International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Design and Analysis of Two-Wheel Drive Forklift for Industrial Warehouses: A Review

Nishant Bhoyar[*1], Dr. P.G. Mehar*[*2]*

[*1]M. Tech Student, Mechanical Engineering Design, K. D. K. College of Engineering, Nagpur, India.

[*2] Associate Prof, Mechanical Engineering Design, K. D. K. College of Engineering, Nagpur, India.

ABSTRACT

Gears are a critical element in a variety of artificial operations similar as machine tools and gearboxes. An unanticipated failure of the gear may beget significant profitable losses. For that reason, fault opinion in gears has been the subject of ferocious exploration. Vibration analysis has been used as a prophetic conservation procedure and as a support for ministry conservation opinions. As a general rule, machines don't break down or fail without some form of warning, which is indicated by an increased vibration position.

By measuring and assaying the machine's vibration, it's possible to determine both the nature and inflexibility of the disfigurement, and hence prognosticate the machine's failure. The vibration signal of a gearbox carries the hand of the fault in the gears, and early fault discovery of the gearbox is possible by assaying the vibration signal using different signal processing ways.

INTRODUCTION

Currently, the main issue for storages is how to increase their productivity. Seeking to address this issue, the exploration studies storehouse processes, which govern the productivity of storehouse. In order to determine possible advancements in storages, the travelling of forklifts is examined. ultramodern Material Handling magazine has made check with regard to storehouse systems. Representatives from different trade sub-sectors (similar as electronics, automotive, medical, paper, artificial products, and others) have responded information about the robotization of storages.

The exploration has set up out that 75 of storages recoup products manually. In similar storages forklifts are the most precious machines due to outfit, labour and conservation costs. This shows the significance of inquiries in similar area. In the literature authors mention that minimization of reiterative and/ or multiple regulations of pallet, as well as non-productive movements and construction of routes for the most- expensive forklifts can help to increase productivity. The utmost of authors mentions that the perpetration of RF- grounded process and the operation of multiple- task approach is used as advanced practice seeking to increase productivity.

On the other hand, scientific knowledge of circumstances and scientifically- proved results should be used to determine the effect of similar executions. In similar complex situations it's necessary to resort to simulation models. One simulation model (which is created by the author) is presented in this exploration. The object of exploration enterprises the travelling of forklifts in storages. The subject of exploration enterprises the evaluation of trip distance savings in storages. The composition is also grounded on relative and empirical analysis.

The object of exploration enterprises the travelling of forklifts in storages. The subject of exploration enterprises the evaluation of trip distance savings in storages. The composition is also grounded on relative and empirical analysis. The end of this paper is after examining the tricks of forklifts travelling in storages, identify openings to reduce trip distance of forklifts. In this paper the travelling of forklift is examined through simulation; and different trials with this simulation model are accepted.

