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"DESIGN AND OPTIMIZATION OF PORTABLE HYDRAULIC SCISSOR LIFT BY USING FEA METHOD"

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ABSTRACT

This project is mainly focused on the design as well as analysis of hydraulic scissor lift when it is extended and contracted. A hydraulic scissor lift is used for lifting and holding heavy weight components at required height. Material selection plays a major role in designing a machine and also influence on several factor such as durability, reliability, strength, resistance, maintenance which increases 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. Drafting & drawing of hydraulic system scissor lift is done on solid works with suitable modeling and imported to Ansys work bench for meshing and analysis. Hence, the static analysis of the scissor lift includes Total deformation load, Equivalent stress, 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 Epoxy E glass fiber, Structure steel and stainless steel are compared for best results.

KEYWORD: A*erial Hydraulic scissor lift, solid works, Ansys work bench, 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 the number of criss-cross 'X' pattern scissor arms attached. The scissor lift mechanism is based on linked arms in a criss-cross 'X' pattern which can be folded and extended in exact

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direction similar to a pantograph. 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 upwards. The platform may also have an extending 'bridge' to allow closer access to the work area.

1.1 Types of Scissor lift

The scissor lifts can be classified as follows:

- Hydraulic lifts
- Pneumatic lifts
- Mechanical lifts

II. METHODOLOGY

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 epoxy e glass fiber structural steel and stainless steel.

2.2 Structure Steel Mechanical properties

Table- 1

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

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2.3 Stainless Steel Mechanical properties

Table- 2

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	586	Mpa
Compressive Ultimate Strength	0	Mpa

2.4 Epoxy E Glass Fiber Mechanical properties

Table- 3

Material Field Variable	Value	Units
Density	2.6e-6	Kg/m3
Young's modulus	85000	Mpa
Poisson Ratio	0.23	
Shear modulus	36000	Mpa
Bulk Modulus	50000	Mpa
Tensile Strength	2050	Mpa
Compressive Strength	5000	Mpa

III. FINITE ELEMENT METHOD

By using solid works, modeling of scissor lift was done and then it was imported to Ansys17.0 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.

