DESIGN OPTIMIZATION AND CONTACT ANALYSIS ON DUAL JOINT

K.ASHOK BABU[1] D.V. SUBBA RAO[2] Dr. P H V SESHA TALPA SAI[3]

ABSTRACT

This Project involves in designing and analysis of a DUAL HOOK JOINT. Modeling was done by using advanced Modeling software CREO 2.0 {Feature based parametric bi-directional software}. By using the features of this software DUAL HOOK JOINT was modeled. Individual parts of this dual hook joint are Modeled separately in the part module and assembled in the assembly module. The detailed drawings are prepared in drawing module. Analysis was done on the outer sheet of the DUAL HOOK JOINT by using CAE software ANSYS 16. The stress

analysis was done to calculate the strength of the hook. This is called as nonlinear contact analysis. Based on the obtained results the stress concentration was observed, to reduce the stresses at critical area the design will be changed and the analysis was repeated with the previous loads and boundary conditions.

Comparison was done with before modification and after modification by using different materials. With the keen observation of the achieved results, the best material for the model will be suggested with design modification

Key Words: Dual Hook, Outer sheets, Stress Concentration, Design Optimization

1.INTRODUCTION

Crane hooks are the components which are generally used to lift the heavy loads in industries and constructional sites. Now a day’s excavators having a crane-hook are widely used in construction works site. One reason is that such an excavator is convenient since they can perform the conventional digging tasks as well as the suspension works. Another reason is that there are work sites where the crane trucks for suspension work are not available because of the narrowness of the site. In general an excavator has superior maneuverability than a crane truck. However, there are cases that the crane hooks are damaged during some kind of

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suspension works. From the view point of safety, such damage must be prevented. Identification of the reason of the damage is one of the key points toward the safety improvement.

performance without failure. Thus the aim of this research is to study stress distribution pattern within a crane hook of various cross

MATERIAL ASSIGNMENT

Many industries manufacture Hook by steel material. These materials are widely used for production of hook and beams of different cross sections. Other than the load carrying capacity of hook, it must also be able to absorb the vertical load and deflection (induced due to variable loads). Ability to store and absorb more amount of strain energy ensures the safety of crane. The mechanical properties of steel

MATERIAL HANDLING

Material-handling equipment is equipment that relate to the movement, storage, control and protection of materials, goods and products throughout the process of manufacturing, distribution, consumption and disposal. Material handling equipment is the mechanical equipment involved in the complete system. Material handling equipment is generally separated into four main categories: storage and handling equipment, engineered systems, industrial trucks, and bulk material handling

DESIGN AND ASSEMBLY

INTRODUCTION TO CAD (COMPUTER-AIDED DESIGN):

It also known as **computer-aided design and drafting** (**CADD**), is the use of computer technology for the process of design and design-documentation. Computer Aided Drafting describes the process of drafting with a computer. CADD software, or environments, provides the user with input-tools for the purpose of streamlining design processes; drafting, documentation, and manufacturing processes. CADD output is often in the form of electronic files for print or machining operations. The development of CADD-based software is in direct correlation with the processes it seeks to economize; industry-based software (construction, manufacturing, etc.) typically uses vector-based (linear) environments whereas graphic-based software utilizes raster-based environments.

