

Design And Fabrication Of Portable Hydraulic Crane

Mrs. J. S. Tilekar¹, Sharnya Gaikwad², Megha Pawar³, Shivanjali Sonwalkar⁴, Pallavi Jadhav⁵

^{1, 2, 3, 4, 5} Dept of Mechanical Engineering

^{1, 2, 3, 4, 5} PES's College of Engineering Phaltan, Maharashtra, India.

Abstract- In material handling, the cranes play a vital role in modern manufacturing Industries. In our project we aim to fabricate a hydraulic operated floor crane for Handling various kinds of materials. The hydraulic floor crane consists of mast, boom, Base, lift cylinder, hand lever, hook and wheels. The hydraulic cylinder is pumped with The help of hand lever at the same time the material with the help of hook and hydraulic Cylinder released to the pressure valve so the material is unloaded. The material from one place goes to the other place with the help of hydraulic floor crane. The crane reduces the worker's fatigue and increases the overall efficiency of production process with good safety. The crane is fabricated with complete clear front, small compact Frame, good reach, high lift. The crane has the capacity of lifting 250kg to half ton with Wide spread application in the shop floor. Thus the floor crane would serve as a safe and versatile model for material handling operations.

Keywords- Material handling, Cranes, Manufacturing industries, Hydraulic operated, Floor crane, Hand lever, Efficiency, Lifting capacity.

I. INTRODUCTION

These hydraulic floor cranes provide an efficient, low cost alternative to other Material handling equipments. Strong, robust, sturdy and built to very standard, these Cranes are maneuverable in loading, unloading and shifting of heavy loads. Crane structure Consists of mast, boom, hook, wheels and the hydraulic pump with cylinder assembly. The Box crane can take heavy loads effectively, avoids damage under rough and unskilled Handling.

A mobile floor crane is equipment with portable features which makes it admirable And recommended for both indoor (workshop/ warehouse) and outdoor purposes, for the Sole aim of lifting and moving heavy materials from one place to another. Some of these Features found in them include; adjustable boom, mast and balance due to rest base design. These adjustable features are to accommodate various heights and sizes of materials to be lifted.

Problem Statement:

It gains a dominant relevance in engineering workshops and warehouses for Carrying, loading and unloading of heavy materials, mostly where there are no provisions for overhead crane. At that times even when there are overhead cranes, space might be a Limiting factor to their use which makes the portability nature of the mobile floor crane a Great advantage.

In repair garages, it is also used in handling engines and its parts. It is also Used in industries for transporting materials from one place to another. It gains relevance Also in the installation of new machine, where it is used in proper positioning of the Machine. Most importantly, its simplicity reduces the cost of labor as it does not require Any special skill in its operation.

Objectives:

- To design a hydraulic mobile floor crane
- To fabricate the designed floor crane to lift and move the objects in shop floors, Garages etc...

II. IDENTIFY, RESEARCH AND COLLECT IDEA

Michael G. Kay, "Material Handling Equipment", January 12, 2012[1]

Material handling involves short-distance movement that usually takes place within The confines of a building such as a plant or a warehouse and between a building and a Transportation agency. It can be used to create "time and place utility" through the Handling, storage, and control of material.

The characteristics of materials affecting Handling include the following: size -width, depth, height; weight; shape; and other Slippery, fragile, sticky, explosive, frozen. Some of the major equipment categories are

1. Transport Equipment. Equipment used to move material from one location to Another for e.g., between workplaces, between a loading dock and a storage area, Etc. The major subcategories of transport equipment are conveyors, cranes, and Industrial trucks.

2. Positioning Equipment. Equipment used to handle material at a single location. For e.g., to feed and/or manipulate materials so that are in the correct position for subsequent handling, machining, transport, or storage.
3. Unit Load Formation Equipment. Equipment used to restrict materials so that they Maintain their integrity when handled a single load during transport and for storage.
4. Storage Equipment. Equipment used for holding or buffering materials over a Period of time.
5. Identification and Control Equipment. Equipment used to collect and communicate The information that is used to coordinate the flow of materials within a facility and Between a facility and its suppliers and customers.

