BASIC COMPONENT DESIGN CONSIDERATION OF OVERHEAD CRANE

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ABSTRACT- Design is an essential task of engineering it consists of scientific principal and technical information and imagination for the development of new or improved machine or mechanical system to perform specification with maximum efficiency and economy. Overhead cranes are gaining more and more importance due to their ease of carrying heavy loads and easy coordination with the space this paper tries the best to incorporate maximum details of overhead crane.

KEY WORDS-Overhead Crane, Hook, Motor, Power Consumed, Capacity, Pulley, Drum.

INTRODUCTION

A crane is a complex machine whose height and reach along with the movement allow it to perform a variety of load handling tasks. They are commonly seen in construction zone, shipyards and factories.

Overhead travelling cranes are widely used in manufacturing plants & metal extraction industries.

Such cranes vary in lifting capacity from about 2 tons to 400 tons span from 6 m to 50 m or more. For capacities of 10 tons and upwards have independent auxiliary hoist rated at 1/5 to 1/3 that of the main hoist.

Depending upon the purpose for which it is designed the crane can be operated from ground or from the cabin. Of many types of overhead traveling cranes in use the most often used is of moveable bridge type.

The design provided here is for 50 tone lifting capacity to approximate 15m hoist height with a speed of 15m/min. Design of overhead crane including designing of hoisting, traversing and travelling mechanism. This includes designing of various parts such as hook, pulley arrangement, drums, selection of motor, etc. Overhead cranes are widely used in warehouses, metal extraction industries and machine shops.

The purpose of this design is to design the various main components of overhead crane widely used in warehouses, metal extraction industries and machine shops.

The main objective of this work are

1. Power requirement (approx).

2. Select the type of motor used.

3. Design the hook for carrying load.

4. Selection and design of pulley system.

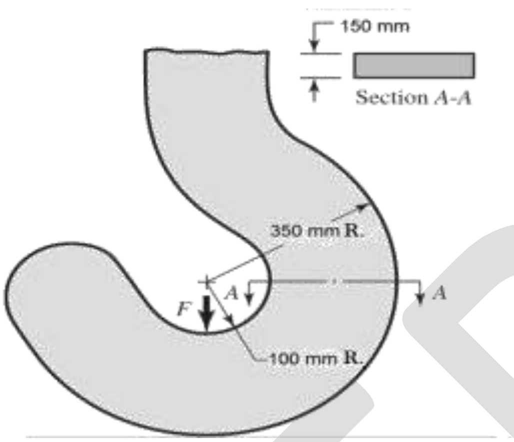
5. Design of drum for carrying rope.

With D.C. equipment it is good practice to rely on the overload capacity of the motor to take care of peace occasional overload variation of lines voltage has marked effect on A.C.

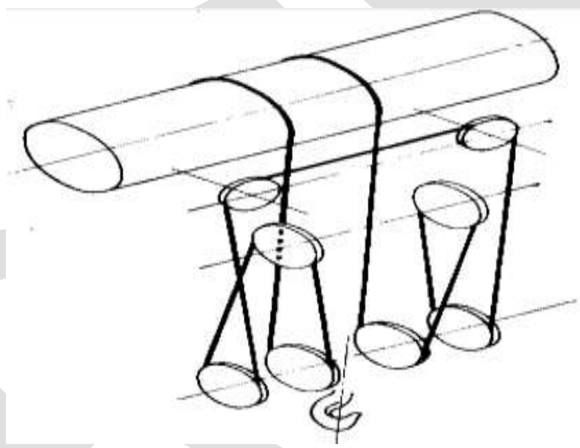
Induction motors has been taken into consideration to ensure that sufficient torque, well within the value is available for starting.

The lifting hooks for crane load are generally made of trapezoidal cross section for load up to 50 tons. These can be designed from the standard proportions in terms of internal diameter. But cross sectional area of hook is assumed to be rectangular in our calculations. But in general trapezoidal is considered to be best optimized. The rectangular cross section is subjected to direct stress and bending stresses. In the analysis done below hook is subjected to bending moment which is calculated about the centroidal axis not the neutral axis.

