The Analysis of Sensitivity to Eccentric Load of Compressed Thin-Walled Laminate Columns

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Abstract. The study investigates the effect of eccentric load on the stability and postcritical states of thin-walled carbon/epoxy composite channel-section columns under compression. The equilibrium paths are then compared with the experimental characteristics of real structures. The numerical results and experimental findings show a satisfactory agreement.

INTRODUCTION

There are many publications investigating the behaviour of composite thin-walled structural members in a critical and post-critical state subjected to axial loads [1-2]. These publications report the results of analyses performed under ideal loading conditions which, from a point of view of engineering practice, are usually disturbed in real structures. The authors of this study investigate the effect of eccentric load on the behaviour of a thin-walled channel section column made of carbon-epoxy composite[3].

THE OBJECT OF THE RESEARCH

Tests are performed on physical models of these structures produced by the autoclave technique. The columns have a symmetrical 8-ply lay-up. The test object was characterized by specific material CFRP and geometric parameters – Fig. 1.

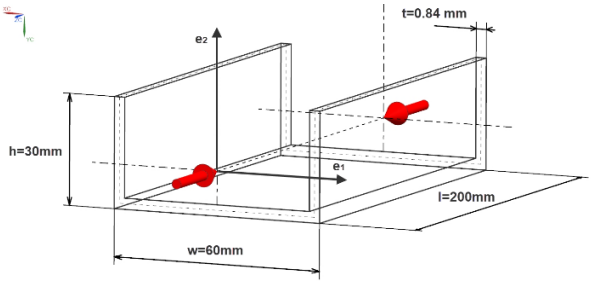


FIGURE 1. Test sample's geometry

RESEARCH METHODOLOGY

The test specimens are subjected to compression on a testing machine provided with a special fixture for introducing eccentric compressive loads. In the tests, loading force, column shortening, deflection and strains of the

column walls and web are measured – Fig. 2. Based on the experimental results, numerical models of composite structures are designed and verified by the finite element method - Fig. 3.

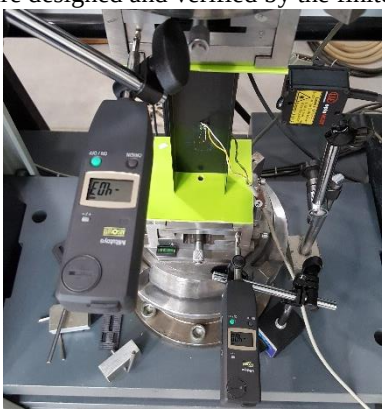


FIGURE 2. Experimental test

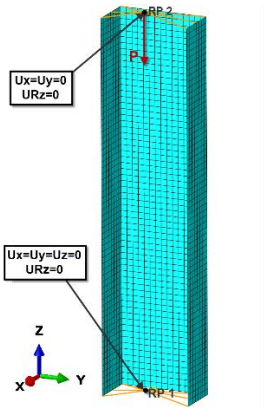
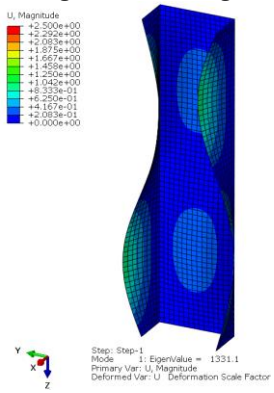


FIGURE 3. FEM model

TEST RESULTS - DISCUSSION

The experimental tests in which the channel section column was subjected to compression, including eccentric load led to determination of the effect of compressive eccentric load on the critical force and state of strain of a real structure. The buckling modes obtained for the tested values of eccentric load is given below Fig. 3.

(a)



(b)

FIGURE 3. The buckling mode: (a) experimental test, (b) numerical analysis

CONCLUSIONS

The results confirm that the numerical models are adequate for estimating the stability loss and performance of composite structures in the postcritical range, depending on the amplitude of compressive load eccentricity.

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