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IV. MODELING

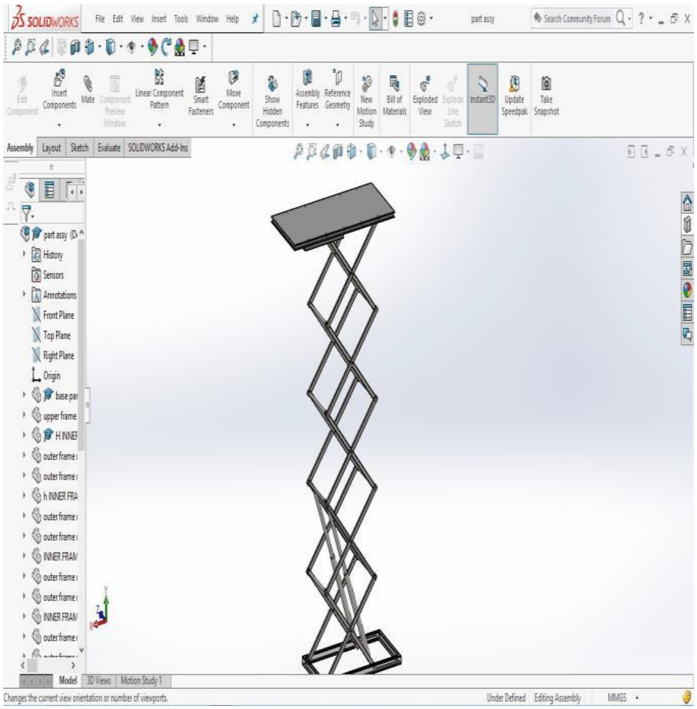

Fig.1

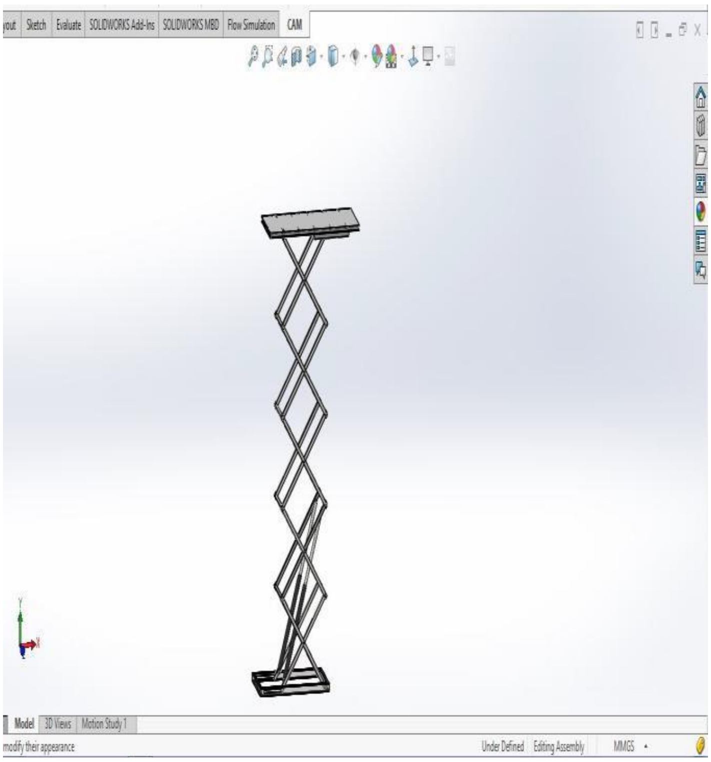

Fig.2

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4.1 Scissor lift Specification

