Design and Analysis of Overhead Material Handling System for Various Types and Sizes of Steel Channels

Shwetali V Bhiogade¹ Prof. A. S. Bharule²
¹M.E Student ²Professor
¹,²Department of Mechanical Engineering
¹,²Shri Sant Gajanan Maharaj College of Engineering, Shegaon, Maharashtra, India

Abstract— Cranes are generally used for moving materials with some considerable size and weight and for intermittent flow of material from one place to another. Usually, loads handled by cranes are varying with respect to shape and weight than those handled by a conveyor. Hoists are frequently attached to cranes for vertical translation that is, lifting and lowering of loads. Cranes can be manually, electrically, or pneumatically. Cranes usually include hoists so that the crane-and-hoist combination provides. In this project, the design of a material handling system which will help in increasing the safety of the workers, the working efficiency and saving the time and efforts of the workers will be designed with the help of CAD and FEA software's. CAD software SOLIDWORKS is used to design OVERHEAD CRANE, whereas, FEA software HYPER-MESH is used to mesh the CAD model and NASTRAN is used for static analysis. This project is related to improving material handling system for MAHALAXMI DHATU, MIDC, and Nagpur.

Key words: Cranes; Material Handling; Over-Head Crane

I. INTRODUCTION

Material Handling involves short-distance movement within the confines of 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 material throughout their manufacturing, warehousing, distribution, and disposal.

There are two types of material handling
- Manual Handling- Manual handling refers to the use of a workers hands to move individual items by lifting, lowering, filling, emptying, or carrying them.
- Automated Handling- Automatic handling refers to the use of a power operated system to move individual items by lifting, lowering, filling, emptying, or carrying them.

Fig. 1.1: Overhead Crane Images of work being done at Mahalakshmi Dhatu

II. LITERATURE REVIEW

1) Pratik R. Patel, V.K.Patel Research scholar, Assistant Professor: The aim of this paper is for review on structural analysis of overhead crane girder using Finite Element Analysis (FEA) technique. Overhead crane girder is subjected to various types of load. Girder is the critical assembly component of overhead crane. Currently research is being carried out to improve the strength structure of overhead crane girder. These efforts help to overcome overhead crane girder failure. Finite Element Analysis (FEA) software offers inexpensive solutions to overhead crane girder failure problem. In this study the researchers used Finite Element Analysis (FEA) technique using different types of approach. Finite Element Analysis (FEA) is a essential tool for helping us in determining the cause of problems, it also recommends the solutions. Finite Element Analysis (FEA) of structural failure should be adopted as standard tool in failure analysis. If engineer is trained, then Finite Element Analysis (FEA) is very quick methodology. It is also easy to deploy. With exponential increase in computing power, Finite Element Analysis (FEA) is easy to carry out. It is widely available with user friendly commercial software.

2) Omkar, K. Sakurikar, D.V. Kushare: The main aim of this paper is to study various components of electric overhead crane, types of overhead cranes, difference between single girder and double girder cranes on various parameters and to find the effect of increase in span on crane components. Planned and unplanned requirements may necessitate changes in span. The distance between two ganttries may get modified during the shed building of factory or the crane in one bay of factory needs to be shifted from one bay to other which have different span. In such condition we have to modify the existing crane to suit the required parameters. Electric overhead crane having 10T capacity and 20m span is to be modified for 22m span.

Fig. 1.2: Work being done at Mahalakshmi Dhatu
We will study effect of increase in span for various components like long travel wheel, long travel motor and long travel brake.

3) B. M. Kwakand, S. W. Cho: An optimal design for minimum weight bridge girders of electric overhead traveling cranes is presented. The welded box-type girder is modeled as a simply supported beam. A generalized steepest descent algorithm is adopted for mathematical programming, which includes constraints on stress, displacement, buckling, and sizes. A computer program capable of designing girders according to CMAA, DIN, BS, and JIS specifications is developed. Numerical comparisons with existing girders for those four specifications are given. A sensitivity analysis of the optimum design with respect to parameters affecting the design is studied for each specification.

4) Kaustubh V. Wankhade and Dr. N. A. Wankhade: Material handling task (of handling molten metal) in casting industries is very difficult and risky one. At present this task carried out manually for small-scale castings and with the help of ladle attached to the overhead crane hook for medium and large-scale castings. Now a day this operation required at least two workers in both cases, and aim of this research paper is to minimize labour requirement for handling and pouring molten metal and with less risk. This paper reviews the design, modeling and computer simulation as a tool for aiding trolley used by various researchers earlier. The results of computer simulations and results obtained by real experimentation compared to get detailed idea about the design ideas. Design and analysis carried out with various CAD software like CREO PARAMETRIC or CATIA and ANSYS. Researchers have done tremendous work in the area of trolley design with greater reliability, protection and robust design also design was adequate and costs reduced. Speed of trolley can increased by increasing gearbox speed and reducing failures in gearbox.

