Go-Kart (FireBall 2.0)- Jan 2024 - Feb 2024

Project Description:

The project involved the creation of FireBall 2.0, a high-performance go-kart designed for competitive racing in the go-kart league. The go-kart initially used a 100cc Splendor engine, which was upgraded to a 150cc Apache bike engine on the second day of 3 days racing league to achieve higher speeds. The design emphasized performance, handling, and reliability, incorporating features like adjustable camber angles and chain tension adjustment to enhance racing capabilities. The go-kart achieved a top speed of 85 km/h.

Project Affiliation:

Academic Project @ IOE, Pulchowk Campus

Objective:

1. **Develop a Competitive Racing Go-Kart:** Create a high-performance go-kart capable of competing in go-kart leagues.
2. **Optimize Speed and Handling:** Enhance the go-kart's speed and handling capabilities to ensure competitive performance.
3. **Customizable Handling:** Implement adjustable caster angles for precise handling customization.
4. **Ensure Reliability:** Incorporate features for optimal chain tension and transmission efficiency to enhance overall performance and reliability.

Methodology/Approach Used:

1. **Design and Analysis:**
    - Conduct detailed design and structural analysis of the go-kart chassis to ensure durability and performance.
    - Use CAD software for modeling and simulation to refine the design.
2. **Engine Selection and Integration:**

- Initially fit a 100cc Splendor engine for testing and baseline performance measurement.
- Upgrade to a 150cc Apache bike engine for increased power and speed.
- Modify the chassis and engine mounts to accommodate the new engine.

3. **Chassis Fabrication:**
   - Fabricate the chassis using high-strength materials to balance durability and speed.
   - Integrate adjustable caster angle functionality, allowing customization within a range of 15 degrees for improved handling.
4. **Performance Enhancements:**
   - Implement a chain adjustment feature to maintain optimal chain tension and ensure efficient power transmission.
   - Optimize the go-kart's steering systems for smooth and responsive handling on the racetrack.
5. **Testing and Optimization:**
   - Conduct thorough testing on various track conditions to evaluate performance.
   - Make iterative adjustments to the camber angle and chain tension based on testing feedback to optimize performance.

Outcome and Result:

The FireBall 2.0 go-kart successfully met its objectives, achieving a top speed of 85 km/h. The integration of the 150cc engine significantly boosted the go-kart's power and speed, while the adjustable camber angle and chain adjustment features enhanced handling and reliability. The go-kart demonstrated excellent performance in racingconditions, showcasing its competitive edge in the go-kart league.