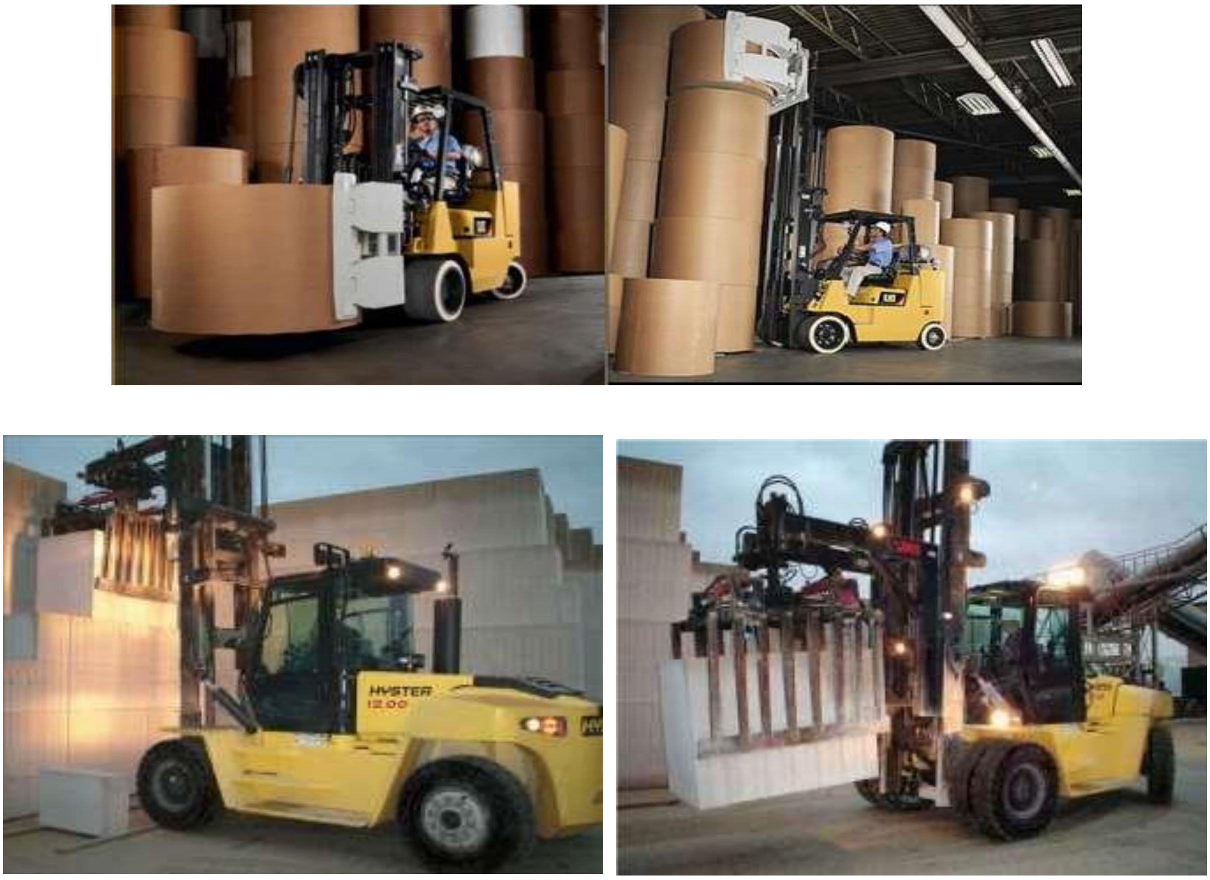


Figure Hyster Forklift Trucks Equipped with Heavy Duty

OBJECTIVES

In this design we probe a forklift design that's new and different from being design. The new design offers two features

1. The forklift attached to the frame body end.

2. The other point is that the new lifting medium by supereminent screw where it's easy to lift and further compact compare to the being design.

3. To reduce the mortal sweats.

4. This machine can be used in storages as well as colorful weight shops, airfields, road junctions.

5. There's a large compass of transportation of goods from one place to another place fluently. The remainder of this thesis describes about further features and details. And also, we do analysis and computation work on the model to make sure it's stable and safe under different working condition.

LITERATURE REVIEW

Pennsylvania Railroad at Altoona:

Pennsylvania Railroad at Altoona introduced a power accumulator in 1906 to a baggage wagon to a primary power truck. The primary transportable lift into a Patent and Trademark.

Dr. R. N. Mall:

There are different types of forklifts around us that are powered by gasoline, electricity but they are very much tough to handle and fuel that are used are very much costly. To solve these criteria, we introduced a 3-wheel forklift that run on both electric power that are used for loading and unloading using hydraulic jack by forks.

Tiny Crane Mounted on a Platform Truck:

Truck was introduced in 1913 that are a combination of both vertical and horizontal handling that are molded on a tiny crane on a platform truck. The hydraulic power that are introduced and development of electric vehicle and utilization of standardized patents in late 1930's.

Low Back Pain in Port Machinery:

In 2002 M. Bovenzi Pintobn Stacchini introduced different varieties of low back pain that was investigated by a standardized questionnaire in a meeting of 219 port machinery operators exposed to whole body vibration & postural load in a meeting of 85 workers that are working in a same company.