Table.4

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

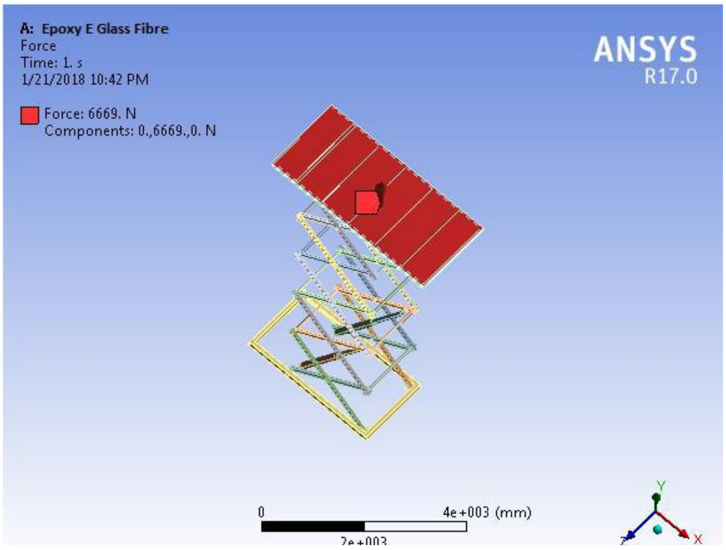

Fig.3

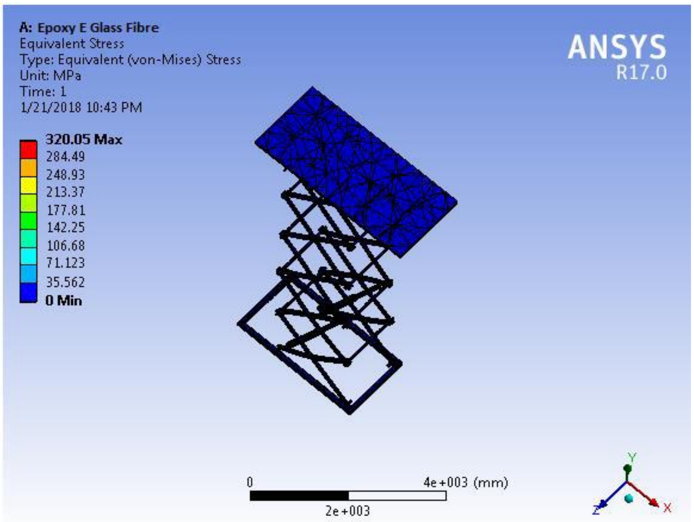

Fig.4

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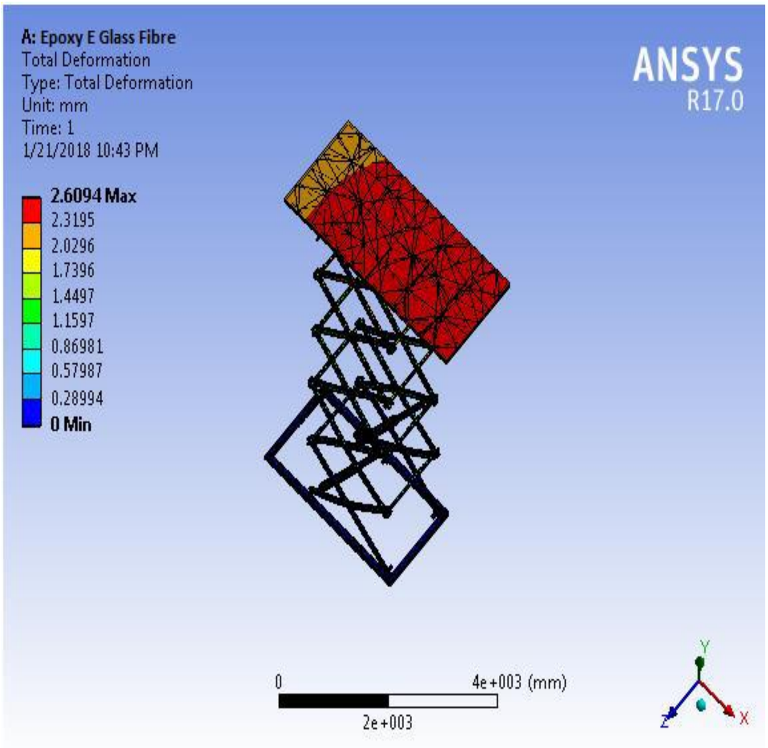

