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# DESIGN AND FABRICATION OF ELECTRO MECHANICAL LADDER

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## INTRODUCTION

Nowadays, ladder becomes the common facilities for human. Different types of ladders are available in worldwide market such as fixed ladder, extension ladder, step ladder, orchard ladder and others. The main purpose of electro mechanical ladder is to help human to do their work especially at the high place that can't be reached and help them to keep it without using a large space. It can reduce time, increase efficiency and reduce space to store. However, the existing ladders are either highly costly or bulky. Each one has its own disadvantages which makes them unsatisfactory. The electromechanical ladder we designed and fabricated can eliminate the dis-advantages of the conventional ladders. Our aims at the design and fabrication of an Electro Mechanical Ladder for the purpose of using it in small scale industries, domestic areas etc. The principle used here is that of a scissor lift which will raise loads to heights, in our the scissor lift is being raised with the help of a lead screw which is coupled to an electric motor (low speed high torque motor). Also, this device is likely to be used in domestic purposes such as in houses, small paper mills etc.

A problem remains a problem until a solution is proffered. With the limitations encountered in the use of ropes, ladders, scaffold and mechanical scissors lifts in getting to elevated height such as the amount of load to be carried, conformability, time consumption, much energy expended etc., the idea of Electro Mechanical Ladder which will overcome the above stated limitations. These electric mechanical ladder is foldable, portable and easy to use. It can be fabricated in many sizes and design to make customer to choose which one is more suitable for them. From the advantages and disadvantages of the ladder in the worldwide market, one new product design can be created. For jobs such as changing of tube lights, painting of buildings and walls around the houses, schools etc. This reviews all the studies up to this date and hope our product will get optimum acceptance in the market.

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## OBJECTIVE

The is aimed at designing and constructing an electrically powered mechanical scissors lift ladder to raise and lower worker and his working equipment with ease and in the most economical way. The lift is expected to work with minimal technical challenges and greater comfort due to its wide range of application. The device can easily be handled to the site to be used with a tow-van and then powered by a generator. Between the heights of lift (i.e. the maximum height) the device can be used in any height with in this range and can be descend immediately in case of emergency, and can be operated independent of a second party.

The aim of this study is to design a scissors lifting device that can be used in the Domestic and Industrial sector. The design conditions are to meet the following specifications;

- The device is limited to an average load of 120 Kg.
- The device will have a maximum lift of 5-6 m.

This objective is desirable to be achieved through the rotation of the lead-screw to flat surface

## DESIGN CONCEPT

Computer aided design or CAD has very broad meaning and can be defined as the use of computers in creation, modification, analysis and optimization of a design. CAE (Computer Aided Engineering) is referred to computers in engineering analysis like stress/strain, heat transfer, and flow analysis. CAD/CAE is said to have more potential to radically increase productivity than any development since electricity. CAD/CAE builds quality form concept to final product. Instead of bringing in quality control during the final inspection it helps to develop a process in which quality is there through the life cycle of the product. CAD/CAE can eliminate the need for prototypes. But it required prototypes can be used to confirm rather predict performance and other characteristics. CAD/CAE is employed in numerous industries like manufacturing, automotive, aerospace, casting, moulding making,

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plastic, electronics and other general-purpose industries. CAD/CAE systems can be broadly divided into low end, mid end and high-end systems. Low-end systems are those systems which do only 2D modelling and with only little 3D modelling capabilities. According to industry static's 70-80% of all mechanical designers still uses 2D CAD applications. This may be mainly due to the high cost of high-end systems and a lack of expertise. Mid-end systems are actually similar high-end systems with all their design capabilities with the difference that they are offered at much lower prices. 3D sold modelling on the PC is burgeoning because of many reasons like affordable and powerful hardware, strong sound software that offers windows case of use shortened design and production cycles and smooth integration with downstream application. More and more designers and engineers are shifting to mid end system. High-end CAD/CAE software's are for the complete modelling, analysis and manufacturing of products. High-end systems can be visualized as the brain of concurrent engineering. The design and development of products, which took years in the past to complete, is now made in days with the help of high-end CAD/CAE systems and concurrent engineering raise or lower the scissor platform. The system must be operated on a flat surface.

