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Design and Fabrication of a Two-Wheel Drive Forklift for Industrial Warehouse Applications

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Abstract: This project focuses on the design, fabrication, and performance evaluation of a two-wheel drive forklift intended for industrial warehouse material handling. The objective is to develop a compact, cost-effective, and efficient forklift capable of handling moderate loads in confined warehouse environments. The system integrates a robust chassis, two-wheel drive mechanism, lifting fork assembly, hydraulic/electric actuation, and safety features. The design emphasizes manoeuvrability, load stability, and ease of operation. Experimental testing was conducted to evaluate lifting capacity, stability, and operational efficiency. The results demonstrate that the developed forklift is suitable for small- to medium-scale warehouse applications.

I. INTRODUCTION

Material handling plays a vital role in industrial and warehouse operations. Forklifts are widely used to transport, stack, and load materials efficiently. Conventional forklifts are often expensive and bulky, making theming suitable for small warehouses. This project addresses the need for a compact two-wheel drive forklift designed specifically for industrial warehouse use. With the rapid growth of manufacturing and logistics industries, the demand for compact, economical ,and efficient forklifts has increased significantly. Conventional forklifts are often bulky, expensive, and designed for heavy-duty operations, making theme suitable for small- and medium-scale warehouses where space constraints and cost limitations exist. Hence, there is a growing need for forklifts that offer adequate load capacity, improved maneuverability, and reduced operating costs. This project focuses on the design and fabrication of a two-wheel drive forklift specifically intended for industrial warehouse applications. The two-wheel drive configuration offers a simplified mechanical structure, reduced power consumption, and enhanced maneuverability, making it suitable for indoor material handling operations. The main objectives of this project are: To design a two-wheel drive forklift suitable for warehouse applications To fabricate a cost-effective and compact forklift model To improve maneuverability in narrow spaces

Efficient material handling reduces labor, time, and operational cost. Forklifts improve productivity, reduce manual effort, and enhance workplace safety Warehouses serve as critical nodes in supply chains where materials are received, stored, and dispatched. Manual handling of materials not only increases labor cost but also leads to worker fatigue, low productivity, and workplace injuries .Forklifts significantly reduce these issues by mechanizing lifting and transportation tasks. The role of forklifts in warehouse operations includes: Efficient loading and unloading of goods Stacking materials at different heights Transportation of pallets within warehouse premises Reduction of material handling time and manpower The use of forklifts enhances operational efficiency while ensuring workplace safety and consistency in material handling processes

A. Role of Two-Wheel Drive System

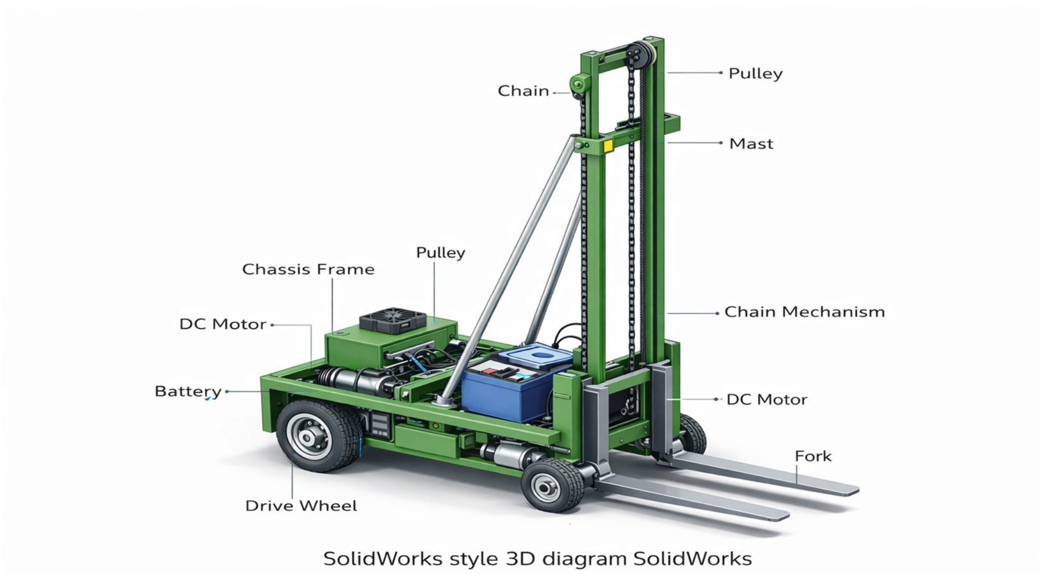
The two-wheel drive (2WD) system drives power to only two wheels ,typically the front wheels, while the rear wheels provide steering. This configuration is widely preferred for indoor and smooth-surface operations due to its simplicity and efficiency. Advantages of the two-wheel drive system include: Reduced mechanical complexity Lower manufacturing and maintenance cost Improved turning radius Lower energy consumption Suitable traction for warehouse floor conditions These advantages make the two-wheel drive forklift an ideal choice for industrial warehouse applications. The scope of the present project is focused on the design, fabrication, and performance evaluation of a two-wheel drive forklift intended for industrial warehouse material handling applications. The project aims to develop compact ,efficient, and cost-effective forklift system suitable for indoor warehouse environments.

