Design and development Of Portable Forklift

Prof. Pankaj Shankarrao Aglawe
Asst.Professor
AISSMS college of Engineering,Pune.

Gund Vishvajeet Popat
Student
Department of Mechanical Engineering
AISSMS college of Engineering
Pune, Maharashtra, India

Khandagale Saurabh Sanjay
Student
Department of Mechanical Engineering
AISSMS college of Engineering
Pune, Maharashtra, India

Bansode Janhvi Rahul
Student
Department of Mechanical Engineering
AISSMS college of Engineering
Pune,Maharashtra India

Jagtap Harshal Vivek
Student
Department of Mechanical Engineering
AISSMS college of Engineering
Pune, Maharashtra, India

ABSTRACT

Abstract *This work deals with the design and manufacture of a portable forklift that can be used for various purposes both in the household and in the industry. The pickup truck really needs to be improved to make it more efficient, friendly and practical and most importantly with high safety features. The in-factory freight system is designed to be user-friendly. The device is used more to transport mechanized work on industrial lines, to transport goods within the production workplace. A forklift is an industrial lift used to lift and transport materials. Lifting and transport is done with a steel fork under load. Currently, various forklifts are available, according to the lifting weight, the lifting weight of the forklift is divided into small (0.5t) and (1t), medium (2t and 3t) and large (5t and more).*

Key words: *Forklift, modeling, simulation, load lifting, dynamic analysis, oscillations, FEM,*

1. Introduction:-

Today, workers are not recommended to carry heavy loads due to the high workload of mechanical industrial lines, where workers are exposed to unhealthy conditions. Due to these factors, some load transfer machines have been developed in recent years. As a forklift Forklift is a motorized industrial forklift used to lift and move materials over short distances. There are forklifts on the market that require more energy to operate and cannot be used on uneven ground. When you work in machine shops or other large factories where loads (bars, plates, machined work, etc.) are transported from one manufacturing unit to another, this device is handy. The annual total number of injuries (minor, severe and fatal) is 96,785 The aim of this project is to change the design of the pickup from the point of view of its functionality and also human factors. In the framework of this project, we are designing a cart with a lifting capacity of up to 500 kg. After obtaining a suitable design, the customer's needs are transformed into technical specifications to obtain concepts for modification and manufacturing. Most people are familiar with the Basic Truck (manual), which is still standard on the latest automated pickups.

1.1 LITERATURE REVIEW

Firs robotic forklift is developed by Aashishkumar.L. Sharnangat, M.S. Tufail (2017) had to work alongside a dying workforce, dealing with staged equipment in busy, half-built outdoor warehouses. The robot operates in a minimally prepared, semi-structured environment, where the forklift handles variable weight placed on bases using only natural vision and transports it in interaction with other moving vehicles..

LiaiPan says: Qiulei Dub As a kind of artificial vehicle, the pickup truck is an indispensable part of people's life. Nowadays, there are more and more types of pickup trucks to meet people's requirements. In this model, which was previously based on the introductory parameters of the tow truck drum, a forklift operating device was introduced..

2. METHODOLOGY

1.Data collection regarding machine dimension and their weights.

2.Concept development.

3.Checking design feasibility

4.Checking of various stresses acting on the body due to axial load. Thus, the different parts of forklift are designed, manufactured as per dimensions.

5.Design trolley in term of comfort.

6.Experimental calculations & Analysed using Analysis software for validation.

The above said work is planned in following phases.

Data Collection:

➢ Forklift Introduction.

➢ Deciding types of lifting mechanism.

➢ Advantages & Disadvantages of forklift.

➢ Research papers regarding forklift design, manufacturing & Analysis.

➢ Technical specifications of forklift components, c channel, frame on welding machine.

Material Selection:

➢ Design of each components and validation as per experimental results.

➢ Selection of Steel Material and justification. Section selection, deciding modelling strategy, property definition.

Assembly of model in Ansys:

➢ Import each frame and pulley model in ANSYS Software.

➢ Meshing analysis in ANSYS.

➢ Finding Stress, Strain analysis with our calculation.

➢ Identifying critical sections.

Testing:

➢ Theoretical analysis of forks & comparison.