Fig.5

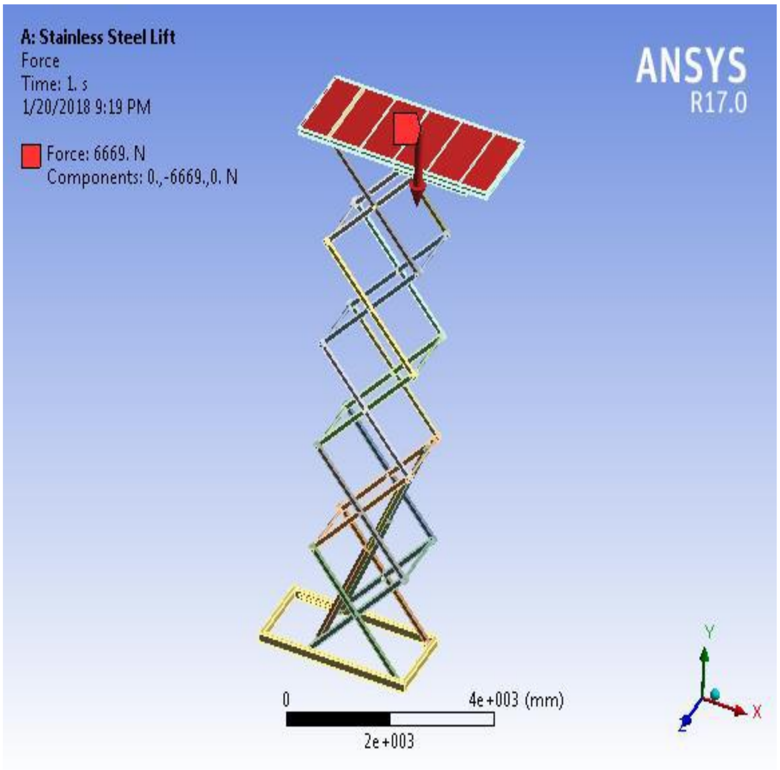

Fig.6

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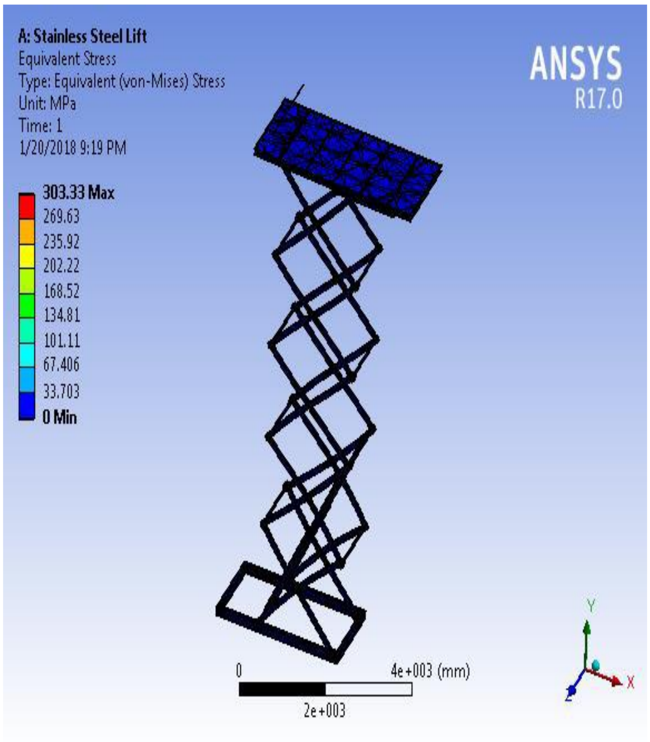

Fig.7

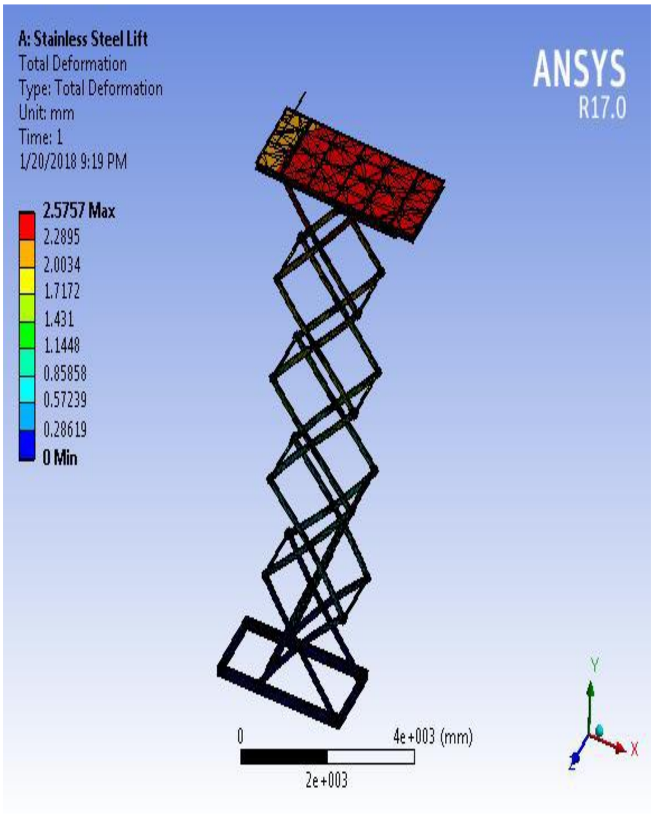

Fig.8

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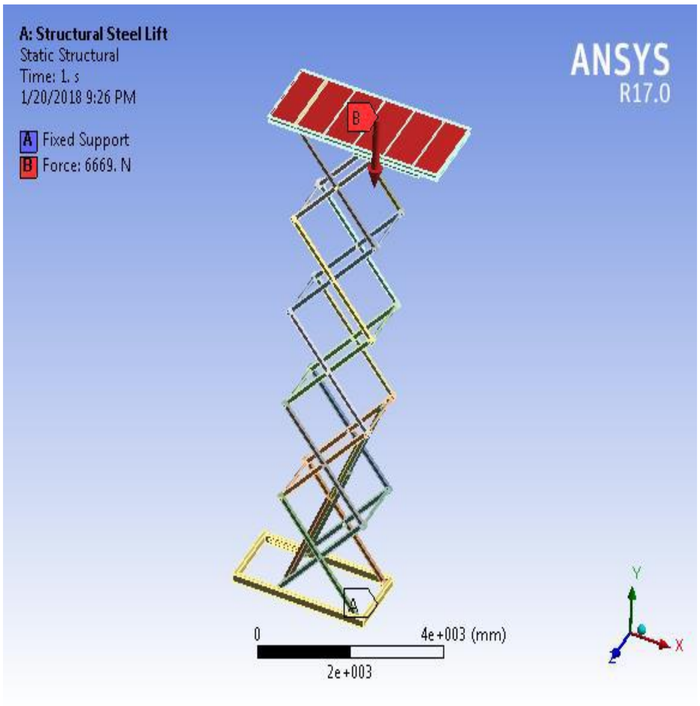

