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Crash Test of Carbon Composite

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Abstract: Composite structures are now increasingly used for their properties in all areas of industrial production where high specific strength is demanded. They gradually replace metal parts and components not only because they are lighter, but above all for their comparable and in many ways even better mechanical properties. Knowledge of behavior of simple synergies between the fibres and the matrix allows the prediction of behavior of complex components and their application in practice [1,2]. The subject of this article is a description of an experiment and numerical model that compares the mechanical properties of carbon fiber composite with the values obtained using analytical models as is Chamis model and Halpin-Tsai model. Carbon composite samples were studied in laboratory conditions through Barrier test (ie. Crash test).

Materials and methods

Measurement and FEM modeling

Samples of the carbon prepreg are double-layered, the layers relative to one another oriented at an angle of 90°. After our previous experiences with similar tests (for examples: tension test, ball-drop test, Charpy test) was the crash test selected as a test of endurance of a composite barrier against penetration. Impactor, which is part of the hydraulic cylinder, encounters at a certain speed a sample of carbon composite and passes through it. The whole process records the speed-camera, other experimental data are registered at the same time. The complete setup is shown in Fig. 1.

Results and Summary

Measured values of the mechanical properties of the tested samples were compared. The force distribution measured during the experiment for given high speed hydraulic cylinder is plotted in (Fig. 2). The distribution of deformation is influenced by composition and angle of fiber layer orientation in the composite. Comparison of FEM simulation models and measurement results are shown (Fig. 3).

Conclusions and acknowledgements

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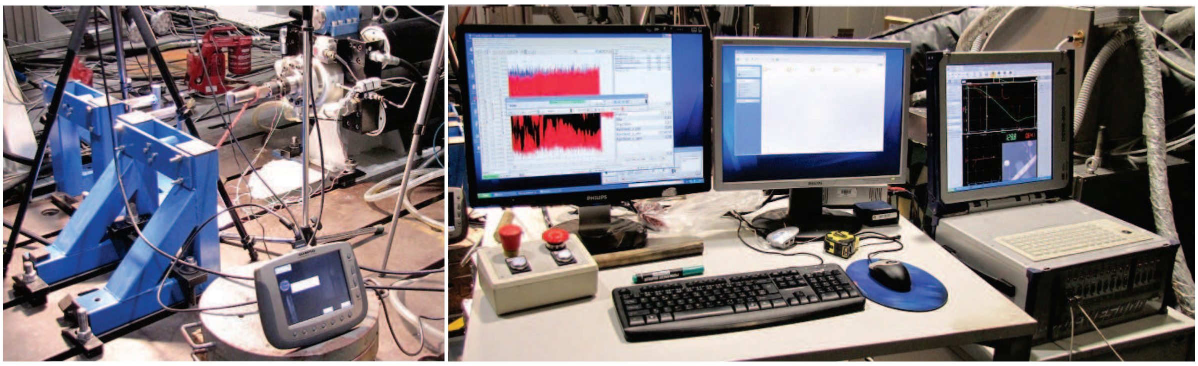

Fig. 1: Experimental device and measurement

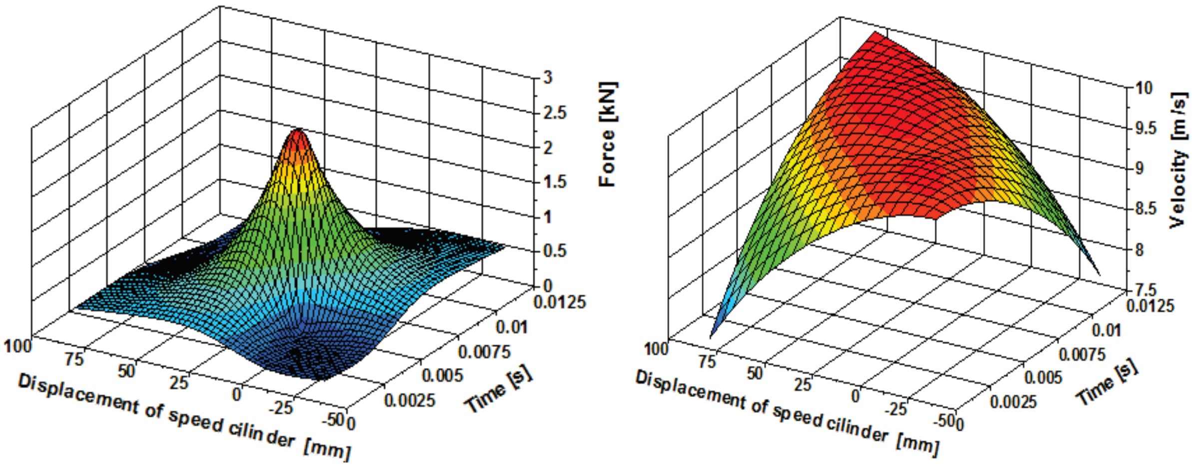

Fig. 2: a) 3D dependency graph of displacement speed cylinder/force/time, b) 3D dependency graph of displacement of speed cylinder/velocity/time

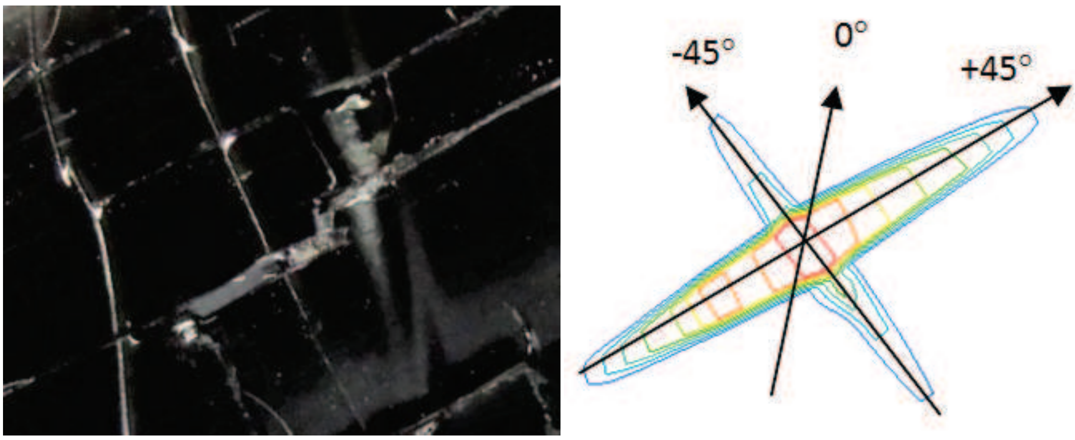

Fig. 3: Strain of the real sample (left), Distribution of stress in FEM model (right).

References

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