FABRICATION OF HYDRAULIC SCISSOR LIFT

Pratheesh Suresh,
Department of Mechanical Engineering, Cape Institute of Technology, Levengipuram, Tamil Nadu, India.
pratheeshsuresh@yahoo.com

A. Sivathanu
Department of Mechanical Engineering, Cape Institute of Technology, Levengipuram, Tamil Nadu, India.
Sivathanua634@gmail.com

Abstract - The aim of the project is to design and fabrication of the automatic lifting machine .It is a modified form of conventional lifting machine that helps to lift the load using scissor frame. Lifting machine is a mechanical device used to raise or otherwise exert a force on an object too heavy to deal with by hand. A common example is the automobile jack, which is used to elevate the end of a car by a system of ratchets, gears, and screws. Lifting jacks are used for levelling or positioning heavy equipment, or for supporting structures. Common types of lifting jacks include bottle, inflatable, pallet, ratchet, scissor, screw, service or floor, toe, and transmission. In our project the manual operated lifting machine is converted into automatically by means of an electric motor. The force is given to the hydraulic cylinder which gives reciprocate motion and lifts the scissor frame. So by this mechanism a heavy load can be lifted. This project has a high advantage of lifting heavy loads and it is applicable to all conditions and places.

I. INTRODUCTIONS:

Hydraulics is a topic in applied science and engineering dealing with the mechanical properties of liquids. At a very basic level hydraulics is the liquid version of pneumatics. Fluid mechanics provides the theoretical foundation for hydraulics, which focuses on the engineering uses of fluid properties. In fluid power, hydraulics is used for the generation, control, and transmission of power by the use of pressurized liquids. Hydraulic topics range through some part of science and most of engineering modules, and cover concepts such as pipe flow, dam design, fluidics and fluid control circuitry, pumps, turbines, hydropower, computational fluid dynamics, flow measurement, river channel behavior and erosion.

Free surface hydraulics is the branch of hydraulics dealing with free surface flow, such as occurring in rivers, canals, lakes, estuaries and seas. Its sub-field **open channel flow** studies the flow in open channels.—– 12

The word "hydraulics" originates from the Greek word (hydraulikos) which in turn originates from (hydor, Greek for water) and (aulos, meaning pipe)

The scissors elevator is an elevator with a system of levers and hydraulic cylinders on which the metal platform is capable of moving in the vertical plane. This is achieved by using of linked, folding supports in a crisscross pattern, called scissor mechanism. The hydraulic lift was chosen as a subject of the thesis because it is a perfect example of mechanical engineering field. This mechanism combines a result of several main fields of engineering and at the same time, it is simple and accessible for understanding. The construction and load distribution represent statics and strength of material subjects, the hydraulic cylinder and the control unit involve knowledge of hydraulic systems and automation.

Scissor lift is an integral part of most of the workshops and building objects. The key advantage of lifts is that they even offer the best way to organise a technological and industrial process. Besides, almost all lifts give the possibility to change the place of their installation without much effort, which is important in the frequently changing conditions in the production process these days.

The need for the utilization of elevators is incredibly wide and it runs across workshops, factories, labs, fixing of billboards, residential/commercial buildings to repair street lights, etc.

II. CLASSIFICATION OF LIFTING PLATFORMS

To start something new it is needed to look at something that already exists. On the design elevators can be divided into the following main types: permanent and portable. The permanent elevators are: scissor raise platforms, track lifting platform, launching and unloading platforms

The portable elevators divided into: several mobile lifting platform, a couple of tractor-lift platforms, improved car lifting platform, AC-DC dual-use working out with a platform, self-elevating podium, crank-type raise platform, foldable arm lift platform, packages cylinder lift platform, lightweight aluminium lift platform, working out with height from 1-30 m. array

2.1 Launching and unloading platform

The drive elevator is divided into electro-hydraulic, electromechanical, pneumatic hydraulic. As the lifting devices elevators divided into: chain, screw, telescopic, lever. As the picking-up devices elevators divided into: platform, frame, and console. Stationary elevators are established in a defined place, frequently without the special foundation on a flat surface of a floor and fastened by means of anchor bolts or special pins. If the elevator is telescopic then for his installation is required the special basement is required

Figure i

2.2 Mobile lifting platform

As the drive elevators divided into: electro-hydraulic, electromechanical, pneumatic hydraulic. As the lifting devices elevators divided into: chain, screw, telescopic, lever. As the picking-up devices elevators divided into: platform, frame, and console. Stationary elevators are established in a defined place, frequently without the special foundation on a flat surface of a floor and fastened by means of anchor bolts or special pins. If the elevator is telescopic then for his installation is required the special basement is required

