Progressive Failure Analysis of Thin-Walled Composite Structure with Open Cross-Section

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Abstract. The subject of study was a thin-walled profile made of carbon-epoxy laminate. The construction was subjected to axial compression. Experimental and numerical research of buckling and loss of load capacity were carried out.

INTRODUCTION

Thin-walled composite profiles lose their stability under axial compression [1] with the further possibility of working in the post-critical state [2], to total failure [3], causing the failure initiation [4] and failure evolution [5-8]. Progressive reduction of material stiffness is controlled by damage variable parameters [9]. Numerical calculations were carried out using the Newton-Raphson method [10].

THE OBJECT OF THE RESEARCH

The test sample was characterized by specific material parameters [11] and geometric parameters – Fig. 1. Thin-walled composite structure had 8 layers with symmetrical arrangement [45/-45/90/0]s.

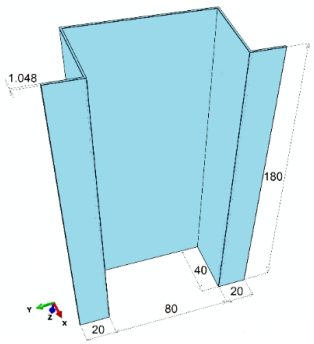
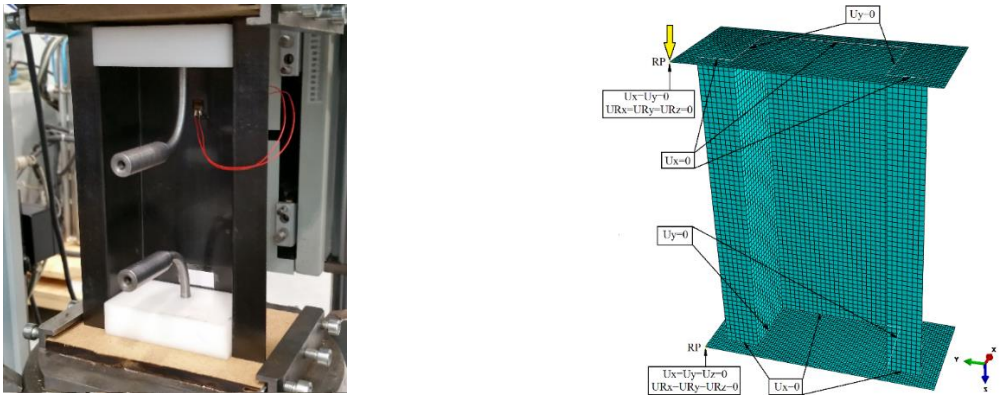


FIGURE 1. Test sample's geometry

RESEARCH METHODOLOGY

Experimental tests of axial compression were carried out on a universal testing machine ZWICK Z100. Numerical analysis was carried out in the commercial program ABAQUS®. Boundary conditions of the numerical model were prepared adequate to experimental research – Fig. 2.

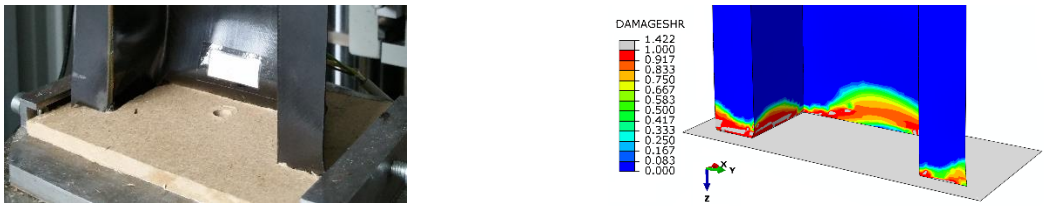


(a) (b)

FIGURE 2. Boundary conditions: (a) experimental, (b) FEM.

TEST RESULTS - DISCUSSION

Graphical presentation of the failure of the structure, within experimental and FEM research are shown in Fig. 3.



(a) (b)

FIGURE 3. Comparison of the results of failure analysis: (a) experimental test, (b) numerical analysis

CONCLUSIONS

The presented results of construction failure shows a high quality of the prepared numerical model which has been verified experimentally.

ACKNOWLEDGMENTS

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