# A Review on Load Carrying Chassis Structure of Robotics Tank System

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**Abstract -** The chassis structure forms the backbone of any robotic ground vehicle, playing a crucial role in supporting onboard systems and ensuring mobility, stability, and durability under varying load conditions. This study presents the design and structural analysis of a load-carrying chassis for a robotic tank system intended for off-road and rough terrain operations. The chassis is designed with a focus on optimal weight distribution, structural integrity, and adaptability to mechanical and electronic subsystems, including tracked propulsion units, batteries, sensors, and control modules. A material selection process favoring lightweight and high-strength materials, such as aluminum alloys, is undertaken to enhance mobility while maintaining durability. Finite Element Analysis (FEA) is employed to evaluate the chassis under static and dynamic loading conditions, simulating real-world forces including impact loads, distributed payloads, and torsional stresses. The results demonstrate that the proposed design ensures minimal deformation and stress concentration within acceptable limits, thereby validating its suitability for robotic tank applications. The study contributes to the development of robust, modular, and efficient chassis systems for autonomous ground robots operating in complex and demanding environments.

***Key Words*:** CAD Modelling, FEA Analysis, Chassis, Design of chassis.

## 1.INTRODUCTION

In the evolving field of mobile robotics, the design and performance of the chassis serve as the backbone of any ground-based robotic platform—particularly in tank-based systems engineered for rugged, real-world environments. The load-carrying chassis is not merely a frame; it is a multifunctional structure that integrates mobility, stability, and durability while accommodating mission-critical payloads such as batteries, sensors, actuators, and communication equipment. In robotics tanks, where terrain adaptability and operational endurance are paramount, the chassis must withstand dynamic stresses, uneven weight distribution, and environmental extremes without compromising performance or maneuverability.

Unlike conventional mobile robots, tank systems typically employ tracked propulsion mechanisms, demanding a robust and well-balanced chassis to ensure optimal traction and ground clearance. This necessitates a deliberate approach to material selection, structural geometry, and integration of mechanical subsystems like suspension and drivetrain components. Furthermore, modern design practices increasingly favor modular, lightweight, and repairable architectures to support field deployment and scalability.

This review explores the critical aspects of load-bearing chassis design tailored to robotics tank systems, highlighting the interplay between mechanical engineering principles and practical field requirements. By examining structural configurations, material innovations, and real-world case studies, we gain insight into how chassis design influences robotic tank capability, resilience, and overall mission success.

## 2. Body of Paper

Literature Paper:

Recent research in battle tank technology highlights significant progress in defense-related advancements. Key improvements in armor systems, propulsion mechanisms, weapon integration, and artificial intelligence have collectively contributed to increased mobility, survivability, and adaptability in diverse combat environments. These innovations play a pivotal role in shaping the evolution of modern military strategies [1].

A novel methodology has been proposed for developing a unified simulation platform for armored combat vehicles using Unreal Engine 4. This approach seeks to integrate various combat vehicle modules into a cohesive virtual testing environment, enabling realistic evaluation and training scenarios [2].

Studies addressing future battlefield dynamics explore whether main battle tanks should evolve incrementally or undergo radical transformation. Critical design parameters such as crew configuration, vehicle weight, armament, survivability, operational range, mobility, transportability, and modularity are analyzed to guide future development strategies [3].

Challenges in turret system operations arise due to mechanical constraints imposed by the tank's own structure. To mitigate the risk of component collision, a Model Predictive Control (MPC) strategy is proposed. This control method effectively handles these physical limitations, enhancing operational safety and efficiency in a simulated linear tank model [4].

Turret structures, known for their geometric complexity and variable load conditions, have been evaluated using Finite Element Analysis (FEA) via the SAP IV platform. Complementary experimental strain gauge testing on a scaled model confirms the suitability of FEM in stress analysis and design validation [5].

An integrated fuel tank and chassis system was engineered for a Cummins QSK19-powered HL260m pump, ensuring up to 12 hours of autonomous operation. Designed per AISC guidelines and Von Mises failure theory, the system was simulated using SolidWorks®, delivering a safe and efficient solution for field deployment [6].

In agricultural robotics, a four-wheel autonomous ground vehicle (AGV) was developed to detect and remove potato plants infected by PVY in uneven field conditions. Stress analyses and optimization procedures guided the material selection and frame size, resulting in a durable chassis tested under real-world conditions [7].

The chassis of a BAJA SAE off-road vehicle was analyzed for structural integrity, crashworthiness, and safety compliance based on competition regulations. Finite Element Analysis using ANSYS Workbench confirmed the chassis's resilience under simulated impact scenarios [8].

Another study focused on ergonomic and structural aspects of chassis design, addressing driver accommodation, safety, and manufacturing efficiency. The design process included considerations for optimal part integration and fixture setup [9].

Heavy-duty ladder frame chassis, common in trucks, were evaluated using AutoCAD and CATIA for structural optimization. While these chassis offer high strength and design versatility, they present challenges in torsional stiffness and fuel efficiency. Enhanced designs achieved better stress distribution and reduced vibration [10].

Automotive chassis optimization studies focused on balancing rigidity and handling by analyzing parameters like stress, deflection, and modal frequency. Using FEA in ANSYS Workbench, improvements in stiffness and reduction in resonance risks were achieved through design refinements [11].

Finally, the dynamic behavior of truck chassis under load and road conditions was analyzed using Finite Element Analysis. Key findings included stress distribution patterns, vibration modes, and design modifications aimed at strengthening the structure and minimizing operational fatigue [12].

This review examines recent literature on the static structural analysis of truck chassis, with a focus on studies conducted over the past two years. It emphasizes the application of Finite Element Analysis (FEA) as a primary tool for evaluating the chassis, which serves as the structural backbone of commercial vehicles, bearing both components and payloads. Key design considerations identified include material selection, structural strength, stiffness, and overall weight. The review consolidates various findings from recent works, offering valuable insights into chassis design optimization [13].

In another study, the structural strength, weight efficiency, and adaptability of two distinct chassis configurations for Aircraft Rescue and Fire Fighting (ARFF) vehicles were investigated. Using PTC Creo for 3D modeling and numerical methods for load assessment, the research employed Finite Element (FE) analysis to evaluate the stress response under static axle loading conditions. The goal was to assess whether the proposed chassis designs met the structural criteria necessary for production [14].

Further research focuses on reducing the weight of heavy vehicle chassis through material innovation. A study involving an existing EICHER heavy-duty chassis explored the use of polymer composite materials—specifically Carbon/Epoxy—across various cross-sectional geometries (C, I, and Box sections). These designs were subjected to identical load conditions as their steel counterparts, with stress distribution and deformation evaluated through both numerical simulation and analytical validation [15].

In a distinct application, another study presents the development of a compact robotic system designed for inspecting the internal structure of fighter jet aircraft wing fuel tanks. Emphasizing effective mobility within hazardous and confined environments, the robot, approximately 70 mm in size, employs a snake-like tracked mechanism to access narrow passages. A supplementary platform deploys inspection sensors into areas unreachable by the primary system. The design enables deep penetration from the wing root toward the tip, significantly minimizing human exposure to hazardous spaces. The paper further addresses stakeholder requirements, current inspection limitations, and provides a comparative analysis with existing inspection technologies [16].

## 3. CONCLUSIONS

During literature review it is found that very few literatures are available on design and analysis of chassis of robotic tank system and material selection. No one had done any work related to design and analysis and material selection of 14 chassis of robotic tank. In this research work same is done. This will going to help for designing the chassis of robotic tank.

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