DESIGN AND ANALYSIS OF EOT CRANE HOOK WITH DIFFERENT MATERIALS USING FEM

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ABSTRACT

A crane is lifting machinery, discontinuous movement aimed at raising and distributing loads in space, suspended from a hook. Cranes available in the market are grinder travelling crane, overhead travelling crane, jib cranes, wire rope hoist, and EOT cranes. The EOT cranes are one of the most important mechanical components in the heavy weight lifting and loading in to cargos, into trains, in to heavy truck vehicles, etc. Different types of EOT cranes available in the industries are container cranes, workstation EOT cranes (or) light weight mobile EOT cranes and semi EOT cranes. These vase verity of EOT cranes are differed based on the tonnages and area to be covered for lifting and moving the weights

The workstation EOT crane is the most economical solution in all those places where it is desired or civil works or expensive fixed mount metal structures, and where necessary make loading (or) unloading on a regular basis and at points different.

In our project, first, three dimensional geometry of the workstation EOT crane is built in, CATIA. Then analysis of different cross sections, the part which is used to carry the loads in EOT crane, is carried out by using finite element method in ANSYS software for maximum loads Apply on crane hook. Using materials in this project structural steel, Ni-Cr steel, ASTM Grade 60 steel , Stainless steel.

We observing **von-missies stresses, Shear stress, and deflections** generated from static analysis in ANSYS 15.0. finally concluded the suitable material on these 4 materials and which cross section is better design for crane hook.

key words: CATIA, ANSYS, Structural steel, Ni-Cr steel, ASTM Grade 60 steel , Stainless steel.

1.1 DEFINITION OF CRANE: Lifting device, used to elevate or lower loads vertically and to move them horizontally while they are hanged It will be presented all types of cranes with their mainly characteristics. The classification will be done as follows

1.2 CRANES CLASSIFICATION AND CHARACTERISTICS

1.2.1 According to design.
1.2.2 According to movement possibilities.
1.2.3 According to the device control.
1.2.4. According to orientation possibilities.

1.2.1 ACCORDING TO DESIGN

1.2.1.1 JIB CRANE:

Revolver crane portal mounted
Revolver crane semi-portal mounted
Crawler mounted latticework boom crane

a. Railroad crane
b. Floating crane
c. Crane vessel
d. Derrick crane
e. Slewing jib crane

1.2.1.2. BRIDGE CRANE

i Overhead Bridge crane
ii EOT crane
a. Work station EOT crane
b. Semi-EOT crane

1.2.2 JIB CRANE:

It will be explained bellow each of the devices mentioned in the above list and their Characteristics that will be explained bellow each off the devices mentioned in the above list and their characteristics It is a crane where the hoist is hanged from a boom or jib that moves along:

1.2.3 (A) REVOLVER CRANE PORTAL MOUNTED:

Jib crane mounted over a EOT that allows vehicles travelling underneath. It is very useful in the trains industry because it easy to leave the railway between both legs of the structure. It is also used in

that working area where there is much traffic of vehicles.

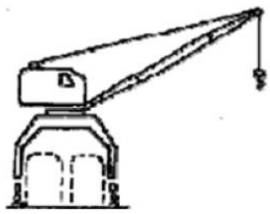


Figure 1 Revolver crane portal mounted

1.2.4 (B) REVOLVER CRANE SEMI-PORTAL MOUNTED:

Jib crane mounted on as semi-portal structure that allows vehicle traveling underneath It is quite similar at the previous one, but it usually used when there is one kind of resistant wall that can be used as part of the structure. So it is possible to save one beam and for that reason get a cheaper structure.

1.2.5 (C) CRAWLER-MOUNTED:

It can be a crane adjustable or fixed that is fitted on a chassis moved by tires, crawler or mixed that allows its movement by itself or towed by a tractor Crawler cranes have both advantages and disadvantages depending on their use. Their main advantage is that they can move around on site and perform each lift with little set-up, since the crane is stable on its tracks with no outriggers. In addition, a crawler crane is capable of traveling with a load. The main disadvantage is that they are very heavy, and cannot easily be moved from one job site to another without significant expense. Typically a large crawler must be disassembled and moved by trucks, rail cars or ships to its next location.

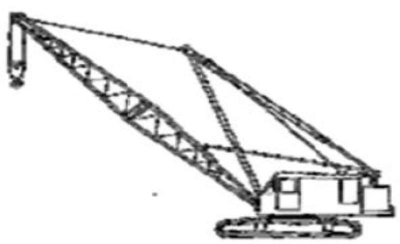


Figure 2 Crawler-mounted latticework boom crane

1.2.6 (D) RAILROAD CRANE:

Type of crane used on a railroad for one of three primary uses: freight handling in goods yards, permanent way (PW)) maintenance, and accident recovery work. Although the design differs according to the type of work, the basic configuration is similar in all cases: a rotating crane body is mounted on a sturdy chassis fitted with flanged wheels. The body supports the jib and provides all the lifting and operating mechanisms; on larger cranes, an operator's cabin is usually provided. The chassis is fitted with buffing and coupling gear to allow the crane to be moved by a locomotive, although many are also self-propelled to allow limited movement about as work site.