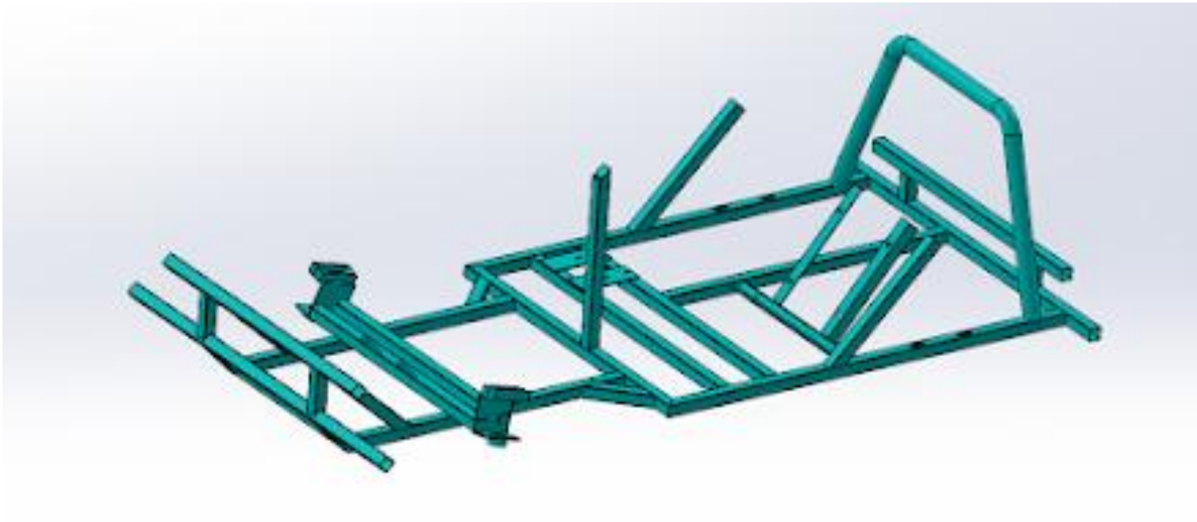

Fig: Chassis Design

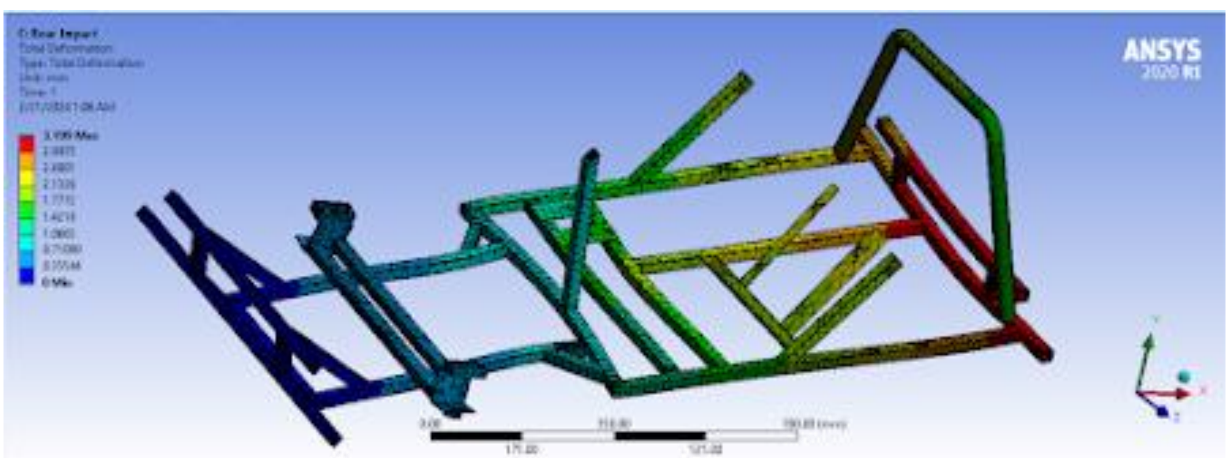

Fig: Chassis Analysis

Fig: CAD Design

Fig: Chassis Fabrication

Design and Analysis of Go-Kart using Finite Element Method

Bibek Shrestha (076BME004), Bipin K.C. (076BME006), Ganesh Sapkota (076BME011), Sanjeev Lamichhane (076BME039)

Department of Mechanical and Aerospace Engineering
IOE Pulchowk Campus, Nepal

INTRODUCTION:

A go-kart is a small, open racing car with four wheels and a single seat. It's commonly used for fun or racing. These karts can be powered by gas engines, electric motors, or other types of engines.

To design our go-kart, we looked at different options and used computer programs like SODIWORKS and ANSYS FEA to analyze them. Based on what the analysis showed, we adjusted and tested the design until optimal design was obtained.

Designing the kart was a step-by-step process where we considered things like cost and availability. We wanted to make sure the kart could handle racing without breaking down.

By combining this approach with standard engineering methods, we made sure our kart looked good, performed well, and was easy to use.

OBJECTIVE:

Our goal is to design a go-kart that outperforms standard models while costing less. We'll use materials that are both suitable and affordable, guided by the results from our FEA analysis.

