

Design and Development of Scissor Type Car Lifter

Dishant Gandhi¹ and Yogesh Dhulugade²

¹UG Student, ²Assistant Professor, Department of Mechanical Engineering,
Sanjay Ghodawat Group of Institutions, Atigre, Maharashtra, India
E-Mail: dhulugade.yn@sginstitute.in

Abstract- Vehicles have always been heavy and requiring regular repairs. That was the necessity behind car lifts' invention. These days, car lifts are an integral part of many garages and repair shops but it's applications are not limited to that, they're also used to raise vehicles for storage in places where ramps are inconvenient or if there are space restrictions. The car lift we are working on is used for raising loaded mini-trucks. The main objective of our project is to design and analyze car lift to fit the given parameters and for doing that, the history and types of car lifts are studied, several research papers are referred to. In case of our lift, it had to be more stable and have a higher capacity so as to lift loaded mini-trucks. The project uses Solid works for design and ANSYS for analysis of the CAD model of the lift. After the design is analyzed, the parts are ordered and the lift is assembled.

Keywords: Car Lift, Hydraulic Lift, Scissor Type, Heavy Duty Lifts

I. INTRODUCTION

Before car lifts were invented, mechanics would often have to deal with cramped and dangerous conditions while working on motor vehicles. They would often use ramps or jacks to lift vehicles and accidents were common. Pits offered a safer option for working on vehicles, but very often these pits did not allow a mechanic to stand comfortably while working on a vehicle. It all changed thanks to the invention of the car lift.

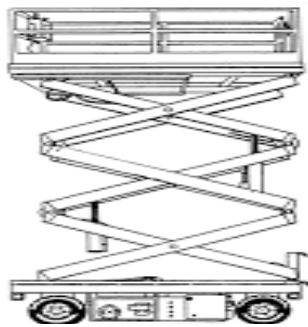


Fig. 1 Scissor Schematic

Scientific developments in the field of hydraulics were vital to the invention of the car lift. In the 17th-century, French mathematician, Blaise Pascal, first described how a hydraulic jack might function. Pascal developed Pascal's Principle, also known as the principle of transmission of fluid-pressure. In laymen's terms, it means that within

closed systems, the pressure exerted on an incompressible fluid will result in equal pressure in all directions.

The first hydraulic car lift was patented in 1925 by Peter Lunati, for lifting vehicles. By 1945, there were many companies making hydraulic lifts for the motor vehicle industry.

Since the invention of the first hydraulic car lift, many other lifts have been patented including the scissors type hydraulic car lift in 1989, a 4-post hydraulic platform vehicle lift for multiple cars in 2000, and an above-the-floor hydraulic lift in 1982.

Hydraulic lifts have been installed by many garages because they are easy to install and safer to use compared to a pit, ramps or jacks. They are much cheaper than digging out a pit for vehicles to drive over.

Car lifts are also useful for providing additional vehicle storage in your home. Many home owners add platform vehicle lifts to their garages so they can store two cars in a one car garage. These Platform car lifts can also be installed into ground excavation to provide even more space for vehicle storage.

II. LITERATURE REVIEW

"Design and analysis of an aerial scissor life" from SSRG-IJME: Vol. 1 Issue 5, September 2014. In this project, they have modelled an aerial scissor lift by using ANSYS software. During the modelling of the components, the material selection is carried out simultaneously based on the design considerations related to loads, etc. The stress and strain concentrations, deformation, have been found by applying certain load on the lift's platform.

"Design and fabrication of mechanical lift for transportation" from GRD Journal for Engineering: Vol. 2 Issue 1, December 2016. This project describes the design as well as analysis of a mechanical scissor lift which works on the principle of screw jack. This design can make the lift more compact and much suitable for medium scale work. In this case, along with lifting a vehicle they are also going to make an effort to move the vehicle to a short distance by incorporating roller mechanism.