1.2.7 (E) FLOATING CRANE AND CRANE VESSEL:

Floating cranes are used mainly in bridge building and port construction, but they are also unused for occasional loading and unloading of especially heavy or awkward loads on and off ships. Some floating cranes are mounted on a pontoon, others Aare specialized crane barges with a lifting capacity exceeding 100000 short tons (8,929 long tons; 9,072 t) and have been used to transport entire bridge sections. Floating cranes have also been used to salvage sunken ships. Crane vessels are often used in offshore construction.

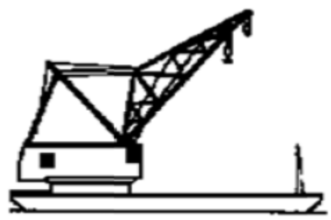


Figure 3 Floating crane and crane vessel

1.2.8 (F) DERRICKING:

A derrick crane is a slewing strut-boom crane with its boom pivoted at the base of a mast which is either guyed (guy--derrick) or held by backstays (stiff-leg derrick) and which is capable of lifting under load. This Derrick system allows changing boom angle by varying the length of the boom suspension ropes.

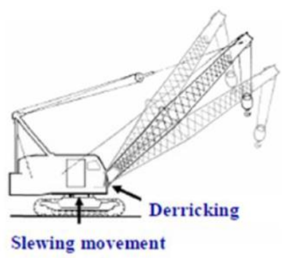


Figure 4 Derricking

1.2.9 BRIDGE CRANE

EOT cranes, bridge cranes, and overhead cranes, are all types of cranes which lift objects by a hoist which is fitted in as hoist trolley and can move horizontally on a r rail or pair of rails fitted under a beam. An overhead travelling crane, also known as an overhead crane or as a suspended crane has the ends of the supporting beam resting on wheels running on rails at high level, usually on the parallel side walls of a factory or similar large industrial building, so that the whole crane can move the length of the building, while the hoist can be moved to and from across the width of the building. A EOT crane or portal crane has a similar mechanism supported by uprights, usually with wheels at the foot of the uprights allowing the whole crane to traverse. Some portal cranes may have only a fixed EOT, particularly when they are lifting loads such as rag always cargoes that are already easily moved beneath them.

Figure 5 BRIDGE TYPE

Overhead crane and EOT crane are particularly suited to lifting very heavy objects and huge EOT cranes have been used for shipbuilding where the crane straddles the ship allowing massive objects like ships' engines to be lifted and moved over the ship.

Components of bridge crane type

i. **The Bridge:** It travels along the working area (building, harbor, construction site…)

ii. **The trolley:** It moves over the bridge and along the width of the working area.

iii. **The hoist:** Mounted in the trolley and performs the lifting and lowering action via a hook or lifting attachment.

The three movements performed by a crane are

1) **Translation of the bridge**: In longitudinal direction of the work area. This is done by a single motor reducer, which give movement to the wheels.

2) **Orientation of the trolley**: Moving the carriage along the bridge.

3) **Elevation-Descent**: The load is raised or lowered by the effect of the engine that holds the hook with the help of a main cable.

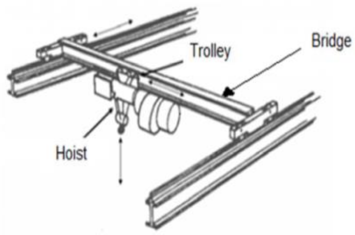


Figure 6 Translation of the bridge

1.3 (I) OVERHEAD BRIDGE CRANE:

An overhead crane commonly called a bridge crane is a type of crane found in industrial environments. An overhead crane consists of parallel runways with a traveling bridge spanning the gap.. A hoist, thee lifting component of a crane, travels along the bridge. Unlike mobile or construction cranes, overhead cranes Aare typically used for either manufacturing or maintenance applications, where efficiency or downtimes are critical factors

Figure 7 Overhead Bridge crane

Applications:

The most common overhead crane use is in tithe steel industry. At every step of the manufacturing process, until it leaves a factory as finished product, steel is handled by an overhead crane. Raw materials are poured into a furnace by crane,, hot steel is stored for cooling by ann. overhead crane, the finished coils are lifted and loaded onto trucks and trains by overhead crane, and the fabricator or scamper uses an overhead crane to handle the steel in his factory. The automobile industry uses overhead cranes for handling of raw materials. Smaller workstation cranes handle lighter loads in n a work-area, such as CNNC mill or saw. Almost all paper mills use bridge cranes for regular maintenance requiring removal of heavy press rolls and other equipment. The bridge cranes are used in the initial construction of paper machines because they facilitate installation of the heavy cast iron paper drying drums and other massive equipment, some weighing as much as 70 tons. In many instances the cost of a bridge crane can be largely offset with savings from not renting mobile cranes in the construction of a facility that uses a lot of heavy process equipment.

1,3.1(II) EOT CRANE

Crane whose carrier elements are supported on a raceway through support legs the difference with the overhead crane ibis that the rails are in a horizontal plane much lower than tithe trolley off the crane.

