Design And Development Of Vertical Material Handling Lift For Reduce Cycle Time And Cost Optimization

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Abstract - Material handling is important thing for the Industries .Material handling involves short-distance movement within the confines of a building or between a building and a transportation vehicle. It utilizes a wide range of manual, semi-automated, and automated equipment and includes consideration of the protection, storage, and control of materials throughout their manufacturing, warehousing, distribution, consumption, and disposal. Material handling can be used to create time and place utility through the handling, storage, and control of material, as distinct from manufacturing, which creates form utility by changing the shape, form, and makeup of material.

Key Words: Material Handling , Cycle Time ,Lift, Design ,System Etc .

1. INTRODUCTION

Material handling is important thing for the Industries .Material handling involves short-distance movement within the confines of a building or between a building and a transportation vehicle. It utilizes a wide range of manual, semi-automated, and automated equipment and includes consideration of the protection, storage, and control of materials throughout their manufacturing, warehousing, distribution, consumption, and disposal. Material handling can be used to create time and place utility through the handling, storage, and control of material, as distinct from manufacturing, which creates form utility by changing the shape, form, and makeup of material.

In industries the loading unloading from first floor to ground and weighting of that product consumes more time, and to reduce this phenomenon we made a simple mechanical arrangement for easy shifting of products.

The mechanical arrangement to reduce the time requiring for loading and unloading of casting products from the conveyer to the vehicle , in industry they uses a mobile Crain for lifting the container filled with heavy casting products and carry for the further operations carried out over the castings. Then we search some of those ideas or thoughts regarding to this time consuming process and to reduce the money factor required for the Crain. Then we made a mechanical arrangement for lifting the heavy castings from the one floor to ground.

2 PRESENT THEORIES AND PRACTICES:

2.1.1 Vertical Material Handling System (GargUttam , BE Mechanical, H.J. TEEM Collage of engineering)

Several definition of material handling exists. Material handling is defined in Compton's Interactive Encyclopedia as "The moment of raw material, Semi-finished goods and finished article through various stages of production and warehousing is called material handling."Traditional view of material handling sees material handling operation as non-value adding and only contributing to the cost of product. The modern view recognizes the space and time utility of material handling operation. Material handling equipment is used to increase output, control costs and maximize productivity. The various methods used for material handling in vertical direction are inclined conveyor, lift, robots, spiral conveyors etc. The angle of inclination in case of inclined conveyor is limited to certain value. The inclined conveyor also consumes large amount of space. The lift is another requipment to transfer the material from ground to first floor.

2.1.2 Material Handling (bhowadrugved, rahulchorghe, yadavsachin "International Journal of Mechanical Engg. & Technology. (IJMET) ,Volume 6 , Issue 2 , February 2015 ,pp.19-29.)

The purpose of this research is to design and suggest a new mechanism other than the very conventional methods used for material handling. Nowadays value and requirement of land in India has grown very rapidly. Thus effective space utilization is given prime importance in industrial design. Various manufacturing processes are carried out on multiple floors. For example while manufacturing wafers, soaps, biscuits and other cookies and also on various assembly lines different processes are carried out at multiple stations. These stations are built on multiple floors for optimizing the space utilization. Also the finished goods are stored at a higher level on racks. Thus the need of an efficient and compact material handling system in vertical direction is arising day by day which will transfer the material at higher rate than some existing material handling system.

Organizations are trying to utilize every inch of space often consider vertical carousels and vertical lift modules because of high storage density they provide.

