Arab Academy for Science, Technology and Maritime Transport

College of Engineering and Technology

Mechanical Engineering department

B. Sc. Final Year Project

HYDRAULIC ENGINE CRANE

Presented By:

Amr Radwan Elshaer | Ahmed Abdelaty Khalifa

Mohamed Hesham Hasaan | Hesham Anter Abdelrahman

Subervised By:

Prof. Hassan ElGamal

Prof. Kamal AbdElAziz

JULY-2022

ACKNOWLEDGMENT

We would like to thank our supervisors Prof. Kamal AbdelAziz and Dr. Rola Afify for their support, patience and great knowledge, their guidance us from the beginning till the end we also would like to thank our families for their support and patience. Finally, we really appreciate our collage Arab academy for science and technology and maritime transport for being the place where we gained knowledge.

Abstract

The modified floor hydraulic crane has the following parts; base plate/pallet, boom and lifting arm, vertical column, horizontal arm, secondary horizontal arm, power screw, roller, hook, nuts and bolts. The selections of materials for the various components were based on the strength, machinability, toughness, ductility, and hardness. It was designed for load of 1200 kg capacities and the development of suitable system configuration having moveable wheel attached base, hydraulic link, basic vertical column, and connections. The assembled machine was tested to evaluate function and reliability of the machine. The test was carried out with various loads ranging from 1000-1200 kg and the results obtained show that as the load increased, the effort required for actuating of the lift cylinder increased. Besides, the performance of the modified floor hydraulic crane was satisfactory and can be used in the laboratory and industry.

Table of content

Chapter One

1 INTRODUCTION

1.1 DEFINITION:

- An Engine crane (too alluded as Engine hoist) could be a common repair device utilized in vehicle repair shops to expel or introduce gasoline or diesel Engine in little and swarmed vehicle motor compartments. It employments an overwhelming cantilevered bolster structure to hold the motor in mid-air so that the technician can carefully interface or detach delicate hoses and wires on the Engine to the outline of the vehicle. The motor crane is commonly utilized in combination with the Engine stand so that the removed engine can be turned in midair to supply get to to underside surfaces of the Engine.

Figure 1-1 Hydraulic Engine Crane

1.2 HISTORY:

Throughout history, people have always drifted toward the water. We built cities on major waterways and used them as thoroughfares. We used running water to power wheels that helped us prepare food and fabric. Hydraulics, or the use of fluid power to run machinery, has been around for quite a while — for over 2000 years. People have always gravitated toward water throughout history. Cities were built on major waterways and used as thoroughfares. Running water was used to power wheels that assisted us in the preparation of food and textiles. Hydraulics, or the use of fluid force to operate machinery, has a long history – over 2000 years.

1.2.1 Ancient Hydraulics in Greece and Rome:

Though ancient hydraulic systems have existed across cultures, our word "hydraulic" has its roots in the Greek language. The Greeks developed complex systems of water and hydraulic power, including irrigation systems, canals and aqueducts. Aqueducts provided a way for cities to get a reliable supply of water from nearby sources and carry it to them for easy access. With the help of aqueducts, civilizations could settle in areas not immediately beside a major water source. One of these impressive aqueducts is the Tunnel of Eupalinos, an aqueduct built in Samos in the sixth century BC. It supplied water to Samos from across Mount Kastro, also known as Mount Castro. The Greeks were no strangers to impressive feats of engineering. Though Ctesibius of Alexandria is more known for his work in pneumatics, he also dabbled in hydraulics. He developed an advanced version of a water clock that included a moving pointer and alarms. He also made a water organ that used the weight of water instead of lead to play the pipes. Following in Ctesibius' footsteps, Hero of Alexandria developed many control systems as well, including the following: The setup for an automated, mechanical play the first known steam engine, or Aeolipile A vending machine that dispensed holy water when someone placed a coin in it another major hydraulic invention attributed to a Greek is the water, or Archimedes', screw. This screw was a major component of ancient irrigation methods. It is the oldest positive displacement pump, dating back to Ancient Egypt, where it was used on the Nile — likely before Archimedes' time, even though he tends to get the credit. Some even believe it was used to irrigate the Hanging Gardens of Babylon, one of the Seven Wonders of the Ancient World. Further east, the ancient Persians completed the Shushtar Historical Hydraulic System in the third century CE. This system was a colossal engineering project and served a variety of purposes, including water supply, irrigation, mills, river transportation and a defensive system. Similarly, the Sri Lankans built elaborate large-scale irrigation systems and developed the concept of a valve tower to regulate the escape of water. Their systems were developed over 2000 years ago in response to water availability that was difficult to manage. The Romans, like Greeks, are known for their advanced engineering skills, including roads, bridges and aqueducts, many of which are still in use today.Aqueducts systems on their own could have inconsistent flow rates. To combat this, the Romans installed regulation devices in-stream and created reservoirs and cisterns at the ends to bring more reliable water supply to the people. A large aqueduct could store enough water for a city for 1-3 weeks, depending on the population and water restrictions. The vast Roman aqueducts are just one example of hydraulic power. The Romans also had many water mills and developed "hushing," an early version of hydraulic mining, for use on gold fields in the region. This method involved building up a plentiful supply of water, through dams or vessels, and releasing it into a mining area. This flood of water would wash away the lighter sediment and leave the prized gold veins accessible. Hushing later paved the way for hydraulic mining during the California Gold Rush.

