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ANALYSIS OF HINGE BRACKET

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ABSTRACT
In the world of aviation, there should be no space left for errors or miscalculations of any sort. Thus, even the factor of safety in an aircraft is usually as low as 2. In order to provide a safe flight in an aircraft be it commercial, military the smallest part must be carefully examined, analyzed before installing it on the aircraft body. Softwares like CATIA, ANSYS are a great help in this regard. In this paper the process of designing a 3-D model of a hinge bracket and analyzing it is described. Also, the maximum value of the load which can be applied to this bracket is calculated by hit and trial method in ANSYS. The boundary conditions and the limits of the material used are kept in mind while the whole process.

Keywords
Hinge Bracket, Aileron, CAD part, analysis, Maximum load, Equivalent stress, Total deformation, etc.

1. INTRODUCTION
An aileron (French for 'little wing') is a hinged flight control surface usually forming part of the trailing edge of each wing of a fixed-wing aircraft. Ailerons are used in pairs to control the aircraft in roll (or movement around the aircraft's longitudinal axis), which normally results in a change in flight path due to the tilting of the lift vector. Literal meaning of a hinge is a jointed or flexible device that allows the turning or pivoting of a part such as ailerons in this case. The bracket bolts to the wing and hinges outward to provide an extremely solid support for ailerons so that it can move properly. The objective in this project is to design a hinge bracket for aileron in CATIA using the given sketch and determine the maximum load it can bear. Aluminum alloy 7075 is aerospace aluminum alloy, with zinc as the primary alloying element. It is strong, with strength comparable to many steels, and has good fatigue strength and average machinability.

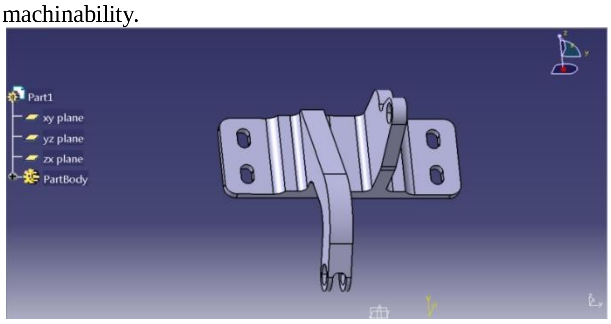

Fig. 2

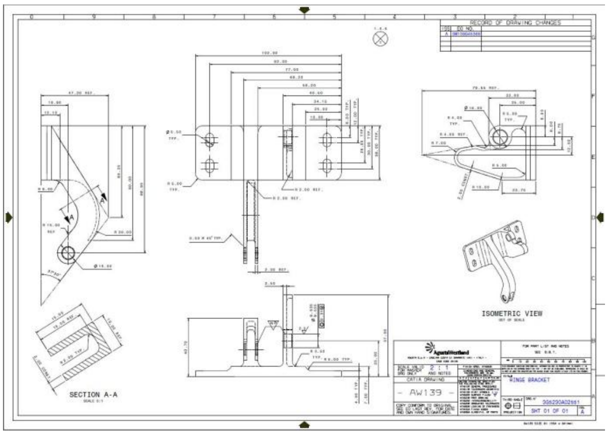

Fig. 1

2. BOUNDARY CONDITIONS
The lower portion of hinge bracket is riveted to the wing with the help of four holes made as shown in the figure. Therefore, this portion of bracket is fixed. The load is applied in the negative x-direction only at the point where the aileron is attached to hinge.

2.1 DESIGN AND NON-DESIGN SPACES
There are some limitations which have to be kept in mind while designing the hinge bracket. The design, parts and dimensions of the bracket are non-design space element, i.e., they cannot be altered. In this project, we are given the part's design and dimensions in a document which are further made as a 3-dimensional model in the software CATIA. Also, as the bracket is bolted to the wing by the holes in lower section, the position of fixed point cannot be changed and the position of load applied (where aileron is attached) too. The load applied on this bracket has to be increased slowly until it reaches its maximum value i.e. the part does not fails or the load does not exceeds value of yield load of the material used.

3. CAD PART
Using the sketch of hinge bracket in the third angle projection along with isometric view of the same the 3-D drawing of bracket is made in CATIA V-5 as shown in Figure 2. The scale of the sketch is 5:1. The 3-D model is made by taking a cubical shape and pocketing the sketches in it. Further holes, chamfer and filleting is also done.