2.1.3 WhaleedKhalafJabbar and Dr. Mohammad Tariq, "Matrial Handling" International Journal of Advanced Research in Engineering &Technology (IJARET), Volume 5, Issue 4, 2012, pp. 68 - 87,

We are focusing on the material handling which takes place between two manufacturing stations which are placed one above the other. For doing so nowadays inclined conveyors are used. Conveyors take longer to transfer material and also consume more space. Thus we have developed a system working on a mechanism which is obtained by fixing the crank of a single slider crank chain. The system is compact and works on inversion of single slider crank chain similar to piston cylinder arrangement in I.C. engine. The system transfers the material vertically in n number of steps. Each step consists of crank, connecting rod and piston arrangement. As the crank rotates piston20reciprocates inside the guides provided. Height of piston is increased in every step. Here six cranks are mounted on one crankshaft at 180 degree to each other. Resembles to six piston cylinder
Mounded on one crankshaft. The top of piston is inclined at an angle with the horizontal. The objects transferred from one piston to next piston after every 180 degree of crankshaft revolution. Thus after every step a certain height is achieved by object. After reaching the peak in every step the material is transferred to the next piston which is at its bottom most position. To move the material up, piston height is increased in every step by certain calculated value. The height achieved by piston in every step is equal to diameter of crank. To transfer the objects with small width this system is more effective. As the width of the object goes on increasing the length of system will also increase. The length can be reduced by
Increasing the crank diameter which will reduce the number of steps required and thus reduces the length.The model which we have prepared lifts a 50 mm wide object to a height of 1150 mm consuming 0.5 meter horizontal length. This system can be modified as per the applications. The system looks like staircase to climb from one floor to another with its steps reciprocating vertically.

3. PROBLEM IDENTIFICATION

1.The process was time consuming .
2.More human efforts was required .
3. Due to more labor expenditure on labor is more .
4.Increased Lead Time .
5.Bulky process .
6. CRAIN rent per hour is more for shifting product from one place to another

4. CONSTRUCTION

The lift consist of two frames in which one moves up & down with relative to other . Main body frame is made up with channel section where slot is provided inside for the motion of moving frame . The whole assembly is made up of MS (Mild Steel) .

The main body frame is provided with a square block at bottom which provides a proper stability to the whole assembly .On the top of the main frame I-section is provided where Motor-Hoist is to be mounted . I-section provides a proper grip and sliding motion to Motor- Hoist .

The Motor-Hoist is consist of Motor of about 3 Hp and a rope which is about 6 mm in length approximately . On moving frame the hook is provided on the top to which up & downward motion is applied through a rope .

While lifting the load to the downward side it also measures the weight of casting products and for that four load cells are provided at the four corners of a moving frame , a metal sheet is placed over the face of frame on which casting are to be carried and the metal sheet is about 8 mm thick .

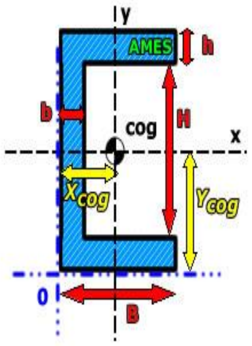
5. WORKING

The lift is placed over the ground floor, where transport vehicles are parked , the casting products traveled over a conveyer gathered in a square block . The weight of that block filled with the castings is about 1 to 4Ton approximately .The container is lifted with the help of pallet truck and placed on sheet provided over the frame .

The up& down motion of moving frame is carried out by using the motor Hoist , on the top of the main body Motor-Hoist is attached with rope . The rope with hook is subjected to a moving frame which causes the up & down motion . The motor is about 3 Hp and rope having a diameter about 6 m in length approximately . The working of motor can be control by a remote by the operator The block filled with casting placed over the sheet and at that time the weight of block is measured by using load cells provided on each center of a two frames. Load cells are further connected to digital indicator by junction box .After that lift goes down to the ground and then again by using pallet truck the block is loaded inside the truck or any transport vehicle and transport to perform a required machining on casting products in different industries . The lift minimizes the time required for the shifting or loading – unloading of casting products and saves money too.

