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Abstract

Lightweight phenolic resin-impregnated aramid paper honeycombs, commercially known as Nomex® honeycombs, is a promising core for sandwich structures in aerospace applications due to its high ratios of stiffness and strength to density. The out-of-plane compressive properties of the Nomex honeycombs have been widely investigated under quasi-static and low strain rates (up to 300 s^{-1}). There is a need to understand the behaviour of this structure under higher strain rate compression. This will widen the applicability of these structures to more areas such as debris impact and other impacts which induce high strain rates. This paper reports the out-of-plane compressive responses of Nomex honeycombs subject to quasi-static loading and high strain rate dynamic loading up to 1500 s^{-1}. The work involves experimental measurements and numerical modelling and validation. The compressive responses of the honeycombs were measured using a sensitive magnesium alloy Kolsky bar setup with front and back face impacts. The failure modes of the Nomex honeycombs were identified to be different under quasi-static and dynamic compressions. Under quasi-static compression, the honeycombs failed with local phenolic resin fracture after the elastic buckling of the honeycomb walls. For the dynamic compression, the honeycombs failed with the stubbing of cell walls at the ends of specimens. A finite element (FE) numerical model was devised and validated with the experimental data. The FE model considered the strain rate effect of