These consists of forklift truck driver, straddle carrier drivers and other workers like crane operators and other company workers. The importance of the low back symptoms was much higher in the working of forklift drivers than others workers.

METHODOLOGY

A forklift; is known as tone- generated or tone- propelled vehicle because it can operate without any support, and some forklift operate on battery-powered artificial machine; Its main purpose is for material running among installations or composites as well as outside the composites. Particularly the implicit to elevate millions to be deposited at height also on lower them. These are connected with specific attachments, the chopstick elevated machine is also made to perform indispensable connected functions like the transfer millions from slip wastes onto pallets, also to fix them or to reverse them.

The lattice was designed to sustain a static cargo is over to 80 kg. There's wheel shod the motors and is attached to the frame or covering. The driving motors are deposited below the frame. The frame incorporates hole for attaching frontal wheel, and for attaching the chopstick lifter. Battery is used for furnishing the power to the wheel.

The battery is placed at the hinder platform. utmost of the time a 12- volt battery used to give power. motor is used in my design for moving the chopstick from one place to another, and carrying objects from one position to other my design consists two motors which is run the 2wheels; whereas the lifting portion is completed by lead screw and it's connected to another motor.

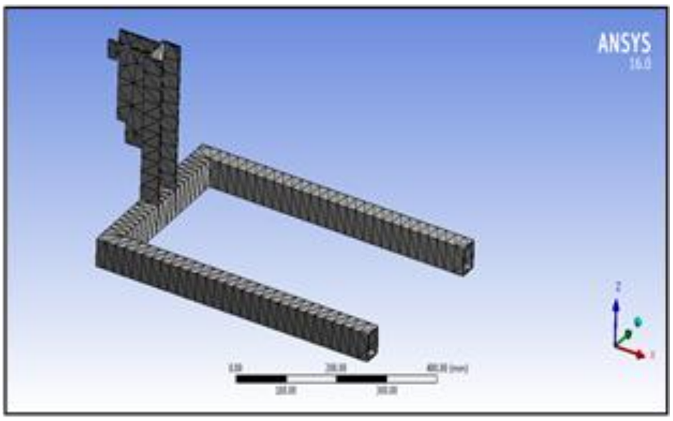
DESIGN PARAMETERS AND CALCULATIONS

Design

The design of forklift is derived as follows.

CHEMICAL ANALYSIS	
C%	Carbon 0.38 – 0.43
Mn%	Manganese 0.75 – 1.00 max
P%	Phosphorus 0.035 max
S%	Sulphur 0.040 max
Si%	Silicon 0.20 – 0.35
Cr%	Chromium 0.80 – 1.10
Mo%	Molybdenum 0.15 – 0.25

Material- AISI 4140



Total load in Newton –

Total Load (W) = Mass (m) × Acceleration due to gravity (g)= 100×9.81

= 981N

Permissible compressive stress (σc)-

σc = Syt/FS = 415/3

=83 N/mm2

Core diameter of screw (dc) –

σc= W/[π/4×dc2] 83= 981/(π/4×dc2)

dc= 3.880 mm

Nominal Diameter d(mm)	Pitch p(mm)
22,24,26,28	5
30,32,36	6
40,44	7
48,50,52	8

Core diameter of screw (dc)

dc= d - p = 22 – 5 = 17 mm

Mean diameter of screw (dm) –

dm = d – 0.5p = 22 – 0.5(5) = 19.5 mm

Helix angle (α) –

tan α = l/ (πdm) = 5/ (π (19.5)) α = 4.666º

Friction angle (∅) –

tan∅ = μ = 0.35 ∅ = 19.29º Since ∅

> α the screw is self- locking.

