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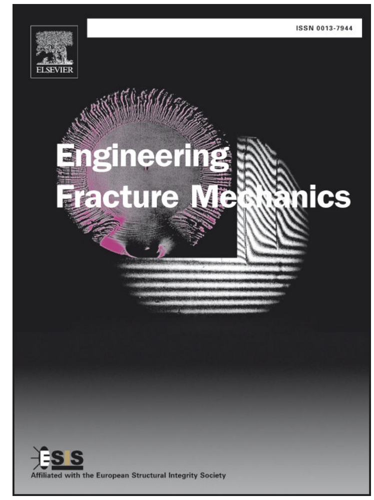


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# Internal-structure-model based simulation research of aramid honeycomb sandwich panel subjected to intense impulse loading

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ABSTRACT

An experimental investigation on the dynamic response of composite sandwich panels, comprising two titanium alloy plates and an aramid honeycomb core, subjected to intense impulse loading was carried out with the electric gun method. And brief results were presented within this paper. Based on the experiments, simulations were conducted with SPH-based internal structure model using the AUTODYN software. Here, the elasto-plastic constitutive was adopted to describe the mechanical behaviour of the core and corresponding matrix constitutive parameters were obtained quantitatively. An optimal particle size was determined by comparing the effects of different particle sizes on computational efficiency and accuracy. Afterwards, the proposed SPH model was validated with the experiments, making it feasible for following studies. To study the weakening effect of the core, a stress decay coefficient was proposed, and the results proved that the aramid honeycomb core played an important role in weakening the reflected tensile wave. Finally, the impact resistance assessment, in which three different forms of panels were compared, indicated that the aramid honeycomb sandwich panel was superior to the other two.

Keywords: Sandwich panel; Aramid honeycomb; Impulse loading; SPH method; Internal structure model

## 1. Introduction

Sandwich panels are widely used in weight-sensitive applications, such as aerospace, transportation and military, due to their superior energy absorption capability and impact resistance. The dynamic response of sandwich structure under different impact loading conditions is not only a hot topic in the field of protective structural design, but also a critical research issue for researchers [1-3]. In their experiments, the loading modes can be divided into blast loading [4-9], projectile impact loading [10-14], impulsive loading produced by the split Hopkinson pressure bar (SHPB) [15-17] and electromagnetic loading. To name a few, in Nurick's [4] and Zhu's [5] study, a ballistic pendulum system was used to investigate the dynamic response of aluminium sandwich panels under air blast loadings. Researches on the ballistic impact behaviour of sandwich panels have been made by Goldsmith and Sackman [14]. In their experiments, effects of impact velocity, projectile shapes and boundary conditions on the ballistic limit and energy absorption of the panels during perforation were identified. The SHPB technique is often used for testing the dynamic mechanical properties of the core materials. Mukai et al. [15] have studied, using a standard SHPB arrangement, the impact response of aluminium foams. And rate sensitivity was observed in his results. However, very few studies have been reported on electromagnetic loading. Compared with the loading methods mentioned above, the kinetic energy of flyers driven by an electric gun [18] is higher, and the loading pressure and pulse width can be controlled by varying the thickness of flyer or the charging voltage. Hence, the electric gun can be applied to simulate the impact of space debris and the attack of directed energy weapon.

As a sophisticated numerical method, FEM is widely used to simulate the impact response of sandwich structures. LS-DYNA was used by Baroutaji et al. [19] to investigate the energy absorption responses and deformation modes of

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