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ANALYSIS OF AIRCRAFT BAGGAGE DOOR LATCH HANDLE

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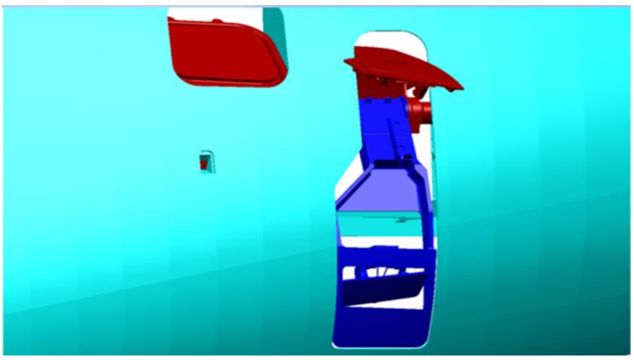
ABSTRACT

Airplanes now-a-days are used not only for transportation of people but, also for transporting large items from one place to other. The baggage compartment's opening should be of high strength and accuracy so that the baggage rmains intact throughout the flight. In this paper, , we study a baggage door latch handle which is jammed in closed position. The latch handle is attached to the latch handle fitting with the help of four fasteners and all fasteners are blocked at the centre giving six degrees of freedom i.e. 3 translational and 3 rotational.

1. INTRODUCTION

Contemporary commercial airplanes are commonly provided with a multiplicity of ingress and egress openings in the lower lobe of the airplane fuselage to permit on-loading and off-loading of baggage, cargo, and the like into and from the cargo hold of the airplane. The ingress and egress openings into the cargo hold are enclosed by cargo doors. Cargo doors vary widely in terms of their construction and operation. Many cargo doors are electrically powered, outwardly opening, canopy-type doors as contrasted with inwardly opening, plug-type doors of the type.

In this project, we study a baggage door latch handle which is jammed in closed position. A load of 1350 N is applied on this latch handle in three directions (x, y and z axis) at a distance of 140mm from hole edge which are termed as three cases. The latch handle is attached to the latch handle fitting with the help of four fasteners and all fasteners are blocked at the centre giving six degrees of freedom i.e. 3 translational and 3 rotational. Material used for this handle is Aluminium alloy 7050 T7451 plate



2. LITERATURE

1) Latch-lock mechanism for load carrying airplane cargo doors by R B Odell and S J Fox: A latch-lock mechanism for an airplane cargo door is disclosed. The latch-lock mechanism includes straight-through drive shafts rotated by a common powered drive unit. Affixed to the outer ends of the drive shafts are pull-in hooks that co-act with pull-in pins affixed to the fuselage of the airplane adjacent to the sides of the cargo door opening. The co-action between the pull-in hooks and the pull-in pins pulls the cargo door into a closed position against a distorted fuselage cargo door opening.
2) Canopy-type aircraft cargo door and actuating mechanisms by F K Barnes and A W Opsahl: Actuating mechanisms for an aircraft door mounted along its upper edge to the body of an aircraft for movement into and out of a door opening in the fuselage. The hinge actuating mechanisms include a drive unit and linkage assembly secured to the body with all actuating components mounted on the door and positioned so that all actuating components move outwardly and upwardly to points outboard of an above the opening except for actuating links which pass through the upper corners of opening, thus defining an essentially unobstructed clearance area for passage of cargo.
3) Vent-latch interlock assembly for an aircraft door by Michael A Fleming and Michael C Strum: A vent-latch interlock assembly for installation to an aircraft door that is provided with a latch assembly that controls the opening and closing of the aircraft door. The vent-latch interlock assembly includes a pressure vent door that is positioned to be seated in an opening formed in the aircraft door. The pressure vent door is rotatably attached to a shaft that is rotatably mounted to the aircraft door.
4) Three track sliding aircraft door by I Baker: An aircraft door of the plug type is mounted on three tracks affixed to an airframe for inward and upward movement to open the door. A pressure seal is provided. The door is powered for upward movement by a link chain connected to an arm on which the door is suspended in one of the tracks. Two of the tracks are mounted adjacent the sides of the door while a third track is mounted above the door and centrally located with respect to the door opening. A positive latching mechanism is also provided to retain the door in a closed position.

3. PROBLEM DESCRIPTION

Contemporary commercial airplanes are commonly provided with a multiplicity of ingress and egress openings in the lower lobe of the airplane fuselage to permit on-loading and off-loading of baggage, cargo, and the like into and from the cargo hold of the airplane.