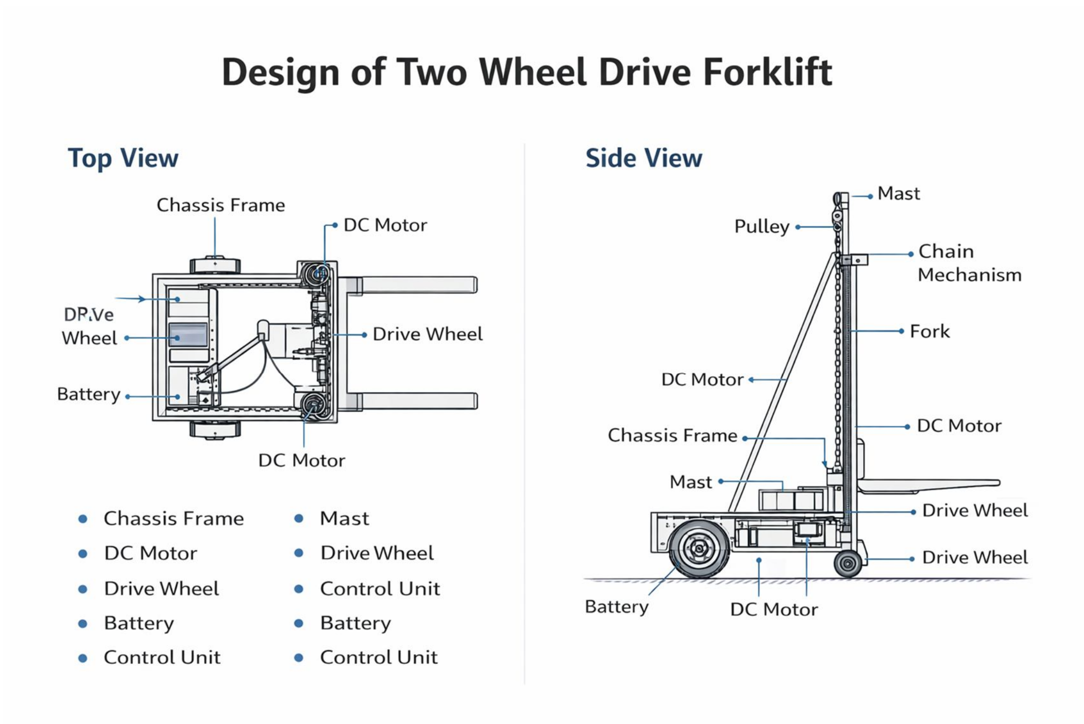
II. METHODOLOGY

1) Problem Identification: Need for compact forklift in warehouse
2) Requirement Analysis: Load capacity, space, safety, cost
3) Literature Review: Study of existing forklifts & drive systems

4) Concept Selection: Two-Wheel Drive Configuration
5) Design Calculations: Load, Stability, Power, Strength
6) CAD Modeling: Chassis, Fork, Mast, Drive System
7) Material Selection: Mild Steel & Standard Components
8) Component Selection: Motor, Wheels, Hydraulics, Bearings
9) Fabrication: Cutting, Welding, Machining
10) Assembly: Mechanical, Electrical, Hydraulic Systems
11) Testing & Performance Evaluation: Load Test, Stability, Maneuverability
12) Result Analysis: Compare Design and Actual Performance