➢ Load testing.

➢ Von-Mises Stress, Strain evaluation and calculations based upon testing calculation.

➢ As per experimental calculation, plotting graphs (Load vs. Stress, Stress vs.).

MATERIAL USED

BASIC FRAME-

Hollow square tubes made of mild steel were chosen for the frame. The tubes are cut to the desired size with a cutting machine. The ends of the tubes are cut at an angle of 45 degrees, forming a rectangular frame. After cutting, the end of the square tubes is polished so that it became smooth and convenient for welding. Square tubes are welded together to form a basic rectangular frame..

Fig1:Mild steel

MS corners made of mild steel material were chosen for the frame. ms corners are cut to the desired size with a cutting machine. The ends of the MS corners are cut at a 90 degree (corner) angle to form a rectangular frame. After cutting, the tip of the MS corners is ground so that it became smooth and convenient for welding. The corners of the MS are welded together to form a rectangular base frame.

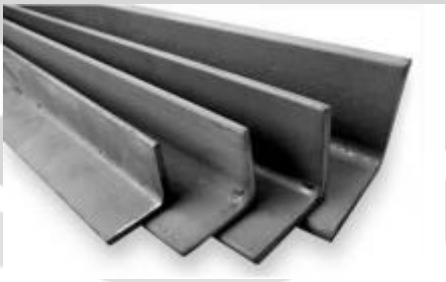


Fig2: Mild steel L Shape plate

MS FLAT:

MS apartment. MS Flats are common in industrial grills, various manufacturing jobs and grills outside the window in Finland. Representation M.S. Levels are made according to the width (W) and thickness (T) of the key. For example: if we say 25 X 5 FLAT, that means width = 25 mm and thickness = 5 mm. The weight of a flat bar is easy to calculate. Simply multiply the density

of the appropriate mixture by the length, width and thickness of the required part. The cross-sectional size of the link used to take the weight of each component is 18x4 mm.

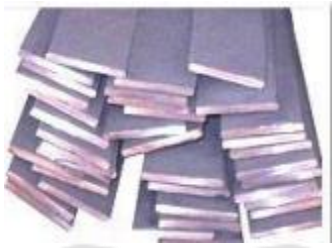


Fig3:Mild steel Flat

Linear actuator:

A linear actuator is a drive that creates direct motion, as opposed to the circular motion of a conventional electric motor. Linear actuators are used in machine tools and industrial machines, computer peripherals such as disk drives and printers, valves and dampers, and many other places where linear motion is required. Hydraulic or pneumatic cylinders essentially produce linear motion. Many other mechanisms are used to produce linear motion in a rotary engine..

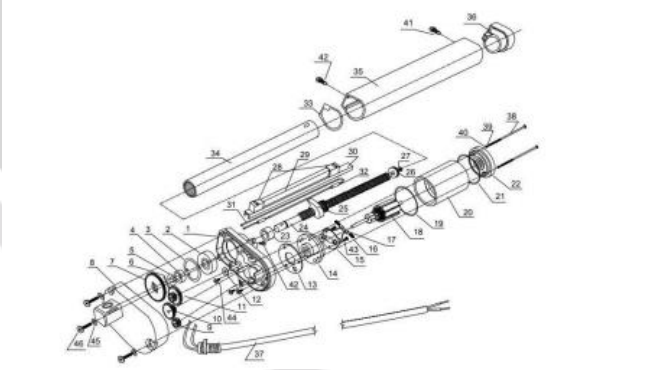


Fig4: Electric Linear Actuator Parts

Within a linear actuator are several different components that all work together to produce the required movements of the device. Although electric screw actuators are specifically designed to have fewer moving parts, reducing the risk of damage and maintenance, and making the actuators lighter and easier to use, many parts are essential to their overall function..

