INVESTIGATION OF WELDED VEHICLE ARMOUR UNDER BLAST LOADING

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ABSTRACT

The design of modern military platforms is often assisted by experiments and computational simulations that provide relevant insights about material reliability, mechanical performance and design vulnerability to blast loading. An important design consideration for land platforms is the damage response of welded structures from near field blast loading, which is characterised by high strain rate loading and complex shock and blast wave interactions and reflections. To understand the damage response of structures under this loading condition, scaled experiments coupled with numerical simulations are used to identify (a) the temporal displacement fields (b) onset of critical failure in various elements and (c) spatial distribution of internal pressure fields.

A methodology for understanding the failure response of welded structures to blast loading, using PETN, is investigated using both true scale experiments, conducted in accordance with BWB TL 2350-0003, and explicit numerical modelling. Experimental observations are compared with simulation results to determine modelling accuracy for both elastic and plastic deformation. The multi-scale modelling approach adopts a discretization technique for the structure by way of variations in the material property attributes of: weld material, Heat Affected Zone (HAZ) and parent material. The blast propagation and fluid structure interaction (FSI) are achieved through an Arbitrary Lagrangian Eulerian (ALE) simulation framework and provided insights into the deformation mechanisms. Multiple weld configurations are simulated to explore the design space and results are compared with the experimentally observed loading and structural response behaviours. The simulation results, alongside the scaled experiments, provide a robust framework for the prediction of blast response of representative welded structures and allows for their optimization to improve both the subsystem and platform integrity.