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Analysis of Deformation and Fatique Life of Crane Hook

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ABSTRACT

Crane hooks are stressed by repeated loading and unloading, which eventually causes them to fail. These are the causes of crane hook fatigue. To avoid failure, the crane hook stress is investigated and reduced to the maximum stress possible in comparison to the current (trapezoidal) crane hook. Crane hook stress can be reduced by altering the shape of the crane hook in comparison to a standard crane hook. The hook's cross section was used as a major parameter in this study to optimise its design for a given weight. The fatigue life of the crane hook will be extended as a result of the reduced stress (have better life comparing with standard crane hook). Crane hooks have four cross-sectional shapes: rectangular, round, square, and oblong.

Keywords: Crane hook, Repeated loading, Optimization, Simulation, Solid works

1.INTRODUCTION

Cranes are classified as weight-handling equipment (WHE). They are intended for heavy lifting and excavating in a variety of terrain and weather conditions with the appropriate attachment. A crane is a piece of equipment that can horizontally raise, lower, and move a load, including the crane's supporting structure and foundations as well as the load itself. Crane configurations are available in a variety of shapes and sizes to accommodate a wide range of industrial and construction operations. Cranes are distinguished primarily by their carriage and boom type. [4] A variety of cranes are frequently used in the construction industry. Overhead cranes, mobile cranes, tower cranes (telescopic and gantry), telescopic mobile cranes, and loader cranes are among the most common crane types. The hoist is either in a permanent equipment building or on a trolley that travels horizontally across tracks depending on the type of girder. It is also referred to as a gantry crane (twin-girder). To support the crane's frame, the gantry system is made up of equalised beams and wheels that run perpendicular to the trolley's travel path. An above-the-head crane's hoist and trolley assembly, also known as a "suspended crane," works similarly to that of a gantry crane, with the exception that one or two fixed beams allow it to only travel in one direction, which are typically found in the factory's assembly area, either on the side walls or on elevated columns.The tower crane is a more modern, updated version of the balancing crane. Tower cranes, which are anchored to the ground and can also be mounted to the side of a structure, provide the best combination of height and lifting capacity in skyscraper construction. Construction workers use mobile cranes to complete their tasks because they can traverse an area without the need for a permanent runway and rely solely on gravity for stability.

2.GAP IN THE RESEARCH WORK

The studies described above, in general, investigated the various types of stress that crane hooks are subjected to, as well as the factors that contribute to crane hook rupture. Based on the amount of stress they were exposed to, they tested the trapezoidal cross section hook against a variety of regular cross sections, including circular, triangular, and rectangular cross sections, and discovered that the trapezoidal cross section hook was the best. While several studies on hook weight reduction have been conducted using various materials and cross sections, their findings have shown that when the weight is reduced, the stress increases when compared to the trapezoidal (standard) hook.However, no research has been conducted on the simultaneous optimization of weight and stress by modifying the cross section of the crane hook's cross section. That is, we can reduce the weight and stress on the crane hook by comparing the trapezoidal (normal) crane hook to a modified one.By utilising this gap, the weight and maximum stress of the modified crane hook are reduced in a manner parallel to that of the trapezoidal (normal) crane hook. The upgraded crane hook will have a longer fatigue life.

3.METHODOLOGY

The methodology to be used is determined by our approach to a certain problem and the settings in which the experiment is conducted.

