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Analysis and Optimization of End Carriage Wheel Design of E.O.T. Crane In Rail Structural Mill

K B Sushma Ankur Malviya

[1]*M.Tech Scholar, Mechanical Engineering Department, Christian College of Engineering & Technology*
[2]*Assistant Professor, Mechanical Engineering Department, Christian College of Engineering & Technology*

Abstract: *It has found that during the working of Electric Overhead Travelling (E.O.T) Crane , the end carriage wheel are getting broken frequently which is used for handling and transporting the rails and other materials. The rail size of thirteen and twenty six meters are manufactured in this plant and these EOT cranes are used to carry to throughout the shop. Due to varying loads cracks developed on end carriage wheel and which results in frequently broken of wheels. Generally in BSP by doing small repairing like grooving in cracks and welding and covering through lap plates are basically done to make these wheel in reuse. These measures were temporary & not succeeded in giving a permanent solution. Due to overloaded wheel get misaligned and running problems occurred because wheel is not in exact rail center. Wheel consumption increased due to misaligned running and crane down time increased and which results in effect on production and maintenance process. The main future scope of this paper is to design, analyze and optimize the design of wheel which is used on end carriage of E.O.T crane in Rail & Structural Mill of BSP.*

Keywords: *Rail and Structural Mill (RSM), E.O.T.(Electric Over Head Travelling) Cranes, Bhilai Steel Plant (BSP)*

I. INTRODUCTION

Material handling plays a vital role in any manufacturing system and the material handling industry is dynamically, actively, and competitively run. An E.O.T crane which stand Electric Overhead Travelling crane is used for moving the maximum specified at specified place. Generally overhead crane composed of lifting trolley, crane moving system & metal structure. A crane is a mechanical lifting device equipped with a rope drum, wire rope and rope sheaves that are used both to lift and lower metals vertically and to move it horizontally. The overhead Cranes handle and move the heavy loads from one place to another. This is most common type of overhead crane, found in most factories. It serves as large floor surface area within its own travelling than any other permanent type hoisting arrangement.

These cranes are commonly used in the transportation industry, in the construction industry and in the manufacturing industry. Electric overhead travelling cranes are widely used in many industries for lifting the safe working load.

E.O.T cranes are electrically operated by a control pendant, radio/IR remote pendant or from an operator cabin attached with the crane itself. The E.O.T. Cranes are used in Rail & Structural Mill in BSP for lifting heavy metals and lowering down it with the help of magnet in plant. Maximum loading capacity of crane is about 10 ton. In RSM of Bhilai Steel Plant, 13m and 26 m rails are manufactured usually and End Carriages were designed for handling and transporting these 13m structural rails**.** As the name implies, this type of crane is provided with movement above the floor level. Hence it occupies no floor space and this can never interface with any movement of the work being carried out at the floor of the building.

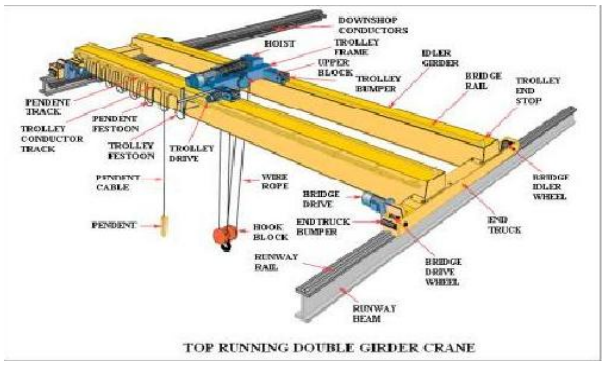

Fig-1 Double Girder Crane

II.BASIC COMPONENTS OF OVERHEAD CRANE

2.1 Bridge

The bridge of the EOT Crane can be top running or under running. This main travelling structure of the crane moves parallel to the runway. The bridge consisting of two end carriages and one or two bridge girder depending on their equipment and also supports trolley and hoisting mechanism for lifting the load up/down.

2.2 Bridge Girders

It is a main structural member lying horizontally. It handles the vertical loads and consist of single piece or more than one piece bound together. Bridge girder is used where the wide space is available. It is directly supported

on columns. These are made to build up the sections and carry the heavier loads over larger spans. The trolley travels on the cross travel rails mounted on the girders.

2.3 End Carriage

Ed carriages are located on corner or both sides of the bridge girder. The end carriage house the wheels on which the entire crane travels. It consists of structural members, wheels, axles, bearings, structural members, etc., which supports the trolley cross members or bridge girder.

2.4 Hoist

The Hoist is a simple device which is used for lifting or lowering the heavy loads vertically only. This mechanism consisting an assembly of gearbox, brakes, motor drive ,coupling, drum, wire ropes and load block designed to hold, lower & raise the maximum rated load. The hook is suspended from drum through wire rope. Size of wire rope depends on load that is to be lifted and the number of rope falls.

2.5 Runway

It consists of beam, rails, framework & brackets in which the crane operates.

2.6 Runway rail

This is supported by the runway beams on which the crane moves.

