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FINITE ELEMENT STRESS ANALYSIS OF CRANE HOOK WITH DIFFERENT CROSS SECTIONS

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ABSTRACT:

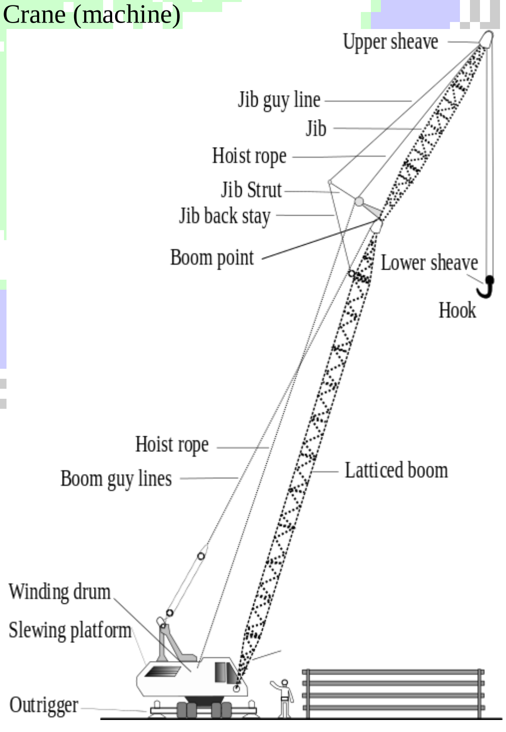
Crane hook is very basic and reliable component used in most industries. The design of crane hook contains such parameters like cross section of hook, material and radius of curvature. We have selected the cross section as a basic parameter to optimize the hook design which carries 8tons load. The design is generated in NX-UG and analyzed in Hypermesh (FEM). In this project we have compared the circular cross section with trapezoidal cross section.

I. INTRODUCTION:

Cranes are industrial machines that are mainly used for material movements in constructional sites, production halls, assembly lines, storage areas, power stations and similar places. [1] Crane hooks are the components which are used to lift heavy loads using wire ropes and cranes in constructional sites and industries. [2, 3] It is basically a hoisting fixture with pulley elongated by a rope or a chain designed to engage a ring or link of a lifting chain or the pin of a shackle or cable socket and must follow the health and safety guidelines. Hence, such an important component in an industry must be manufactured and designed in a way so as to deliver maximum performance without failure. [4, 5] Crane hooks with trapezoidal, circular, rectangular and triangular cross section are commonly used. Crane hooks are highly liable components and are always subjected to failure due to accumulation of large amount of stresses. Cranes undergo continuous loading and unloading. This causes fatigue of the crane hook. If the crack is developed in the crane hook, it can cause fracture of the hook and lead to serious accident. [6] In ductile fracture, the crack propagates continuously and is more easily detectable and hence preferred over brittle fracture. In brittle fracture, there is sudden propagation of the crack and the hook fails suddenly. This type of fracture is very dangerous as it is difficult to detect. [7] Control of lifting hooks can prevent the fall of the load during service and minimize the risk to which people are exposed in the danger zone. [8] Bending stresses combined with tensile stresses, weakening of hook due to wear, plastic deformation due to overloading, and excessive thermal stresses are some of the other reasons for failure. Continuous use of crane hooks which increases the magnitude of stresses and eventually results in failure of the hook may be prevented if the stress concentration areas are well predicted and some design modification is made to reduce the stresses in these areas. [9] Thus the aim of this work is to design a crane hook using NX-CADD and assign Material properties of commonly used materials for hooks using ANSYS workbench and calculate the total deformation and von mises stress distribution. Von mises stress theory is considered in this work as the factor of safety in this theory is high which facilitates a safer design. The analysis is performed considering an ambient temperature of 25°C in order to replicate normal working conditions.

II IMPLEMENTATION:

Crane (machine)



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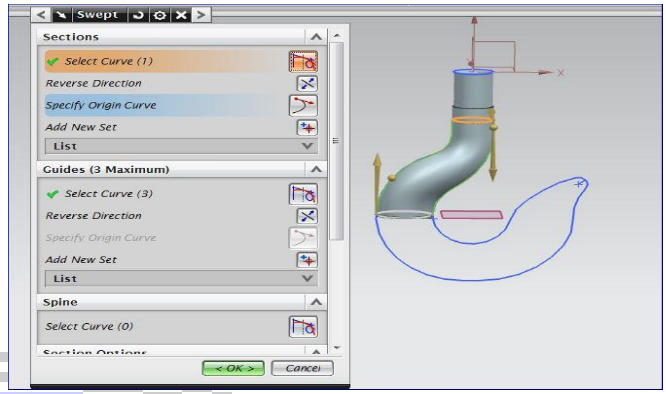
A crane is a type of machine, generally equipped with a hoist rope, wire ropes or chains, and sheaves, that can be used both to lift and lower materials and to move them horizontally. It is mainly used for lifting heavy things and transporting them to other places. It uses one or more simple machines to create mechanical advantage and thus move loads beyond the normal capability of a human. Cranes are commonlyemployedin the transport industry for the loading and unloading of freight, in the construction industry for the movementof materials and in the manufacturing industry for the assembling of heavy equipmentThe first known construction cranes were invented by the Ancient Greeks and were powered by men or beasts of burden, such as donkeys. These cranes were used for the construction of tall buildings. Larger cranes were later developed, employing the use of human tread wheels, permitting the lifting of heavier weights. In the High Middle Ages, harbour cranes were introduced to load and unload ships and assist with their construction – some were built into stone towers for extra strength and stability. The earliest cranes were constructed from wood, but cast iron, iron and steel took over with the coming of the Industrial Revolution.

