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[Shailendra et al. , 3(4), April 2018]

ISSN : 2455-9679
Impact Factor : 2.015

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INTERNATIONAL JOURNAL OF RECENT TECHNOLOGY SCIENCE & MANAGEMENT

"DESIGN AND ANALYSIS OF SCISSOR LIFT BY USING FEA METHOD THROUGH ANSYS"

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ABSTRACT

This project is mainly focused on force acting on the hydraulic scissor lift when it is extended and contracted. Generally, a hydraulic scissor lift is used for lifting and holding heavy weight components. Material selection plays a key role in designing a machine and also influence on several factor such as durability, reliability, strength, resistance which finally leads to increase the life of scissor lift. The design is performed by considering hydraulic scissor lift as a portable, compact and much suitable for medium type of load application. Design of hydraulic system scissor lift is done using CATIAV5R20 with suitable modeling and imported to ANSYS V18.1 for analysis. Hence, the static analysis of the scissor lift includes total deformation load, Equivalent stress, force, weight was done in ANSYS and all responsible parameters were analyzed in order to check the compatibility of the design value. The computational values of three different materials such as Carbon fiber, structural steel and Aluminium Alloy are compared for best results.

Keyword*: Hydraulic scissor lift, CATIA, ANSYS, Total deformation load, Equivalent stress, Static analysis*

I. INTRODUCTION

Scissor lifts are typical one of the vertical lifting equipment portable elevating work platforms . Scissors lift can be used indoor or outdoor with a considerable extensive space Their primary function is to elevate workers, tools, and materials to a desired working height, while allowing the operator to control the movement and position of the lift. Compared with conventional methods of lifting, scissor lift greatly reduces the psychological stress and physical demands on a worker at elevated height. Therefore, if a scissor lift is properly designed, manufactured, maintained, and appropriately used, it can increase not only the workers' productivity but also their safety. For these reasons, scissor lifts with different capacities and elevating heights are increasingly used at many workplaces. A scissor lift is a portable, easily extended and compressed, safe operating machine used for transportation of medium sized components to its expected position. A scissor lift is machine which moves in vertical direction using criss-cross 'X' pattern scissor arms. The required elevation of the lift is achieved based on

1.1 Types of Scissor lift

The scissor lifts can be classified as follows:

- Hydraulic lifts
- Pneumatic lifts
- Mechanical lifts

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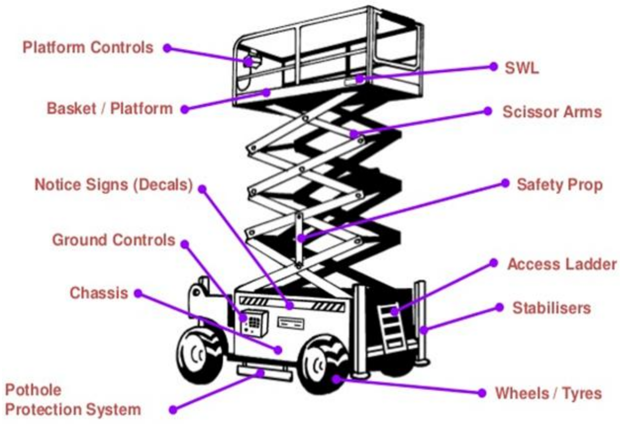

Fig. 1.1 Lift Machine

II. METHODOLOGIES

Deflection in scissors lifts can be defined as the change in elevation of all parts to the original size of entire assembly i.e from the floor to the top of platform deck, whenever loads are applied to or removed from the lift. Each component within the scissors lift has the potential to store or release energy when loaded and unloaded. Deflection takes place in all parts of scissor lift i.e Scissors Legs, Platform Structure, Base Frame, Pinned Joints**.** To reduce stresses and deflection in scissor lift the load should transfer equally between the two scissors arm pair. Base frames should be attached to the surface on which they are mounted.

