A Proposed Work on Scissor Lift

Kapatel Jainil[1] Prit Patel[2] Rana Mitul[3] Prof. Jayesh Patel[4] Prof. Mihir Rana[5]
[1,2,3]BE Student [4,5]Assistant Professor
[1,2,3,4,5]Department of Mechanical Engineering
[1,2,3,4,5]Sardar Patel College of Engineering, Bakrol, Gujarat Technological University (India)

Abstract— A scissor lift is a type of platform that can usually only move vertically. The mechanism to achieve this is the use of linked, folding supports in a criss-cross "X" pattern, known as a pantograph (or scissor mechanism). The upward motion is achieved by the application of pressure to the outside of the lowest set of supports, elongating the crossing pattern, and propelling the work platform vertically. The following paper describes the design as well as analysis of a simple scissor lift. Conventionally a scissor lift or jack is used for lifting a vehicle to change a tire, to gain access to go to the underside of the vehicle, to lift the body to appreciable height, and many other applications also such lifts can be used for various purposes like maintenance and many material handling operations. It can be of mechanical, pneumatic or hydraulic type. The design described in the paper is developed keeping in mind that the lift can be operated by mechanical means so that the overall cost of the scissor lift is reduced. Also such design can make the lift more compact and much suitable for medium scale work. Finally the analysis is also carried out in order to check the compatibility of the design values.
Key words: Scissor Lift, Pantograph

I. Introduction

The most common industrial lift is the hydraulic scissor lift table. This may seem like a complicated piece of equipment, but in actuality hydraulic lift tables are really very simple in design.
Hydraulic scissor lift tables are comprised of five major components:

A. Platform

This is the top of the lift table where lifted product sits. It can be supplied in a variety of sizes.

B. Base

This is the bottom of the structure that rests on the floor. It contains the track the scissor legs travel in.

C. Scissor legs

These are the vertical members that allow the platform to change elevation.

II. Selection of Material

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:

1) Scissors arms
2) Top plat form
3) Base plat form
4) Wheels

A. 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 an hardness. A recommended material is stainless steel.

B. 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.

C. 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, SAE 1020, In-conel 600 is used.

III. Design of Different Components of Aerial

A. Scissor Lift

Aerial Scissor Lifts comprises of six components.There is no concrete design procedure available for designing these components. The main components of the lift are Base plate, Upper plate, lead screw, nut, links and pins. On the basis of certain assumptions the design procedure for each of the components has been described as follows:

B. Design of Base Plate

The base plate in a scissor lift only provides proper balance to the structure. Considering the size constraints, the dimensions of the base plate are taken as under. Also it has been found that not much of the stresses are developed in the base plate. Length of the plate (L) = 450 mm and Width of the plate (B) = 300 mm Weight of the plate (W) = 250 N

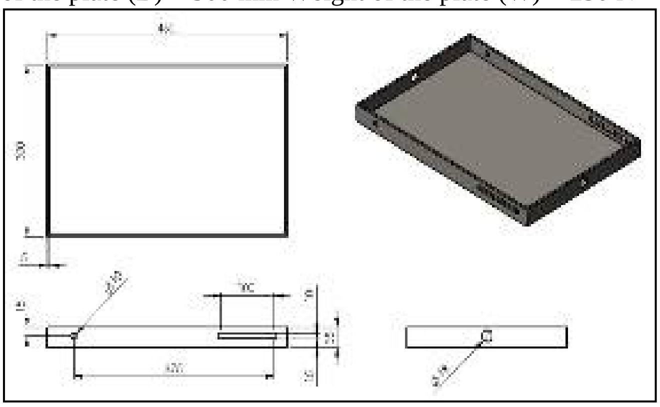
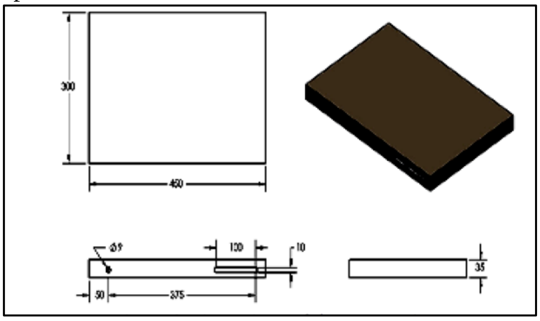


Fig. 1: Dimensions of the Base Plate.
(All dimensions in mm)

C. Design of Upper Plate

The upper plate in a scissor lift is used to place the load and transfer it to the links. The designing of the upper plate is undertaken similar as the base plate. The upper plate has the similar requirements as the base plate. Also it has been found that not much of the stresses are developed in the upper plate as well.