Ibrahim O Abdulmalik, “Design and manufacture of a hydraulic workshop crane”[2]

ISSN 2319-5991, Vol. 3, No. 3, August 2014 Oil at high pressure from the reservoir is sent to one end of the cylinder through the Rubber pipes. The oil exerts pressure on the piston and thus pushes it upwards. Process Goes on and the entire side of the cylinder is filled with oil and thus moving the piston to Its extreme. The release liver valve is used to bring the piston back to its original position. The hydraulic oil returns back to reservoir. K Suresh Bollimpelli1, “Design and Analysis of Column Mounted JIB Crane”, 2015 In this work, a static, modal and harmonic analysis of a column mounted jib crane.

K Suresh Bollimpelli1, “Design and Analysis of Column Mounted JIB Crane”, 2015[3]

In this work, a static, modal and harmonic analysis of a column mounted jib crane Using ANSYS software is presented. A column mounted jib crane of 1.5 Ton capacity is Modelled using CATIA which is imported into ANSYS where calculations are performed. The detailed drawing of various parts of the crane is obtained from TATA Advanced Systems Ltd (TASL) Adibhatta village, Hyderabad. The deflection values, Von Misses Stress etc are obtained using the static analysis. The hand calculations of the column Mounted jib crane have been done using simple strength of material expressions. The Deflection is obtained as 3.709mm, when the load applied is 1.5 tons. The maximum stress Obtained is 147.8Mpa which is less than the allowable stress.

The static stress was found to be within the limits of safety. The model analysis Shows the natural frequencies of the crane to be in the lower range 0-10Hz. The Fundamental frequency is found out to be 0.323589 Hz. All the other higher frequencies Are also found to be very low making the jib

crane less stiff and highly stable for any Transient loading. The harmonic analysis is performed with a view to predict the Performance of the crane if a cycle time dependent load is allowed to act at the trolley. For This hypothetical situation, the von-mises stress and displacement along the z-directions Were obtained using ANSYS. The maximum von-Mises stress of 60Mpa occurs at Fundamental frequency of 1 Hz. The maximum z-direction displacement of 5mm was Observed. These values indicate that the column mounted jib crane is safe to operate under The load of 1.5 Tons under static and cyclic time dependent loads also.

Okolie Paul Chukwulozie, “Steel Work Design and Analysis of a Mobile Floor Crane” 2016[4]

The transportation of heavy machine parts and equipment within and outside the Workshop has been a source of concern and needs urgent attention because of the hazard it Exhibits. This negative effect on the health of engineers, led to the invention of the floor jib Crane but research shows that contemporary designs of floor jib crane fail over time when These static load is left on it for a prolonged period of time. This project is centred on the Design and fabrication of a mobilefloor crane equipped with a facility to lock the load at Any level as a special feature, to tackle the issue of failure due to static load.The mobile Crane is designed to bear a maximum load of about 1000 kg, with a counter weight of 2.6 KN which gave the crane a 3.034 factor of Safety. The materials employed are; sheet metals, angular iron, bolts, nuts, metal rollers Etc. The fabrication processes involved drawing, marking out, cutting, filling, welding and Assembling. For permanent joints, the arc welding process was employed. As indicated Earlier, the mobile floor crane gains its significance in the transportation of heavy machine Parts within and outside the workshop. It can also be used to load and unload machine Parts on trucks.

III. SCOPE OF THE PROJECT OR OVERVIEW

- Hydraulic crane are used for picking and moving huge amount of loads. Generally loads are kept in containers for bulk loading.
- Hydraulic trucks cranes have good flexibility with high load carrying capacities.
- Hydraulic workshop foldable crane used in industries for moving small to medium sized materials from one place to another. The load carrying capacity can vary from 4 tone to 5 tone.
- Integration of automation and robotics for enhanced efficiency and precision in load handling.

- Implementation of advanced sensors and IoT technology for real-time monitoring of crane operations, predictive maintenance, and safety enhancements.
- Development of hybrid or electric-powered hydraulic cranes to reduce environmental impact and operating costs.
- Exploration of lightweight materials and advanced engineering techniques to improve the crane's load capacity and maneuverability.
- Integration of artificial intelligence algorithms for optimizing crane movements, load distribution, and route planning.
- Adoption of augmented reality (AR) or virtual reality (VR) technology for training operators and simulating complex lifting scenarios.
- Incorporation of remote control or autonomous operation features for increased flexibility and safety in hazardous environments
- Collaboration with other industries such as construction, logistics, and warehousing to expand the application range of hydraulic cranes beyond manufacturing.
- Research and development of modular crane designs for easier assembly, customization, and scalability to meet diverse material handling needs.
- Exploration of additive manufacturing (3D printing) techniques for rapid prototyping and customization of crane components, leading to faster innovation cycles and cost savings.

