

Topology Optimization For An Attachment Bracket Of Aircraft Wing By Using Additive Manufacturing

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Abstract—In this paper, we describe a manner to format & look at the brackets at severa tensile loading conditions performing at Centre of Gravity component of fasteners. The cloth used for brackets & fasteners are Al alloy 7075-T6. This is done to ensure structural stability. The same strain is in evaluation to the yield power of the material used.

In this task we did the design of bracket with the useful resource of the usage of 3d cad model tool i.e. CATIAV5R20 after that we did the structural analysis further to topology optimization .With that topology optimization we changed the layout of bracket. Once extra we did the structural analysis on each brackets & we evaluate the outcomes. After that we did the mechanical load sorting out through using the UTM machine & calculate the yield factor.

Keywords—Brackets, Stress assessment, Modal analysis, Static load, Finite detail method, use of brackets in plane, CATIA, ANSYS & Wing attachment Brackets.

I. INTRODUCTION

An aircraft is a complicated structure, but a very inexperienced artifical flying device. Aircraft are typically constructed-up from the easy components of wings, fuselage, tail units, & control surfaces. The load-bearing members of those important sections, the ones subjected to essential forces, are called the airframe. Brackets are connector kind elements significantly used as structural helps to hold hydraulic & electric powered traces applied in engines, wings & l&ing equipment links. Failure of brackets can also purpose the catastrophic failure of the complete form. Finite detail assessment studies & experimental records help the fashion clothier to protect the shape from catastrophic failure. I-Bracket is taken into consideration for our assignment to investigate stress that could reason resonant response under the proper excitation forces.

II. LITERATURE REVIEW

B.K. Sriranga, Dr.C.N. Ch&rappa, R. Kumar & Dr.P.K. Dash, “Stress Analysis of Wing-Fuselage Lug attachment Bracket of a Transport Aircraft” [1]: Civil delivery plane is used for evaluation. At the time of flight at most enhance, the wings

will go through the very quality bending. Fuselage & wings are connected thru wing-fuselage-brackets. Bending load joints are used for evaluation. In this thesis they used geometries which embody I-spar of Aluminium Alloy 2024-T351 & Lug-joint of Alloy metal warm temperature dealt with AISI-4340 as material. They carried out pressure assessment & identified the most tensile stress role at lug holes & validation is carried out thru thinking about plate with round hole.

Umesh S.Ghorpade & Prof. D.S. Chavan, Prof. M.V. Kavade, “Static Structural& Modal Analysis of Engine Bracket Using Finite Element Analysis” [2]: The technique of optimization of herbal frequency of engine mount bracket is finished to for noise good buy the usage of unique light-weight substances for structural stability, which reduces weight of aircraft. The outcomes from the thesis concluded that low natural frequency will show as a undertaking in vibration trends of the bracket.

Shashikumar.C, Nagesh.N, Ganesh, “Design & Analysis of Wing fuselage attachment bracket for fighter plane” [3]: Design & analysis of wing-fuselage bracket for fighter plane are completed to count on the fatigue lifestyles. In a metal form fatigue manifests itself inside the form of a crack that propagates. Fatigue cracks will seem on the region of immoderate tensile strain. As a give up give up end result maximum pressure concentrations have been located at one of the lug holes.

Harish E.R.M., Mahesha.K, Sartaj Patel, “Stress Analysis for Wing Attachment Bracket of a six-seater Transport Airframe Structure” [4]: Stress assessment of the wing-fuselage lug attachment bracket is carried out to make certain static load-sporting functionality. Finite detail technique is used to discover maximum tensile stress at one of the rivet holes of I-spar plate

II. INTRODUCTION TO CATIA

CATIA is a total automation programming that relates to the mechanical trouble. It is graphical UI this is in reality no longer tough to investigate moreover the object is spotlight primarily based certainly & parametric strong illustrating. We can draw 2D & 3-D models of a place & as necessities are the social occasion of the components need to be workable in it. The form or geometry of the version or assembling is destitute upon the capabilities which might be insinuated as situations. Modules, as an instance, sketcher module used to diagram 2D drawings, element arrange

module is used to format the three-D models of geometry, & Assembly paintings setup is used to accumulate the one-of-a-type elements which can be pulled in the component set up module. Kinematics is used to offer the technology or development to the aspect our our bodies which is probably organized & accumulated to three diploma & get collectively diagram modules.

