9th ECCOMAS Thematic Conference on the Mechanical Response of Composites: COMPOSITES 2023

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# Validation of composite pressure vessels modelling methodology using 2D-shell elements at coupon level

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## ABSTRACT

This paper describes a methodology developed to estimate the material properties in the dome and cylindrical area of composite pressure vessels (COPV). A COPV is produced on a hexagonal shaped so-called "soccer ball" mandrel, which has cleverly-designed flat faces in the dome and cylindrical regions.

Firstly, coupons with specific dimensions and stacking sequences are extracted from the cylindrical region of the COPV and tested. The intra-laminar material parameters of an advanced damage model of an orthotropic ply [1] are then identified, neglecting the interweaving of the yarns. Partial results of the identification process are presented in Figure 1.

Secondly, flat coupons in the dome area are modelled using 2D-shell elements: the first step of the modelling process consists of reproducing the deposition of successive yarns on the mandrel, knowing the result of the manufacturing process and the width of the yarns.

As a validation, four-point bending tests are conducted on coupons extracted from the dome area in the longitudinal and circumferential directions. Figure 1 compares tests and simulation results for a longitudinal coupon at dome. A good agreement, in terms of stiffness and strength, validates the present approach.

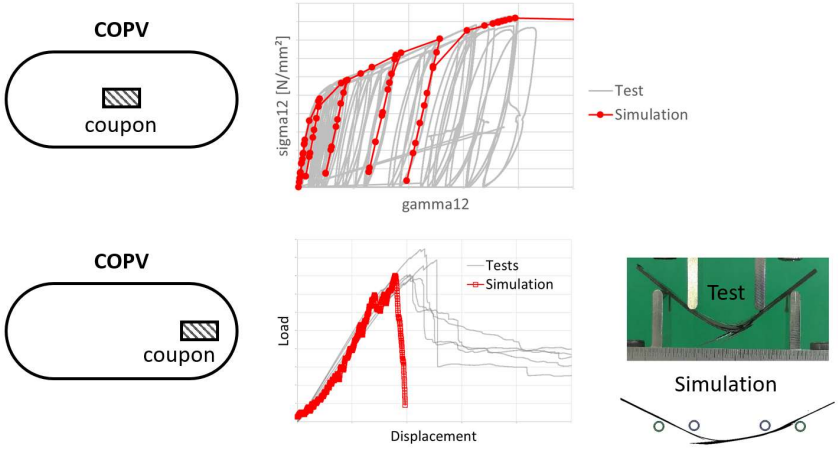


Figure 1. Results of the material parameters identification process. Tests/simulation comparison for 4-points bending on a coupon from the dome area

## REFERENCES

[1] Rajaneesh A., Bruyneel M. (2023). Low-velocity impact and compression after impact modeling of composites using modified mesoscale model. Composite Structures, 311, 116821.