IV. DETAILS OF DESIGN, WORKING AND PROCESSES

A mobile floor crane has a tubular, rigid structure that supports a boom pivotally connected to the top end of the mast. The base end of the mast is disposed between the Adjacently disposed mid portions of the tubular, rigid legs of the crane. A support member Extends transversely through the mid portions of the legs and the base end of the mast and Supports the mast. In an alternative embodiment, the legs have telescoping members, and a Rolling member is provided on the base end of the stanchion to provide mobility for the Crane.

The crane is equipped with lift cylinders and ram that provides the upward thrust to The boom while lifting a heavy material. The lowering is effected by slacking a screw on The side bottom of the lift cylinder. The base frame can be wide enough to take the load Between the two outstanding legs. The four wheels are provided for the mobility of the Crane. It is designed with two handles, one for lifting purpose, while the other is for pulling Crane.

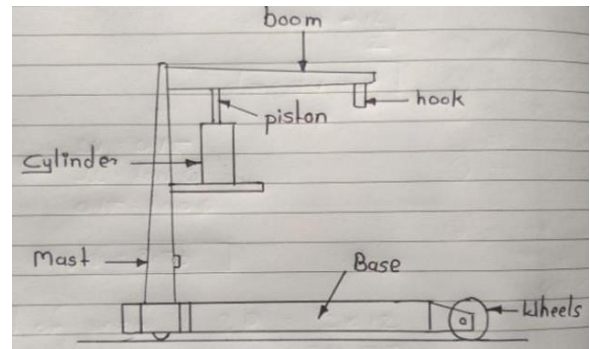


Figure.1 Schematic Diagram of Floor Crane

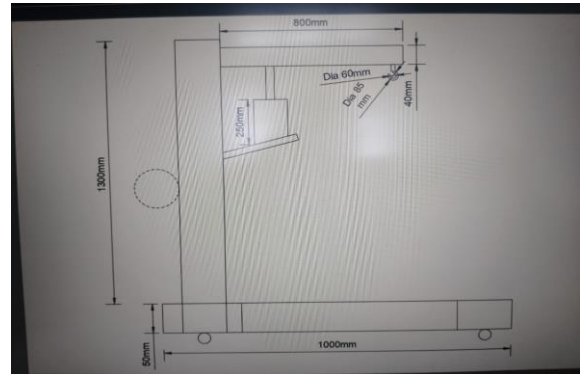


Figure.2 CAD Drawing (2D) of Floor Crane

The mobile floor crane has the following components.

- Mast (Vertical Column)
- Boom:

It is the structure which lifts the weight. One end of the boom is attached to the hinge at the top of the mast and the other end is fixed with a hook to lift the weight. It is also made up of Mild steel.



Photo 1: Boom

TABLE.1: DETAILS OF BOOM

Features	Data
Length	800mm-1300mm
Breadth	50mm-40mm
Thickness	40mm
Material	Mild steel
Quality	1
Nature of operation	Cutting, welding and grinding

Base Frame

The supporting frame includes base platform and the mast. It is made up of mild steel.

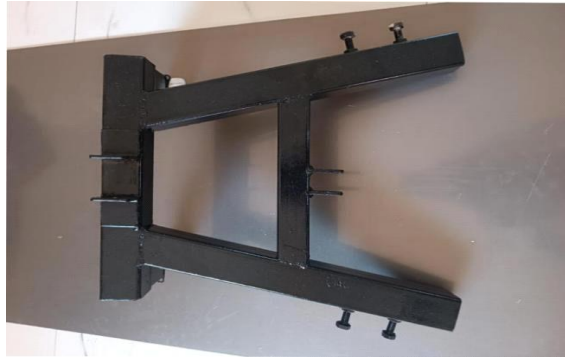


Photo 2: Base Frame

TABLE.2: DETAILS OF SUPPORTING FRAME

Features	Data
Length	430mm
Breadth	350mm
Thickness	50mm
Material	Mild steel
Quality	1
Nature of operation	Cutting, welding and grinding

Lift cylinder

The hydraulic cylinder is also made up of mild steel. It is placed on a projected plate like structure welded to the mast. The capacity of the hydraulic cylinder is 1ton



Photo 3 : Hydraulic Cylinder

TABLE: 3 DETAILS OF CYLINDER

Features	Data
Outer diameter	60 mm
Diameter	30mm
Length	250 mm
Material	Mild steel
Quality	1

Hand lever

Connecting Rod: The connecting rod is also made up of mild steel. One end of the connecting rod is attached to piston and the other end is attached to boom, so that it lifts the boom to required height.