4. DESIGN & NON-DESIGN SPACE

We can vary the dimensions of the door depending upon the stresses calculated keeping in mind to use minimum material

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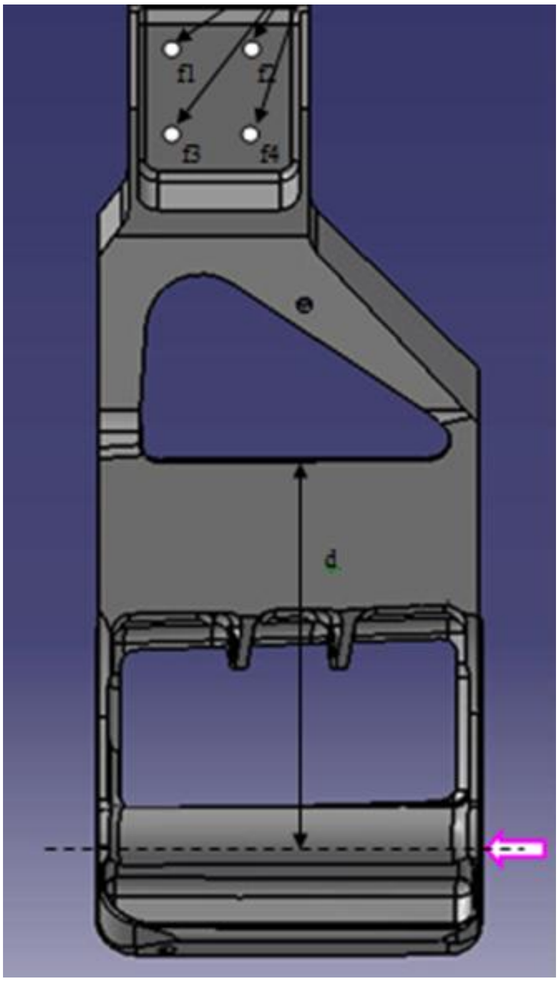
and, that the design does not fail or buckles. There are some limitations which have to be kept in mind while designing. The fasteners are blocked at center and the mechanism is jammed and thus, these two are non-design space element, i.e., this cannot be altered. If the given design fails, we can change in the design spaces but keeping in mind the limitations of a cargo door and also ones in this case.

5. LOADING CONDITIONS

There are three loading conditions and these are:

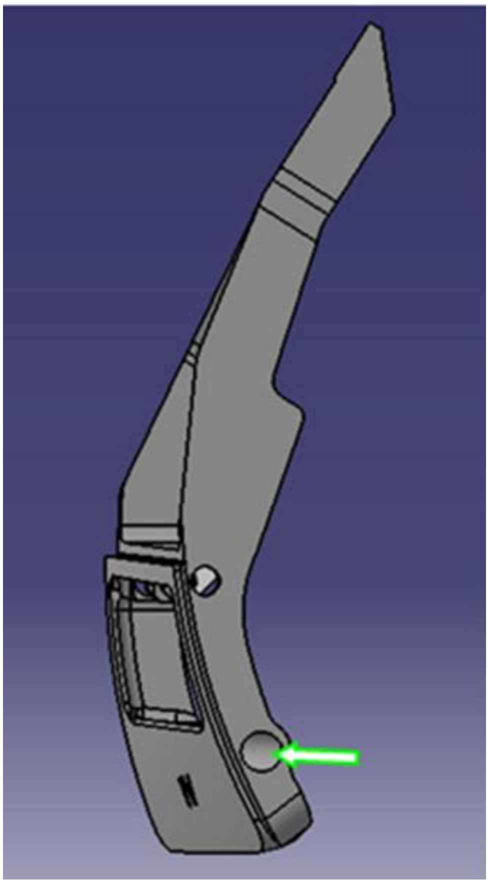
5.1 Case 1

Load of value 13500 N is applied at a distance of 140 mm in XA direction. This is the most critical direction.