Figure 8 EOT crane

Variants and its applications:

Container crane: A ship-to-shore rail mounted EOT crane is a sp equalized version of the EOT crane in which the horizontal EOT rails and their supporting beam are cantilevered out from between frame uprights spaced to suit the length off a standard freight container, so that the beam supporting the rails projects over a quayside and over the width off an adjacent ship allowing the hoist to lift containers from the quay and move out along the rails to place the containers on the ship. The uprights have wheels which run in tracks allowing the crane to move along the quay to position the containers at any point on the length of the ship.

1.3.2 (II). A. WORKSTATION EOT CRANES:

Workstation EOT crane s are used to lift and transport smaller items around a working area in a factory or machine shop Some workstation EOT cranes are equipped with an enclosed track, while others use an I-beam, or other extruded shapes, for the running surface. Most workstation EOT cranes are intended to be stationary when loaded, and mobile when unloaded. Workstation EOT Cranes can be outfitted with either a Wire Rope hoist as shown in the above hoist (device) picture or a lower capacity Chain Hoist.

Figure 2 Workstation EOT Cranes

Application:

They are commonly found in factory applications such as steel yards, paper mills or locomotive repair shops. Thee EOT crane functions similarly to an overhead bridge crane, but has rails installed on the ground and EOT-style legs to support the crane. Capacities range from 2 to 200 tons, and sometimes even greater capacities. Most are electrically powered and painted safety yellow.

2. LIETARATURE REVIEW

The comparative study by Mr. A Gopichand. Et al. [1] has shown that taguchi method can be used for optimization of crane hook. In his work optimization of design parameters is carried out using Taguchi method. He considered total three parameters and made mixed levels a L16 orthogonal array. The optimum combination of input parameters for minimum Vonmises stresses Are determined. From that array he found optimum combination of area radius for minimum Vonmises stress.

Ram Krishna rathour. et al. [2] has worked on a general approach for the multiple responses. He started optimization with the regression models to calculate the correlation between response function and control function. An objective function is generated with the help of system for collecting various response functions together. By using artificial neural network (ANN) to find out the response function. He used multiple objective genetic algorithms (MOGA) to optimize shape function of the crane hook for same capacity by considering combination of objective function to find out the optimize shape of crane hook. The result shows that the reduction in mass as well as safety of factor is not disturbed.

Nishant soni et al. [3] has worked on the optimization of low carbon steel for its self-weight. The self-weight and component load coming on the crane–hook hence he worked with objective of the optimization of the mass for cane hook-under the effect of static load comprising the peak pressure load. He used finite element analysis for the shape optimization of crane hook as well as for validation of final geometry.

Chetan N. Benkar.et al. [4] worked on crane hook for the optimization. He estimated the stress pattern of crane hook in its loaded condition by preparing a solid model with the help of ANSYS 14 workbench. He calculated stress pattern for various cross section topology such as rectangular, triangular, trapezoidal, and circular by keeping the area constant and found that rectangular cross sectional area gives minimum stress and deformation level.

Rashmi Uddanwadiker.et.al. [5] Has calculated the stress pattern produced due to the load on hook. He compared the analytical result of stress and the stress estimated from the FEM analysis and found that there was 8.26% percent error between them. Photo elasticity test is based on the property of birefringence. From the analysis he found the area at which high stress concentration occurs. For the design improvement if the inner side of hook at the portion of maximum stress is widened then the stress will get reduced. He estimated that the stress is reduced up to 17% if the thickness of the inner curvature is reduced by 3mm

C. Oktay Azeloglu.et al. [6] has studied the method for the calculation of stress based on the different assumption. He adopted Timoshenko‟s curved theory and Bach approximation on the simple hooks calculation. He used finite element method to estimate the stress and compared it with different method.

M. Shaban. et al [7] prepared a solid model of crane hook to estimate the pattern of stress in the crane hook. They used ABAQUS software and obtained real time pattern of stress concentration. The value and

location is very much important factor in reducing the failure. If the inner curvature of hook is widened the stress will be reduced. For complicated mechanical element it is suitable to use caustic method. In caustic method several small several holes are drilled to predict accurate stress value.

Takuma Nishimura.et al. [8] studied damage factor estimation of crane hooks to recognize the tendency of the load condition. They used FEM to estimate the relation between the load condition and its deformation. First, load –deformation database that has the relation between the load condition of crane hook and its deformation using numerical calculation is constructed. After the completion of study they found that load acts in downward position and tip –end position and load direction is not downward normal in damaged hook.

Santosh Sahu.et al. [9] made a model of crane hook of trapezoidal using CATIA V5R20.Then estimated the location of stress after Appling the 2 ton load using FEM. They also analyzed the effect of variation in length of two parallel sides of trapezoidal hook on stress.

Apeksha K Patel.et al. [10] has worked on reduction of weight of girder which has reduced the cost of girder and also life of girder is increased. They made a mathematical design for crane component by using ANSYS workbench V12.They also optimized hook by using Trapezoidal cross sectional area.

3.METHODOLOGY

1) To study the EOT crane design and materials properties from different journals.
2) In this project first, 3D geometry of the workstation EOT crane is built with a CATIA V5 R20 software .
3) Then analysis of Different cross sections is carried out by using finite element method in ANSYS software different materials.
4) The main criteria of hook is obtained in igs format in Ansys after find out the stress, total deformation, shear stress using static analysis .