INTRODUCTION TO PRO-E

PRO-ENGINEER (Pro/E) is developed by PTC Company. It is a program

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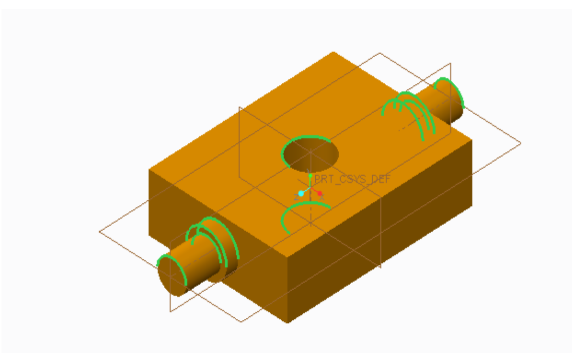
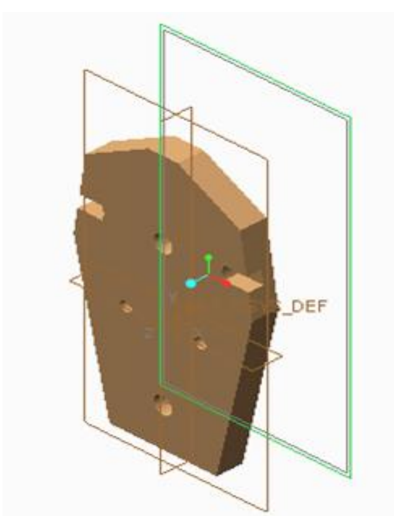
that is used to create precision three dimensional computer models. The 3-D parts created on Pro /E use a technique known as solid modeling. Other important definition used to classify Pro/E is: feature-based parametric bi-directional associative software.

Each Part of the Hook Assembly:

Hook Support: This is used to hold the hook and placed below the partition plate.

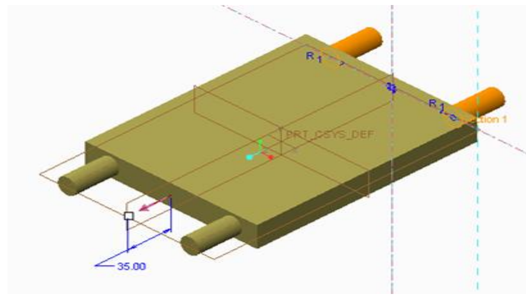


Side Plate: This plate is used to hold the hole assembly of the dual hook with one more adjacent plate.

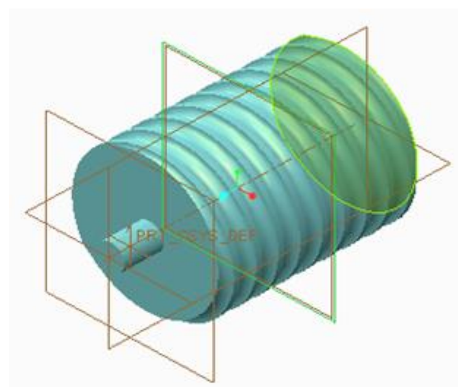


Patrting Plate: This plate is used as a partition plate between the hook and the rope drum.

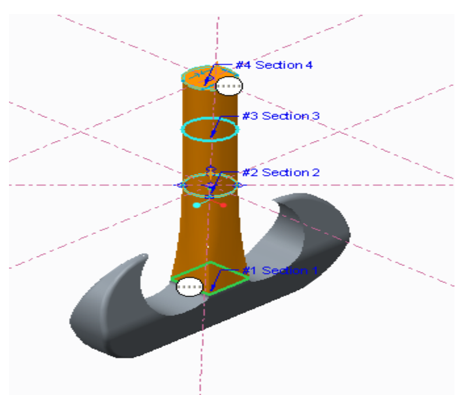
Rope Drum: This drum is used to



hold the rope, which is wounded by rope.



Hook: This is the main part of the hook assembly to lift any load.



