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MODELING FAILURE IN COMPOSITE MATERIALS

1000 - FRACTURE, DAMAGE AND FAILURE MECHANICS

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ABSTRACT

The use of fiber reinforced polymer composites as structural materials has seen a significant growth in the past decades on a wide range of industries, from aerospace to construction. This has been mainly motivated by their high strength-to-weight ratio and corrosion resistance. On the other hand, their brittle failure modes have been pointed out as one of their main weaknesses. Despite their linear-elastic behaviour, which could seemingly indicate easier analyses, due to their composite and anistropic nature, determining the strength of composite structures and components is a complex problem, often requiring onerous experimental tests. In fact, while failure initiation criteria for anisotropic materials have been developed since the 1950s, their application without coupling of damage progression models leads to overly conservative strength predictions in composite structures. In fact, in any moderately complex structural component, the failure index of those initiation criteria may be reached in localized stress concentration areas without affecting the global behaviour and for load levels much lower than those leading to collapse.

In this context, computational methods are a promising cost-effective alternative to experimental testing, and several researchers have focused on the development of composite damage progression models to be applied with structural analysis computational methods. In fact, some studies have been successful in predicting the failure behaviour of very complex problems (e.g., bolted connections), although, generally, at the expense of high computational costs.

This mini-symposium focuses on the use of computational methods to model the failure and post-failure behaviour of composite materials, components and structures. The validation and comparison of the computational results with experimental data is highly valued, particularly concerning the predictions of strength and failure modes, as well as the applicability of the proposed methods to real design situations and their suitability for practitioners.