**ENGINEERING DESIGN (SOLID WORKS)**

Solid works offers a range of tools to enable the generation of a complete digital representation of the product being designed. In addition to the general geometry tools there is also the ability to generate geometry of other integrated design disciplines such as industrial and standard pipe work and complete wiring definitions. Tools are also available to support collaborative development.

A number of concept design tools that provide up-front Industrial Design concepts can then be used in the downstream process of engineering the product. These range from conceptual Industrial design sketches, reverse engineering with point cloud data and comprehensive free-form surface tools. The figures represent CAD model in Solid Works.

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**DESIGN CALCULATIONS**

Torque in the Motor = $\varphi \frac{Z P I_a}{2\pi A}$ Nm

$= 0.159 \times \varphi \times Z \times I_a \times \frac{P}{A}$ Nm

$= 0.162 \times \varphi \times Z \times I_a \times \frac{P}{A}$ Kgm

Torque Given by Motor = $\frac{60P}{2\pi N}$

Gear

Gear Ratio = number of teeth on drive gear / number of teeth on driven gear

Output Rpm = input rpm $\times \frac{1}{\text{gear ratio}}$

Output Torque = input torque×gear ratio

Lead Screw Torque required to raise the load = $w \times \tan(\lambda+\Phi)\frac{dm}{2}$

Torque required to lower the load = $w \times \tan(\Phi-\lambda)\frac{dm}{2}$

W is the load and $d_m$ is themean diameter Efficiency of lead screw = $\frac{\tan(\lambda)}{\tan(\Phi+\lambda)}$

Φ is the friction angle and λ is the lead angle of power screw

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## RESULTS AND DISCUSSION

ANSYS is the usually preferred analysis software package because of its functionality. In this interface, you can apply forces, pressures, torques, etc on models and see how the stresses develop. The ANSYS Workbench platform is the framework upon which the industry's broadest and deepest suite of advanced engineering simulation technology is built. An innovative schematic view ties together the entire simulation process, guiding the user through even complex multi physics analyses with drag-and-drop simplicity. With bi-directional CAD connectivity, an automated level update mechanism, pervasive parameter management and integrated optimization tools, the ANSYS Workbench Platform delivers unprecedented productivity, enabling simulation driven product development.