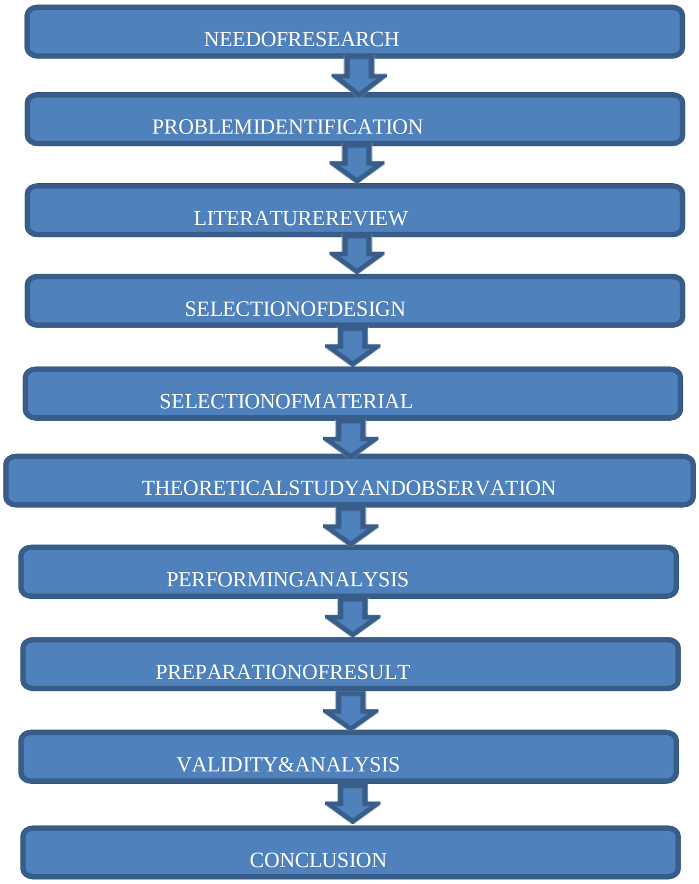

Figure 3-1: Schematic diagram for the methodology adopted

4.RESULT

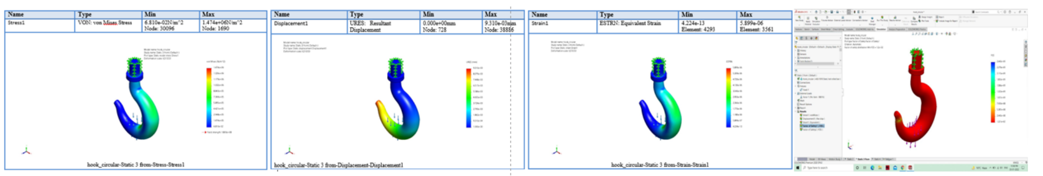

Figure 1: Von-misses stresses Figure 2: Deformation Figure3: Equivalent strain Figure 4: Factor of safety

- **With material gray cast Iron**

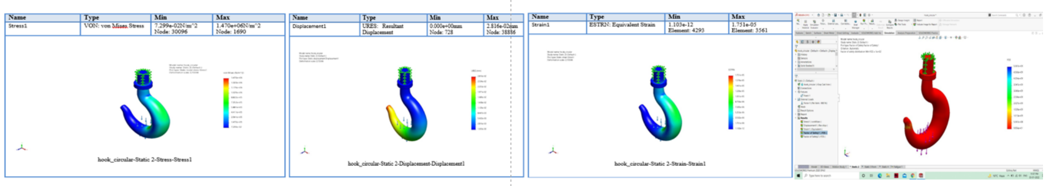

Figure 5: Von-misses stresses Figure 6: Deformation Figure7 : Equivalent strain Figure8: Factor of safety

Figure 4.1 - AISI 1010 Steel

- **With material Gray Cast Iron**

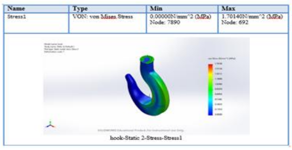

Figure 1: Von-misses stresses

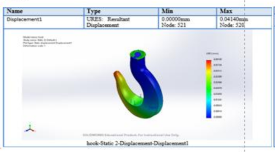

Figure 2: Deformation

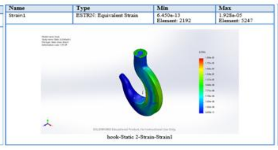

Figure 3 : Equivalent strain

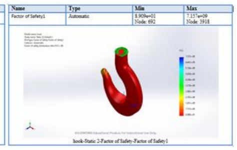

Figure 4: Factor of safety

- **With material Structural Steel**

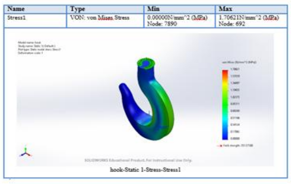

Figure 5: Von-misses stresses

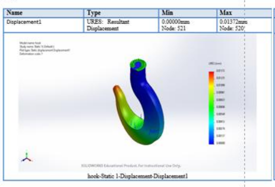

Figure 6: Deformation

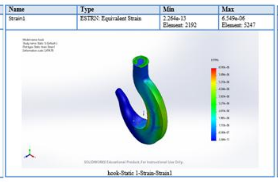

Figure 7 : Equivalent strain

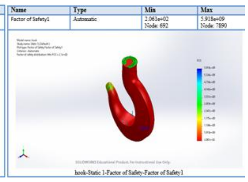

Figure 8: Factor of safety

Figure 4.2 – Grey cast iron

5.CONCLUSION

The results of each updated modelling crane hook must be compared to the results of a standard crane hook in order to decide whether the maximum Von-Misses stress and total deformation of models -1 and -2 are raised. The standard crane hook, which is included in both the model-1 and model-2 crane hook variants, is less fatigue resistant. The maximum Von-Misses stress is decreasing as overall deformation increases. The fatigue-resistant crane hook has a much longer life span than standard crane hooks.

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