5) In this paper author has made an attempt to review the design, modeling and computer simulation as a tool for aiding trolley used by various researchers earlier. The results of computer simulations and results obtained by real experimentation compared to get detailed idea about the design ideas.

6) Ankur Kulshrestha, Anurodh Prashant: This particular literature review introduces a concept of customized overhead gantry crane being used for very specific use for ISRO but under n-nos. of constraints. It includes the design part of particular overhead beam which undergo the stresses during loading, unloading and transverse movement of the test load and the deflection measured thereafter and reached to the safest gantry. The design details received from the FEA is the accurate analysis for design of the safest mode for a customized gantry crane, and the design criteria depends not only the study by FEA but all possible constraints were taken in mid and a final conclusive way was achieved, and ultimately the deflection received was well within the scope of the design and at rated load too. In all, it can be concluded that the developed gantry is useful for customized gantry with unlimited constraints, this activity course provide a second opinion to all of the manufactures and overcome the disadvantages of general gantry manufacturing.

7) Ismail Gerdemeli, Serpil Kurt, Metinylıdrım: This paper presents the modeling, calculations and analysis using Finite Element Method (FEM) of the rubber tyred container stacking crane in ports. All elements of the rubber tyred container stacking crane was modeled and made its calculations. Although stress and deformation analysis of crane bridge girder and buckling analysis of the crane legs are performed. ANSYS Workbench program has been used to perform the finite element method. In addition, rubber tyred container stacking crane has been modeled by using Autodesk INVENTOR 2010 program. Stress, deformation and buckling analysis have been compared with calculations. The aim of this work is to consider the new possibilities and the gains of finite element method over conventional calculation methods on rubber tyred container stacking crane design. When we examine the results, deformation formed on crane system is not significant when considering geometric dimensions of model and it was observed that the stress values remain under the yield strength of the steel which is used for crane bridge and legs.

III. PROBLEM FORMULATION

During a visit to the industry it was revealed that there is a need of designing a semi automated material handling system. The current material handling system used for loading and unloading of the various materials requires a lot of manual handling. At this industry various types and sizes of steel channels are manufactured. These channels are very heavy and usually require two cranes to carry them from one place to another which is quite dangerous for the men working around the loading area. In this project, the design of a material handling system which will help in increasing the safety of the workers, the working efficiency and saving the time and efforts of the workers will be designed with the help of CAD and FEA software's. With this project the company will be benefited from the advancements of computer technologies.

IV. OBJECTIVE

In this project, we have to design a material handling system for six ton mass which will help in increasing the safety of the workers, increasing the working efficiency, saving the time and efforts of the workers.

V. PLAN OF WORK

1) Data accumulation: From the site requirements, current material handling system, problem and all required data collected.

2) Design calculation and CAD modeling: To obtain required cross sections of members, a design calculations performed and these cross sections are used for building CAD model using CAD software solid works.

3) Analysis of design in FEA: A finite element analysis will be performed in FEA software after discretizing the CAD model in Finite elements.
4) Modification of the design if needed and Analysis of modified design in FEA.
5) Result discussion: Results of existing and modified design will be discussed to draw a conclusion
6) Conclusion: Conclusion will be drawn to finalize the design which produces safer results.

VI. DATA ACCUMULATION
1) Total length of the area: 115 Meters
2) Total width of the area: 25 Meters
3) Total area to be covered under material handling system: 2875SQ.Meters
4) Maximum weight of one stack: 4000 Kg
5) Minimum length of one stack: 10 Meters
6) Mode of operation: Semi automated
7) Number of labor: 6
8) Time taken to load one truck: 45 minutes

VII. CAD MODELING OF MATERIAL HANDLING SYSTEM

VIII. FINITE ELEMENT ANALYSIS
A. Finite Element Modeling

B. Static Analysis

Fig. 8.1: FE model of Over-Head Crane

Maximum Displacement: 12.7 mm

Fig. 8.2: Displacement and stress analysis result of overhead crane using finite element analysis

Maximum Stress: 219 MPA
IX. CONCLUSIONS

The material handling system will be designed with the help of CAD and FEA software’s; with this project the company will be benefited from the advancements of computer technologies. The chances of accident will reduce, Interference with the work on the floor is minimized, Valuable floor space will be saved and increasing the working efficiency and saving the time and efforts of the workers.

REFERENCES


[4] International Journal of Application or Innovation in Engineering & Management (IJAEM), Kaustubh V. Wankhade1 and Dr. N. A. Wankhade2Volume 4, Issue 2, February 2015
