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Analysis of Crane Hook for Different Material and Cross Section

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ABSTRACT

Crane hooks are stressed by repetitive loading and unloading, which finally leads to their failure. These are the reasons for crane hook fatigue failure. To avoid failure, the crane hook stress is examined and reduced to the maximum stress possible compared to the current (trapezoidal) crane hook. Crane hook stress can be reduced by changing the shape when compared to a standard crane hook. In this study, the hook's cross section was employed as a major parameter to optimise its design for a given weight. As a result of the reduced stress, the crane hook's fatigue life will be extended (have better life comparing with standard crane hook). Rectangular, round, square, and oblong are the four cross-sectional shapes of crane hooks. Using SOLIDWORK and SOLIDWORKS Simulation, these crane hooks are deigned and modelled and the consequences of each rebuilt crane hook are analysed.

Keywords: Crane hook, Stress, Optimization, Simulation, Solid works

Introduction

Cranes are classified as weight-handling equipment (WHE). They're built to handle heavy lifting and excavation in a variety of terrain and weather conditions with the correct attachment. A crane is a piece of machinery that can lift, lower, and transfer a load horizontally, which includes the crane's supporting structure and foundations as well as the load itself. Crane configurations are available in a wide range of shapes and sizes to suit a wide range of industrial and construction applications. Cranes are classified primarily based on their carriage and boom type. Several cranes are regularly used in the building industry. The most popular cranes include overhead cranes, mobile cranes, tower cranes (telescopic and gantry), telescopic mobile cranes, and loader cranes.

Matertial Selection

A range of additional components in a variety of applications influence the behaviour of an electronic component in service, in addition to the properties of the material employed in its production. This is especially true when a component or structure is subjected to fatigue loading. In these circumstances, factors such as the service environment and surface condition, as well as fabrication method and structural design features, can have a significant impact on the component or structure's fatigue resistance. Because the above attributes are so important, the role of the material in achieving an adequate fatigue life may be small in some cases, as long as the material is free of major flaws. Steel is a common type of material for fatigue resistance design because of its strength. Steels are commonly utilised as structural materials in fatigue applications because they provide great fatigue strength and good processability at a reasonable cost, making them a popular choice among manufacturers. The tempered marten site steel structure is the most suitable for fatigue resistance because it gives the greatest degree of uniformity. In fatigue applications, a high hardenability steel provides excellent strength with just little quenching, and so produces minimal residual stresses, which is desirable. In comparison to coarse pearlite structure formed by annealing, normalized structures have a finer structure and hence provide superior fatigue resistance.

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Table 2-1: Materials are compared based on their mechanical characteristics.

Properties	StructuralSteel	GreyCastIron	AISI1010Steel
ElasticModulus	200000	205000	205000
Poisson’s Ratio	0.3	0.32	0.285
ShearModulus	76923	80000	80000

Mass density	7850	7850	7850
Ultimate tensileStrength	460	1110	745
Yieldstrength	250	710	470

1. Design of crane hook

SolidWorks is used by designers to automate their design processes. SolidWorks is a piece of software that allows students, designers, engineers, and other professionals to generate simple and complex components, assemblies, and drawings in a variety of sizes and shapes. This application is now used to design goods, produce machines, and set up manufacturing processes all over the world. It's also employed in the development of production systems. SolidWorks software has shown to be a successful advanced tool for designers and engineers in engineering jobs such as mechanical engineering, industrial design, and transportation technologies.