1.2.2 The History Of Cranes In The Middle Ages:

The Medieval times saw the return of the tread wheel to power cranes. This had been briefly used by the Romans but hadn't been used since the fall of the Roman Empire. Tread wheel cranes were put to use at harbors, mines and building sites around Europe as they offered a cost-effective and efficient way to vertically transport goods. During this period, the crane was a crucial tool in the construction of the many Gothic cathedrals dotted around Europe, including the incredible Kölner Dom in Germany. As cranes evolved throughout the middle Ages, they became a staple of construction sites across Europe.

1.2.3 The Birth of the Hydraulic Crane:

As the Industrial Revolution took a firm hold, the demand for cranes only increased further. Many of the earlier cranes had been constructed from wood; however, this was swapped out for more popular materials such as cast iron and steel during the industrial revolution.
During the industrial revolution, cranes were being used regularly outside of the construction industry. Many were installed at harbours to load cargo quickly and effectively. Because of the high demand, cranes continuously evolved throughout this early modern age. It was during the industrial revolution, in 1838 to be exact, the industrialist and businessman William Armstrong designed the first hydraulic water powered crane.

1.2.4 Modern Day Cranes:

The crane allowed our predecessors to build the magnificent and iconic buildings and temples around the world that still stand today. So many aspects have shaped this fascinating piece of equipment into the modern-day crane we used every day in a variety of industries.
Today we have mobile cranes, tower cranes, crawler cranes, telescopic cranes, rough-terrain cranes and many others. Each with various abilities, functions and lifting capacities. Modern-day cranes have enabled us to create some of the world's very best structures, including the Burj Khalifa in Dubai and the Empire State building. The purpose of hydraulic cranes is to stay stable whilst lifting heavy weights. Although cranes have been used throughout the history of construction engineering, hydraulic cranes use a more technical design. If you're considering making a purchase any time soon, there are several factors that you should keep in mind. The hydraulic crane depends on three separate parts when lifting incredibly heavy loads: the hydraulic cylinder, the pulley and the lever. The latter is a horizontal beam that takes on the task of the fulcrum. When a heavy object is loaded, an amount of force is applied at the other end, and in the other direction. Known also as the jib,

the pulley is a strut tilted to support a pulley block. The fixed block is wrapped with several layers of cable that is then pulled by machine or by hand. This can then create a force that is equal to the weight of the load. The hydraulic cylinder is then used to lift the load.
Hydraulic cranes are available in a number of different types, and understanding what the differences are can help when you make your choice.

-Tower crane: This modern piece of technology can either be fixed on a structure such as a building or fixed on the ground. They are typically favored for their height in addition to their lifting capacity. They are essential when it comes to the construction of tall buildings.
- Railway crane: Typically used to support the maintenance of railway tracks, its wheels are flanged in order to be able to use the tracks to travel. Some hydraulic railway cranes are custom designed, with others being basic enough to be mounted onto a car.
-Self-erecting crane: Designed to make it easy to assemble, this type of crane will lift itself up from the ground in order for the next segment of crane to be inserted. Self-sufficient so no outside help is required.
-Telescopic crane: A number of tubes are fitted inside the other to provide a boom that will extend to the required length. These are suited to short terms jobs such as construction or even rescue -Manual crane: When there is no accessible power, manpower is required. Rarely used for construction, but sometimes brought in for special jobs, these do not run off electricity and are very cost effective.

-Hydraulic cranes are just another use of the ingenious hydraulic system that our Greek forefathers discovered, but one that has changed the face of this planet, our skylines and how we live.

1.3COMPONENTS OF HYDRAULIC CRANE SYSTEM:

Most designs are the same or have slightly different variations due to size and weight allowance but the frame and structure of how they are made up should be relatively the same.

We're going to look at the different aspects of this lifting equipment so you know how they're made up and what each part is responsible for when using one.

1.3.1Frame

The frame for this piece of equipment is made up of multiple metal plates that hold the hydraulic system in place and give a frame for the hydraulic cylinder to be attached to. The frame is the most important part as it gives structure to the way the piece of equipment works and how it's able to lift and hold the heavy-duty loads. This consists of everything that makes them up and allows them to work as they do with it consisting of the main bar, support bars, and space for the hydraulic cylinder to sit and operate.

The main bar is thicker than the support bars because it has to withstand the highest force when loads are being lifted. The support bars are what hold the load and support the main bar carrying the bulk of the weight.

Figure 1.2-Frame

1.3.2LegsandWheels:

In most cases, you will find they have four wheels with two nearly directly under the main upward support frame and a hydraulic cylinder with the other two on each end of the legs allowing them to move forwards, backward, and to the sides with lift capacities usually going up to two tons.

Figure1.3-Wheel

sometimes when they're being used for projects where more flexibility is required, there will be six wheels to them so they can be moved in any direction providing there is the room to do so.There are two types of legs that are regular and adjustable. Regular are fixed legs that have a standard length while adjustable legs, like the name says, can be adjusted for longer and shorter legs dependent on the item(s) that need to be moved and their weight. The longer the legs, the more stable and bigger the weight the crane can handle.

Figure 1.4-Leg

1.3.3 Boom, Chain, and Hook

These are the overhanging parts that come off the main bar and allow it to pick up items, move the items, and lower the items with ease.

It's quite common for them to have adjustable booms as this allows them to reach further locations and get to other departments within a car for example. However, when the boom becomes more extended it decreases the allowed lift capacity which needs to be considered when lifting heavy-duty items and, of course, different versions will have different weight capacities that will need to be considered.

A crane hook is a point of attachment on a crane designed to connect with chains and ropes attached to loads like crates, construction beams, and machinery. Hooks come in a variety of styles to meet various needs and like other parts of the crane; they are rated for loads of a specific size and type. It is important to avoid using an underrated crane hook, as this could result in damage to the crane or loss of the load.

