EXPERIMENTAL BUCKLING TESTS OF FML PROFILES

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1. INTRODUCTION

For different structural members one can find different theoretical approach which allow for considered structural member the strength, load carrying capacity or failure conditions to determine. Each one of standing for application methods are based on some assumptions and requirements. Therefore their applicability for specific structure element requires some kind of validations. This should be achieved before the real structure creation than in monitoring its behaviour in real loading conditions. For years an effective way of comparison has been experimental testing of scaled or full dimension members [3]. In the case of aircraft thin-walled structures this method is of special meaning especially for loads which can be source of these elements buckling [4].

The subject of this research were thin-walled profiles made of Fiber Metal Laminate material type, with 3-2 stacking sequences where 0.3 mm aluminium was of 2024 T3 lot and composite layers were made of glass fiber reinforced epoxy resin (TVR 380 M12/R). Each one of composite layers was created of two 0.26 mm prepreg plays of specific orientation angle - equal or different, but always giving sequence symmetry with respect to plate mid-plane, to avoid coupling effects. Considered profile shapes and overall dimensions are given in Fig. 1. These dimensions correspond to fuselage stringer size and fulfil thin-walled plate theory limits. Three specimens of each case of stacking were manufactured. All specimens were subjected to axial uniform compression.

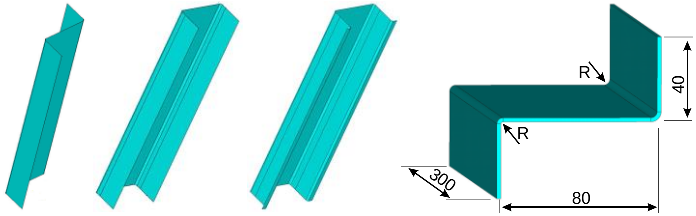


Fig. 1. Cross-section shapes and dimensions of tested profiles

2. FULL SCALE MODEL BUCKLING TEST PROCEDURE

The buckling experiments were carried on in the classical tensile test machine. It was equipped with special supporting rigs with milled flat bottom groves allowing freedom of rotation (Fig. 2), where profile loaded edges were constrained [4]. With two pairs of back-to-back bonded strain gauges - one pair in the geometrical centre of the web and one in the middle of flange edge, compressive and bending strains were measured.

The deflection of these two locations were measured with two laser beam devices. All data was registered for further processing.

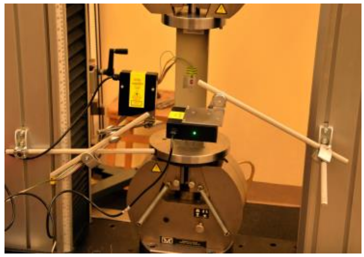
a) 

Fig. 2. Experimental test rig with measuring devices

There are many 'widely used' techniques for buckling load determinations based on measured strains and/or deflections [2]. Some of them were applied in this research to buckling load determination [4]. The exemplary results obtained with strain inversion method are presented in Fig. 3 with reference to FEM computation results. The broader comparison of all performed analysis with their mutual comparison, will be given during the Symposium.

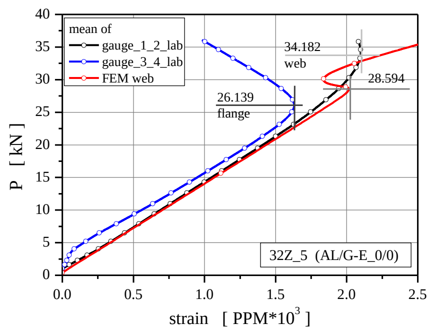


Fig. 3. Buckling load determination with 'strain inverse method'
an example of Z-shape profile investigation

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