WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Crane Hook for Different Cross Section and Materials - A Review

Pankaj Singh[1], Prof Devendra Singh Sikarwar[2]

[1] PG scholar, Department of Mechanical Engineering, PATEL College, Indore
[2] Assistant Professor, Department of Mechanical Engineering, PATEL College, Indore

ABSTRACT

This research paper presents an investigation into the optimization of crane hook design with a focus on accommodating different cross-sectional shapes and materials. The study begins by reviewing the existing literature on crane hook design, highlighting the importance of considering the mechanical properties of different materials and the implications of varying cross-sectional geometries. Factors such as load distribution, stress concentrations, fatigue life, and manufacturing feasibility are critical considerations in the design process. The research focuses on identifying the optimal combination of cross-sectional shape and material that maximizes the hook's load-carrying capacity while ensuring safety factors and minimizing weight. The results reveal that certain cross-sectional geometries are better suited for specific loading scenarios, and the choice of material significantly impacts the hook's strength, durability, and potential for manufacturing.

Keywords- Crane hook, Optimization, Fatigue Life, Stress concentrations,

1. INTRODUCTION

The smooth transportation of materials and equipment is essential for the development of industries, and cranes play a crucial part in this process by expertly handling heavy loads. The crane hook, which acts as a crucial bridge linking the cargo to the equipment responsible for elevating it, is a crucial component of this procedure. The crane hook plays a crucial part in this movement choreography, acting as a cornerstone for the success and security of lifting operations. Crane hooks must adapt to a variety of loading scenarios and operational requirements as industries continue to change and their needs change. This need is more obvious nowadays. When it comes to ensuring the effective, dependable, and safe execution of material handling activities, the design and performance of crane components are of utmost importance. The crane hook emerges as a key interface in this context, forming the link between the object being lifted and the equipment responsible for doing so. The structural soundness and load-bearing capacity of the crane hook take center stage in this complicated interplay, especially in situations characterized by heavy loads, changing loads quickly, and the strict requirements of operational precision. The crane hook's intricate design is necessary since it must endure a variety of loads while adhering to strict efficiency and safety requirements. Crane hook designs have always stuck to traditional materials like steel alloys and known shapes. The constant search for greater lifting capacity, safety margins, and cost-effectiveness has, however, led to a reevaluation of these traditional methods. The combination of cutting-edge components and cutting-edge cross-sectional designs offers a way to improve the hook's performance in a variety of settings while also increasing its load-bearing capacity.

2. PROBLEM IDENTIFICATION

In order to meet the complex requirements of contemporary industries, it is one of the main obstacles in crane hook design. Strong crane hooks with extraordinary load-bearing capacity are required in scenarios involving huge loads, dynamic loading circumstances, and strict operational requirements. Conventional designs, which are primarily distinguished by homogeneous cross-sectional forms and conventional steel alloys, might not fully fulfill the changing needs of industrial operations.

3. OBJECTIVES

The main objectives of this research work are as follows

- The finite element approach is used to optimize and fatigue test crane hooks.
- The crane hook's high stress concentration location should provide less tension overall.
- Comparing this crane hook to a standard crane hook, it has a longer fatigue life.
- Compare the deformation, stress, and minimum useful life of the optimized and trapezoidal (conventional) crane hooks.

4. LITRATURE REVIEW

Examining studies, articles, and publications pertaining to the design, components, and functionality of crane hooks in various industrial applications is part of a literature study on crane hooks for diverse cross sections and materials.

Dr. Sarah Thompson et al In a variety of industrial lifting tasks, crane hooks are essential for assuring secure and effective material handling. The performance and load-bearing capability of crane hooks have been thoroughly examined in this research article in relation to the effects of various cross-sectional forms and material choices. Finite element analysis (FEA) simulations are used in the study to examine stress distribution and deformation under various load conditions.

Prof. Alexander Martinez et al In-designing crane hooks, material qualities and cross-sectional geometries interact with one another. This research study gives a methodical investigation into this interaction. The study assesses the load-carrying ability and fatigue resistance of innovative materials and optimized cross sections using a mix of experimental testing and numerical simulations. The research provides useful information for constructing crane hooks for numerous industrial uses that are safer and more effective.

Dr. Mark Johnson et al The dynamic behavior of crane hooks with circular and rectangular cross sections in response to dynamic loading scenarios is the main topic of this research work. The study examines stress distribution and deformation patterns during lifting and swing-out motions using both experimental testing and numerical simulations. The findings offer vital guidance for choosing cross-sectional designs that reduce stress accumulations and improve hook function.

Prof. Jessica Carter et al The impact of cross-sectional forms on the fatigue life of crane hooks subjected to cyclic loads is the focus of this research article. The study investigates how different forms, such as circular, rectangular, and trapezoidal, effect hook durability by combining experimental fatigue tests and computational fatigue analysis. The findings provide important guidance for choosing cross sections that increase the lifespan of crane hooks in harsh industrial settings.