METHODOLOGY:

Roll cage	
Weight	15 kg
Material	AISI 1018
Outer Diameter	25.4 mm
Thickness	2 mm
Engine	
Displacement	97.2 cc
Max Torque	8.05 Nm
Rated Power	7.91 bhp
Vehicle Dimensions	
Wheelbase	950 mm
Trackwidth	825 mm

Overall Length	1580 mm
Overall Width	940 mm
Ground Clearance	100 mm
Braking	
Type	Rear Hydraulic
Disc diameter	200 mm
Performance Target	
Max. Speed	70 Kmph
Max. Acceleration	3.5 m/s^2
Max. Deceleration	30 m/s^2
Overall weight	50 kg

Table.1: Specifications of Kart

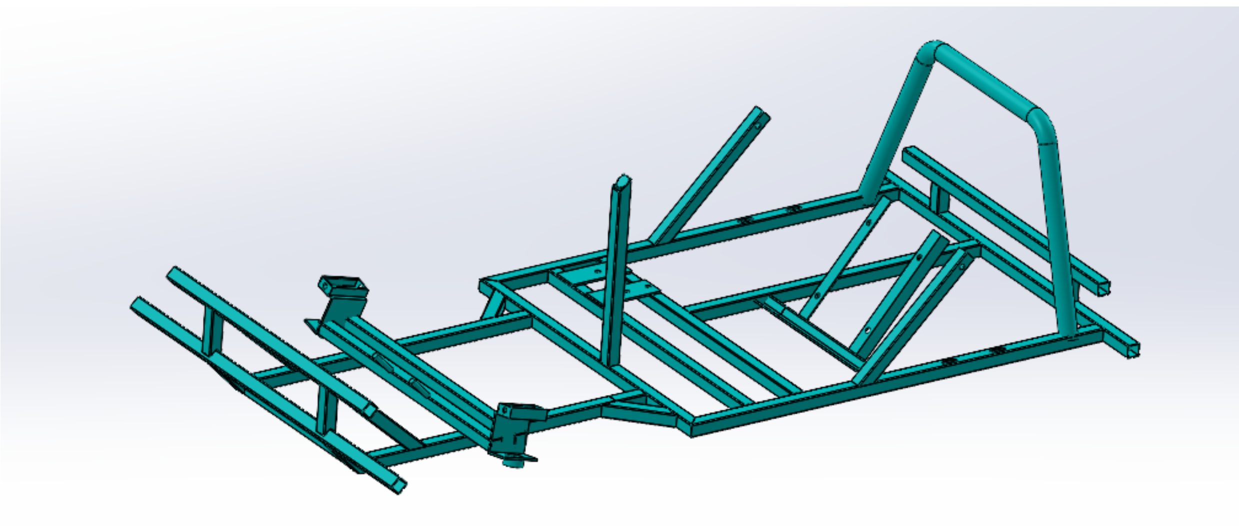

Fig.1: Chassis CAD Model

Ultimate Strength	460 MPa
Yield Strength	250 MPa
Density	7850 kg/m3
Strength to Weight Ratio	60 KN-m/kg
Elongation	15%

Table.2: Material Properties

ANALYSIS:

Structural integrity of the frame is verified by comparing the analysis result with the standard values of the material. Analysis was conducted by use of finite element analysis FEA on ANSYS software. To conduct finite element analysis of the chassis an existing design of chassis was uploaded from the computer stresses were calculated by simulating four different induced load cases. The load cases simulated were static loading, frontal impact, side impact, and rear impact. The test results showed that the deflection was within the permitted limit.

1. **Meshing:**

Auto meshing has been done in ANSYS 2020 R1 software. Following data has been found after meshing of chassis.

