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Design Consideration of Material Handling Equipment for Ganga Iron and Steel Limited, Nagpur

Dr. Bharat Chede[1], Ashish Mangilal Sinha[2], Swapnil Choudhary[3], Nitin Sawarkar[4]
[1]Guide and Assistant Professor, Department of Mechanical Engineering
[2, 3, 4]Project student, Department of (M.Tech CAD/CAM).
Wainganga College of Engineering and Management, Nagpur

Abstract: In the last several years' material handling has become a new, complex, and rapidly evolving science. Material handling system (MHS) design has a direct influence on the logistics cost. This work is to locates and identifies the wasteful activities regarding the material handling, and to streamline the activities to reach a minimum of material handling. Most of industries are using EOT cranes for handling of material. In today's modern era, crane is very important material handling equipment in industry because of safety reliability, fast speed, economy etc. In this paper, discussed about design Consideration of material handling equipment for ganga iron and steel limited Nagpur. In the current material handling equipment, the life of the overhead crane as well as the cost of the material handling equipment is too important to stay in the competitive market of the industries. The cost of the material handling equipment is depending on the weight of the material. The performance of the material handling equipment will be done by the working on the optimization of the overhead crane used in the industries. Crane is a reliable component for lifting load in industries. Crane fails due to high friction in between wire rope and pulley. It leads to failure in gear box or it may increase power requirement of crane to lift loads. It is necessary for the crane to lift the load with minimum effort and minimum friction between the mating surfaces Based on the design calculations and analysis, a prototype crane was simulation, ncs, analysis.

I. INTRODUCTION

Any human activity involving materials need material handling. However, in the field of engineering and technology, the term material handling is used with reference to industrial activity. In any industry, be it big or small, involving manufacturing or construction type work, materials have to be handled as raw materials, intermediate goods or finished products from the point of receipt and storage of raw materials, through production processes and up to finished goods storage and dispatch points. Material handling as such is not a production process and hence do not add to the value of the product. It also costs money; therefore, it should be eliminated or at least reduced as much as possible. However, the important point in favors of material handling is that it helps production. Depending on the weight, volume and throughput of materials, mechanical handling of materials may become unavoidable. In many cases, mechanical handling reduces the cost of manual handling of materials, where such material handling is highly desirable. All these facts indicate that the type and extent of use of material handling should be carefully designed to suit the application and which becomes cost effective.

There are thousands of pieces of material handling devices. This equipment's vary from the most basic manual too to the most sophisticated computer-controlled material handling systems that can incorporate a wide range of other manufacturing and control functions. The efficient handling and storing of materials are vital to industry. In addition to raw materials, these operations provide a continuous flow of parts and assemblies through the workplace and ensure that materials are available when needed. Material handling equipment (MHE) is used for the movement and storage of material within a facility or at a site. Logistics is all about getting the right product to the right place at the right time to the right person for the least cost Material handling involves the movement of materials, in batches

or one item at a time within the plant. Material handling system provides transportation and storage of materials,

components and assemblies. Material handling activities start with unloading of goods from delivery transportation, the goods then passed into storage, machining, assembly, testing, storage, packaging, and finally loading onto transport. Each of these stages of the process requires a slightly different design of handling equipment's. Expressed in simple language, Material handling is loading, moving and unloading of materials. To do it safely and economically, different types of tackles, gadgets and equipment's are used, when the material handling is referred to as mechanical handling of materials. Since primitive men discovered the use of wheels and levers, they have been moving materials mechanically. Material handling uses different equipment and mechanisms called Material Handling Equipment.

