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“A STUDY DESIGN, AND ANALYSIS OF HYDRAULIC SCISSOR LIFT BY USING ANSYS”

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ABSTRACT

The following researcher describes the design as well as analysis of a simple aerial 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 required height, and many various applications such as 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.

Keyword: Aerial Work Platform, Mechanical, Jack, Material Handling, Von Misses Stress, Scissor Lift

I. INTRODUCTION

Scissor lifting mechanism is a typical lift machine [1-6] which has many advantages such as stable structure [4], reliable operation [1], high efficiency [2, 3, 5] and low failure rate [2, 6], etc. As a key component of platforms, the stability of scissors lifting mechanism determines the safety of the platform equipment [1, 6]. The instability of scissor lift will make agency staff wounded or even death. In this paper, models of single scissor arm are made by using Finite Element software. The Critical load is calculated by buckling analysis. The theoretical results of critical loads are calculated by using energy method. The two results of modeling and energy method are compared. The FEM models of the total scissor lifts mechanism are made and the stability of scissor lifts with different input vectors are compared. For a scissor lift with one input force of hydraulic actuator, and the input is on the lines of the nodes of the scissor lifts, there are 6 different kinds of scissor lifts in total.

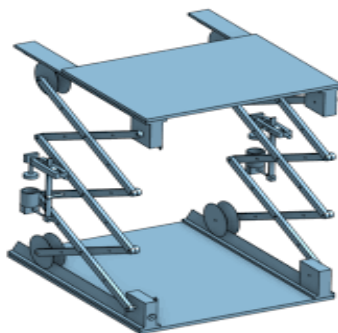


Fig.1 Scissor Lift

1.1 Types of Scissor lift

The scissor lifts can be classified as follows:

- Hydraulic lifts
- Pneumatic lifts
- Mechanical lifts

Hydraulic scissor lift tables are comprised of five major components:

- **Platform**
It is the top of the lift table where lifted product is carry. It can be supplied in a variety of sizes.
- **Base**
It is the bottom of the structure that rests on the floor. It contains the track the scissor legs travel.
- **Scissor legs**
These are the vertical members that allow the platform to change elevation.
- **Hydraulic cylinder**
The scissors lifts are actuated by one, two, or three single acting hydraulic cylinders. Hydraulic cylinders allow the lift table to lift and lower.
- **Motor or Power Source**
The hydraulic scissor lifts are powered by either an electric or air motor. They provide power to the hydraulic pump which actuates the scissor lift table.

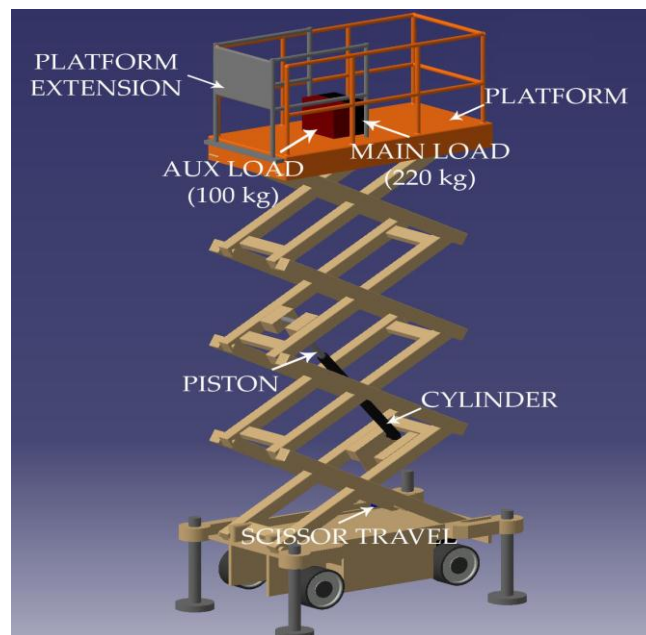


Fig.2 Scissor Lift Component

1.2 Hydraulic Lift Working

A hydraulic lift table raises and lowers when hydraulic fluid is forced into or out of the hydraulic cylinder(s). As hydraulic fluid is forced into a cylinder, the cylinder strokes outward forcing the scissor legs apart. Raising the Lift Table: Since one end of both the inner and outer legs are connected to the base and platform, the platform rises vertically as the scissors legs open. The free end of the scissors legs are fitted with rollers that run in the base. Any time a lift table is raised, it is being supported by a column of fluid. The lift table remains in a raised position because the fluid is held in the cylinder(s) by a simple check valve. A lift table's up speed is a function of the hydraulic pump and the motor that is turning it. The desired up speed and capacity to be lifted determine the amount of work the motor has to do, thus the horsepower required. If a lift table needs to move faster, it will take more horsepower. If a lift table has to have greater capacity, it will also take more horsepower. Lowering the Lift Table: The lift table is lowered by opening a down valve that allows fluid out of the cylinder at a controlled rate. This down valve is solenoid operated and

a “normally closed” type valve, which means it stays closed until the electric solenoid is actuated. This feature prevents the lift table from lowering if there were a power failure. When the solenoid opens the down valve, the fluid returns to the reservoir. The down speed of a lift table is a function of controlling how fast the fluid is allowed to leave the cylinder. This is done with a flow control (FC) valve. The FC valve is pressure compensated, which means it regulates the flow to a predetermined range whether the lift is loaded or empty. These FC valves are fixed rate or non-adjustable and typically the lift table’s down speed is matched to lift table’s up speed.

