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CFRP LAYUP OPTIMISATION TO REDUCE RESULTING DISTORTIONS OF RTM-PRODUCED HYBRID STEEL-CFRP PLATES

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Abstract: The production of hybrid metal-composite structures is often bound to multi-step-processes. In contrast, it is possible to produce hybrid components in a single-step Resin Transfer Moulding (RTM) process [1], which avoids additional steps to join the metal and the CFRP component. This results in the need for developing special resin systems capable of joining metal to CFRP while being a good binding agent for the dry carbon fibres. Nevertheless, new problems arise, as the different material properties result in residual strains, stresses and final component distortion while cooling the component from the warm RTM process down to room temperature. Finite element simulations help to gain insight and understanding of those problems as well as to reduce their impact. In previous research work [2] it was shown, that it is possible to predict the resulting distortions of a hybrid metal-composite plate, manufactured in a single-step RTM technology,by simulating the cooling phase of the process. In the present study, a parameter optimisation was set up based on previously developed simulation model [2] in order to find an optimised CFRP layup capable of reducing final residual distortions. For the optimisation, plates with dimensions of 500x500 mm² were chosen as geometry, with a 2 mm thick steel and a 2 mm CFRP component. Besides reducing the distortions, the optimisation aimed at a homogenized distortion distribution compared to the saddle shaped distortion geometry of the original plates [2]. For validation and comparison purpose, the resulting, optimized CFRP layup will be manufactured and compared with the original, symmetrical 0°/90° layup. The produced plates will be optically scanned and measured so to evaluate the optimisation results. This paper presents and discusses the optimisation model as well as the analysis and validation with experimental results. For the validation the plates were produced in three different layup configurations to ensure a good comparability of the experiments to one another. The validation through experiments show a good agreement with numerical results and produce promising results. Nevertheless, the simplified modelling technique in the FE model leaves room for improvement which will also be discussed. Future prospects and fields of applications will be discussed and conclude the underlying research. [

References

[1] E. Fauster, et. Al.. HybridRTM – Quality Controlled Manufacturing of Hybrid Material composites through Resin Transfer Moulding. 21st Symposium on Composites. Bremen, 5-7.July 2017

[2] S. Scheiblhofer, S.Ucsnik. Deformation Prediction of RTM Produced Hybrid Metal-carbon Composites. NWC17. Stockholm, 11-14.June 2017