Design Guidelines for the Collapse Analysis of Composite Structures

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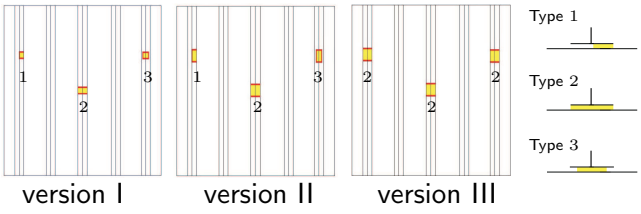
BAUSTATIK

Introduction

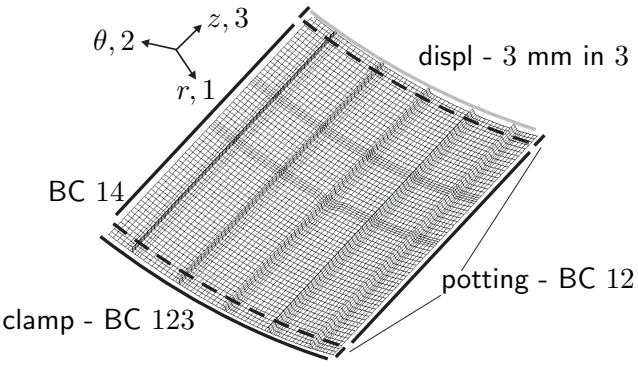
In recent years advanced fibre-reinforced polymer structures have emerged in aerospace engineering to build more efficient structures. Such composite materials offer a high specific strength and stiffness. A new approach named *postbuckling design* aims for the development of structures that can withstand high loads even after they have buckled. Research in composite design and postbuckling analysis have been done separately. However, combination of these leads to higher load-carrying capacities. Exploitation of composite material under safe design is what the European 6th Framework Project COCOMAT deals with. New tools to improve the prediction of damage by fast and also precise analysis procedures were developed and compared to the experimental tests.

Collapse Analysis

Three different versions (I-III) of pre-damaged multi-stiffener panels were proposed, including different types, sizes and locations of initial debonds. These were analysed with an extended version of the commercial FE code MSC.Marc in order to predict which version shows observable crack growth more likely during experimental tests.

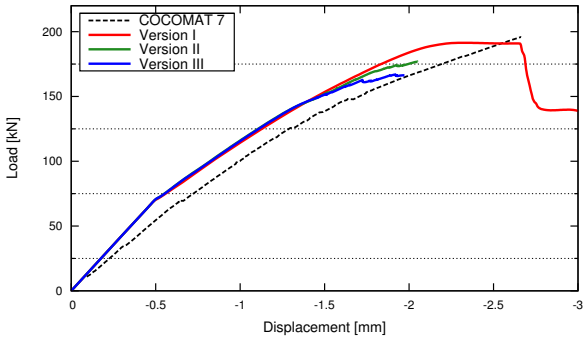


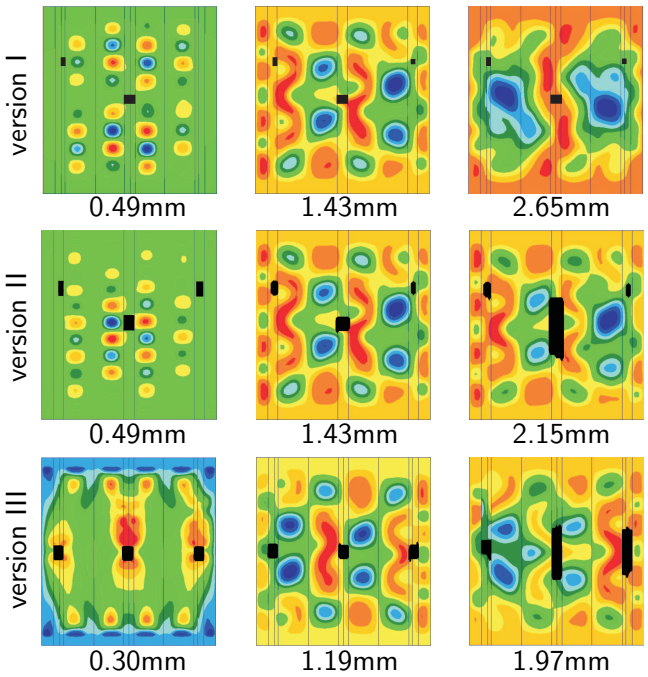
The finite element model, as seen below, depicts the generated mesh for the pre-damaged configuration under investigation.



Results

The following load-displacement curves present the experimental results and the finite element analyses. The fringe plots show radial displacements at different compression levels including the current crack propagation (black areas). The three different pre-damage types were classified according to their sensitivity to crack propagation.





Version I predicted no crack growth and is not recommended for experimental tests to observe crack propagation. The second proposal, version II, showed crack growth, hence, it is recommended to investigate different types of pre-damage, however crack growth occurred in a batch-wise mode. Version III would be suitable to experimental tests for validation of numerical tools, due to a continuous crack growth at two different locations.