4) Concluded the suitable material on these Structural steel, Ni-Cr steel, ASTM Grade 60 steel, Stainless steel.

3.1 SPECIFICATION OF THE PROBLEM

The objective of the present work is to design and analyze the different cross section of the EOT crane with the materials generally used it is manufactured and also for the other metal alloys viz., grey cast iron, AISI 4130 alloy steel and ASTM A710 STEEL GRADE A (CLASS III). The solid model of the EOT was created in CATIA V5. Model was imported in ANSYS 15.0 for analysis by applying the normal load conditions on ,hook in different sections. The model was tested for stress and deformation as the design constraints. After analysis a comparison is made between existing Structural steel, Ni-Cr steel, ASTM Grade 60 steel , Stainless steel viz., in terms of deflections and stresses, Shear stresses, strains to choose the best one.

EOT crane is used to transfer the loads from one place to another place. The major part of EOT crane is I-section beam, which is fixed at two ends of the EOT crane stand bars. It is used for carrying the loads. In Different cross sections failure may occur due to carrying heavy load .Even Impact (or) sudden loads .

In our project, first, three dimensional geometry of the workstation EOT crane is built with a CAD program, CATIA V5 R20. Then analysis of Different cross sections is carried out by using finite element method in ANSYS software for maximum loads and at different cross sections on the hook. The main criteria for the analysis is, obtained stress values should not exceed the safety stress of the material used. Now we can observe how the Different cross sections will behave when loads are applied.

Stress Calculation | Figures

Circular cross section

D=d=256.2

A=51526.1 mm^2

R=c+d/2= 428 h^2 =4280.89

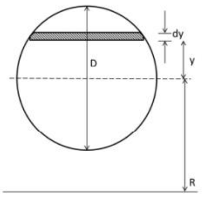
$$\sigma = \frac{W}{A} + \frac{M}{AR}\left[1 - \frac{R^2 y}{h^2(R-y)}\right]$$

Considering $M \approx W \times R$ we can have

$$\sigma = \frac{W}{A}\left[2 - \frac{R^2 y}{h^2(R-y)}\right]$$

σ = -368.7 for y =d/2

For y= -d/2



Rectangular Cross section

D= 256.2 mm

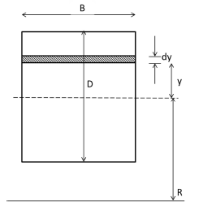
A=51562.1mm^2

B=120.4

$$h^2 = 2.3\frac{R^3}{D}\log\left(\frac{2R+D}{2R-D}\right) - R^2$$

h^2 = 5626

σ = 12.50 for y =d/2



Triangular cross section

D=256.2 mm

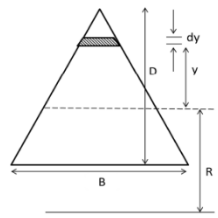
B=402.5

A=51552 mm^2

$$h^2 = \frac{R^3}{A} \times \frac{B}{D}\left[2.3R_2\log\frac{R_2}{R_1} - D\right] - R^2$$

Considering $M \approx W \times R$ we can have

$\sigma = 7.97$



Trapezoidal cross section

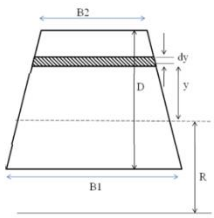
B1=300

B2=102.4

$$h^2 = \frac{R^3}{A}\left[2.3\left(B_2\frac{(B_1-B_2)R_2}{D}\right)\log\frac{R_2}{R_1} - (B_1 - B_2)\right] - R^2$$

Considering $M \approx W \times R$ we can have

σ =16.35



3.2 DIFFERENT CROSS SECTIONS:

Cross Section	Value of link radius
rectangular	$h^2 = 2.3\frac{R^3}{D}\log\left(\frac{2R+D}{2R-D}\right) - R^2$
circular	$h^2 = \frac{d^2}{16} + \frac{1}{8} \times \frac{d^4}{16R^2}$
trapezoidal	$h^2 = \frac{R^3}{A}\left[2.3\left(B_2\frac{(B_1-B_2)R_2}{D}\right)\log\frac{R_2}{R_1} - (B_1 - B_2)\right] - R^2$
triangular	$h^2 = \frac{R^3}{A} \times \frac{B}{D}\left[2.3R_2\log\frac{R_2}{R_1} - D\right] - R^2$

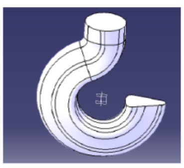
Modified Section

d= $3.2\sqrt{P} + c/10$

=256.2mm

R=0.75 d =192.1

r =1/8d =32.05



Modified cross section

3.3 MATERIAL PROPERTIES:

	STRUCTURAL STEEL	STAIN LESS STEEL	ASTM GRADE 60	Ni14-46Cr STEEL
Density (Kg/mm³)	7.85	7.75	7.80	7.75
Modulus of elasticity (Mpa)	200	193	210	150
Possion's ratio	0.3	0.31	0.3	0.26
yield strength (Mpa)	250	207	265	170
Tensile strength (Mpa)	460	586	415	330

Table 1 material properties

4. CATIA INTRODUCTION

4.1 INTRODUCTION TO CATIA V5R20

Welcome to CATIA (Computer Aided Three Dimensional Interactive Application). As a new user of this software package, you will join hands with thousands of users of this high-end CAD/CAM/CAE tool worldwide. If you are already familiar with the previous releases, you can upgrade your designing skills with the tremendous improvement in this latest release.

