ST JOSEPH ENGINEERING COLLEGE

An Autonomous Institution

VAMANJOOR, MANGALURU-575 028

Computational Tool for Engineers (22CTE48)

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Chassis Design and Analysis Using SolidWorks and Ansys for Different Materials.

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Problem Statement

Automobile manufacturing in India requires lighter yet safer materials for fuel efficiency. How can we optimize a car chassis design using advanced materials to reduce weight while maintaining crash safety standards?

SDGs linked:

SDG 12: Responsible Consumption & Production
SDG 9: Industry, Innovation & Infrastructure

Introduction

The project focuses on optimizing automobile chassis design using advanced materials to reduce weight while maintaining crash safety. ANSYS software is employed for structural simulation and material optimization, balancing performance, strength, and safety. The Indian automotive industry is transitioning to lighter materials, such as aluminum alloys and composites, to enhance efficiency. Challenges in cost, scalability, and integration of new materials remain in the adoption of lighter materials in chassis design. ANSYS-driven optimization provides a promising solution to meet both safety and environmental goals in the automotive sector.

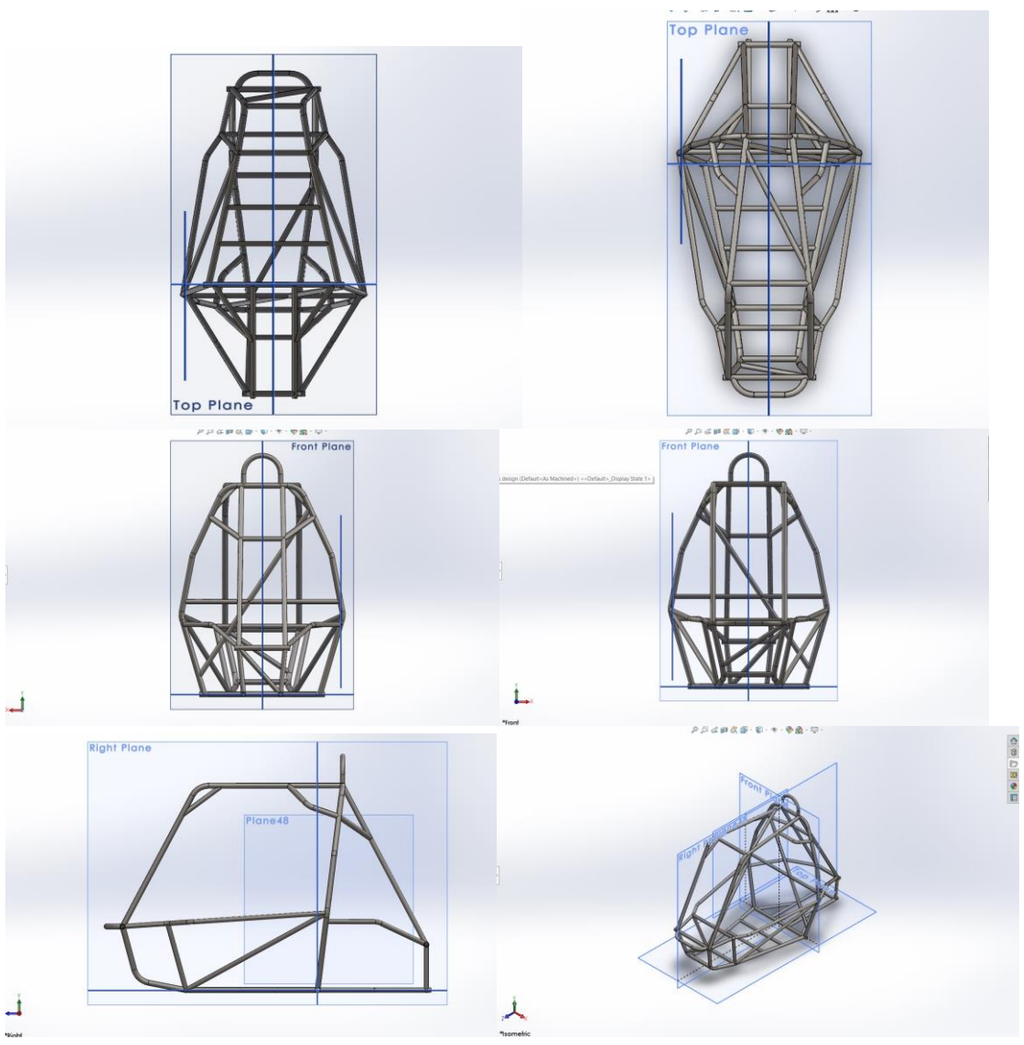
Objectives

- Design a robust and efficient car chassis.
- Improve crash safety standards while maintaining structural integrity.
- Optimize the chassis design for a balance between strength and weight.
- Utilize lightweight materials such as high-strength steel, aluminum, and titanium to reduce vehicle weight.

Methodology

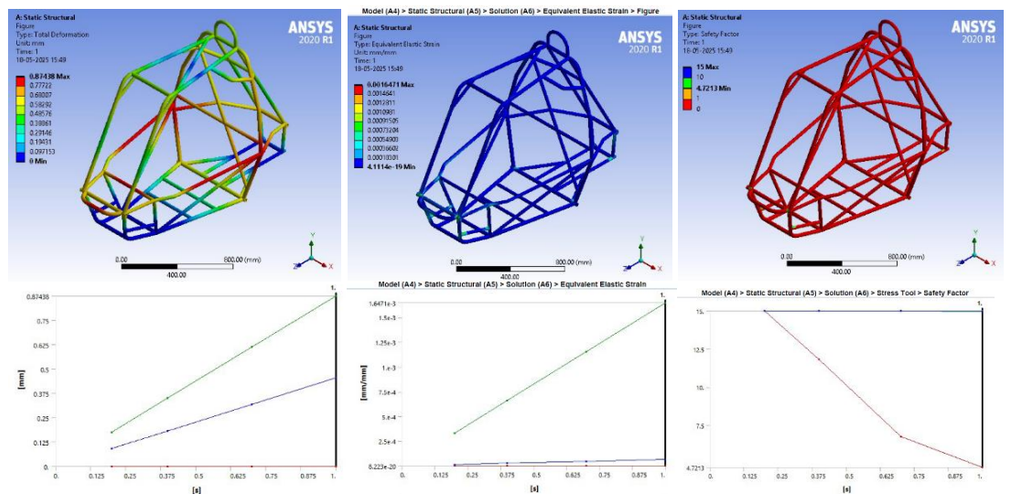
1. Problem Identification
   Identify the need to reduce chassis weight for better fuel efficiency while ensuring compliance with crash safety standards.
2. Material Selection & Concept Development
   Research and choose advanced lightweight materials (e.g., aluminum alloys, high-strength steel, composites) suitable for structural strength and manufacturability.
3. Chassis Design in SolidWorks
   Model the chassis using SolidWorks, incorporating design optimizations like crumple zones and topology optimization.
4. Analysis & Testing
   Perform Finite Element Analysis (FEA) to evaluate structural integrity, crash performance, and stress distribution under impact scenarios.
5. Evaluation, Documentation & Presentation
   Compare designs, validate results against standards, and document the process for presentation, highlighting sustainability and innovation outcomes