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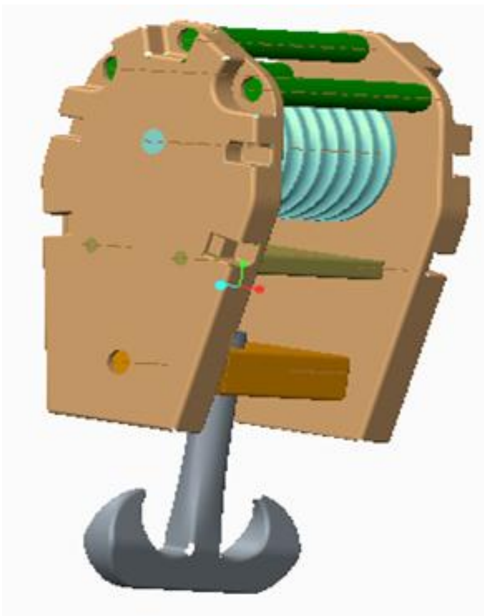
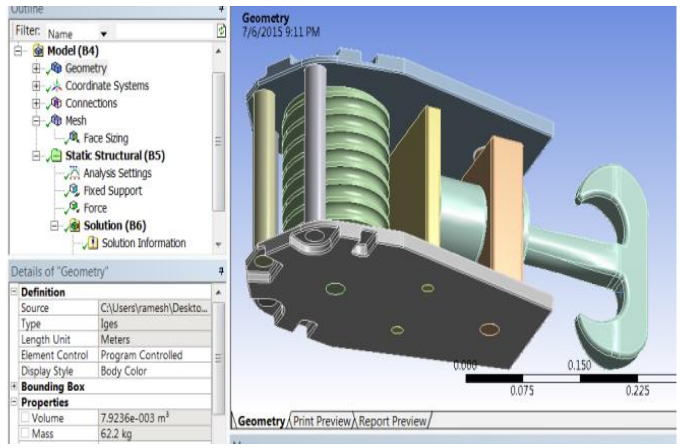
Dual Hook Assembly: This is the total assembly of dual hook assembled in assembly module of Pro-E. On this analysis was done after converting into IGES, which is a supporting file format of ANSYS.



INTRODUCTION TO FEM AND NSYS:

The very basic concept of FEM is a system-a-body of a structure can be divided into elements of finite dimensions, called "finite elements". The fundamental concept of the finite element method is that any continuous quantity, such as temperature, pressure or displacements can be approximated by a discrete model composed of a set of piece wise continuous functions defined over a finite number of sub domains. These series of functions are piece wise continuous and should approach the exact solution as the number of sub domains approaches infinity. FEM is more appealing to the engineer as it can be explained through the physical concept and also for heat transfer and fluid mechanics. It is amenable for programming on a digital computer in a systematic way.



LIMITATIONS OF FINITE ELEMENT METHOD ONE:

limitation of finite element method is that a few complex phenomena are not accommodated adequately by the method at its current state of development. Some examples of such phenomenon from the realm of solid mechanics are cracking and fracture behavior, contact problems, bond softening. Another example is transient and unconfined seepage problems. The numerical solution of wave propagation or transient problems is not satisfactory in all respects. Many of these phenomena are

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presently under research and refinement of the method to accommodate these problems can be expected.

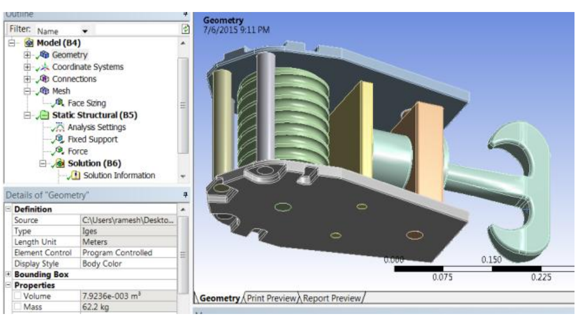
ANALYSIS :

Open Ansys Workbench16.0, It opens a project Schematic window with tool box graphical User Interface with some other important tools.

Use import tool to import the geometry with IGES or STEP file format.

After importing the geometry file, we do the Analysis. Now on our Dual Hook Model Static Structural analysis was done.