Figure1.5-Hook

A crane boom is a long fixed or hydraulic arm that is used to move large objects in construction. It bears most of the weight when positioning a load, and its length determines a crane's maximum reach. Crane booms take on a variety of roles and appearances depending on the type of crane.

Figure1.6-Boom

Chains are commonly used in garages where they are able to remove engines from cars easily. Because they can be operated by one person, Chain Blocks are a wonderfully efficient way to complete jobs which may have taken more than two workers to do.

Chains are also used on construction sites where they can lift loads from the higher levels, in assembly line factories to lift items to and from the belt and sometimes even to winch cars from a treacherous terrain.

Chains Blocks come in a variety of different capacities making them suitable for a wide range of operations. Here at SafetyLiftinGear, we stock Chain Blocks with lifting capacities of up to 20tonnes.

Figure1.7-Chain

1.3.4HydraulicJack

We've briefly touched on this already where we mentioned it as a hydraulic cylinder and the hydraulic jack is the same thing. Just like other parts of this equipment, these have their own maximum lift capacity which is usually larger than what the frame can lift overall to make sure it does not fail, almost like a fail-safe.

The hydraulic jack is operated through a lever and the bigger the weight its lifting and carrying, the longer this can take as it's being required to lift and hold an increased weight.As mentioned above, when the item needs to be lowered, there's a bleed valve that needs to be turned which releases the pressure in the hydraulic pump and lowers the item at a safe rate and in line with the person operating it. Whenever lowering a piece of equipment, please make sure you do so safely as releasing can be done a lot quicker and as a result brings health and safety risks as well as potentially costly results such as damaged goods.

Figure 1.8- Hydraulic Jack

1.4 TYPES:

- There are many types of the hydraulic crane, This variation due to the range of lifting load and application:

1.4.1- Black Widow 1 Ton Folding Crane.

Double bearing swivel casters provide smooth maneuverability as you move this Black Widow 2 Ton Folding Crane around your workspace. The black aesthetic will look sharp

Figure 1.9-Black widow

Double bearing swivel casters provide smooth maneuverability as you move this Black Widow 2 Ton Folding Crane around your workspace. The black aesthetic will look sharp in any garage or shop, and the unit folds down to an impressively compact size when not in use.

Key Features:

- 2000-pound weight capacity.
- Boom arm extends 36 to 47.5 inches.
- Height adjusts 64.75 to 88.5 inches.

1.4.2- Dragway Tools 2 Ton Folding Crane.

Figure 1.10- Dragway

The Dragway Tools 2 Ton Folding Crane is a beast that can lift up to 4000 pounds which should be enough to hoist your entire vehicle off that ground. It has six fully rotating three-inch caster wheels that allow you to easily move it around your workspace in any direction whether it is loaded with weight or not.

Key Features:

- 4000-pound weight capacity.
- Boom arm extends 48 to 102 inches.
- Height adjusts from floor to 102 inches.

1.4.3- Vestil Heavy Duty Engine Hoist.

Figure 1.11- Vestil Heavy

The Vestil Heavy Duty Engine Hoist is an extremely heavy-duty crane that does not fold to save space because it is constructed for high-strength applications and long-lasting durability. This is the hydraulic crane that professional garages want to have on hand. It has a large diameter ram to withstand angled loads when lifting.

Key Features:

- 6000-pound weight capacity.
- Telescoping boom with four positions.
- Maximum lifting height of 24 inches.

1.4.4- MDY30, 300KN, Hydraulic Gantry.

Model: MDY30

Series: MDY

Product Lines: Heavy Lifting Technology

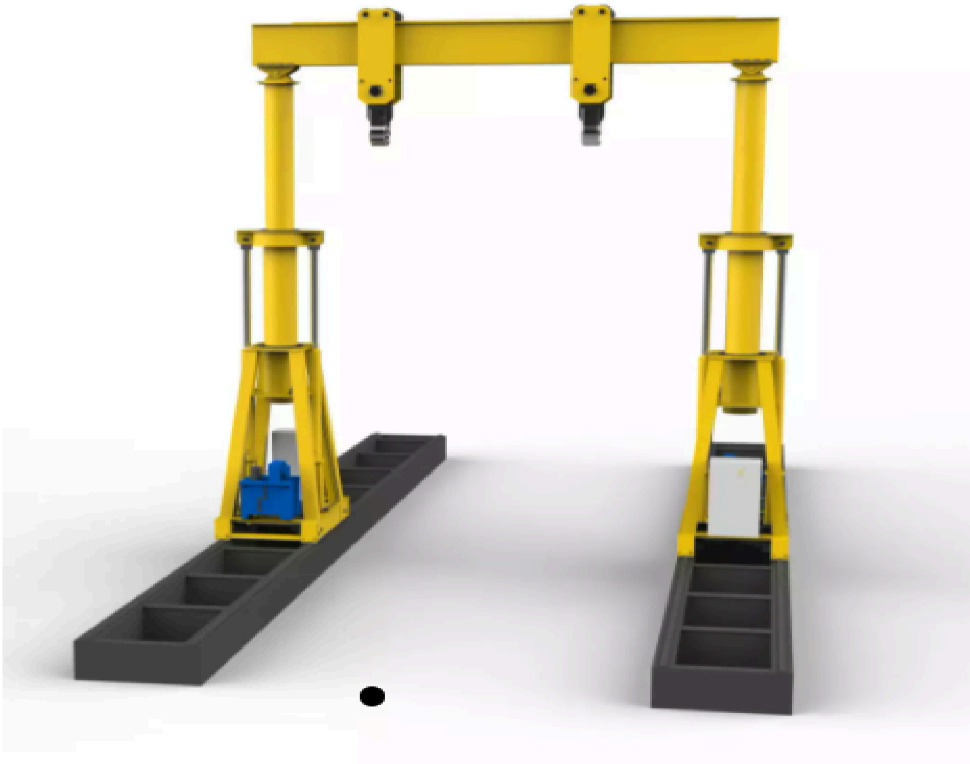


Figure 1.12 MDY30,300KN,Hydraulic Gantry

The cost-effective, compact MDY30 gantry, with wireless controls offers several key features:

Safety: Stroke synchronization ensures a level lift regardless of load distribution. PLC controlled lifting using feedback from a stroke encoder maintains even height on all legs and will stop the lift if necessary to prevent issues.

