

# LARGE-SCALE VIRTUAL TESTING OF AN AUTOMATIC FIBRE PLACED GRID-STIFFENED FUSELAGE PANEL

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Virtual testing can be a viable solution to improve experimental testing and could in theory even eliminate the need to perform a physical test. In this work, a step-wise approach of the virtual testing of a large-scale fuselage panel is presented as part of the Advanced Concepts for Aero-Structures with Integrated Antennas and Sensors (ACASIAS) project. This grid-stiffened fuselage panel, shown in Figure 1A and 1B, is manufactured using Automatic Fibre Placement (AFP). Incorporated in the panel is a glass fibre section to allow for the integration of communication antennas, visible in Figure 1G. Finite Element Analyses (FEA) are performed in Abaqus. At the coupon level, the stiffness and cohesive failure behaviour at the grid-skin interface is calibrated by virtual testing of rib-peel coupons (Figure 1C and 1D). These calibrated properties are validated by simulating a single grid section shear test (Figure 1E and 1F). Both failure and (post-)buckling behaviour are predicted accurately, which gives the confidence to extend the model to the full-scale ACASIAS panel. A virtual test of the most critical static ultimate load test of the panel was performed. At this stage, the panel contained an artificial manufacturing defect, Barely Visible Impact Damage (BVID), and Clearly Visible Impact Damage (CVID) as visible in Figure 1A. A combined axial load and cabin pressure are applied using the ROTOP test setup at Royal NLR (Figure 1B). Other features of this test set-up are incorporated into the model to increase the accuracy of the virtual test. Prior to the execution of the physical test the virtual test showed no failure at ultimate load. The predictions were compared with strain gauge readings and digital image correlation using ARAMIS deformation and showed good agreement.

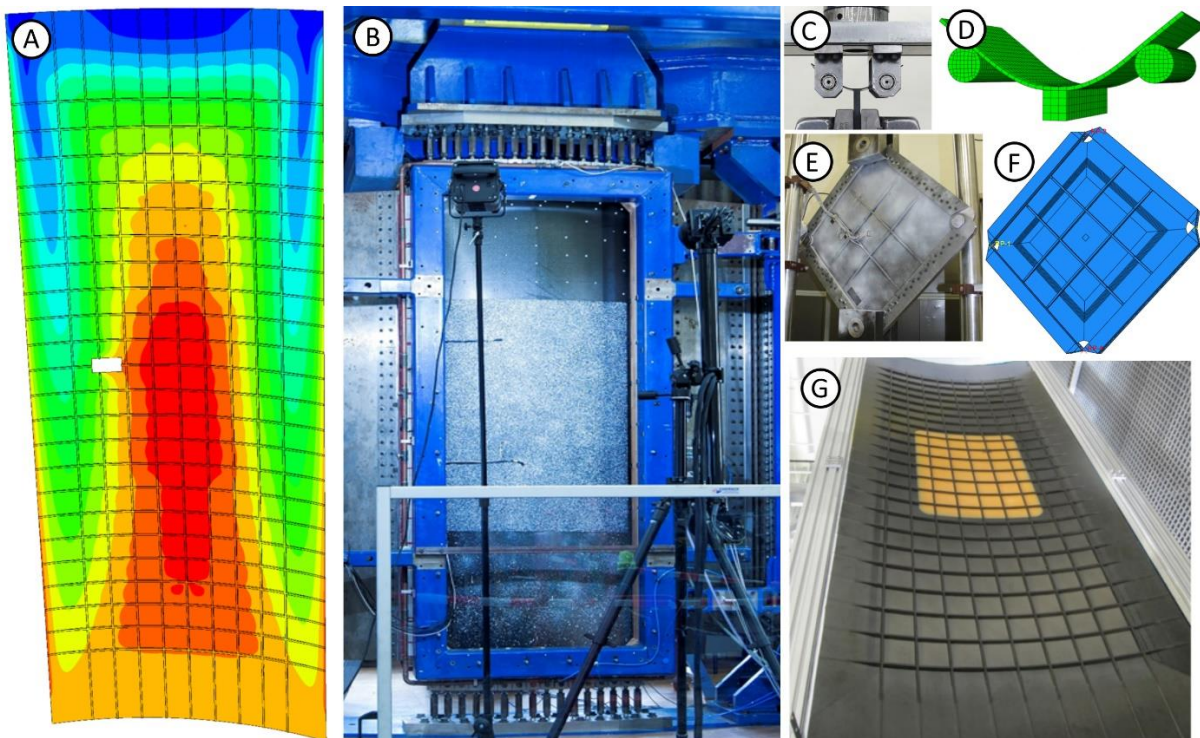


Figure 1. A) Deformation of the 3x1.2 m ACASIAS panel at ultimate load. (as computes in Abaqus) B) The test set-up of the Grid stiffened fuselage panel. C) Test set-up of the rib-peel coupon tests. D) Numerical model of the rip-peel coupon test, showing deformation. E) Test set-up of the single grid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