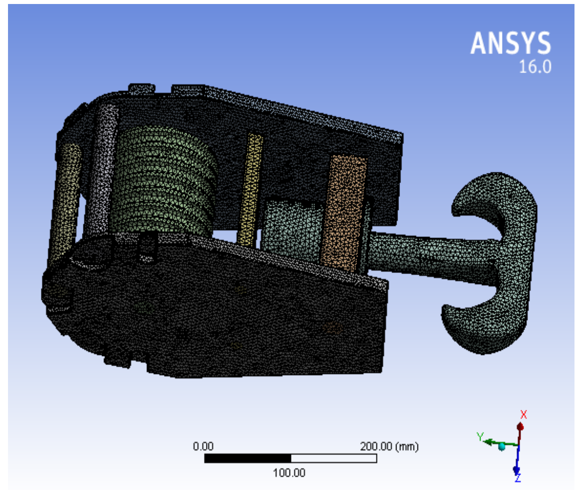
Imported Model in the ANSYS work bench looks as shown below.



Masses of the bodies:

1. Before Modification: Mass of the body Before Modification is 62.2kg.

2. **After Modification:** Mass of the body after Modification is 62.035kg.

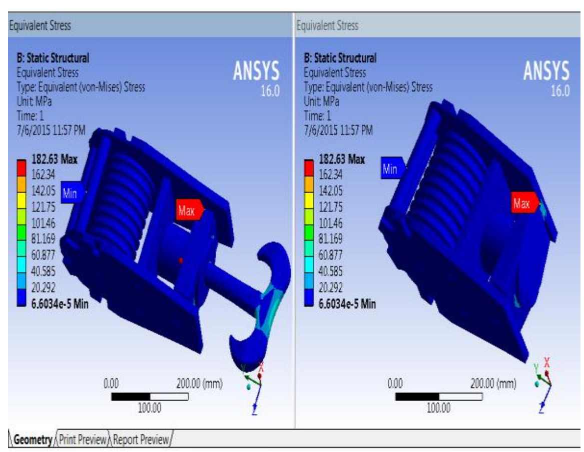


after importing into the simulation software the meshed model looks as shown below.

Analysis results with different materials:

Meshed body

Sectioning at Stress Concentration



Analysis was done with different materials to choose the suitable material. And the analysis was done before and after modification.

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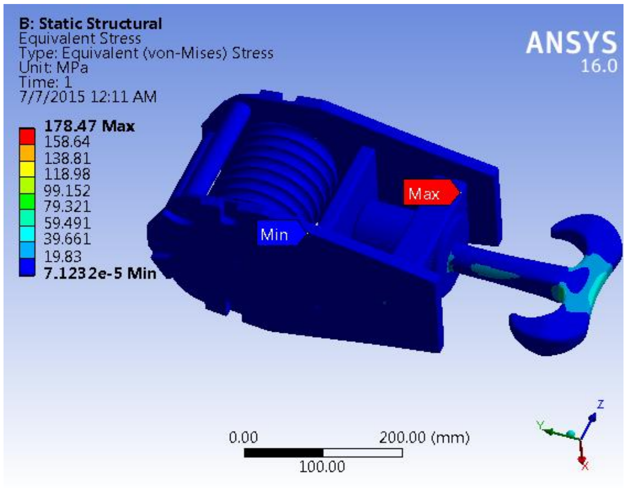
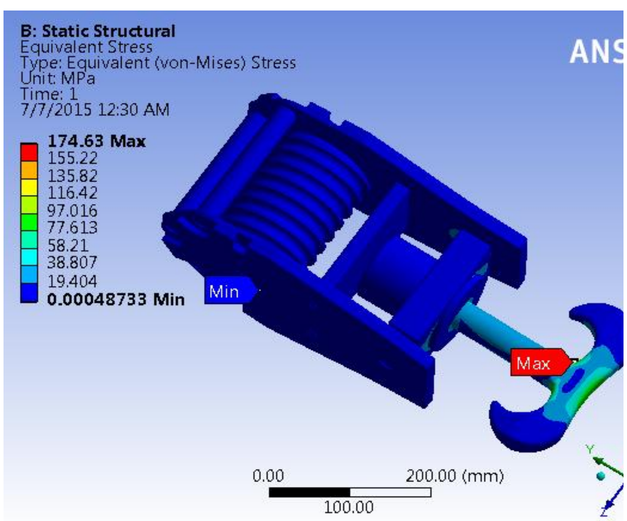
Material 1: Forged Steel

Before Modification:



The stress obtained is 178.47 which is within the yield strength of forged steel, yield strength of forged steel is 263MPa.

