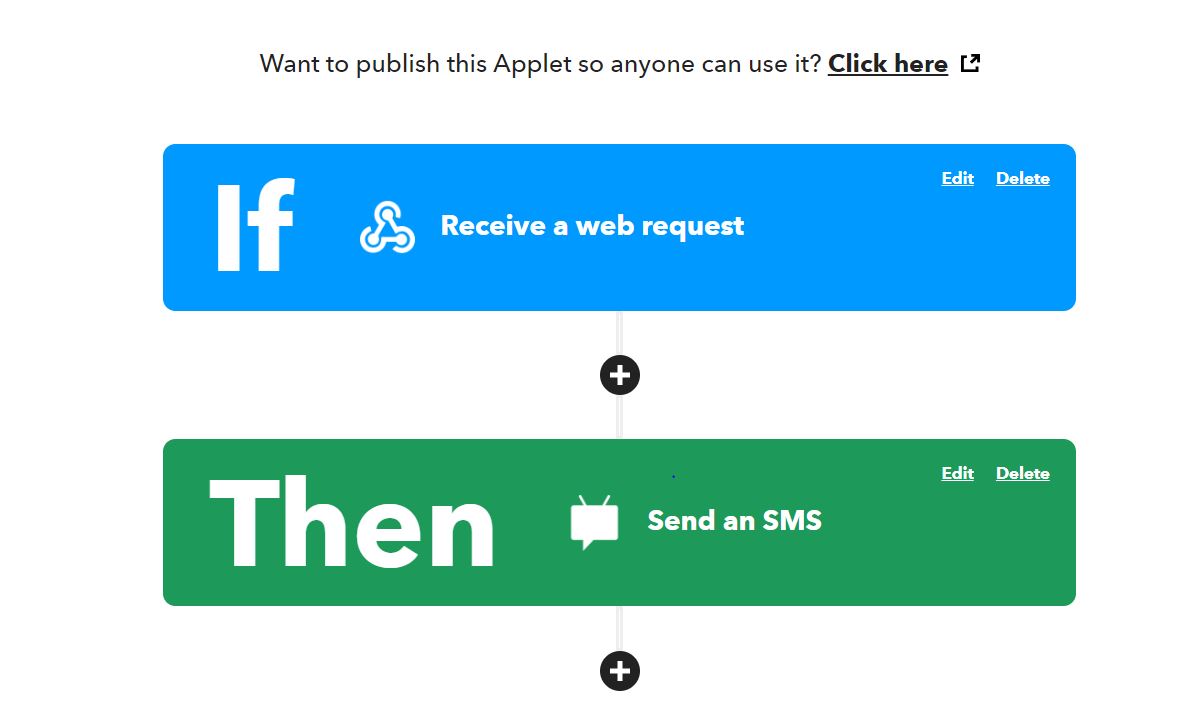
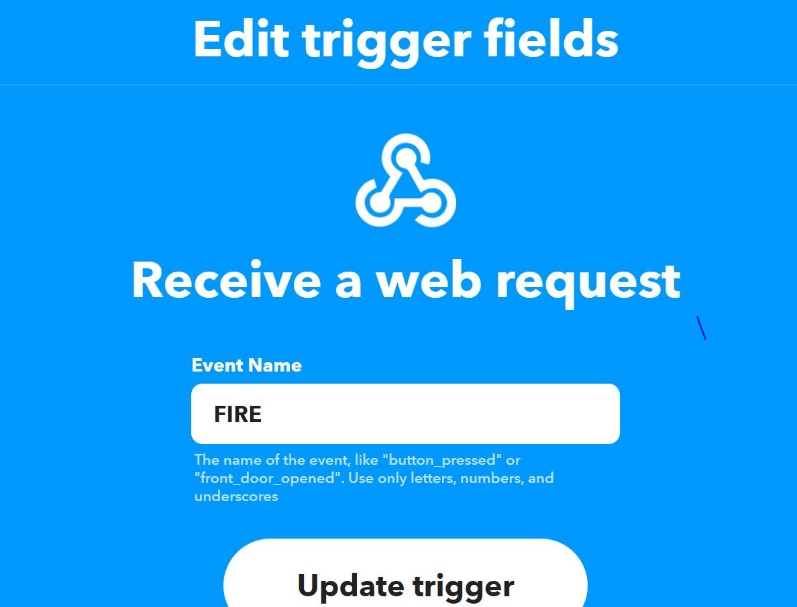
client.print(String("GET ") + url + " HTTP/1.1\r\n" + "Host: " + host + "\r\n" +"Connection: close\r\n\r\n");