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II. CLASSIFICATION OF MATERIAL HANDLING SYSTEM

A. Equipment Oriented System
1) Convey system
2) Tractor transfer system
3) Fork lift truck
4) Industrial truck system
5) Underground system

B. Material Oriented System
1) Unit handling system
2) Bulk handling system
3) Liquid handling system

C. Method Oriented System
1) Manual systems
2) Automated system
3) Job shop handling system
4) Mass production system

D. Function Oriented System
1) Transportation systems
2) Conveying systems
3) Transferring systems
4) Elevating system

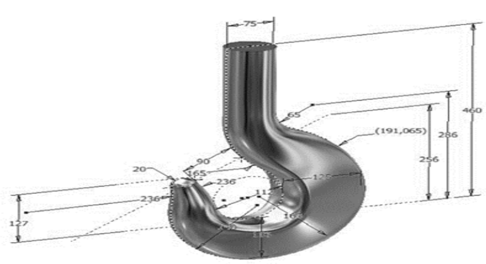
III. OBJECTIVES

A. Reduction in manufacturing cycle time through faster movement of material and by reducing the distance though which the material are moved cycle time result in reduced work-in-progress inventory cost .
B. Improved working condition and greater safety in moment in material.
C. Increased storage capacity through better utilisation of storage areas.
D. With an integrated material handling system installed, failure/stoppage in any position of it lead to increased downtime of the production system.

IV. DESIGN OF MATERIAL HANDLING EQUIPMENT

Components used in material handling Crane Design-
1) Crane Hook
2) Pulley
3) Wire rope
4) Drum
5) Electric motor
6) Brake

A. Design Of Crane Hook



In this phase basic dimensions for crane hook are calculated like bed diameter, throat diameter, depth of crane hook. In this study trapezoidal type cross-section are considered.

The hooks are tested to more than double the working load, and for this reason their strength need not be investigated ordinarily. Analysis of the stresses in the hook, which is a curved bar subjected to combined bending and tensile stresses is a matter of same complexity.

The most suitable practical section for the body of the shank hook approximates the triangular or trapezoidal from with the proportions.

Hook bed diameter is given by the formula,

$C=\mu\sqrt{p}$

Where P is the load applied in tonne & μ is a constant varying from 3.75 to 7.5

For economy of material, the value of μ should be kept as low as possible, the lower limit being fixed by the size of slings, ring etc. to be accommodated. In shank hooks using metal fittings, μ has been fixed at 3.75. For 50 Tonne Hook, $C = 3.75\sqrt{5}$ $= 8.385$ cm This relation between C and d for the recommended standard section is $d= 3.125\ \sqrt{P} +0.1\ C = 3.125\ \sqrt{5} + 0.1\times 8.385 =7.8275$ cm $=7.8$ cm This value of d will be at the horizontal and vertical center lines of the hook, whilst at a plane mid way between these (say at 45 to the horizontal), a section having a value of d some 8% greater is used. In this case, a value of $78\times 1.08=8.5$ cm. is attained. As the body curves to join the shank, the section may be reduce provided that the reduction does not case the maximum stress to exceed a specified value.

The working tensile stress in the shank may be assumed at 400 kgf/cm² .as recommended by some authors.

Let d^1=Dia. Of shank at bottom of the threads.

Then, $0.785\ (d^1)^2\times 400= 500$

$(d^1)^2= 16$, $d^1= 4$ cm

The hook load will be carried bal thrust bearing through a round nut screwed on to the end of the shank.

Full dia. Of the shank = 40/0.84 = 48 mm say 50mm

The other dimensions of triangular (or trapezoidal as it is called) section of the body of the hook can now be known.

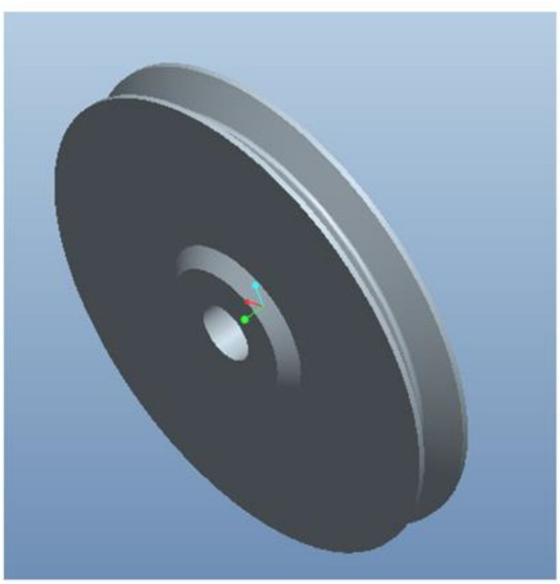
Breadth at intrados =0.65 × 78 =50.8 say 51 mm