2.1 Material Selection

Material selection plays a very important role in machine design. Three metals are considered for the analysis of scissor lift is Carbon fiber structural steel and Aluminium Alloy

2.2 Structure Steel Mechanical properties

Properties as follow in Table-1

Table-1 Mechanical properties structure steel

Material Field Variable	Value	Units
Density	7850	Kg/m³
Young's modulus	2E+05	Mpa
Poisson Ratio	0.30	
Shear modulus	76923	Mpa
Bulk Modulus	1.6667E +05	Mpa
Tensile Yield Strength	250	Mpa
Compressive Yield Strength	250	Mpa
Tensile Ultimate Strength	460	Mpa
Compressive Ultimate Strength	0	Mpa

Table-2 Mechanical properties Aluminium alloy

Material Field Variable	**Value**	**Units**
Density	7750	Kg/m³
Young's modulus	1.93E+05	Mpa
Poisson Ratio	0.31	
Shear modulus	76664	Mpa
Bulk Modulus	1.6937E+05	Mpa
Tensile Yield Strength	207	Mpa
Compressive Yield Strength	207	Mpa
Tensile Ultimate Strength	310	Mpa
Compressive Ultimate Strength	0	Mpa

2.3 Aluminium Alloy materials Mechanical properties

Properties are shown in Table-2

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2.4 Carbon Fiber materials Mechanical properties

Table-3 Mechanical properties Carbon Fiber

Material Field Variable	Value	Units
Density	1950	Kg/m³
Young's Modulus	300000	MPa
Poisson Ratio	0.30	
Tensile Strength	5090	MPa
Compressive strength	1793	MPa

III. FINITE ELEMENT METHOD

By using CATIAV5R20, modeling of scissor lift was done and then it was imported to Ansys18.0 for the analysis of scissor lift. The goal of meshing in ANSYS Workbench is to provide robust, easy to use meshing tools that will simplify the mesh generation process. In this hydraulic scissor lift automation meshing is applied and complete analysis of scissor lift was done.

IV. MODELING

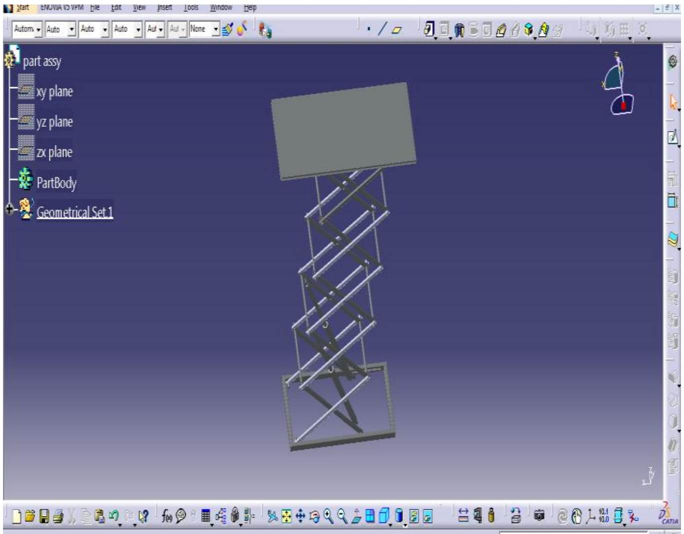

Fig.2 Scissor lift 3D model on CATIA software

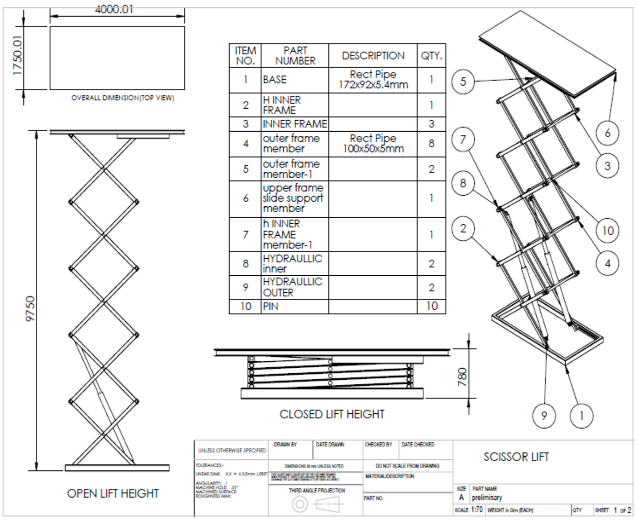

Fig.3 Scissor lift 2D layout

4.1 Scissor lift Specification

Table 4 Lift Specification

S.No.	Particulars	Dimensions
1	Scissor lift closing height	780mm
2	Scissor lift open height	9750mm
3	Loading capacity of scissor lift	680kg

