Design and Fabrication Battery Operated Of Three Wheeler Forklift

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Abstract : Mechanical Forklifts brought great revolution in the industry as the warehousing work was greatly influenced by the widespread use of forklift in the middle of 20th century. They gave a single person the ability to move quintiles of weight at a time. Factories, Go downs and warehouses needs forklifts to move 50-70kg of weight that are comparatively lighter but cannot be moved around by a labor. To rectify this problem we have proposed "Three Wheeler Forklift" to move such medium weight goods, as it is efficient, fast, economical, safe and environment friendly. The third wheel enables the vehicle to turn easily due to small turning radius and it can easily move around in congested areas or places with less floor area.

I. INTRODUCTION

In general the forklift can be defined as a machine capable of lifting quintals of weight. A forklift is a vehicle similar to a small Truck that has two metal forks on the front used to lift pallets of weight. The forklift operator drives the forklift forward until the forks push under the pallet, and can then lift the cargo several feet in the air by operating the forks by the controls. The forks are usually made out of steel and can lift up to a few tons. Forklifts are powered by gasoline, propane, or electricity. Electric forklifts relay on batteries to operate. Gasoline or propane forklifts are sometimes stronger or faster than electric forklifts, but they are more difficult to maintain, and fuel can be costly. Electric forklifts and hydraulic forklift are great for warehouse use because they do not give off noxious fumes like gas powered machines do. A forklift is a one type of power industrial truck that comes in different shapes, sizes and forms. A forklift can be called a pallet truck, rider truck, fork truck or lift truck. Yet, the ultimate purpose of forklift is the same to safely allow one person to lift and moves large heavy loads with little effort.

The vast majority of rough terrain forklifts operate on gasoline, but some use diesel or natural gas. Rough terrain forklifts have the highest lifting capacity of all forklifts and heavy duty tires (like those found on trucks), making it possible to drive them on uneven surfaces outdoors. Forklifts have revolutionized warehouse work. They made it possible for one person to move thousands of pounds at once. Well-maintained and safely operated forklifts make lifting and transporting cargo infinitely easier. This is the general description of a normal forklift truck. To make the project work more realistic, much importance is given for practical orientation, therefore a prototype module is constructed for the demonstration purpose. This module simulates the real working system & based on this technology with slight changes in the structure & motor ratings, the system can be converted for real applications.

Hydraulic forklift also know as hydraulic hand pallet is a tool used to lift and transport heavy load for long distances with the help of pallet. Pallet jacks are the most compact and modern form of forklift and are intended to move heavy and light weight material within a warehouses. For the purpose of training, a forklift is a small or large industrial truck with power operated platform. Like other forms of forklift hydraulic forklift doesn't require any kind of electric power source or diesel and gasoline because hydraulic forklift works on principle of hydrostatic force transmission. Lifting of heavy loads are accomplished with the help of hydraulic cylinder in the forklift. Cylinder is generally fitted at lower parts of fork. Forklifts are most often used in warehouses, but some are meant to be used outdoors.

II) HISTORY OF FORKLIFTS

A few developments helped the forklift to increase in production including the introduction of the standardized pallet in 1930 and World War II. Both of these developments increased production of forklifts and allowed distributors the means to efficiently move heavy loads. As the use of forklifts increased so did the amount of hours they were being used. Shortly after forklifts became prevalent, they were designed with a rechargeable battery that could last 8 hours. In the 1950s warehouses expanded upward instead of out so forklifts were designed to lift loads up to 50 feet (15.2 meters), which was higher than ever before. With the increased load height, certain safety measures to were applied to the forklift during this time including a cage for drivers to prevent them falling materials and a backrest to help keep the load in place as it's lifted. More safety measures were introduced in the 1980s including the operator safety restraint and developments in forklift balance technology

III) III. LITERATURE REVIEW

After conducting an intensive literature review, it was found that Extreme pressure is placed on all functions of traditional warehouse. The warehouses have to be flexible and have possibility to increase or decrease its operations in order to meet any demand. This has both advantages and challenges. A key advantage is that warehouses are ready to underlay economic trends and seasonality. A key challenge is that they have to stay competitive in today's market. This means that managers and engineers must continue to improve the performance of their warehouse operations.

