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Dynamic Characteristics of Aluminium Foams Under Impact Crushing

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Abstract

The dynamic behavior of metal foams under impact crushing is of great interest for both fundamental research and engineering applications. This paper presents a systematical and thorough investigation on the dynamic response of a colliding mass impacting on metal foams that exhibit strain hardening. Experimental investigation, finite element (FE) simulation and analytical modelling are conducted in this study. In the experimental work, an instrumented projectile acting as a colliding mass was designed and implemented by using a novel *in situ* deceleration measurement unit embedded within a metal body. This projectile measures *in situ* rigid-body deceleration and provides a measure for net resistance on the projectile during the dynamic impact test. In each test, the impact velocity and crushing depth of the projectile were recorded. Based on the metal foams that exhibit strain hardening in this study, an exponential stress-strain relation is proposed to model the static strength of aluminium foam specimens, which is used for subsequent FE simulation and the analytical model. The predictions of the proposed analytical model are compared with an earlier analytical model based on Rigid Perfectly-Plastic-Locking (RPPL) idealization. RPPL can only well approximate the stress-strain characteristic of metal foams with low strain hardening. It is found that the proposed analytical model matches the experimental results much better than the earlier analytical model based on