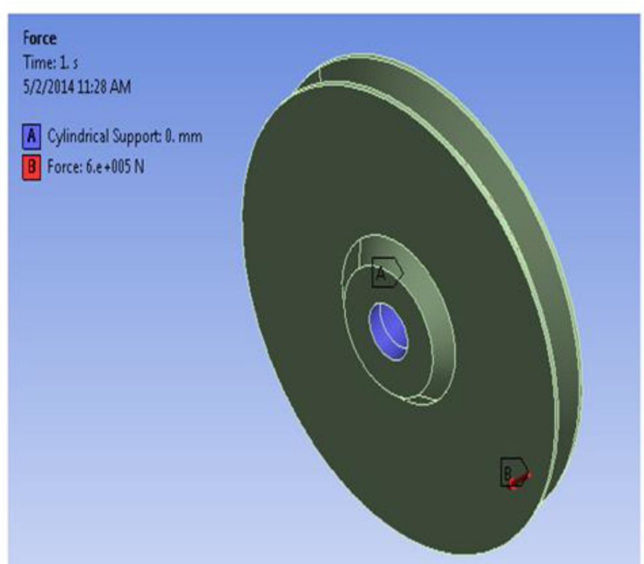
Radius of intrados curve = 0.75×78= 58 mm

Bed dia. = 84 mm

Corner radius = 78/8 =10 mm

B. Design Of Rope Pulleys





For 6/37 construction of the wire ropes the minimum dia. Of rope pulley at the bottom of the

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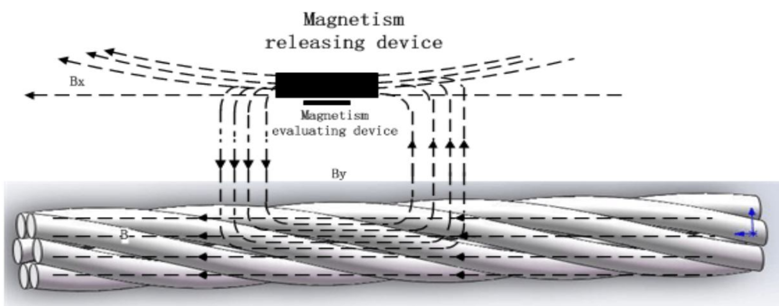
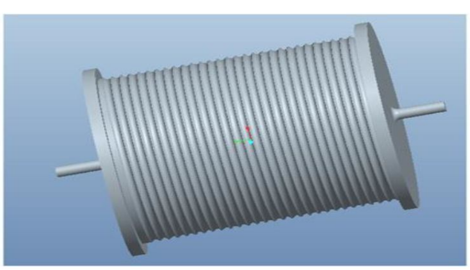
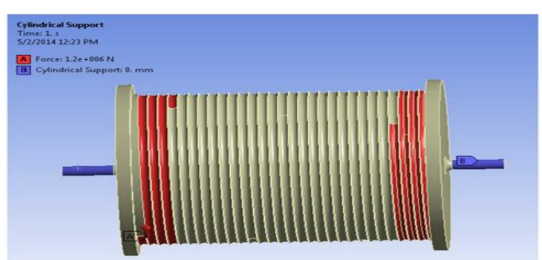
v-groove as recommended by IS-2266-1963, should be 6 times the circumference of the rope.
On this assumption, the P.C. dia. Of rope pulley should be 6×4.4 =26.4, say 27 cm or 270 mm at the bottom of the groove say 285 mm rope crs (min.) adopt 290 mm dia.
The general design of the rope pulleys may now proceed.
As the dia. Of the pulley is 290 mm (rope crs) only a solid web with cored holes (to lighten the weight) and with lateral ribs for stiffening will be preferable.
One point that requires special investigation is the intensity of bearing pressure on the pulley pin. In this case the pulley boss acts as a bearing and is not fixed to the pin.
The bearing pressure on pulley pin should not exceed 18 kgf/cm².
Minimum projected area required for each pulley = 5250/(2×78) = 33.65 cm²
Both the pulley will have to be accommodated within a space of 118 mm (distance between the side plates), so that the boss length of each pulley should not exceed (118-2)/2 = 58 mm.