Item	Description	Qty
1	Actuator base	1
2	Shaft Bearing	1
3	Shaft Bearing Lock	1
4	Shaft Base Spacer	1
5	Shaft Base Spacer Lock	1
6	Shaft Gear Wheel Holder	1
7	Shaft Gear Wheel	1
8	Base Cover with Mounting Support	1
9	Electric Motor Gear Wheel	1
10	Small Intermediate Gear Wheel	1
11	Medium Intermediate Gear Wheel	1
12	Teflon Washer	1
13	Electric Motor Base Washer	1
14	Electric Motor Base	1
15	Brush Holder PCB	1
16	Electric Motor Brush	2
17	Electric Motor Brush Spring	2
18	Electric Motor Rotor	1
19	Motor Enclosure Bottom Washer	1
20	Electric Motor Encloser with Stator	1
21	Motor Enclosure Top Washer	1
22	Electric Motor Cap with Rotor Bearing	1
23	Shaft Spacer	1

Item	Description	Qty
24	Treaded Shaft Drive / Lead Screw	1
25	Shaft Base with Limit Switches Arm	1
26	Shaft Drive End Support	1
27	Shaft Drive End Support Screw	1
28	Limit Switch	2
29	Limit Switches Spacer	1
30	Limit Switches Base	1
31	Limit Switches Wiring	1
32	Diode	2
33	Shaft Encloser Bottom Washer	1
34	Shaft with Mounting Hole	1
35	Shaft Encloser	1
36	Shaft Enclosure Top Cap	1
37	Power Cable	1
38	Motor Enclosure Screw	2
39	Motor Screw Spring Washer	2
40	Motor Screw Washer	2
41	Shaft Eclosure Top Cap Screw	1
42	Shaft Enclosure Base Screw	3
43	Brush Holder PCB Screw	2
44	Motor Base Screw	3
45	Base Cover Washer	3
46	Base Cover Screw	3

Table1:Linear actuator description

Motor:

The motor is what enables the movement and communicates with the other parts of the electric linear actuator. The most common type of motor is the 12v DC motor, but it can be changed to another form for stronger or weaker actuators. The engine provides movement. The engine is also subject to the duty cycle of the actuator, which is the amount of time it can run before it has to rest..

Fig5: Motor

Lead Screw:

lead screw actuators are the most common form of electric actuators. The lead screw is mounted inside the cylinder and this part of the actuator converts the rotary motion into linear motion. The head screw moves up and down in the cylinder, creating the necessary movement..

Fig6: Lead Screw

Limit Switch:

A limit switch is incorporated in most (though not all) models of electric actuators and is a means of limiting the movement of the actuator. When the limit switch is activated, all movements stop..

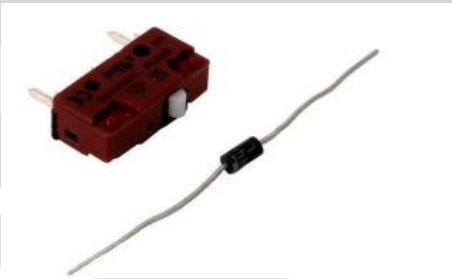


Fig7: Limit Switch

The motor provides real motion, which is converted into linear energy by a lead screw moving up and down the cylinder, and a limit switch is placed to prevent things from moving too far. The rotor and stator assemblies of the linear actuator both enter at this stage like the primary and secondary functions of the motor. Voltage is first applied to the stator assembly (primary action), which is then converted into current that is sent to the rotor assembly (secondary action).

Together, these two actions form a field that ultimately causes motion. Once this motion is generated within the engine, it is transmitted to the cylinder where it is converted into linear motion by interacting with a limit switch..Gears The gears are what attaches the motor to the lead screw, and allow them to move freely.

About Project

This project deals with the design and manufacture of a forklift. The forklifts used in this project are linear drive forklifts because they are more reliable and easier to use. To develop a new forklift design concept, we conducted a survey while talking to the forklift operator. The goal of the project was to design a maximum lifting capacity of 50 kg. To achieve the new design goals, we need to do some work on the existing forklift design and what product transport is being used. Based on this work, we have to find the shortcomings of the existing models. The new design offers both new and improvised features in addition to the existing ones..

Figure 9: Portable Forklift

Objective

The main objective of this work is to minimize the human effort by improving the design of lift. To fulfill the requirement of industry, to reduce the cycle time and improving the productivity of plant.

The following objective will focus in this work:-

1. To study the various types of lifting mechanism.
2. To study the technical specification, critical dimensions and manufacturing process of various components of lift.
3. The design of lift will be analyzed by using analysis tool for validation.

