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DESIGN AND DEVELOPMENT OF PICK AND PLACE ARRANGEMENT BY FORKLIFT MECHANISM FOR LIBRARY PURPOSE

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ABSTRACT— Using Forklift which is a small industrial mechanism, having a power operated forked platform coupled at the front that can make the forks to be raised and lowered for installing under a freight to lift and move it. Forklift provides the need of various industries including storehouse and other large storage efficiency and this would be used for library automation. In our project we are developing the concept of forklift for library automation purpose which is operated by rope pulley system. The frame we are designing has to be constrained with the library working parameters and the lifting platform is designed to carry books weights 5 kg. The sliding of the books in the shelves is controlled by lead screw which pushes the vertical plate. This whole assembly is movable on caster wheels and thus transportation is easy.

Keywords: Forklift, Manually Operated Forklift, Lifting Mechanism, Rope and Pulley, Rope Drive etc.

I. INTRODUCTION

The project is about design and development of an attachment which will be use the rope and pulley and lead screw mechanism and due to this attachment forklift be able to lift and place the load easily. Placing the load will work on lead screw mechanism. In this way we will be able to increase the mechanical advantage of the forklift. Some basic definitions and principles that we are going to use are given below.

Now days due to heavy work load environment in the mechanical industrial line's workers are stressed for carrying a heavy load, where the workers are abhorrence to unhealthy conditions. Due to these factors some forklifts were developed in the recent past years. Working in the mechanical workshops or any other large fabrication unit, where load is to carry from one unit of the factory to the other unit this device is useful. The device finds greater use in the industrial lines for transport of the machined jobs, carrying goods internally in the fabrication plant.

II. SCOPE

In this research, we investigate a forklift design that is new and different from other existing designs. Our project relates to operate forklift as manual operated without any power drive and lifting the load and placing to required area with the help of lead screw.

III. LITRETURE REVIEW

a) Types of forklifts

There are in industries many types of forklifts are use. Types of forklifts are following, [8]

i. Hydraulics operated Forklifts
ii. Pneumatics operated forklifts.
iii. Manually operated forklifts.
iv. Combine hydraulics and pneumatics operated forklifts.

b) Mechanisms used in forklifts

There are many types of mechanisms are used in forklifts. [6]

i. Rope and Pulley Mechanisms.
ii. Chain Drive Mechanisms.

iii. Sesser lift Mechanisms.
iv. Screw Lift Mechanisms.

IV. DISCUSSION ON LITRATURE REVIEW

i. Lead screw mechanism which has not been used in conventional forklift.
ii. No any hydraulic or pneumatic components are using, so less maintenance.
iii. Manually operated forklifts have easy to operate.
iv. Easy operating for user friendly.
v. It saves time and space.
vi. Improve the load carrying capacity.
vii. Loading and unloading process is easy.
viii. Effective cost.
ix. Easy to maintenance.

V. PROBLEM STATEMENT

i. In this research, we investigate a forklift design that is new and different from existing designs. The new design offers two features: one is that the forklift is attached to the body on both ends, and the other feature is that the new lifting mechanism is more compact. The remainder of the thesis elaborates these new features in more details.
ii. To achieve our new design goals, we need to do some research about the forklift existing design and what kind of product transportation is using the forklifts.
iii. Based on that research, we need to find what the failing of existing designs are. The new design offers both new and improvised features, over what is currently available.

VI. MAIN PARTS

i. Wheel Axial and Supporting frame
ii. Handle Rod
iii. Pulley and Rope
iv. Lead Screw
v. Plate Moving Part
vi. Motor

a) Design of Lead Screw

The Power selected for this application is a mild steel screw, M10 (P = 1.5 mm), which is a standard material available in market. To prove that our selected is material is safe we are going to measure the factor of safety available for our application. [4]

W = 80 N
$S_{yc} = S_{yt}$ = 330 N/mm^2
d_c = d – p = 10 – 1.5 = 8.5 mm
σ_c = 56.75 N/mm^2
F.O.S. = 5.815

This power screw is designed to slide the load of 50 N, its own weight & miscellaneous load i.e. 30 N considered.