4.2 Simulation

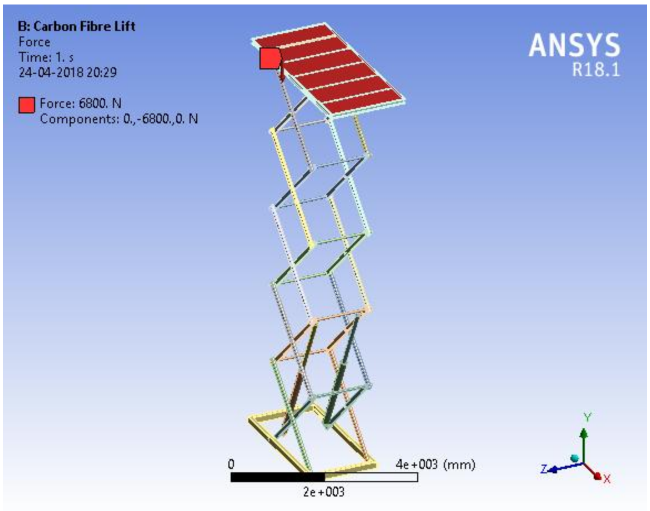

Fig.4 Boundary conditions Carbon Fiber

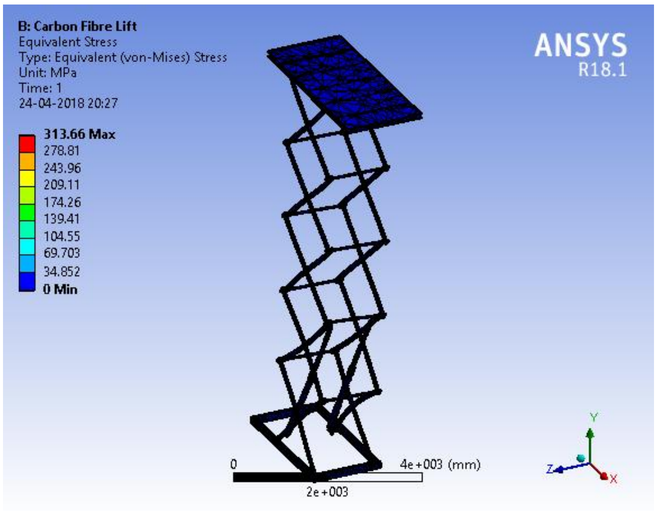

Fig.5 Von misses stresses value in carbon fiber

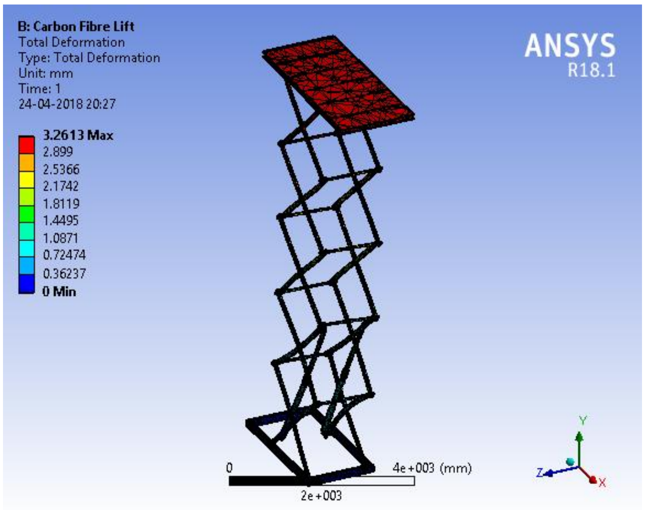

