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## Design & Fabrication of Advance Forklift

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### ABSTRACT

*This abstract provides a concise overview of the research conducted on forklifts to enhance their performance and efficiency. The study focused on exploring improvements to the self-propelled nature of forklifts, aiming to optimize their overall functionality. By analyzing factors such as power sources, lifting mechanisms, maneuverability, and control systems, researchers identified areas for enhancement. The research incorporated advanced methodologies and innovative technologies to propose modifications that improve weight distribution, stability, maneuvering precision, and safety. The results of this research contribute to the evolution of forklifts as fundamental transportation tools, making them more efficient and effective in various industrial settings.*

Keyword: *mechanism, forklifts and modification.*

### 1. INTRODUCTION

A forklift, also known as an industrial truck or lift truck, is a specialized, self-propelled, and counterbalanced vehicle designed for the purpose of lifting, carrying, and transporting heavy loads over short distances in industrial settings. Forklifts play a pivotal role in various industries, including warehousing, manufacturing, construction, and logistics, where they facilitate the movement of goods and materials within confined spaces, such as warehouses, distribution centers, and construction sites.

The fundamental structure of a forklift consists of a rigid frame, front-mounted traction wheels, and a rear-wheel steering system. The lifting mechanism, a primary component of a forklift, comprises a pair of horizontally adjustable forks capable of vertical movement to raise and lower loads. The forks are hydraulically operated, allowing for efficient load handling and adjustment to accommodate different load sizes and shapes. Additionally, forklifts can be equipped with various attachments, such as clamps, rotators, or platforms, to facilitate specialized load handling requirements.

Forklifts are available in several configurations and types to cater to diverse operational demands:

1. **Counterbalance Forklifts:** These forklifts utilize a weight distribution system, typically located at the rear of the vehicle, to counterbalance the load being lifted at the front. Counterbalance forklifts are commonly employed for general material handling tasks and are offered in both electric-powered and internal combustion engine (ICE) variants.
2. **Reach Trucks:** Designed specifically for narrow aisle applications, reach trucks incorporate extendable forks that can reach forward and retract to lift and deposit loads onto high racking systems. The extendable reach allows for efficient utilization of space within narrow storage aisles.
3. **Order Pickers:** Primarily used in warehouse environments for order fulfillment, order pickers feature an elevated platform for operators to stand on during operations. This platform, integrated with the lifting mechanism, enables operators to elevate themselves along with the load, facilitating convenient picking of items from elevated shelves.
4. **Pallet Jacks:** Commonly referred to as pallet trucks or pump trucks, pallet jacks are manually operated forklifts designed for moving palletized loads on flat surfaces. They employ a hydraulic mechanism to lift loads slightly off the ground, enabling their transportation within confined spaces.
5. **Rough Terrain Forklifts:** Engineered specifically for outdoor applications on rough and uneven terrains, rough terrain forklifts feature robust construction and specialized tires capable of navigating challenging surfaces. They possess higher ground clearance and enhanced stability to ensure safe operation in rugged environments.

The power sources employed in forklifts vary based on specific requirements and considerations. Electric forklifts utilize battery-powered electric motors, offering advantages such as reduced noise levels, zero emissions, and increased energy efficiency. Internal combustion forklifts, on the other hand, are powered by gasoline, diesel, or liquid petroleum gas (LPG) engines, providing higher power output and extended operating durations.

Safety is of utmost importance in forklift operations, necessitating adherence to strict regulations and guidelines. Operators are required to undergo comprehensive training and certification to ensure competency and safe handling practices. Forklifts are equipped with safety features, including seat belts, horns, warning lights, and audible alarms, to alert both operators and pedestrians of their presence and movement. Complying with load capacity limits, adhering to maintenance schedules, and conducting regular inspections are critical aspects of ensuring the safe and efficient operation of forklifts.

In conclusion, forklifts serve as indispensable tools in modern industrial sectors, facilitating the movement and transportation of materials and goods within confined spaces. Their versatile designs and various types cater to specific operational needs, while advancements in technology continue to drive improvements in performance, safety, and efficiency, making forklifts an essential component of industrial

## **2. METHODOLOGY**

### **2.1. Area of interaction**

#### **2.1.1. Different type of forklift use in Automotive Sector :**

The study explores the following forklift types commonly employed in the automotive sector:

- I. Counterbalance Forklifts: These forklifts are widely utilized for general material handling tasks in automotive manufacturing facilities. Their ability to counterbalance loads at the front allows efficient handling of automotive components, pallets of parts, and other materials. The research assesses their load capacities, stability, and suitability for automotive applications.
- II. Reach Trucks: Reach trucks play a significant role in automotive manufacturing and distribution centers, especially for handling automotive parts stored in high-racking systems. The extendable forks enable operators to reach forward and retract, facilitating the retrieval and placement of parts at elevated heights within narrow aisles. Performance factors such as lift height, load capacity, and maneuverability are critically evaluated.
- III. Order Pickers: With a focus on efficient order fulfillment, order pickers are extensively used in automotive warehouses and distribution centers. Equipped with a raised platform, these forklifts enable operators to access and pick items from shelves or racks, optimizing productivity. The study investigates factors such as platform stability, lifting mechanism reliability, and ergonomic considerations.
- IV. Turret Trucks: Turret trucks, also known as very narrow aisle (VNA) forklifts, are vital in automotive manufacturing facilities and warehouses where space optimization is crucial. These specialized forklifts operate in narrow aisles and offer features such as rotating forks and high-lifting capabilities to efficiently utilize vertical space. The research examines their maneuverability, lift height, and performance in complex warehouse layouts.
- V. Side Loaders: The automotive sector often requires the handling of long and bulky loads, necessitating the use of side loaders. These forklifts feature forks positioned at the side of the vehicle, enabling safe and efficient sideways loading and unloading of materials. Load capacity, stability, and specialized features for handling oversized automotive components are assessed.
- VI. Electric Pallet Jacks: Electric pallet jacks find widespread use in automotive manufacturing and assembly lines, streamlining the movement of palletized loads. Their compact size and maneuverability contribute to minimizing manual handling and improving productivity. Factors such as battery life, maneuvering capabilities, and load capacity are examined.
- VII. Automated Guided Vehicles (AGVs): Automation has gained prominence in the automotive sector, with AGVs offering efficient and autonomous material handling solutions. These unmanned, computer-controlled forklifts navigate through automotive facilities, transporting

components, sub-assemblies, and finished products. The study evaluates their navigation accuracy, programming flexibility, and adaptability to changing operational requirements.

Through a comprehensive evaluation of these forklift types, this research study provides valuable insights into their performance, suitability, and optimization for automotive material handling operations. The findings aim to assist automotive industry professionals in making informed decisions regarding forklift selection and utilization, ultimately enhancing operational efficiency.

### **2.1.2. Working principle of forklift : -**

The working principle of a forklift involves the integration of various components and systems. Powered by electric batteries or internal combustion engines, the forklift's chassis and frame provide stability and support. Front wheels enable maneuverability while rear-wheel steering allows navigation. The lifting mechanism consists of hydraulically operated forks attached to the front, controlled by a hydraulic system. A vertical mast with a lift cylinder facilitates the vertical movement of the forks. A load backrest prevents load shifting. Operator controls, housed in the cabin, enable precise operation. Safety features like seat belts, horns, and sensors ensure safe operation. The operator maneuvers the forklift using the controls to position the forks and raise or lower them. The hydraulic system transfers fluid to the lift cylinder, extending or retracting it to move the forks accordingly. Overall, this working principle enables efficient handling and transportation of heavy loads in industrial applications.

### **3. DISCUSSION OF ABOVE STUDY**

in the study can be identified as the need for a comprehensive evaluation and analysis of the performance, suitability, and optimization of different types of forklifts used in the automotive sector. While the study outlines various forklift types and their applications in automotive material handling operations, it does not delve into specific areas of comparison, such as their efficiency, productivity, safety features, maintenance requirements, and cost-effectiveness.

To bridge this research gap, future studies could focus on conducting in-depth comparative analyses of the identified forklift types in terms of their specific performance metrics, such as load capacity, maneuverability, lifting height, energy efficiency, and overall productivity. Additionally, investigating the impact of different forklift types on operational costs, including maintenance, training, and downtime, would provide valuable insights for automotive industry professionals in selecting the most suitable forklifts for their specific requirements.

Furthermore, the research could explore the integration of advanced technologies, such as automation in forklifts to enhance their capabilities and optimize automotive material handling processes. This could include examining the feasibility and benefits of implementing automated guided vehicles (AGVs) or exploring emerging trends in electric or hybrid forklift technologies that offer improved environmental sustainability and operational efficiency.

### **4. OBJECTIVE OF THIS STUDY**

In this study, we investigate a new and innovative forklift design that introduces two key features: the implementation of a Chain Mechanism in the forklift's Lifting Mechanism and the integration of a Better Integrated Body design. The aim of incorporating the Chain Mechanism is to effectively

distribute and divide the total load by four within the Lifting Mechanism. By doing so, the load exerted on the motor is significantly reduced, resulting in improved efficiency and reduced strain on the motor. This feature enables the forklift to handle heavier loads more efficiently and effectively.

