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Design and Fabrication of Hydraulic Goods Lift

Material Handling Machine

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Abstract *—As a kind of industrial lifting weight Hydraulic Goods lift plays an important role in people's life. Nowadays, in order to meet the needs and requirement of the people, the types of Hydraulic Goods lift are more and more. The basic parameters of the push upward lift in the market; the working device of the Hydraulic Goods lift has been introduced. And according to the calculation and checking, the main structural parameters of the lifting oil cylinder have been determined. The hydraulic system has been designed for lifting weight up to 500kg with minimum time to 6m. Deformation analysis, beam 188 reaction forces, equivalent stress analysis of goods lift were done by ANSYS design software in this paper.*

Keywords- *Goods lift, Hydraulic system, Material handling, Mild Steel, ANSYS*

I. INTRODUCTION

From earlier times operation of lifting is performed manually and it requires more workers to do such operation. Further some manually operated machines are introduced to do operations like lifting where less skilled workers can do the work. But still with these machines some problems are occurred such as injuries, damage, Cracks, scratches, loss of time. To eliminate such defects hydraulic goods lift is invented for material handling . These machines can be operated by unskilled operators also. Goods lift was easy to use/operate and it will be used mostly at industries and other common places.

II. MATERIAL SELECTION

As per the market study for material selection on the basis of Strength, Hardness, Weldability, Availability, Machinability and cost it was found out that the Mild Steel (MS) is suitable material for fabrication of Goods lift. Also Hard chrome material was used for making Piston, Roller and Pulley.

III. DESIGN

3.1 Design of Base Plate:

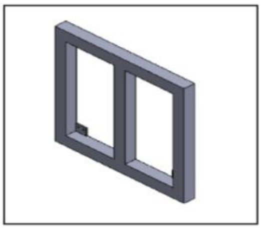

Figure 3.1 Base Plate

The base Plate in a Goods lift provides at the bottom of the frame. Which support the cage and frame. Considering the size constraints, the dimensions of the base Plate are taken as under. Also it has been found that not much of the stresses are developed in the base frame.
Length of the plate (L) = 1200 mm
Width of the plate (B) = 900 mm
Thickness of the Plate (t) = 100mm
Weight of the plate (W) = 610 N

3.2 Design of Frame

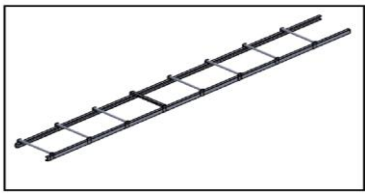

Figure 3.2 Design of Frame

The Frame in a Goods lift provides proper balance to the structure and to support the cage. Considering the size constraints, the dimensions of the base Plate are taken as under. Also it has been found that not much of the stresses are developed in the frame.
Length of the Frame (L) = 7400 mm
Width of the Frame (B) = 800 mm
Thickness of the Frame (t) = 100mm

3.3 Design of Cylinder:

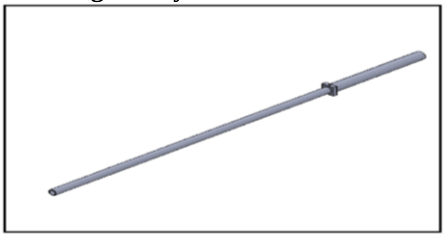

Figure 3.3 Cylinder

The hydraulic cylinder is mounted in vertical position. The total load acting on the cylinder consists of

a. Mass to be put on lift= 500 kg
   Taking FOS = 1.5 for mass in pallet
   500 x 1.5 = 750 kg
b. Mass of cage = 335kg
c. Mass of chain box = 110kg
d. Mass of cage guide = 55kg

Total Mass= 335+110+55= 500kg
Total load = 500x 9.81 = 4903.2 N
Now the maximum force will act on the cylinder.

For cylinder design we use pressure is 30 bar.
Therefore,

$$\frac{\pi}{4}D^2 = \frac{4903.2}{3}$$

Therefore,

$$D = \sqrt[2]{\frac{4 * 4903.2}{3\pi}}$$

D= 45.61 ≈ 63 mm
Therefore we select 63 mm diametric cylinder.

