MANUFACTURING AND LARGE-SCALE TESTING OF AN AUTOMATIC FIBRE PLACED GRID-STIFFENED FUSELAGE PANEL WITH GLASS – AND CARBON FIBRES

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In the European H2020 project Advanced Concepts for Aero-Structures with Integrated Antennas and Sensors (ACASIAS) a novel composite fuselage panel with orthogrid stiffening has been developed for the structural integration of a Ku-band satellite communication antenna. The panel is manufactured using thermoset prepreg materials, which are suitable for aerospace structural applications. The electromagnetic transparent part of the composite skin consists of Glass Fibre Reinforced Polymer (GFRP) material. The remaining panel skin and the ortho-grid ribs consist of Carbon Fibre Reinforced Polymer (CFRP) material. At the edges of the transparent part of the skin, the glass and carbon fibre plies are interleaved to create the transition. The cells of the orthogrid are used to embed Ku-band antenna tiles behind the transparent glass fibre skin (see Fig 1G). The panel has been designed such that it can withstand representative loads of the crown section of a Fokker 100 aircraft. To aid in the design of the panel and to verify the panel after manufacturing multiple physical tests were performed, at coupon, structure and full scale level (see Figure 1 B, C and E). These test have also been performed virtually, where the coupon and structure level simulations were used for calibration and the full scale model was used to predict the result of the physical test. The full scale panel was subjected to a testing scheme consisting of multiple static tests, impact damage test and dynamic loading tests. The results of the physical tests show that the full scale panel can withstand the representative loads of the crown section of a Fokker 100. The results of the virtual tests show that the chosen modelling approach is capable of predicting the loading behaviour of the panel (with an exception for buckling behaviour).

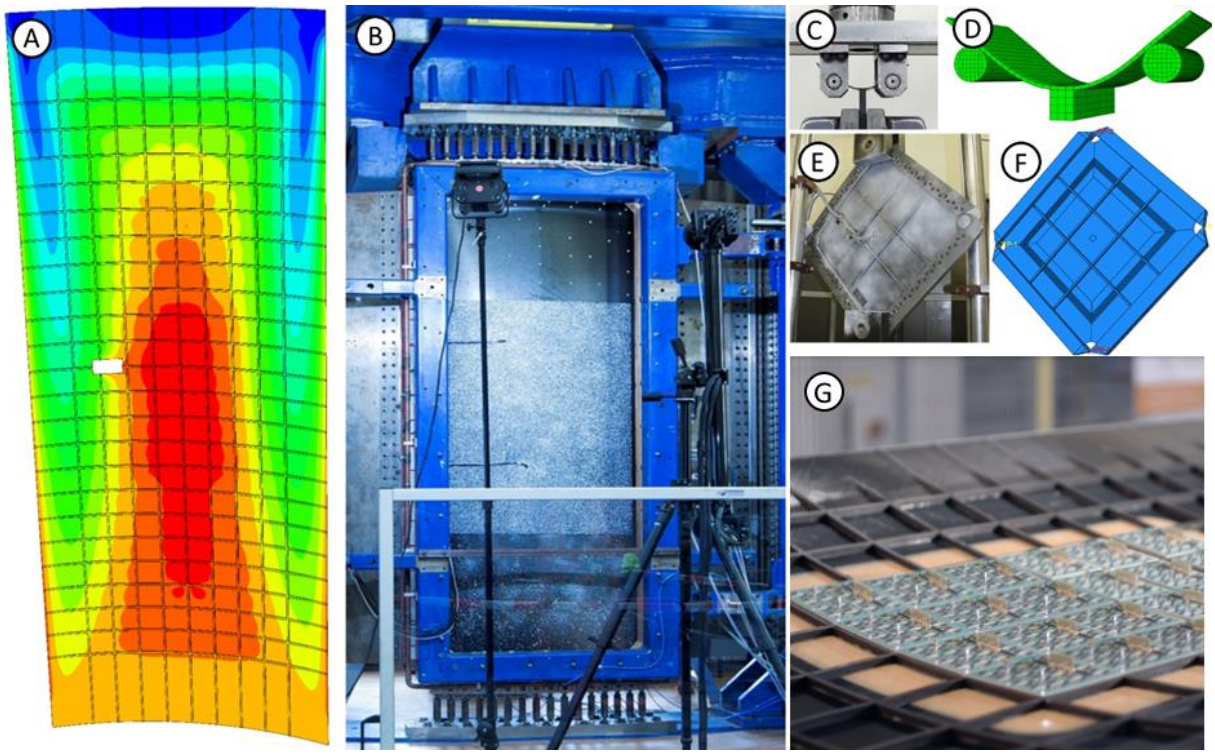

Figure 1. A) Deformation of the 3x1.2 m ACASIAS panel at ultimate load. (as computes in Abaqus) B) The test set-up of the Grid stiffened fuselage panel. C) Test set-up of the rib-peel coupon tests. D) Numerical model of the rip-peel coupon test, showing deformation. E) Test set-up of the single grid section shear test. F) Numerical model of the single grid shear test. G) The large scale fuselage panel, with the glass fibre section and antenna arrays showing.