Capacity: 35 ton lifting capacity at full extended lift height. Even with its compact size, the MDY30 can lift full capacity to full height of 14.8 m, making it the most versatile portable gantry in the market.

Compact: Fits through standard doorway and is easily moved and set up. The MDY30 gantry can be moved through the tightest spaces imaginable in all industrial settings. Easy to push, pull and maneuver, the MDY30 can get into spaces that no other gantry can. Compact design for use in areas with limited space. Self-contained hydraulics with synchronized lifting for enhanced safety. Powered travel, under load, standard on all models for ultimate utilization. Three-stage, double-acting cylinder provides extended lifting capacity. Easy-to-use handheld pendant control can operate four legs simultaneously.

Compatible with different type of gantry accessories. Operates on 220V or 380V 3-phase power.

GB/T3811 compliant and load tested under witness of Lloyd's Register.

CE & ISO9001 certification.

Table 1.1: MDY30,300KN,Hydraulic Gantry.

Maximum Capacity 4 Legs (metric tons)	30
Maximum Capacity 4 Legs (kN)	300
Stage 1 Maximum Capacity 4 Legs (kN)	300
Stage 2 Maximum Capacity 4 Legs (kN)	300
Retracted Height (mm)	4800
Stage 1 Maximum Height (mm)	9800
Stage 2 Maximum Height (mm)	14800

Table 1.2: Dimensions

Retracted Height (mm)	4800
Stage 1 Maximum Height (mm)	9800
Stage 2 Maximum Height (mm)	14800
Base Length (mm)	2500

1.4.5- MDY200,2000KN,Hydraulic Gantry.

Model: MDY200

Series : MDY

Product Lines : Heavy Lifting Technology

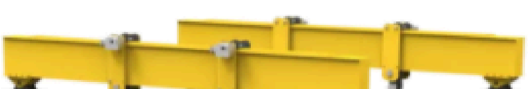


Figure 1.13 MDY200,2000KN,Hydraulic Gantry

Self-contained hydraulics and electronics.

🎬Intelli-Lift wireless control system

🎬Self-propelled wheels or tank rollers

🎬Full range of supplementary equipment: header beams, lifting lugs, side shifts and skid tracks

🎬Designed and tested to meet GB/T3811 safety standards

🎬Lloyds witness tested to 125% of maximum working load.

🎬CE & ISO9001 certification.

Chapter two

2 THEORETICAL ANALYSES

2.1 WORKING PRINCIPLE

Pascal's law is very popular in every equipment where heavy loads needs to be lifted by applying negligible amount of forces. "Pascal's law simply states that when there is an increase in pressure at any point in confined fluid, there is an equal increase in pressure at every other point in the container. "Pressure is equal to the force divided by the area on which it acts. According to the Pascal's law, in a hydraulic system a pressure exerted on a piston produces an equal increase in another piston in the system. If the second piston has an area 10 times that of the first piston, the force produced on second piston will be 10 times more than the force applied on the first piston.

2.1.1 Applied hydraulic laws

Let

W= Weight to be lifted,

F = Force applied on the plunger,

A = Area of ram, and

a = Area of plunger.

Pressure intensity produced by the force F,

p = f/Area of plunger = F/area of ram **(2.1)**

As per Pascal's law, the above intensity p will be equally transmitted in all directions.

Therefore,

The pressure intensity on ram = p = F/a = W/A or W= F(A/a) **(2.2)**

Above Equation indicates that by applying a small force F on the plunger, a large force W may be developed by the ram.

Magnification Factor of hydraulic = A/a

If the force in the plunger is applied by a lever which has a mechanical **Magnification factor (L/l)**

Then **total Magnification factor of machine = (L/l)(A/a)** (2.3)

The ratio (L/l) is known as **leverage of press**.

2.2 THEORITICAL CALCULATIONS

2.2.1 The design calculation is based an assumption of 400 kg payload

W = m*g (2.4)

= 400 * 9.8

= 3920 N

2.2.2 Average human force is 290 N

F = 290 N

2.2.3 Total Magnification factor (MF)

W/Plunger= (A/a)*(L/l)

= 3920 / 290

= 13.517

Applying safety factor of 20%

Total Magnification factor (MF) = 16.22

2.2.4 Pressure intensity

P = F/Area of plunger = W/Area of Ram

P = F/a = W/A

P = 290/a = 3920/A

W= F (A/a)

2.2.5 Hydraulic Magnification factor

= A/a = D2 / d2

(A/a)

Lever Magnification factor

(L/l)

Total Magnification factor (MF)

= (A/a) * (L/l)

= 16.22

Let

L= 60

l = 5

Let (L/l) = 12

Hydraulic (MF)

= (A/a)*12

=16.22

The Hydraulic Magnification factor needed is

(A/a) = (D/d)

= 1.35

Let

Diameter of Ram D = 3cm

(7.5/d) = 1.35

d = 5.5 cm

2.2.6 Efficiency

= (Output / Input) * 100 (2.5)

= (Output Force / (Input Force * MF total)) * 100 (2.6)

= (3920/ (290*16.22))*100

= 91.01%

2.2.7 Pump Flow rate

Q: Pump Flow rate.

