

Energy Absorption of Circular Thin-Walled Tube with Curved-Crease Patterns under Axial Crushing

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Abstract : Thin-walled tubes are commonly used as energy absorption devices for their excellent mechanical properties and high manufacturability. Techniques such as grooving and pre-folded origami shapes were introduced to circular and polygonal tubes to improve its energy absorption efficiency. This paper examines the energy absorption characteristics of circular tubes with pre-embedded curved-crease pattern. Set of numerical analyzes were conducted with different grooving patterns for tubes with various diameter (D) to thickness (t) ratio. It has been found that even very shallow grooving can positively affect thin wall tubes, leading to increased energy absorption and higher crushing load efficiency. The phenomenon is associated with nonsymmetric deformation that is usually observed for tubes with a high D/t ratio (> 90). Grooving can redirect a natural mode of post-buckling deformation to a one with a higher number of lobes such that its beneficial and more stable. Also, the opposite effect can be achieved, and highly disrupted deformation can be a cause of reduced energy absorption capabilities. Curved-crease engraved patterns can be used to stabilize and change a form of hazardous post-buckling deformation.

Keywords : axial crushing, energy absorption, grooving, thin-wall structures

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