Elevators at which racks move belong to mobile. The main advantage of mobile elevators is their mobility - a possibility to use serially on various posts and in various technological zones of the enterprise

Figure ii

III. ADVANTAGE AND APPLICATION

The concept of a scissors lift with hydraulic power comes from Pascal's law applied in car jacks and hydraulic rams which states that "pressure exerted anywhere in a conformed incompressible fluid is transmitted equally in all directions throughout the fluid such that the pressure ratio remains the same

Since the emergence in the light of different cultural achievements, the individual tries to maximize their use to facilitate the work. Only a century ago, the society did not have the opportunity even to dream about what is already openly available at present. The rough labor is replaced by technology

"A scissor lift elevator is a vertical transportation cab which is raised and lowered from underneath, somewhat like a traditional hydraulic elevator, except that instead of a hydraulic cylinder the extendable mechanism is a folding lattice of crisscrossed beams similar to a pantograph. The entire mechanism extends upward when pressure is applied to the lowest members.

On Figure below general examples of scissors elevators can be seen

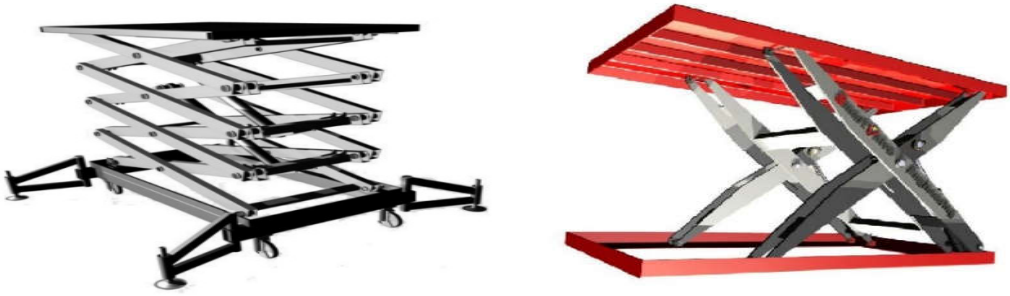


Figure iii

People use a huge number of different lifts. The aim is also different, some are used in some situations while others are for a totally different environment. For example, there is an electro-hydraulic scissors elevator — quite a small device allowing to lift hundreds of kilograms of freight on a height of tens of meters. Thus, in particular, the hydraulic scissor hydraulic lift has been used successfully to electrical and other works on the heights of about 2-3 floors. Also, it allows making work at a greater height than tens of meters.

Also, lifts of this type could also be applied to other conditions, such as daily loading and unloading work in warehouses. The scissor lift perfectly meets the needs for certain warehouse facilities, mainly because of the fact that above the lifting platform it has a lack of any mechanisms. This is complemented by access from all four

sides, which gives the opportunity to use it for loading of objects on the top shelves of warehouse racks. A distinctive feature of an electro-hydraulic scissor lift in comparison with other analogues is the low price due to the use of a relatively simple design. A special lifting platform is driven by a simple metal structure with levers that look like scissors connected with others in a long chain. As a lifting force is used electrohydraulic mechanism for driving a pair of scissors in motion In addition, a scissor lift is suitable for use in situations, where movement of other types of lifts is limited. This capability makes this type of lift particularly versatile and convenient. A platform with load is movable not only vertically, but also on the meter to the side, as is for example available on some models. This feature is highly convenient in situations in the workplace where there is no possibility to put the basis of lift exactly under the desired object

IV. MATERIAL SELECTION

It is necessary to evaluate the particular type of forces imposed on components with a view to determining the exact mechanical properties and necessary material for each equipment. A very brief analysis of each component follows thus:

I. Scissors arms
II. Hydraulic cylinder
III. Top plat form
IV. Base plat form
V. Wheels Scissors Arms

Scissors Arms: This component is subjected to buckling load and bending load tending to break or cause bending of the components. Hence based on strength, stiffness, plasticity and hardness. A recommended material is stainless steel.

Hydraulic Cylinder: this component is considered as a strut with both ends pinned. It is subjected to direct compressive force which imposes a bending stress which may cause buckling of the component. It is also subjected to internal compressive pressure which generates circumferential and longitudinal stresses all around the wall thickness. Hence necessary material property must include strength, ductility, toughness and hardness. The recommended material is mild steel.

Top Platform: this component is subjected to the weight of the workman and his equipment, hence strength is required, the frame of the plat form is mild steel and the base is wood.

Base Platform: this component is subjected to the weight of the top plat form and the scissors arms. It is also responsible for the stability of the whole assembly, therefore strength. Hardness and stiffness are needed mechanical properties. Mild steel is used.

