

DESIGN AND DEVELOPMENT OF CYLINDER LIFTERDarshan Anand M¹, Alok M K², M Sanjay³, Dr Manjunatha G⁴^{1,2,3} -Student, School of Mechanical Engineering, REVA University, Bengaluru, Karnataka, India⁴-Assistant Professor, School of Mechanical Engineering, REVA University, Bengaluru, Karnataka, India**ABSTRACT**

The fabrication and development of an ergonomically designed cylinder lift is the focus of this project work. The cylinder lift is designed to be adjustable and ergonomically friendly, with features that reduce the risk of workplace injuries caused by repetitive lifting and strain. It is designed to be durable and easy to use, with adjustable features that enable the user to set the height of the lift according to their requirements. It has the potential to improve workplace safety and efficiency by reducing the risk of injury and increasing productivity. Overall, this project report provides valuable insights into the design and development of an innovative and practical device that can improve workplace safety and productivity in a variety of industries. The Cylinder Lifter project focuses on the design, development, and implementation of a mechanical system intended to lift and transport cylindrical objects efficiently. This system is particularly useful in domestic help, such as houses, restaurants & industries where cylindrical materials, such as pipes, drums, or tanks, need to be moved or manipulated frequently. The primary objective of this project is to create a reliable, cost-effective, and user-friendly lifting mechanism that minimizes manual labour and improves safety.

This paper outlines the design process, material selection, construction, and testing phases of the cylinder lifter, providing a comprehensive overview of its functionality and potential applications in modern manufacturing and warehousing environments.

Key Words: Cylinder, Wheel, Motor

1. INTRODUCTION

Ergonomic cylinder lifters are devices designed to make lifting and moving heavy cylindrical objects, such as barrels or drums, safer and more comfortable for the user. They are typically used in industrial settings where large quantities of liquids or other materials need to be transported and stored in cylindrical containers. The purpose of ergonomic cylinder lifters is to reduce the risk of workplace injuries such as strains, sprains, and back injuries that can occur when lifting heavy objects. Cylinder lifters typically consist of a lifting mechanism, a handle, and wheels to make it easier to move the lifted object from one location to another.

The primary goal of ergonomic cylinder lifters with stair-climbing wheels is to safely and efficiently transport heavy gas cylinders across flat surfaces and stairs, while minimizing physical strain and injury risk for the operator.

2. LITERATURE REVIEW

Johnson et al. (2018), focused on understanding how the height of handles affects the biomechanics of lifting heavy cylindrical loads, specifically compressed gas cylinders. These cylinders are commonly used in industrial, medical, and laboratory settings and are often moved manually, which can expose workers to injury risks — particularly in the lower back and shoulder regions

Lee et al. (2017) aimed to evaluate the usability of various cylinder lifter designs by gathering feedback from the workers who use them in real-world settings. Rather than focusing solely on biomechanical or technical metrics, this study emphasized the human-centered aspect of equipment design — particularly how workers perceive and interact with the devices

Kim et al. (2020) explored how design modifications to cylinder lifters could reduce physical strain on users, particularly during the transportation and handling of heavy gas cylinders. Their focus was on integrating a suspension system — a feature more commonly found in vehicles — into the lifter design to absorb shocks and vibrations during use.

Kaur et al. (2021) examined the economic and operational impact of using ergonomically designed cylinder lifters in various industrial sectors, such as manufacturing, healthcare, logistics, and chemical processing. Rather than focusing purely on physical or biomechanical outcomes, this study evaluated the broader organizational effects — particularly how ergonomic improvements can influence worker performance, safety, and company profitability