Torque required to lift & lower the load –

Mt = (Wdm)/2 × [(μsec θ±tanα)/ (1±μsec θ tanα)] For Lifting – Mt= 4366.06 Nmm For lowering – Mt = 2558.005 Nmm

Check for shear & compressive stress failure- 1

. τ = (16Mt)/ (πdc3) = (16(4366.06))/ (π (17)3) = 4.5282 N/mm2 2. σc= W/ [π/4×dc2] = 981/ (π/4×172) = 4.321 N/mm2

Moment of Inertia (I) –

I = π/64 ×dc4 = π/64 × (17)4 = 4099.82 mm4

Cross sectional area (A) –

A = π/4 × dc2 = π/4 × 172 = 226.98 mm2

Radius of gyration (K) –

K = √(I/A) =

√ (4099.82/226.98) = 4.249 mm

Slenderness ratio (l/K) –

l/K = 1000/4.249 = 235.84

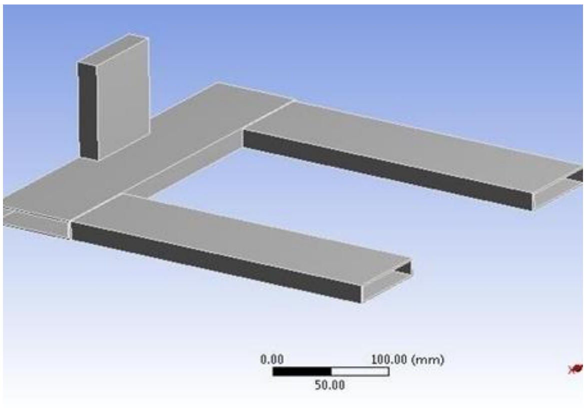
Critical slenderness ratio –

End fixity coefficient (n) = 0.25 Syt/2 = (nπ2 E)/(l/K)2 415/2 = (0.25π2×210×103)/(l/K)2 l/K = 49.94

Critical load on buckling (Pcr) –

Pcr= SytA [1- Syt/4nπE (l/K)2 Pcr= 415 × 226.98 [1- 415/ (4 ×0.25 × π2

×210 ×103) (49.94)2] Pcr= 47109.57 N



Factor of safety for buckling Failure –

FS = Pcr/W

= 47109.57/981 =48.0219 so the design is safe against buckling failure.

Selection of Motor – ·

Required torque of motor (Mt) = 4366.06Nmm · Required speed of motor (N) = 70 - 100 rpm · Type of supply to motor = 12 Volt D.C. Torque required to raise maximum load in Kg-cm = (MtRAISE)/ (9.8 ×10) = 4366.06/ (9.81 ×10)

= 44.506 kg-cm Required speed of motor shaft in rpm

= 70-100 rpm after searching in the market we found no motor of this specification so we choose a motor with 100 rpm 100 Kg-cm torque motor

Gear ratio (G) –

Motor output = (2πNMt/60) = 33.066w Motor torque = 3.2Nm(given) Required torque = 4.3Nm

So, gear ratio should be = 2:1

Torque at driven shaft will be 2*(3.2) = 6.4Nm

Selection of Battery –

From battery available range in market, we assume battery capacity 12V, 7.2 Ah

Battery capacity = V × I

= 12 × 7.2

= 86.4 Watt

The output power will be less so we will have to use two batteries in a series.

Total capacity of both batteries combined = 2 x 84.4 = 168.8

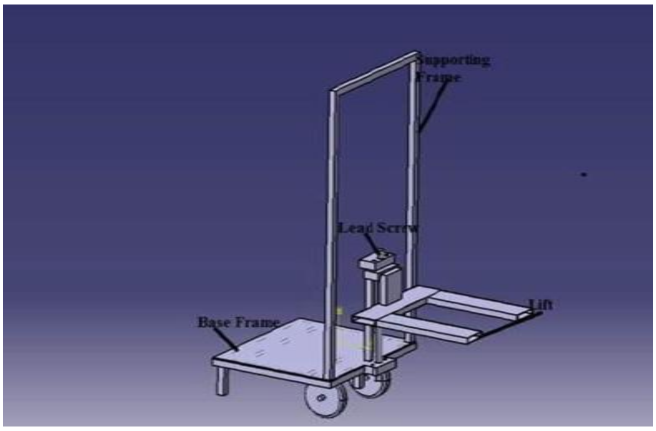
But consider deep cycle of battery is 80% of total capacity of battery

