



Design & Analysis Of Composite Structure Trolley With Variable Height

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Abstract : This Scissor Lifts are widely used for lifting significant load at required height safely and efficiently. The area of application includes vehicle loading, pallet handling, work positioning, etc. Scissor Lifts come in varied form which can be built to facilitate specialized industrial activities and tasks. They can be driven by hydraulic cylinder, pneumatic sources and also push chains or hydraulic foot pump in case of light load. This paper deals with analysis and optimization of hydraulic scissor lift. CATIA V5R20 is used for modeling purpose, ANSYS 15.0 (Student Version) for analysis work i.e. to check stress, strain, displacement and deformation induced in the system. The main aim is to reduce lift weight by modifying parameters like Link's & platform and replacing supporting link of cylinder ultimately reducing the cost. This is done by utilizing metal composite structure such as Triangular, Circular, Flat plate etc.

I. INTRODUCTION

Any machine part in order to move to desired location requires a component which should move in horizontal or vertical direction to place it at desired position at required height. Thus for loading and unloading purpose scissor lift is used which is portable machine that can be easily extended or compressed for transportation of the component to its expected position. Scissor lift is a machine that has vertical with criss- cross „X“ pattern scissor arms .Among its classified types are hydraulic, pneumatic and mechanical scissor lift. Hydraulic scissor lifts are used very popularly due to their ability to bear heavy load operations. The main components of scissor lift are bottom and top frame, scissor arm, link connector and cylinder. Hydraulic scissor lift is a vertical transportation cab which can be raised or lowered by using hydraulic actuator. The concept of hydraulic scissor lift comes from Pascal's Law applied to the hydraulic ram which states that “The pressure exerted by incompressible fluid anywhere is transmitted equally in all directions throughout the fluid such that its pressure ratio remains the same.

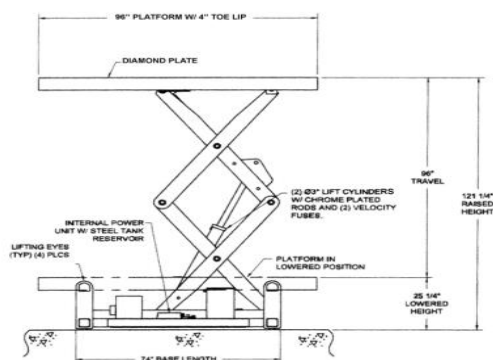


Fig.1 Principle of operation

Sandwich panels or structures with top and bottom plates as well as the core made up of steel are called steel sandwich Panels or structures. The core structures which are divided into different types i.e. I core, O- core with rectangular beams, Vf/V- core with hat or corrugated sheets as a core, web core, round O-core and X core with two hats as a core as shown in Figure 1. In this paper Rectangular composite structure have two plates i.e. top and bottom side of plates are made from mild steel material and core which is made up of glass fiber reinforced polymer (E-glass/epoxy).

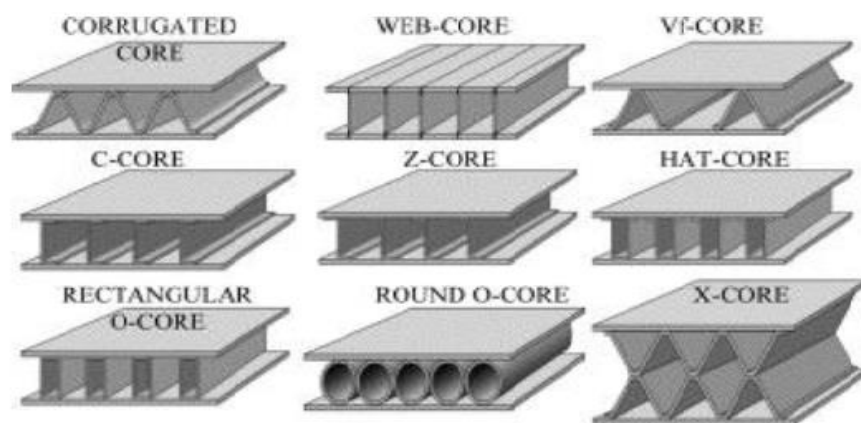


Fig.2 Different steel sandwich structure with various cores.