No. of Nodes = 158768

No. of Elements = 65375

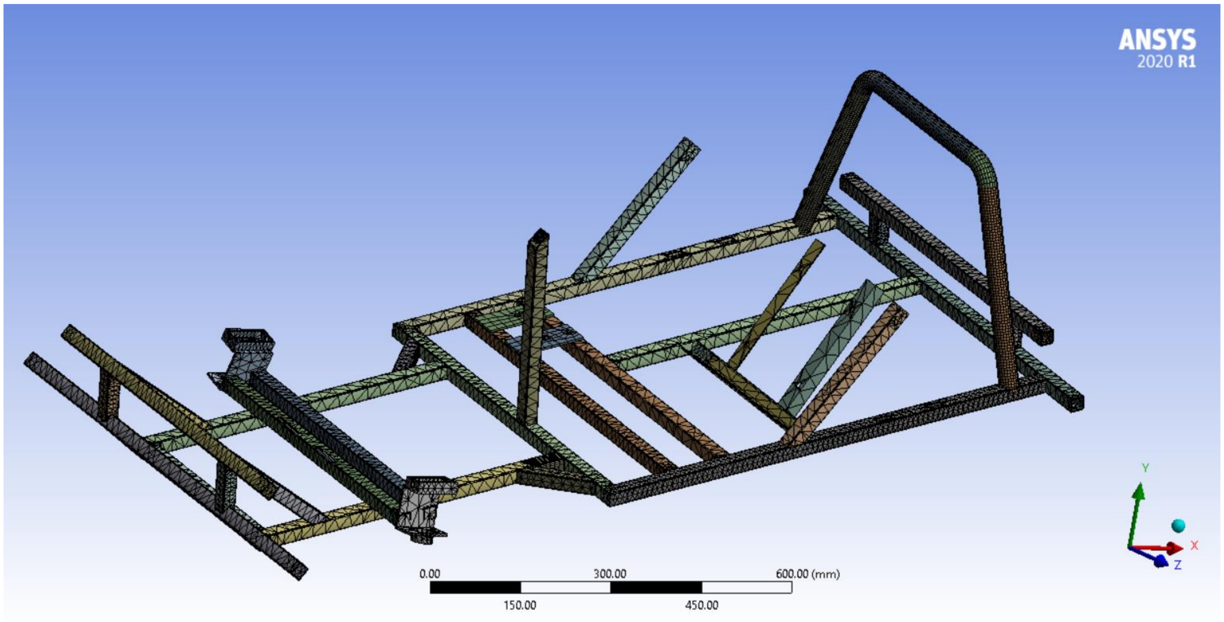

Fig.2: Auto Meshing in ANSYS 2020 R1

2. **Static Loading Condition:**

Self-weight of the chassis, engine weight and the driver weight was considered while analyzing the static load condition.