CATIA V5, developed by this assault Systems, France, is a completely re-engineered ,Next-generation family of CAD/CAM/CAE software solutions for Product Lifecycle Management. Through its exceptionally easy-to-use and state-of-the-art user interface, CATIA V5 delivers innovative technologies for maximum productivity and creativity, from the inception concept to the final product. CATIA V5 reduces the learning curve, as it allows the flexibility of using feature-based and parametric designs.

CATIA V5 provides three basic platforms:

P1, P2, and P3. P1 is for small and medium-sized process-oriented companies that wish to grow toward the large scale digitized product definition.P2 is for the advanced design engineering companies that require product, process, and resource modeling. P3 is for the high-end design applications and is basically for Automotive and Aerospace Industry, where high quality surfacing or Class-A surfacing is used. The subject of interpretability offered by CATIA V5 includes receiving legacy data from the other CAD systems and even between its own product data management modules. The real benefit t is that the links remain associative. As a result, any change made to this external data gets notified and the model can be updated quickly.

4.2 CATIA V5 WORKBENCHES

CATIA V5 serves the basic design tasks by providing different workbenches. A workbench is defined as a specified environment consisting of a set of tools that allows the user to perform specific design tasks. The basic workbenches in CATIA V5 are Part Design, Wireframe and Surface Design, Assembly Design, Drafting.

4.3 MODELLING OF EOT CRANE HOOK IN CATIA

While designing the Crane Hook , whole structure is divided in to cell. The single cell is created first and mirrored to create entire structure. By considering the cell configuration dimensions i.e. cell angle $^{\theta}$, height h, and length l that were mentioned above in the geometrical dimensions and geometrical aspects, the Crane Hook design.

