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Stress Analysis Evaluation of Aircraft Lug-Joint

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Abstract - *Aircraft is the complex flying structure. For Aircraft lift is generated through wings. Through lug-joints the wings are attached to fuselage. Structural components of wings are spars, and the entire load which is applied is carried by wings is through spars. There will be bending moment and shearing effects produced and these effects shifts to the lug-joint. Spar has to withstand the fatigue loads, as generally failure of wings is always due to fatigue loads. In this paper bending loads are considered as of more length, bending is dominant.*

Key Words: Residual strength, Stress intensity factor Damage tolerance , lug joint.

1. INTRODUCTION

Lug joints are one of the important structural components of aircraft, which are widely and generally used to connect different structural components of aircraft. For example- wing fuselage attachment, landing gear attachment links etc. Lugs are components with simple geometry and helps in better transmission of loads compared to bolts and nuts. Lugs are easy to assemble with major components, thus for lugs it is necessary to create design criteria's and analysis methods for damage tolerance of brackets called lugs. Damage tolerance is the property related to the ability to sustain damages safely until n unless the repair can affect the part or component. The assumption made for this approach is that the flaw will be existing in any component and similar damages will propagate by using it continuously. In aerospace engineering part is said to be damage tolerant, if the crack detection procedure detects the flaw and it repair of damages and cracks before the flaw reduces the strength within threshold limit. Within this process the inspection schedules are mandatory to ensure continuous safe operations of the structure which is damage tolerant.

1.1 Fracture Toughness:

Fracture toughness is the property that helps to find the ability or capacity of a componant to resist failure which contains a crack. It is one of the important properties of all materials for design applications. The fracture toughness of the linear elastic material is estimated from stress intensity factor (K) where exactly the crack begins to grow in the material. Fracture toughness symbol is given by K_{IC}. When the fracture toughness of the material becomes equal to stress intensity factor of the material at the crack tip the fracture will occur.

2. GEOMETRICAL MODELING OF LUG-JOINT:

The material used for the spar is Aluminum alloy 2014-T3 51. It is collected from ASM (American Society for Metals). This material gives good strength during heat treated as it is cold worked.
The Material allotted for Lug-part is Alloy Steel-Heated treated AISI-4340.

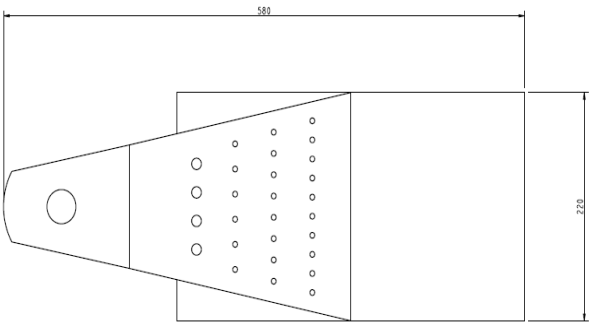

Figure 2.1

3. STRESS ANALYSIS OF LUG-JOINT:

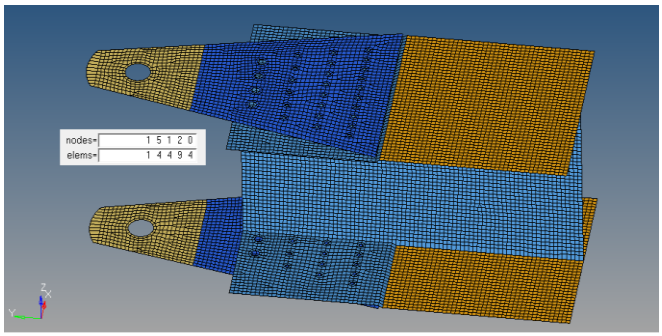

Figure 3.1: Meshed lug-joint model with spar

The meshing is carried out for the part or component. We have used 2-dimensional mesh. We have extracted the mid-surface of the component and then using Quad and Trias meshing is performed. Even the FE mesh Quality conditions are also considered and at the hole locations the split washer is also put to have uniform distributions of stress.

3.1 Boundary conditions:

At the end of lug joint all degrees of freedom is fixed ie it is constrained, not allowed to translate and rotate. And on the other and on spar load is applied. This takes bending load.

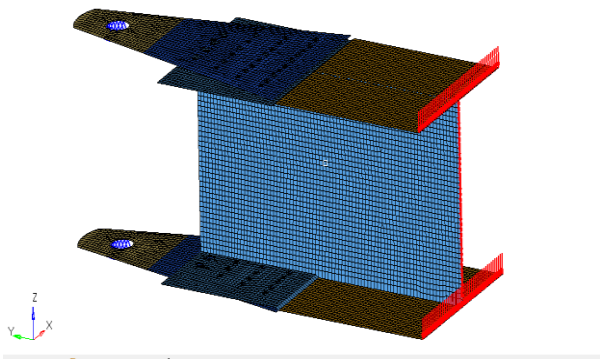

Figure 3.2: Boundary conditions applied for model

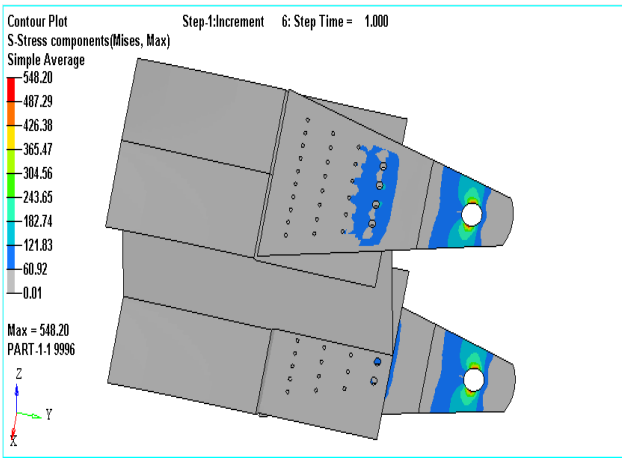

Figure 3.3: Stress analysis of the component

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