Procedure to Calibrate Composite Materials by Serial/Parallel Mixing Theory

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ABSTRACT

The use of composite materials in the naval industry is a fact. Prove of it is composite materials are widely used in the marine industry (e.g. competition vessels and leisure boats), offshore industry and renewable energy industry. If engineers want to design reliable structures made of composites, the numerical tools have to be capable of accurately representing the behaviour of these materials, such as their high anisotropy and non-linear performance. Hence, a good model capable of taking into account the different failure modes of the laminates is required in order to reduce the uncertainty associated with the simulation of composite structures.

There are many models capable of simulating the elastic and specific non-linear behaviour of laminates, while also accounting for their anisotropic behaviour. However, few of them are capable to take into account most of the composites failure modes in a general way. This work proposes using one of them, the Serial/Parallel Mixing Theory (SP RoM) [1].

The main advantage of the SP RoM versus other formulations is that the composite performance is obtained from the mechanical properties of its constituent materials. Therefore, once these are calibrated, different composite configurations can be analysed without further calibrations. The Serial/Parallel Mixing Theory (S/P RoM) acts as a constitutive law manager of the constituent materials, being capable of reproducing the composite performance in its linear and non-linear regime.

In order to obtain the material parameters required by the formulation, this work proposes a set of different tests to obtain different loading conditions and failure modes. Then, a guideline to get the material parameters from the tests is given. Finally, the numerical results are compared with results obtained from an experimental campaign. These results show that, once all the material parameters are obtained for fibre and matrix, the formulation introduced is capable of representing all the failure modes of the composite for different loading conditions, as well as their failure strength.

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REFERENCES

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