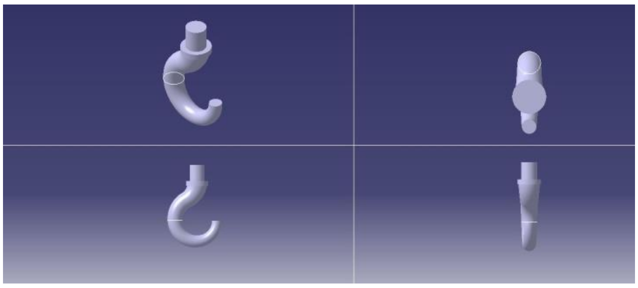


Figure 10 Modeling of EOT crane hook in Circular cross section

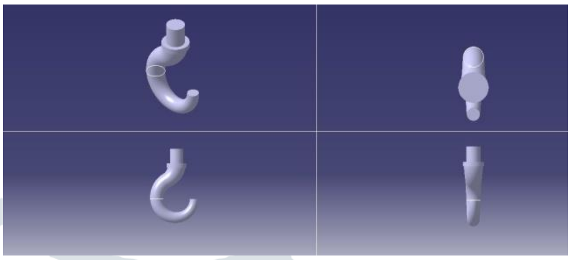


Figure 10 Modeling of EOT crane hook in Circular cross section

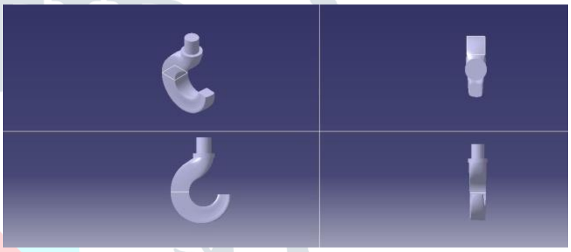


Figure 11 Modeling of EOT crane hook in Rectangular cross section

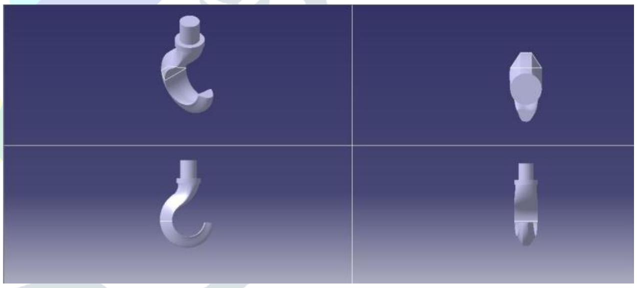


Figure 12 Modeling of EOT crane hook in Trapezoidal cross section

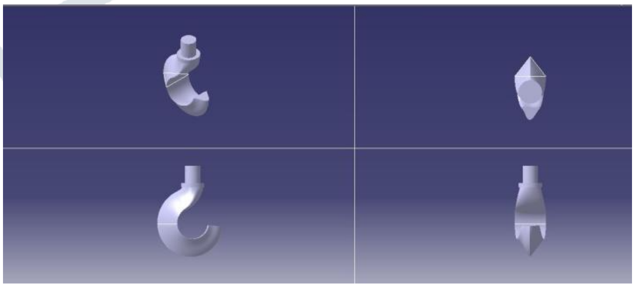


Figure 13 Modeling of EOT crane hook in Triangular cross section

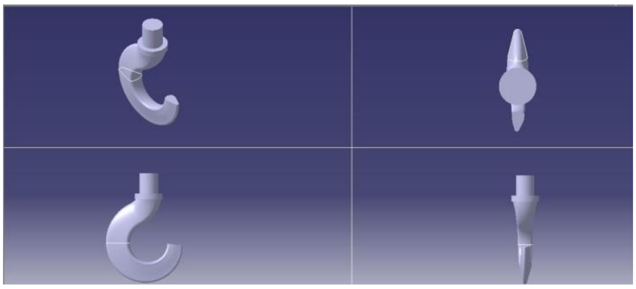


Figure 14 Modeling of EOT crane hook in new modified-1 cross section

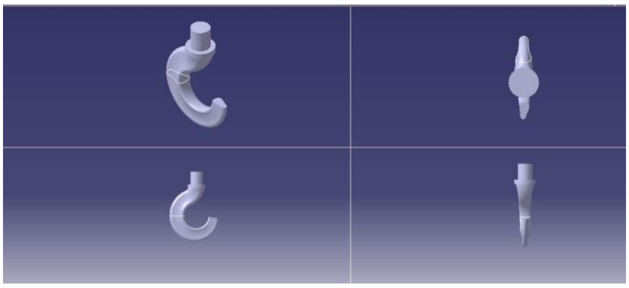


Figure 15 Modeling of EOT crane hook in new modified-2 cross section

4.STATIC ANALYSIS OF CRANE HOOK

In this section the 3D CAD models and 3D FEM Models along with loads and boundary conditions will be presented Using above mesh model with boundary and loading conditions in ANSYS 15.0 required results are predicted.

5.1 BOUDARY CONDITIONS AND IN STATIC ANALYSIS

1. Apply force is 300000N on crane hook
2. Fixed top surface of hook

Step 1: 3D CATIA Model Creation of Different cross sections was done.

Step 2: The 3D CATIA model for the Different cross sections was created by using CATIA modeling software. The mesh has been generated using tetrahedrons elements

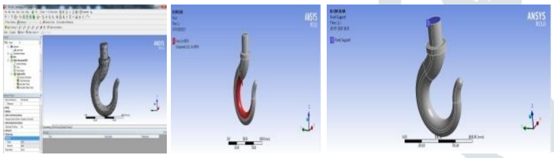


Figure 16:Boundary condition and meshing for circular cross section

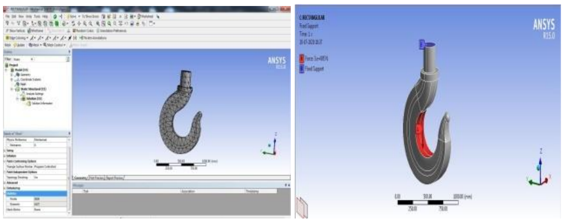


Figure 17:Boundary condition and meshing for rectangular cross section

Figure 18:Boundary condition and meshing for Trapizoidal cross section

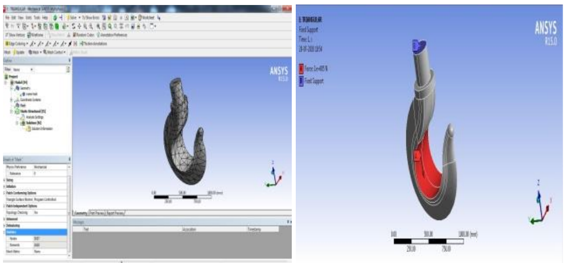


Figure 19:Boundary condition and meshing for Triangular cross section

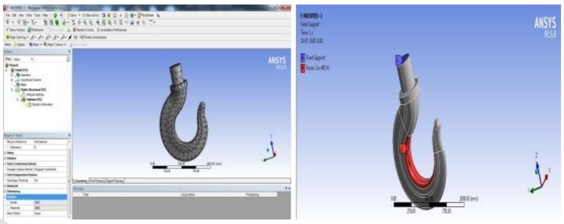


Figure 20:Boundary condition and meshing for new modified-1 cross section

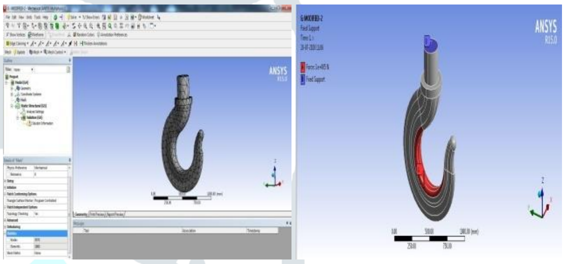


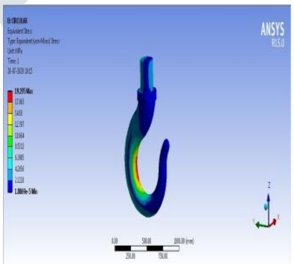
Figure 21:Boundary condition and meshing for new modified-2 cross section

6 .RESULTS AND DISCUSSIONS

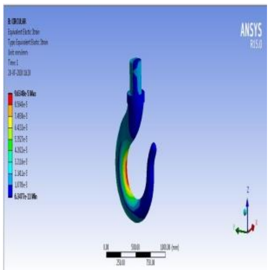
We analyzed Crane Hook in ANSYS 15 and finding out Von misses stress, strain and total deformation of Crane Hook various cross sections and different materials as show in below figures and then resulting all the max values at every load and are compared in the form of graphs.