6. DESIGN CALCULATION

1. Stress Calculation for Working Frame Channels-



A) To calculate Area of channel having length,

l = 1700 mm.
We have ,
B= 45mm
H= 80mm
l=1700mm
b= 8mm , h=10mm.
now ,

$A_1 = 2(2BH+Hb\times l)$
$= 2(2\times45\times10+80\times8\times1700)$
$= 2.17\times\times10^6$ mm²

Now ,

B) Area of channel having length , l= 1445

$A_2 = 2(2\times45\times10+80\times8\times1445)$
$= 1.85\times\times10^6$ mm²

Now ,

C) Total area of square channel ,

A = A1+A2
$= 2.17\times10^6 + 1.85\times10^6$
$A = 4.02\times10^6$ mm²

D) To calculate force acting on channels (F)-

F = m × g………..(g = 9.81)
= 4000×9.81
F = 39240 N

E) To calculate stress upto which the channel can withstand ,

$$\text{Stress} = \frac{force}{area}$$
$$= \frac{39240}{4.02\times10^6}$$
$= 9.76\times10^{-3}$ N/mm²

i.e compressive stress = 9.76×10^{-3} N/mm²

i.e selected design of load can withstand upto this **stress**

2) Torque calculation for selected motor –

Motor specifications –
Vtg.- 415v-3Ø
I – 4.8 Amp
Rpm – 1440
Now ,

$$\text{Total torque} = \frac{Hp\times5252}{rpm}$$
$$= \frac{3\times5252}{1440}$$
= 10.94 lb.ft
T = 1.094 N.m

3) Selection of rope –

Material selected - stainless steel - 6×19

At first , stresses acting on the rope are taken into consideration ,

I) Direct stress due to axial load lifted & weight of the rope ,

Let ,
W = Load lifted
w = weight of rope
$= 0.0383\times d^2$
$= 0.0383\times8^2$……..(d = 8 …std. tables)
w = 2.45 N/mm.
A = Net-cross section area of rope .
$= 0.38\times d^2$ ……(std. table)
$= 0.38\times8^2$
= 24.32 mm²
Now ,
Direct stress ,

$$\sigma_d = \frac{W+w}{A}$$
$$= \frac{39420+2.45}{24.32}$$
$$\sigma_d = 1.61\times10^3 \text{ N/mm}^2$$

II) Bending stress in the rope due to wound over a Hoist sheave or drum ,

$$\sigma_b = \frac{Er \times dw}{D}$$

Where ,
Er = Modulus of elasticity i.e. 84 KN/mm^2…….(for stainless steel)
dw = diameter of wire .
= 0.063×d
=0.504 mm.
D = diameter of sheave or drum .
= 45×d
= 45×8
= 360 mm.
Now ,

$$\sigma_b = \frac{84\times10^3\times0.504}{360}$$
$$\sigma_b = 117.6 \text{ N/}mm^2$$

Now ,

I) Equivalent bending load on rope ,

$$W_b = \frac{Er \times dw \times A}{D}$$
$$= \frac{84\times10^3\times0.504\times24.32}{360}$$

$= 2.860 \times 10^3$ N

II) Effective stress –

$= \sigma_d + \sigma_b$

$= 1.61 \times 10^3 + 117.6$

$= 1.72 \times 10^3\ N/mm^2$

Now ,
For designing a wire rope ,

$$\sigma_d + \sigma_b < \frac{\sigma_{ut}}{FS}$$

And,
it is conclude that the design is safe for selected material for wire rope
i.e. stainless steel (6×19).

1. Specification of proposed indexing mechanism for vertical lift –

Function – to save time and cost optimization in material handling for ease of operations .

2. Specifications –
Type of prime mover – Motor Operated
Capacity of motor – 3Hp
Type of Load Cell – shear beam type Load Cell (RSL 803)
Capacity of Load Cell – 1 TON
Rope – 8 mm in length
Channels – C & I Channels
Human requires – 2 to 3