II. LITERATURE SURVEY

Ghangale Prashaletal., described the design and analysis of hydraulic scissor lift. Lift was needed to be designed portable and also work without consuming any electric power therefore cylinder was actuated by using hydraulic hand pump. Also such design can make much suitable for medium scale work.

Sabde Abhijit Manohar raoetal., investigated the problem at DS Engineers regarding hydraulic scissor lift. It was found that job to be lifted is heavier which causes more deformations in hydraulic lift frame hence, checking deformations & stress induced in it was the major objective of this project. Also weight of the lift was high so weight optimization was prime objective of this project. As loading & unloading is repeated there were chances of fatigue failure so life of lift was checked. Thus Design & Analysis of the Hydraulic lift that should with stand maximum load without failure in working conditions and checking vibration of hydraulic lift during working time by modal analysis was carried out.

Gaffar G. Mominetal., in the paper "Design manufacturing and analysis of hydraulic scissor lift" Has described the design and analysis of hydraulic scissor lift. In this paper they have provided the brief description of different parts of hydraulic scissor lift and the material used for that part as per the mechanical properties of that material like ductility, strength, toughness, hardness etc. Also they have discussed all the design concepts for the different parts of the lift. Then the analysis were carried out by using Ansys software in which parameters like Deformation, Von misses stress, Shear stress were analysed. Thus they have done the design and fabrication of hydraulic scissor lift including Ergonomics, Material handling as well as comfort.

P S K Narasimha Murthy etal., has done modelling and analysis (Linear Static) of a scissor lift which is carried out using Solid Works. Whenever a load is applied on the top of the platform, every post leg of the lift is subjected to displacement, stress, and strain. In this project result of the displacement, stress and strain values, and their Behaviour are tabulated.

Structural Design and Experimentation of Wheeled Home Monitoring Robot with the Obstacle Performance (Intelligent Machine Institute, Harbin University of Science and Technology, Harbin 150080 China.)

Nowadays, due to the increasing pressure of life, people always need for work away on business, so that no one in the state long-term care home, the chance of catch fire, gas leaks and other problems occur increased. In addition, the trend of population aging, empty nesters phenomenon is particularly prominent. Based on the above reasons, people for home monitoring robot needs more and more intense, a variety of home robots emerged.

III. METHODOLOGY

3.1 Design of Machine:-

In our attempt to design a special purpose machine we have adopted a very a very careful approach, the total design work has been divided into two parts mainly;

Mechanical design

System design mainly concerns with the various physical constraints and ergonomics, space requirements, arrangement of various components on the main frame of machine no of controls position of these controls ease of maintenance scope of further improvement; height of m/c from ground etc.

In Mechanical design the components are categories in two parts.