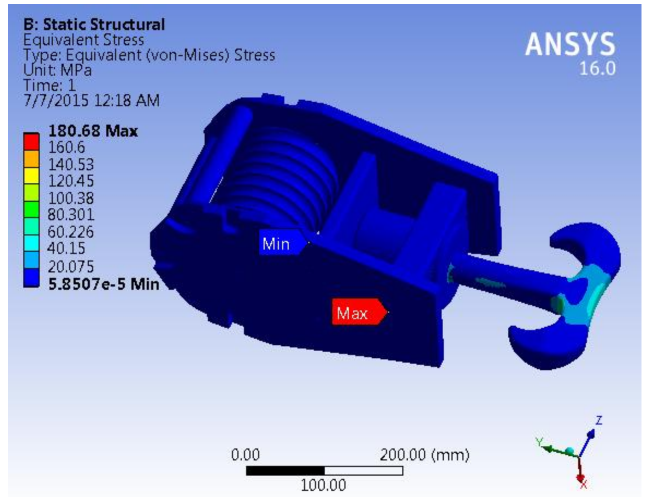
After Modification:



The stress obtained is 174.63MPa which is within the yield strength of forged steel, yield strength of forged steel is 263MPa.

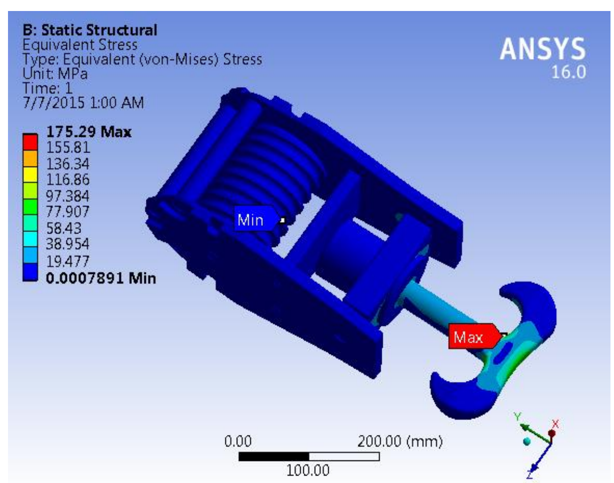
Material 2: Stainless Steel

Before Modification:



The stress obtained is 180.68MPa which is within the yield strength of Stainless Steel, yield strength of Stainless Steel is 207MPa.

After Modification:



The stress obtained is 175.29MPa which is within the yield strength of Stainless Steel, yield strength of Stainless Steel is 207MPa.

