iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** VI **Month of publication:** June 2021

DOI: https://doi.org/10.22214/ijraset.2021.35471

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VI Jun 2021- Available at www.ijraset.com

Design and Development of Forklift

Mr. Amol. A. Patil[1], Muzammil A. Desai[2], Swapnil D. Khot[3], Omkar A. Mali[4], Harshal J. Patil[5]
[1]*Assistant Professor,* [2,3,4,5] *Students, Dept. of Mech, NMCOE, MAHARASHTRA, INDIA.*

Abstract: ***In this research work, the Forklift was carried out. The forklift has the following parts, base plate, battery, vertical column, horizontal arm, roller, hook, nuts and bolts, crank plate, lever arm and DC motors. It was designed for load of 50 to 100 kg capacities and the development of suitable system configuration having movable wheel attached base. The performance of this forklift was satisfactory and can be used in the laboratory and industry.***
Keywords: portable crane, forklift, lifting, hydraulic cylinder.

I. INTRODUCTION

In material handling, the cranes play an important role in modern manufacturing industries. A crane is a kind of system commonly ready with hoists, wire, ropes or chains and pulleys that can be used to both increase and decrease materials and pass materials horizontally; it is specifically used to raise heavy loads Lifting loads and transporting them to different locations. It uses one or more simple machines to create mechanical advantage and thus move loads beyond the normal human physical lifting capability.

A. Problem Definition

Nowadays in this country, the most available jacks are manually powered, we found out that these manual jacks were very difficult to be used by our labours especially the female ones due to the strength and energy needed to work it making it to be time consuming; furthermore, in scenarios of those manual jack malfunctioning and subsequently the collapse of the machine under maintenance could lead on to musculoskeletal disorders, injuries of the neck, back and shoulder. Thus, to overcome this problem of drudgery, injuries, increase timeliness and efficiency in the industrial material handling.

B. Types of Portable Crane

The cranes are broadly categorized into three
Overhead crane
Fixed crane
Mobile crane

1) *Overhead Crane:* The basic components of overhead cranes are the hoist to lift the item, a bridge, the trolly to move along the bridge. Most of the time overhead cranes are applicable in steel mfg industry and vehicle production industry.
2) *Fixed Crane:* Fixed cranes are preferable in order to insure the ability to carry heavy reaches greater heights due to increased stability. The structure basically is fixed in one place.
3) *Mobile Crane:* The cranes can also be designed to be mobile for efficient and versatile use. Mobile cranes are designed in different ways for use on road, rail, water and air.

II. THEORY

The portable crane is a selected product in the design application for this project. The portable crane is a small crane that can be split into several parts for easy transportation. It should be mounted and bolted in a location where it can be used effectively. Crane for a wide variety of flood lifting work. The portable crane is widely used in mechanical engineering to help with heavy work. There are different types of portable cranes available in the market with different functions and features.

A. Statement of Problems

In industry, the components are transported from the workshop to the factory with forklifts and this creates costs for fuel consumption. In addition, electrical energy is required to operate the crane, i.e. if there is no electrical energy, the factory is bound to wait. For electrical service during this time, workers are expected to work and this is another cost loss for the work.

B. Objective

1) To design the portable lifting machine lift slightly heavy objects that can't be carried by a single worker.
2) To minimize cost for fuel that is made for operating forklift transporting every component in the industry.
3) To minimize risk of life and property.
4) To produce the movable crane for the production shop.

C. Working of Hydraulic Jack

Hydraulic jack uses the principle of Pascal's law. When the handle is operated, the plunger reciprocates then oil from the reservoir is sucked into the plunger cylinder during upward stroke of the plunger through the suction valve. The oil in the plunger cylinder delivered into the ram cylinder during the downward stroke of the plunger through the delivery valve.

This pressurized oil increases the weight on the top plate of the hydraulic cylinder. After the work is completed, the pressure in the hydraulic cylinder is reduced by unscrewing the countersunk screw, so that the pressure is reduced, the hydraulic cylinder is lowered, and the oil flows into the oil tank. It consists of a piston cylinder on one side and a hydraulic cylinder on the other side. The two cylinders are mounted on a mild steel base. The piston cylinder consists of a piston used to generate pressure through work. The piston cylinder consists of two check valves, one for suction and one for discharge. The piston cylinder consists of a piston that lifts the load. The piston cylinder is connected to the piston cylinder supply valve. It also includes a sub screw. It is nothing more than a manually operated valve, used to release the pressure in the cylinder of the hydraulic cylinder to reduce the load.