A: Area of cylinder.

V: velocity.

Assume V = 7 m/min

A = 0.004 m^2

Q =A*V (2.8)

Q = 0.004*(7/60) = 4.66*10^-4 m^3/sec

2.2.8 Pump Pressure

F: force applied on Ram

P = F/A

P = 3920/0.004

P = 980 KPA

2.3 EXPERIMENTAL SPECIFICATION

2.3.1 Dimensions

- Dimensions of X : 87 cm
- Dimensions of Y : 175 cm
- Dimensions of Z : 149 cm

2.3.2 Operational Specification

- can lift up to 400 kg
- can lift to 80 cm from the ground
- can lift body with width 37 cm and more

2.3.3 Specification of Main Parts

Plunger:

- outer diameter 5.5 cm
- Inner diameter 1.2 cm

Ram:

- inner diameter 3 cm
- Outer diameter 7.5 cm

Rod:

61 cm

2.4 SOLIDWORK DRAW

Figure 2-1: Side view

figure 2-2: Elevation view

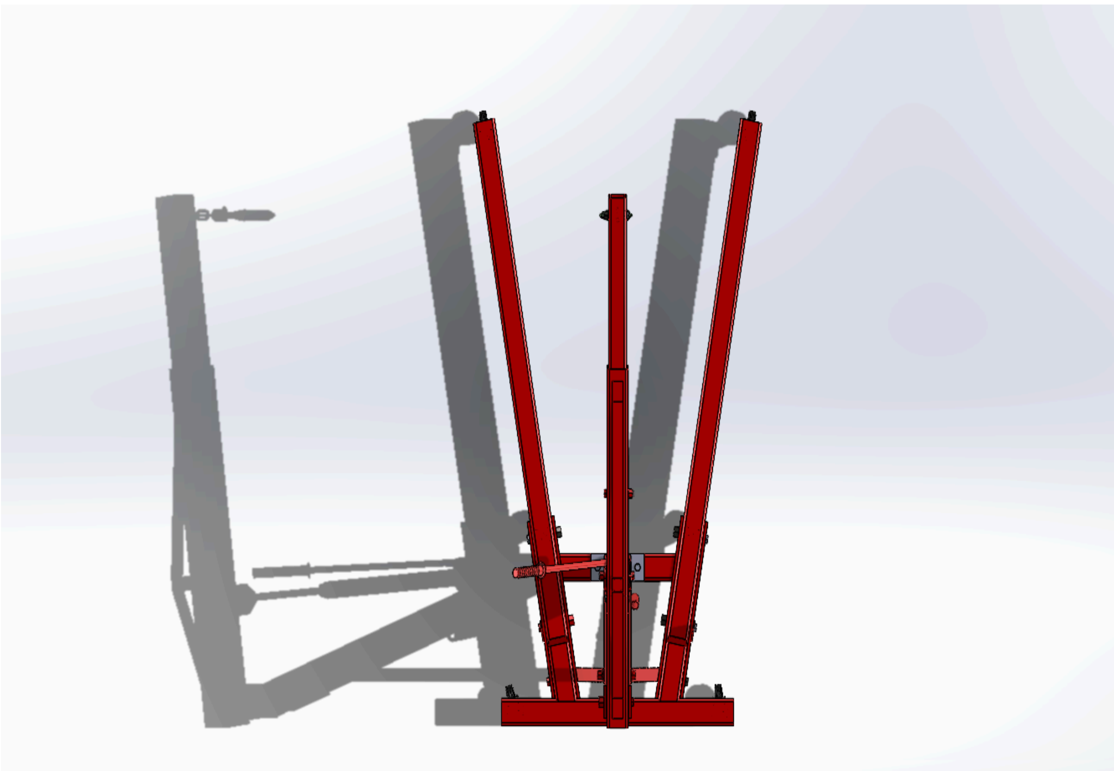
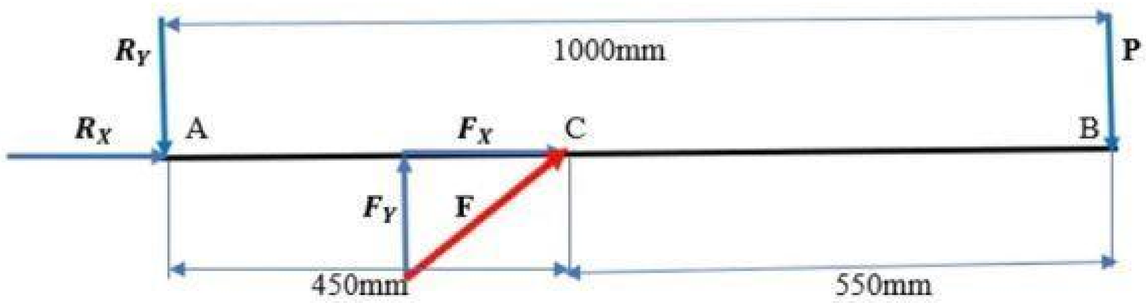