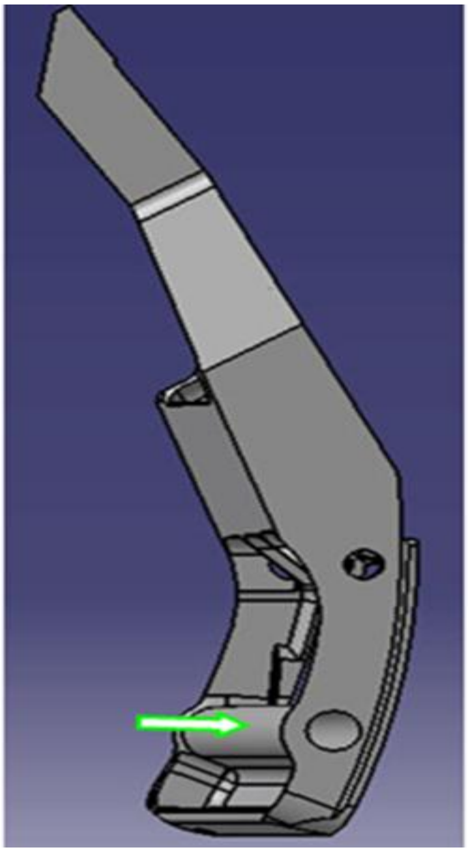
5.2 Case 2

Load of value 13500 N is applied at a distance of 140 mm in ZA direction (with the maximum arm distance from control shaft axis from load application point).



5.3 Case 3

Load of value 13500 N is applied to the door at a distance of 140 mm YA direction.



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6. BOUNDARY CONDITIONS

In all the three cases, degree of freedom 1,2,3,4,5,6 are blocked (all translations and all rotations) at fasteners f1,f2,f3,f4 (attachment between latch handle and latch handle fitting). The fasteners f1,f2,f3,f4 can be modeled by bar elements with correspondent inertia and rigid elements (RBE2 type / radial shape) with centre node of cylinder as master node and nodes on hole edge as slave nodes (one or more layers can be modeled).

7. MATERIAL

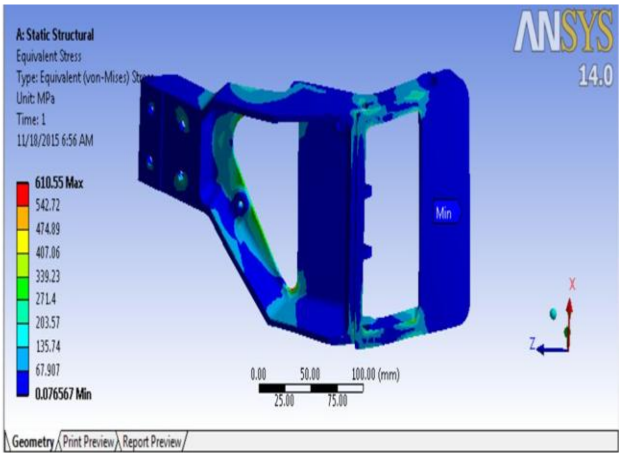
Name of the material	Young's modulus of elasticity	Poisson's Ratio	Yield Point	Ultimate Stess
Aluminium Alloy 7050	71.7 GPa	0.33	464 MPa	529MPa

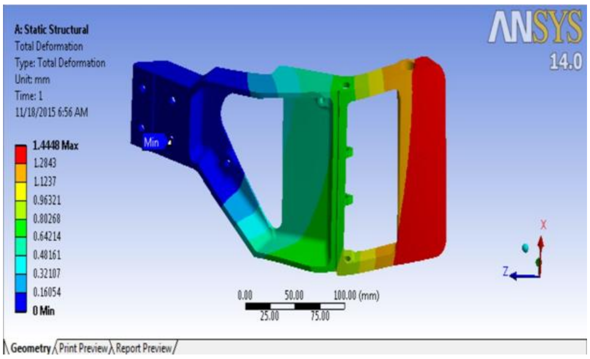
Aluminum alloy 7075 is aerospace aluminum alloy, with zinc as the primary alloying element. It is strong, with a strength comparable to many steels, and has good fatigue strength and average machinability. And thus, this material is used for the manufacturing of cargo doors.