“Analysis and optimization of hydraulic scissor lift” from IJEDR: Vol. 4 Issue 4, 2016. The main objective of the devices used for lifting purposes is to make the table adjustable to a desired height. A scissor lift provides most economic dependable & versatile methods of lifting loads; it has few moving parts which may only require lubrication. This lift table raises load smoothly to any desired height. The scissor lift can be used in combination with any of applications such as pneumatic, hydraulic, mechanical, etc. Lift tables may incorporate rotating platforms (manual or powered); tilt platforms, etc., as a part of the design. Scissor lift design is used because of its ergonomics as compared to other heavy lifting devices available in the market.

“Design, manufacturing, and analysis of hydraulic scissor lift” from IJERGS: Vol. 3 Issue 2, 2015. It is found that they are facing some problems regarding hydraulic scissor lift like job to be lifted are heavier which causes more deformations in hydraulic lift frame checking deformations & stresses induced in it is a major objective of this project. It is also found that weight of the present lift is high weight optimization is also prime objective of this project

III. PROBLEM STATEMENT

A car-lift is to be produced which should be stable enough for vehicles to drive on and off it with ease. The lift should be able to support weights as high as 4.5 tonnes with a factor of safety of 1.5 and should be able to raise it to 22 feet. The external dimensions should not be more than 12 feet by 6 feet.

IV. METHODOLOGY

Working on as complicated a project as this, planning is an important part of design and development as the work needs to be divided and executed at the right time.

1. Define objectives and problem statement.
2. Components and description
3. Design and analysis of components.
4. Preparation of drawing.
5. Manufacturing of components.
6. Assembly of components.
7. Validation

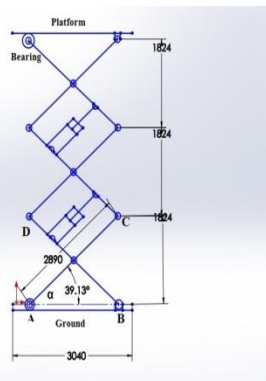


Fig. 2 Scissor Mechanism, Line Diagram

V. RESULTS AND DISCUSSION

A. Design Calculations

1. Find out the angle made by link AC with ground.
 - a. In open condition
 - b. In closed condition
2. Distance travelled by roller at an instance.
3. Choosing no. of hydraulic cylinders.
4. Raw material- MS IS2062

1. Angle Made by Link AC with Ground

In Open Condition

In ΔBAC ,

$$\sin \alpha = (BC/AC)$$

$$\sin \alpha = (1824/2890)$$

$$\text{therefore, } \alpha = 39.13^\circ$$

In Closed Condition

In ΔBAC ,

$$\sin \alpha = (BC'/AC')$$

$$\sin \alpha = (333.33/2890)$$

$$\text{therefore, } \alpha = 6.62^\circ$$

2. Distance Travelled by Roller While Working

In Open Condition

$$\tan \alpha = (BC/AB)$$

$$AB = (1824/\tan(39.13))$$

$$\text{therefore, } AB = 2242 \text{ mm}$$

In Closed Condition

$$\tan \alpha = (BC'/BA')$$

$$BA' = (333.33/\tan(6.62))$$

$$BA' = 2872.10 \text{ mm}$$

3. Distance Travelled by Roller

$$x = BA' - AB$$

$$x = (2872.10 - 2242)$$

$$\text{therefore, } x = 630.10 \text{ mm}$$

4. No. of Cylinders Required

As per the load requirements, available hydraulic cylinders, design of the lift, and the budget, 2 hydraulic cylinders are chosen. They are connected to a power pack which supplies pressurized oil to the cylinders through hoses. Pneumatic cylinders were considered but they are expensive and not very efficient and raised the chances of failure.