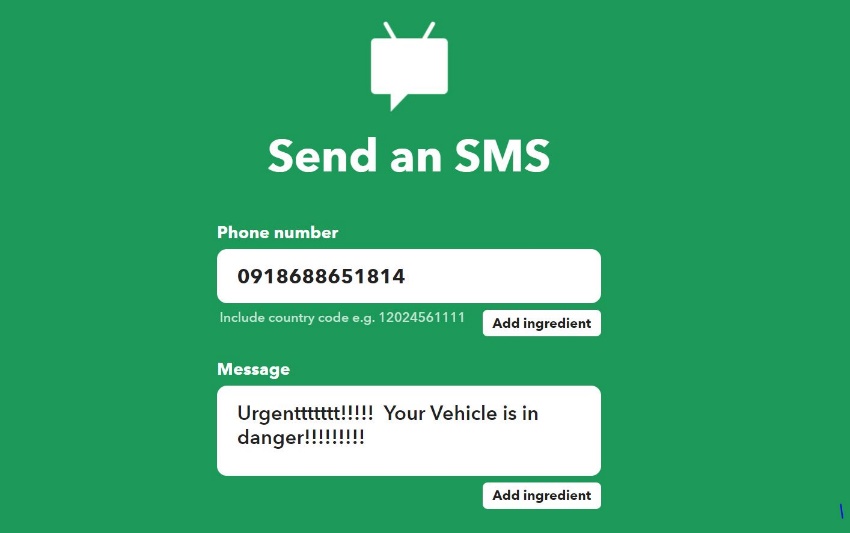
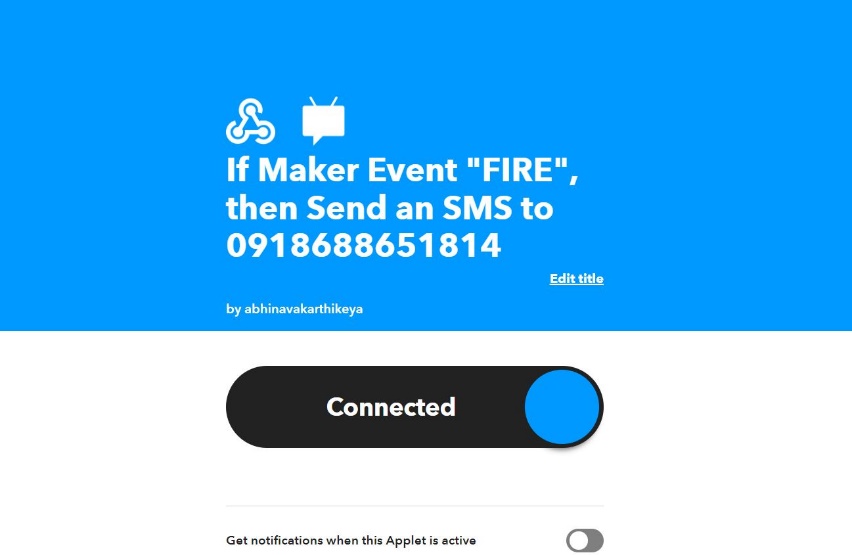
Serial.write("f",1);

delay(10000);

}

}





# Analysis

**Front impact analysis:**

1. Assumptions and calculations:

Mass of the vehicle = 75Kg

Assumed mass of driver = 85Kg

For front impact analysis foot mat of chassis is fixed and 2G force is applied on front part of chassis.