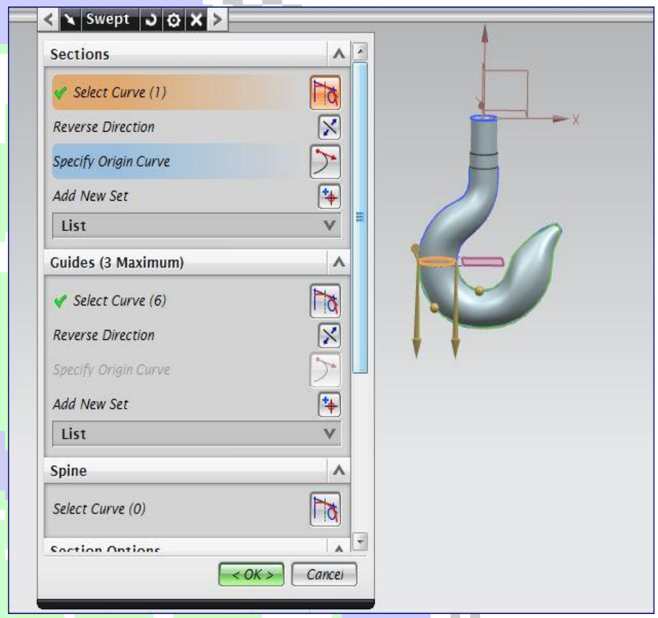
For many centuries, power was supplied by the physical exertion of men or animals, althoughhoistsin watermills and windmills could be driven by the harnessed natural power. The first 'mechanical' power was provided by steam engines, the earliest steam crane being introduced in the 18th or 19th century, with many remaining in use well into the late 20th century. Modern cranes usually use internal combustionengines or electric motors and hydraulic systems to provide a much greater lifting capability than was previously possible, although manual cranes are still utilized where the provision of power would be uneconomic.

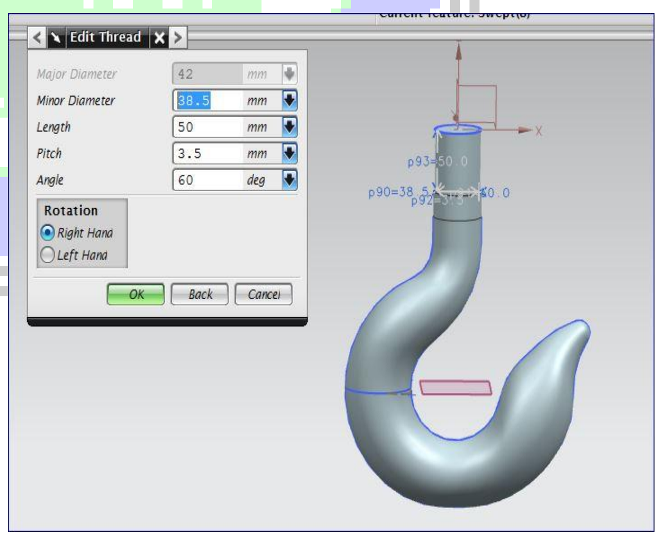
Cranes exist in an enormous variety of forms – each tailored to a specific use. Sometimes sizes range from the smallest jib cranes, used inside workshops, to the tallest tower cranes, used for constructing high buildings. Mini-cranes are also used for constructing high buildings, in order to facilitate constructions by reaching tight spaces. Finally, we can find larger floating cranes, generally used to build oil rigs and salvage sunken ships.

Some lifting machines do not strictly fit the above definition of a crane, but are generally known as cranes, such as stacker cranes and loader cranes.

