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Design, Analysis and Re-Modification of Chain Block System

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Abstract—Chain block system plays an important role in an industry to carry the load/materials from one place to another. Computer aided design and analysis of chain block system is one of the techniques used in manufacturing sectors to arrive for the best manufacturing condition, which is an essential need for industry manufacturing of Chain block at lower cost. The objective of my paper work is to study the design of various components which are used in chain block system. A sufficient amount of research work has been described by researchers on the modification of chain hoist system. In a vision of above, my paper work present design, analysis and re-modification of chain block system.

Keywords-*Drum, Von-Mises and chain link*

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I. INTRODUCTION

A crane is hoisting device used for lifting or lowering load by means of a drum or lift wheel around which rope or chain wraps. EOT crane is a mechanical lifting device used for lifting or lowering the material and also used for moving the loads horizontally or vertically. It is useful when lifting or moving the loads is beyond the capacity of human. Crane is specially design structure equipped with mechanical means for a load by raising orlowering by electrical or manual operation. Cranes are commonly employed in the transport industry for loading and unloading of freight, in construction industry for the movement of materials; and in the manufacturing industry for the assembling of heavy equipment [3, 4, and 5].

Appropriate solution of shape and materials of hooks enables the increase of loading capacity of hoisting machines. Need of the present day, equipment to handle heavy loads with fast speed, reliability, safety, economy etc. So the crane is used. Crane is one of the most important equipment used in the industries. It works as a material handling equipment or device. Applications of material handling device is a prime consideration in the construction industry for the movement of material, in the manufacturing industry for the assembling of heavy equipment, in the transport industry for the loading and unloading and in shipping etc. This device increase output, improves quality, speed up the deliveries and therefore, decrease the cost of production. The utility of this device has further been increased due to increase in labour costs and problems related to labour management. Crane is acombination of separate hoisting mechanism with a frame for lifting or a combination of lifting and moving load. There is very much useful to pick up a load at one point and be able to transport the object from one place to another place to increase human comfort.

There are three major considerations in the design of cranes. First, the crane must be able to lift the weight of the load. Second, the crane must not topple. Third, the crane must not rupture. There are so many types of crane are available such as Tower crane, Truck mounted crane, EOT crane, Telescopic crane, Gantry crane, Aerial crane, stocker crane, etc. Here, discus about Electric Overhead Travelling (EOT) crane. EOT crane is also known as bridge crane. Electric Overhead cranes typically consist of either a single girder or a double girder construction.

II. PROBLEM IDENTIFICATIONS & OBJECTIVES

A. *Problem Identification*

In this chapter discussion of the problem is elaborated and the objectives behind the thesis work are converted also in this chapter. Stresses in a pulley and chain link found maximum during the gradually impacting loading, a designer needs focused on different design parameters in order to make it suitable with the operation. The problem with used of existing material is tried to overcome by replacing the existing material.

B. Objectives

1. To developed, an analytical calculation for design of pulley and chain link for capacity of 0.5 ton.
2. Analysis of deformation at various loading conditions.
3. To modelled the model with PRO-E software
4.To apply the loading conditions using the ANSYS software on the both components design with different materials.
5. To compare results of the existing materials and new material used for design and validated the results of the study.

III. DESIGN CALCULATION OF CRANE COMPONENT

A. *Selection Of Material*

The selection of material is very important thing in order to design any mechanical components. The recent trends towards optimizing the mechanical components through continuous design modification needs lots of data to maintained, also during the design proper material selection is also needed. The presented design of drum and chain link for EOT crane described with used of two different material like SAE 1041 and glass fiber is used. The basic mechanical properties of the materials as shown in the following table 4.1 and 4.2

B. Basic Calculation Of Eot Crane

a. Total Lifting Capacity (W) = 0.5 ton
= 0.5 X 10000 N
= 5000 N

b. Lifting Height = 29.95 meter
= 29.95 X 1000
= 29950 mm

c. Breaking Strength of Chain Link
No. of rope parts (nt) = 1
Efficiency of pulley or drum (p) = 94%
From Design Data Book, for n =11,

$$P = \frac{5000}{\eta pxnos.of Chainlink} = 5319N$$

d. Selecting the Chain Link
Now,

$$A = \left[\frac{P}{\frac{\sigma u}{\eta f} - \frac{(dw - Er)}{Dmin}}\right]$$

$$A = 30.39mm^2$$

e. Design of Pulley or Hoisting Drum
Minimum diameter of pulley = 16d = 128mm
It is advisable to take diameter of pulley = 27d = 216mm
Diameter of compensating pulleys
D1= 0.6x 216 =129.6mm, D1=130mm
a) Number of turns on a drum for one rope member

$$n = \left(\frac{h_i}{\Pi D}\right) + 2 = \left(\frac{6000*2}{3.14*200}\right) + 2 = 21.10 \text{ turns} \cong 22 \text{ turns}$$

