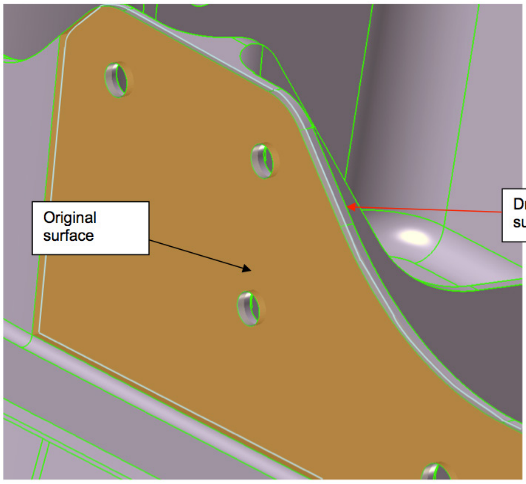
Case Study: **DEMA SpA**

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.



Mid-Surface extraction of vertical stiffeners

“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 than the section is analyzed with 10% damage. 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 status margin with 5% damage is greater than or equal to 0.05, then 5% damage is permitted in this area. If the calculated static margin at 5% damage is less 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 of 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 re-create 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

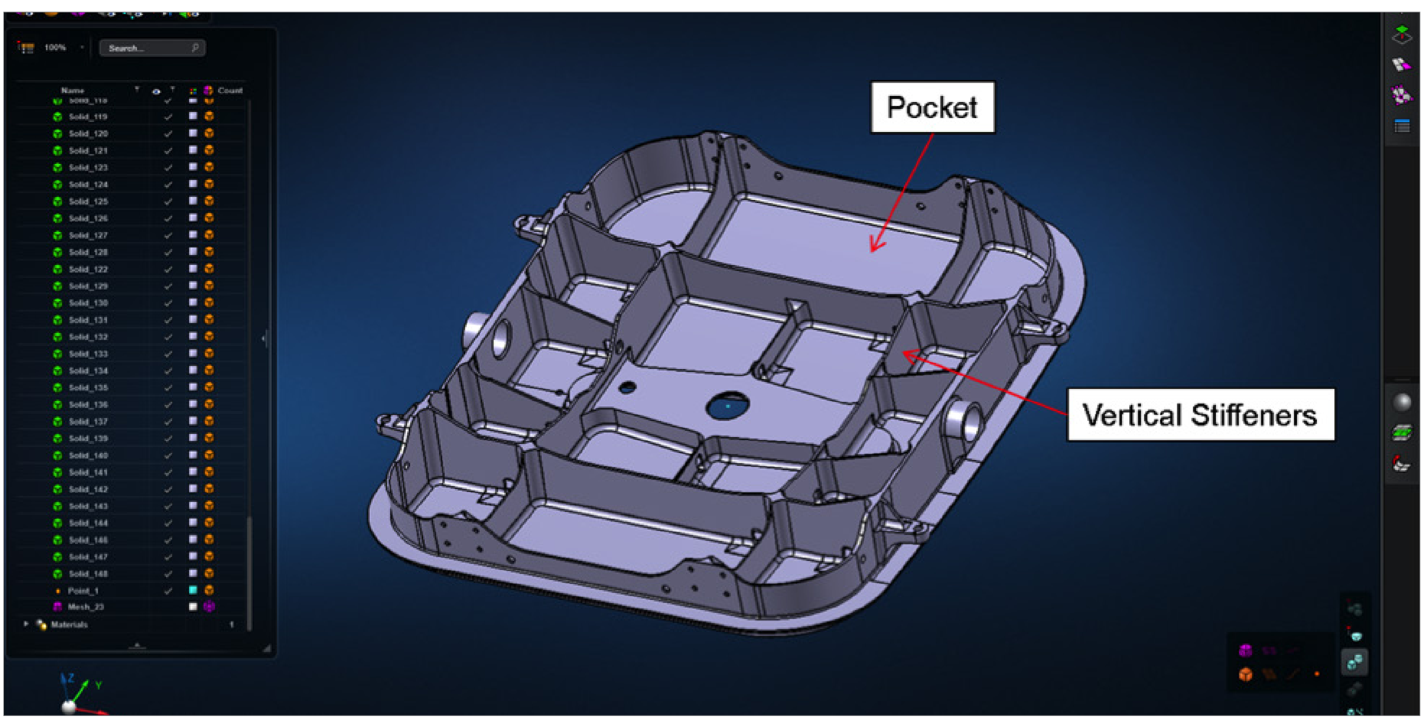


Fig. 1: CAD model inside MSC Apex

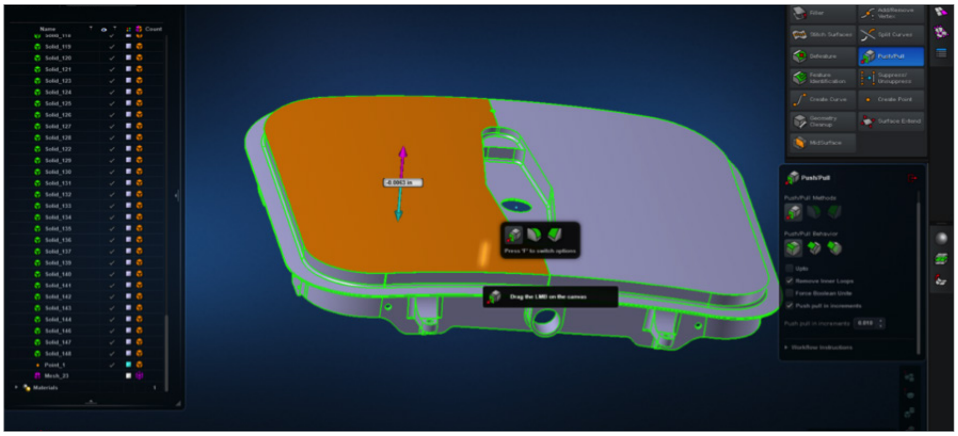


Fig 2: Pocket thickness modification inside MSC Apex

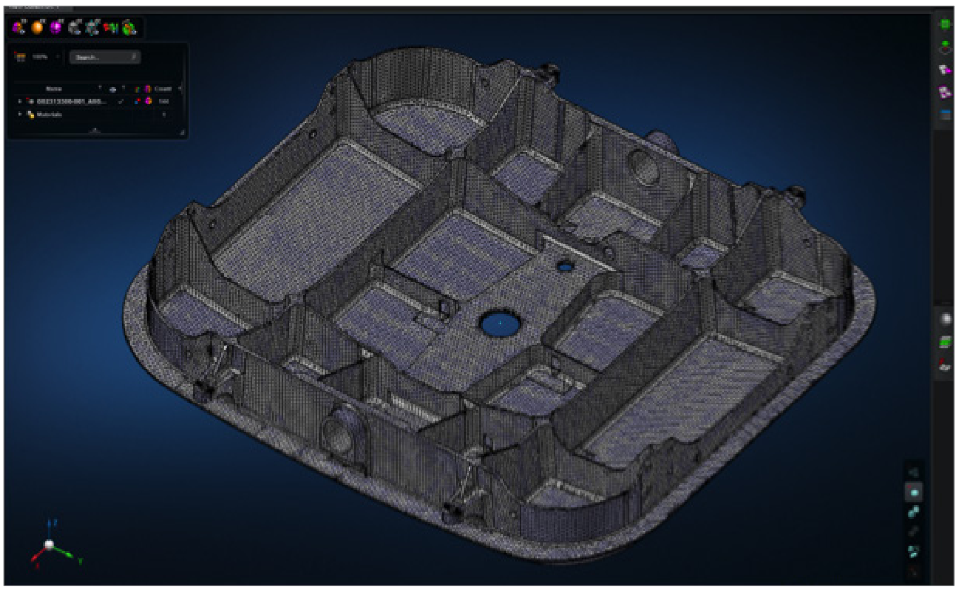


Fig. 3: Finite element mesh inside MSC Apex

Solution/Validation

"We decided to evaluate the MSC Apex Modeler because we were looking to reduce the amount of time required for geometry modification," said Danilo Malacaria, Head of Research and Innovation for DEMA. MSC Apex Modeler uses a direct modeling approach in which the geometry is directly created as features or individual operations without requiring a network of constraints between the features and without reference to its history. Users can edit geometry interactively by simply selecting entities of interest, such as a face edge or vertex, and push, pull or drag them to implement any modifications. For models that have already been meshed, modifications to the geometry will cause the mesh to be immediately regenerated with the geometry. DEMA engineers modified the door geometry inside the MSC Apex environment by dragging the zones impacted by the reductions to proper dimensions. The mesh was then automatically updated.