8. FEA OF LATCH HANDLE

8.1 Case 1

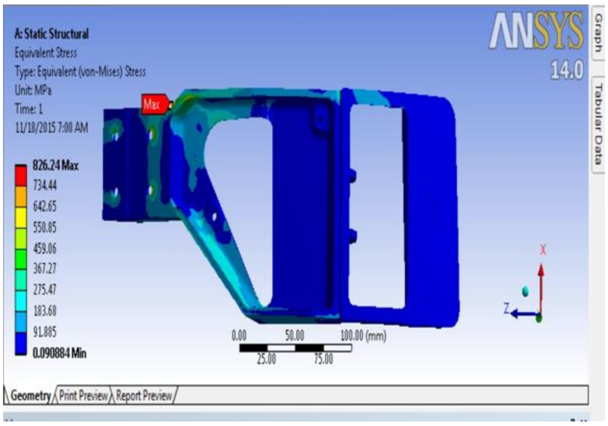
On analyzing the baggage door latch handle in ANSYS, we have two sets (minimum and maximum) of values of equivalent stress and total deformation. In case 1, we have the load applied on latch handle in the most critical direction or the transverse load in x-axis of value 1350 N. Minimum equivalent stress after applying boundary conditions and load, comes out to be 0.0766 Mpa and maximum value is 611 Mpa. Minimum total deformation's value is 0mm and maximum is 1.45 mm. The maximum value of stress is more than the allowable value I.e 455 Mpa (Yield strength). Hence, our model fails in this case.

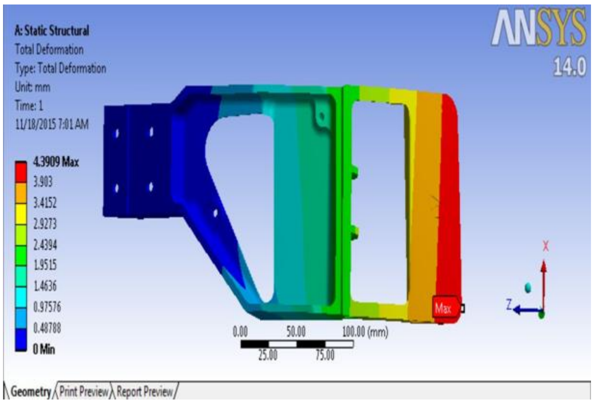




8.2 Case 2

In this case the load (1350 N), is applied in y-axis. Minimum equivalent stress is 0.0909 Mpa and maximum is 826.24 Mpa. Maximum total deformation for this case is 4.39 mm. Again, the maximum value of stress is more than allowable value i.e. 455 Mpa and thus, the model fails in this case.





8.3 Case 3

In this case the load is applied in z-axis of value 1350 N. Minimum equivalent stress is 0.124 Mpa and maximum value is 104.04 Mpa. Maximum total deformation is 0.57723 mm. In this case the maximum value of equivalent stress does not exceed the yield stress and hence, the latch handle can withstand the load in z-axis.

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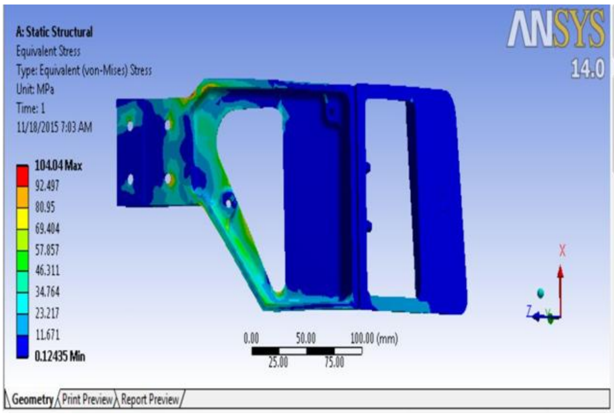

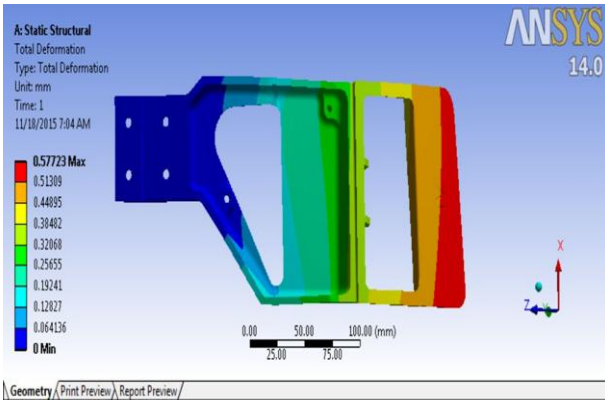

9. REFERENCES

[1] Latch-lock mechanism for load carrying airplane cargo doors by R B Odell and S J Fox:Ding, W. and Marchionini, G.

[2] Canopy-type aircraft cargo door and actuating mechanisms by F K Barnes and A W Opsahl Fröhlich, B. and Plate, J. 2000.

[3] Vent-latch interlock assembly for an aircraft door by Michael A Fleming and Michael C Strum Tavel,

[4] Three track sliding aircraft door by I Baker