Total weight of vehicle = 160Kg

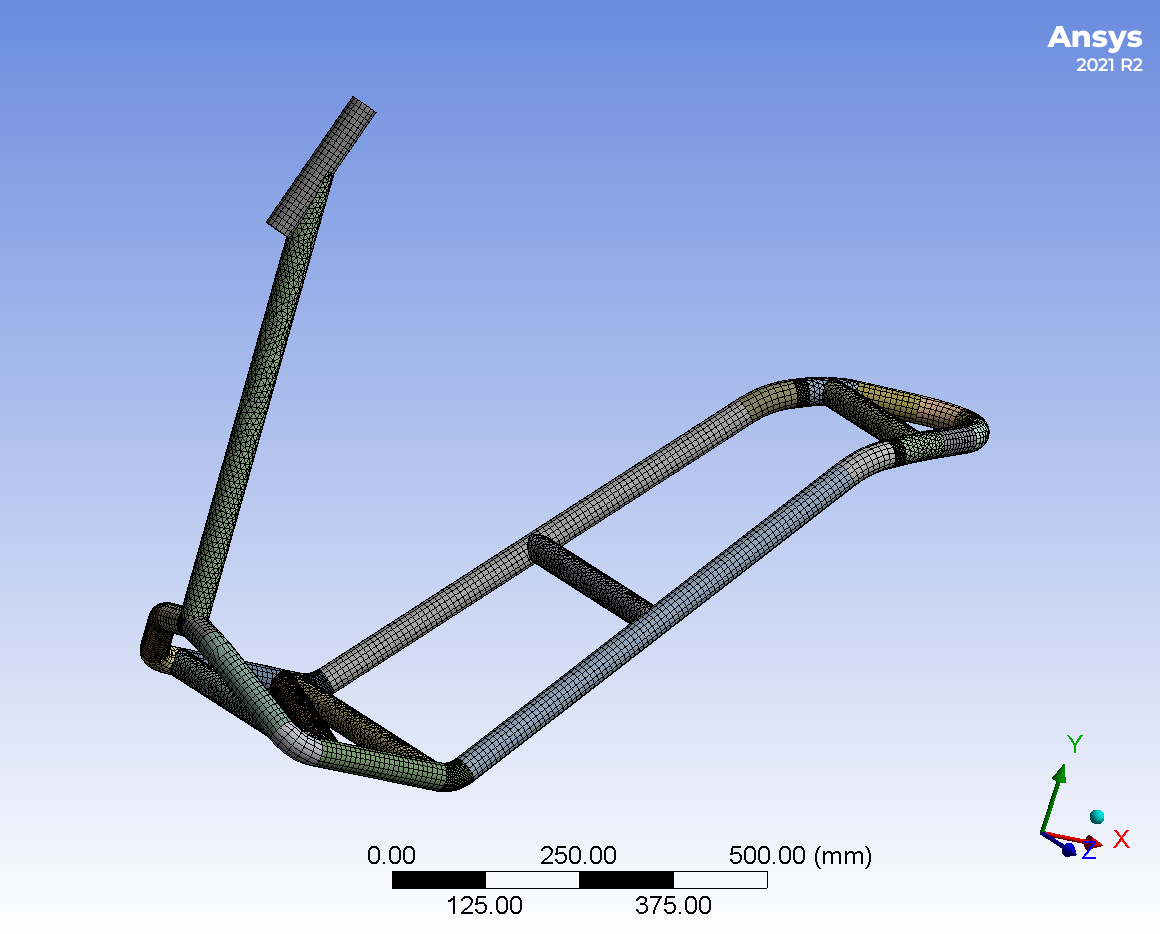
2G force = 2 x 9.81 x 160 = 3139.3 N

2. Boundary conditions:

Diagram

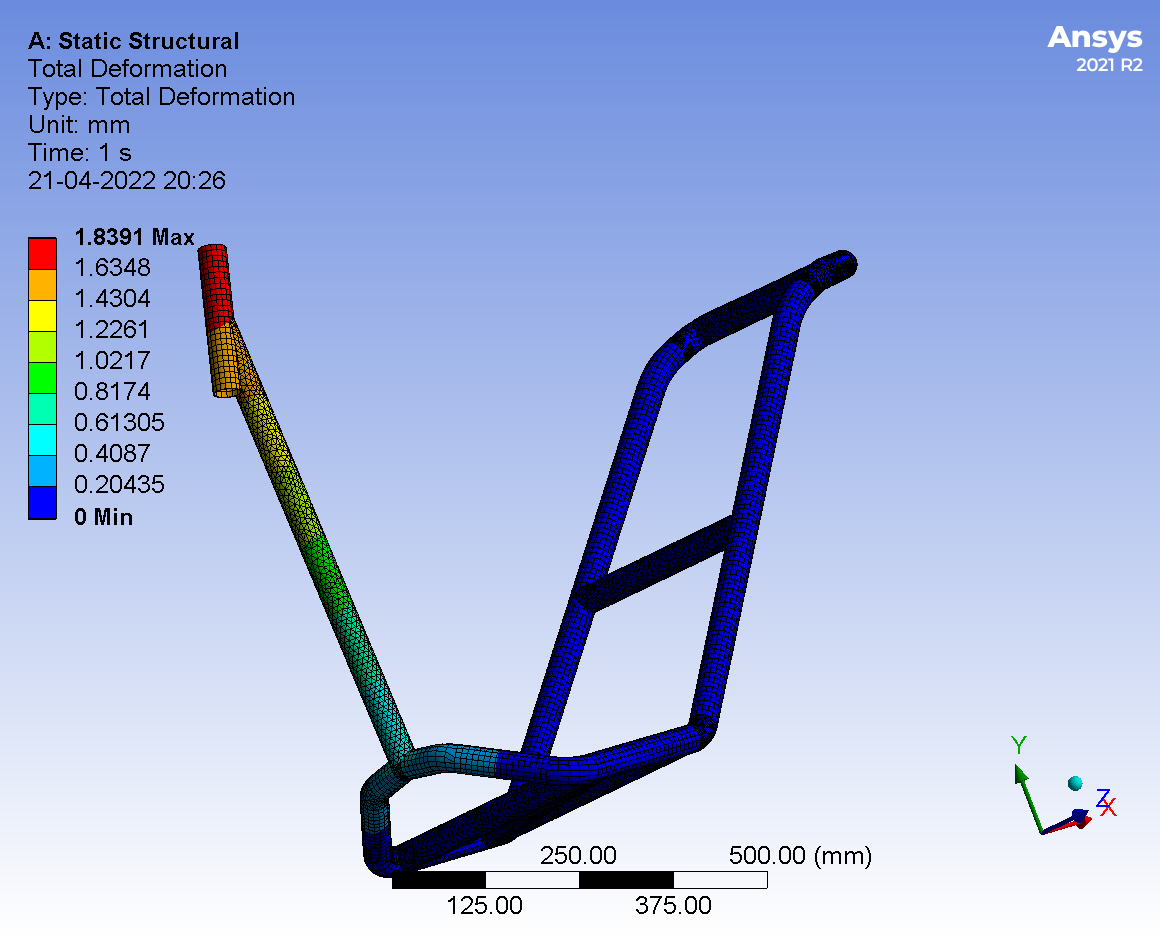
Description automatically generated