Results

"Editing the geometry for one scenario took only 4 hours, a 75% reduction from the traditional method," said Antonio Miraglia, Stress Lead for DEMA. "Prepping the model took four hours, the same as the traditional method. A total of 8 hours were thus required to model each scenario and 32 hours were required for all four scenarios, a 60% reduction from the time required in the past."

DEMA is planning to implement MSC Apex Structures, an add-on module that provides linear structural analysis capabilities. This module will save additional time in the future because the elements, loads and constraints will updated along with the geometry changes in the MSC Apex environment. "We project that the use of MSC Apex Structures will reduce the time required for prepping the model to 2.5 hours for each scenario, reducing the total time needed to model all four scenarios to 26 hours, a 67.5% reduction from the previous method," Malacaria said.

About DEMA SpA

DEMA SpA manufactures and supplies aerospace assemblies and components such as aircraft fuselage sections, passenger floors, cockpits, tail cones, fan cowls, ramps, cargo doors, slide boxes, horizontal stabilizers, helicopter fuselages, helicopter tail booms and helicopter rear fuselages. The company's areas of expertise include engineering, design, configuration management, weight and stress reduction, materials and processes, sheet metal processing, industrial engineering, manufacturing and composite part production. Founded in 1993, DEMA has about 800 employees and the headquarter is based in Somma Vesuviana, Napoli - Italy.

For more information on MSC Apex and for additional Case Studies, please visit **www.mscapex.com**

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