D. *Design of Lead Screw*

Lead screw is the ultimate component that takes up the load that is to be lifted or lowered by lift. It also delivers torque from the motor to the nut and also prevents falling of the lift due to its own weight Link length is assumed to be 385 mm It can be seen from the above figure 3 that maximum pull on the power screw occurs when lift is in lowermost position. In minimum position, the core diameter of the screw is taken asdc = 12 mm And the pitch of the screw is taken as p = 2 mm Therefore outer diameter do = 14 mm. And the average diameter, d = 13 mm

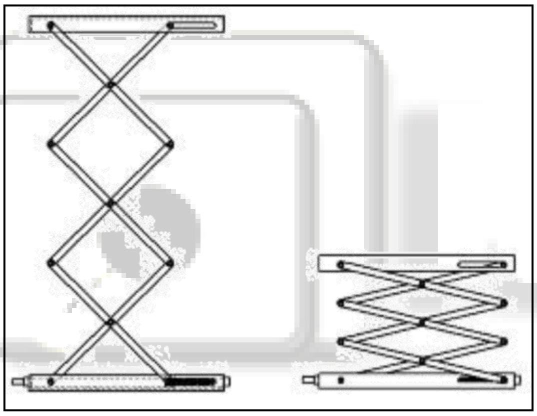


Fig. 3: Scissor lift showing maximum and minimum positions

Let α be the helix angle

Now tan α = p / (л.d) = 2 / (л.13) = 0.0489

Assume μ = tan ϕ. Thus we get ϕ = 0.20 Effort required to rotate the screw while increasing the height, P = W x tan (α + ϕ) = 135.23 N

Similarly effort required to reduce the height,

P = W x tan (α - ϕ) = 80.5 N Torque required in rotating the screw, T = P x (d/2) = 878.9 N.mm

Tensional shear stress (calculated) = 10.36 N/mm2

Direct tensile stress (calculated) = 4.76 N/mm2 Maximum principle stress (calculated) = 13 N/mm2 Maximum shear stress (calculated) = 10.63 N/mm2 It has been found that all the above calculated values are within the permissible limits. Therefore all dimensions considered are correct.

E. *Design of Nut*

The material of the nut is assumed to be mild steel.
And therefore the bearing pressure of mild
Steel = 20 N/mm2.
Assumed that the load W is uniformly distributed
Over the cross sectional area of the nut, therefore the
Bearing pressure between the threads is given by

Pb = W / (_/4) x [(do2) – (dc2)] x n

Thus we get n = 0.1903 (n is the number of threads in Contact with screw)
In order to have good stability and also to prevent the Undesirable movement of screw in the nut, take n = 4
Now thickness of nut (t) = n x p = 24 mm and
Width of nut (b) = 1.5 do = 27 mm

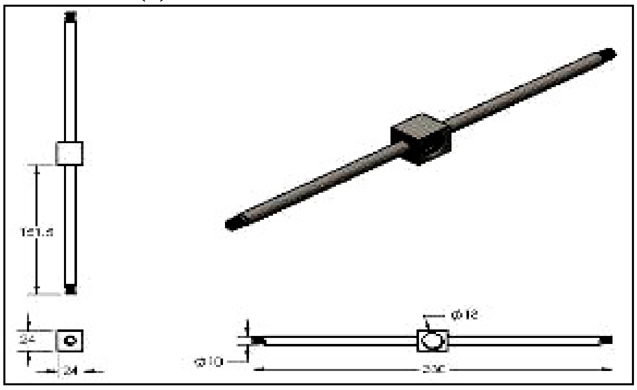


Fig. 4: Dimensions of Nut
(All dimensions in mm)

Design of Link
Load acting on one link = F / 2 = 269 N
The link is designed for buckling load, assuming factor of safety (FOS) = 5
Thus critical buckling load = 269 x 5 = 1345 N
Assume width of link = 3 x thickness of link and c/s area of link = 3 x thickness2
Moment of Inertia = 2.25 x thickness4
Radius of gyration = 0.866 x thickness
Since for buckling of the link in the vertical plane, the ends are considered as hinged, therefore equivalent length of the link is, L = 385 mm. considering the Rankin's Formula, we find Thickness of link = 5 mm and Width of link = 15 mm

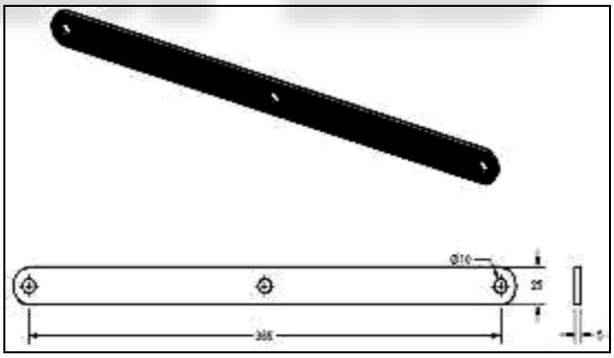
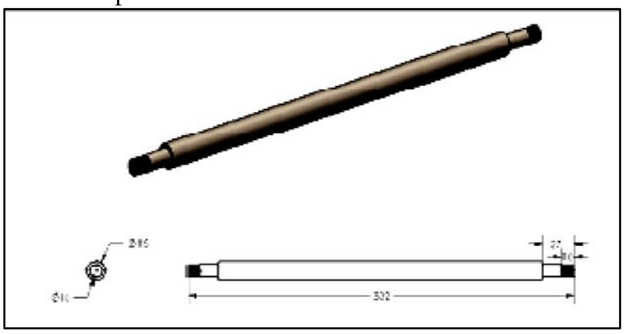


