Modelling of Blast Performance of Welded Aluminium Structures in Military Vehicles

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The use of Improvised Explosive Devices (IEDs) on the modern battlefield is widely considered to be a major threat to military land vehicles. Consequently, there is interest in understanding the performance of aluminium armour materials and welded structures subjected to blast and ballistic loading. The performance of joints is of particular interest as they generally represent the weakest points of any structure. Welding processes are energy intensive and generally cause significant microstructural changes owing to the weld thermal cycle. These changes generally result in significant local variation in the material properties across a weld and typically induce localised weakening of the material.

It is the long term objective of research within LATEST2, in collaboration with Defence Science and Technology Laboratory (DSTL), to develop a modelling capability to predict the structural response of welds in advanced aluminium alloys, like 2139, under blast loading. The aim of the project is thus to link process and microstructural models to predict the weld zone static and dynamic properties, which can then be incorporated into an FE model to give the deflection and deformation behaviour of a welded joint under blast conditions. The resultant increased understanding of the relationships between the welding parameters, material properties in the weld zones, and the structural performance of an overall welded panel in blast, sought in the project, will enable design principles to be developed for building safer military vehicles.

Fig. 1 Warrior armoured vehicle

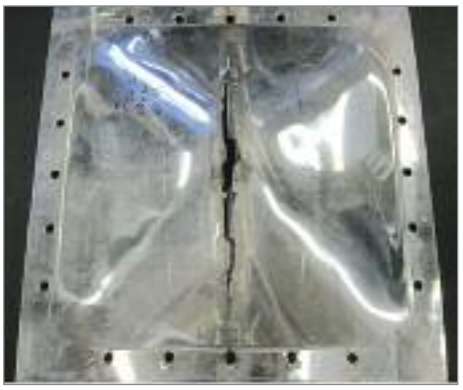

Fig. 2 Failed blast test panel

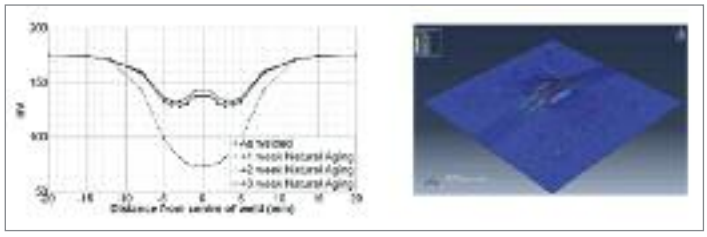

Fig. 3 Model prediction for the hardness distribution across a welded joint as a function of natural ageing time and an FE simulation showing the resultant plastic strain distribution expected across a weld in a blast test.

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Publications: A. J. Awang Draup, J. D. Robson, P. B. Prangnell, M. J. Lunt, Modelling of blast performance of welded aluminium structures in military vehicles manufactured by friction stir welding, LightMat 2013, Bremen Germany, 3-5 September 2013.

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