3.4 Design of Pin:

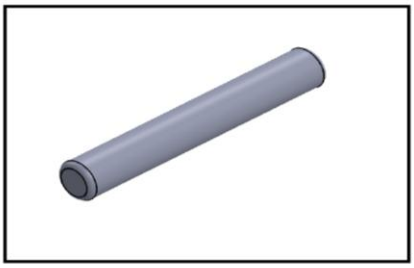

Figure 3.4 Pin

Pin is the major factor in Goods lift. It played an important role in joining the two pulleys with the rope guide. We know that in Goods lift, pin goes under shear stress. Shear stress defined as force per unit cross section area.

$$\tau_{all} = \frac{0.5 \text{ x Yieldstress}}{\text{Fos}} = \frac{0.5 \text{ x } 250}{4} = 31.25 \text{ N/mm}^2$$

$$\tau_{all} = \frac{P}{2A}$$

Where,
τ_{all}= Allowable shear stress in pin (N/mm^2)
P = Total force applied on pin (N)
A = Cross section are under in shear (mm²)

$$31.25 = \frac{4 \text{ x } P}{2 \text{ x } \pi D^2}$$

Therefore, D= 4.99 ≈ 15mm

IV. FINITE ELEMENT ANALYSIS OF MACHINE ON ANSYS

4.1 Material Props & Assumption:

a. Material Properties:

i. Material Yield Strength = 250 MPa

b. Assumptions:

i. 500kg load is uniformly distributed over pulley pin.

ii. Since main objective of analysis is to deduce forces at cylinder region, face is constrained in tangential direction.

4.2 Solid work Model

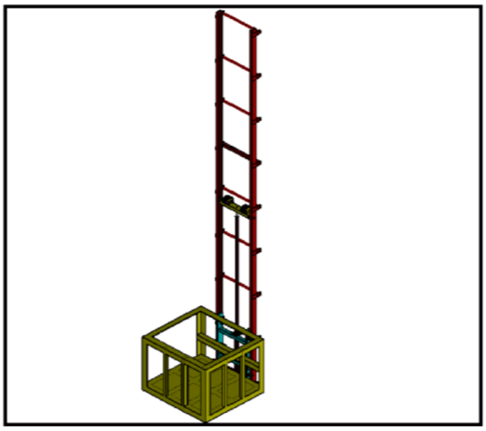

Figure 4.2 Solid work Model Goods Lift

4.3 FEA Mesh Model

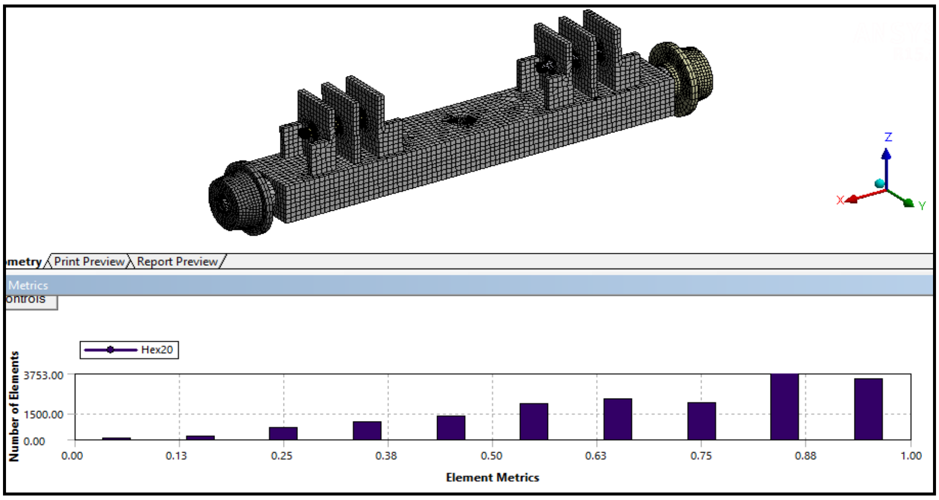

Figure 4.3 FEA Mesh Model

Meshing was a common term used for preprocessing phase of Finite Element Analysis (FEA). In meshing the minimum elements across the thickness are 10 to achieve desired accuracy or to get precise results.

Three dimensional meshes created for finite element analysis (FEA) are needed to consist of tetrahedral, pyramids, prisms or hexahedra. The Aspect ratio is defined as relationship between width and its height. For more accurate result and fine meshing aspect ratio is maintain below 10. The above plot shows number of elements present in the structure. From the above plot we selected hexahedral meshing which give precise results.