CAD Modelling

Procedure:

•The entire model has been designed with the help of designing software solid works.

•With the help of colour feature the colours are given to the entire model.

Fig.Assembly of Portable Forklift

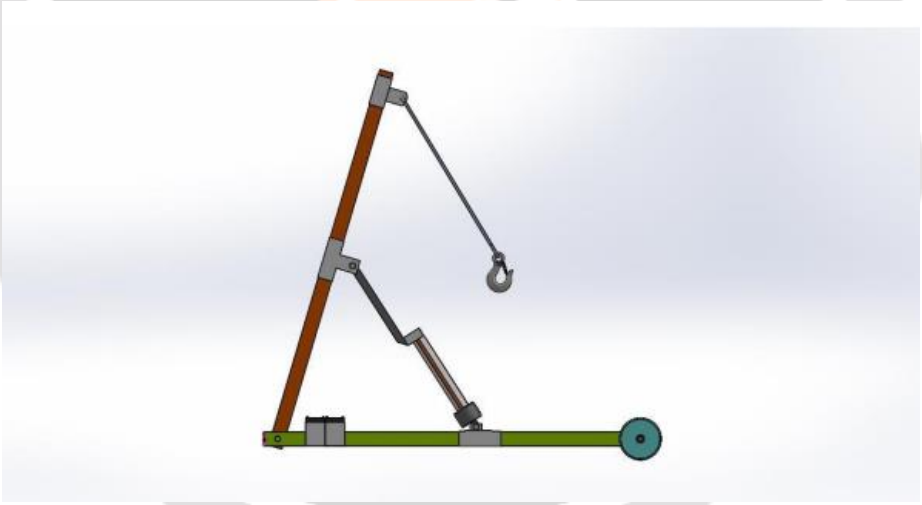


Fig.Side view

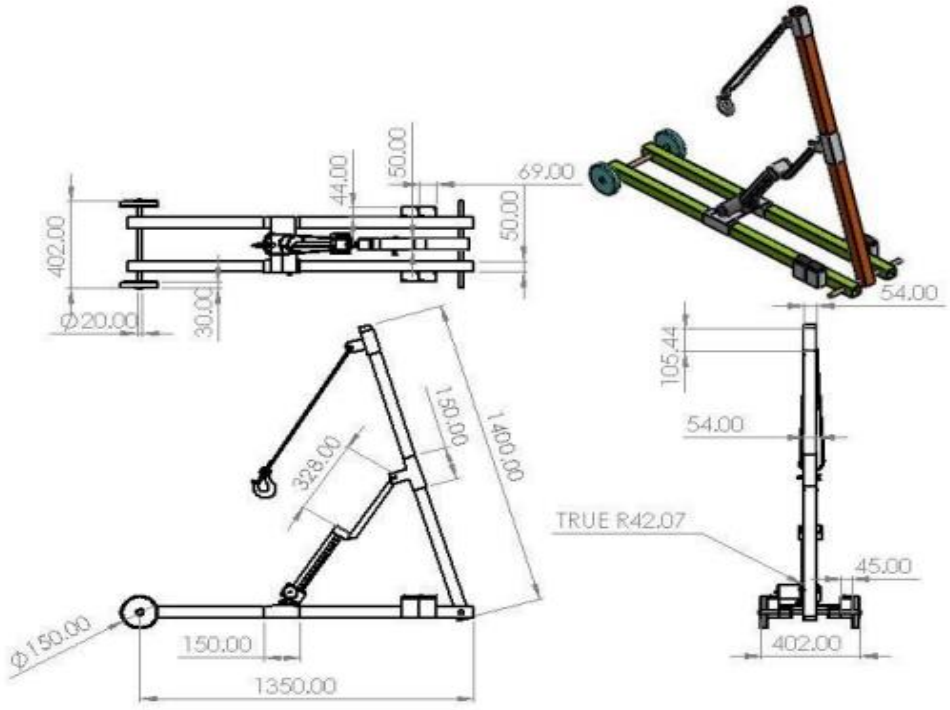


Fig.. Drafting Of Portable Forklif

Design Calculation

Conception IN M.D.P.