These types of lifts are used to achieve high travel with relatively short platform. Industrial scissor lifts & tilters are used for a wide variety of applications in many industries which include manufacturing, warehousing, schools, grocery distribution, military, hospitals and printing. The scissor lift contains multiple stages of cross bars which can convert a linear displacement between any two points on the series of cross bars into a vertical displacement multiplied by a mechanical advantage factor. This factor depends on the position of the points chosen to connect an actuator and the number of cross bar stages. The amount of force required from the actuator is also amplified, and can result in very large forces required to begin lifting even a moderate amount of weight if the actuator is not in an optimal position. Actuator force is not constant, since the load factor decreases as a function of lift height. 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 by using pantograph so that the overall cost of the scissor lift is reduced. In our case our lift was needed to be designed a portable and also work without consuming any electric power so we decided to use a hydraulic hand pump to power the cylinder. Also such design can make the lift more compact and much suitable for medium scale work. Finally the analysis of the scissor lift was done in ansys and all responsible parameters were analyzed in order to check the compatibility of the design.

II. LITERATURE REVIEW

Gaffar G Momin, et al “Design, Manufacturing & Analysis of Hydraulic Scissor Lift”, This Paper is on design and analysis of a hydraulic scissor lift. Conventionally a scissor lift or jack is used for lifting a automobile for maintenance, to gain access to go to the lower of the automobile, or to lift the body to appreciable height, and many other applications also lifts can be used for various applications like maintenance and many material handling operations. In this case scissor lift was needed to be designed a portable and work without consuming any electric power so they decided to use a hydraulic hand pump to supply power to the cylinder also such design can bring the lift more compact and suitable for medium scale work. Finally the analysis of the scissor lift was done in ANSYS and all responsible parameters were analyzed in order to check the compatibility of the design values

Divyesh Prafulla Ubale, et al. “Design, Analysis and Development of Multiutility home equipment using Scissor Lift Mechanism”, The traditional method of using rope, ladder lift getting person to a height bear a lot of limitation (time and energy consumption, comfort ability, amount of load that can be carried etc.) also there may be a risk of falling down or broke down in case of ladders hence hydraulic scissors lift is designed to overcome all these problems. Before now, several scientist and engineers have done a lot of work as regards the scissors lift in general. A review of some of that work gives the design and construction of a hydraulic scissors lift a platform.

Setu Dabhi, et al, “Design and Analysis of Hydraulic Pallet System in Chain Conveyor”, This paper describes the design and analysis of hydraulic pallet system used in chain conveyors. Such a system is used in numerous industries for loading or unloading of materials or to move items between places. The major components of this system are- an electrical hydraulic convertor, a sequence conveyor and a pallet system. A PLC system is used for mechanical control of the pallet. This paper aims at designing a low cost and feasible hydraulic actuated lift mechanism. This paper also compares the hydraulic propulsions with pneumatic and servo actuations.

S. B. Naik, et al “Finite Element analysis of Frame of Hydraulically Operated Beam Lifting Machine” A special type of beam lifting device is designed for textile industries. The machine is operated hydraulically. Beam lifting device having two frames one horizontal and another vertical. Finite element analysis of the frames is done on ANSYS software considering the requirement of the textile industries. Machine has been designed to lift the beams in textile industries. The finite element analysis of the frame of this machine is done to get the information of stresses & deformation of the structure in order to modify the same if needed.

M.Abbinay, P.SampathRao,Designandanalysis of an aerial scissor Lift, Aerial scissor lifts are usedor versatile access functions corresponding to maintenance and construction work or by fire-fighters for emergency access, and for varied different functions that distinguishes them from ermanent instrumentality corresponding to elevators. Aerial scissor lifts are designed to lift restricted weights typically less a large amount, though some aerial scissor lifts have a better safe operating load (SWL). The increasing demand and uses of aerial scissor Lifts in industries so as to enhance their producing flexibility and output.

Deepak Rote, Kaustubh Kolhe, Vinit mangaonkar, Vinay shinde, ",Optimisation in Design of Mechanical Scissor Lift", This paper describes the design as well as analysis of a mechanical scissor lift which works on the principle of screw jack. Conventionally, a scissor lift or jack is used in many automobile industries for many applications and also for many material handling operations. The scissor lift can be of mechanical, pneumatic or hydraulic type. This type is separated according to the lifting mechanism used in construction of lift. The lift is selected such that calculation regarding the allowable maximum deflection must not be exceeded. To analyze, solid modeling and computer simulations were involved using CAE software. Several linear static FEA analyses have done to get accurate results. Also these results can be verified by using manual calculations simultaneously. The result shows that the designed component of scissor lift is still in the acceptable range. With such a design of a scissor lift, the complexities in the design can be reduced. With this design process, the manufacturing time of a scissor lift can be reduced. Such a design can be widely used in automobile industries and for production in other industries.

III. PROBLEM STATEMENT

Problems regarding hydraulic scissor lift like job to be lifted are heavier which causes more deformations in hydraulic lift frame which may causes failure at loading points. As loading & unloading is repeated there may be chances of fatigue failure, it is also found that weight of the present lift is high. Vibrations produced by lift during working are also more. Above images shows the failure zones of lift which are taken at workshop.



Fig.3 Failure of Hydraulic Scissor lift due to maximum deformations

IV. CONCLUSION

Static analysis is helpful for understanding and improving the operating performance of the hydraulic scissor lift static and dynamic analysis have very important significance for the life of the specific parts. Specific process will be no longer introduced. This concept of static is followed by number of researches for their application. This review provides the background of hydraulic scissor lift to carried out further research work in same era.

V. FUTURE SCOPE

This device has plenty of scope for modifications for further improvements and for operational efficiency, which should make it commercially available and attractive. Hence, it has various application in industries, hydraulic pressure system for lifting of vehicle in garages, maintenance of huge machines, and for staking purpose. Thus, it is recommended for the engineering industry and for commercial production.

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