3D View





III. LITERATURE SURVEY

A detailed review of existing scientific, engineering, and computational work was carried out to understand various aspects of automotive modification, mechanical impact, vehicle performance modelling, coating technologies, and intelligent recommendation systems. This chapter presents the literature chronologically from 2025 to older studies, each beginning with the author, year, and article title, followed by key findings and relevance to the present project. J. Smith and R. Kumar (2021) analysed the impact of forklift-assisted material handling on warehouse efficiency. Their study demonstrated that mechanized handling systems reduce labour fatigue and improve through put by more than 30% compared to manual methods. The authors highlighted that compact forklifts with optimized drive systems are particularly effective in small-and medium-scale warehouses where space utilization is critical.

L. Chen et al. (2022) compared two-wheel drive and four-wheel drive forklifts in controlled warehouse environments. Their results indicated that two-wheel drive forklifts exhibit lower power consumption, reduced mechanical losses, and improved manoeuvrability on smooth warehouse floors. The study concluded that four-wheel drive systems are often unnecessary for indoor operations and increase cost and maintenance complexity. M. Rao and S. Patel (2020) performed stress analysis on forklift chassis and fork assemblies using finite element methods. Their results showed that mild steel provides sufficient strength and fatigue resistance for moderate load applications while maintaining cost-effectiveness. The study emphasized that proper chassis 6 geometry and load distribution play a vital role in maintaining forklift stability during lifting operations.

A. Wilson (2019) investigated forklift tipping accidents and introduced stability-based design guidelines. The study reinforced the importance of the stability triangle concept and highlighted that improper load positioning and excessive lifting height are primary causes of forklift instability. The author recommended shorter wheelbase optimization and controlled lifting speeds to enhance operational safety

K. Nakamura al. (2023) evaluated electric motor-driven forklifts and found that electric systems provide smoother torque delivery, reduced no is levels, and zero emissions. The study also highlighted that electric forklifts are more suitable for indoor environments when combined with simplified two-wheel drive mechanisms.

P. Fernandez and T. Gomez (2021) studied the performance of hydraulic cylinders used in industrial lifting equipment. Their findings confirmed that hydraulics offer precise control, smooth lifting motion, and high load capacity when properly designed. The study emphasized correct cylinder sizing and pressure regulation to avoid system failure. 7 R. Mehta and D. Singh (2022) proposed a simplified forklift model aim edit reducing manufacturing and maintenance costs. Their design utilized locally available materials and a two-wheel drive configuration, resulting in a cost reduction of approximately 25% compared to conventional forklifts. The study supports the feasibility of developing low-cost forklifts for warehouse applications. S. Lee et al. (2024) discussed sensor-based autonomous forklifts underpotential to improve warehouse efficiency. However, the study concluded the thigh initial investment and technical complexity limit their adoption in small-and medium-scale industries. As a result, manually operated forklifts with optimized mechanical design continue to be widely preferred. From the reviewed literature, it is evident that extensive research has been carried out on forklift efficiency, stability, drive systems, and safety. However, limited studies focus on the design and fabrication of a two-wheel drive forklift specifically optimized for industrial warehouse applications with emphasis on cost, simplicity, and manoeuvrability. Most existing studies either focus on heavy- duty forklifts or advanced automation systems.

H. Thompson and E. Rodriguez (2020) studied the relationship between forklift size, turning radius, and aisle width in warehouses. Their experimental analysis showed that compact forklifts with reduced turning radius significantly improve space utilization and reduce material handling time. The authors emphasized that two-wheel drive forklifts offer better steering response and are more suitable for narrow aisle layouts commonly found in modern warehouses

Verma and P. Iyer (2021) analysed energy consumption patterns of forklifts operating in indoor warehouses. Their findings indicated that simplified drivetrain configurations, such as two-wheel drive systems, consume less energy.

A. Müller et al. (2019) conducted a lifecycle cost assessment of warehouse forklifts and found that maintenance cost accounts for a significant portion of total ownership cost. The study revealed that forklifts with fewer moving parts, such as two-wheel drive systems, require less frequent maintenance and experience fewer mechanical failures. This supports the adoption of simplified forklift designs in cost-sensitive industrial environments. Fork design and load interface have also been widely studied.