In 1906, the Pennsylvania Railroad introduced battery powered platform trucks for moving luggage at their Altoona, Pennsylvania train station. World War I saw the development of different types of material handling equipment in the United Kingdom.

In market there are several types of forklifts are used in warehouses. These forklifts are either powered by gasoline, propane or electricity but they are more difficult to maintain and fuel can be costly which takes more space. To overcome this entire problem we designed and fabricate the three wheel forklift which drives on electric power and loading & unloading is done by hydraulic jack through forks. In general, there are a lot of activities in traditional warehouses. Product typically arrives packed on a large scale and leaves packed on a smaller scale. In other words, the most of products arrive in pallets, but leave packed in cases; some very fast-moving products are received in pallets and are shipped in pallets. In almost all supply chains, raw materials, parts, and product inventories still need to be stored or buffered. In warehouses products are received in pallets, placed to storage or pick locations, picked and sent to customers. So, the material flow is based on following activities: receiving, put-away, keeping in buffer, refilling (replenishment), picking and shipping. The receiving activity includes the unloading of products from the transport carrier, updating the inventory record, finding quantity or quality inconsistency. Put-away involves the transfer of incoming pallets to storage locations. Also put-away includes physical movements between different functional areas. Pallet pick is considered as retrieval of pallet from storage location to shipping doors. In our project, we tend to square measure exploitation the battery power for the horizontal movement the vehicle and therefore the human power to carry the cargo or packaged product from the bottom.

IV) RECTIFICATIONS OF ERROR:

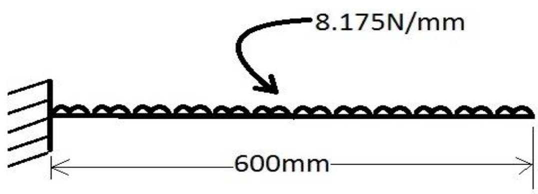
One of the major problem was its complexity in operation and mobility. Previous design constitutes of four wheels which were providing a stable base but at the same time they were causing problems like bigger turning radius, also more the number of wheels more will be the maintenance cost for the same. These machines were operated on both diesel or petrol engines and thus causing pollution in indoor applications. Due to use of conventional engines the work environment was hazardous as the products of combustion contains various harmful fumes many times special arrangements for ventilation were needed to remove such harmful gasses

V) SOLUTIONS

In our project we have countered many of such problems along with those mentioned above. Primarily we have replaced the rear axle two wheel with a single wheel and fork arrangement which steers the vehicle with a drastic reduction in turning radius making it suitable for application in congested areas. As the forklift is battery operated it aims at eco-friendly, fuel efficient and robust working with easy material handling and reduced number of accidents. Its main advantage is that it is battery operated and can be fully automated which can be operated remotely.

VI) DESIGN CALCULATIONS

Calculations for bending moment



B.M.=WL/2 = $8.175*600^2/2 = 1.4715*10^6$N-mm

Let, bending moment on left side be

$1.8*10^6$N-mm (for safe functioning and counterbalancing)