Chassis weight-15kg
Engine weight-20kg
Driver weight-50kg

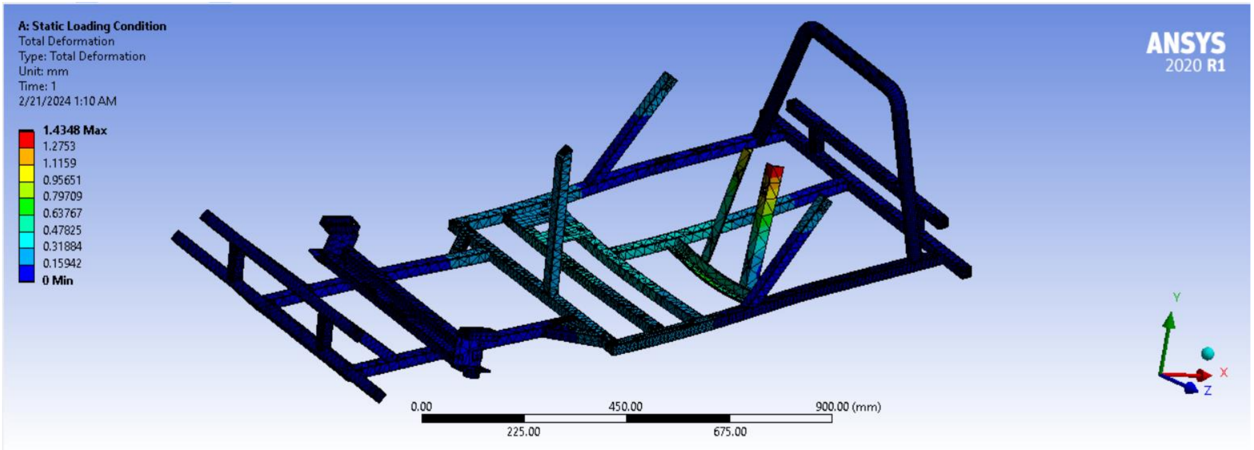

Fig.3: Deformation under static loading condition

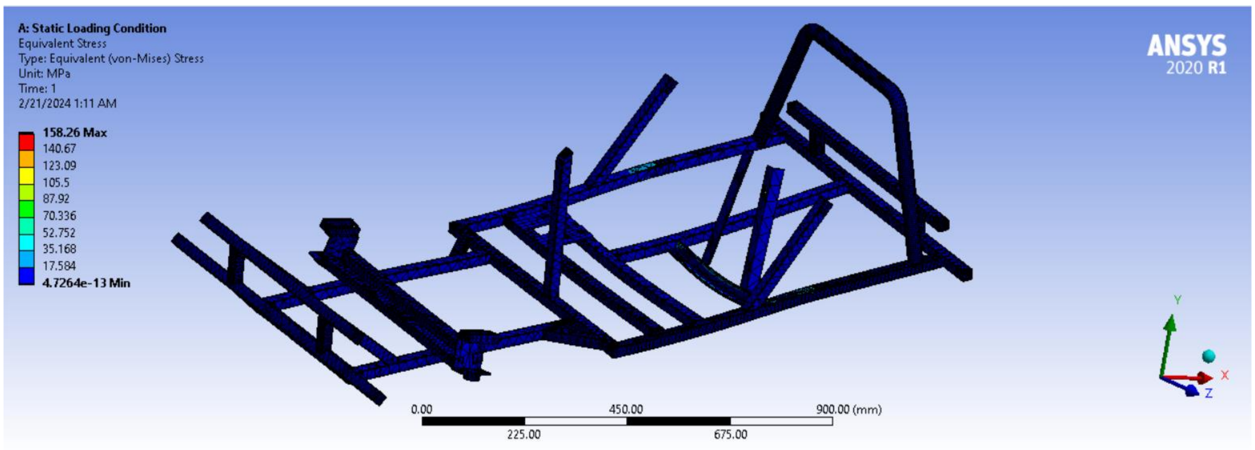

Fig.4: Equivalent Stress under static loading condition

Deformation	1.434 mm
Max. Stress	158.26 MPa
Factor of Safety	2.906

Table.3: Static loading condition

3. Front Impact:

For the front impact, engine and driver load was given at respective points. The kingpin mounting points and rear wheels positionkept fixed. Front impact was calculated for an optimum speed of 60 km/h. From impulse momentum equation, 5g force has beencalculated. The loads were applied only at front end of the chassis because application of forces at one end, while constraining theother, results in a more conservative approach of analysis. Time of impact considered is 0.2 seconds as per industrial standards.