III. CALCULATION

A. Selection of Motor

The manual effort we have considered 20 kg

= 200N

The same effort we are applying by using motor.

So the load on crank pin = 200N

The distance from center of crank pin = 75mm (Dia of crank =150mm)

So Maximum Torque T = 200x 75 = 15000N-mm

Speed of motor considered for smooth operation = 30rpm to avoid jerk.

we know power

$$P = \frac{2\pi \times N \times T}{60}$$

P = 47.1 watt

By considering application and extra jerk and safe design prime mover power considered = 110 watt. Here we will use DC motor.

B. Design of Base

Fix the dimensions of base plate as l × b × tb = 200×150×25

Where l = Length

b = Width

tb = Thickness of base

Base is made up of mild steel.

Permissible compressive stress of M.S (σc) = 20 N/mm2

Compressive area of base = 200×150 = 30000

Permissible shear stress of mild steel (τ) = 20 N/mm2

Shearing area = π × d × tb

= π × 71.5 × 25 =5615.59

Where

d = inner dia of ram cylinder

tb = thickness of base plate

Load acting on base = 100.17 KN

Checking for compressive strength

σc = 3.339 N/mm2

Checking for shear strength

τ =17.83 N/mm2

The induced shear and compressive stresses are less than permissible valve. Hence the design is safe.

C. Design of Ram Cylinder

It is a cylinder in which produces a slide way to the ram. The ram cylinder is made up of mild steel with density of 7.868 gm/cc. It is mounted on the base plate.

Let,

d = Inner dia of ram cylinder

D = Outer dia of ram cylinder

P = Pressure acting on cylinder = 25mpa

W = Load = 60KN

T = Thickness of ram cylinder

D. Design of Plunger Cylinder

The plunger cylinder is made up of mild steel and is mounted on the base plate. It provides slide way to the plunger in order to build up the pressure. Let

dp= inside dia of plunger cylinder = 8 mm

Dp = outside dia of plunger cylinder

tp = thickness of plunger cylinder

Assume the thickness of plunger cylinder (tp) = 5 mm

Tensile strength of mild steel (σt) = 120 N/mm2

By using thickness and inside diameter, we can calculate the outer diameter of plunger cylinder Dp =dp + 2t

=8+2(5)

=18 mm

Outer diameter of plunger cylinder (DP) = 18 mm

E. Design of Plunger

Let the plunger is made up of mild steel which reciprocates in plunger cylinder to increase the pressure of the oil.

Let,

W = load acting on plunger

dp = diameter of plunger

P = pressure developed in plunger cylinder

From standard table inside diameter of

plunger cylinder is fixed i.e. 8 mm

Load acting on plunger = pressure × area

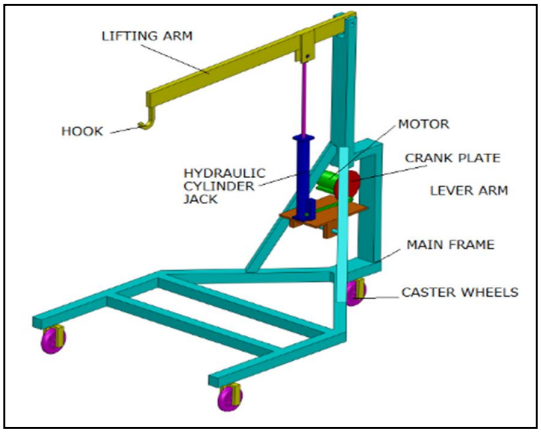
= 25×106

= 1256.63 N

= 128.09kg

Consider Load acting on the plunger =130 kg

IV. DESIGN



The Forklift has the following parts:

Base plate, battery seat, and vertical column, lifting arm, hook, caster wheels, crank plate, lever arm and DC motor. The main frame is made of 2 in. square pipe. They were cut according to the dimensions and they were welded using metal arc welding. The motor and hydraulic cylinder were selected according to the power required and weight to be lifted.

V. CONCLUSION

The construction and manufacture of a Forklift with automatic lifting was carried out successfully in meeting the required construction standards. The Hydraulic portable crane was designed for a load of 50-100kg load capacity with a correspondingly high load capacity. The mobile floor crane is easy to use and does not require routine maintenance, it can also lift heavier loads.

VI. RESULT

The assembled machine has been tested to evaluate the machine's performance and reliability. The test was carried out with various loads in the range of 50-100 kg and the test showed that the greater the load, the more time required to operate the lift cylinder.