C. Parkand J. Kim(2022) investigated fork geometry optimization to reduce stress concentration during lifting operations. Their analysis showed that proper fork thickness and surface finish reduce wear and improve load stability. The authors recommended that fork design should be aligned with standard pallet dimensions to ensure compatibility and safe handling. These findings are relevant for designing forklifts intended for general warehouse applications. Research related to braking and control systems emphasizes their importance in ensuring forklift safety. D. Brown (2020) evaluated braking performance in industrial forklifts and identified that

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controlled braking significantly reduces load shift and tipping risk. The study recommended incorporating reliable braking mechanisms and speed control systems, especially for forklifts operating in confined indoor spaces.

IV. RESULTS AND DISCUSSIONS

A. Simulation

In this project, simulation analysis was performed to evaluate the structural strength and performance of the fork component of the two-wheel drive forklift. The fork is the main load-carrying part of the forklift and is responsible for lifting and transporting materials in industrial warehouse applications. Therefore, analyzing the stress and deformation of the fork under load is essential for ensuring safe operation.

The 3D model of the forklift fork was designed using CAD software and then imported into ANSYS for structural analysis. The simulation mainly focused on static structural analysis, where the stresses, strains, and deformation produced due to the applied load were studied.

The analysis was carried out by applying the expected load on the fork to simulate real working conditions. The objective of this simulation was to verify whether the designed fork can withstand the load without excessive deformation or structural failure.

Only static analysis was performed in this study. Dynamic factors such as vibration, impact loading, and fatigue were not included in the analysis. The results obtained from the simulation help in understanding the load-bearing capacity and structural reliability of the forklift design.