2.7 Trolley

It carries the hoist mechanism and travel in a direction perpendicular to crane runway on the bridge rails. Trolley frame is the main structure of the trolley on which hoisting and traversing mechanism are mounted.

2.8Bumper and Stops

Bumper is an energy absorbing device when the crane moves at the end of its permitted travel. Depending on the normal speed of a bridge crane, stops may be needed to prevent over travel. Bumper or buffer absorb energy and soften the shock of a travelling bridge crane, while stop bring the bridge crane to a complete stop.

III.ANALYSIS

The purpose of the present study is to optimize the design of double box girder and a comparative study of results of finite element analysis of a crane with 10 ton capacity and 20 m span length has been conducted.

Moreover to understand the effect of long span on crane wheel, simulation is being performed on crane wheel model to suggest suitable results

Following Assumptions were made for analysis:
Wheel Material: C55Mn75 [4]
Ultimate strength: 720 GPA [4]
Duty factor: 1.5 [4]
Basic Stress factor: 3.15 [4]
Safety Factor: 1.12 [4]

After preparation of 3d Cad model of the wheel it is exported to ANSYS Workbench for simulation purpose in which meshing of crane wheel is done.

IV. RESULT

On successful completion of meshing, we got following result for crane girder and crane wheel.For crane Girder summarized results are as follows: [2]Values of finite element analysis for redesigned EOT Crane Box girder.

TABLE 1– PROPOSED RESULT OF CRANE GIRDER SIMULATION

Sr. no	Description	Allowable parameters as per IS:3177 & IS:807	Results from FEA
1	Maximum stress	166Mpa	110Mpa
2	Minimum safety factor	1.5	1.96
3	Maximum displacement in y-direction	16mm	3.13mm

For crane wheel, the stresses obtained are less than the permissible stress [3]. Hence the same wheel is safe for 22m span.

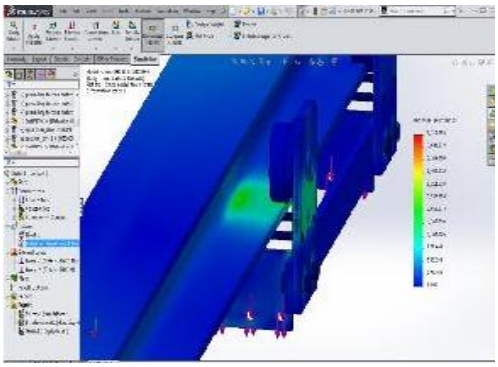

Fig2– VON MISES Stress report of Crane Girder

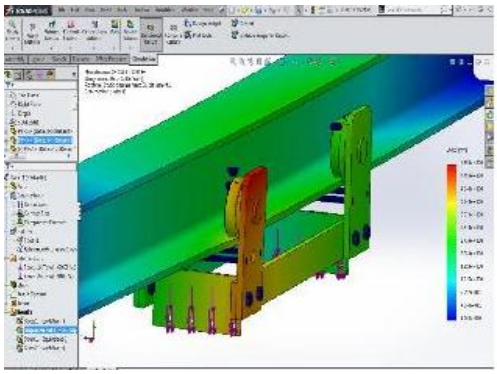

Fig 3– Equivalent Stress report of Crane

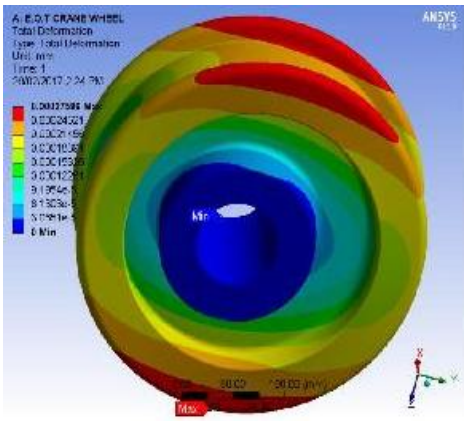

Fig 4– Total Deformation of E.O.T Crane Wheel

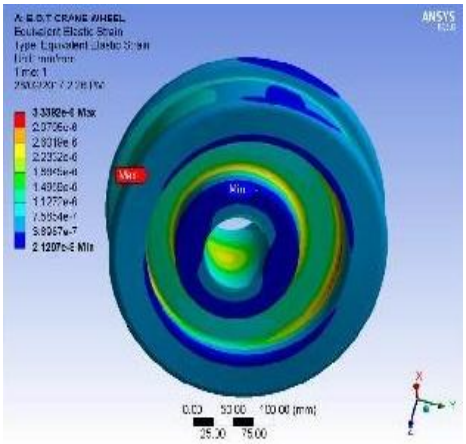

Fig 5– VON MISES Strain of E.O.T Crane Wheel

V. CONCLUSION

The main conclusion is summarized as:

We studied on overhead crane and its basic components and some parameters are taken for analysis. We have focused on end carriage wheel and crane girder after meshing of end carriage wheel on ANSYS software we got the result that stress is less than the permissible stress as per IS which is quite good. We applied VON MISES theory on crane girder and on end carriage wheel for obtaining the result.

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