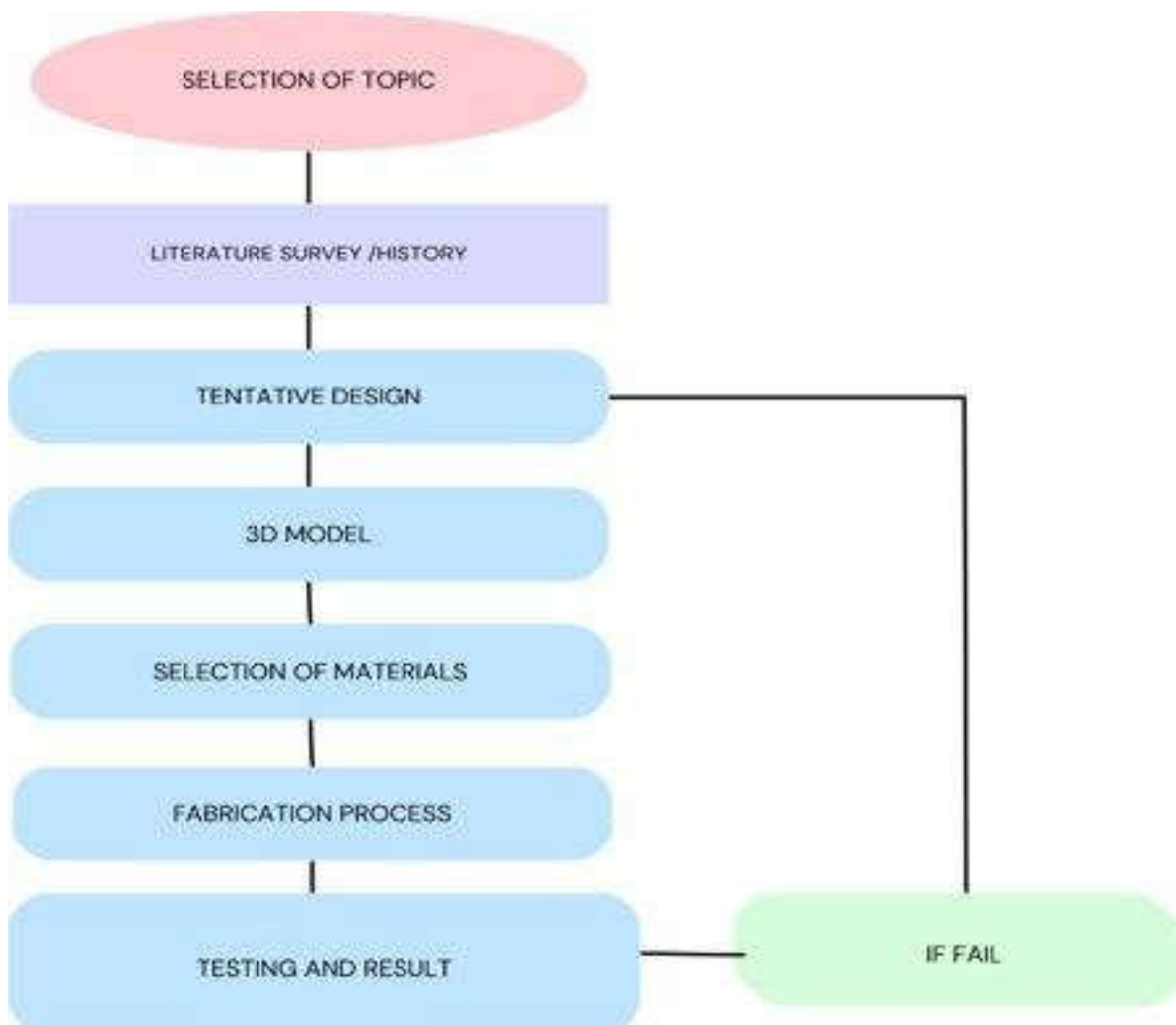
Zahoor et al. focused on evaluating the ergonomic performance of a specially designed gas cylinder lifting device, with the goal of reducing the physical strain on workers. Given the high frequency of manual handling of heavy gas cylinders in various industries — such as healthcare, welding, and manufacturing — this study aimed to determine whether such a device could effectively reduce the risk of musculoskeletal disorders (MSDs), which are a major cause of workplace injuries and lost productivity

3. OBJECTIVES

The work aims to address the challenges by designing and developing a DC motor operated cylinder lifter that is structurally robust, user friendly and capable of lifting standard industrial cylinders with minimal risk and high operational efficiency. From extensive literature survey, the following objectives are drawn.

- To Design a Safe and Reliable Lifting Mechanism
- To Integrate a DC Motor-Based Drive System
- To Minimize Manual Effort and Improve Ergonomics
- To Enhance Operational Efficiency and Precision

4. METHODOLOGY



5. CONCEPTUAL DESIGN

In the initial stage, the construction of the cylinder lifter involves a systematic approach that includes the selection of suitable materials, fabrication of components, and assembly of the lifting mechanism. The lifter is designed to be robust, easy to operate, and capable of safely lifting and transporting cylindrical loads such as gas cylinders or drums. The square shaft is reciprocating to elevate the cylinder. We employed locking mechanisms such as spring catchers and squeeze locks to secure the square shaft.



