EXPERIMENTAL AND NUMERICAL STUDY ON DYNAMIC BUCKLING OF CYLINDRICAL COMPOSITE SHELLS

E. Eglitis [1], K. Kalnins [1], O. Ozolins [1], G. Teters [2]

[1] Riga Technical University, Institute of Materials and Structures, Latvia
[2] University of Latvia, Institute of Polymer Mechanics, Latvia

Current structural design procedures incorporate simplification of the load as quasi-static, which can lead to over-designed structures on one hand. On the other hand, investigations show that in some cases buckling strength can be significantly less under dynamic loading [1]. Considering the load dynamic's and understanding it's effect on structural load carrying capacity is one of the ways to improve both design efficiency and reliability. The present investigation focuses on the dynamic effects associated with load speed versus buckling behavior of the axially compressed cylinders.

Several glass, aramid and carbon fiber reinforced plastic cylindrical specimens have been produced for the experimental validation. The production method was selected cylindrical winding with vacuum resin impregnation. All produced specimens have the length of 850 mm with the conical inner diameter of 300 mm. The production technology requires that the testing specimens are slightly conical, so the inner diameter actually varies along the length.

The test specimen has been loaded quasi-statically up to the post-buckling region (see Figure 1) to evaluate the buckling load and post-buckling behavior under static loading. Furthermore the axial loading test has been repeated, gradually increasing the loading speed up to 0.15 m/s with extraction of the load-shortening curves along with the loading speed data. A non-destructive vibration testing has been applied to the test specimens before and after tests to verify that no damage has occurred.

The numerical part represents benchmarking of commercially available implicit and explicit finite element analysis software packages ABAQUS and ANSYS/LS-DYNA has been performed employing the data obtained from the physical experiments. The effects of the loading speed and imperfection inclusion over analysis parameter's values have been studied and the optimum design procedure has been proposed.

Figure 1: The post-buckling shape of an axially compressed glass fiber cylinder

REFERENCES

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