Consideration in Machine Design When a machine is to be designed the following points to be considered-

a. Types of stress and stresses caused by the stress.

b. stir of the corridor and kinematics of machine. This deals with the

c. Type of stir i.e. reciprocating. Rotary and oscillatory.

d. Selection of material & factors like strength, continuity, weight, erosion resistant, weld capability, machine capability is considered.

e. Form and size of the factors.

f. Frictional resistances and ease of lubrication.

g. Convenience and frugality in operation.

h. Use of standard corridor.

i. installations available for manufacturing.

j. Cost of making the machine.

k. Number of machine or product to be manufactured.

GENERAL PROCEDURE IN MACHINE DESIGN

The general way to be followed in designing the machine are as followed.

i) Preparation of a statement of the problem indicating the purpose of the machine.

ii) Selection of groups of medium for the desire stir.

iii) computation of the force and energy on each machine member.

iv) Selection of material.

v) Determining the size of element delineation and transferring for manufacture.

vi) Preparation of element delineation and transferring for manufacture.

vii) Manufacturing and assembling the machine.

viii) Testing of the machine and for performing.

ix) Preparation of a statement of the problem indicating the purpose of the machine.

x) Selection of groups of medium for the desire stir.

xi) computation of the force and energy on each machine member.

xii) Selection of material.

xiii) Determining the size of element delineation and transferring for Manufacture.

xiv) Preparation of element delineation and transferring for manufacture.

xv) Manufacturing and assembling the machine.

xvi) Testing of the machine and for performing.

EN 10083 C45 steel sheet carbon steel sheet

Spacing of C45 steel plates The physical and chemical test data of manufacturing products include tension test, hardness test, impact test, leveling test and chemical composition analysis, etc. C20, C45 steel plate pipes are manufactured by cold drawn process..

Grade	Condition	Yield Strength R°(Mpa)	Tensile Strength Rm (Mpa)	Elon-gation A5(%)	Hardness HRC	Quenching Temperature (°C)	Benda-bility	Nominal Thickness,t 1.95mm≤t≤10.0mm	
								Rolled	Annealed
C45	Rolled Annealed Water-quenched Oil quenched	460 330	750 540 2270 1980	18 30	58 55	820 860	Min.reco-mmended Bending radius (≤90°)	2.0×t	1.0×t

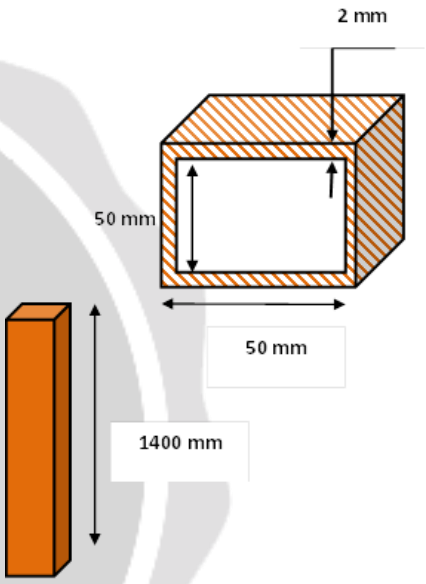
Table2: Mechanical Properties of EN C45 steel

	Comparision of steel grades	
C45 EN 10083-2 Number:1.0503	JIS G 4051	S 45 C
	DIN 17200	C 45
	NFA 33-101	AF65-C 45
	UNI 7846	C 45
	BS 970	070 M 46
	UNE 36011	C 45 k
	SAE J 403-AISI	1042/1045

Table 3:Steel grades

Grade	C(%)min-max	Si(%)min-max	Mn(%)min-max	P(%)max	S(%)max	Cr(%)min-max
C45	0.42-0.50	0.15-0.35	0.50-0.80	0.025	0.025	0.20-0.40

Table 4:chemical Composition of EN C45 steel



Material = C 45 (mild steel)