The Better Integrated Body design is another focal point of this study. The objective is to achieve enhanced balance and a smooth sliding mechanism during the forklift's operation. The integration of wide wheels further enhances stability, ensuring reliable and secure movement even in challenging environments. By combining the benefits of the Chain Mechanism and the Better Integrated Body design, the proposed forklift offers improved load distribution, reduced motor load, enhanced balance, and increased stability. These advancements have the potential to greatly improve material handling capabilities in various industries. The study aims to assess the performance and feasibility of the new forklift design, evaluating its load distribution efficiency, motor load reduction, balance enhancement, and stability improvement. The findings of this research contribute to the understanding of innovative forklift designs and their potential applications in industrial settings.

## 5. DESIGN MODEL OF FORKLIFT:

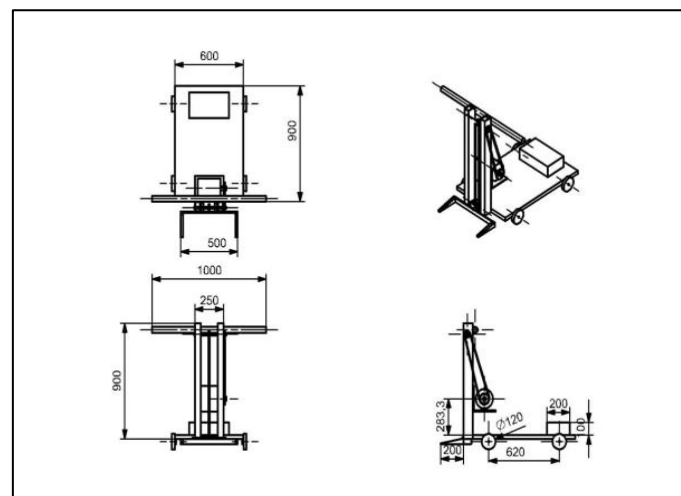
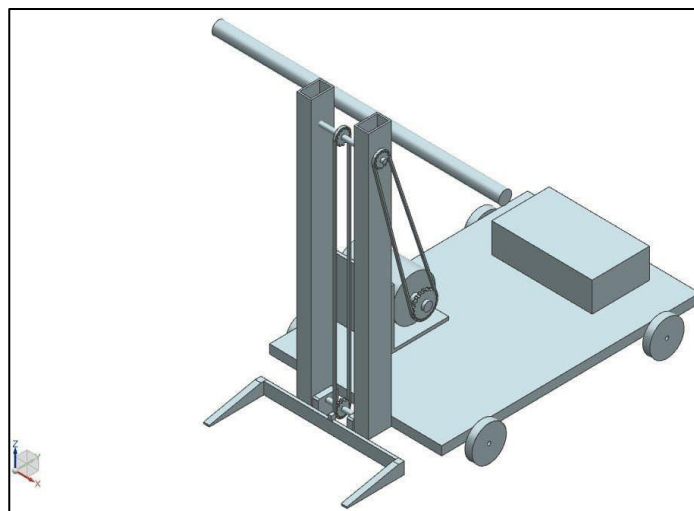


Fig.1 : CAD Model

## **6. PRINCIPLE OF WORK**

The mini fork, designed for lifting loads, incorporates a pulley and belt arrangement. This mechanism allows for the efficient transfer of power from a powerful 12V DC motor, which is responsible for providing the necessary lifting force. Additionally, to ensure proper balance during the lifting process, a counterweight is integrated at the back of the mini fork. This counterweight helps maintain stability and equilibrium while lifting heavy loads, preventing any potential tipping or imbalance issues.

The focus of this project lies in the manufacturing of an industrial-grade forklift that offers low cost and easy operation. Unlike heavy fork lift machines that typically employ twin shafts, this particular model utilizes a single shaft shredder for its operations. The choice of the shredder tool significantly impacts the efficiency of the machine and directly influences the quality of the crushing results achieved. Moreover, careful consideration is given to selecting the appropriate motor for the machine, as it directly affects the overall performance and operation of the forklift. By ensuring the right motor is chosen, optimal functionality and efficiency can be achieved during the machine's operation.

Design Calculation :

In this practical example, we are designing a Rigid Flanged Coupling to transmit a power of 1.2 kW at a speed of 600 rpm between two co-axial shafts. The flanged coupling is constructed using PLA and ABS filament materials, and it is secured using three bolts. The diameter of the shaft is 15 mm, and it is keyed to the flanged hub.