VII. ACKNOWLEDGMENT

We take this opportunity to express our gratitude towards those who directly or indirectly helped us in completion of our Project. First of all we would like to express deep sense of gratitude towards our Guide Prof. A. A. Patil for his valuable guidance and encouragement throughout Project.

Also thanking to our Project Coordinator Prof. H. P. Gawade, Head of Mechanical Department Prof. D. D. Patil Also thanking to principal Dr. A. A. Miraje and Executive Director Prof. M. B. Joshi. We also thanks to library department, computer lab op for providing book, online resource for Project. Finally, we would like to thanks our parents, friends who help me directly and indirectly during completion of this Project.

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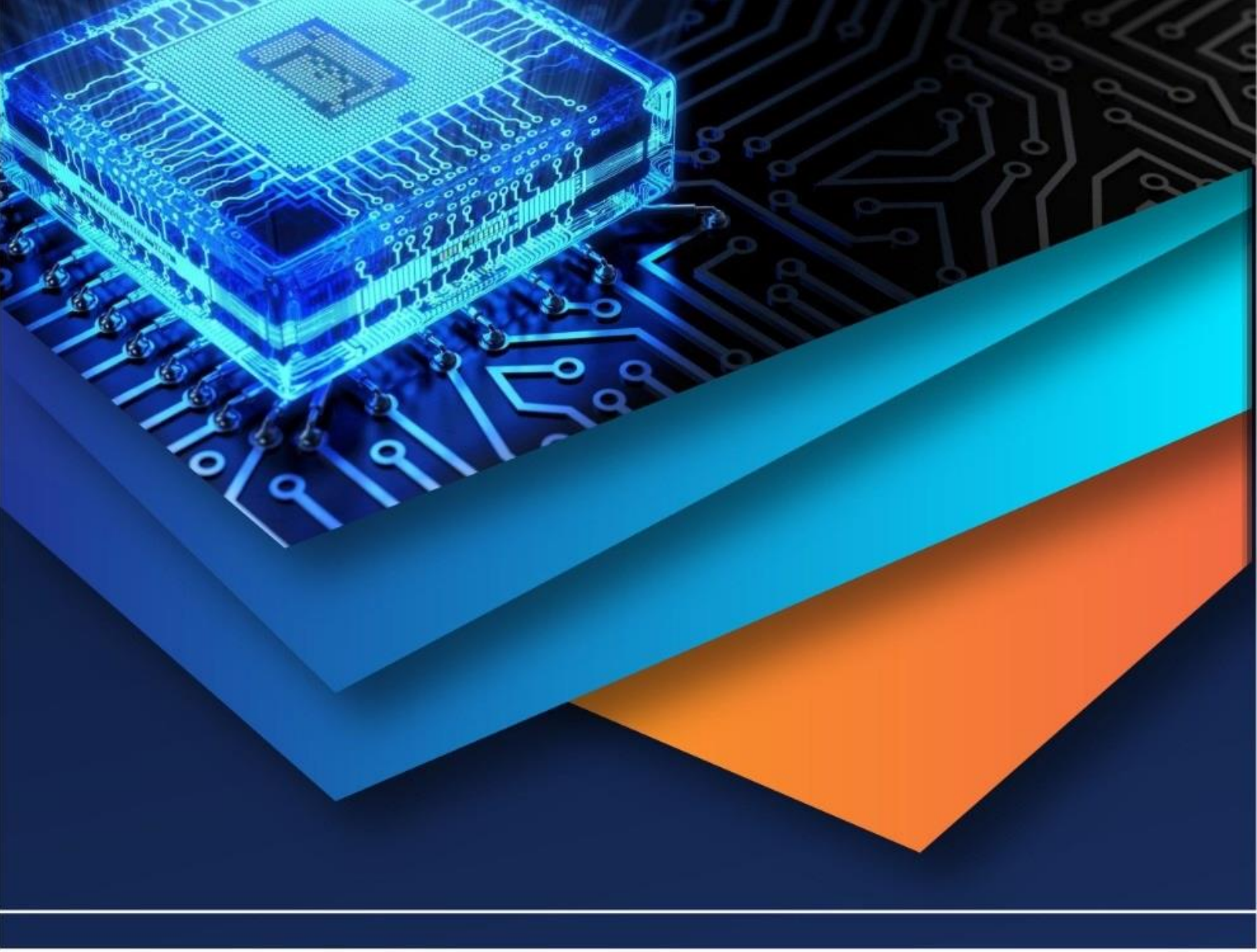

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