Fig.9

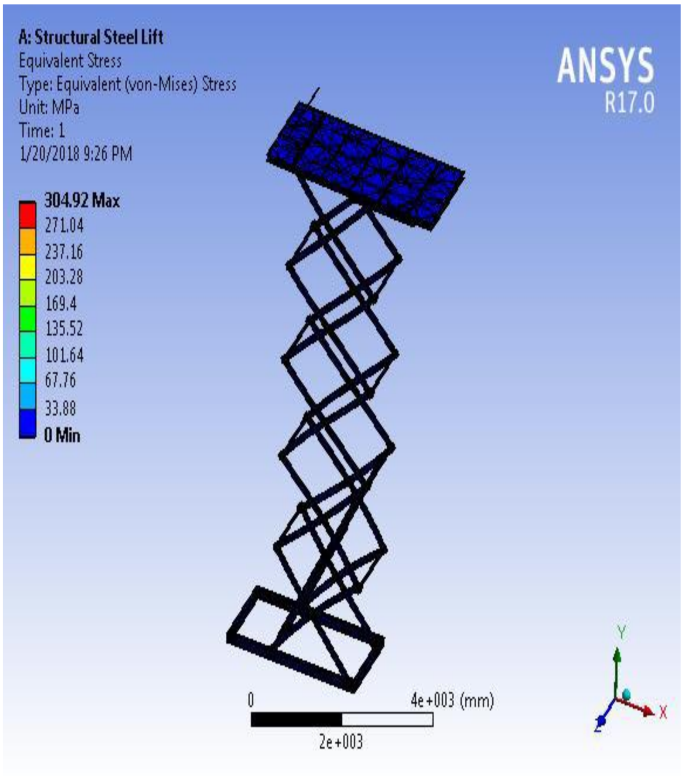

Fig.10

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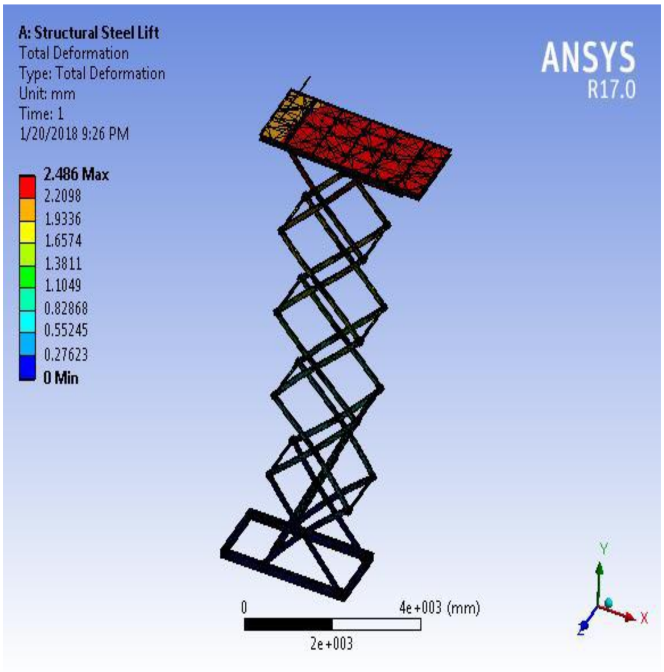

Fig.11

IV. RESULT & DISCUSSION

The maximum deformations induced in epoxy E glass fiber hydraulic lift is 2.60mm, which is in safe limits (1% of total span). Hence based on rigidity the design is safe, but if we compare deformations induced in Stainless Steel 2.57 mm. If we compare corresponding deformations in structure steel it is 2.48 mm which has less than other two materials. The equivalent stress induced for three materials is 320.05Mpa, 303.33 Mpa, 304.92 Mpa epoxy e glass fiber, stainless steel and structural steel respectively which is less than the allowable stress. Hence the design is safe based on strength. On optimization it is clear that Structure steel lift shows good results as compared to other two lift, hence Structure steel lift is suggested for manufacturing to said industry.