4.4 Loading & Boundary Conditions

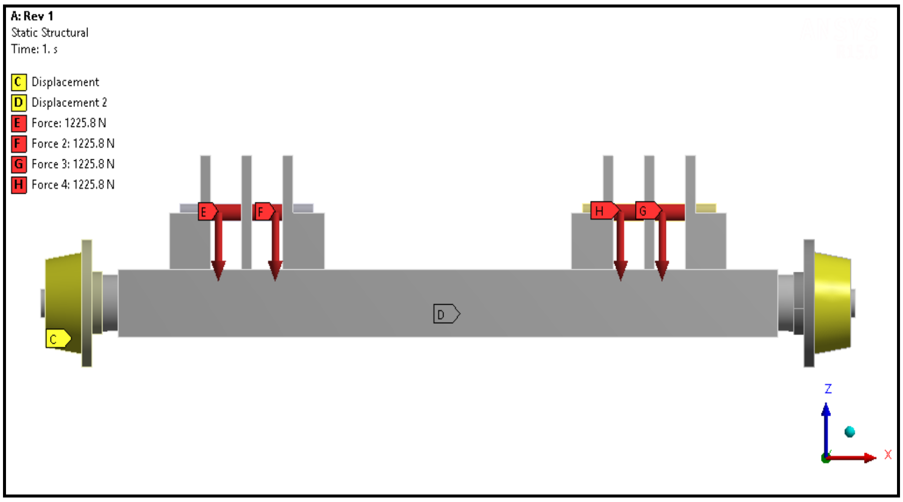

Figure 4.4 Loading & Boundary Conditions

To convert actual scenario into engineering prospect loading and boundary were defined as follows-

1. From the above plot ends C and D of the Roller we allowed rotational displacement along Y-axis.

2. At the ends H and G of Pin and E and F of Pin when the equally force (i.e.1225.8N) acting on pin on downward direction.

3. We were distributed load equally on Two Pins.

4.5 Total Deformation

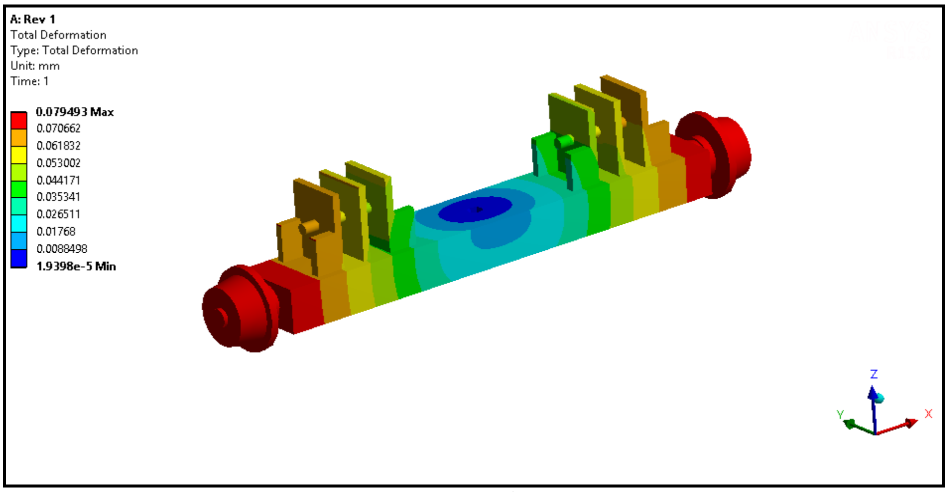

Figure 4.5 Total Deformation

The deformation analysis figure shows the deformation at the end of the rope guide was very small. The deformation at the middle of the rope guide was approximate 1 mm and which was negligible so design was safe.

4.6 Beam188 Reaction Forces

- Beam forces are compressive.
- Axial force of around 4.3kN.

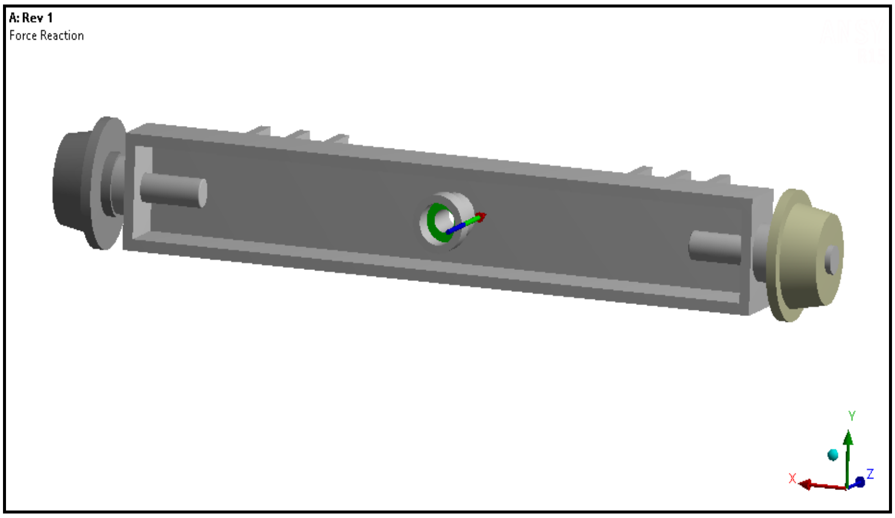

Figure 4.6 Beam188 Reaction Forces

Beam elements are line elements used to create a one dimensional idealization of a three dimensional structure. They are computationally more efficient than solids and shell and are mostly used in several industries. ANSYS has many other beam elements, but BEAM188 is generally recommended because,