$F*t = m*(V_i - V_f)$
$F*0.2 = 100*(16.66-0)$
$F = 8.33KN$

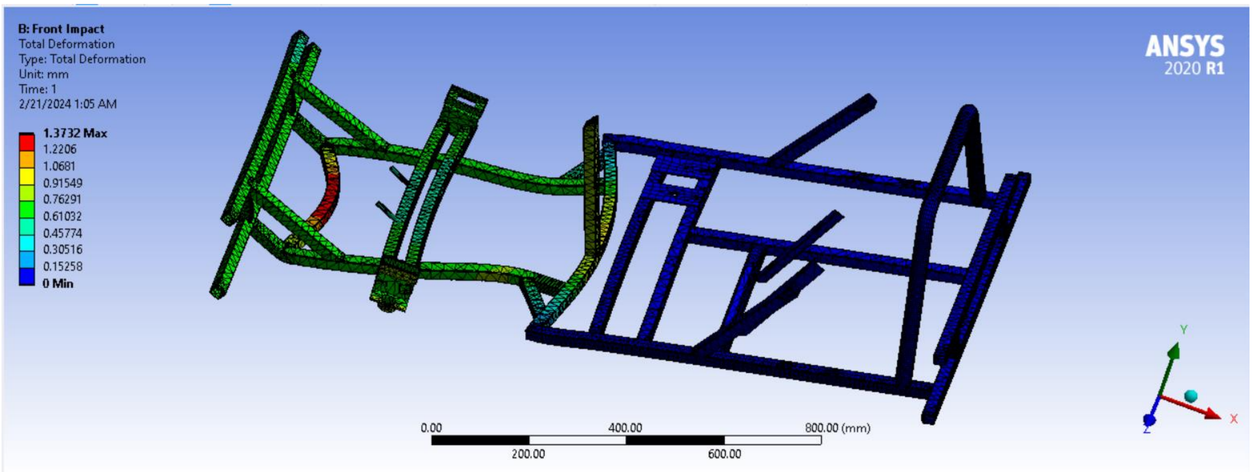

Fig.5: Deformation under Front Impact

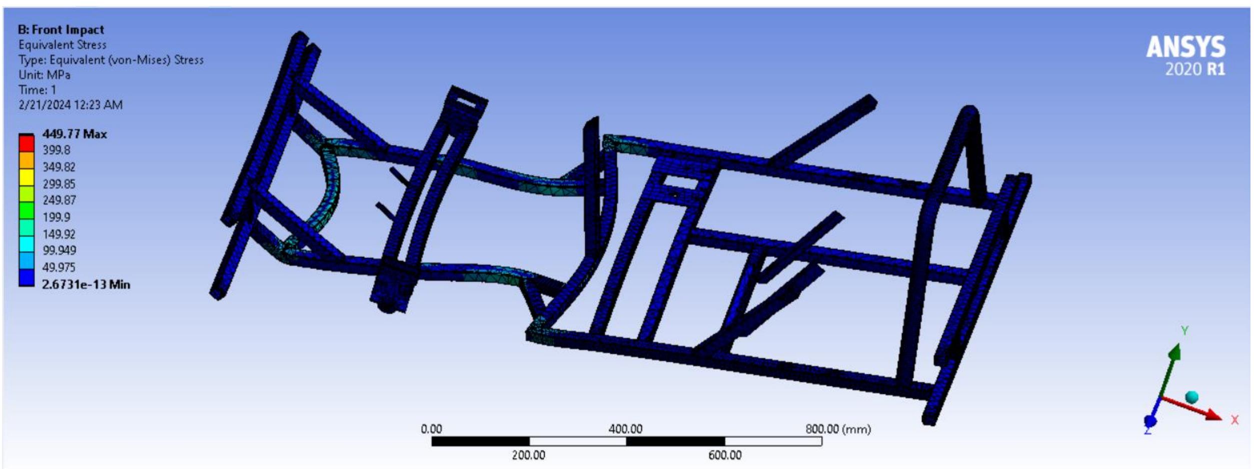

Fig.6: Equivalent Stress under Front Impact

Deformation	1.3732mm
Max. Stress	449.77 MPa
Factor of Safety	1.022744959

Table.4: Front Impact

4. Rear Impact:

Considering the worst case collision for rear impact, force is calculated as similar to front impact for speed of 60 km/h. The valueof 5g force has been calculated. Load was applied at rear end of the chassis while constraining front end and king pin mounting points. Time of impact considered is 0.2 seconds as per industrial standards.