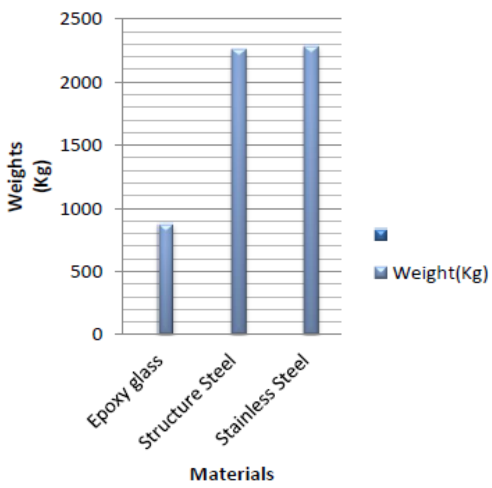

Fig.12

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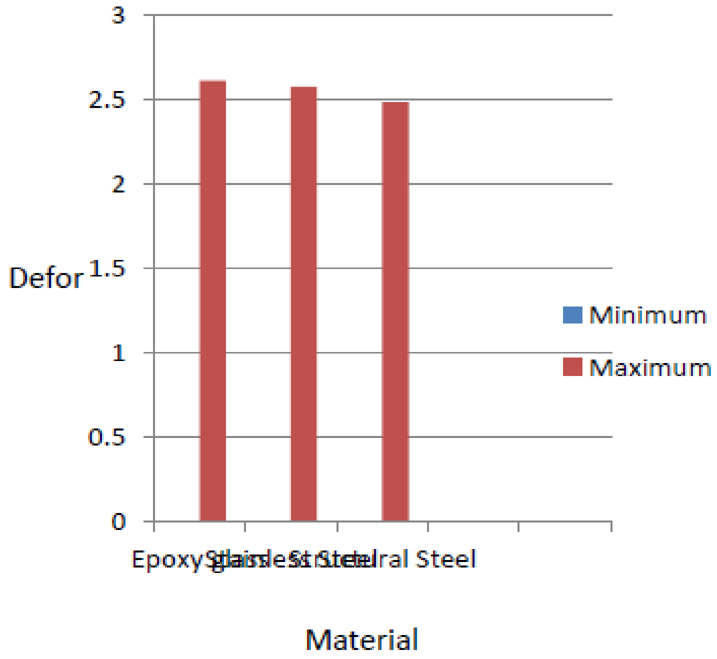

