The Hydraulic Floor Crane

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***Abstract*—The hydraulic floor crane is a versatile material handling equipment used in automobile workshops, garages, and industries for lifting and transporting heavy loads with ease. It operates on Pascal's law, where a small applied force is converted into a large lifting force through hydraulic pressure. This project includes the design, analysis, fabrication, and working of the crane. It studies important components such as the hydraulic jack, lifting boom, base frame, wheels, hook, and control system, ensuring proper strength, stability, and durability. The fabrication process involves cutting, welding, drilling, and assembly. The project also focuses on safety and efficiency, including proper load distribution, controlled lifting, and stable movement. Cost estimation is considered to make the crane suitable for small-scale industries.**

***Index Terms*—Hydraulic Floor Crane, Hydraulic Jack, Fabrication, Load Distribution**.

I. INTRODUCTION

A hydraulic floor crane is a versatile and essential material handling device widely used in workshops, garages, warehouses, and industrial environments for lifting, lowering, and transporting heavy loads with ease and safety. It operates on the fundamental principle of hydraulic power, where force is transmitted through an incompressible fluid to achieve significant mechanical advantage. The crane typically consists of a sturdy base frame, a vertical mast, an extendable boom, a hydraulic cylinder, and a lifting hook or chain assembly. By applying a small force on the hydraulic pump handle, the operator can generate a much larger lifting force, enabling the crane to handle heavy components such as engines, machinery parts, and equipment that would otherwise require extensive manual effort or multiple workers. The design of a hydraulic floor crane emphasizes portability, stability, and efficiency. It is usually mounted on caster wheels, allowing easy movement across the workshop floor, while foldable or adjustable legs enhance space utilization and storage convenience. The boom length can often be adjusted to vary the load capacity and reach, making the crane adaptable for different applications. Safety is a critical aspect of its operation, with features such as pressure relief valves, locking mechanisms, and stable load distribution ensuring reliable performance during lifting tasks. In modern industries, hydraulic floor cranes play a crucial role in improving productivity and reducing the risk of workplace injuries associated with manual handling. Their simple construction, ease of operation, low maintenance requirements, and cost-effectiveness make them a preferred choice for small-scale as well as large-scale operations. This project focuses on understanding the design, working principle, components, and applications of hydraulic floor cranes, providing detailed insight into their functionality and significance in mechanical and industrial engineering.

II. LITERATURE REVIEW

Dr. S. R. Koli, Nikita Dethe. (2024) Design and Fabrication of Hydraulic Floor Crane Hydraulic floor cranes offer a cost-effective and efficient alternative to traditional material handling equipment. With their robust and sturdy construction, these cranes are capable of maneuvering heavy loads with ease consisting of a mast, boom, hook, wheels, & hydraulic pump with cylinder assembly, the crane structure is designed for durability and reliability. The box crane configuration enables effective hand ling of heavy loads while minimizing the risk of damage, even under rough conditions. Additionally, mobile floor cranes

feature portable design elements, making them suitable for both indoor and outdo or applications in workshops, warehouses, and beyond. Key features such as adjustable boom, mast, a nd balance enhance versatility, allowing for the lifting of materials of various heights and sizes. Ajit Bhoyar, Akshay Sonule (2021) Assessment of Hydraulic Floor Crane In this research work, the modification of floor hydraulic crane was carried out. The modified floor hydraulic crane has the following parts; base plate/truck/pallet, battery seat, boom and lifting switches, vertical column, horizontal arm, secondary horizontal arm, power screw, roller, hook, nuts and bolts. The selections of materials for the various components were based the strength, machinability toughness, ductility, and hardness. It was designed for load of 50 to 100 kg capacities and the development of suitable. Santosh Tiwari, Prince Thakur, Mandeep Rathod (2019) design and fabrication of Hydraulic floor crane. This project deals with the fabrication of Hydraulic Floor Crane which provides an efficient, low-cost alternate option to other material lifting machines. The purpose of our project is to design an d fabricate a hydraulic floor crane and give its boom-mast assembly the rotational stability of 360° in horizontal plane. The rotational motion is provided by assembling the boom-mast assembly on a circu lar plate above the base with thrust ball bearings for circular movement. The hydraulic bottle jack wh ich is fixed on the circular plate is used for lifting the load attached to the fixed hook of the boom. A wiper motor is used for operating the hydraulic jack. The power to the system is provided through the battery. The self-locking caster wheel provides mobility to the hydraulic floor crane as well as it gives s its base the stability while lifting of the load. This hydraulic floor crane is applicable in workshops and small-scale industries for lifting moderate loads.

III. SCOPE OF PROJECT

The scope of this project involves the comprehensive study, design, fabrication, and performance analysis of a hydraulic floor crane used for lifting and transporting heavy loads in industrial and workshop environments. It focuses on understanding the working principle of hydraulic systems based on Pascal's law, and applying it to develop an efficient, portable lifting mechanism. The project includes detailed evaluation of structural components, load capacity, stability, and safety considerations to ensure reliable operation. It also covers material selection, manufacturing processes, cost estimation, and maintenance aspects. Additionally, the project aims to explore practical applications such as engine handling, machine installation, and material movement, while suggesting possible improvements in design for better efficiency, durability, and ease of operation.

IV. METHODOLOGY

Problem Identification and Objective Definition- The process begins with identifying the need for a hydraulic floor crane and defining the objectives such as required lifting capacity, portability, and safety. The scope of the project is clearly established based on industrial or workshop requirements.

