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MECHANICAL BEHAVIOUR OF POLYETHYLENE FOAM SANDWICH PANELS UNDER COMPRESSION LOADING

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ABSTRACT

This work aims to study the mechanical behaviour of high density polyethylene foam sandwich panels (HDPEFS) under compression loading. These panels can be built without using adhesives as the polyethylene foam grows inside mold and then adheres to facesheets while material still is at high temperature. In the present study, polyethylene foam panels are tested under edgewise compression loading. The resulting out-of-plane deformation is monitored through strain gauges and by means of a projection moiré setup including two projectors and one CCD camera. A finite element model of a foam sandwich panel was built to better interpret the experimental findings.

Keywords: polyethylene foam sandwich, compression loading, buckling, core, facesheet.

INTRODUCTION

The interest in polymeric and metallic foams has greatly increased in recent years, due to technological improvements in manufacturing processes. Foam sandwich panels are rapidly spreading in naval, aerospace, railway and automotive constructions. However, it is still difficult to establish a direct relationship between mechanical properties of foam sandwich panels and the specific manufacturing process. The mechanisms behind deformation, crack growth and fracture still are not completely understood and for this reason are intensively studied. In particular, structural behavior under compression is a critical issue, also in view of the lack of official standards relative to foam core sandwich panels (Boccaccio *et al.*, 2011).

A total of 10 individual edgewise tests were performed. In the edgwise test the specimen is loaded in the parallel direction to the skins. Such tests have been carried out partially according to standards (ASTM C364) that supply indications for generic sandwich structures. The tests were carried out on an electromechanical testing machine (MTS Alliance RT/30). Load and displacement signals and strain gage signal (two strain gage rosettes were bonded on the skins with 3 mm gage length and 120 Ω electrical resistance for the edgewise tests, bonded with the central grid aligned with the longitudinal axis of the specimen) were acquired by System 5000, Micro Measurements, USA.

The out-of-plane displacement field experienced by the foam sandwich panels subject to edgewise compression was investigated in detail with the multi-projector moiré model developed by Sciammarella *et al.* (2008)a,b (Fig. 1). Images were acquired every 0.5 mm displacement of the crosshead of the testing machine. A finite element model of the sample submitted to the test was built to correctly interpret the experimental results.

RESULTS AND CONCLUSIONS

The evolution of the deformed profile of the samples in each of the loading steps, well shows the onset of the buckling (Fig. 2a)

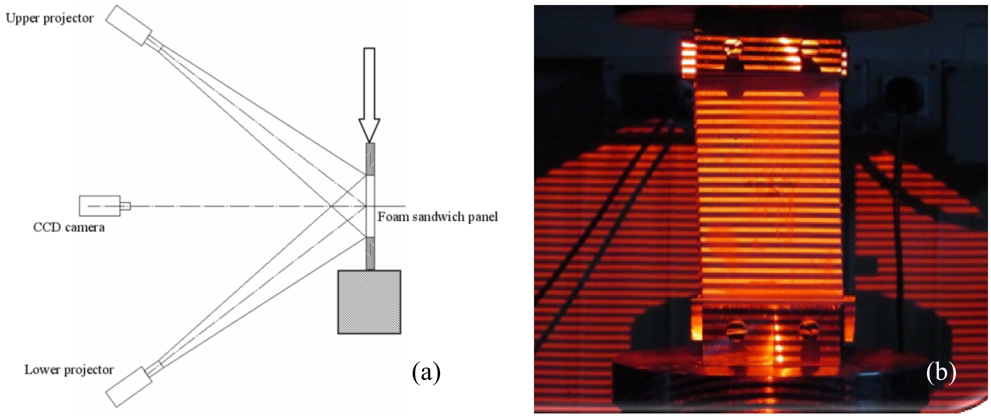

Fig. 1 - (a) Schematic of the optical set-up utilized to monitor the out-of-plane displacement field of the sandwich foam under compression loading; (b) typical pattern of fringes projected on the sample during the edgewise test.

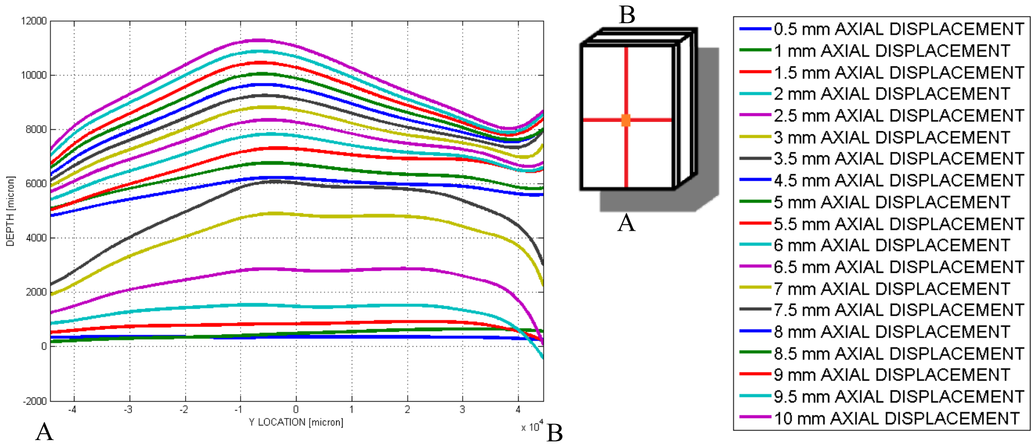

Fig. 2 - Out-of-plane displacement measured with projection moiré along the path AB for each of the displacements imposed to the crosshead.

These onsets were detected for the same loading values found with the strain gauges. Finally, the trend of the out-of-plane displacement investigated with the optical set-up was consistent with that predicted by the finite element model.

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