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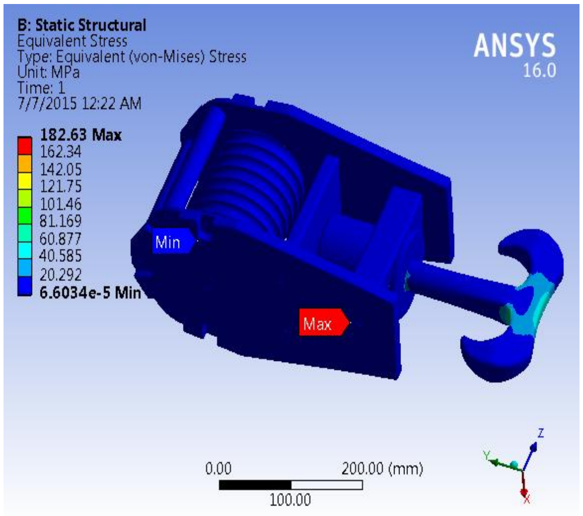
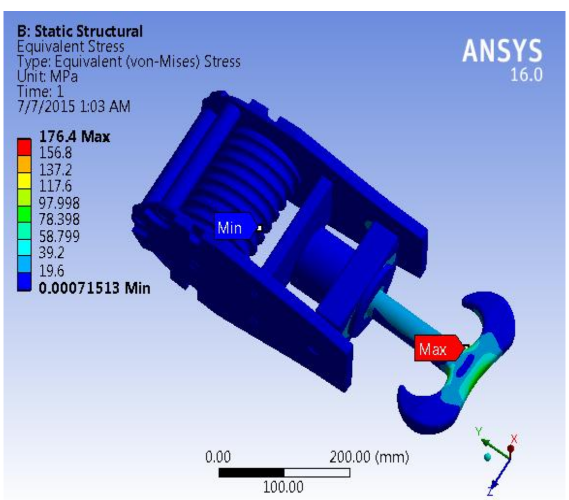
Material 3: Structural Steel

Before Modification:



The stress obtained is 182.63MPa which is within the yield strength of Structural Steel, yield strength of Structural Steel is 250MPa.

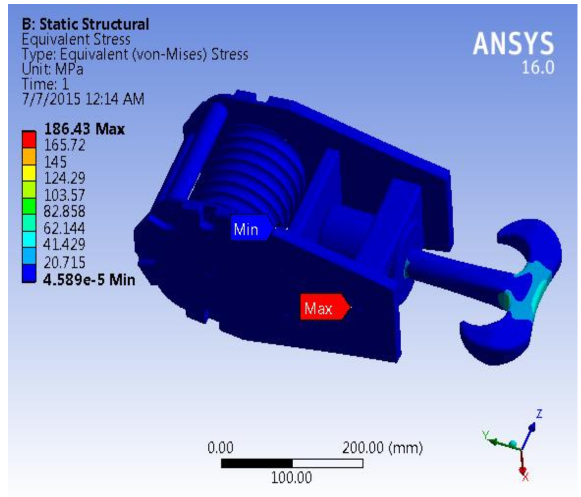
After Modification:



The stress obtained is 176.4MPa which is within the yield strength of Structural Steel, yield strength of Structural Steel is 250MPa.

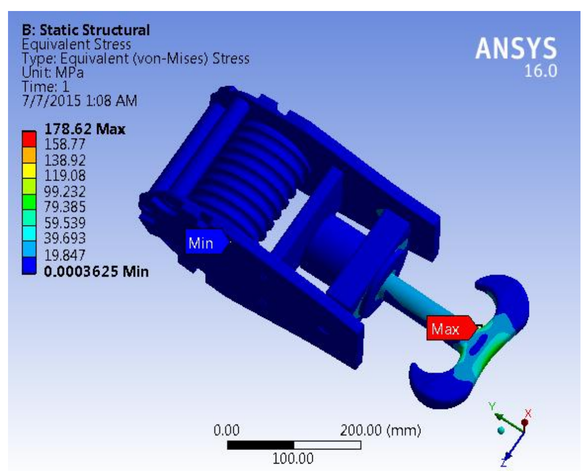
Material 4: Grey Cast Iron

Before Modification:



The stress obtained is 186.43MPa which is within the yield strength of gray cast iron, yield strength of gray cast iron is 240MPa.

After Modification:



The stress obtained is 178.62MPa which is within the yield strength of gray cast iron, yield strength of gray cast iron is 240MPa.