V. DESIGN THEORY AND CALCULATION

In this section all design concepts developed are discussed and based on evaluation criteria and process developed, and a final here modified to further enhance the functionality of the design. Considerations made during the design and fabrication of a single acting cylinder is as follows:

a. Functionality of the design

b. Manufacturability

c. Economic availability.

Hydraulic cylinder: The hydraulic cylinder is mounted in inclined position.

The total load acting on the cylinder consists of:

- Mass to be put on lift: 500 kg

  (Taking FOS = 1.5 for mass in pallet 500 x 1.5 = 750 kg

  Rounding the mass up to 800 Kg)

- Mass of top frame= 22.5 kg
- Mass of each link: 5kg (5*8) = 40kg
- Mass of links of cylinder mounting=4kg
- Mass of cylinder=8.150kg

Total Mass: 22.5+40+8.150+4+800 = **874.65 kg**

Total load = 874.65x 9.81 = **8580.316N**

5.1 Scissors lift calculations:

For a scissor lift Force required to lift the load is dependent on, Angle of link with horizontal Mounting of cylinder on the links Length of link.

Formula used

Where W = Load to be lifted

S= a2 + L2 -2aL*cos α

S = Distance between end points of cylinder.

L= length of link = 0.6 m

α = angle of cylinder with horizontal.

Now the maximum force will act on the cylinder when the cylinder is in shut down position i.e. when the scissor links are closed

.For calculations we will consider α=30 Thus substituting α=30 we get F=8580.316N Selecting 63mm diameter cylinder

Area of the cylinder= force/pressure

Area= (3.14*632)/2 =3117.24mm2

Pressure = (Force/Area) = (8580.316/3117.24*10-6) =**27.52bar**

5.2 Design of link

Now Let Hy0 =Mass applied on the lift=800kg

B = Mass of the lift which the cylinder needs to lift=74.65kg

H_{yi}=Total weight =8580.316N

- Only two forces are calculated here
  1. Forces at the end of link: as forces at ends of link are same in magnitude.
  2. 2. Force at middle of link.
- In our case, the levels are numbered from the top.

  For level 1 X1 = X_{Bi}-1

For level 2 X 2= X_{Bi}

The angle of cylinder with horizontal is θ=20 °.

H_{yi}=8580.316N

$X2=H_{yi}*\cot\theta/2$

=8580.316*1*0.5*(cot20/2)

=11787.112N

Resultant of X 2 & $H_{Yi}/4$

R1 = √ (11787.112)2 + (8580.316/4)2

R1 = 11980.708N.

Above force will act on all the joints at end of each link. Now force acting on the intermediate point of link is given by,

X_{mi} = (2i-1)*Hyo* + (2i2 -2i+1)*by *cot θ/4

=Hyo*cot θ/2 + (2i2 -2i+1)*by*cot θ/4

= (7848X0.5Xcot 20°) + (732.316 X 0.25 X cot20°)

