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On design of hybrid material double-hat thin-walled beams under lateral impact

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Abstract

An innovative double-hat thin-walled beam comprised of aluminum-steel hybrid materials is proposed for potential application in passenger vehicle bumper systems to reduce pedestrian injury. The beams are featuring an aluminum alloy upper hat and a high strength steel lower hat riveted together to increase the specific energy absorption (*SEA*) and to reduce the initial peak force (F_{ip}) simultaneously under lateral impacts. Quasi-static three-point bending test was performed to explore the bending resistant characteristics of such a double-hat beam. Furthermore, bending behavior of the hybrid beam under lateral impact was numerically investigated using LS-DYNA and compared with that of its counterparts with homogeneous materials and identical geometrical dimensions. It was found that the aluminum-steel hybrid beam shows a well-balanced and better bending performance under lateral impact compared to beams made of a single material. Parametric studies were further conducted to investigate the influences of critical geometric parameters on the crashworthiness performances of such double-hat beams under lateral impacts. Based on radial basis function (RBF) metamodels and using non-dominated sorting genetic algorithm

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