Where,
h = height of load to which it is raised
i = ratio of pulley system = 2
D = drum diameter = 25d = 25(8) = 200 mm
b) Length of Drum

$$L = \left[\left(\frac{2h_i}{\Pi D}\right) + 7\right] * P_i$$

$$L = \left[\left(\frac{2 * 6000 * 2}{3.14 * 200}\right) + 7\right] * 9.5 = 430mm$$

p = pitch of grooves of two turn = 9.5mm

c) Thickness of Drum

$$t = 0.02D + 10 = 14mm$$

d) Outer diameter of drum

$$D_o = D + 6d = 248mm$$

e) Inner diameter of drum

$$D_i = D - 2t = 172mm$$

f) Checking for the stresses in the drum
i. Compressive stress in the drum

$$\sigma_c = \frac{W}{t(pi)} Mpa = \frac{5000}{14 * 9.5} 37N/mm^2$$

ii. Maximum bending stress

$$\sigma_c = \frac{8WLD}{(D^4 - D^4)} \Pi Mpa$$

$$\sigma_c = \frac{8 * 5000 * 430 * 200}{(200^4 - 172^4)} * 3.14 \text{ Mpa} = 14.90N/mm^2$$

iii. Maximum shear stress

$$\tau = \frac{16T_{max} D}{(D^4 - D^4)} \Pi Mpa = \frac{16 * 553176 * 200}{(200^4 - 172^4)} * 3.14$$

$$= 7.66 \text{ N/mm}^2$$

iv. Total normal stress on drum

$$\sigma_n = \sqrt{(\sigma_{b^2} - \sigma_{c^2})} = \sqrt{(14.90^2 - 37^2)} = 39.88N/mm^2$$

(Permissible bending stress is 20 MPa)

IV. MODELING & ANALYSIS

A. Modeling Of Drum

The drum is model with the below rated parameter

TABLE I SUMMARIES OF DIMENSION

Diameter of Drum (D)	248 mm
Inner Diameter of Drum (H)	172 mm
Thickness	14 mm
Diameter of Chain Link	8mm

TABLE IISUMMARIES OF THE MATERIAL PROPERTIES

SAE1045		***SAE 1018***	
Young's modulus	200 Gpa	Young's modulus	180-200 Gpa
Poisson's ratio	0.290	Poisson's	0.20
Tensile strength	310 Mpa	Tensile strength	300 Mpa
Bulk Modulus	140 Mpa	Bulk Modulus	120 Mpa
Shear Modulus	80Mpa	Shear Modulus	75Mpa