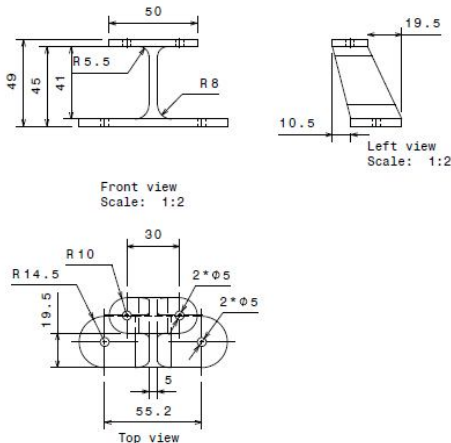


Fig no 1 views of bracket

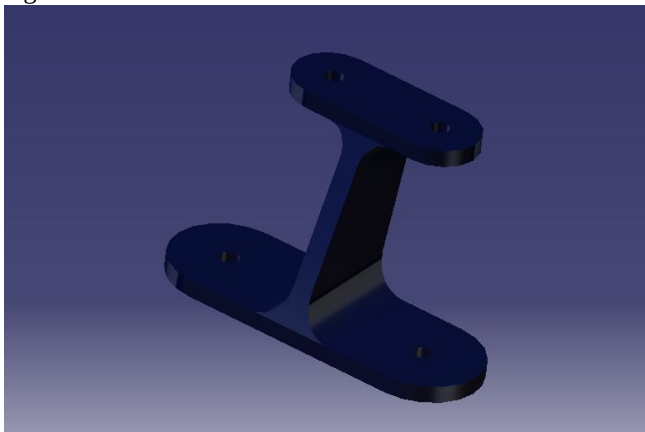


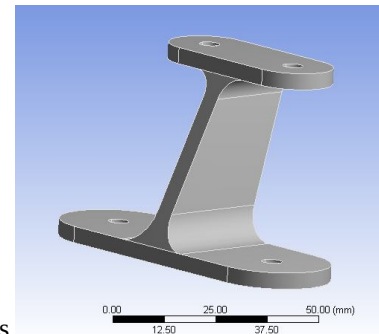
fig 2 bracket model in CATIA

II. INTRODUCTION TO FEA

FINITE ELEMENT ANALYSIS (FEA)

The actual idea in FEA is that the frame or shape can be detached into more humble additives of constrained estimations called "Constrained Elements". The primary body or the shape is then considered as an collection of these portions associated at a foreordained form of joints referred to as "attention focuses". Coordinate factors of confinement are approximated the removals over each obliged factor. Such recognized cutoff factors are known as "form limits". This will suggest the development in the quantities similar to the motion on the focuses of the elements.

The Finite Element approach is an clever tool for settling regular & notably talking differential examination in slight of the truth it's far a numerical mechanical assembly, it can manage the brain boggling problem that can be implied in differential logical verbalization from. The use of FEM is endless as respects the approach of balanced diagram troubles. Thus of immoderate price of searching after compel of years traveled with the resource of, FEM has a basis set aside through being achieved to manipulate complex & price