To calculate the dimensions and stress analysis of the flanged coupling, we begin by determining the maximum bending moment. The perpendicular distance (H) is given as 540 mm, and the load (W) is 45 kg. Using the formula for bending moment ( $M = \text{force} * \text{perpendicular distance}$ ), we calculate the maximum bending moment to be 238.383 kN/mm.

Next, we calculate the moment of inertia (I) using the formula  $I = (b * d^3) / 12$ , where b represents the width of the frame and d represents the depth. Given the dimensions of the frame as L = 1200 mm and B = 900 mm, we convert them to meters ( $L = 1200 * 10^{-3}$  m and  $B = 900 * 10^{-3}$  m) and substitute them into the formula to find I as  $7.29 * 10^{10}$  mm<sup>4</sup>.

Finally, we calculate the bending stress ( $\sigma_b$ ) using the formula  $\sigma_b = (M * y) / I$ , where y is the distance of the layer at which the bending stress is considered. To determine the maximum value of y, we take the distance of the extreme fiber from the neutral axis. Substituting the values into the formula, we find the bending stress to be 1.962 N/mm<sup>2</sup>.

This analysis provides important information about the dimensions and stress distribution in the flanged coupling, enabling us to ensure its structural integrity and suitability for transmitting the specified power and speed.

## **7. REAL MODEL FOR EXPERIMENT**



Fig 2 : experimental model

## **8. DISCUSSION OF RESEARCHER**

Firstly, forklifts designed with a minimum turning radius are advantageous in environments with limited space or narrow aisles. This feature enables better maneuverability and allows operators to navigate through tight spaces more efficiently.

Secondly, the cost-effectiveness of forklifts is an important consideration for businesses. Forklifts that are low in cost, both in terms of initial investment and maintenance, provide economic benefits to companies, especially those operating on smaller scales or with budget constraints.

Furthermore, the environmental impact of forklifts is a growing concern. Forklifts that are less hazardous to the environment offer significant advantages. By eliminating the need for fossil fuels and opting for alternative energy sources, such as electric power or hydrogen fuel cells, forklifts can reduce greenhouse gas emissions and contribute to a more sustainable operation.

The eco-friendly operation of forklifts encompasses multiple aspects, including reduced noise pollution, lower emissions, and the use of recyclable materials in their construction. Forklifts designed with eco-friendly features align with the principles of environmental conservation and promote a greener working environment.

Incorporating forklifts in low-scale industries provides an opportunity for smaller businesses to benefit from the efficiency and productivity gains offered by these versatile machines. Their adaptability and versatility make them suitable for a wide range of industries, regardless of scale.

Small-sized forklifts offer advantages in environments where space is limited or where maneuverability is crucial. Their compact design allows them to navigate through narrow passageways and confined areas, providing increased flexibility in operation.

Moreover, while being small in size, these forklifts can still carry significant loads. Their load carrying capacity ensures that they can handle the required tasks efficiently and effectively, despite their compact dimensions.

Lastly, forklifts with robust construction and the capability to handle small-scale purposes are highly valued. Their durability, strength, and versatility make them suitable for various applications, including lifting, carrying, and transporting materials in a wide range of industries.

In summary, the technical aspects of forklifts that encompass a minimum turning radius, low cost, environmental friendliness, adaptability to low-scale industries, small size, good load carrying capacity, and suitability for small-scale purposes contribute to their effectiveness and practicality in diverse operational settings.

## **9. CONCLUSION**

The project undertaken by our team has made significant advancements in the field of production and manufacturing industries. It introduces a highly beneficial scrap collecting vehicle that eliminates the need for risky parking maneuvers. This project effectively reduces costs associated with scrap collection and offers efficient task completion within the shortest possible time.

The implementation of our forklift design demonstrates its remarkable usability in various institutes and warehouses. It enables workers to load, unload, and transfer materials with enhanced efficiency compared to manual handling. This leads to a reduction in physical strain, particularly minimizing spine-related problems. The forklift's effectiveness and ease of operation ensure smooth and efficient performance in various tasks.

As a mechatronics product, the forklift proves its versatility and can be utilized across numerous industries. The design showcases its ability to lift loads of up to 80 kg to a height of 1.8 m. The integration of electronic circuits makes its control simple and user-friendly. Additionally, the forklift offers an economical alternative to commercially available models, while maintaining smooth operation on various surfaces such as concrete floors or roads.

In conclusion, our project introduces a highly functional and cost-effective forklift solution that significantly improves material handling operations in industrial settings. Its performance and features make it a valuable asset in streamlining operations, enhancing efficiency, and reducing physical strain for workers.

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