$F*t = m*(V_i - V_f)$
$F*0.2 = 100*(16.66-0)$
$F = 8.33$ KN

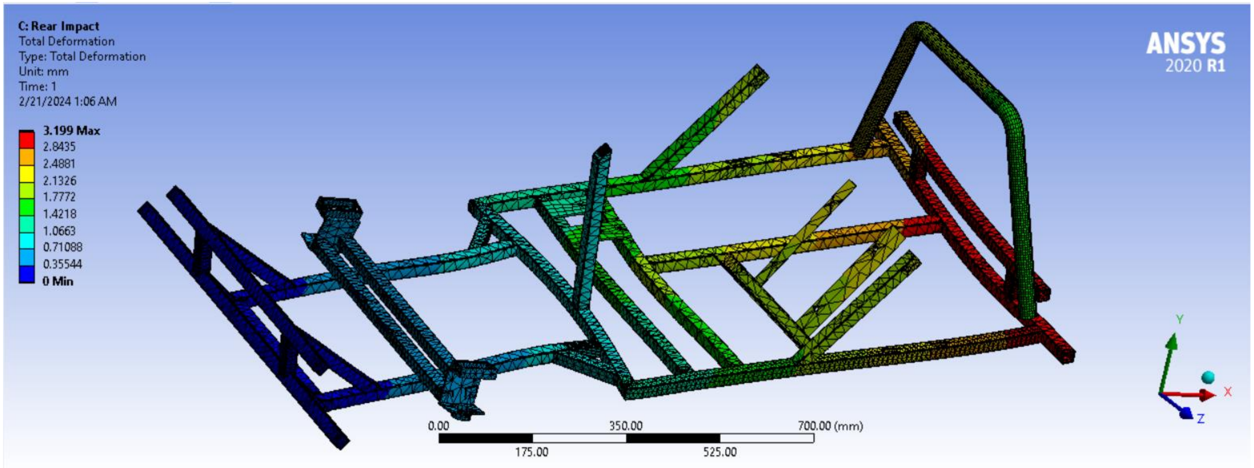

Fig.7: Deformation under Rear Impact

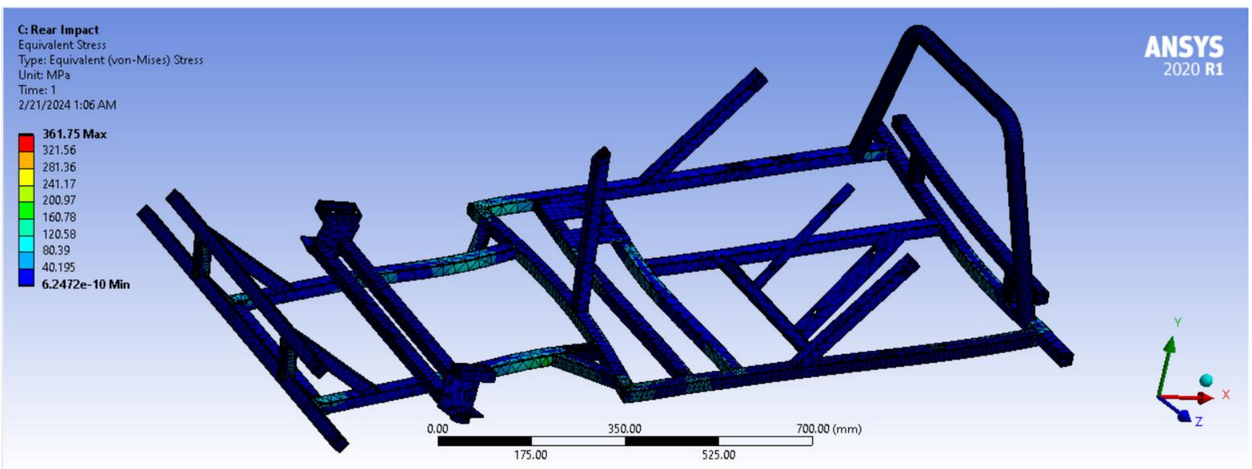

Fig.8: Equivalent Stress under Rear Impact

Deformation	3.199 mm
Max. Stress	361.75 MPa
Factor of Safety	1.271596406

Table.5: Rear Impact

5. Side Impact:

The most probable condition of an impact from the side would be with the vehicle already in motion. So it was assumed that neitherthe vehicle would be a fixed object. For the side impact the velocity of vehicle is taken 30 km/h and time of impact considered is 0.2 seconds as per industrial standards. Impact force was applied by constraining left side of chassis and applying load equivalentto 2.5g force on the right side.