- **Design parts**
- **Parts to be purchased.**

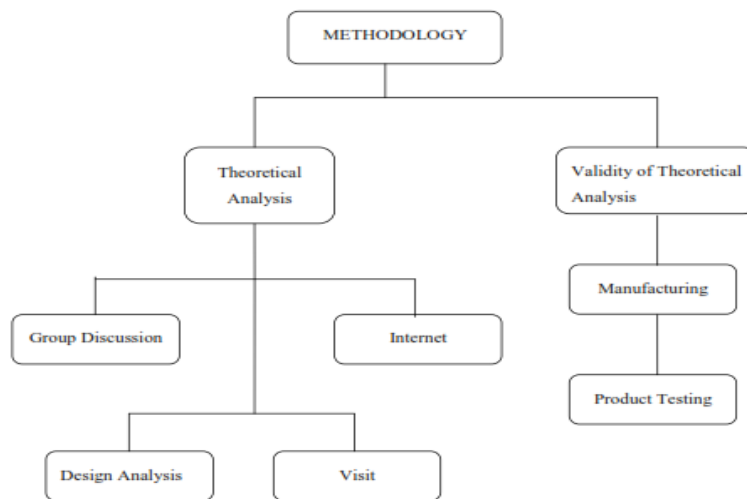


Fig.3 Methodology

3.2 Flow Chart

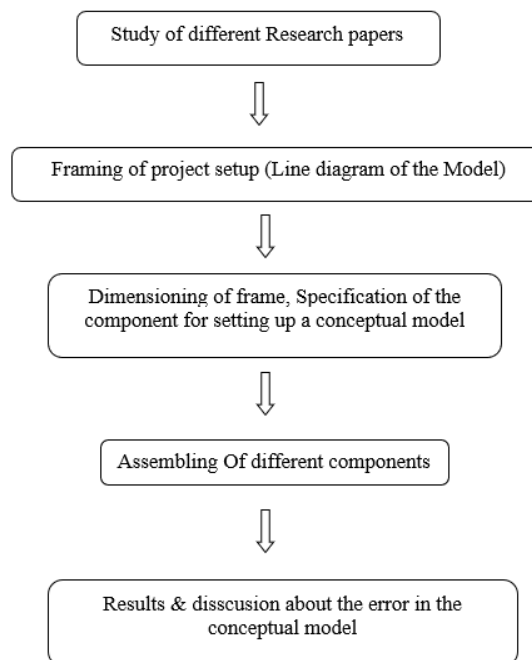


Fig.4 Flow Chart For Working Process

IV. DESIGN AND CYLINDER

Considerations made during the design and fabrication of a single acting cylinder was as follows: research paper Cylinder (07)

- Functionality of the design
- Manufacturability

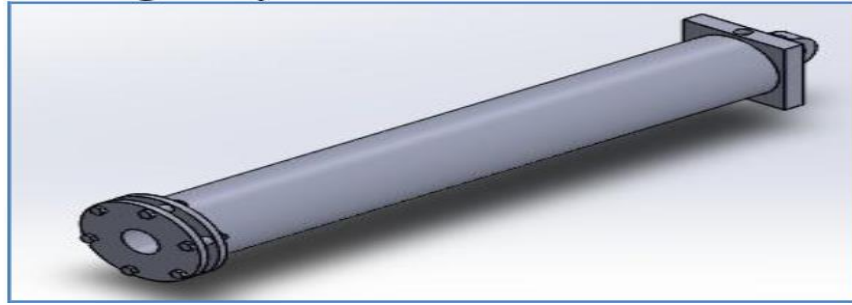


Fig.5 Hydraulic Cylinder(Design)

Structure diagram of guide disc hydraulic clamping mechanism of cylinder

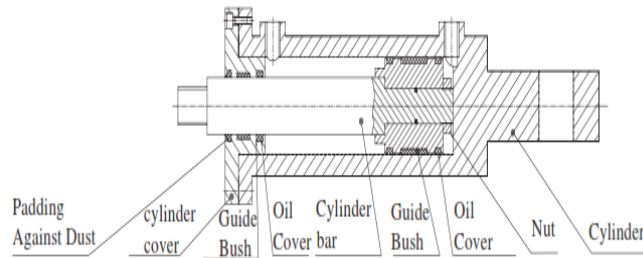
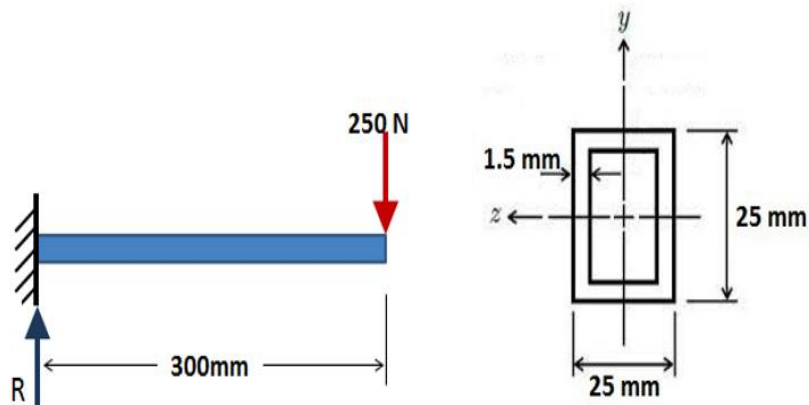