B. Total Deformation

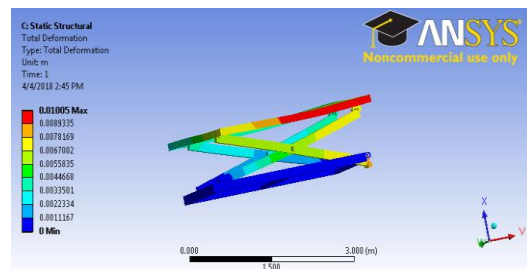


Fig. 3 Deformation in Scissor Lift

C. Capacity Calculation

Hydraulic Power = (Flow rate in gpm × Pressure in PSI) / 1714

Where, Flow Rate of Pump = 5 lpm (Equals to 1.32 gpm)

Pressure in bar = 230 (Equals to 3335 PSI)

Hence, Hydraulic Power = $(1.32 \times 3335) / 1714 = 2.56$ hp

Cylinder output force (pounds) = pressure × cylinder area

= PSI × inch²

= $(50 \times 14.54) \times (27.29)$

= 19842.29 pounds

= 8929.03 kg

= 8.929 Tonn

D. Cylinder Dimensions

Cylinder Bore: Inner diameter- 125mm, Outer diameter- 150mm, Length- 1750mm

Cylinder Pushrod: Diameter- 125mm, Length- 700mm

E. Trial



Fig. 4 Actual Photo, Scissor Type Car Lifter

VI. 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. Ergonomics, material handling and providing comfort to the operator were motive behind developing this lifter. This was considered as a radical improvement in the productivity by the company.

The scissor lift is designed 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.

VII. FUTURE SCOPE

As we have seen, car lifts have a wide range of applications and with the development of newer technology every day, they're becoming cheaper and easier to use. Hydraulic lifts these days are integrated with many manufacturing industries but car lifts are more specialized and hence have a more limited application. They are being used more and more in residential complexes, banquet halls and go downs.

REFERENCES

- [1] Balkeshwar Singh, Anil Kumar Mishra, "Analysis and fabrication of remote control lifting jack", *International Journal of Scientific Engineering and Applied Science (IJSEAS)*, Vol. 1, No. 3, ISSN: 2395-3470, June 2015.
- [2] C. G. Ramachandra, Krishna Pavana, ShivrajShet and Venugopal Reddy, "Design and fabrication of automotive hydraulic jack system for vehicles", *International Journal of Advances in Engineering Research (IJAER)*, Vol. 6, No. 6, Dec. 2013.
- [3] M. M. Noor, K. Kadigama, M. M. Rahman, M. S. M. Sani and M. R. M. Rejab, "Development of Auto Car Jack Using Internal Car Power", *Malaysian Science and Technology Congress, MSTC08*, KLCC, Malaysia, 16-17 Dec. 2008.
- [4] Helmi Rashid, "Design Review of Scissors Lifts Structure for Commercial Aircraft Ground Support Equipment using Finite Element Analysis", *International Symposium on Robotics and Intelligent Sensors (IRIS 2012)*, 2012.
- [5] Jaydeep M. Bhatt and Milan J. Pandya, "Design And analysis of an aerial scissor lift", *Journal of Information Knowledge and Research in Mechanical Engineering*, Vol. 2, No. 2, pp. 452-455, Nov 12-Oct 13.
- [6] Gaffar J. Momin and RohanHatti, "Design, manufacturing, and analysis of hydraulic scissor lift", *International Journal of Scientific Engineering and Applied Science (IJSEAS)*, Vol. 3, No. 2, April 2015.
- [7] Thomas Gomes Jr., "Design, construction, and evaluation of an automotive bridge jack", June 2011.
- [8] Manoj R. Patil and S. D. Kachave, "Time, design, and analysis of scissor jack", *Int. J. Mech. Eng. & Rob. Res.*, Vol. 4, No. 1, Jan. 2015.
- [9] H. Spakman, "Mathematical analysis of actuator forces in scissor lifts", Technical Document 2643, May 1994.
- [10] V. B. Bhandari, "Design of Machine Elements", *Tata McGraw-Hill Publication*, Third edition, pp. 843-858
- [11] [Online] Available at www.hydraulicsscissorlifts.com/catalogues.