C. *Selection Of Wire Rope*



The load will be on 4 falls; i.e., on two rope pulleys through the medium of an equalizing pulley or sheave fixed to the crab (trolley) frame. Load per fall = 5000/4 =1250 kg plus 5% due to
D.T. of Hook block =1313 kg A factor of safety of 8 (minimum) is usual in the design of electric overhead travelling cranes and hoists etc.
Breaking load of the wire rope should be 1313×8 = 10500 kg (approx.)
Three construction of wire rope are in most common use for the design of hoists etc. 6/19, 6/24 (with fiber), and 6/37 out of these three, 6/37 is preferable, being more flexible than the other two. Also, to reduce the dia. Of rope pulleys to a minimum possible a superior grade of wire rope having a tensile breaking stress of 1725 to 1885 kgf/cm² will be adopted.
From IS: 2266 – 1963 a wire rope having a circumference of 44 mm (14 mm ra.) and having a tensile breaking stress of 1725 to 1825 kgf/cm² will have a guaranteed breaking load of 10900 kg.

D. *Design of Rope Drum*

The rope drum should be made of seamless pipe machined & grooved accurately, to -ensureproper seating of wire rope in a proper layer. The drum should be fitted with two heavy duty Ball Roller bearings of reputed make for smooth operation & longer life.
Drum length =pitch x ground height x no of rope fall/drum dia =35x10000x8/667 =4197mm [let ground height be 10m]
Average drum thickness = h+h/2 = 31.9+7.1/2 =35

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E. Selection Of Electric Motor

Hoist & crane duty hour rated squirrel cage induction motors, confirming to IS 325 with comparatively higher H.P. and higher starting torque to reduce handling time. It is flange mounted to suit the design and provided with suitable insulation
Lifting speed varies from =10 to 26 f or 50.79 to 132.08 mm/sec.
Speed of drum =4×0.132/R = 2N
For drum rotating angular speed = w lifting speed/dia. Of the drum=0.184 radian
Power transmitted by shaft = 2NT/60
Power = 4×0.132×50000×6 = 158400
Watt=158.4 kW [7]

F. Selection Of Brakes

When selecting the proper brake for a specific application, there are several factors are consider; a few that need to be reviewed- Brake torque, stopping time, deceleration rates, brake mounting, brake location, thermal rating, environment, brake style. The brake systems manufactured external friction brakes

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G Bhagyaraj1, K Suryaprakash2, K Subba Rao **3**
1M.Tech. CAD/CAM, Godavari Institute of Engineering and Technology, Rajahmundry
2Associate Professor, Godavari Institute of Engineering and Technology, Rajahmundry
3Head of Department, Godavari Institute of Engineering and Technology, Rajahmundry

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1Kumbhar P.M., 2Ballal Y.P and 3Pawar G.B. 1Student, 2,3Assistant Professor, Department of Mechanical engineering, Annasaheb Dange College of Engineering and Technology, Ashta, India