Fig. 13

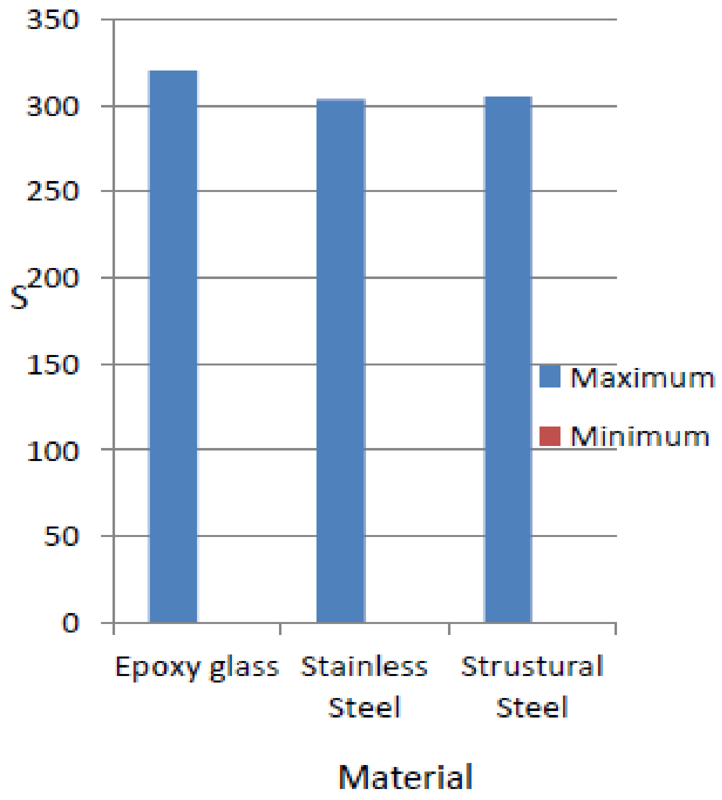

Fig. 14

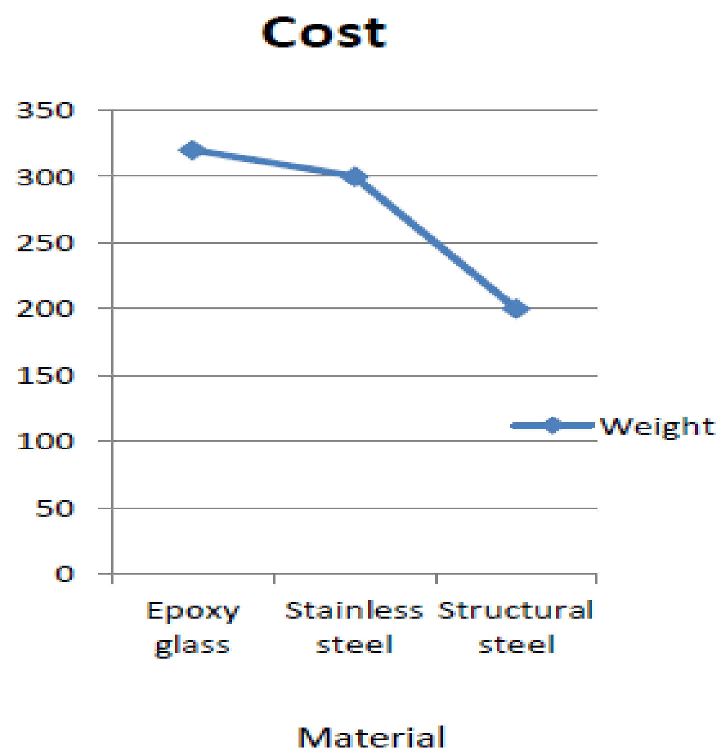
Cost
350
300
250
200
150
100
50
0
Weight
Epoxy glass
Stainless steel
Structural steel
Material

Fig. 15

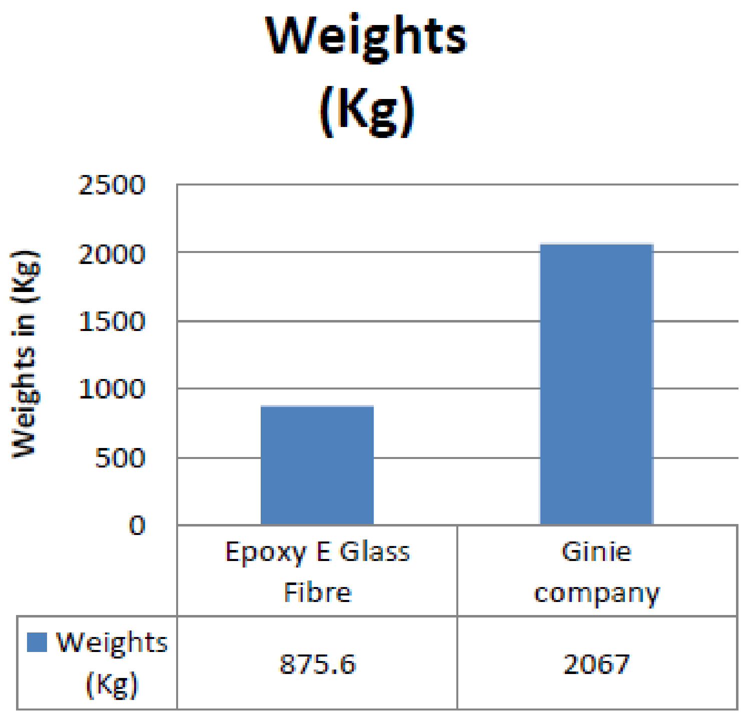
Weights (Kg)
Weights in (Kg)
2500
2000
1500
1000
500
0
Epoxy E Glass Fibre
Ginie company
Weights (Kg)
875.6
2067

Fig.16

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V. 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 which is operated by a motor. 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. 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.

VI. FUTURE SCOPE

This device affords plenty of scope for modifications for further improvements and operational efficiency, which should make it commercially available and attractive. Hence, its wide 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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