Literature Review and Study- A detailed study of hydraulic systems, lifting mechanisms, and existing crane designs is carried out. This helps in understanding the working principles, advantages, and limitations of different designs.

Engineering Calculations and Material Selection- Necessary calculations are performed to determine load capacity, stress, and factor of safety. Suitable materials such as mild steel are selected for structural components to ensure strength, durability, and cost-effectiveness

Component Selection and Procurement-All required components such as the hydraulic jack, wheels, steel sections, fasteners, and pins are selected based on design specifications and procured from reliable sources.

Fabrication Process- Fabrication is carried out using standard manufacturing processes such as cutting, welding, drilling, and grinding. The frame and other structural parts are manufactured according to the prepared design. Assembly of Components All fabricated parts and purchased components are assembled properly. The hydraulic jack is mounted, and the boom and base are connected with proper alignment and secure fastening.

Testing and Inspection -The assembled crane is tested under different load conditions to evaluate lifting capacity, stability, and smooth operation. Any defects or issues are identified during this stage. Performance Analysis and Documentation - Finally, the performance of the crane is analyzed based on test

results. Observations are recorded, necessary improvements are suggested, and complete documentation is prepared for the project report.

V. DETAILS OF DESIGNS, WORKING, PROCESSES OF MAIN COMPONENTS

Material Selection
Boom (Jib Arm)
Function: (carry) the main load and experience bending stress Material:

- Mild Steel (IS 2062 / ASTM A36)
- Properties:
- High strength
- Good weldability
- Low cost
- Easily available

Reason:
Boom is subjected to high bending moment, so mild steel provides sufficient strength with economical cost.
Base Frame & Legs
Function: Provide stability and support

Material:

- Structural Steel (Mild Steel Square/Rectangular Tubes)
- Properties:
- High load bearing capacity
- Good rigidity
- Shock resistance

Reason:
Must resist tipping and deformation under heavy loads
Hydraulic Cylinder
Function: Generate lifting force
Material:

- Cylinder body → Alloy Steel
- Piston rod → Hardened Chrome-Plated Steel

Properties:

- High tensile strength
- Corrosion resistance
- Wear resistance

Reason:
Handles high pressure (5–10 MPa) and repeated motion.
Hook
Function: Hold the load

Material:

- Forged Alloy Steel (EN8 / EN24)
- Properties:
- Very high strength
- Toughness
- Fatigue resistance

Reason:
Critical safety component → must not fail under load.
Pins & Joints
Function: Allow rotation and movement

Material:

- Medium Carbon Steel (EN8)
- Properties:
- Good strength
- Wear resistance

Reason:
Handles shear and bending forces.
Wheels (Casters)
Function: Mobility of crane

Material:

- Cast Iron / Polyurethane Coated Steel Wheels
- Properties:
- High load capacity
- Wear resistance
- Smooth movement

Fasteners (Bolts & Nuts)

Material:

- High Tensile Steel (Grade 8.8 or 10.9)

Reason:
To withstand heavy load and vibration.
Hydraulic Oil

Type:

- ISO VG 32 / 46 Hydraulic Oil

Properties:

- Good lubrication
- Thermal stability
- Anti-wear properties

Design Process
Design calculation of hydraulic floor Crane.

- Maximum load lifted, m = 2000 kg
- Acceleration due to gravity, a = 9.81 m/s^2
- Distance from pivot to hook A =95cm = 0.95m 4) Distance from pivot to cylinder connection, B-35cm = 0.35m

Step I
Load Force
W = m * g
= 2000*9.81
= 19620 N
Step II
Bending Moment at Pivot
M = W * A
= 19620 * 0.95
= 18639 Nm

Step III
Force Required by Hydraulic Cylinder

$$F = \frac{W*A}{B}$$

$$= \frac{18639}{0.35}$$

= 53254 N
Step IV
Area of Cylinder

$$A = \frac{\pi}{4} * D^2$$

$= 0.00159\ m^2$
Step V
Hydraulic Pressure

$$P = \frac{F}{A}$$

= 33.5 MPa

VI. CONCLUSION AND FUTURE SCOPE

Conclusion
The hydraulic floor crane project successfully demonstrated the design, construction, and working of a material handling system based on hydraulic principles. The crane was able to lift and move heavy loads efficiently with minimum manual effort, proving the effectiveness of Pascal's law in practical applications. All major components such as the frame, hydraulic jack, boom, mast, hook, and wheels functioned properly and provided stability, strength, and smooth operation during testing.
The system showed reliable performance, safety in load handling, and ease of operation, making it suitable for use in workshops, industries, and maintenance applications. The project also helped in Understanding the importance of proper design, material selection, and assembly in ensuring durability and efficiency. Overall, the hydraulic floor crane proved to be a cost-effective and practical solution for lifting and handling heavy loads.

Future Scope of Project
The future scope of the hydraulic floor crane project includes advancements in lifting technology, where modern hydraulic systems can be integrated with electric or motorized pumps to improve efficiency and reduce manual effort; improvement in design and strength, using advanced materials and optimized structures to increase load capacity while reducing weight; automation and smart features, including load sensors, digital displays, and remote operation for better control and safety; expansion in industrial applications, where cranes can be adapted for heavy-duty and specialized tasks in manufacturing and construction sectors; safety enhancements, such as overload protection systems and advanced braking mechanisms; mobility improvements, with better wheel design and compact foldable structures for easy transportation; and cost-effective manufacturing, making the crane more accessible for small-scale industries and workshops.

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