3. Meshed view:

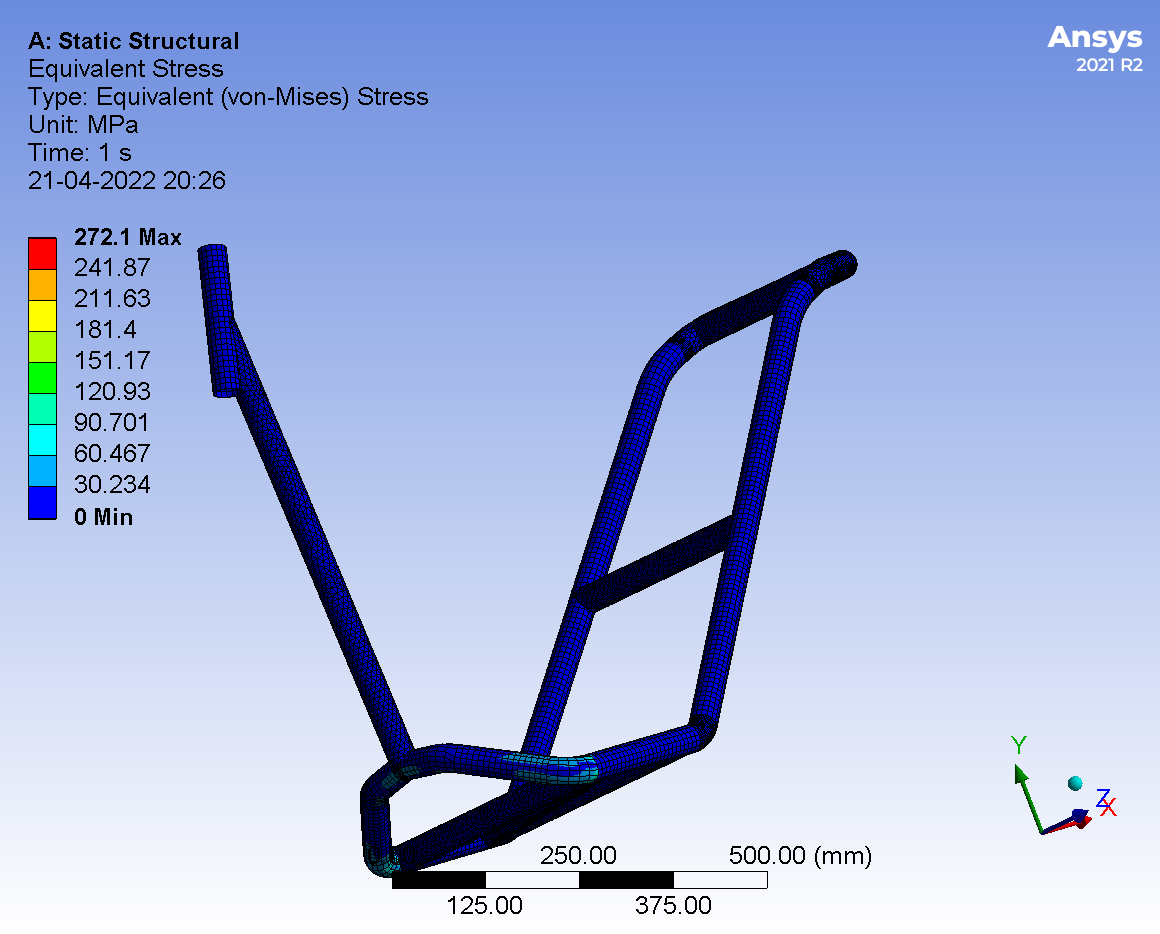


4. Results:

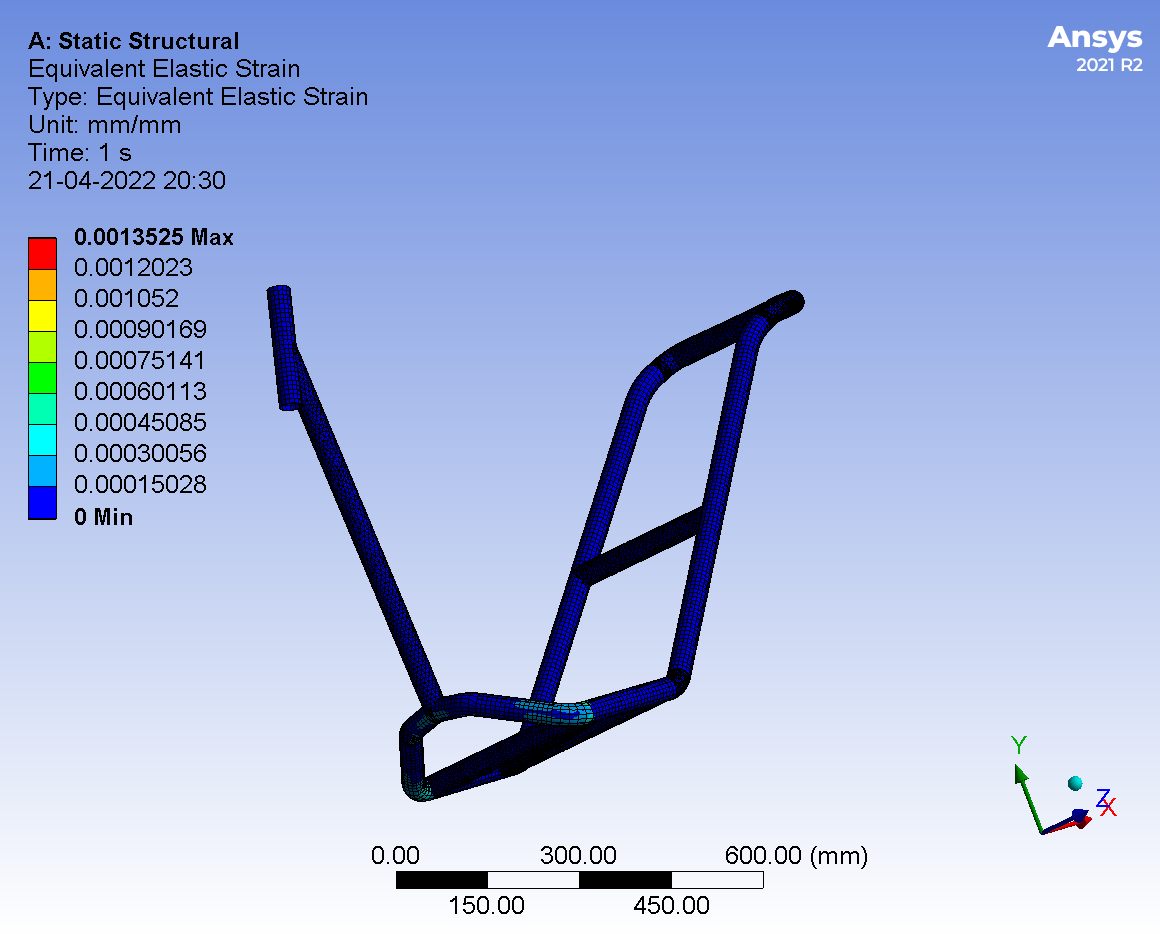
(a) Total deformation:



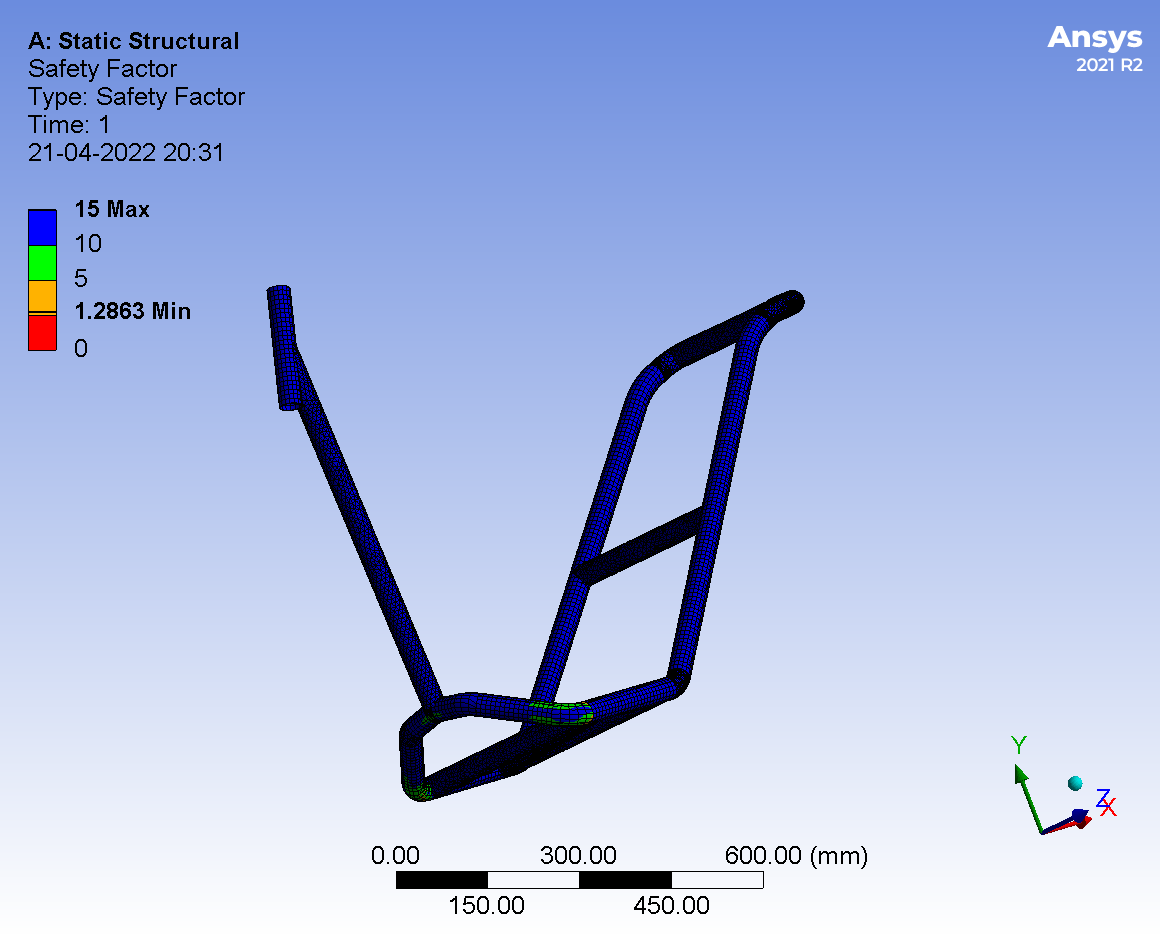
(b) Equivalent stress:



(c) Equivalent elastic strain:



(d) Safety factor



**Side impact analysis:**

1. Assumptions and calculations:

Mass of the vehicle = 75Kg

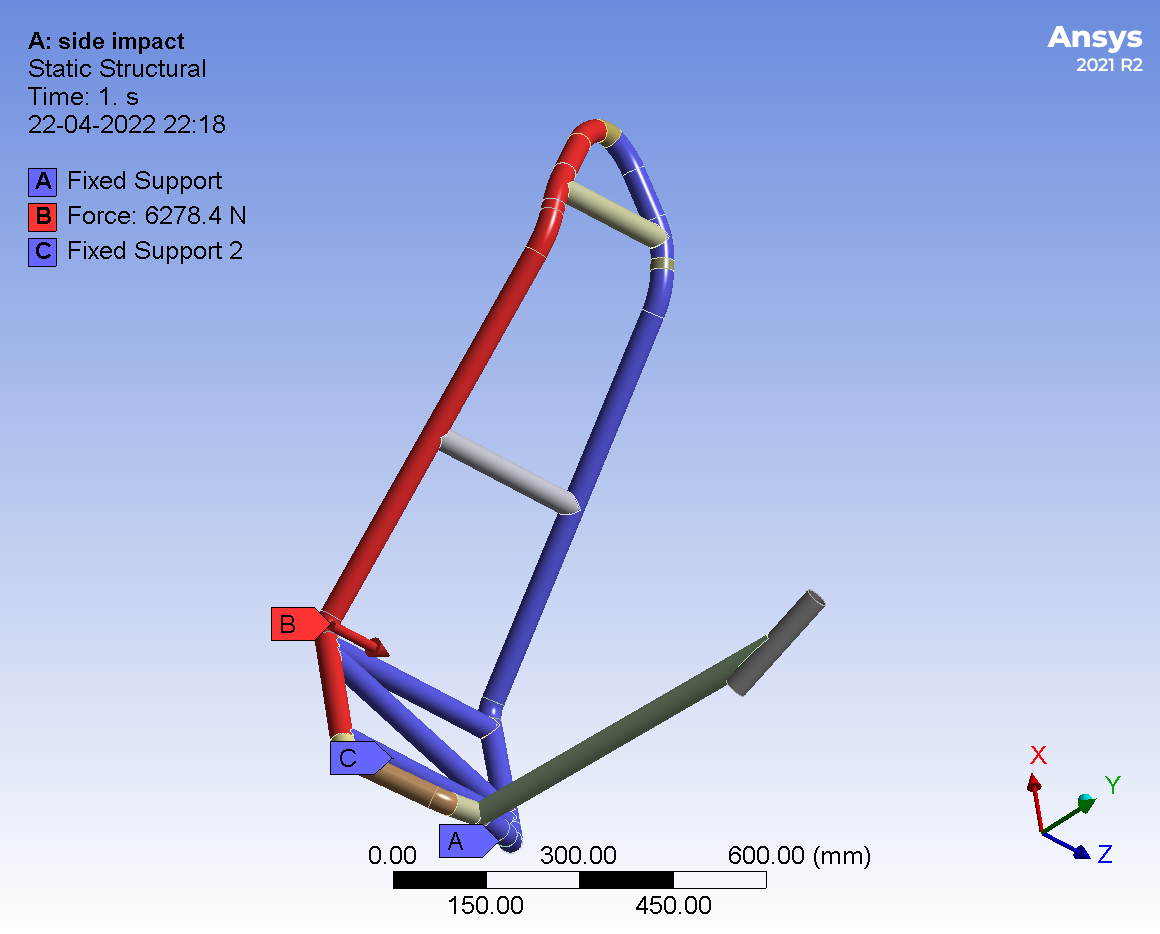
Assumed mass of driver = 85Kg

For front impact analysis foot mat of chassis is fixed and 2G force is applied on front part of chassis.