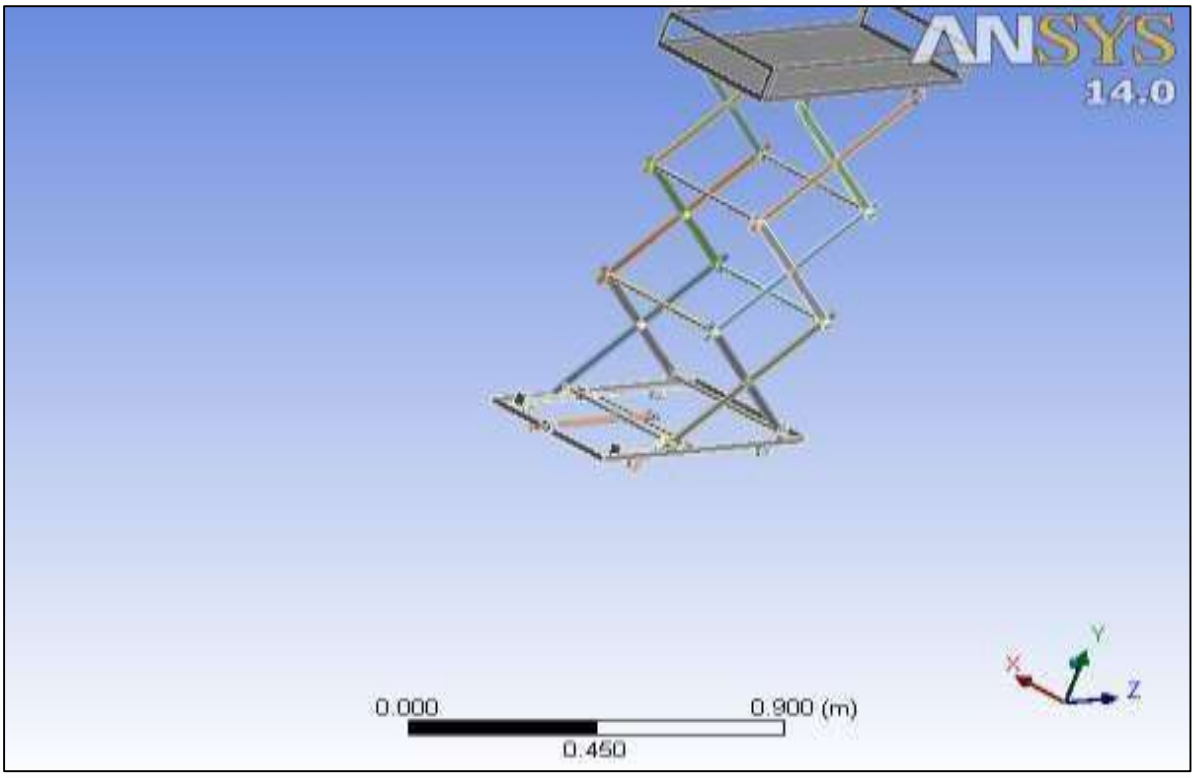


Fig. 2 : Model

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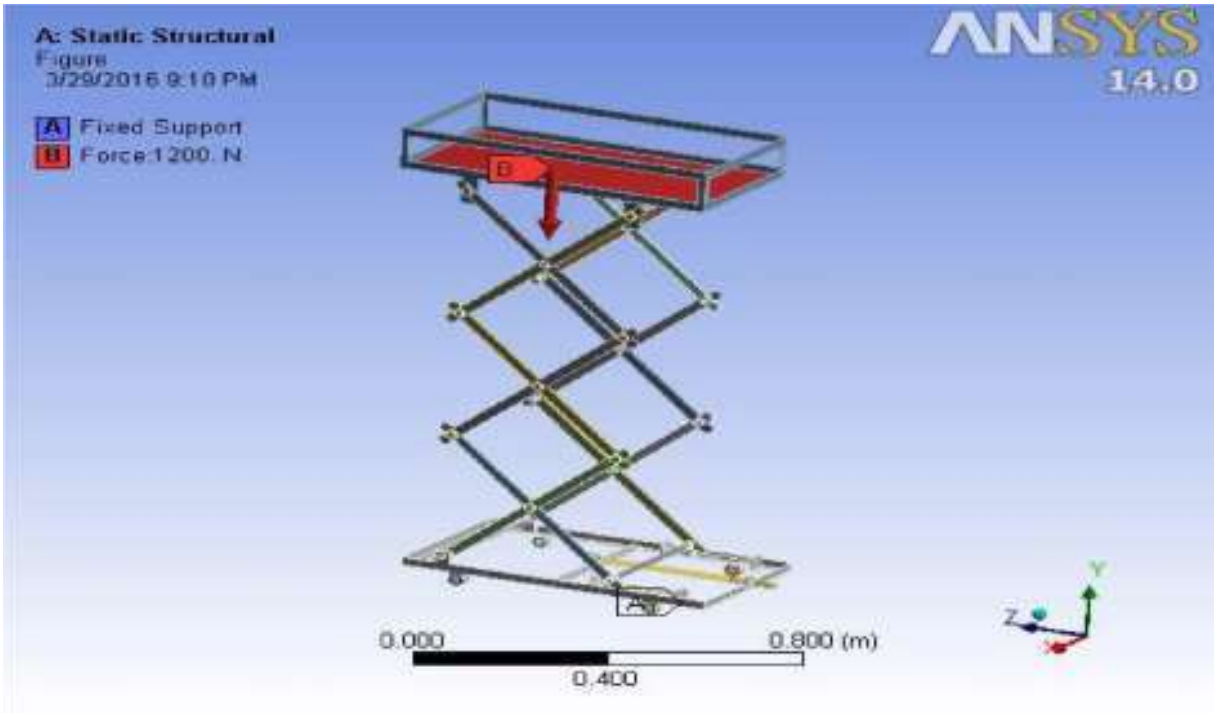