Fig. 5: Dimensions of Link (All dimensions in mm)

F. *Design of Pin*

The pins will be in double shear conditions. Thus the diameter of pin is calculated as 10 mm



IV. NEED OF THE PROJECT

We want to small production company in GIDC and we showed in this company some worker were doing their job they transport part by using table and stool in storage department they do same kind of work and this work man power is to much needed and by this work it is hard to think so we got the idea of scissor lift that become the work load easy and not needed man power.

V. WORKING

The body of the scissor lift that is holding the platform used to carry materials or people has foldable support that looks like a criss-crossed pattern linked together. The body is known as the pantograph which is the lifting mechanism. Pantograph functions like a spring wherein the elevation or upward motion takes place due to the application of pressure. Its length and size is defined by the expansion and contraction of the body of the scissor lift.

Pantograph can be moved through three various mechanisms. Generally, the most frequently used type of scissor lifts is gasoline or electrically powered. Electricity or gasoline from a direct outlet or battery is employed to power the entire scissor lift. Electrically powered scissor lifts are preferably used in places where flammable materials and objects are prohibited. Areas that have too many fumes such as combustion areas and manufacturing sites ought to avoid gasoline or diesel powered lift. Both gasoline and electrical scissor lifts are commonly used outdoors and are less likely to be used in stocking various materials and goods. This type of lifting equipment is capable of reaching 10 to 18 meters above the ground. Another variation is the hydraulic lift. The hydraulic lift is powered by fluid that is deposited in the equipment's tubing. This works when pressurized hydraulic fluid is pumped in a continuous downward and upward motion inside the tubing. On the other hand, fluctuations on the temperature may cause malfunctions on the lift. Temperature fluctuations may possibly cause viscosity of the hydraulic fluid that will result to issues in the lift's mechanism. The other type of lifting equipment utilizes air pressure to move the platform up and down and is called pneumatic lift. It is environmental friendly and very efficient to use. Pneumatic lift utilizes compressed air. It does not easily act in response to extreme temperatures. This kind of lift does not require extensive maintenance. It will carry out its functions as long as there is air.

A scissor lift is utilized extensively on emergencies such as fire fighting. It is able to help the workers to reduce efforts as there is no need to carry and lift heavy loads manually instead of taking everything up one piece at a time. This lifting equipment is also used for doing maintenance work on high-rise buildings and structures. Moreover, it helps the workers reach a height where it is comfortable to perform task correctly. Warehouses and supermarkets may use scissor lift to store items up on a tall shelf.

Another advantage of using a scissor lift is that there is enough space for more than one person to be on the lift at the same time which results to higher productivity and efficiency. One reason that the scissor lift is ideal for doing elevated works is because people will have a platform with a barricade for safety so the tendency of stepping off the platform is reduced.

A. *Advantage*

Easy transportation.
1) Less- effort.
2) Low time consumption
3) The behaviour of worker was very polite. Atmosphere was so motivating. The first thing which impressed our mind was the uniform of workers

B. *DIS-ADVANTAGE*

1) Hard transportation.
2) More effort.
3) Accidents.
4) Corrosion.
5) More time consumption.

VI. FUTURE SCOPE

1) The lift table can be very useful for patients in a stretcher, which has to be shifted to location having difference of height.
2) The lift table, if suitably modified can be useful for a handicapped person wheel chair for reading, dining and routine activities.
3) Even in industrial applications where there is a need for lifting heavy loads to much larger heights

VII. CONCLUSION

With such a design of an aerial scissor lift, the Complexities in the design can be reduced. Also with such design parameters, the manufacturing time of an aerial scissor lift can be reduced. So such a design can be used for production in industries. The analysis on ANSYS has also shown that the design is safe under certain accepted parameters. Also further modifications can be implemented for optimizing the design and further analysis can also be carried out by finding other important parameters related to aerial scissor lifts.

REFERENCES

[1] Design and analysis of an aerial scissor lift by *jaydeep m. Bhatt, milan j. Pandya*
[2] Design and analysis of hydraulic scissor lift by fea sabde abhijit manoharrao, prof. jamgekar r.s.
[3] Analysis & optimization of hydraulic scissor lift by sabde abhijit manoharrao, prof. jamgekar r.s.
[4] Deriving a generalized, actuator position-independent expression for the force output of a scissor lift by amay saxena, university of california, berkeley