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Dynamic Damage Analysis of Carbon Fiber Reinforced Polymer Composite Confinement Vessels

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Abstract : This study uses analytical modeling, experimental testing, and explicit numerical simulations to evaluate failure and spall damage in Carbon Fiber-Reinforced Polymer (CFRP) composite confinement vessels. It investigates the response of composite materials to explosive loading dynamic impact, revealing varied failure modes. Hashin damage was used to model in-plane failure, while the Virtual Crack Closure Technique (VCCT) modeled interlaminar damage. Results show moderate agreement between simulations and experiments regarding free surface velocity and failure stresses, with discrepancies due to wire alignment imperfections, material model limitations, and wave reverberations. The findings can improve design and risk-reduction strategies in high-risk scenarios, leading to enhanced safety and economic efficiency in material assessment and structural design processes.

Keywords : numerical, spall, damage, CFRP, composite, vessels, explosive, dynamic, impact, Hashin, VCCT
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