4. FINITE ELEMENT ANALYSIS
4.1 ANALYSING HINGE BRACKET
The CAD model of hinge bracket was imported in the software ANSYS. The properties of material are given by

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specifying the material as stainless steel-304. Fixed point and the point of application of load are also specified. As the value of maximum load is to be evaluated, in which the equivalent stress does not exceeds yield stress, the hit and trial method is used. Firstly, the value of load is put as 10000 N. The maximum value of equivalent stress comes out to be 4572.10MPa which is very high as compared to yield point of the material which is 464MPa. The value of total deformation is very high too. Hence, we lower the value of load.

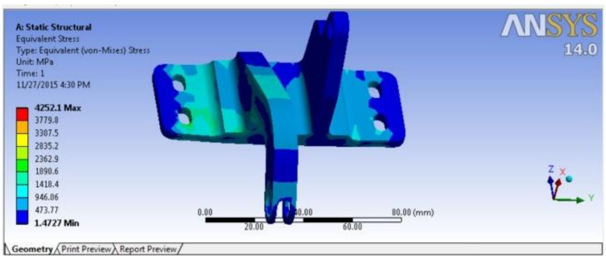

Fig. 3

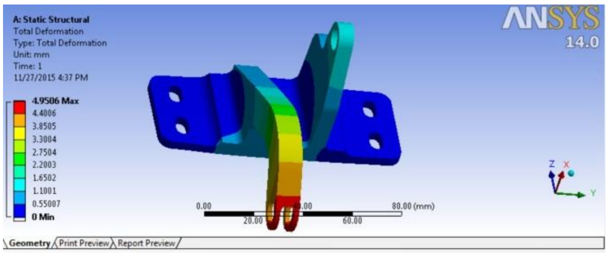

Fig. 4

4.2 LOAD CALCULATION

As can be seen in the above figures the value of stress exceeds yield point on the load being 10000 N. So, we input the new value of load as 1050 N. The value of stress is 447MPa which is apt and is less than yield stress SS-304 i.e. 464MPa. Total deformation in this case turns out to be of the value 0.52 mm.

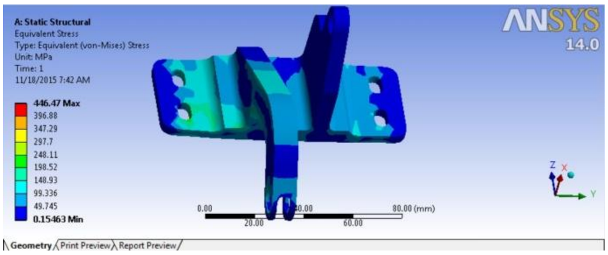

Fig. 5

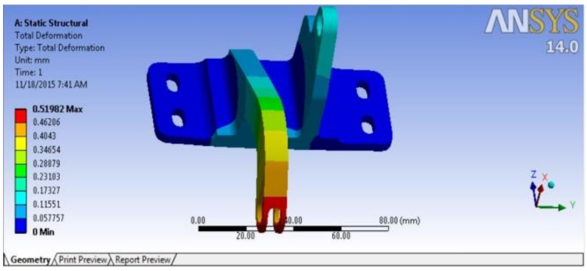

Fig. 6

5. CONCLUSION

The three-dimensional model of the given 2-D drawings was made in CATIA with the help of dimensions of each part, various views(top view, side views, isometric view) provided in the drawing . On analyzing this CAD part in ANSYS, we conclude that the highest value of load that can be applied to the hinge bracket is 1050N which causes a total deformation of 0.52 mm. Beyond this value of load, the bracket will fail under the given conditions. Hence, in order to use this bracket aileron's weight and moment should be kept such that the total load on bracket is within this range only. Otherwise, for higher loads, the bracket should be optimized.

6. REFERENCES

[1] The Armstrong-Whitworth Argosys by Peter Bunnet
[2] Crouch, Tom. Oldies and Oddities: Where Do Ailerons Come From?
[3] Magoun, F. Alexander and Eric Hodgins. *A History of Aircraft*, Whittlesey House, Latch-lock mechanism for load carrying airplane cargo doors by R B Odell, S J Fox, H J Salmon, J A Ennes
[4] Airplane Aileron by Albert E Arlsan, John G Hazard
[5] Latch-lock mechanism for load carrying airplane cargo doors by R B Odell, S J Fox, H J Salmon, J A Ennes.
[6] Canopy-type aircraft cargo door and actuating mechanisms by Franklin K. Barnes and Allan W. Opsahl.
[7] Vent-latch interlock assembly for an aircraft door by Michael A Fleming, Michael C. Strum.
[8] Cushioned hinge bearing by R.H. Cowles