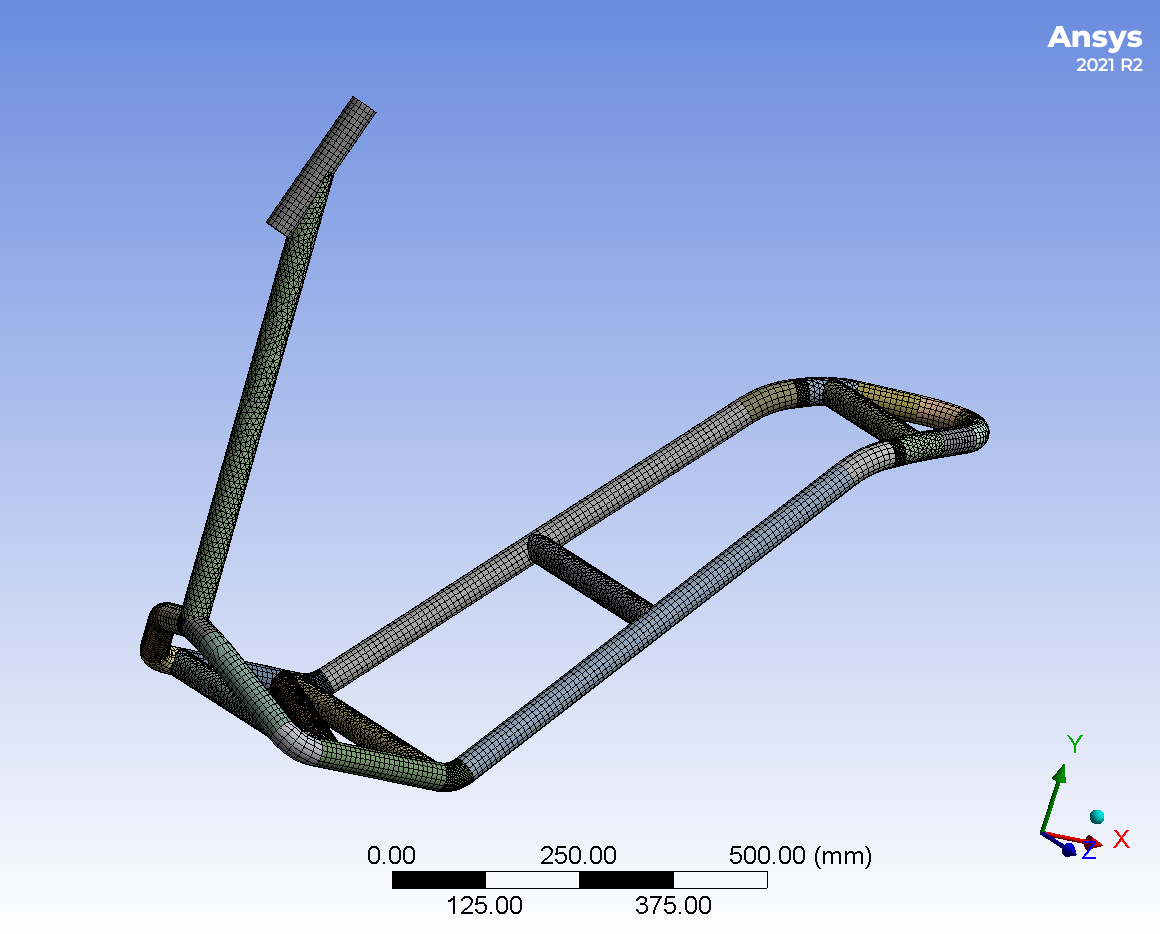
Total weight of vehicle = 160Kg

4G force = 4 x 9.81 x 160 = 6278.4 N

2. Boundary conditions:

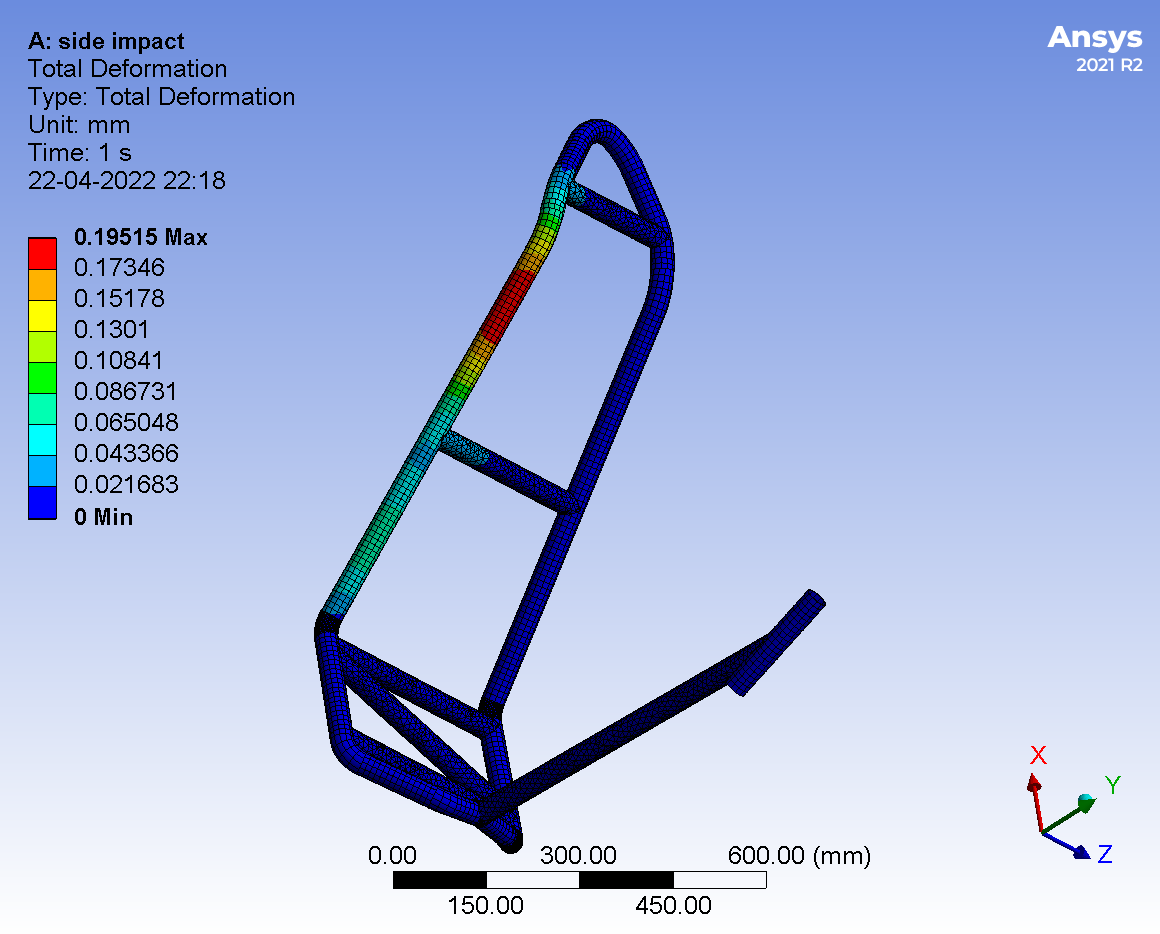


3. Meshed view:

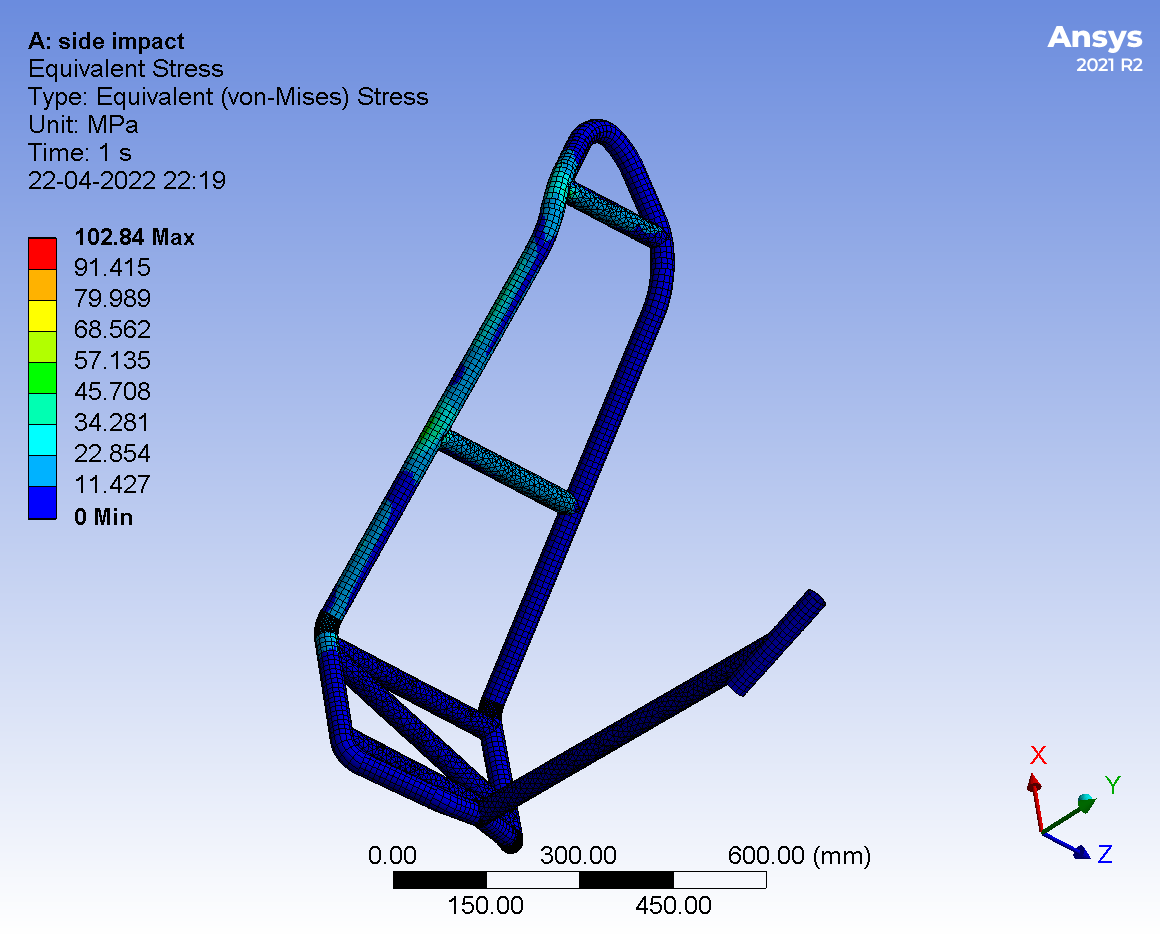


4. Results:

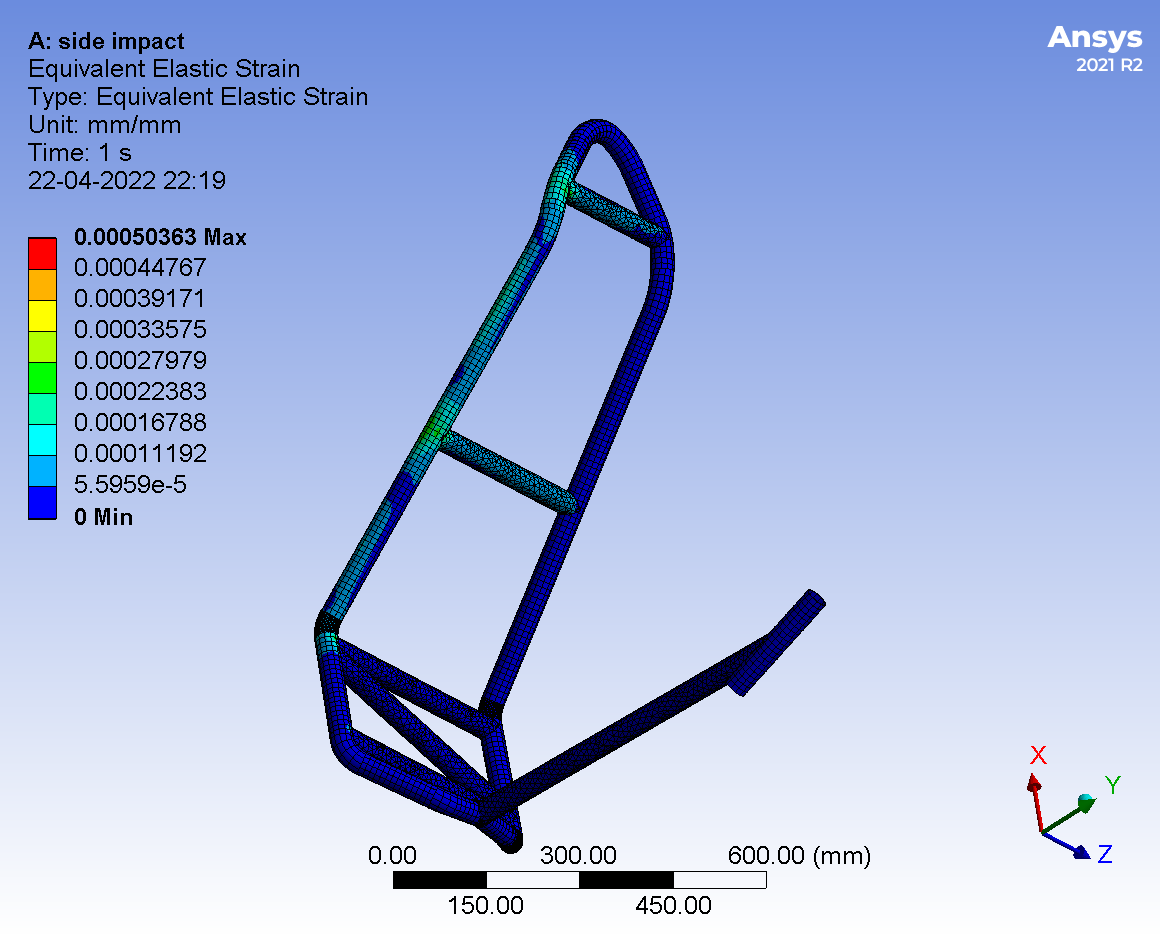
(a) Total deformation:



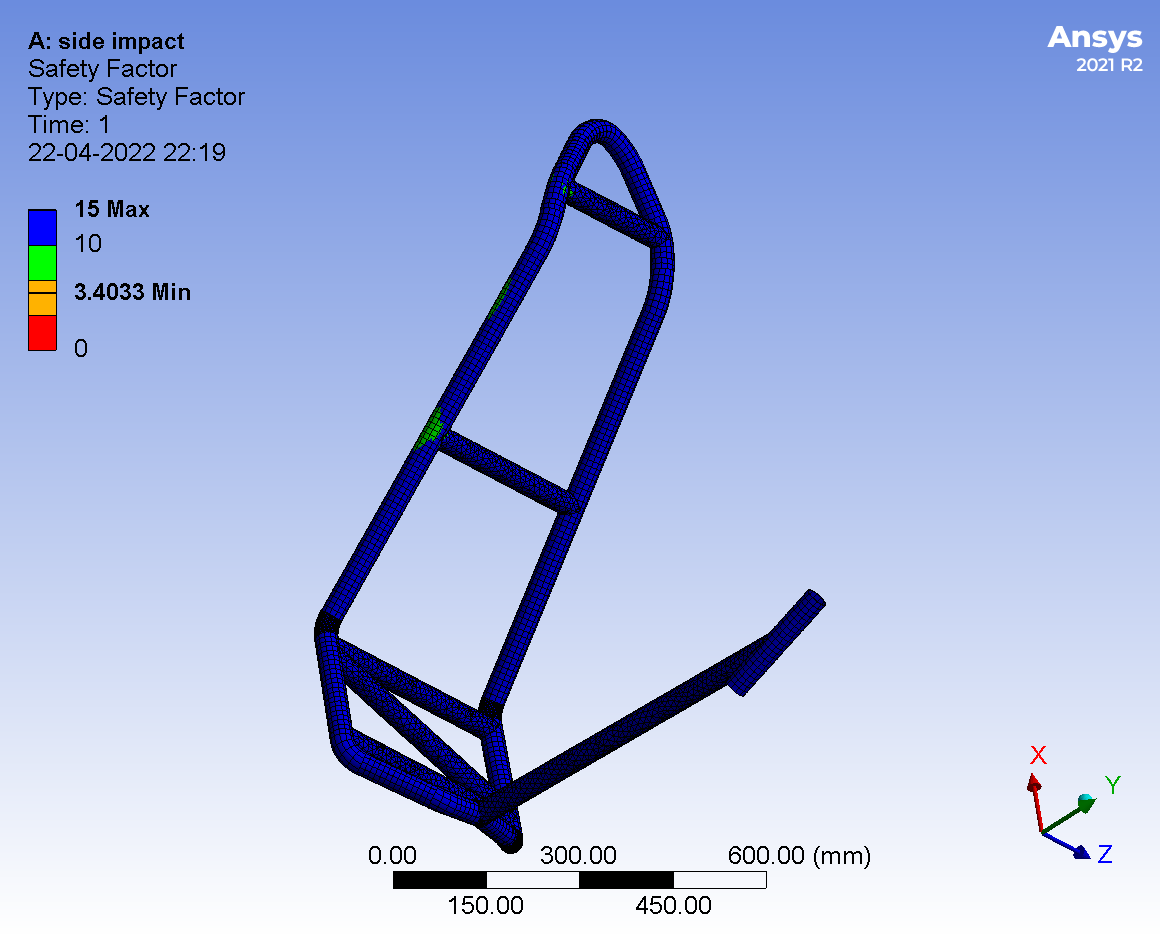
(b) Equivalent stress:



(c) Equivalent elastic strain:



(d) Safety factor



# Conclusion

We as a team designed electric two wheeler which is suitable for college students. Our vehicle provides safe travel. We also sorted out problems in electric two Wheelers like temperature issues , charging time . Indeed we found a solution for the issues and mentioned them. In the section of innovation we included a idea / solution for temperature issues by putting sensors to alert temperature raises. Static structural analysis is also done and we concentrated on front impact and side impact analysis . We have given force in terms of G's. Results we got are good. FOS was above 1 so there was no need of further optimization