Length of Screw (L) = 350 mm
Total Load (W) = 80 N
Pitch (P) = 1.5 mm by Standard Value
Nominal Diameter (d) = 10 mm by Standard Value
Type of Thread = Metric Thread
Friction Factor (μ) = 0.2
Number of Starts (n) = 1
Lead = n x P = 1 x 1.5 = 1.5 mm
Collar Friction (μ_c) = 0.15
Motor RPM (N_s) = 30 RPM

Mean Diameter

$$(d_m) = d - \frac{p}{2} = 10 - \frac{1.5}{2} = 9.25 \text{ mm} \quad \text{...(1.1)}$$

Helix Angle

$$(\alpha) = \tanh^{-1}\frac{1.5}{\pi dm} = \tan^{-1}\frac{1.5}{\pi \times 9.25} = 3.312^{o} \quad \text{... (1.2)}$$

Friction Angle

$$(\varphi) = \text{Tan}^{-1}(\mu) = \text{Tan}^{-1}(0.2) = 11.3^{o} \quad \text{... (1.3)}$$

Effort required sliding the plate against Thread Friction

$$(P_r) = W \times \text{Tan}(\alpha + \varphi) = 80 \times \text{Tan}(3.312 + 11.3) = 20.856 \text{ N.mm} \quad \text{... (1.4)}$$

Torque required sliding the plate against Friction

$$(T_{tr}) = Pr \times \frac{dm}{2} = 20.856 \times \frac{9.25}{2} = 96.46 \text{N.mm} \quad \text{... (1.5)}$$

Torque Required to Overcome Collar Friction

$$(T_c) = \mu_c \times W \times \frac{dm}{2} = 0.15 \times 80 \times \frac{9.25}{2} = 55.5 \text{ N.mm} \quad \text{... (1.6)}$$

Torque Required to raise the load

$$(T_r) = 96.46 + 55.5 = 151.96 \text{ N.mm} = 0.151 \text{ Nm} \quad \text{... (1.7)}$$

Hence a 12 v D.C motor of torque rating 3 Nm and 30 rpm is used for the above application.

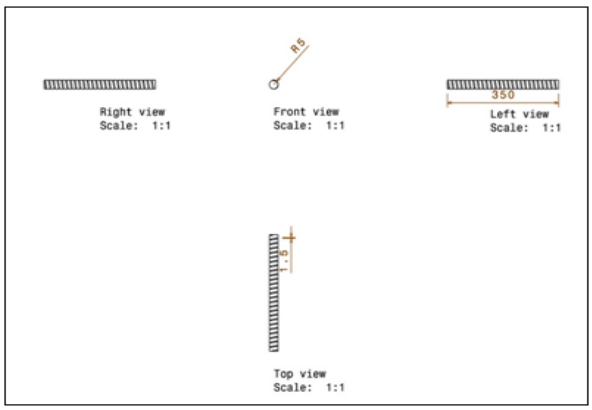

Fig.1 2D Drafting of Lead Screw

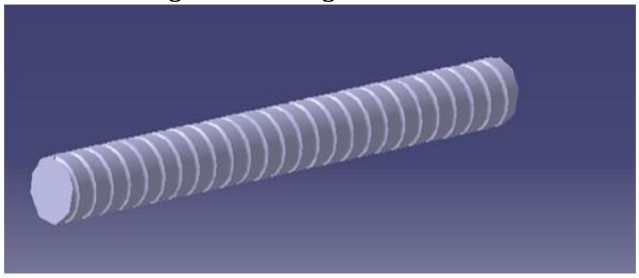

Fig.2 3D Drawing Lead Screw

b) Design of Rope And Pully

Maximum load generated on rope
= load due to books + load of M.S plate

Load due to books (Approx) = 50 N
Self wt. of Plate around 6kg
6 × 10 = 60 N.