Fig.3. Structure diagram of guide disc's hydraulic clamping mechanism on oil cylinde

4.1 Cantilever Beams at square section



- Load(W) = 250N
- Member Length(L) =300 mm
- Thickness(T) = 1.5 mm
- The distance from the neutral axis (y) =12.5 mm
- Width (B) = 25 mm
- Depth (D) = 25 mm

For Circular hollow section

$$I = \frac{BD^3}{12} - \frac{bd^3}{12}$$

$$y_{max} = \left(\frac{D}{2}\right)$$

$$Z = \frac{1}{6D} [BD^3 - bd^3]$$

$$I = \frac{25 * 25^3}{12} - \frac{22.5 * 22.5^3}{12}$$

$$I = 390625 - 256289.0625$$

$$I = 11419.6614$$

$$Y = 12.5 \text{ mm}$$

$$M_A - 250 * 300 = 0$$

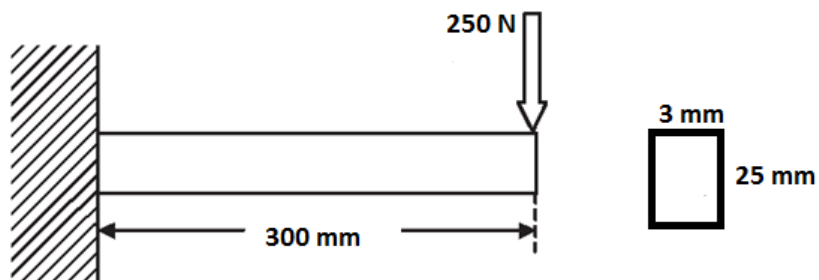
$$M_A = 75000 \text{ N.mm}$$

$$\sigma = \frac{My}{I}$$

$$\sigma = \frac{75000 * 12.5}{11419.6614}$$

$$\sigma = 82.09 \text{ N/mm}^2$$

Simple Cantilever Beams:

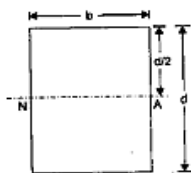


For flat plate section

$$I = \frac{bd^3}{12}$$

$$y_{max} = \frac{d}{2}$$

$$Z = \frac{bd^2}{6}$$



V. SYSTEM CAD 3D/2D DESIGN

5.1 3D Design using CATIAV5R20

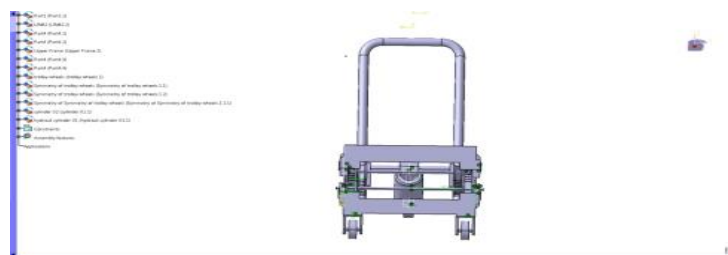
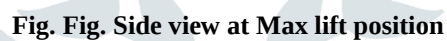
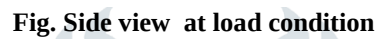
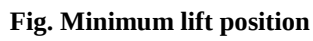


Fig. Front View



5.4 Design calculations

Design import in Ansys software to calculate the weight of scissor lift

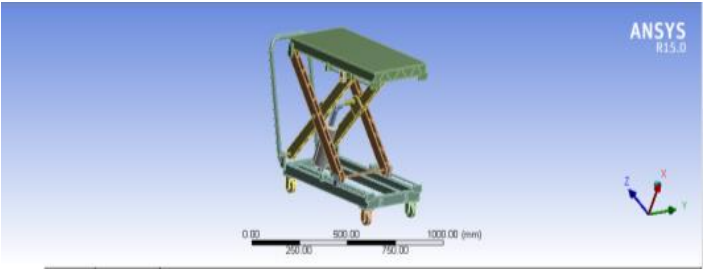


Fig. 7.1 Weight of scissor lift Comes to almost 72 Kg.