3. Motor specification –
Manufacturer – Siemens
Capacity – 3 Hp
Motor speed – 1440rpm
Vtg. Required –340 v

7.CATIA DRAWING

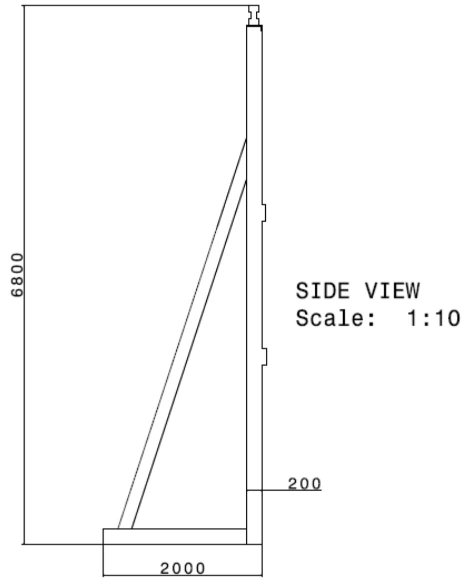


Fig -1: SIDE VIEW – MAIN FRAME

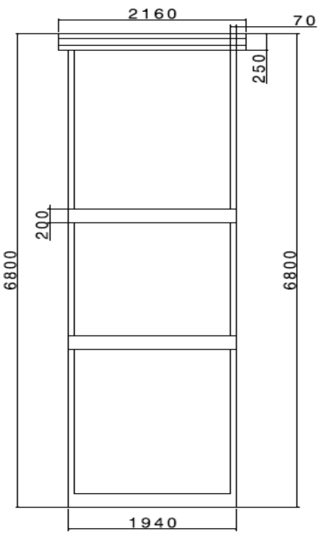


Fig -2: FRONT VIEW – MAIN FRAME

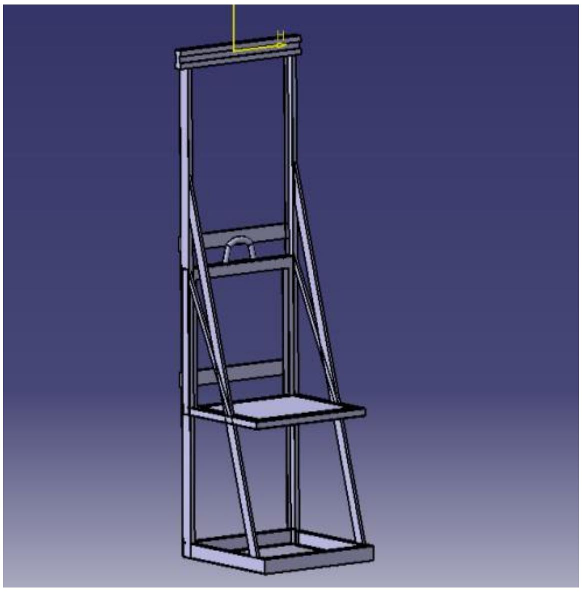


Fig 3: LIFT

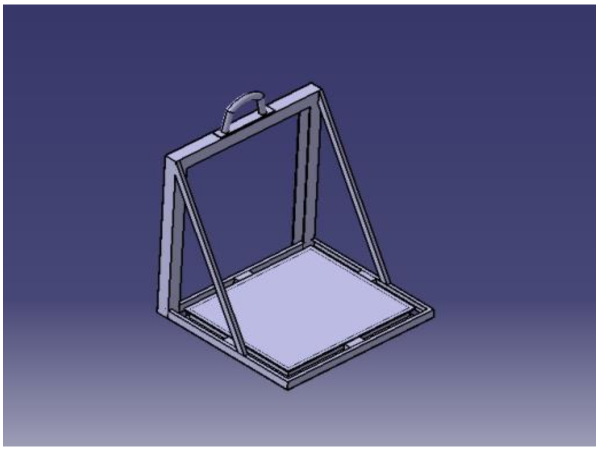


Fig -4: WORKING FRAME

8. COCLUSION

From above project we conclude that ,

1.Reduces manufacturing cycle time.

2.Reduces delays, and damage ,

3.Promotes safety and improve working conditions,

4.Maintains or improves product quality .

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BIOGRAPHIES

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