Total Wt. = 50 + 60 = 110 N
Diameter of pulley assumes as 200 mm

Arm length required to wrap the rope is approx
= 110×100 = 20 × A
A = 550 mm
Arm length = 0.55 m. [9]

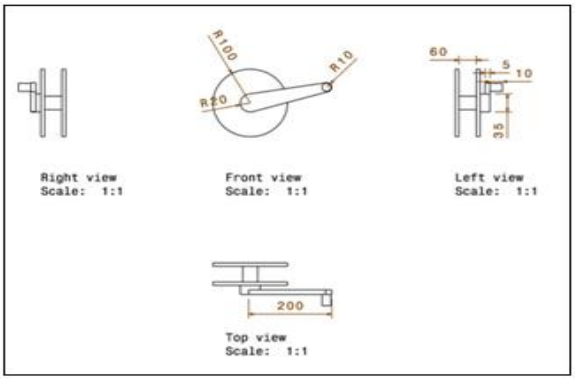

Fig.3 2D Drafting Pulley

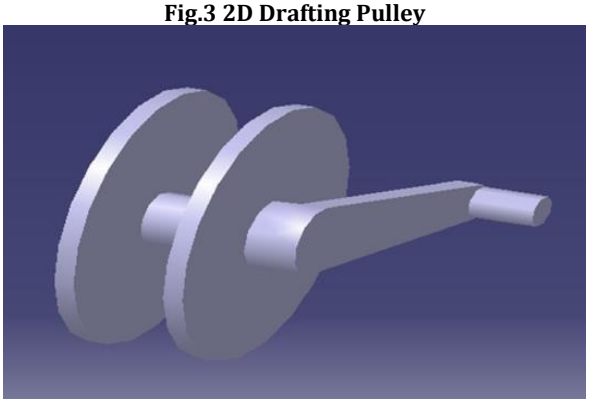

Fig.4 3D Drawng Pulley

c) Software Analysis

A. Design of Plate

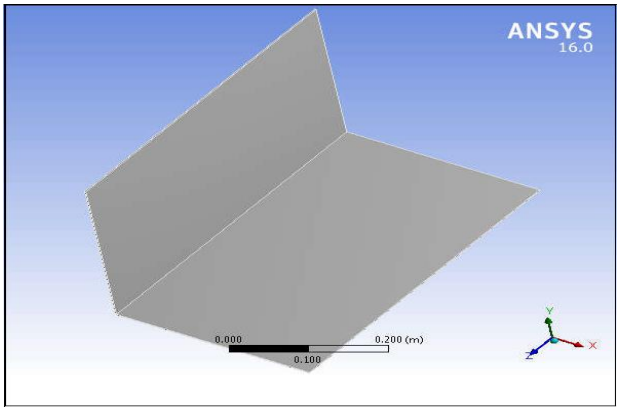

Fig.5 3D Drawing of Plate

B. Total Deformation

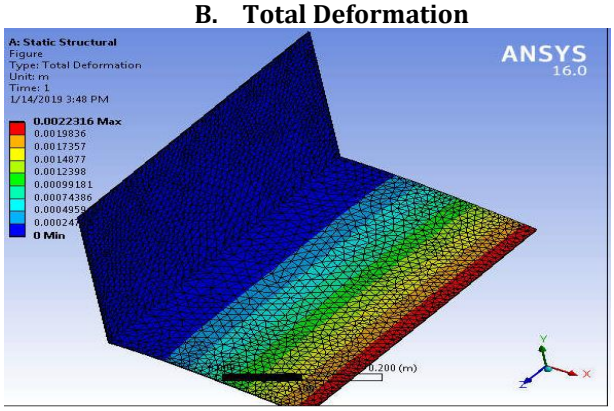

Fig.6 Total Deformation

C. Equivalent (Von - Mises) Stress

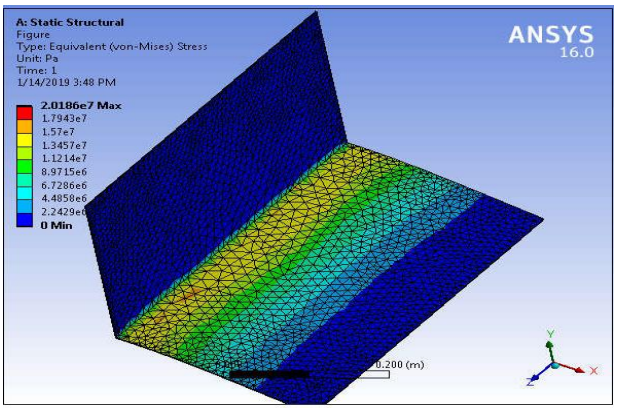

Fig.7 Equivalent (Von – Mises) Stress Torque Load

D. Safety Factor

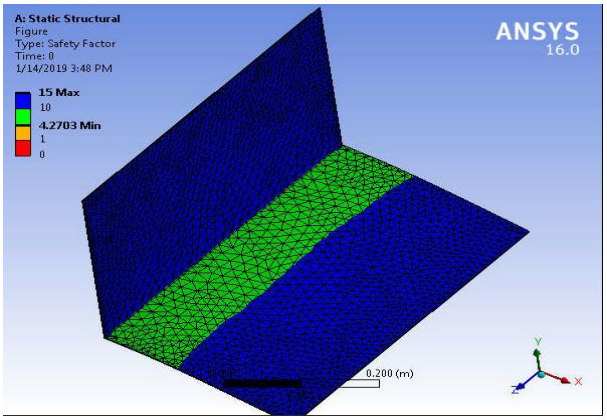

Fig.8 Safety Factor

VII. CONSTRUCTION

The movement of the lifting mechanism, the lifting mechanism has been shown in figure. The front end of the lifting rope was connected to the forklift plate which is to the move up and down, on this plate attach the lead screw mechanism with the help of moving plate and lead screw, this plate movies forward and backward direction with the help if lead screw and this lead screw operate with the help of motor, the middle was around the guide pulley, the forklift plate and guide pulley attach with the rope for the movement of up and down.

VIII. WORKING

The forklift can be assembled as per our concept and design. For this forklift we are use the rope and pulley is

