FINITE ELEMENT ANALYSIS OF THE VERTICAL TAILPLANE OF PZL-106BT AIRCRAFT WITH A CAD/CAE BASED MULTIDISCIPLINARY PROCESS

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Abstract: In today's developing and growing aircraft industry, manually performing the state-of-the-art aircraft design phases is not practical, therefore a fast and accurate automated analysis and data exchange are crucial. A Multidisciplinary CAD/CAE based concept assessment and design is already widely used in major aircraft designing companies to automate the optimization process in case of weight estimation, structural modifications or even other time consuming analysis. The idea of MDCAD is to allow any software to be used if the output files are compatible with certain software. This work describes a Finite element analysis of a vertical stabilizer of a Polish agricultural aircraft (PZL-106BT) with the possibility of an automated approach.

Investigation of parametric-associative CAE methods was made using PANUKL, a software capable of creating geometrical models of an aircraft and aerodynamic characteristic calculations. Transferring the CAD model and the pressure coefficients is carried out using an in-built function of PANUKL for data export, called FEM Export. Pre-processing definitions such as boundary conditions, material selection, leading edge or trailing edge cuts, selection of ribs and output file extension parameters are also set. Further modifications on the geometry, introducing stringers and concentrated loading are made in CalculiX GraphiX (CGX). Solution of the FEM and post-processing the results is performed in CalculiX CrunchiX (CCX).

The aim was to compare two models, a reduced top section of the vertical tailplane with the original structure model. The size reduction was carried out in order to increase the maneuverability of the aircraft in lateral movement. The FEM analysis revealed the nodal displacements of the vertical stabilizer models, its stresses at its fittings, spars, ribs and stringers. Furthermore, a frequency analysis was made to determine eigenmodes together with buckling factors for the critical load case. Although the analysis was completed manually, the study shows a possible example of how a multidisciplinary technique can be used for the preliminary design of vertical tail-box structure. The file extensions used for naming conventions and input style formats are based on those used by ABAQUS. Any further analysis of more complex calculations is possible through other advanced FEA programs.

Keywords: Aircraft Design Optimization, PZL-106BT, Vertical Stabilizer, Multi-disciplinary Process, MDCAD, FEM analysis