6.1 For Structural steel material

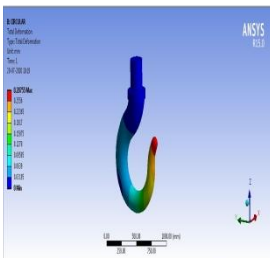
6.1.1 Circular cross section results



Von-mises stress

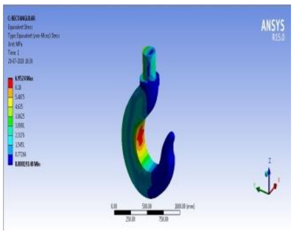


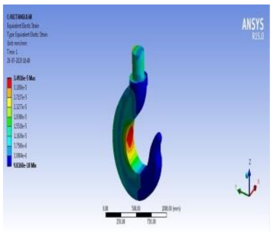
Strain

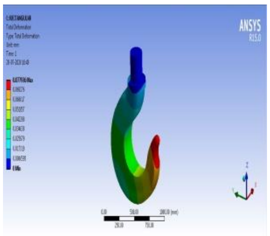


Deformation

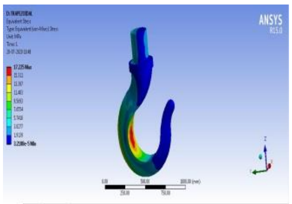
6.1.2 Rectangular cross section results

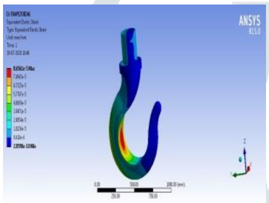

Von-mises stress

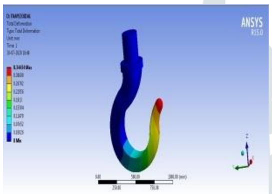

Strain


Deformation

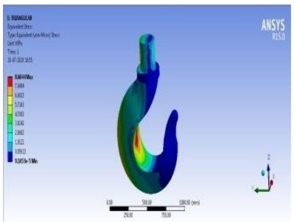
6.1.3 Trapezoidal cross section results

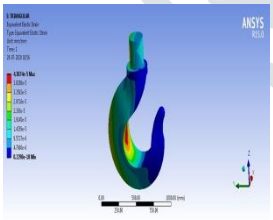

Von-mises stress

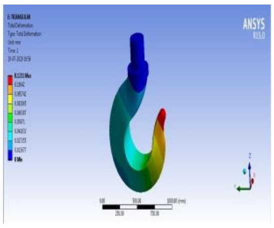

Strain


Deformation

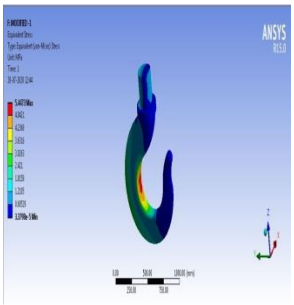
6.1.4 Circular cross section results

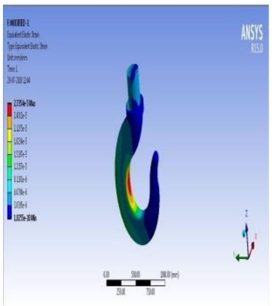

Von-mises stress

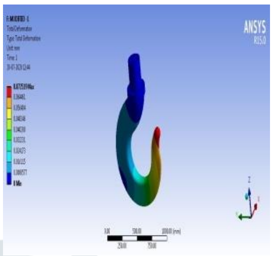

Strain


Deformation

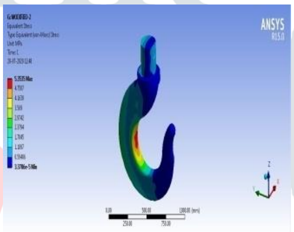
6.1.5 New modified -1 cross section results

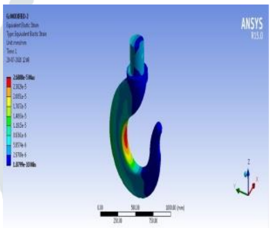

Von-mises stress

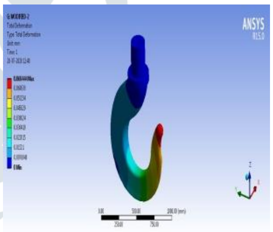

Strain


Deformation

6.1.6 New modified -2 cross section results


Von-mises stress


Strain


Deformation

6.2 Static Analysis Result Table & Graphs:

The below Table and graph shows that Result Of Crane Hook at various cross sections with different materials applied