Properties	
Volume	9.1768e+006 mm ³
Mass	72.038 kg

Checking the design safety for load capacity of 150 kg/ 1500N

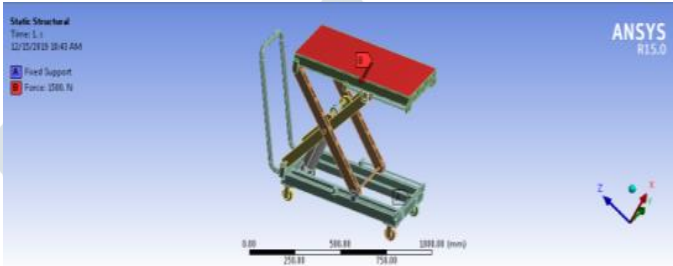


Fig. Loading Conditions

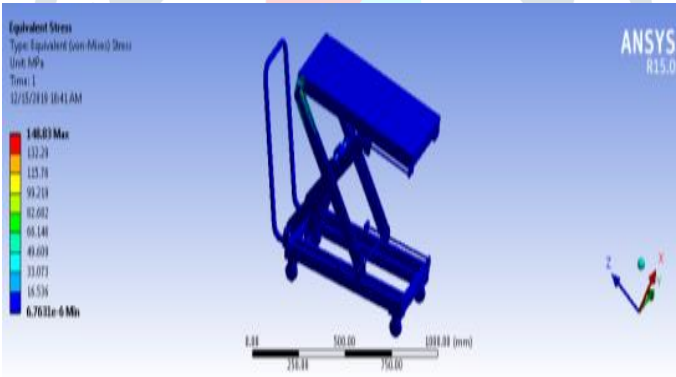
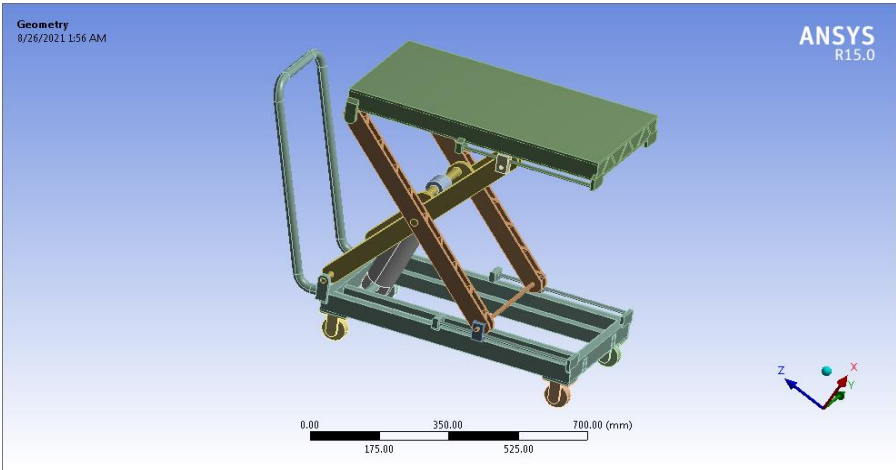