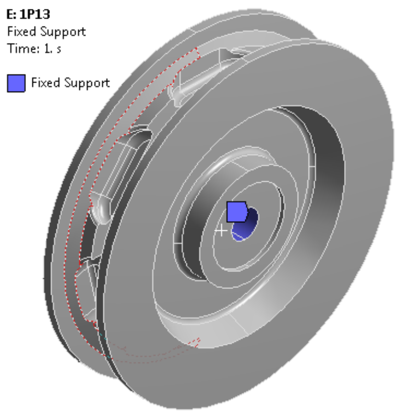

Figure 1. 3D model of Drum or Pulley

B. Analysis of Drum

For SAE1045

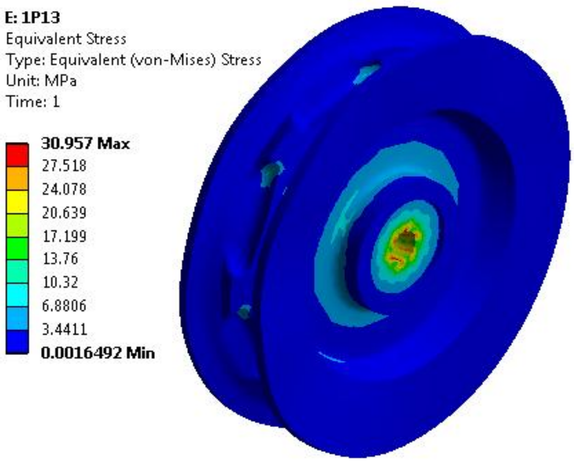

Figure 2.Equivalent Stress of drum

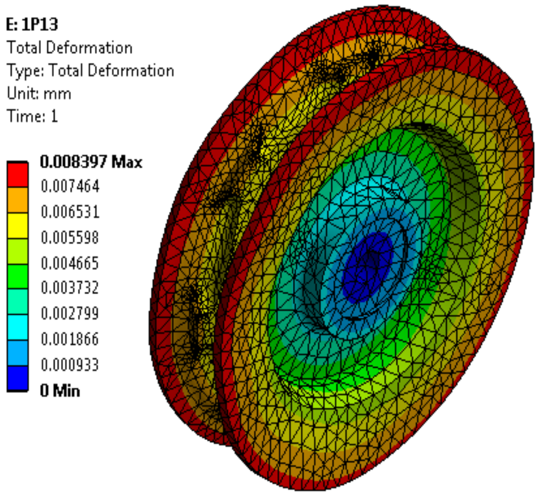

Figure 3.MaximumDeformation

For SAE 1018

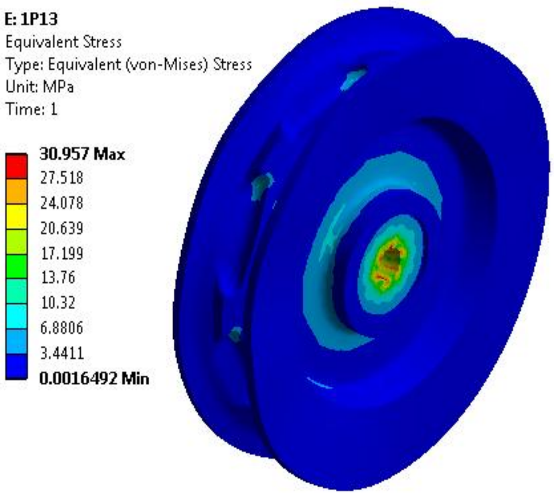

Figure 4.Equivalent Stress of drum

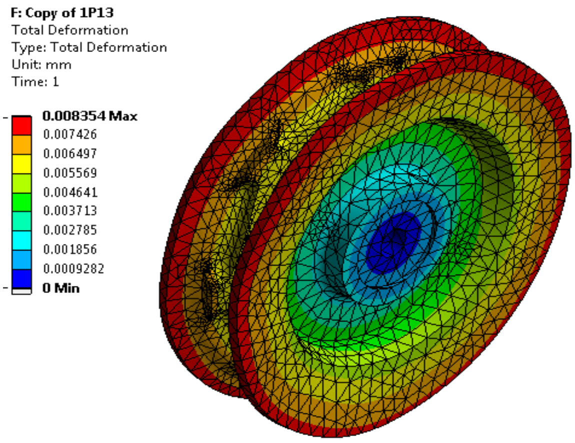

Figure 5.MaximumDeformation

TABLEIII. SUMMARIES OF RESULTS OBTAINED FROM COMPUTATIONAL AND ANALYTICAL CALCULATIONSFOR DRUM

Properties	SAE 1045	SAE 1018
Equivalent Stress (Mpa)	30.957	30.95
Total Deformation (mm)	0.008397	0.008354

V. CONCLUSION

This study investigated the elements that contribute to design and analysis of drum of EOT Crain. In this research work the analytical and computational analysis of is carried out for load of 5000N. The drum and chain link of EOT is designed by using Pro-E software. The structural feasibility is analyzed by Finite Element Analysis method. Finite Element Analysis is used in this project. Finite Element Analysis method is used to obtain the maximum deformation and stress experienced by the drum and chain link with loading of 5000N.

REFERENCES

[1] Mr. A. Gopichand, Ms. R. V. S. Lakshmi, Mr. B. Maheshkrishna “Optimization of design parameter for crane hook using taguchi method” in international journals of innovative research in science ,engineering and technology, vol. 2, Dec 2013, ISSN: 2319-8753.

[2] Chetan N. Benkar, Dr. N. A. Wankhade “Finite Element stress Analysis of Crane Hook With Different Cross Sections” in International Journal For Technological Research In Engineering, volume 1, Issue 9,May-2014, ISSN 2347- 4718.

[3] M. Shaban, M. I. Mohamed, A. E. Abuelezz and T. Khalifa,“Determination Of Stress Distribution in Crane Hook by Caustic” in International Journal of Innovative Research in science, Engineering and Technology, Vol. 2 Issue 5, May 2013, ISSN: 2319-8753.

[4] Apeksha. K. Patel, Prof. V. K. Jani, “Design and Dynamic Analysis of 70T Double Girder Electrical Overhead Crane” in Journal of Information, Knowledge and Research in Mechanical Engineering Vol.2, Oct-2013, ISSN-975-668X.

[5] Pradyumnakesharimaharana, “Computer Aided Analysis and Design of Hoisting Mechanism of an EOT Crane”, .Thesis, National Institute of Technology Rourkela, May-2012.

[6] Yogi Raval, "Design analysis and improvement of EOT crane wheel", International Journal of science technology & engineering, ISSN: 2349-784X, Volume 1, Issue 11, May 2015.

[7] AbhinaySuratkar and Vishal Shukla, "3D Modelling and finite element analysis of EOT crane", International Journal of mechanical and production engineering, ISSN:2320-2092, Volume-1, Issue 2, Aug2013.

[8] Patel P. and Nirav K, "Design and analysis of major components of 120 Tones capacity of EOT crane", IJEDR 2014, ISSN: 2321-9939, volume-2, issue 2.

[9] Prof.V.K.Jani and Apeksha Patel, "Design and Dynamic analysis of 70T double girder electric overhead crane", ISSN: 0975-668X, Nov-12 to Oct-13, Volume-2,and Issue 2.

[10] N. Rudenko, Material Handling Equipment, 2nd edition, Envee Publishers, New Delhi.