1. Applicable to most beam structures
2. Reduce computational time of ANSYS
3. Easy to use
4. Support linear as well as nonlinear analyses

4.7 Equivalent Stresses MPa

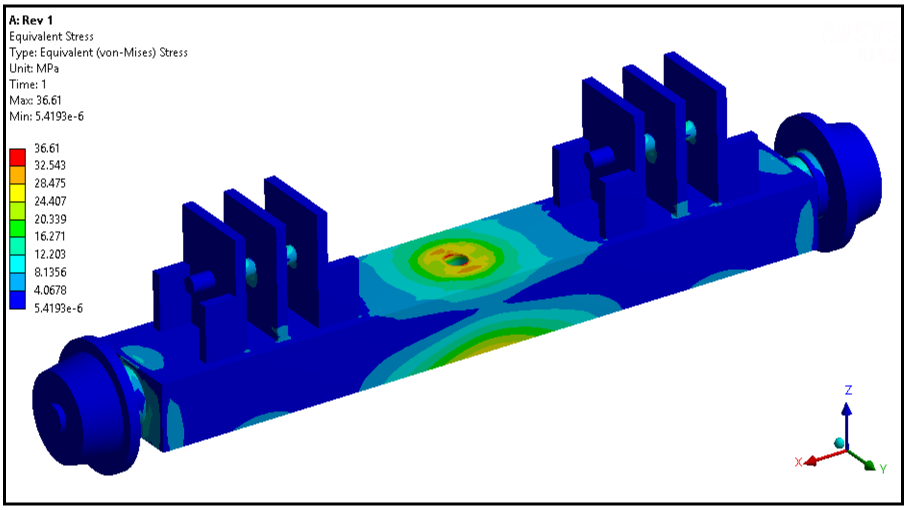

Figure 4.7 Equivalents Stresses MPa

Equivalent stress i.e. Von mises stress gives average value of stresses. Von mises stress is widely used by designer to check whether their design will withstand a given load conditions.

Equivalent stress analysis shows stresses at the middle of rope Guide. The figure equivalent stress analysis shows there maximum stress values is 36.61MPa. For that we were doing a stress linearization to check whether our design was safe for this stresses or not.

Remarks:

- Axial force of around 4.3kN is required at bottom face to hold applied load.
- Stresses far less than yield are observed as highlighted in previous slide. Current design is safe for applied loading is safe

V. CONCLUSION

The hydraulic Goods lift was simple in use. It can also lift heavier loads. Material handling and providing comfort to the operator was our main motivation behind the developing this lift. With such design of Goods lift, the complexities in a design and fabrication time was reduced. But the limitation of this lift is high initial cost. The analysis on ANSYS has also shown that the design was safe under certain accepted parameters. In this paper we carried out detailed analysis of Goods lift mechanism Rope guide against bending and sagging failure and also focused on various design aspects. In this, lift was only capable of lifting the weight up to 500kg at elevation 6m with minimum effort.

REFERENCES

[1] Mr. Liai Pan, Qiulei Du,and Chunshan He, "Design Research on Hydraulic System of Working Device of a Forklift", 5th International Conference on Advanced Design and Manufacturing Engineering (ICADME 2015).

[2] Mr. Gaffar G Momin, Mr. Rohan Hatti, Mr. Karan Dalvi, "Design, Manufacturing & Analysis of Hydraulic Scissor Lift", International Journal of Engineering Research and General Science Volume 3, Issue 2, Part 2, March-April, ISSN 2091-2730, 2015

[3] MrHuang Lei1,2,Yuan Genfu1,Chen Xuehui1, "Simulation Analysis of Certain Hydraulic Lifting Appliance Under Different Working Conditions", 2012 International Conference on Solid State Devices and Materials Science

[4] Mr. V. B. Bhandari, "Design of machine elements", TATA McGraw-Hill Education, 2010

[5] MACHINE DESIGN DATABOOK, Digital Engineering Library @ McGraw-Hill Education, 2004

