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MOTIF AND INVESTIGATION ON CHASSIS OF COMMERCIAL VECHILE

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ABSTRACT

The chassis forms the essential structural foundation that supports and integrates all major systems, including the engine, transmission, suspension, and braking components, ensuring the vehicle's durability, stability, and ability to handle heavy loads under a variety of conditions. Typically constructed from high-strength steel or aluminum alloys, the chassis is designed to maximize load-bearing capacity while minimizing weight to improve fuel efficiency and vehicle handling. Modern commercial vehicle chassis are increasingly incorporating advanced technologies such as modular frameworks, which allow for greater flexibility in design and customization for specific applications, including freight transport, passenger buses, and specialized construction vehicles.

Keywords: Load-Bearing Capacity, Modular Design, Light-Weight Materials, Fuel Efficiency, Durability.

I. INTRODUCTION

The term "Chassis" originates from the French language use to indicate the frame or main structure of a vehicle. And now it is use to indicate the complete vehicle except the body for the heavy vehicle having a separate body. Chassis is the most important part of a vehicle and only fewer people care about it. Chassis contains all the major parts to propel the vehicle, direct its movement, stop it, and also run smoothly over uneven surfaces. It is also known as a carrying unit because all of the components are mounted on it including the body.

II. OVERVIEW OF CHASSIS

Chassis is the load bearing framework of a manufactured object, which structurally supports the object in its construction and function. An example of a chassis is a vehicle frame, the underpart of a motor vehicle, on which the body is mounted; if the running gear such as wheels and transmission, and sometimes even the driver's seat, are included, then the assembly is described as a rolling chassis.

III. TYPES OF CHASSIS

There are mainly four types of chassis systems, they are

LADDER CHASSIS

TABULAR CHASSIS

MONOCOQUE (UNITARY) CHASSIS

BACK BONE CHASSIS

1. LADDER CHASSIS

A ladder frame looks like a ladder! Ladder frames are one of the oldest yet most reliable car chassis frames out there. Ladder frames are constructed by fitting 2 long beams perpendicular to 2 short beams. These frames are simple to construct, but are heavy. This makes them ideal for transporting goods and many people. Vehicles that use ladder frames are buses, trucks, and semis. Ladder frames are easy to assemble. This makes it easy to replace and repair parts for vehicles with this frame. Since several components in the ladder frame are separate, it's simple to replace them, and cheaper too.

2. TABULAR CHASSIS

Tabular frame has hollow tubes that make up the body of this lightweight frame. It's designed specifically for performance vehicles like race cars and sports cars because it's lightweight and very aerodynamic. A tubular chassis is made from lightweight aluminum or specially constructed steel. The tubular frame is lighter, but doesn't compromise on strength. Because of its construction, the tubular frame takes on impact and distributes it across the frame for a safe drive, and even durability in a crash.

3. MONOCOQUE (UNITARY) CHASSIS

A monocoque chassis, also known as a unitary chassis, is a design where the body and chassis are integrated into a single structure. The term "monocoque" is French for "single shell. In this type of Chassis Frame, the body and frame of the car are constructed together to make one cohesive unit. Some of the car's bodywork may be incorporated into the unibody construction. You might find parts like panels, roof, the sides of doors, and the car floor in a unibody structure.

4. BACK BONE CHASSIS

A backbone chassis is a type of car chassis that's named for its structure, which resembles a human spine. The backbone car chassis frame looks like a backbone and holds the entire vehicle together. It's an H-shaped frame with a tube that connects both ends of the frame together. This rigid construction gives this type of vehicle an excellent ground clearance. A vehicle with a backbone chassis is ideal for off-roading, and heavy usage like trucks.

IV. METHODOLOGY

KEY ASPECTS OF CHASSIS DESIGN

1. MATERIAL SELECTION: choosing the right materials is essential for balancing strength, weight, and cost. common materials include steel, aluminum, and composite materials, each offering different benefits.

2. STRUCTURAL ANALYSIS: Engineers use finite element analysis (FEA) to simulate how the chassis will respond to various loads and stresses. This ensures durability and safety under real-world conditions

3. WEIGHT OPTIMIZATION: Reducing weight is crucial for improving fuel efficiency and payload capacity. Techniques like advanced computational modeling help in optimizing the chassis design.

4. SAFETY CONSIDERATIONS: The design must comply with safety standards, incorporating features like crumple zones and reinforcement in critical areas to protect occupants in the event of a collision.

