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Accurate FEA Prediction of Extrusion Forming To Improve Aircraft Design and Manufacturing

The Boeing Company

Various extrusion cross-sections designs are used to build advanced aerospace planes. Material for these designs vary, most use aluminum, titanium, steels and composites. Most metallics are formed in the elastic-plastic range of the material. Considerable spring-back occurs coupled with buckling and necking during forming operations.

The analysis of a major fuselage I-beam join section is modeled. The standard forming practice for extrusions currently utilize two forming steps: Pre-forming in the “O” condition, heat treated to the “W” condition where the final forming operation is performed. Each part then requires costly hand forming which is typically integrated into the production process.

Utilizing the finite element technique, several forming operations are eliminated thus reducing the cost and time for manufacturing. A single forming operation is used by developing the die configuration for the “7075-W” extrusion and by determining the optimum forming parameters. Reduction in process steps are accomplished while additional hand forming operations are eliminated.

The FEA model results are compared against experimental forming data to determine accuracy. Catia robotic solid models are used to verify the dynamic boundary conditions needed for the finite element setup and solution. Net and developed extrusion test dies were used for the FEA comparisons.