=11512.48N

5.3 Design of moving end pin

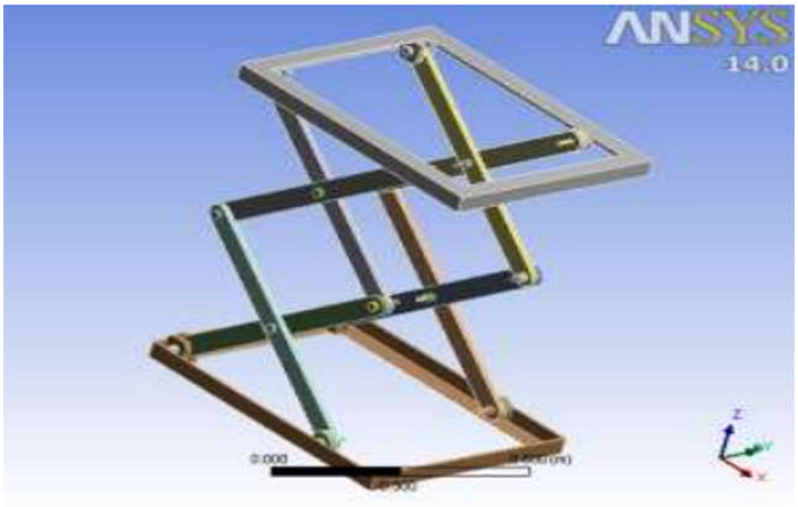
τall = 0.5*380/FOS

= 63.33Mpa 63.33= 4*F/3.14*D² *2

= 10.76mm

D = 12mm……selecting standard value

VI. ANALYSIS OF HYDRAULIC LIFT



ISO Assembly

Figure 4: ISO Assembly

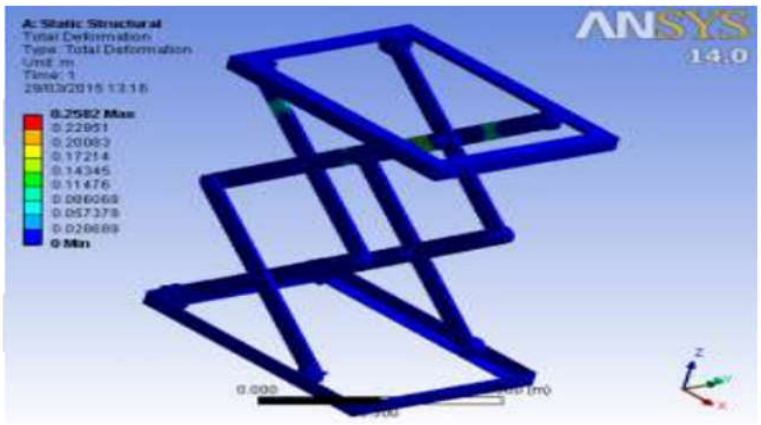


Figure 5: Deformation Analysis

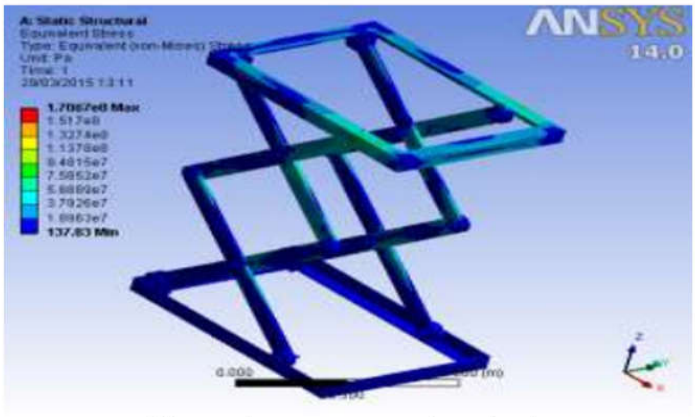


Figure 6: Vonmises stress Analysis

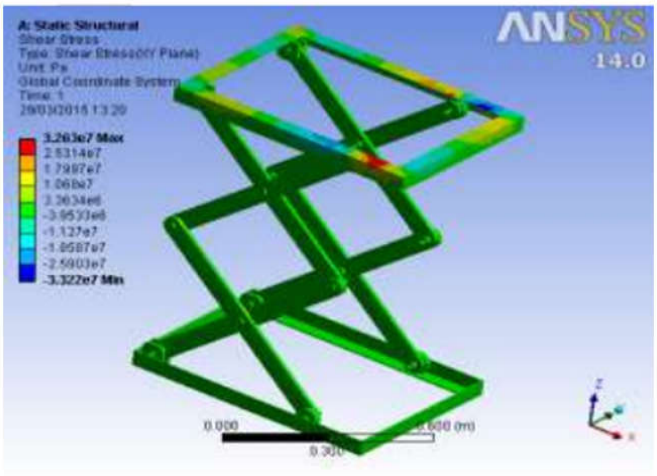


Figure 7: Shear stress Analysis

VII. CONCLUSION

The design and fabrication of a portable work platform elevated by a hydraulic cylinder was carried out meeting the required design standards. The portable work platform is operated by hydraulic cylinder which is operated by a hand pump ergonomics of a person or an operator working in the company premises is a responsibility of an organization. It is an important thing to give some comfort to the operator. Hence, by making this hydraulic lifter we improved the comfort level of the operator working on the cold forging machine. Ergonomics, material handling and providing comfort to the operator was our main motive behind developing this lifter this was considered as a radical improvement in the productivity by the company. The scissor lift can be design for high load also if a suitable high capacity hydraulic cylinder is used. The hydraulic scissor lift is simple in use and does not required routine maintenance. It can also lift heavier loads. The main constraint of this device is its high initial cost, but has a low operating cost. The shearing tool should be heat treated to have high strength. Savings resulting from the use of this device will make it pay for itself with in short period of time and it can be a great companion in any engineering industry dealing with rusted and unused metals.

REFERENCES:

1. G.B.S Narang, "Automobile Engineering", Khanna Publishers, Delhi, 1991, PP.671.
2. William H. Crowse, "Automobile Engineering".
3. MECHANISMS IN MODERN ENGINEERING DESIGN VOL. V. PART I
4. Elements of Workshop Technology – VOLL II
5. Strength of Materials – I.B. Prasad
6. Experiments in Hydraulic Engineering by Singh
7. Industrial hydraulics from parker
8. Basic Principles and Components of Fluid Technology
   By Mannesmann Rexroth GmbH
9. Rigging Engineering Basics *by* **Keith Anderson**