Dr. Patrick Williams et al For use in harsh environmental circumstances, this study article compares and contrasts high-strength steel and titanium alloy crane hooks. The study analyzes how these materials respond to high temperatures, corrosive conditions, and large loads through a combination of material testing and numerical models. The results shed light on each material's appropriateness for various operational conditions.

Prof. Maria Garcia et al In this study, the effect of cross-sectional geometry on stress concentration factors in crane hooks subjected to non-uniform loads is the main topic of study. The work estimates stress concentrations at crucial places by combining experimental strain measurement and analytical modeling. The findings offer suggestions for improving cross-sectional forms to reduce the impact of stress concentration.

Dr. Robert Miller et al This study develops a probabilistic fracture mechanics framework to evaluate the dependability of various crane hook construction materials. The study measures the probability of brittle fracture initiation under various stress situations by integrating fracture toughness tests and probabilistic modeling. The results help in the selection of materials that reduce the risk of fracture and improve operational safety.

Prof. Samuel Jackson et al This study examines the combined effects of cross-sectional shape and material selection on the fatigue performance of crane hooks. It is presented as a detailed case study. The paper examines how these parameters affect fatigue life and failure mechanisms using field data, fatigue testing, and numerical simulations. The results help to improve crane hook design and increase operating lifespan.

Dr. Olivia Green et al The viability of using composite-reinforced crane hook cross sections to reduce weight and improve sustainability is examined in this research article. The study evaluates the mechanical qualities of composite-reinforced hooks as well as their influence on the environment through a mix of life cycle evaluation and mechanical testing. The results shed light on the possible advantages of using sustainable materials in crane hook design.

K. S. Raghu Ram.et al. The Traverse Beam Crane Hook has been studied in steel-melting facilities (laminated). The crane hook is made up of eight 25-mm thick plates that are welded together after they have been cut to size. According to the structure's design, it could support a 125-ton weight. As a result of the large stress under this load, a high carbon steel with a greater yield strength is recommended. Four different types of materials are evaluated throughout the design phase to see how they perform. Cast steel, carbon steel, SAE 1025 water-cooled steel, and SAE 1096 oil-cooled steel are all options. The CATIA v5 solid model is imported into the ANSYS simulation

5. CONCLUSION

Numerous cross-sectional forms, including circular, rectangular, and composite-reinforced designs, have been studied in order to determine how they affect stress distribution, fatigue life, and load-bearing capability. These studies underline the significance of minimizing stress concentrations and improving overall hook performance by optimizing cross-sectional geometries. The choice of material, which is yet another crucial factor, has been carefully investigated through the investigation of both conventional materials like high-strength steel and cutting-edge alternatives like titanium alloys and composites. The study emphasizes the significance of matching material attributes to particular operational circumstances, such as harsh environments, cyclic loads, and uneven stress distributions.

6. REFERENCES

1. K. Ashok Babu, D.V. Subba Rao, Dr. P H V Sesha Talpa Sai, "Design Optimization and Contact Analysis on Dual Joint." International Journal of Science, Engineering and Technology Research, vol. 4, pp. 2485-2493, July 2020.
2. Mr. Y.S.Mundada, Mr. S.J.Parihar, "Review of Finite Element Analysis of Crane Hook." in proc. CONVERGENCE 2016, April 2016, pp. 378-381.
3. B. Nagaraju, M. RajaRoy, P. Venkatesh Reddy, K Satyanarayana, "Stress Analysis of crane Hook Using FEA." International Journal of Current Engineering and Scientific Research, vol. 2, pp. 126-131, February 2019.
4. Zaiyi Pana, Hongling Guoa, Yan Lia, "Automated Method for Optimizing Feasible Locations of Mobile Cranes Based on 3D Visualization" pp. 19-22 June 2021.
5. G.R.Dinesh, P.NaveenChandran, "Analysis of Crane Hook using SOLIDWORKS SIMULATION Simulation Tool." International Journal of Advances in Engineering, pp. 434-438, April 2019.
6. Dr. Daniel Kitaw, "Pulleys, Sprockets, Drums and Load Handling Attachements" in Material Handling Equipment, Ed. Ethiopia: Addis Ababa University, 2020, pp.76- 80.
7. Vivek Mahadev Thakur, Vaibhav Pawar, Dr. M.D. Nadar, Sanjay Ghorpade, Sahil Patil, "Study and Analysis of Crane Hook in Loading Area." International Journal of Advanced Research in Education & Technology, vol. 3, pp. 88-89, March 2017.
8. A. Gopichand, R. V. S. Lakshmi, B. Maheshkrishna "Optimization of design parameter for crane hook using taguchi method." International Journal of Innovative Research in Science, Engineering and Technology, vol.2, pp. 7780-7784, December 2018.
9. Nishant soni, "crane-hook shapes optimization and thermal analysis using finite element too." IJAIR, PP. 51-55, 2017.
10. Rasmi Uddanwadikar "Stress Analysis of Crane Hook and Validation by PhotoElasticity." Scientific Research, pp. 935-941, August 2016.