Case Study: DEMA SpA

MSC Apex reduces time required to analyze aircraft avionics door for damage scenarios by 60%

Overview

DEMA SpA is a major aerospace supplier that provides work packages for many major aircraft programs such as the Boeing 787, Airbus A380 and A321, ATR 42-72, Augusta Westland AW139, and Bombardier CS100. DEMA recently designed and built an innovative avionics bay pressurized door for a commuter jet. DEMA engineers developed an innovative design concept in which the door is assembled from sheet metal using a machinable plate that saves weight by eliminating the need for mechanical joints. DEMA needed to analyze the ability of the door to meet in-flight structural requirements in spite of multiple damage scenarios that might be incurred during service operations or could result from manufacturing variation in order to determine whether or not the structure maintains a sufficient safety margin. These damage scenario analyses are used as the basis for inspection protocols that are performed on a regular basis to ensure that the door is flight-ready.
“Editing the geometry for one scenario took only 4 hours, a 75% reduction from the traditional method.”

Antonio Miraglia, Stress Lead for DEMA

The damage scenarios included reductions in the thickness of the pockets and reductions in the thickness and height of the vertical stiffeners. The analysis procedure begins with analyzing the door at the as-designed thickness and height. If the calculated static margin is less than or equal to 0.05 then no damage is permitted in this area. If the calculated static margin is greater than 0.05 then 10% damage is allowed in this area. If the calculated static margin at 10% damage is greater than or equal to 0.05 then 10% damage is allowed in this area. If the calculated static margin is less than or equal to 0.05, then the section is analyzed with 5% damage. If the calculated static margin at 5% damage is less than or equal to 0.05 then no damage is allowed in this area.

Challenge

Four damage scenarios needed to be analyzed: 1) 5% reduction in stiffener height and pocket thickness 2) 10% reduction in stiffener height and pocket thickness 3) 5% reduction in stiffener thickness and pocket thickness 4) 10% reduction in stiffener thickness and pocket thickness. The door geometry had to be edited and the new geometry then had to be meshed and analyzed for each scenario. The normal procedure was to first analyze the baseline geometry based on the computer-aided design (CAD) model that contains the geometry definition. The next step was to modify the CAD geometry to replicate the first damage scenario. Modifying geometry can often be difficult with conventional parametric CAD because only features configured in the original definition as parametric can be easily modified. In some cases it is necessary to recreate the geometry from scratch because of inherent limits on editing parametric geometry. The resulting geometry was then meshed in the CAD program and exported to Patran where the model was completed with the addition finite elements such as MPC or CBUSH and then constrained and loaded with the appropriate load cases. Finally, MSC Nastran finite element analysis software was used to perform the simulations. “Generically in the past, each scenario would have required 16 hours for geometry modification and 4 hours to prepare the mesh for analysis. The four scenarios required for the door would have taken a total of 80 hours to evaluate” said Matteo Capobianco, structural analyst in charge of these activities.

Key Highlights:

**Product:** MSC Apex  
**Industry:** Aerospace  
**Benefits:**  
- Process of constructing 4 damage scenarios reduced from 80 hours to 32 hours  
- Time to modify geometry reduced by 75%  
- Solver validation further reduces the process from 80 hours to 26 hours
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