Running capacity of battery = 0.80 × required battery capacity

= 135.04 Watt

Design of Fork –

- Outer face height (D) = 50.8 mm
- Outer face width (B) = 50.8 mm
- Inner ace height (d) = 44.8 mm
- Inner face width (b) = 44.8 mm
- Length of fork (L) = 600 mm



Moment of Inertia of fork (I) -

I= 1/12 [BD3-bd3]

I= 1/12 [6659702.81-4028209.56] I = 219291.10 mm4

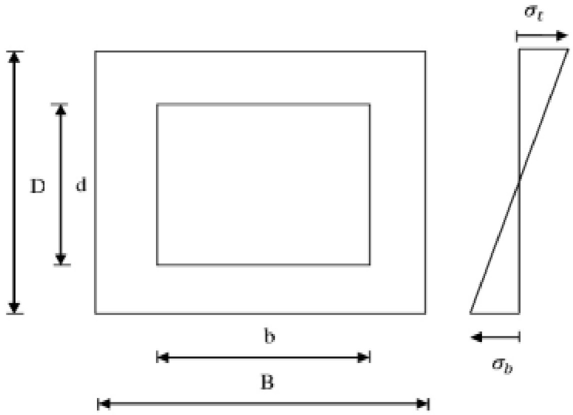


Fig. dimensions of forklift

Consider Two Fork with Point Load –

Moment of Inertia for two fork (I) – I = I1+I2 = 219291.10 + 219291.10 I = 438582.2 Bending Moment (MA) - MA = -W × L = - 981 × 600 M_A = -588600 Nmm Deflection (y_max) - ymax = (WL3)/3EI = (981×600^3)/(3×210×103×438582.2)

y_max = 0.766 mm

Consider Two Fork with Uniform Distributed Load –

Moment of Inertia for two fork (I) – I = I1+I2 = 219291.10 + 219291.10 I = 438582.2 mm4 Find W/mm – W/mm = W/L = 981/600 W/mm = 1.6355 N/mm Bending Moment (M_A) - MA = (-W×L2)/2 = (- 1.655×6002)/2 MA = - 294300 Nmm

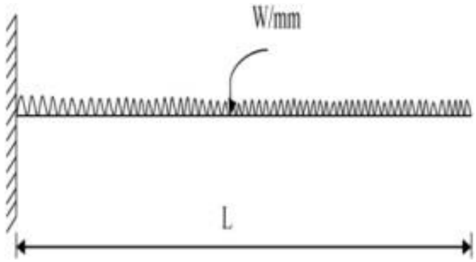


Fig.4 Uniform distribution diagram

Deflection (y_max) – ymax = (WL4)/8EI = (1.6355×6004)/(8×210×103×438582.2) ymax = 0.2875 mm

Selection of bearing –

· Bearing life = 12000-20000 Hrs · Radial load (P) = 2450 N · Speed (n) = 50 rpm · Assume L10h = 12000 Hrs. **Bearing life (L10) –** L10= (60 × n × L10h)/106 L10= (60 ×50×12000)/106 L10 = 36 million rev.

Load capacity (C) –

C = P(L10) (1/3) C = 981(36) (1/3) C =

3239.19 N Using standard table of bearing selection, C = 9950 N C0 = 4150N d = 12mm, D = 37mm, B = 12mm But,

from available bearing range in market, we are assuming suitable bearing – d = 12mm, D = 28mm, B = 8mm

Centre Of Gravity- PartABC

= (517.13, 400, 25) PartDEF

= (536.42, 400, 25) PartGHIJ = (900, 400, 25) PartMKL=

(825,485,547.5) CG of whole frame lies on the coordinates (768.5X, 442.5Y,275Z) above coordinates are with respect to origin that lies on the upper left corner of component A. CG of the part is lying on the part B and as low as 225mm from the ground so the design could not topple, additional trolly wheels are fixed on part A and B to give mobility to the machine.