Photo 4: Connecting Rod

Hook: The hook is attached to the end of the boom. The material to be lifted will be attached to the hook and lifted by the hydraulic action of the cylinder. It is made up of mild steel.



Photo 5: Hook

Wheels: This is the component of the machine that makes mobility possible. 6 inches of four Wheels are used.



Photo 6: Wheel

V. CONCLUSION

The aim of our project was to build a fully functional HYDRAULIC FLOOR CRANE mechanism which is capable of lifting load up to 100 kg from the hook attached to the

horizontal arm. We accurately achieved our first goal of lifting the load from the hook by up and down movement of the horizontal arm. We feel that our design and fabrication was a great success both in terms of strength and stiffness. Our project weighed 50kg which is capable of lifting load up to 100kg using hydraulic power.

Features

- Overload safety
- Lifting/lowering speed control
- Simple to use and maintain

VI. RESULT AND APPLICATIONS

Result:

1. Most powerful means of lifting objects: It is one of the most powerful means of lifting objects is with the strength of a hydraulic crane. By harnessing the strength that liquid under pressure gives, and the ease with which it can be used, it is possible to transfer a relatively small amount of effort from one place to another and hydraulic cranes are amongst the most efficient lifting systems available in the modern workplace
2. Extremely stable in use: Because the hydraulic cranes use a fixed system of pipes, constant pressure can be maintained once a part of the system has been moved into place, and this makes them extremely stable in use, and able to support relatively large weights.
3. A very versatile tool: Most hydraulic cranes are comparatively light weight, and the ease with which they can be moved from one area to another within the factory or distribution center, makes them a very versatile tool with lots of uses on a day to day basis. From simple loading jobs in your loading bay area where the portable hydraulic cranes can be used to lift objects into a waiting truck to more complex jobs within the main factory, the lifts will come in very useful.
4. Quite simple Design: A hydraulic system works with a system of pumps and pistons that are filled with a liquid, usually a light oil or water. By moving the liquid under pressure from the pumps, pistons can be extended or reduced, and when these pistons are connected to a system of levers, the pistons can be used to lift surprisingly heavy weights.

Application:

- Cranes exist in an enormous variety of forms – each tailored to a specific use. Sometimes sizes range from the smallest jib cranes, used inside workshops, to the tallest tower cranes, used for constructing high buildings. For a while, mini – cranes are also used for constructing high buildings, in order to facilitate constructions by reaching tight spaces. Finally, we can find larger floating cranes, generally used to build oil rigs and salvage sunken ships.
- These days hydraulics principle is being used extensively in material handling processes through cranes. Depending on the loads to be handled and the operations to be performed there are different types of cranes like Crawler Cranes, Truck Cranes, Floor Cranes.
- Hydraulic Crawler cranes are used for picking and moving huge amount of loads. Generally loads are kept in containers for Bulk loading.
- Hydraulic truck cranes have good flexibility with high load carrying capacities
- Hydraulic workshop foldable crane used in industries for moving small to medium sized materials from one place to other. The load carrying capacity can vary from 80 kg to half ton



Photo 7: Portable Hydraulic Crane

REFERENCES

- [1] Michael G. Kay, “Material Handling Equipment”, January 12, 2012
- [2] Ibrahim O Abdulmalik, “Design and manufacture of a hydraulic workshop crane”, ISSN 2319-5991, Vol. 3, No. 3, August 2014
- [3] K Suresh Bollimpelli, “Design and Analysis of Column Mounted JIB Crane”, 2015
- [4] Okolie Paul Chukwulozie, “Steel Work Design and Analysis of a Mobile Floor Crane” 2016

- [5] International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-3, Issue-2, December 2013.
- [6] British Journal of Applied Science & Technology .13(5): 1-9, 2016, Article no.BJAST.23079
- [7] International Journal of Biotech Trends and Technology (IJBT) – Volume2 Issue 1 Number1–Jan 2012