Take Factor of Safety=2

$\sigma t = \sigma b = 540/fos = 270$ N/mm2

$\sigma s = 0.5\ \sigma t = 0.5 \times 270 = 135$ N/mm2

The linear actuator we will purchase will be of 150 lbs = 68 kg

Square pipe of 50x50 section is used as a column, we will check for its bending load.Let the maximum load applied by linear actuator be 68 kg So, load on column is = 68 kg = 680 N

W = 680 N

M = W L / 4 = 680 X 1400/ 4=238000Nmm

Z = B3 – b3 / 6 = 503 - 463 / 6 =4610.6mm3

$\sigma b = M / Z$

$\sigma b = 238000 / 4610.6 = 51.62$ N/mm2

σb INDUCED < σb ALLOWED

36.14 N/mm2 < 270 N/mm2 Hence our design is safe

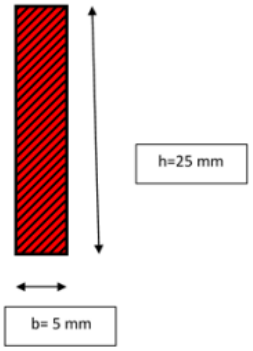
Design of bolt for sheer stress failure: -

Bolt is to be fastened tightly also it will take load due to rotation. Stress for C-45 steel. Standard nominal diameter of bolt is 9.31 mm. From table in design data book, diameter corresponding to M10 bolt is 8 mm.

Let us check how much load bolt can sustain - P =? N is the value of force Stress

= load/area Fig Nut Bolt

Stress = load/area



$P = 135x49.984$ P = 6747.84 N = 687 kg

The calculated load is much higher than any applied load, hence our design is safe.

Design of transverse fillet welded joint: -

Hence, selecting weld rod size = 3.2mm

Area of Weld = 0.707 x Weld Size x L = 0.707 x 3.2 x 25 = 56.56 mm2

Force exerted = ---N

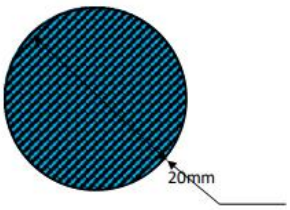
Stress induced = Force Exerted / Area of Weld 21 = F / 56.56 F= 1187.76 N = 121.07 kg

Maximum Allowable Stress for Welded Joints = 21 N/mm2

Design of shaft used as a wheels: -

Now, shaft will fail under bending due to weight of forklift and

job on itLet check how much weight shaft can take



The shaft will be directly welded on tube support and will Not rotate Load is cantilever

M= W X L

The shaft diameter = 20 mm M = W x 46 = 46 W N-mm

$Z = \pi/32 \times d3$ $Z = \pi/32 \times 203$ $Z = 785.3\ mm^3$

σb (allowable)= M/Z 270 = 46W/785.3

W = 4609.3 N W = 469 kg

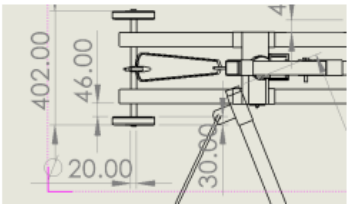


Fig Draft

The maximum capacity of forklift is 68 kg As induced bending load is less then allowable load, so design is safe.

Conclusion

We conclude that,

1. our project will helpful for small scale industries as it is easy to operate with less cost and indirectly it will save the labour cost. Savings resulting from the utilization of this machine will make it pay for itself with in short period of time and it can be a great companion in any field dealing with rusted and unused metals.
2. it's mechanical device, doesn't required electricity as well as any external source of battery. the event of mechanical forklift assures the ergonomically comfort to the operator or worker and to reduces time required for manual lifting and handling. This increases efficiency of productivity and it provide safety of operator while handling of the fabric

REFRENCES

1. **https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=648e97993c3f1dd526bb830bcbf8a86a12093a3b**
2. **https://www.academia.edu/9499439/Design_and_Manufacturing_of_a_Stair_Climbing_Vehicle**
3. **https://computers.stmjournals.com/index.php?journal=JoARB&page=article&op=view&path%5B%5D=300**
4. **https://ijeir.org/administrator/components/com_jresearch/files/publications/IJEIR-1308_final.pdf**
5. **https://www.academia.edu/78432676/Trolley_Turning_and_Lifting_Mechanism**