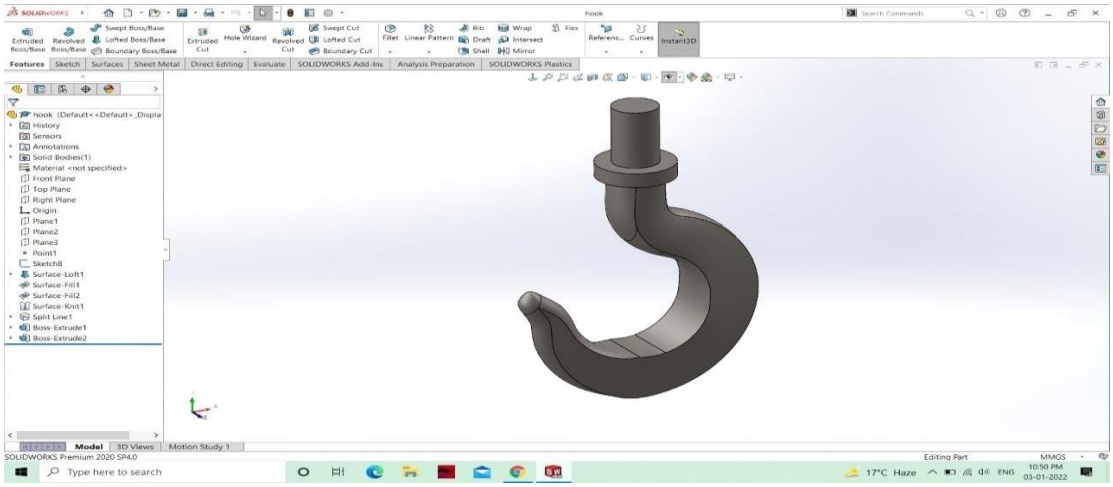

Figure3-1:RectangularProfileHook

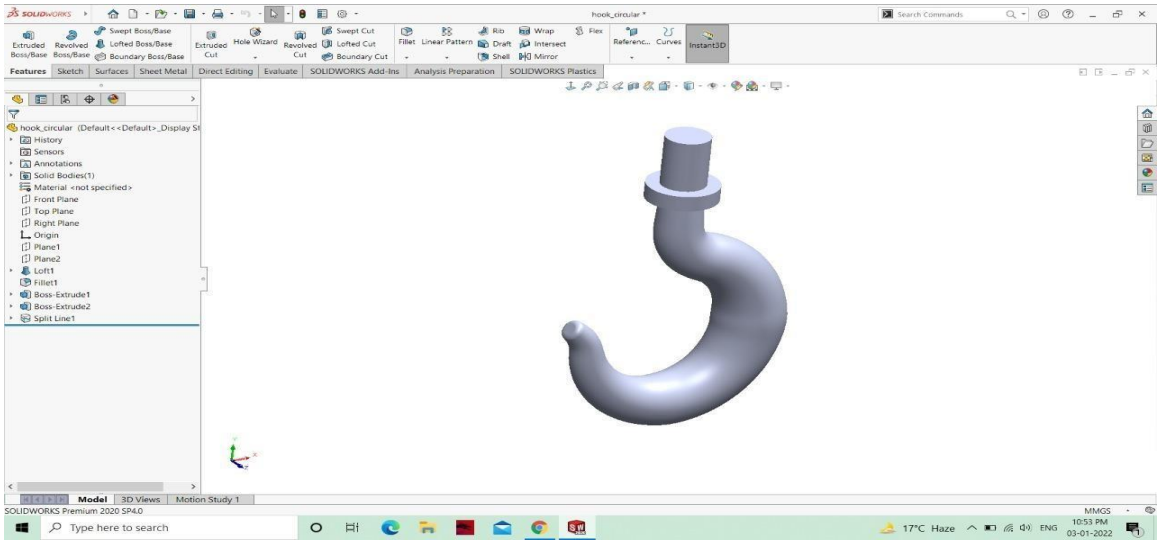

Figure3-2:CircularProfileHook

2. Analysis of crane hook

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0.000e+00mm Node: 728	9.310e-03mm Node: 38886

