Analysis of an adhesively bonded single lap joint subjected to eccentric loading - DTU Orbit

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A new experimental test is proposed, which allows the contribution of Mode I, II and III fracture modes to the failure of the adhesive layer of bonded joints aiming at achieving the realistic conditions often occurring during loading of practical joints. The main objective of this test is benchmarking of computational tools. The test is based on a Single Lap Joint subjected to Eccentric Loading (SLJ-EL). The basic concept that lies behind this configuration is that the applied in-plane tensile load leads the adhesive layer to develop normal stresses, in-plane and out-of-plane shear stresses, which correspond to Mode I, II and III loading and fracture. These tests were designed so that the metal substrates do not enter plasticity and the adhesive achieves a mode mixity ratio between Mode II and Mode III not lower than 0.5. The experiments were simulated in a 3-dimensional finite element space and a previously developed mixed-mode model is utilized for the adhesive layer, under the framework of Cohesive Zone Modeling (CZM) techniques. The numerical results are in very good agreement with the corresponding experimental measurements, as regards both the linear and non-linear region, and the attained strength. It is concluded that in the early stages of loading the contribution of Mode III is 150% higher than that of Mode II.

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