Figure 2-3: Top view

3 stress analysis

3.1 Force analysis



$$\sum MA = 0$$

$$FY \times 450 - P \times L = 0 \quad (3.1)$$

$$FY = \frac{10000 \times 1000}{450} = 23KN$$

$$F = \frac{Fy}{sin45\circ} = 32KN \quad (3.2)$$

$$FX = cos45° \times F = 23KN$$

The summation of all forces along the vertical direction can be calculated as below:

$$\sum Fv = 0$$

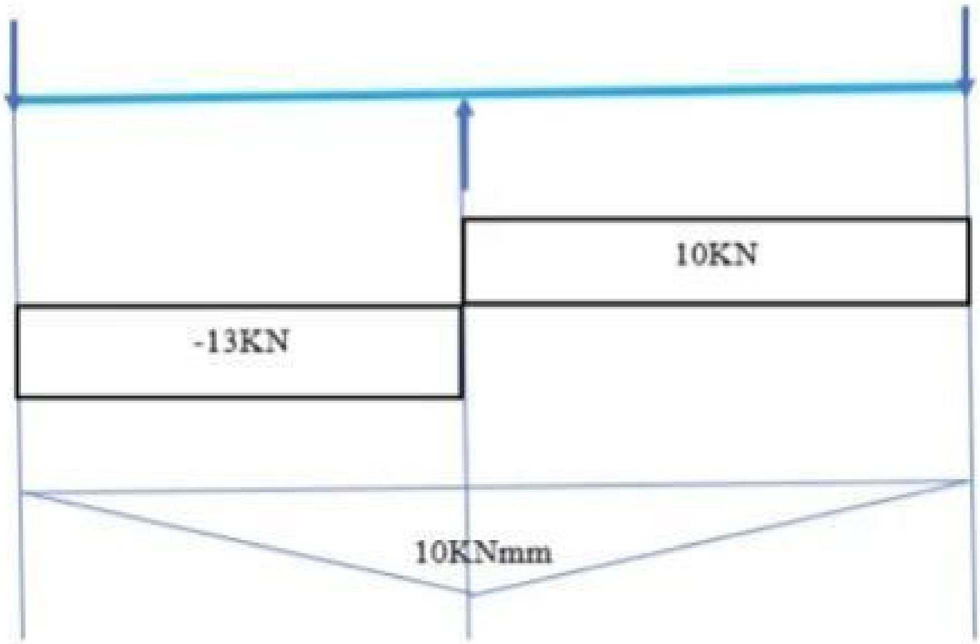
$$Ry + Fy - P = 10KN + Ry + 23KN \quad (3.3)$$

$$Ry =- 13KN \sum Fh = 0Rx + Fx = 0Rah =- 23N$$

<u>Shear force diagram</u> **<u>Bending moment diagram</u>**

$FA =- 13KN$ $MA = 0FCR =- 13KN$ Mc

$FCL =- 13KN + 23KN = 10KN$ $MB = 0FB = 10KN$



3.2 Design of vertical column

Figure 3-1 Vertical column

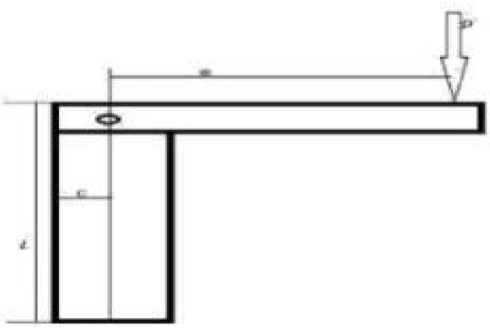


Figure3-2 Vertical column

$$\sigma c = \frac{P}{A}(1 + \frac{ec}{K^2}) \quad \textbf{(3.4)}$$

where,

σc = compressive stress , K= radius of gyration

c = distance between axis of column, A= area of column

Therefore: c=0.07/2 , e=0.09m

The area of coulmn cross section is :

$$A = \left[\left(0.07^2\right) - \left(0.062^2\right)\right] = 1.056\times10^{-3}m^2$$

3.2.1 Moment of inertia

(horizontal direction) $Ixx = \frac{[(0.07)^4 - (0.0624)^4]}{12}$ $\quad Ixx = 0.9234 * 10^{-5}m^4$ (3.5)

(vertical direction) $Iyy = \frac{[(0.07)^4 - (0.0624)^4]}{12}$ $\quad Iyy = 0.9234 * 10^{-5}m^4$ (3.6)

$$K = \sqrt{\left(\frac{Ixx}{A}\right)} \qquad (3.7)$$

$$K = \sqrt{\left(\frac{0.9234*10^{-5}}{1.056*10^{-3}}\right)} = 0.0935m the\ maximum\ load\ to\ be\ lift\ is\ 1ton = 1000kgW = 1000 * \frac{9.81m}{s^2} =$$

$$P = \frac{W}{cos12°} = 10.1KN$$

3.2.2 Direct stress (σd)

$$\sigma c = \frac{P}{A} = \frac{10100}{1.056\times10^{-3}} = 19.03Mpa \qquad (3.8)$$

3.2.3 Bending stress(σb)

$$\sigma b = \frac{M}{Z} = \frac{P}{A}\left(1 + \frac{ec}{K^2}\right) = \frac{10100}{1.056\times10^{-3}}\left(1 + \frac{0.09*0.035}{0.0935}\right) = 685.7Mpa \qquad (3.9)$$

3.2.4 Maximum compressive stress,

$$\sigma c = \sigma b + \sigma d = 685.7 + 19.03 = 704.73Mpa \qquad (3.10)$$

3.2.5 Maximum tensile stress,

$$\sigma t = \sigma b - \sigma d = 685.7 - 19.03 = 666.67Mpa \qquad (3.11)$$

3.3 Design of Boom

Figure3-3 Boom

$\sigma b = \frac{M}{Z}$ (3.11) σb=Bending stress

M=Bending moment at point of connection

Z=Section modulus

Since the boom is hollow rectangular cross section, the area of boom to which the effect of load P induces the stress Is: $A = 0.88(0.07 - 0.062) = 7.04\times10^{-3}m^{2}$