For hook we have considered dimensions : Breadth, b=150mm, height, h=250mm, Internal radius of curved section, r_o =350mm,External radius of curved section, r_i =100mm, factor of safety considered as 5.3 and material for hook as High strength alloy steel.



1. hook



2.Pulley arrangement for reducing the load

For designing a pulley system the principle of tackle block is employed. Here the drum pull is multiplied by reeving to obtain the hook pull and divided by the reeving to obtain the hook speed. Doubling the number of parts of rope, for example would double the lifting capacity of the block and reduce the hoisting speed by one half.

CONTENT

1. Power Requirement for motor

P= T*ω

T=F*r

T=Torque which the drum is supposed to lift (N-m)

r=radius of drum.

ω- Angular velocity in radians.

P= Power required for lifting load (Capacity of Motor of Hoisting Motion)

2. For a pulley system

Reduced load

P=C*F,

P – Effort

C – Factor of resistance

F – Load which is to be lifted

P = F * {C^n (C – 1)}/ {C^n – 1}[2]

N – Number of pulleys used

If C = 1.08 (for well lubricated bronze bearing)

3. P* drum radius* ω = F* hoisting velocity

4. b& h = dimensions of cross - section of hook

r_i = radius of internal fibre

r_o = radius of external fibre

R_n= radius of neutral axis

R= mean radius

σ= Bending stresses

F=load carrying capacity

$R_n = A/\int dA/r = bh/\int_{ri}^{ro} b/rdr = h/\ln(r_o/r_i)$ [1]

The moment is positive and

M = F* R

Finding the bending stresses on the extreme fibers

$\sigma = F/A + My/A*e\,(R_n - y)$[1]

if stress are found safe, dimensions are safe.

5. Drum diameter ranges from 26d – 34d (d, diameter of rope) if rope is 6X37type

The minimum diameter of the drum is usually expressed in terms of the rope diameter and the D/d ratio depends upon the construction of the rope material of which the rope is made. It is also influenced by the rope speed and may be operating condition. Large lifting height may necessitate increasing the diameter of the drum in order to limit the overall length. Intensive operation necessitates large drum, and the A.I.S.S.E. call for a minimum drum pitch diameter of 30 d for 6X37 rope.

Due to restriction on size of crane trolley, therefore a drum diameter of 28d is chosen.

Drum diameter, D = 28d

The material for drum can be taken as cast iron.

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CONCLUSION

The following table provides the result of design

1. MOTOR

Type of Motor	Capacity (kW)	Speed (RPM)
AC Induction	125.78	00

2. HOOK

Material Used	Internal Radius (mm)	External Radius (mm)
High Strength Alloy Steel	00	50

Assuming Factor of safety as 5.3

3. PULLEY SYSTEM

No. of Pulleys Used	Reduced Load (tonnes)	Speed (RPM)
7	.6	0

4. DRUM

Material Used	Diameter (mm)	Length (mm)
Cast Iron	40	00

5. POWER REQUIREMENT

P=125.78KW
Hoisting speed = 15 m/min

It design requires application of design principles into practical situation of industry. The basic parameter which was considered in problem was the load to be lifted. Accordingly speed of hoisting, was considered.

The parts design here is the main parts and forms the basis of any overhead carne. This design is for general purpose over head crane generally used in warehouses, metal extraction industries and machine shops. Have capacity of about 50 tons, lifting capacity to approximate 15m hoist height with a speed of 15m/min.

Different components were designed using the basic principles of machine design. Material was considered for various components and subsequently each component's strength was calculated. Appropriate factor of safety has been taken into account. Space limitation has also been taken into consideration. All machine elements were then integrated to give final shape to assembly.

The design of crane provides scope to find further compacted design with better safety limit. Also, it gives an idea to study other engineering equipment.

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