V. MESHING

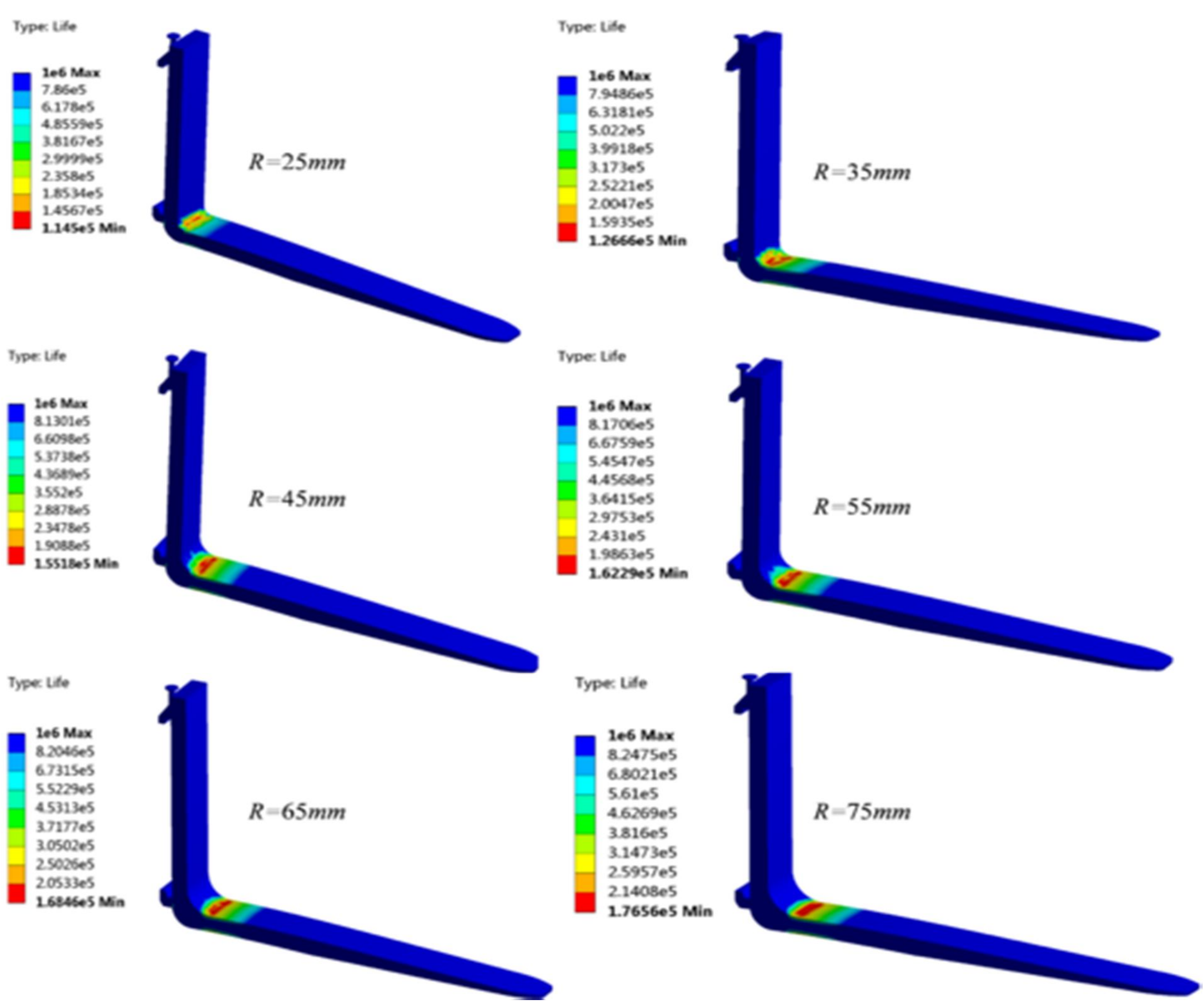

Figure: Meshed Model Of Forklift Fork

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VI. BOUNDARY CONDITIONS

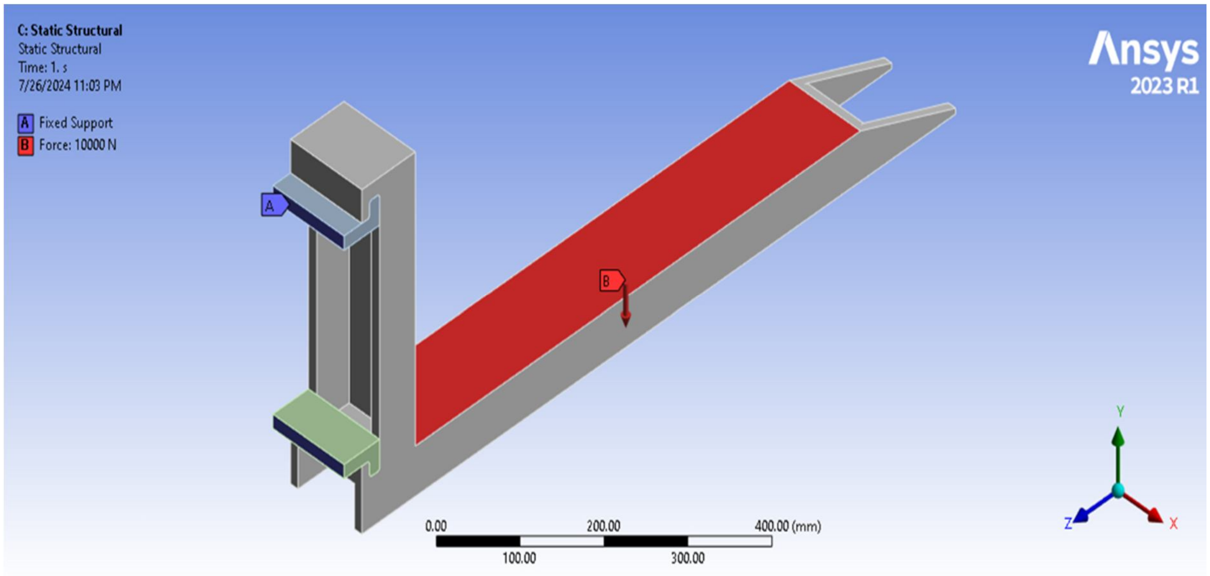


Figure 1: Boundary Conditions Applied to the Forklift Fork in ANSYS Static Structural Analysis

A. Post Processing and Solution

After completing the meshing and applying the boundary conditions, the simulation was solved using the static structural analysis module of ANSYS. The solution stage involves calculating the structural response of the model based on the applied loads and constraints.