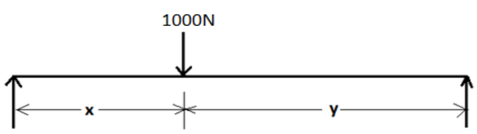
B.M.=x+y

$1.8*10^6$=1000+y

Y=1800mm

Calculations for chassis dimensions

(i) Support reactions



(a) ∑Upward forces = downward forces

Ra+Rb=1000+500*0.7+6500*2-Rb*1.985-100*0.25=0

Ra+Rb=8100(N)--------------①

(b) ∑M@a=0

1000*0.2+500*0.7+6500*2-Rb*1.985-100*0.25=0

Rb*1.985=13525

Rb=6813.602(N)-------------②

From ①and ②

Ra+6813.602=8100

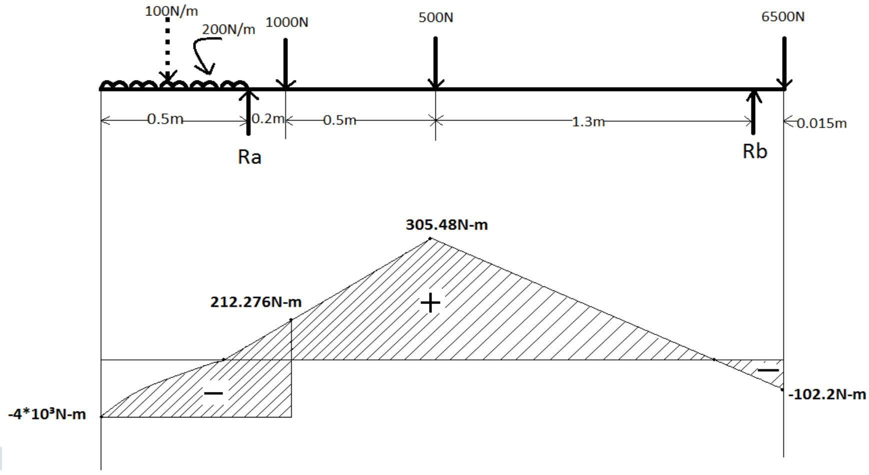
Ra=1286.4(N)

(ii) Bending Moment Considerations

Ma=Mb=0

Moment at point E

Me=-4*10³N-m. (From R.H.S.)



Moment@ point c

Mc= 212.276N-m

Moment @ D (from L.H.S.)

Md= 305.48N-m

Moment @ F

Mf= 1272.04*0.015++1327.95*2-500×1.3-1000×1.8-100×(2+0.25)

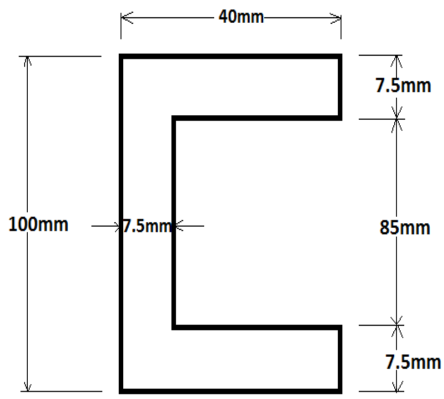
Mf= -102.2N-m

Considering Maximum Bending Moment

Mmax= 305.48N-m

Moment of Inertia

Considering rectangular cross-section



$I=bh^3/12\times2$. Let b=2h. (Material SAE 1045 δ=286)

M/I=δB/Y.

$305.48\times10^3/I=153/40$

Considering material as SAE 1040

δb=Syt/F.S.=306/2 =153Mpa

$I=79.86\times10^3 mm^4$ (allowable)