Cross section	Stress (Mpa)	Strain	Total Deformation (mm)
Circular	19.128	0.000128	0.3843
Rectangular	6.9213	4.63 e -05	0.1039
Trapezoidal	17.107	0.000114	0.4562
Triangular	8.5542	5.709 e -05	0.162
New design modified-1	5.4183	3.62 e -05	0.0964
New design modified-2	5.3286	3.55 e -05	0.091

Table 2: For NI-Cr Steel Material

Cross section	Stress (Mpa)	Strain	Total Deformation (mm)
Circular	19.211	9.92 e -05	0.29779
Rectangular	6.9606	3.62 e -05	0.0807
Trapezoidal	17.25	8.98 e -05	0.3573
Triangular	8.617	4.47 e -05	0.1278
New design modified-1	5.454	2.83 e -05	0.0751
New design modified-2	5.36	2.78 e -05	0.0709

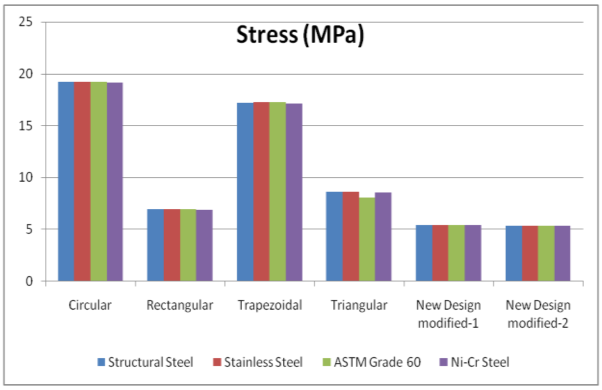
Table 3: For Stainless steel Material

Cross section	Stress (Mpa)	Strain	Total Deformation (mm)
Circular	19.2	9.18 e -05	0.2736
Rectangular	6.9606	3.32 e -05	0.0742
Trapezoidal	17.255	8.25 e -05	0.32844
Triangular	8.107	4.108 e -05	0.11749
New design modified-1	5.454	2.60 e -05	0.0691
New design modified-2	5.36	2.556 e -05	0.0652

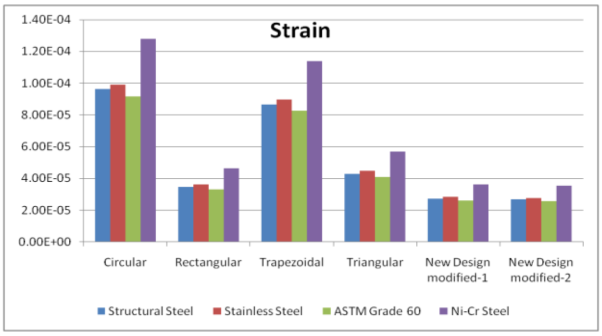
Table 4:For ASTM Grade 60 Material

Cross section	Stress (Mpa)	Strain	Total Deformation (mm)
Circular	19.195	9.63 e -05	0.28755
Rectangular	6.9524	3.49 e -05	0.0779
Trapezoidal	17.225	8.65 e -05	0.3443
Triangular	8.6044	4.307 e -05	0.1231
New design modified-1	5.4473	2.73 e -05	0.072519
New design modified-2	5.3535	2.68 e-05	0.06844

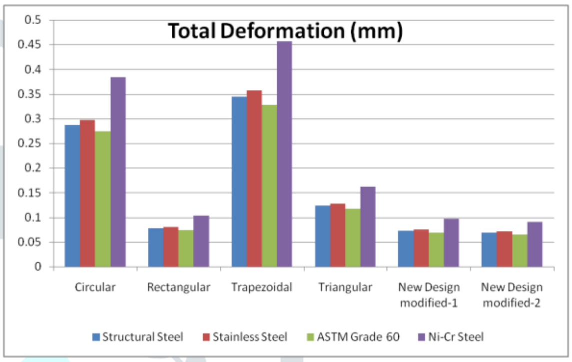
Table 5:For Structural steel Material



Stress results graph



Strain results graph



Deformations results graph

7. CONCLUSIONS

In design of Crane hooks FEA tool can be effectively used. Typically it helps the designer to understand behavior of EOT Crane hook. Thus, among the viable materials used for making hooks which were analyzed in this work

- In the designed Eot model both new modified-1&2 section show less stress compared to other 4 cross sections
- Also both new modified-1&2 section show less deformations compared to other 4 cross sections
- Using more no. of rope falls divide the load and make the tension less. Also it makes the work faster .E.g if we use 4 rope falls then using the same force 4 times work is done
- But increase in rope fall increase the rope length by that times ,which is expensive
- Also the rope length determine the drum length. Increase in drum length increase the volume of setup to reduce the volume we can double winding of rope on the drum can be adopted
- Motor power required depends on lifting speed and load applied
- The angular speed of drum and the motor are different so a gear box is used for power transmission

• Finally we concluded both new modified-1&2 section are applicable for crane hook design more suitable for making crane hooks as they have higher capacity to withstand loading, because results variations is very less

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