Model/sketch/circuit diagram

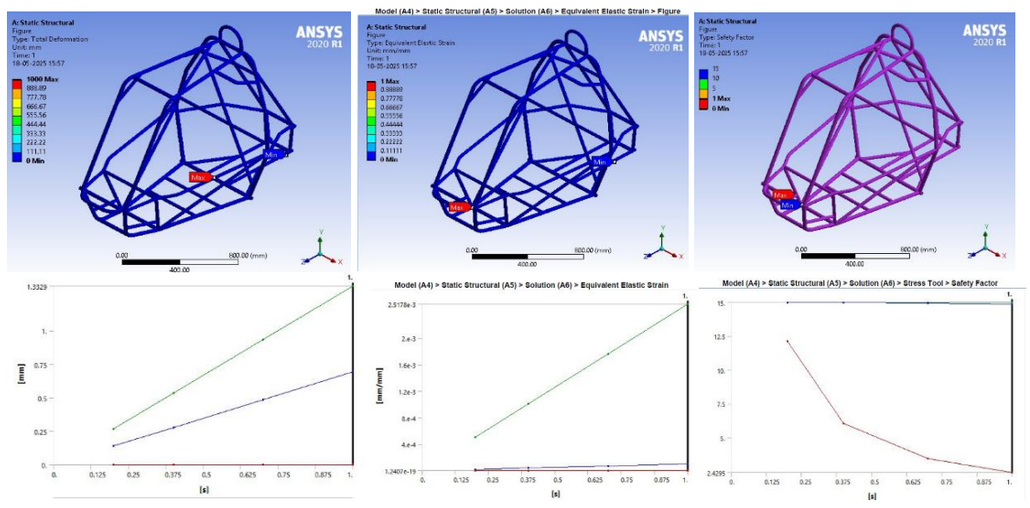


Results and discussion and images

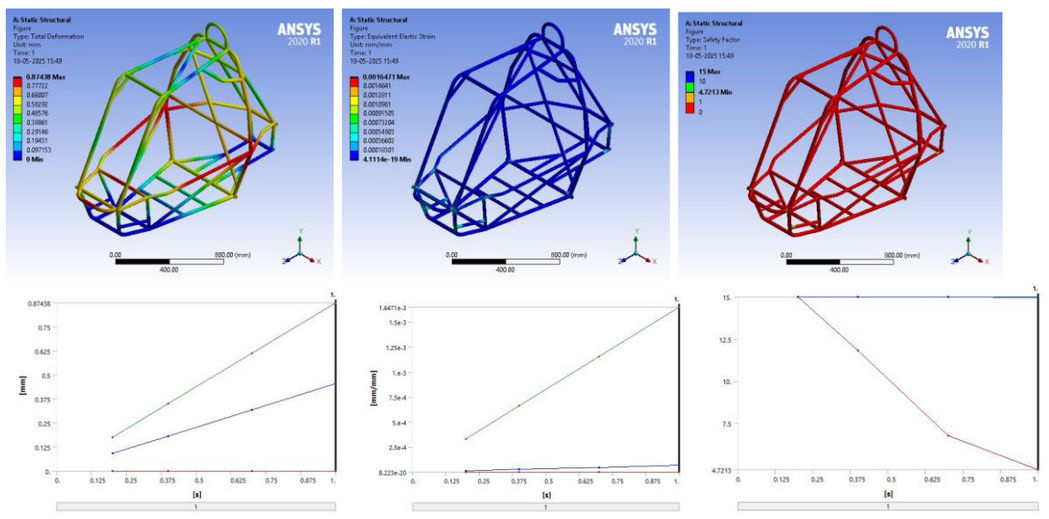
Analysis using Steel:



Analysis Using Aluminium:



Analysis Using Titanium:



Conclusion

Structural Steel is robust and cost-effective but heavy. Suitable for applications where weight is not a concern.

Titanium Alloy offers excellent strength-to-weight ratio and a high safety margin — ideal for high-performance or aerospace vehicles.

7075-T6 Aluminium provides the best weight reduction with moderate deformation and acceptable safety good for racing or lightweight automotive applications.

The chassis design is mechanically sound under a 10,000 N load for all tested materials. However, material selection significantly affects weight, stiffness, and safety margin.

For weight-sensitive applications, Titanium or 7075-T6 Aluminum are preferable over Structural Steel, despite higher costs.

References

Singh et al. (2019)
- Used ANSYS for chassis optimization.
- Aluminium 7075 reduced weight by 35% with sufficient strength.

Sharma & Patel (2021)
- Crash analysis with carbon fiber composites.
- Achieved 40% weight reduction with high crash resistance.

Ramesh et al. (2020)
- Designed chassis in SolidWorks and validated in ANSYS.
- Demonstrated efficiency in virtual prototyping.

Das & Verma (2022)
- Focused on sustainable materials using LCA.
- Supported eco-friendly options like aluminium & composites.