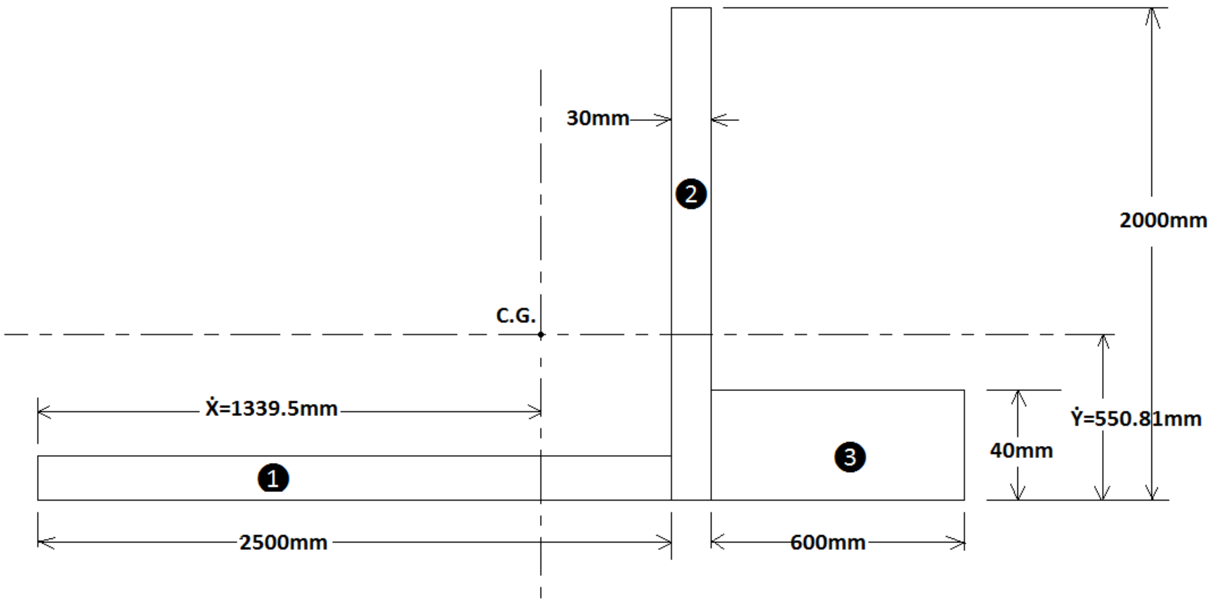
$I=bd^3-h^3\times(b-t)/12$

$= 40\times(100)^3-85^3\times(40-7.5)/12$

$= 1.67\times10^6 mm^4$ lessthan $79.86\times10^3 mm^4$

Hence, the design is OK

Center of Gravity (C.G.)



$A1=2500\times20=25{,}000mm^2$

$A2=1980\times30=59{,}400mm^2$

$A3=600\times40=24{,}000mm^2$

Total area $A=108400mm^2$

Distance of centroid from left side

X1=1250mm ; X2=1280mm ; X3=1580mm

Xbar = A1X1+A2X2+A3X3/A

= 2500×1250+59400×1280+24000+1580/108400

Xbar = 1339.502mm

Distance of centroid from bottom

Y1=5mm ; Y2=995mm ; Y3=20mm

Ybar= 25000×5+59400×995+2×2400/108400

Ybar= 550.811mm

And,

Ybar=984.76mm when the fork is at top.

Calculations for Fork

1)Total Load in Newton

Total load(W)=m×g

=500×9.81

=4905 N

2)Permissible/Allowable Compressive Stress

Taking material as 30c8 or C45 (carbon steel)

δc= Syt/fos

=400/3

=133.33 Mpa

3)Design of Fork

Length of Fork=600mm

Thickness of Fork=25mm

Width of Fork=80mm

a)Moment of Inertia

$I=bd^3/12$

$I=80\times25^3/12$

$I=104.167\times10^3$ mm^4

CASE1)Considering point Load

i)Moment of Inertia

I=2×I (since there are 2 forks)

ii)Bending Moment(M.A)

M.A=-W×L

=-4905×600

$=-2.943\times10^6$ N-mm

(iii) Deflection (Ymax)

$Ymax=WL^3/3EI = 4905\times600^3/3\times203\times10^3\times209.34\times10^3$

Ymax=8.35mm

Exceeding beyond limit

Hence design is not safe

Assuming Ymax=2

And b/d=2 therefore b=2d

$1=2=4905\times600^3/3\times203\times10^3\times I$

$I=869.85\times10^3 mm^4$

$I=I/2$ (for individual Fork)

$I=434.92\times10^3$

Therefore, $I=bd^3/12=2d\times d^3/12$

d=40.91mm

b=80.38mm

CASE II : For Uniformly Distributed Load

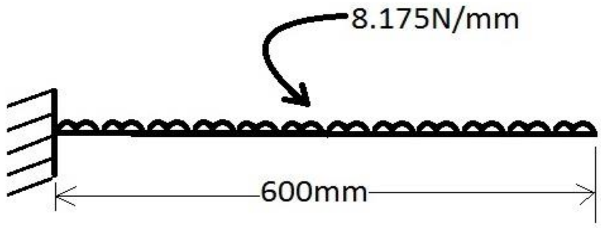
$I=2\times434.92\times10^3=869.85\times10^3$

W/mm=4905/600=8.175N/mm

(I). Bending moment

(M.A.) = $-WL^2/2 = -8.175\times600^2/2$

$=-1.4715\times10^6$ N-mm



(II). Deflection

$Ymax= WL^4/8EI$

$= 8.175\times600^4/8\times203\times10^3\times869.85\times10^3$

Ymax. 0.753mm

VII) REFERENCES

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