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Continuum Damage Modeling of Shear Postbuckling in Honeycomb Core

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Recently, the authors have highlighted by both numerical analysis and experiments the nonlinear behavior under shear of honeycomb [1]. The results showed that the buckling of the Nomex honeycomb core present a nonlinear elastic behavior beyond the buckling point. This is due to a reversible postbuckling as in aerospace structures. Depending on the load direction and the boundaries of the honeycomb the failure scenario is different. In classical tests such as double rail shear tests or double lap shear tests, the main loading direction is orthogonal to the cell edges at the vertex of the hexagonal shape. Thus, after a postbuckling regime, the honeycomb fails by collapse in shear of theses edges. Although for the tested specimen which mimics quite well the inserts in sandwich panels, the loading direction is parallel to this cell edges and the structures takes more easily the shear buckling thus generating a gain in the allowable up to 35 %. These observations allow the authors to propose a two parameters damage model to capture the shear nonlinear behavior of honeycomb cores. The first parameter will represent the initial buckling of the cells and the start of the collapse of the cells, this is from the initiation of the nonlinear behavior until the maximal shear stress. The second will represent the final collapse of the cells, this is from point where the maximal shear stress is reached until the shear stress is zero. Main results are shown below (the upper curve is the comparison with experiments and the two other represents the evolution of the damage parameters.

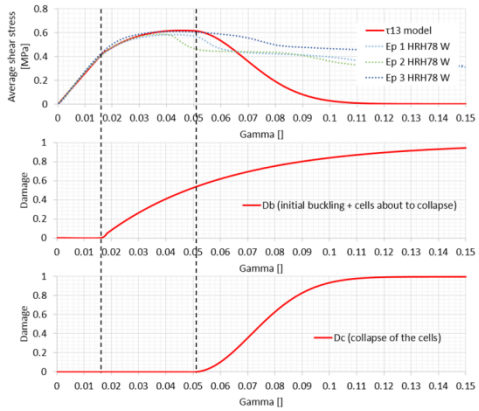

Figure 1 Comparison of the experimental curves of shear tests on the HRH-78 honeycomb and the model based on the damage laws..

[1] Juan de Dios Rodriguez, Bruno Castanié, Christophe Bouvet, Experimental and numerical analysis of the shear nonlinear behavior of the Nomex honeycomb core: application to insert sizing. Composite Structures 2018;19: 121-139