+IV: Results







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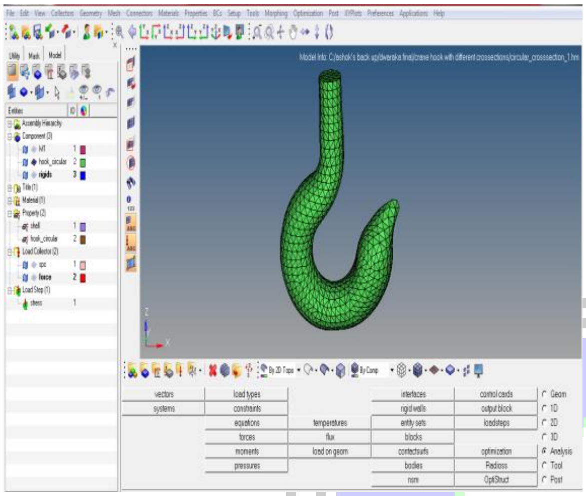
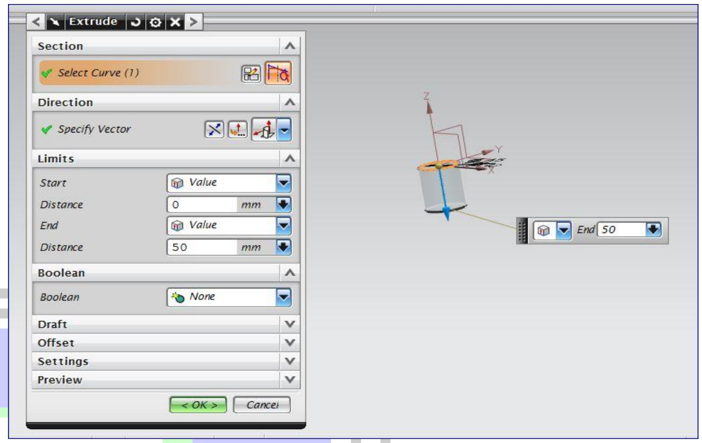
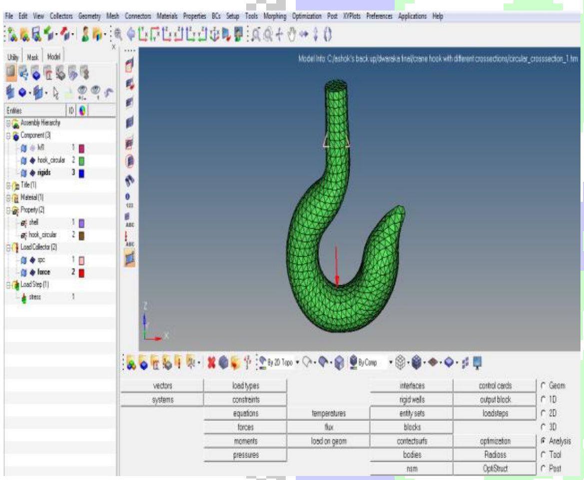
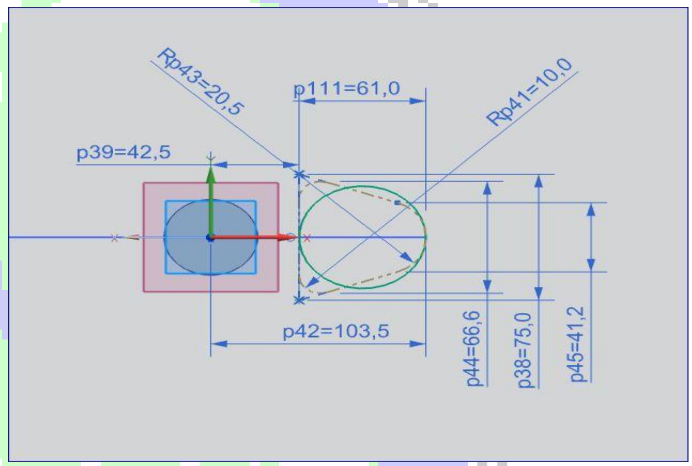
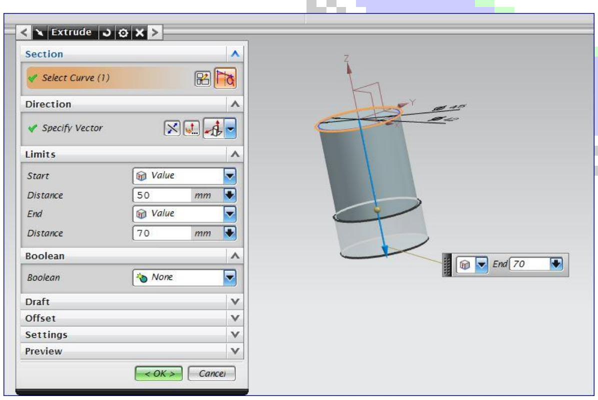