3.2.1 Moment of inertia

$$Ixx = \frac{0.88\left(0.07^{2}-62\right)}{12} = 7.68\times10^{-6}m^{4}$$

- distance from neutral axis extreme fiber ,is: c=(0.07)/2=0.035m

- section module(z)

$$z = \frac{Ixx}{c} = \frac{7.68*10^{-6}}{0.035} = 2.19 * 10^{-4}m^{3}$$

3.2.2 Bending moment,

$$M = P * LM = 10KN * 0.88m = 18 * 10^{3}Nm\sigma c = \frac{M}{Z} = \frac{18*10^{3}}{2.19*10^{-4}} = 80.77Mpa\sigma b = \frac{Sy}{n} \qquad n: fa$$

(3.12) $\sigma b = \frac{520}{4} = 130Mpa$

3.3 Design of base plate

Figure3-4 Base plate

Assumption:-

- its length is depending on the main stand and the hydraulic system components

-Since the base is mobile that is not grounded it can be affected by stress. Therefore, strong materials that withstand the stress needed.

$$\sigma t = 394 Mpa \sigma y = 294.8 Mpa$$

3.3.1 Design analysis:

$$tb = C \times da \sqrt{\frac{P}{\frac{\sigma y}{F.s}}}$$ where,c=constant and assumed to be 0.4 (3.13)

da=internal diameter of cylinder

P=maximum fluid pressure

taking f.s=3

$$tb = 0.4 \times 84 \sqrt{\frac{18Mpa}{\frac{294.8Mpa}{3}}} = 4.79mm$$

Chapter 4

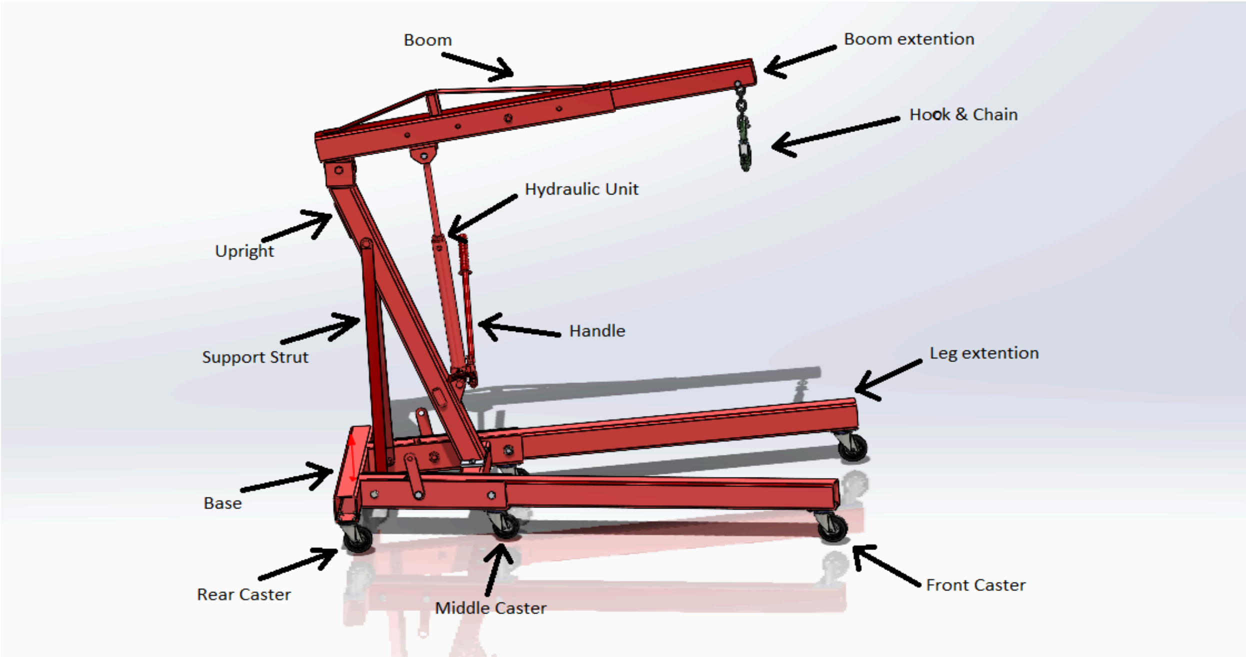


Figure4-1 Hydraulic crane

4.1 Main components:

- Hydraulic bottle jack.
- Base.
- Boom.
- Legs.
- Upright.
- Hook.