$F*t = m*(V_i - V_f)$

$F*0.2 = 100*(8.33-0)$

$F = 4.16KN$

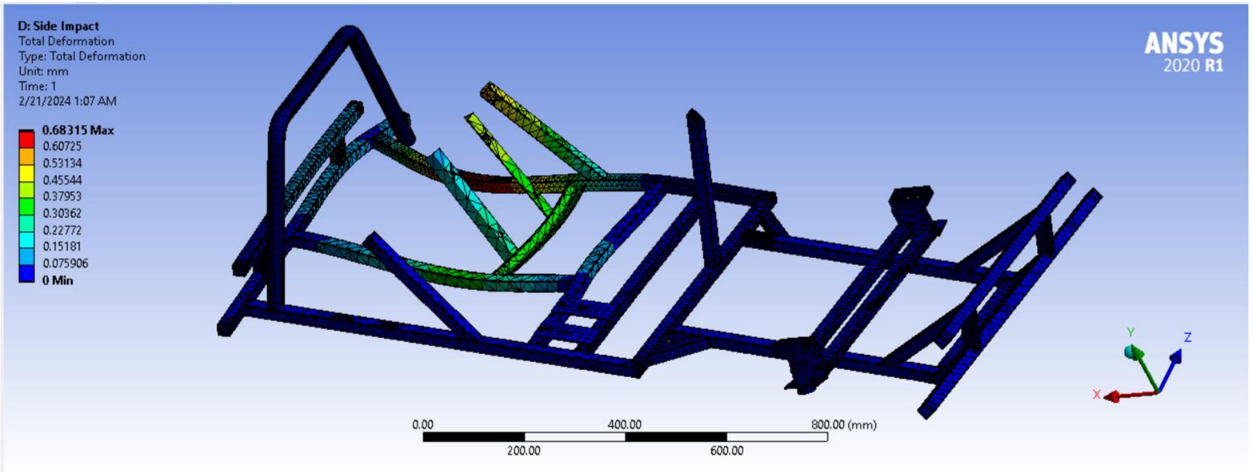

Fig.9: Deformation under Side Impact

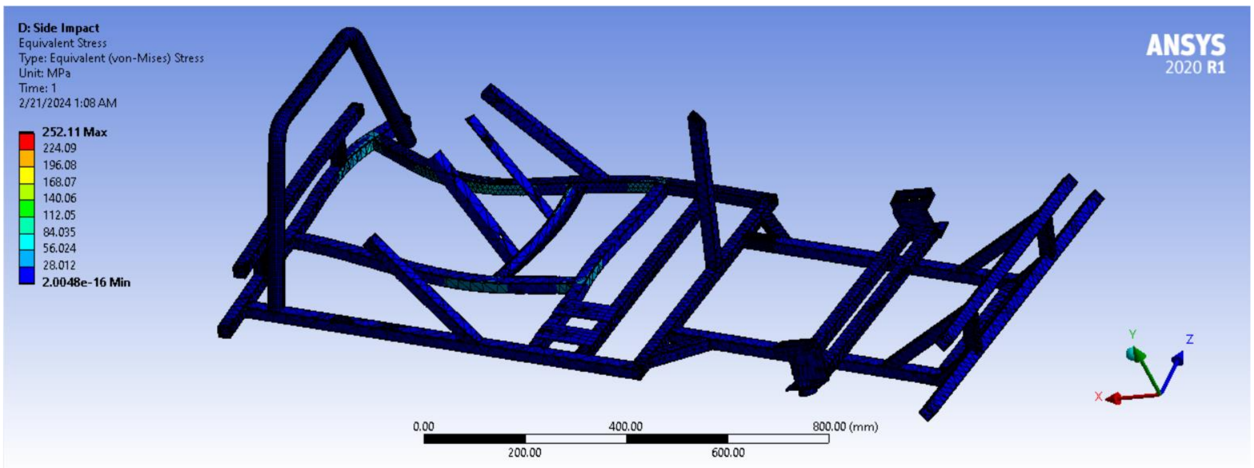

Fig.10: Equivalent Stresses under Side Impact

Deformation	0.68315 mm
Max. Stress	252.11 MPa
Factor of Safety	1.824600373

Table.6: Side Impact

CONCLUSION

We conducted a static analysis using the finite element method on the chassis CAD model. This helped us determine the equivalent stresses, maximum deformations, and Factor of Safety at various points on the chassis. The Factor of Safety we calculated was found to be greater than 1, indicating that the chassis design is safe.

It provides comprehensive insights and design guidelines for modeling a go-kart. After completing all the analyses and design calculations, we concluded that our go-kart design is safe for fabrication using sound manufacturing practices.