critical troubles

Fig 3 model in Ansys

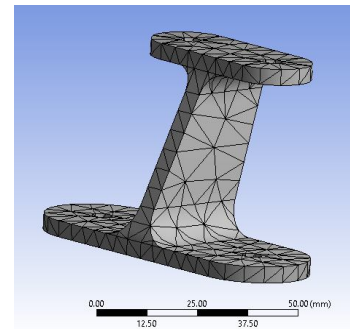


Fig 4 mesh model in Ansys

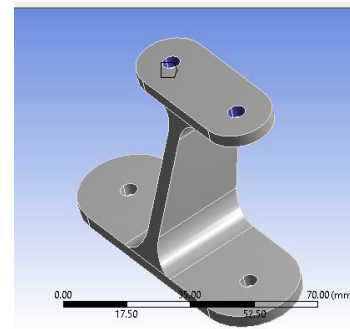


fig5 fixed support

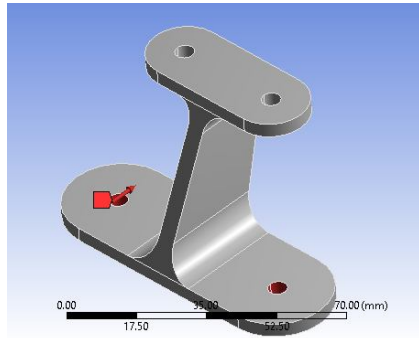


Fig 6 loads

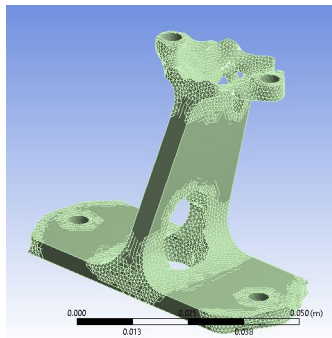


Fig 7 Topology optimization
optimized design in catia

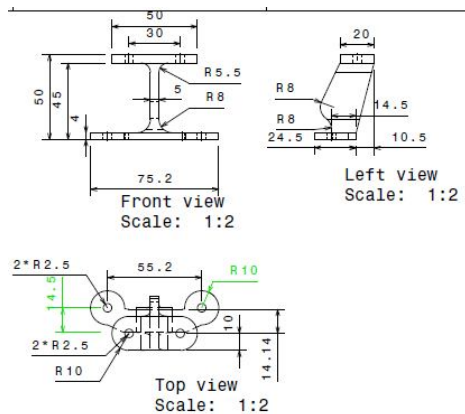


fig 8 drafting of optimized part

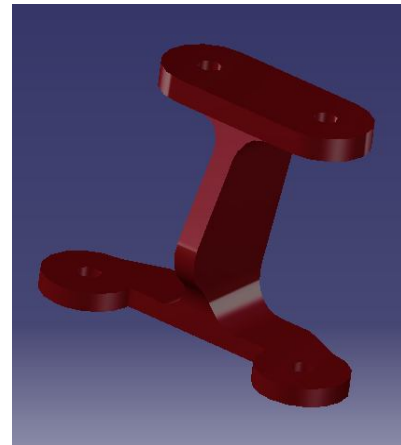


fig 9 part model with modified dimensions

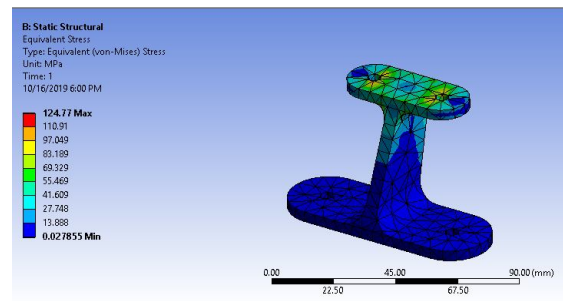


fig 10 equivalent stress for 171 N loads

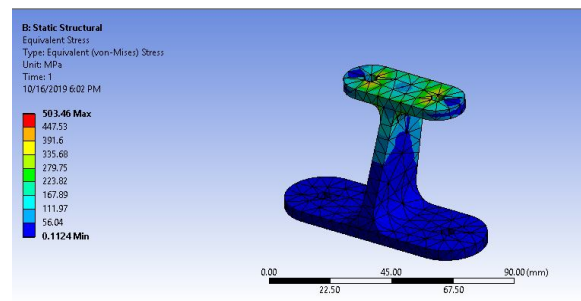


fig 11 equivalent stress for 600 N loads

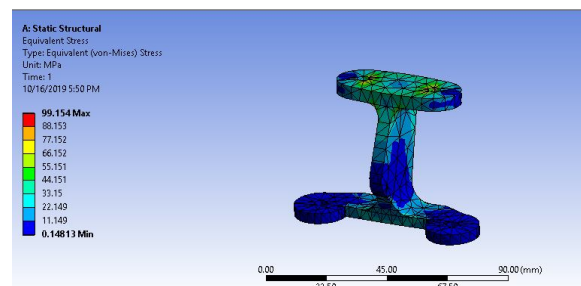


fig 12 equivalent stress for 171 N loads

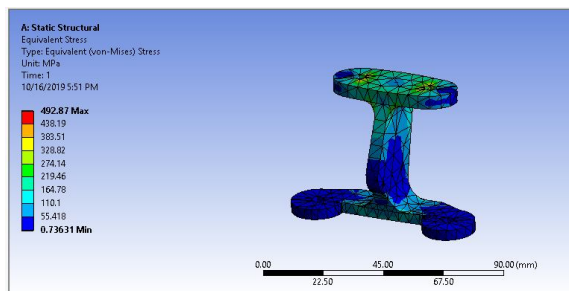


fig 13 equivalent stress for 850N load

V Introduction to Additive Manufacturing

The 3D printing process builds a 3-dimensional object from a laptop-aided layout (CAD) model. Usually it successively including material layer with the aid of layer which is why it is also known as additive Manufacturing, unlike conventional system, in which fabric is removed from a stock object (subtractive manufacturing) poured into a mold & formed by dies, presses, & hammers.

VI INTRODUCTION TO CNC

CNC machining is the maximum extensively used subtractive production era. In CNC, the fabric is eliminated from a robust block using a spread of lowering device to offer a detail primarily based on a CAD model. Both metals & plastics may be machined with CNC.

CNC produces elements with tight tolerances & splendid material houses. CNC is appropriate for one-off jobs & occasional-to-medium quantity production (as much as a thous& components), due to its high repeatability. When as compared to 3-d printing despite the fact that, CNC has more design regulations, because of the subtractive nature of the era.



fig 13 old bracket



fig14 new bracket

VII Results

S. NO	Parameter	Ansysis result in old geometry	Ansysis result in the new geometry	Mechanical testing old geometry	Mechanical testing new geometry
1	Equivalent stress (MPa)	503MPa at 600N load at each hole	492.87 MPa at 850N load at each hole	500N at each hole	725N at each hole
2	Mass	0.14484 kg	0.11049 kg	-	-

VIII CONCLUSION

In this undertaking we did the analysis of bracket with the aid of using the Ansys tool & we did layout optimization & redesigned the bracket we did structural evaluation for each geometries the old geometry reaches the yield point at 503MPa at the load of 600N & the br& new geometry reaches the yield factor 492.87 on the load of 850N while we evaluate the result of Ansys & mechanical testing we proved that the br& new geometry is ideal than the vintage one & the burden all so decreased.

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IX AUTHOR DETAILS



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