4.1.1 Hydraulic bottle jack:

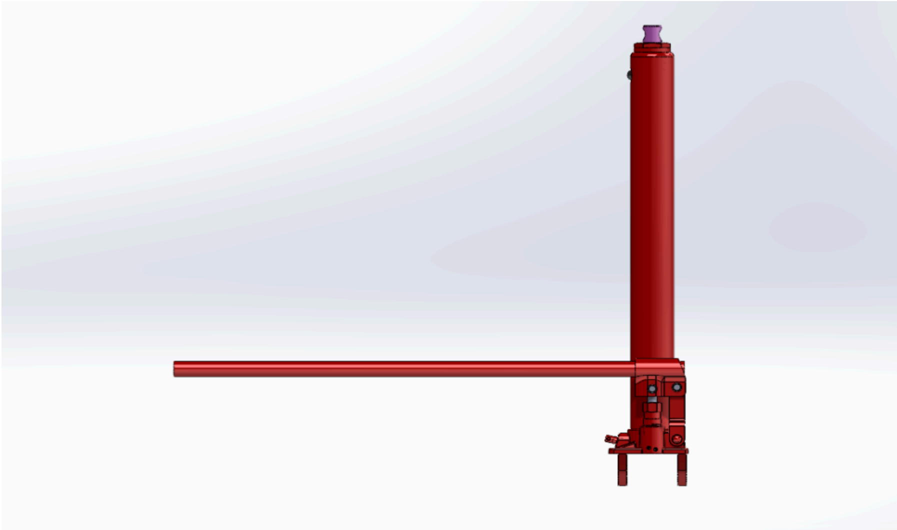


Figure 4-2 Hydraulic jack

- **Material:** Most pieces are made of mild steel, that has been shopped in some way, usually on a mill or a lathe. The non steel parts are either rubber or plastic and are purchased or injection molded.
- **Dimensions :** Base Dimensions: 125 x 110 mm

  Min. Hight **:** 230mm

  Weight : 5.8kg

4.1.2 Base:

Figure4-3 Base

- **Material:** Robust cast steel.
- **Dimentions:**

    Main beam: 60cm * 7cm

    Beam Supports: 15cm * 8cm

- **Specifications:**

- Foldable design for convinient easy storage & weight Supportant.

4.1.3 Boom:

Figure4-4 Boom

- **Material:** Robust cast steel.
- **Dimentions:** 80cm
- **Specifications:** 4hole positions reinforced boom enables 4 diffirent load capacities.

4.1.4 Legs:

Figure4-5 Legs

- **Material:** Robust cast steel.
- **Dimentions:** 140cm * 7cm
- **Specifications:** main weight supportive, grease and dirt resistance for easy cleanup.

4.1.4 Upright:

Figure4-6 Upright

- **Materials:** High-grade steel.
- **Dimentions:** 118cm * 7cm
- **Specifications:** Durable frame is constructed of high grade steel and built to support all over the weight. (main supportive components)

4.1.5 Hook:

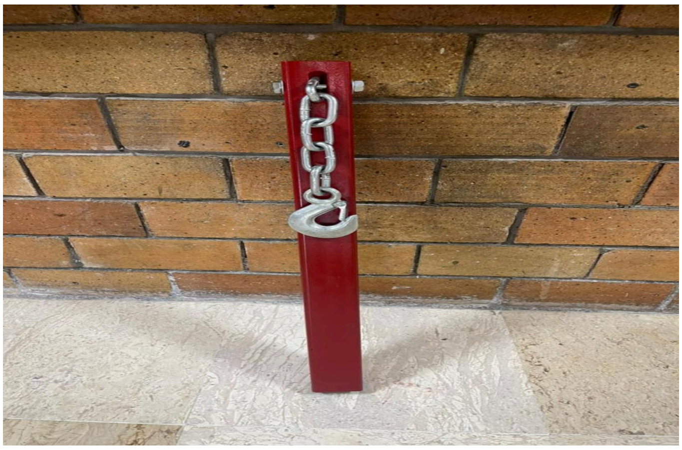


Figure4-7 Hook

- **Material:** Carbon steel, Alloy steels and cast iron
- **Specifecitions:** includes engine leveler making engine handling and positioning easier , Widely Used in Lifting, Mining, Petroleum, Chemical and Other Industries.

Chapter 5

5 conclusion

- for many years, cranes have designed for lifting heavy objects with different capacity in different work sites. hydraulic cranes are not type of cranes designed for lifting objects, which are beyond the capacity of human beign. practicable of this lifting operation by using portable and moveable crane. which is only one being use before we have identified that there is the need for using portable crane to lift up objects these are beyond the capacity and difficult of human power. thus, this paper provides the redesign of each part of portable crane. In addition, the design analysis for each part is ckecked that it is safe accordingly the size of each part of the crane.

REFERENCES

1. https://www.googleadservices.com/pagead/aclk?sa=L&ai=DChcSEwj7ibmptd_4AhW0j2gJHeQcBFkYABACGgJ3Zg&ae=2&ohost=www.google.com&cid=CAESbOD2jSQWvlnSWfvUB4frCGrPh_xMiWSIA6caE0BJflkWbqhYhT5Rd1BP-6m6vsaIjVnAt705qVENmrp_bd8TiVVGstKlZwvzQC6HD584K4_l6Da6nusm2Y5yCE4Q6blsyi4BLfXZXku6-4ODgQ&sig=AOD64_3MCTTT36MK5LBzFolqkHtpP41Jzg&q&adurl&ved=2ahUKEwjpi7Cptd_4AhWWQPEDHatxBmkQ0Qx6BAgDEAE
2. https://www.directindustry.com/industrial-manufacturer/2-ton-shop-crane-251183.html
3. https://awtools.pl/en/hydraulic-cranes/170-2-ton-foldable-workshop-engine-crane-5902198740209.html
4. https://canbuilt.com/cranes-and-engine-stand/2-ton-mobile-crane-c-w-manual-hydraulic-model-3900/
5. https://www.slideshare.net/EbrahimAyelegn/hydraulic-shop-crane-design-project?from_action=save
6. https://www.safetyliftingear.com/news/post/what-is-a-chain-block
7. https://www.liftingequipmentstore.com/blog/how-do-engine-cranes-work-and-what-do-they-do--
8. https://www.researchgate.net/publication/292151341_Steel_Work_Design_and_Analysis_of_a_Mobile_Floor_Crane
9. https://www.academia.edu/35363070/Design_of_a_Floor_Crane