Once the solver completed the calculations, the results were analyzed through the post-processing stage. Post-processing is the process of interpreting and visualizing the simulation results using graphical representations such as stress distribution plots, deformation diagrams, and strain contours. These results help in understanding how the forklift components behave under working conditions.

In this project, the post-processing results mainly focused on the fork structure of the two-wheel drive forklift, as it is the primary load-bearing component. The simulation results provided important parameters such as total deformation, equivalent (Von-Mises) stress, and strain distribution.

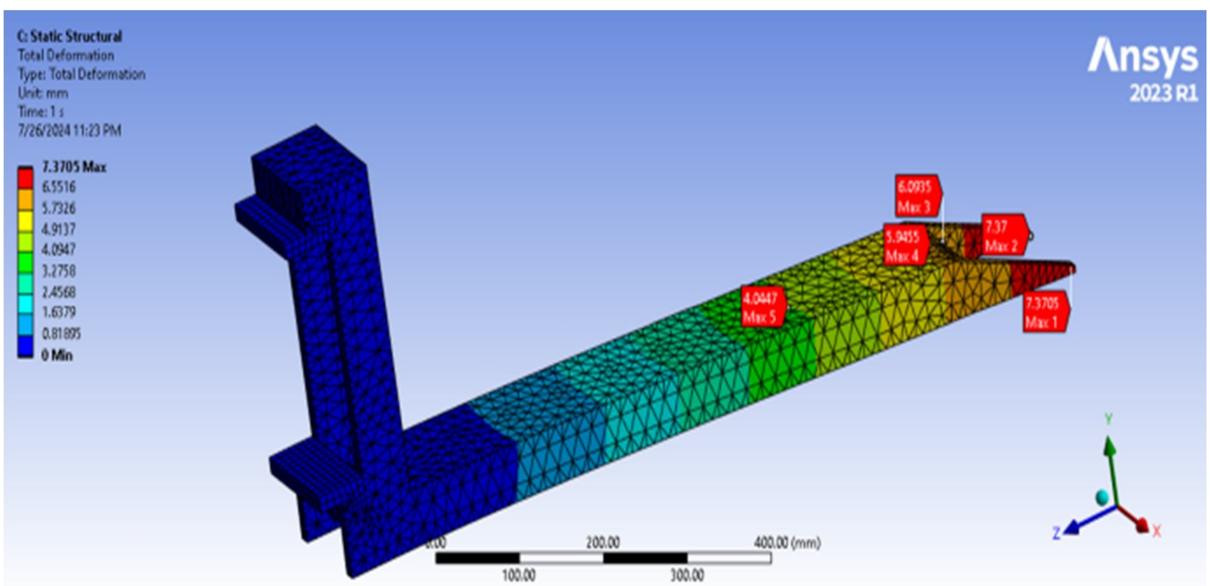


Figure 2: Total Deformation Result of Forklift Fork under Applied Load

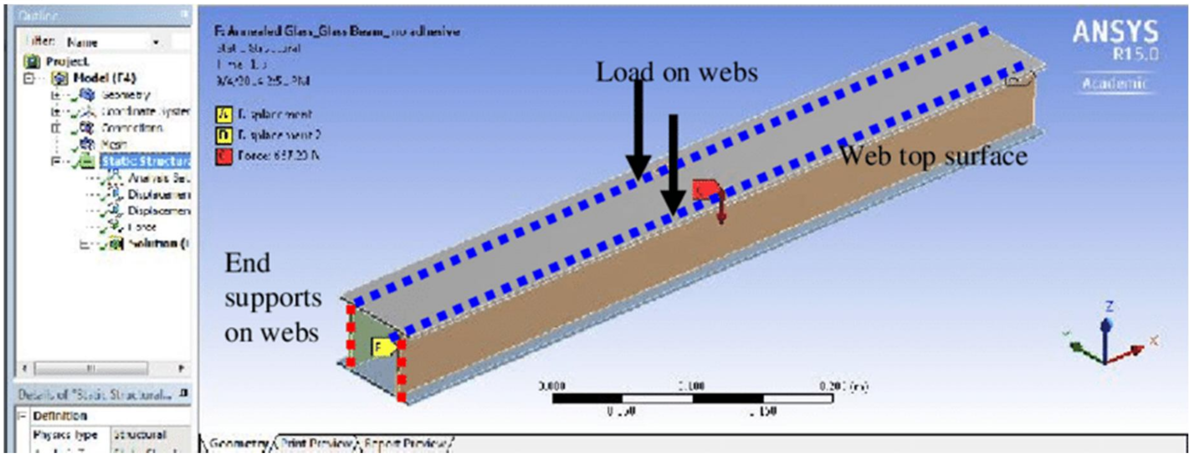


Figure 3: Load and Support Conditions Applied to the Fork Model in ANSYS

VII. WORKING

The working principle of the two-wheel drive forklift is based on lifting and transporting loads efficiently within industrial warehouse environments. In this system, power from the motor or engine is transmitted to the two driving wheels, which provide the necessary traction for movement. When the operator activates the control system, the driving wheels rotate and move the forklift forward or backward. The fork mechanism, which is attached to the lifting carriage, is used to lift pallets or materials placed on the forks.

During operation, the forks are inserted beneath the load or pallet. The lifting mechanism, which may consist of a hydraulic system or mechanical arrangement, raises the forks along the vertical mast. As the forks move upward, the load is lifted from the ground and can then be transported to the desired location. The operator controls the direction, speed, and lifting height of the forklift to ensure safe and efficient material handling.

The two-wheel drive configuration provides improved maneuverability and efficient load handling in confined warehouse spaces. Once the load reaches its destination, the operator lowers the forks carefully, placing the material in the required position. This working mechanism allows the forklift to perform material handling tasks such as loading, unloading, stacking, and transporting goods within industrial storage areas safely and efficiently.

VIII. CONCLUSION

The project “Design and Fabrication of a Two-Wheel Drive Forklift for Industrial Warehouse Applications” was successfully completed with the objective of developing an efficient and compact material handling system. The designed forklift demonstrates the ability to lift and transport loads within warehouse environments with improved manoeuvrability and operational efficiency.

The structural design of the forklift components, especially the fork mechanism, was analysed to ensure that it can withstand the applied loads safely. Simulation analysis performed using ANSYS helped evaluate the stress distribution and deformation under static loading conditions. The results indicated that the designed structure can safely handle the expected load without significant structural failure.