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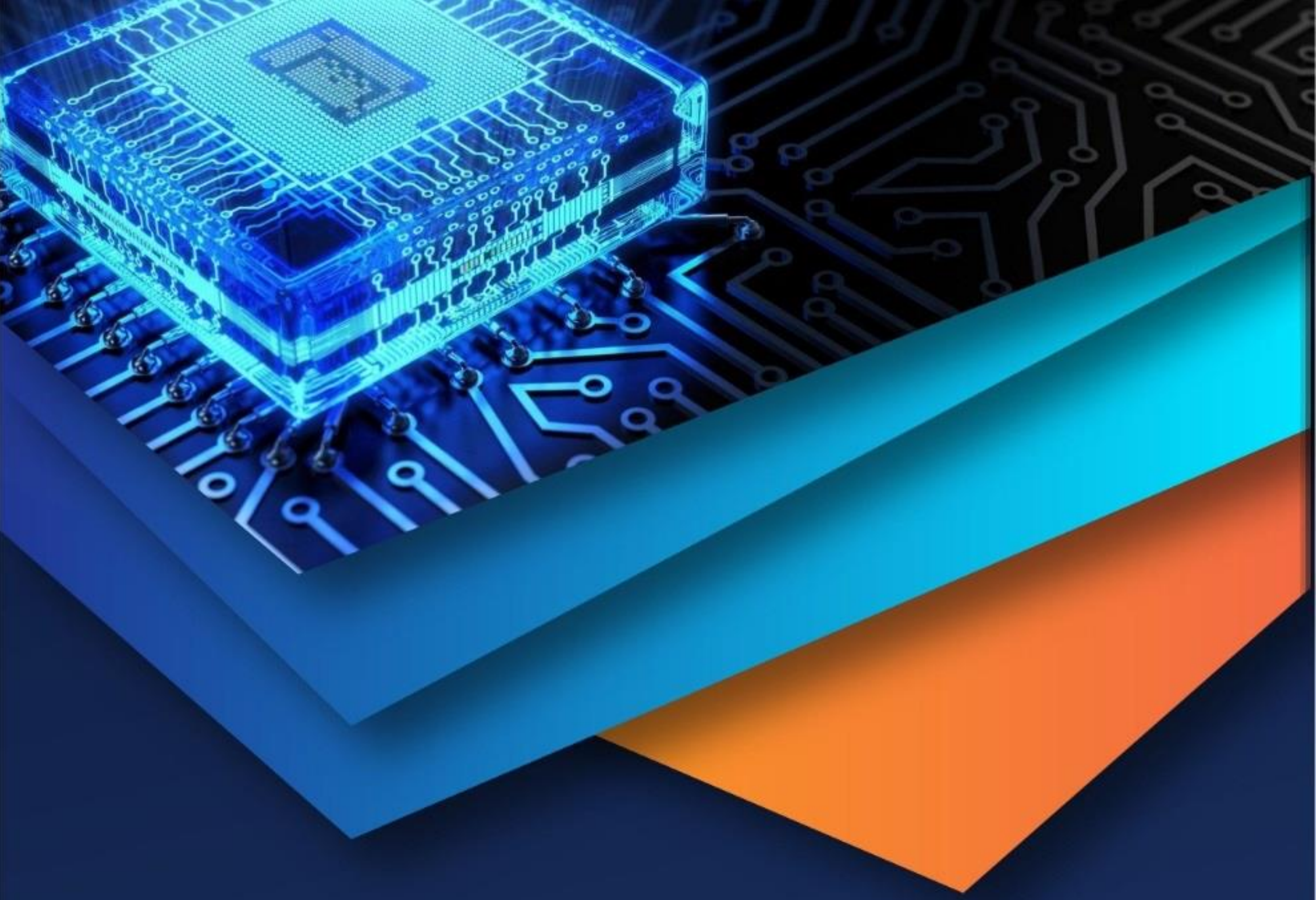
1Patel Paresh, 2Nirav Kamdar
1PG Student, 2Assistant Professor
1KIRC Kalol, india



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