STABILITY ANALYSIS OF SANDWICH PANELS WITH CORE-SKIN DELAMINATIONS

M.A. Aiello & L. Costantino

Department of Engineering Innovation, University of Lecce, Italy

Sandwich structures, made with two skins characterized from high mechanical performances and a core with lower mechanical properties, are widely used in different fields of engineering, mostly in aeronautic and aerospace industries. The success of sandwiches structures is mainly due to the possibility of optimising the structural response by an opportune choice of materials and geometry. In particular, the introduction of composite laminates, as skins materials, allows attaining an optimal solution in terms of mechanical response, weight and costs. More generally the tailor ability of the structures, on the basis of the specific application, makes such elements very attractive; in fact faces can be designed varying the geometry, the fibers orientation, the kind of materials by means the hybridisation technique. On the other hand the core materials can be varied in geometry and mechanical properties, from a more traditional rigid core material to a soft one.

The high performances of sandwich structures, in particular sandwich panels, allow a reduction of geometrical dimension, mostly as regard the thickness, obtaining very often a structure with high slenderness. For this reasons the predominant mechanisms of failure are those related to instability instead to the attainment of the ultimate strength. Different kinds of instability may take place, depending on sandwich panel properties, as global buckling, local buckling or even an interaction between local and global instability.

Several studies have been made on this topic and results are available in the literature [1], [2], [3], [4], [5], [6]. Stability problems become more critical in presence of imperfections, such delaminations. Delaminations can be caused both from mechanical or environmental conditions and can involve the laminas interface or the skin-core interface. The prediction of buckling load of delaminated plates and sandwiches have been studied from many researchers by utilizing both analytical and numerical approaches [7], [8], [9], [10], [11].

In the present paper a numerical, FEA, approach is presented to determine the initial buckling load of delaminated sandwich plates under compression, with the delamination zone interesting the skin-core interface. The utilized numerical model uses three dimensional brick elements for every constituent part taking into account the whole state of strain and stress; the analysed delamination zone is centred within the panel, rectangular in shape, and having dimensions D and H. Buckling loads and buckled panels configurations are evaluated varying the damage degree, that is the delaminated zone dimensions. Different kinds of skins and core are analysed and the buckling phenomenon, referring to initial buckling load and buckling configuration, is investigated varying some key parameters, as the panel aspect ratio, the mechanical properties of core and skins, the thickness of the skins and the core, the boundary conditions. A mesh sensitivity analysis has been also performed preventively.

In the Fig. 1 the buckling load is reported versus the delaminated zone dimensions, related with the panel dimensions a and b. The figure refers to a sandwich panel made with a foam core and GFRP skins; as one can observe the buckling load decreases increasing the delamination zone. In particular a sudden drop of the buckling load is observed for D/a and $H/b>0.3$, corresponding to the change from global to local instability, as shown in Fig.2.

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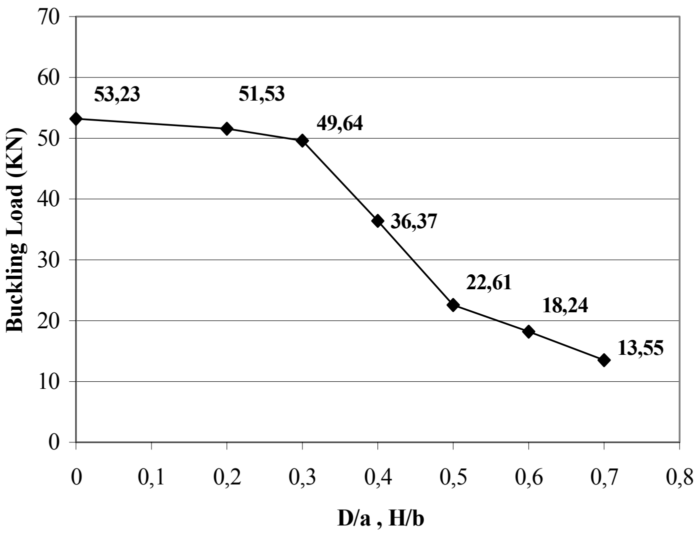
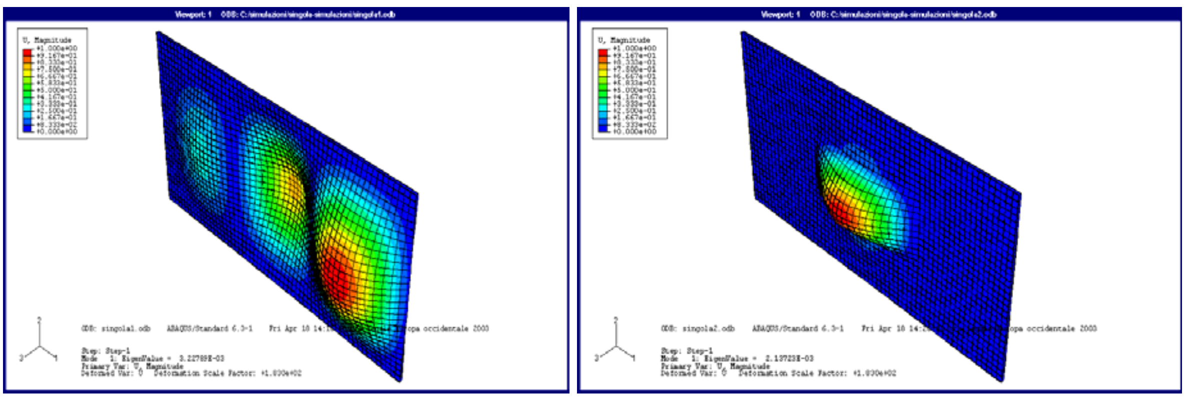


Fig.1: Buckling load versus delaminated zone dimensions



a) b)

Fig. 2: Buckled panel configurations. a) D/a, H/b=0.2; b)D/a,H/b=0.3.