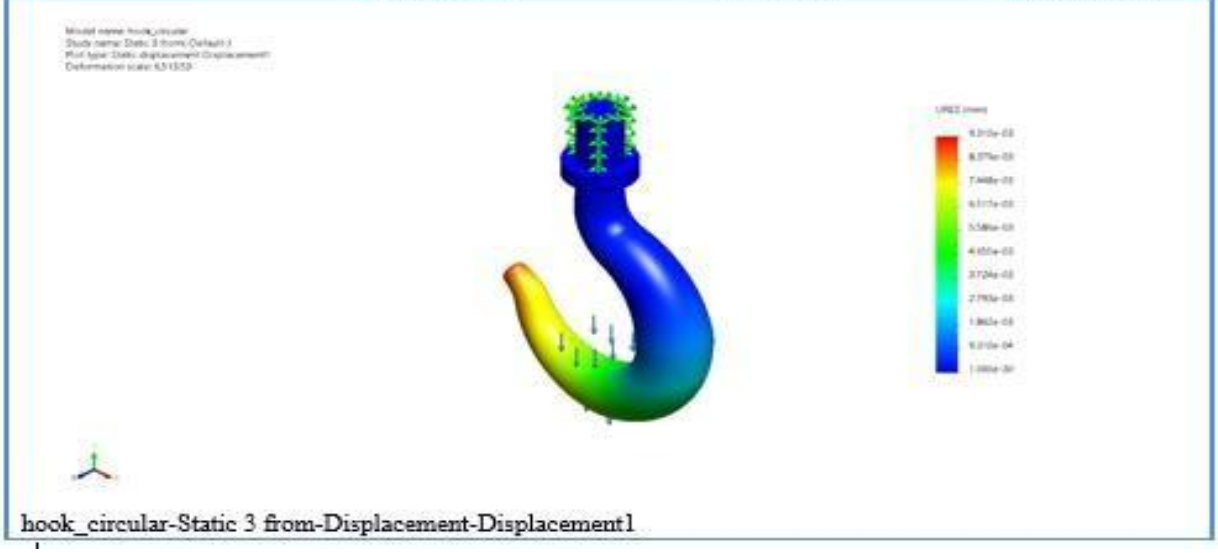

Figure4-1:Deformation of CircularProfileCraneHook

Name	Type	Min	Max
Stress1	VON: von Mises Stress	0.00000N/mm^2 (MPa) Node: 7890	1.70457N/mm^2 (MPa) Node: 692

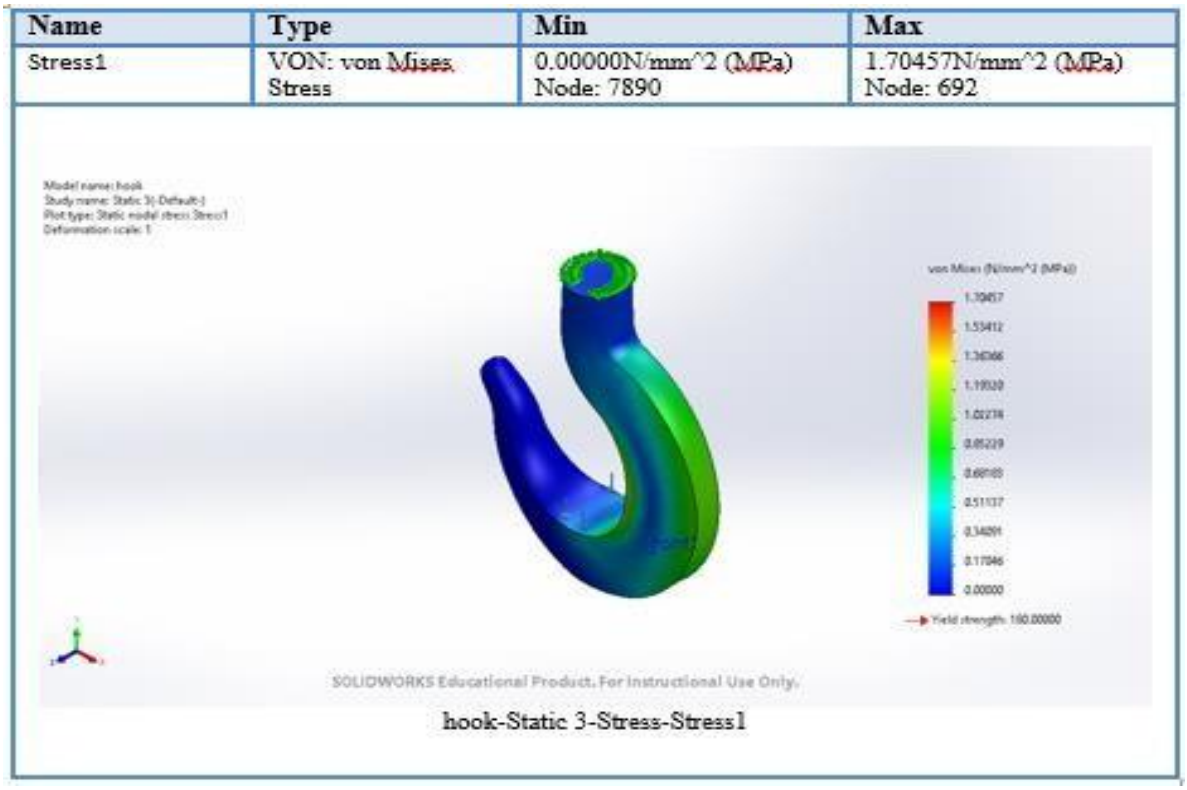

Figure 4-2: Deformation of RectangularProfileCraneHook

Conclusion

To decide that the maximum Von-Misses stress and total deformation of models -1 and -2 are raised, the results of each updated modelling crane hook

must be compared to the results of a standard crane hook. The normal crane hook, which is included in both the model-1 and model-2 variants of the crane hook, is less fatigue resistant. The maximal Von-Misses stress is decreasing, whereas overall deformation is increasing. The crane hook with fatigue resistance has a much longer life span than standard crane hooks.

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