Fig 3 : model

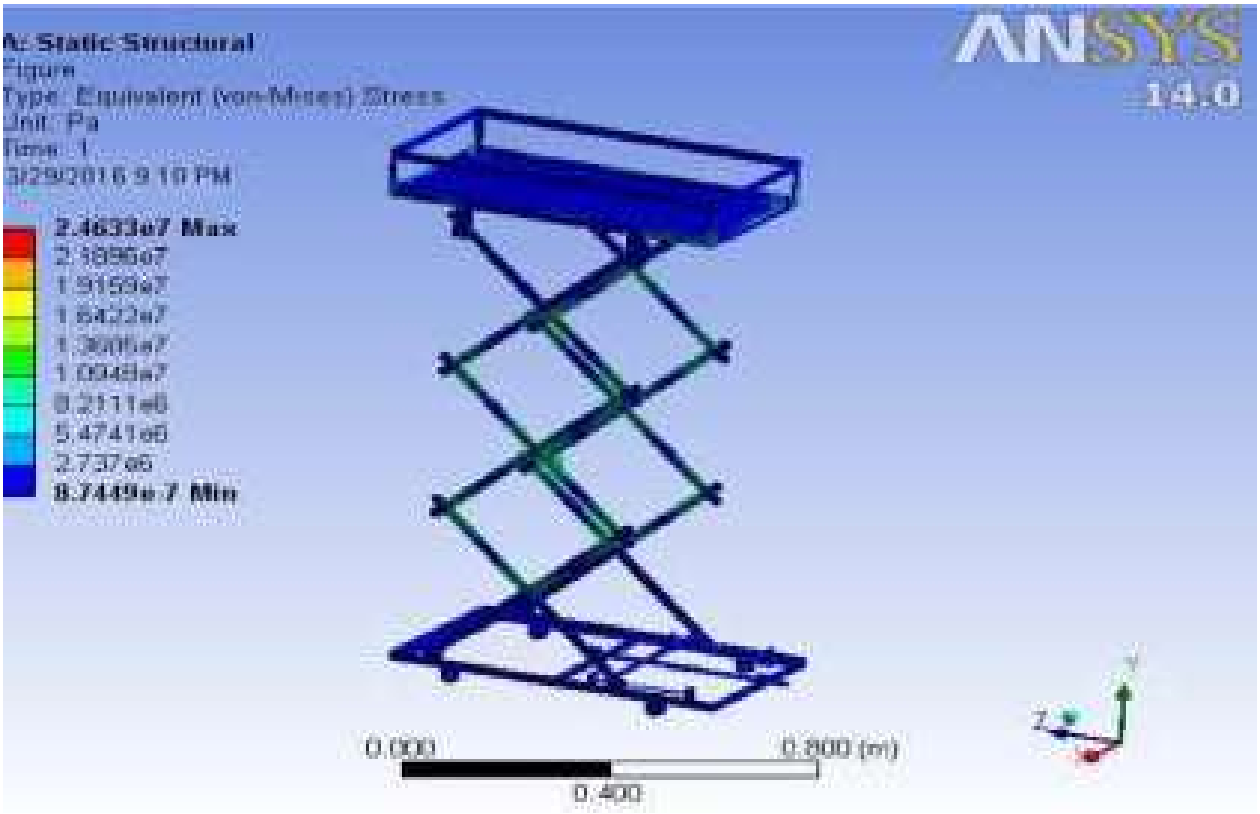


Fig 4 : model

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## CONCLUSION

This work has provided us an excellent opportunity and experience, to use our limited knowledge. We gained a lot of practical knowledge regarding, planning, purchasing, assembling and machining while doing this work. We feel that the work is a good solution to bridge the gates between the institution and the industries.

We are proud that we have completed the work with the limited time successfully. The "DESIGN, FABRICATION AND ANALYSIS OF ELECTRO MECHANICAL LADDER" system is working with satisfactory conditions. We were able to understand the difficulties in maintaining the tolerances and also the quality. We have done to our ability and skill making maximum use of available facilities. In conclusion of remarks of our work, let us add a few more lines about our work.

Thus, we have developed an "ELECTRO MECHANICAL LADDER" which helps to fabricate a less weight and more compactable ladder that is actuated using simple mechanisms. This reviews all the studies up to this date and hope our product will get optimum acceptance in the market. By using more techniques, they can be modified and developed according to the applications.

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