Fig.6 Deformation value in carbon fiber

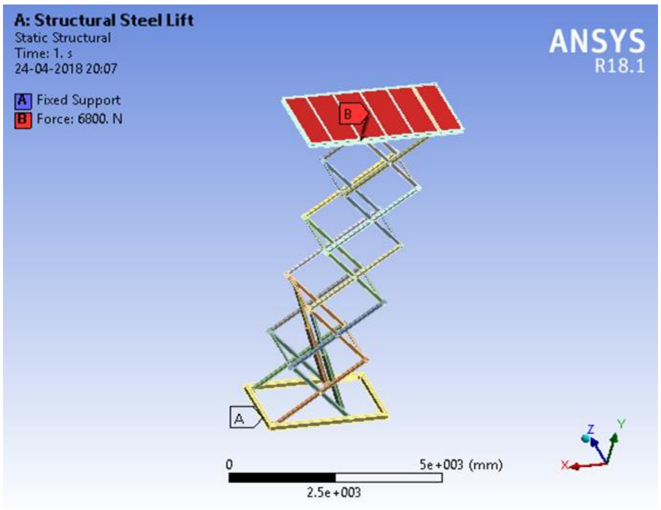

Fig.7 Boundary conditions for Structural steel

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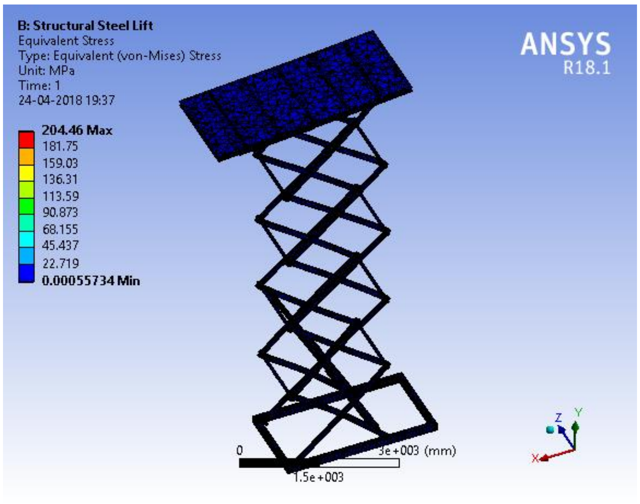

