EVALUATION OF CONSTITUTIVE MODELS FOR PREDICTING THE DEFORMATION AND RUPTURE BEHAVIOUR OF ARMOUR STEEL UNDER LOCALISED BLAST LOADING

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Previous experimental work has evaluated the performance of multiple high strength armour steels under localised blast loading. These investigations identified that higher strength grades of armour steel can provide improved deformation resistance and a higher rupture threshold than lower strength steels with greater ductility.

This investigation focuses on the material characterisation and numerical modelling of two of these armour steels under localised blast loading, with the goal of reproducing the experimentally observed target plate deformations and rupture thresholds. A range of constitutive models to describe the plasticity and fracture for each steel are presented and evaluated using fully-coupled FSI numerical models of the small-scale blast experiments. The deformed plate profiles are effectively captured across all intact experimental conditions with a plasticity model accounting for strain rate and Lode angle dependence. It was found that the Johnson-Cook and Cockcroft-Latham fracture models significantly over-predicted both materials rupture threshold. The Bai-Wierzbicki 3D fracture model, with a strain rate and temperature dependent extension was the only model evaluated that provided an acceptable measure of the rupture threshold for these loading conditions.