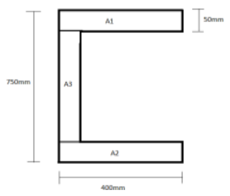


Fig. Lifting fork

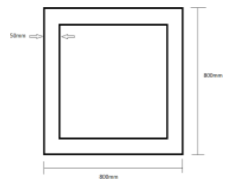


Fig. Box section

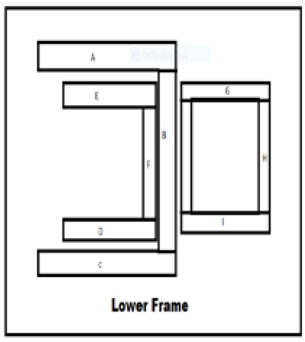


Fig. Lower frame

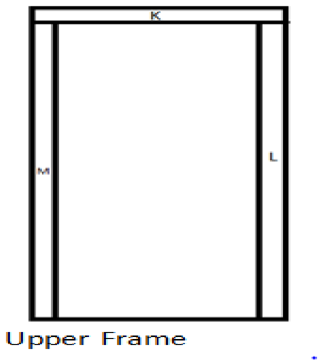


Fig. Upper frame

Power output: -

P = τ * ω = 17 * (100 * 2 π)/60 =

177.93 watts

CONCLUSION

The purpose of this paper was to concentrate on the solving problems at the storages using forklift to carry cargo of lighter weight and making it effective n reduce the accident's passing in storages due to large forklifts. The two- wheel aisle forklift is designed keeping the Centre of idea to increase work effectiveness, reducing power Consumption, lower dimension and hence aisle for movement in narrow space of storages, high safety factor, time saving operation, easy controlling from on board.

At the ending of this report, it's apparent that there are important areas which call for unborn exploration and analysis. The first of this is that fully independent working without any mortal assessment. This will enable further productivity and high trust ability. also, system of lifting forklift can be changed safety measures, power consumption can be reduced. For the coming step in the design of this particular forklift, advanced dedication analysis system should be employed to ensure that lifting medium would to intriguing and give direction towards the operation of this forklift.

REFERENCES

[1]. Seidl M, Dvo ák Z (2011) In-house transport as a part of business logistics. J Eng Manag Compet 1(1/2):1-5.

[2]. Masztelarz M (2010) Methods for accounting of ancillary activities' costs (Metody rozliczania kosztów działalności pomocniczej) [IN] Gabrusewicz W. (ed.) Audyt w systemie kontroli; Conference Proceedings, KIBR, Poznan, Poland 29.11.2010 pp. 131–142 ISBN: 978-83-61287- 45-2 http://www.pracownicy.ue.poznan.pl/ asztalerz/rozliczanie .pro duk cji.pomocniczej.pdf (in Polish) access: 5th November 2015.

[3]. Michałowska K (2013) Logistics costs in a company (Znaczenie I sposoby rozliczania kosztów logistycznych); Zeszyty Naukowe Uniwersytetu Szczecińskiego nr 765, Finanse, Rynki Finansowe, Ubezpieczenia^ Wydawnictwo Naukowe Uniwersytetu Szczecińskiego. 61(2):325–334. In Polish.

[4] R S Khurmi, J.K Gupta (2005), a text book of Machine Design.

[5]. S. S. Rattan (2009), Theory of Machines, Professor of Mechanical Engineering, National Institute of Technology, Kurukshetra.

[6]. J B Gupta (2011), Basic Electrical & Electronics Engineering.

[7]. B L Thareja, A K Thareja Revised by S G Tarnekar (2005), Electrical Technology, Former Professor & Head, Electrical Engineering Department,

[8]. Visvesvaraya National Institute of Technology, Nagpur

[9]. Conte M (2010) Super capacitors technical requirements for new applications. Fuel Cells 10:806–818.

[10]. Hyster-Yale Materials Handling, Inc. Retrieved 15 December 2013.