Fig.8 Von misses stresses value in Structural

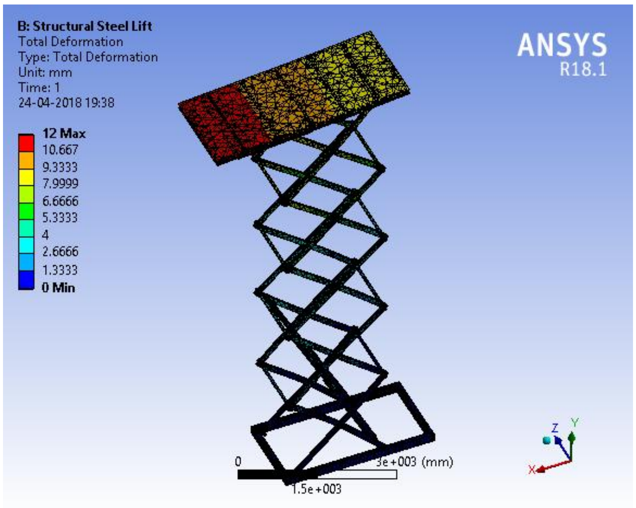

Fig.9 Deformation value in Structural Steel

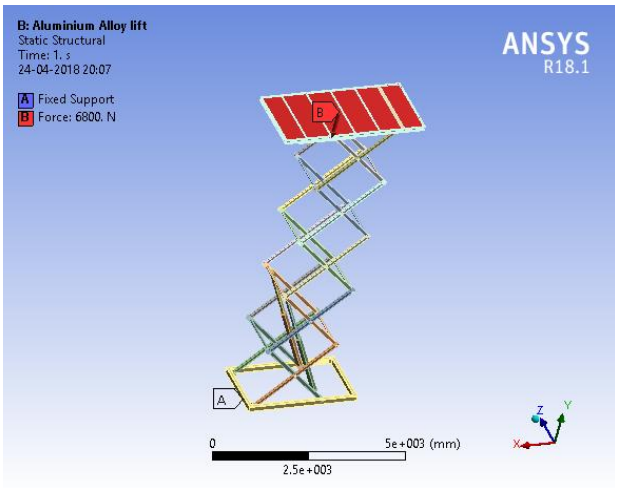

Fig.10 Boundary conditions for Aluminium Alloy

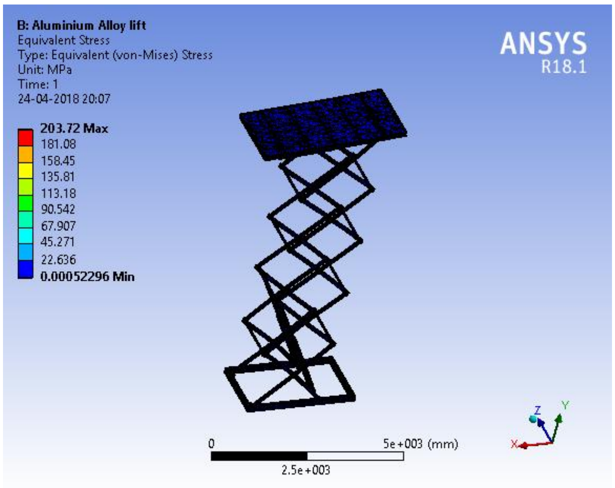

Fig.11 Von misses stresses value in Aluminium alloy

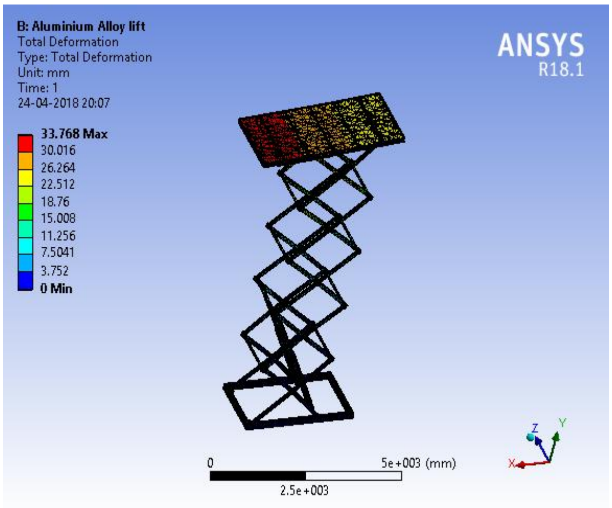

Fig.12 Deformation value in Aluminium Alloy

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V. RESULT & DISCUSSION

The maximum deformations induced in Carbon fiber hydraulic lift is 3.26 mm, Structural Steel deformation is 12mm and Aluminum Alloy deformation 33.76 mm. If we compare corresponding deformations in Carbon fiber 3.26 mm which has less deformation. The equivalent stress induced for two materials respectively structure steel and Aluminium is almost same i.e. 204.46 Mpa, 203.72 Mpa which is less than the Carbon fiber stress 313.66Mpa.