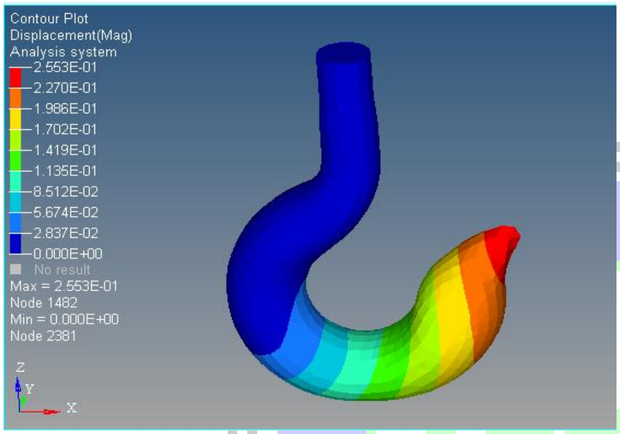


MECHANICAL PROPERTIES	VALUES	UNIT
YOUNG'S MODULUS	2×105	MPa
POISSON'S RATIO	0.3	-
DENSITY	7850	Kg/m3
TENSILE YIELD STRENGTH	250	MPa
TENSILE ULTIMATE STRENGTH	460	MPa

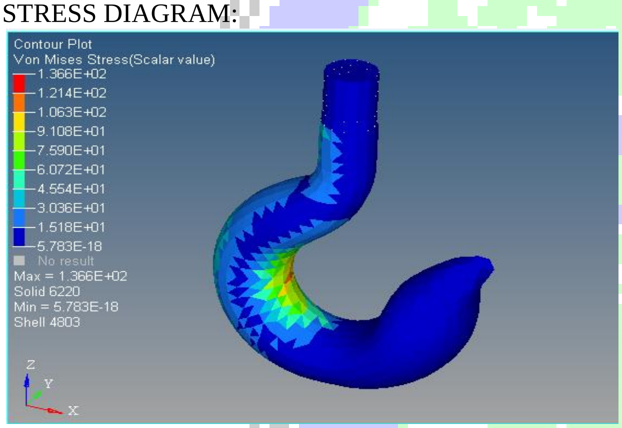
MESH MODEL OF CRANE HOOK:

LOADS AND BOUNDARY CONDTION DIAGRAM:

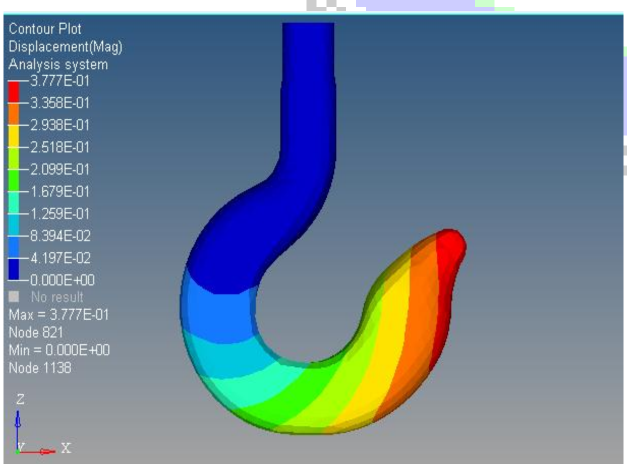
CIRCULAR CROSS SECTION:
DISPLACEMENT DIAGRAM:



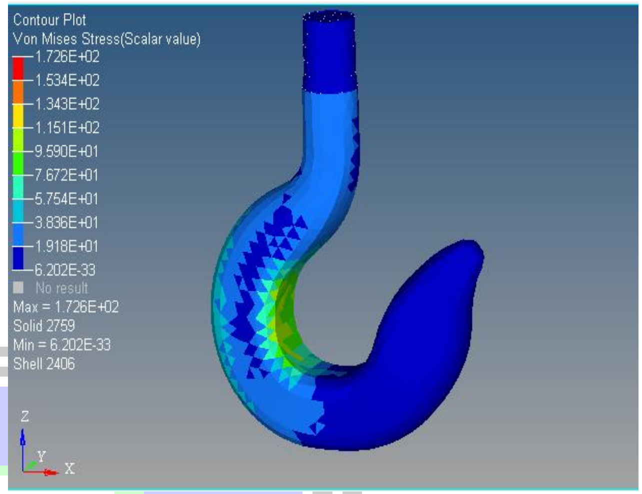
STRESS DIAGRAM:



TRAPEZOIDAL CROSS SECTION:
DISPLACEMENT DIAGRAM:



STRESS DIAGRAM:



COMPARISON OF DIFFERENT PARAMETERS OF VARIOUS CROSS SECTIONAL HOOK:

Different cross Sections	Max equivalent stress (MPa)	Total deformation (mm)
Circular	136.6	0.255
Trapezoidal	172.6	0.377

CONCLUSION

We have optimized the standard design applying various cross sections and the optimized cross section has beenselected in which the stress is increased by 12.96% which is acceptable and the weight is reduced by 18% nearly which can be considered as optimize results.

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