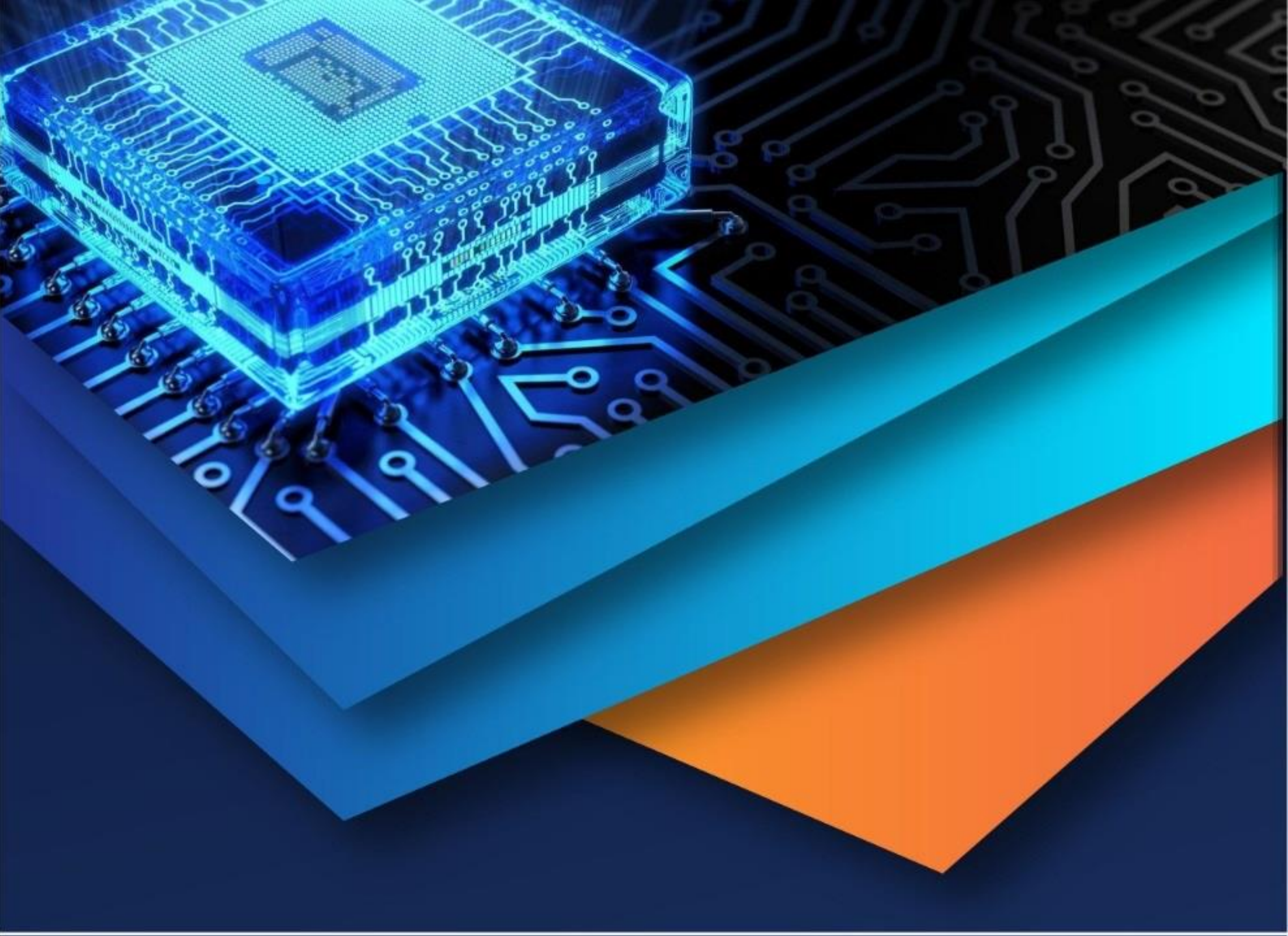
The fabricated model of the two-wheel drive forklift is suitable for use in small industrial warehouses where space is limited and efficient material handling is required. The project also demonstrates the practical application of mechanical design principles, CAD modelling, and simulation techniques.

Overall, the developed system provides a cost-effective, reliable, and efficient solution for material handling, and it can be further improved by incorporating advanced features such as automated control systems, improved lifting mechanisms, and enhanced safety features in future developments.

REFERENCES

[1] Safa, U. (2025). Tribological Characterization of Alcorn, Tiarnan Other PVD Coatings. Journal of Surface Engineering,
[2] Smith, J., & Kumar, R. (2021). Impact of Forklift-Assisted Material Handling on Warehouse Productivity. International Journal of Industrial Engineering,.
[3] Chen, L., Wang, Y., & Lee, H. (2022). Performance Analysis of Two-Wheels .Four-Wheel Drive Forklifts in Indoor Warehouses. Journal of Mechanical Systems, .
[4] Rao, M., & Patel, S. (2020). Stress Analysis and Optimization of Forklift Chassis Using Finite Element Method. Materials Today: Proceedings,

[5] Wilson, A. (2019). Forklift Stability and Safety Design Guidelines. Safety Science,
[6] Nakamura, K., Ito, T., & Yamada, H. (2023). Electric Motor-Driven Forklifts for Indoor Applications: Efficiency and Performance Analysis. International Journal of Electrical and Mechanical Engineering.
[7] Fernandez, P., & Gomez, T. (2021). Hydraulic Lifting Mechanisms in Industrial Material Handling Equipment. Journal of Hydraulics and Fluid Mechanics
[8] Mehta, R., & Singh, D. (2022). Design of Low-Cost Two-Wheel Drive Forklifts for Warehouse Applications. International Journal of Manufacturing Engineering,
[9] Lee, S., Park, J., & Kim, H. (2024). Sensor-Based Autonomous Forklifts: Opportunities and Challenges. Robotics and Automation Review.
[10] Thompson, H., & Rodriguez, E. (2020). Manoeuvrability of Compact Forklifts in Narrow Warehouse Aisles. Journal of Material Handling Research



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