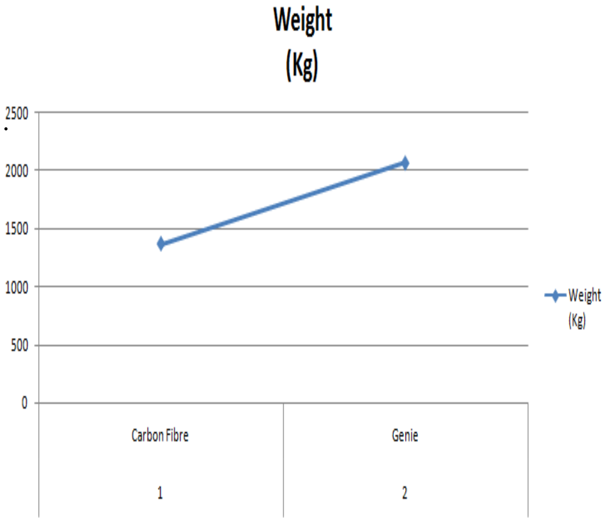

Fig.12 Weight comparison charts

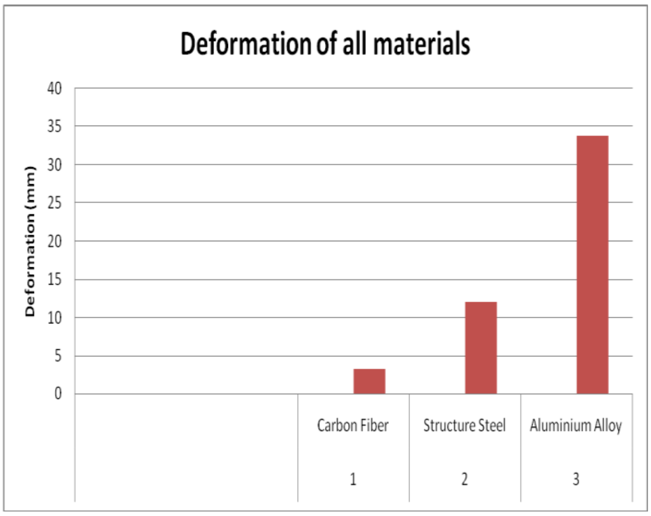

Fig. 13 Deformation comparison charts

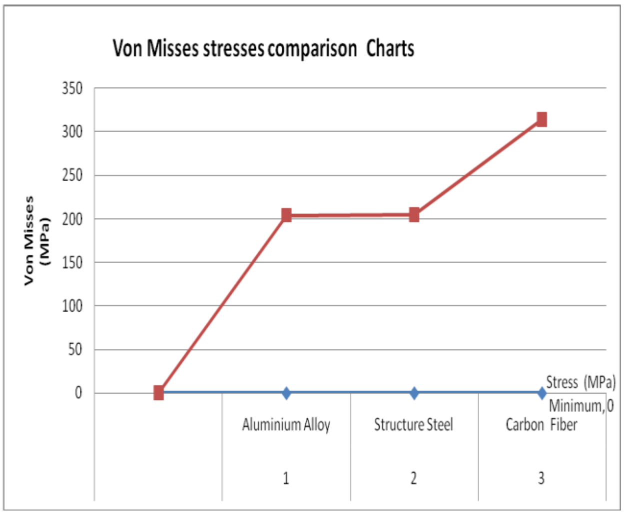

Fig. 14 Von misses stress comparison charts

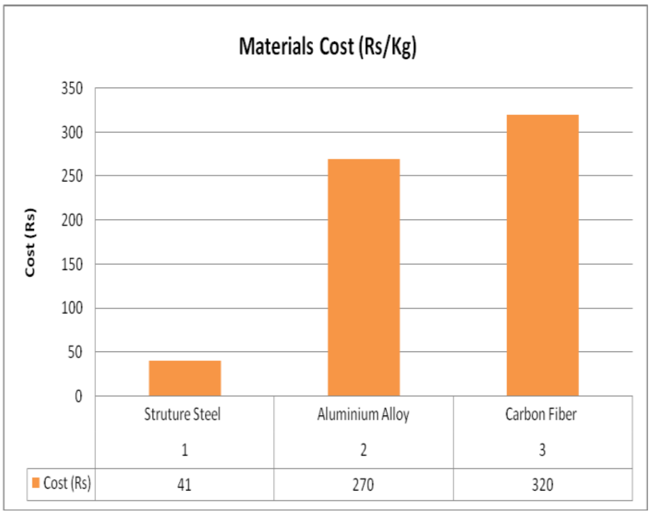

Fig. 15 Cost comparison charts

VI. CONCLUSION

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. 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.

ISSN : 2455-9679
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VII. FUTURE SCOPE

From all the experimental analysis performed, it can be seen clearly seen that Carbon fiber material has extremely lower weight than other conventional materials being use for manufacturing of scissor lift. We can used our equipments in maintenance work.

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