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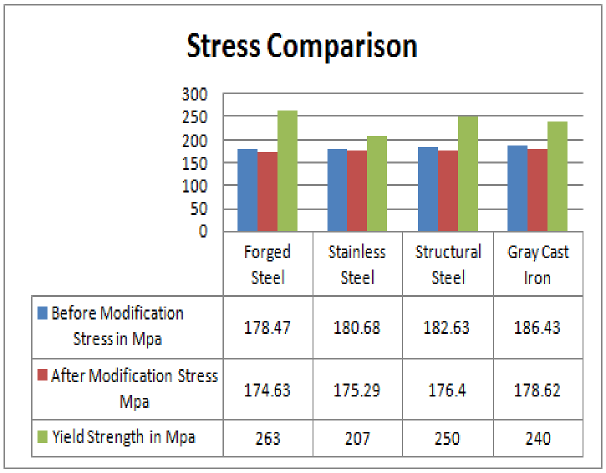
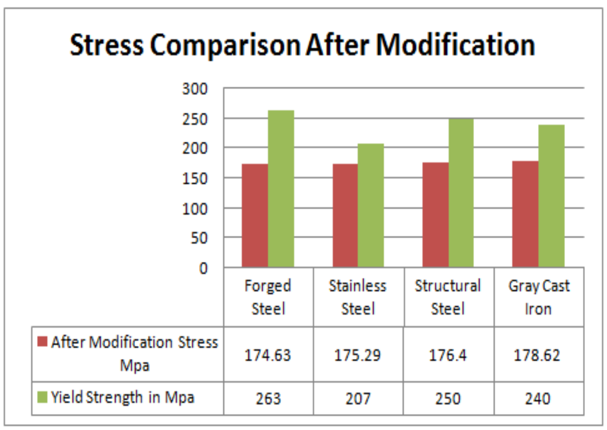
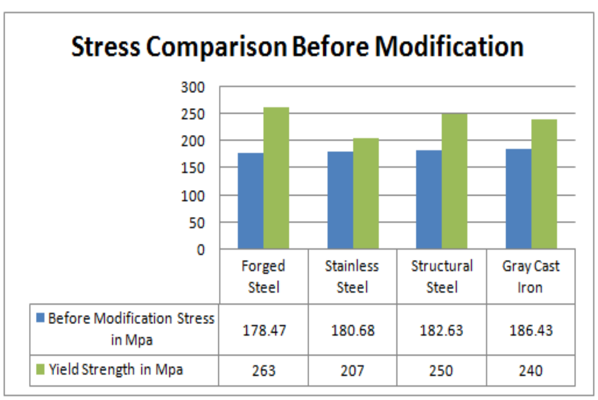
Graph1: Stress Comparison before and after modification







RESULTS AND GRAPHSTable1:

ANSYS stress values with different materials

Material	Before Modification	After Modification	Yield Strength
Forged Steel	178.47MPa	174.63MPa	263
Stainless Steel	180.68MPa	175.29MPa	207
Structural Steel	182.63MPa	176.4MPa	250
Gray Cast Iron	186.43MPa	178.62MPa	240

CONCLUSION:

The design of the Dual Hook was modeled by using advanced design software PRO-E and analysis was done by using ANSYS 16.0 the results were achieved for different materials before and after modification and the results are tabulated with Yield strength. The Forged steel stress values are less as compared to the other materials, so forged steel was suggested for the manufacturing of Dual Hook joint assembly.

SCOPE FOR FUTURE WORK

The Design of the outer sheets of the Dual hook joint was done to reduce the Stress concentration on critical area and increasing

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the carrying capacity and life time of the Dual hook joint.

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1. ***K.Ashok Babu,PG scholar Mallareddy College of Engineering and Technology, Maisammaguda,Hyderabad.***

2.D.V.Subba Rao Assistant professor of mechanical department, Mallareddy college of engineering and technology, Maisammaguda, Hyderabad.

3. **Dr.P H V Sesha Talpa Sai, HOD of Mechanical Department,** ***Mallareddy college of engineering and technology, Maisammaguda, Hyderabad***

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