V. CALCULATIONS

Bending Stress Calculation:

$$\sigma = \frac{M.y}{I}$$

σ: Bending stress (N/m^2)

M: Bending moment (Nm)

y: Distance from the neutral axis to the outermost Fiber (m)

Maximum Bending Moment

$$M=\frac{\omega L^2}{8}$$

for a uniformly distributed load, where:

ω: Load per unit length (N/m

L: Length of the beam (m)

Deflection Calculation:

$$\delta=\frac{5\omega L^4}{384EI}$$

δ: Deflection (m) w: Load per unit length (N/m) E: Young's modulus (N/m^2) I: Moment of inertia (m^4)

MATERIAL USING: steel

Properties of steel: Young Modulus (GPa): 2E+11

Density (kg/m3): 7850

Poisson's Ratio:0.30

Yield strength:250 MPa

Load =1000Kg

Length=8ft

Width=4ft

Wheel base=3ft

Track width=2.5ft

Material	Deformation(mm)	Stress(MPa)	FOS
Steel	1.71	58.4	4.2

VI. MODELING AND ANALYSIS

In this project, a 3D CAD model was developed using **Fusion 360**, a comprehensive tool widely used in mechanical engineering for its precision and robust simulation capabilities. Fusion 360 combines design and analysis functionalities, allowing us to create and evaluate our model within a single platform.

After the design phase, we completed the analysis directly in Fusion 360. This streamlined approach enabled us to perform an in-depth simulation to understand the model's performance under real-world conditions. The analysis involved defining boundary conditions and applying loading scenarios, crucial steps in assessing stress distribution and total deformation across the model. These insights allowed us to pinpoint potential areas of weakness, guiding design improvements to enhance resilience and reliability.

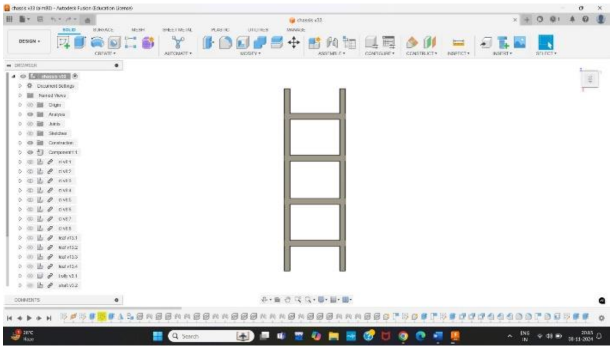

Fig 3.1 front Views

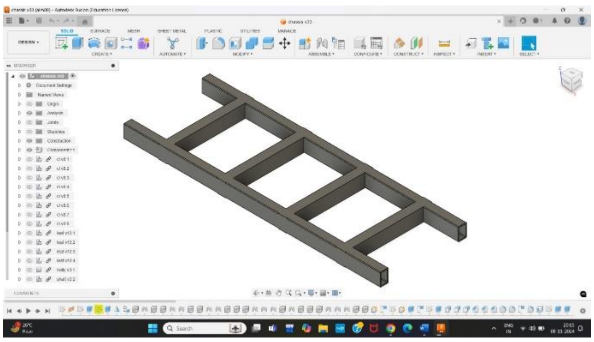

Fig 3.2 isometric view

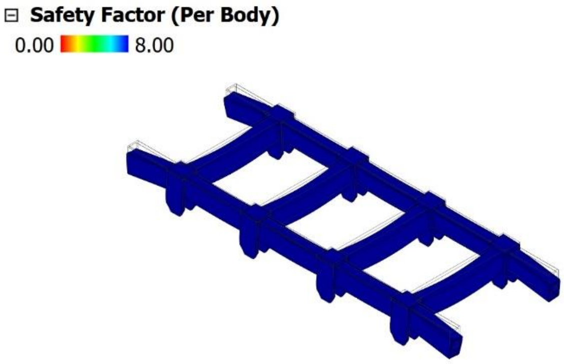

Fig 3.3 Fos

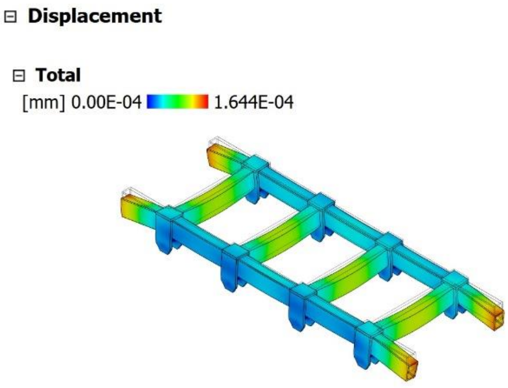

Fig 3.4 Displacement

sing Fusion 360's integrated simulation capabilities, we streamlined the workflow by completing both the design and analysis phases within a single platform, eliminating the need for additional software. This efficient approach allowed us to assess the model's real-world performance under various conditions directly in Fusion 360.

The simulation process involved setting boundary conditions and applying realistic load scenarios to analyze stress distribution and total deformation throughout the model. This provided critical insights into areas of potential weakness or high-stress concentration, essential for optimizing the design for strength and reliability.

VII. CONCLUSION

The modification and investigation of the chassis of a commercial vehicle have demonstrated the potential for significant improvements in structural performance. By identifying and addressing areas of high stress concentration and excessive deformation in the original design, the modified chassis shows enhanced strength, reduced deformation, and improved torsional rigidity. These improvements contribute to better load distribution, increased safety, and potentially extended service life of the vehicle.

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