used for the taking the motion of upward and downward direction. When pulley rotate in clockwise it will go in upward direction and it will rotate in anticlockwise direction it will goes downward direction. For this Forklift we use one D.C. Motor this motor is used for rotating the lead screw for moving the sliding plate in forward direction for the placing the books. This type of forklift also uses for transport the material from one place to another place.

The Book Placing Mechanism for Library Purpose itself says that the function of this project or Mechanism is that to place the book vertically into the rack at some specific height.

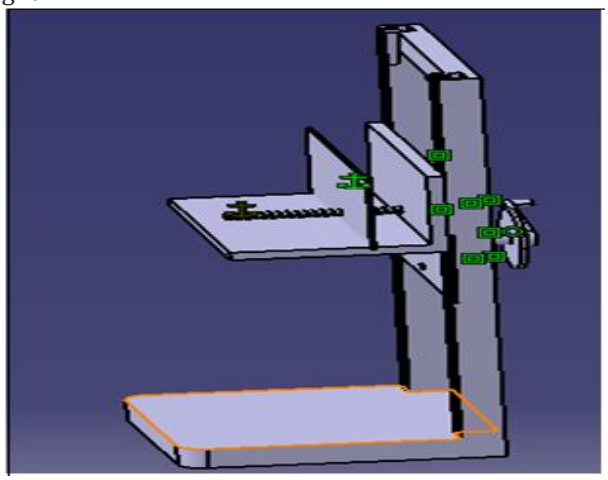

Fig.9 Main Assembly

IX. ADVANTAGES

i. Professional staff need not spend much time to do the routine work.
ii. Eliminates human errors.
iii. Excellent control over circulation.
iv. Reduce Human Effort.
v. Less Maintenance.
vi. Easy Operation.
vii. Pulley systems rely on the relationship between load and effort.
viii. Useful for getting the drive action to happen in awkward places.
ix. It helps in applying force in any direction.

X. CONCLUSION

We conclude that, this paper will helpful for manufacturing of forklift for placing the books in library. As per the design calculation the forklift is very efficient with maximum carrying capacity without any obstruction.

The main advantage of using this technology it increases the safety of operator by operating the forklift. Human errors due to the poor visibility can be minimized.

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