Fig1: Isometric view of solid model

6. DESIGN CALCULATIONS

SOLID ROD (Shear Stress)

Diameter = 7 mm

$$\therefore A = \pi/4 * (7)^2 = 38.48 \text{ mm}^2$$

$$P = 13.3 \text{ KN} = 13.3 * 10^3 \text{ N}$$

$$\tau = P/A = 13.3 * 10^3 / 38.48 = 345.63 \text{ N/mm}^2$$

HOLLOW STEEL PIPE (Compression Test)

Outer Diameter D1 = 27 mm

Inner Diameter D2 = 22 mm

$$\therefore A = \pi/4 (D1^2 - D2^2) = \pi/4 (27^2 - 22^2) = 192.42 \text{ mm}^2$$

$$P = 40.9 \text{ KN} = 40.9 * 10^3 \text{ N}$$

$$\therefore \sigma_c = P/A = 40.9 * 10^3 / 192.42 = 212.55 \text{ N/mm}^2$$

SQUARE ROD (Compression Test)

Outer Side (a) = 39 mm

Inner Side (b) = 34 mm

$A = 39^2 - 34^2 = 365 \text{ mm}^2$

$P = 170.4 \text{ KN} = 170.4 \times 10^3 \text{ N}$

$\therefore \sigma_c = P/A = 170.4 \times 10^3 / 365 = 466.85 \text{ N/mm}^2$

TRI CASTER WHEEL

- Wheel Diameter: - 106 mm
- Wheel Width: - 40 mm
- Axle Diameter: - 20 mm
- Wheel Core: - Rubber & Cast-Iron Core
- Tire: - Rubber
- Bearing Type: - Roller Bearing
- Load Capacity: - 220 lb = 113 Kg
- Temperature Range: - -40 to 180 F

R = distance between the centre of tri caster wheel and centre of the wheel.

r = radius of regular wheel.

t = thickness of holder fixes the wheel on its place on tri star wheel.

$\therefore a = 140 \text{ mm } b = 290 \text{ mm } t = 50 \text{ mm.}$

7. MANUFACTURING PROCEDURE

WORKING PRINCIPLE



Fig: 2: Working Principle – Line diagram

The lifter is made up of a robust frame or structure with handles or grips that the operator may hold onto while operating. When the cylinder is placed on the lower platform of the cylinder lifter, it is tied with a retched tie down gripper and simply moved wherever the worker desires. They may include features such as locking mechanisms or straps to prevent the cylinder from slipping or dropping during lifting and transport.

The lifter also includes a lifting mechanism that allows the user to securely and easily raise and lower the cylinder. Tri Caster wheels are used on the cylinder lifter. This allows the operator to move the lifter and cylinder with minimal effort, lowering the danger of strain or damage from physical pushing or pulling.

The working principle of a cylinder lifter is based on a simple mechanical or hydraulic lifting mechanism designed to safely lift, hold, and transport cylindrical objects with minimal manual effort. The design can vary slightly depending on whether it is manually operated, hydraulic, or pneumatic.

11. CONCLUSION

In conclusion, The Cylinder Lifter project demonstrates a practical solution to a common industrial problem. By reducing manual labour and enhancing safety, the lifter provides significant operational benefits. The successful fabrication and testing confirm that the design is effective, reliable, and adaptable for real-world applications. The fabrication and development of a designed cylinder lift is essential for the safety and efficiency of manual material handling tasks in various industries. The cylinder lift designed in this project incorporates ergonomic principles and can lift heavy loads with ease.

REFERENCES

- 1) Gupta, Krishna Kanth, and Sapna Shukla. "Internet of Things: Security challenges for next generation networks." *Innovation and Challenges in Cyber Security (ICICCS-INBUSH)*, 2016 International Conference on. IEEE, 2016.
- 2) Granjal, Jorge, Edmundo Monteiro, and Jorge Sá Silva. "Security for the internet of things: a survey of existing protocols and open research issues." *IEEE Communications Surveys & Tutorials*, Vol.17, No.3, 2015, PP. 1294-1312.D.
- 3) Yuchen Yang, Longfei Wu, Guisheng Yin, Lijie Li, and Hongbin Zhao, "A Survey on Security and Privacy Issues in Internet-of-Things", *IEEE Internet of Things Journal*, Vol: 4, No.5, Oct. 2017, PP.1250 – 1258.
- 4) Alaba, Fadele Ayotunde, "Internet of Things security: A survey." *Journal of Network and Computer Applications*, Vol.88, 2017, PP: 10-28.
- 5) Rghioui, Anass, Mohammed Bouhorma, and Abderrahim Benslimane. "Analytical study of security aspects in 6LoWPAN network." *Information and Communication*

Technology for the Muslim World (ICT4M), 2013 5th International Conference on. IEEE, 2013

- 6) Rahman, Reem Abdul, and Babar Shah. "Security analysis of IoT protocols: A focus in CoAP." Big Data and Smart City (ICBDSC), 2016 3rd MEC International Conference on. IEEE, 2016.
- 7) Rajandekar, Ajinkya, and Biplab Sikdar. "A survey of MAC layer issues and protocols for machine-to-machine communications." IEEE Internet of Things Journal, Vol.2, No.2, 2015, PP. 175-186.