Fig. Stress induced in lift

5.5 Results for load 1550 are as follow



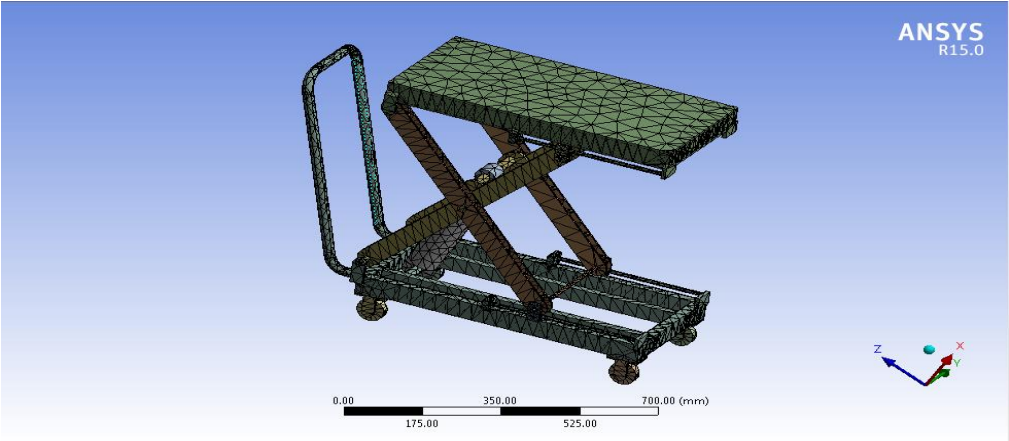


Fig. Meshing

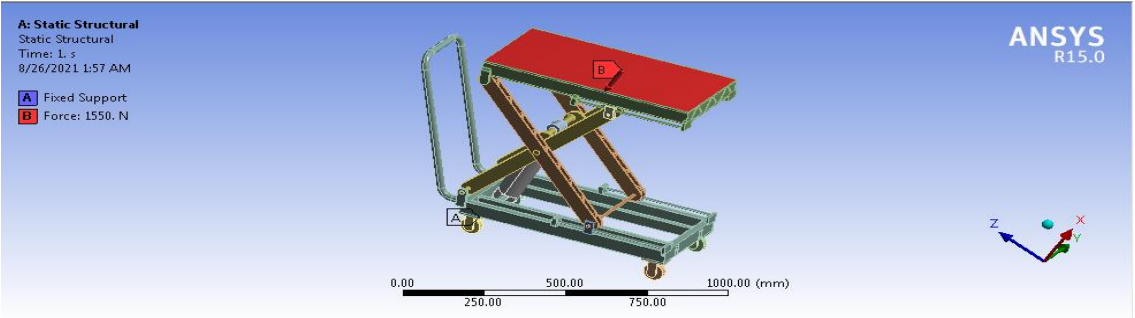


Fig. Boundary Condition induced in lift

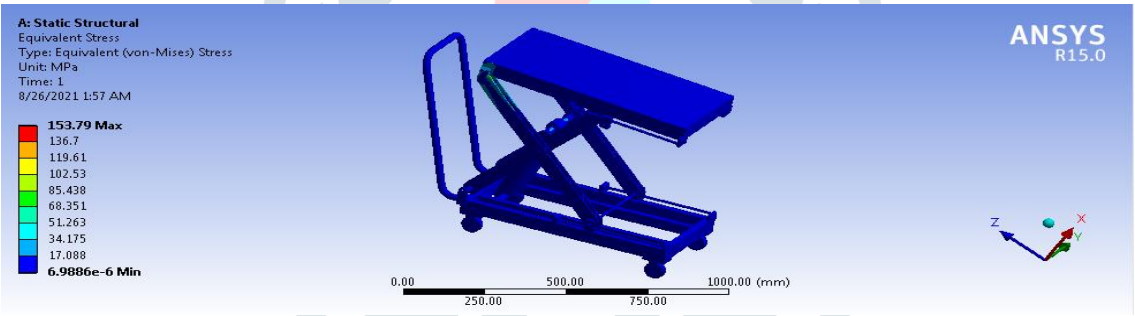


Fig.7.6 Stress induced in lift

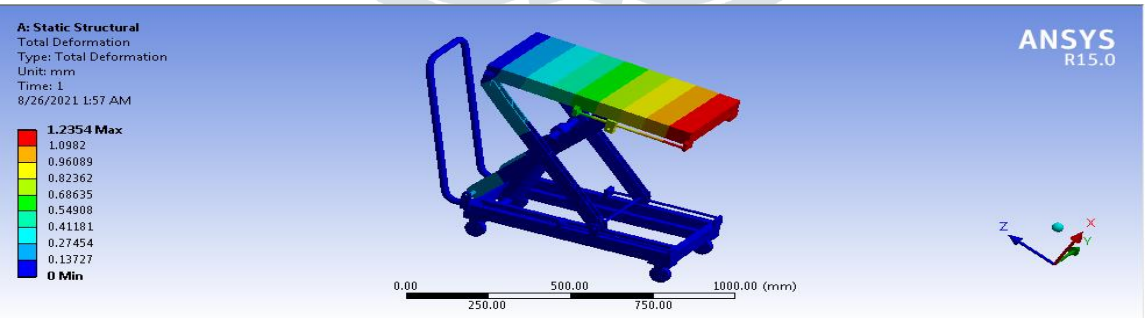
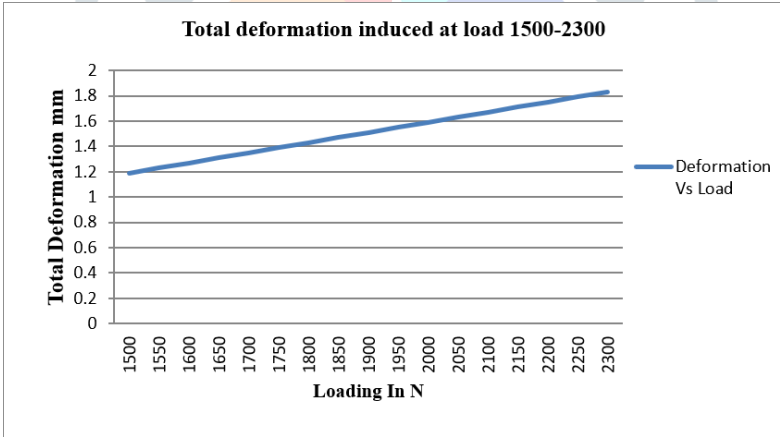


Fig. Deformation induced in lift

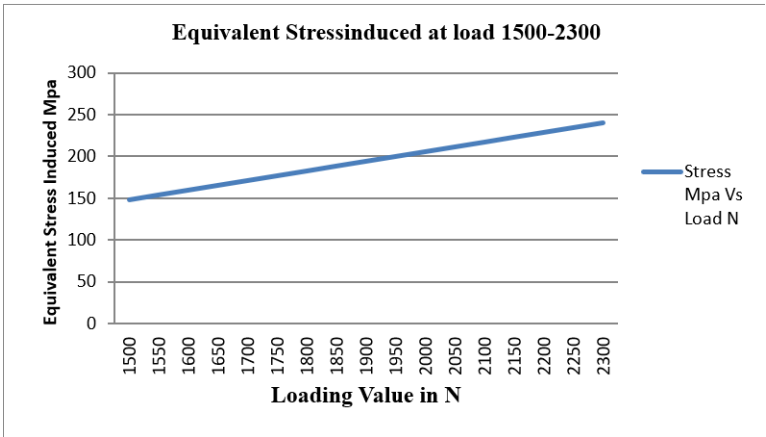
5.6 Tabulated Results at loading condition From 1500-2300 N

LOAD	Stress	Deformation
1500	148	1.19
1550	153.79	1.23
1600	159.58	1.27
1650	165.37	1.31
1700	171.16	1.35
1750	176.95	1.39
1800	182.74	1.43
1850	188.53	1.47
1900	194.32	1.51
1950	200.11	1.55
2000	205.9	1.59
2050	211.69	1.63
2100	217.48	1.67
2150	223.27	1.71
2200	229.06	1.75
2250	234.85	1.79
2300	240.64	1.83

5.7 Graphical presentation of Total deformation induced at load 1500-2300



5.8 Graphical presentation of Stress induced at load 1500-2300



VI. CONCLUSION

The weight of the Scissor Lift has been reduced up to 45 kg which resulted in 29% weight reduction. The stability of lift is not affected even though link connectors were removed as rods were introduced as support between two links and the displacement values obtained for both the lifts are same. The moment loading check has been done for Existing as well as Optimized Lift and we can infer that the stress values are within allowable limit. So we can say that the lift is safe in case of eccentric loading.

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