ICCES, 2025, vol.34, no.1

Tech Science Press

DOI: 10.32604/icces.2025.012320

PROCEEDINGS

Improved Self-Locking Multi-Cell Structures with Customizable Energy Absorption

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ABSTRACT

Assembled structures attracted increasing attention due to their ultimate flexibility, wide design space, manufacturing and transporting conveniences. In this study, a novel assembled multi-cell structure was proposed to achieve tunable energy absorption characteristics. The quasi-static compression experiments demonstrated that the crashworthiness of the assembled multi-cell structure could be effectively and rapidly tailored by varying the number and material of cells. Furthermore, to enhance the mechanical interlocking capability and energy absorption performance of existing assembled structures, three connection joints were further proposed. Tensile tests were conducted to investigate their mechanical properties, and the results revealed that the connection joint with two interlocking units exhibited the most superior mechanical properties, making it the preferred choice for assembled multi-cell tubes. Quasi-static compression experiments demonstrated that the assembled four-cell tube with improved connection joints exhibited greater structural synergy and higher energy absorption compared to the original assembled tube. Based on the simplified super folding element theory and experimental findings, a theoretical model was established to predict the mean crushing force of assembled structures with varying cell numbers and materials. The theoretical predictions aligned well with experimental studies. This study provided a promising approach to customize the dimensions and crashworthiness of energy absorbers to adapt to various collision scenarios.

KEYWORDS

Assembled structure; multi-cell structure; energy absorption; tunable performance

Funding Statement: This work was supported by the Natural Science Foundation of Hunan [2024JJ5434], and the Scientific Research Project of Hunan Provincial Department of Education [24A0029].

Conflicts of Interest: The author(s) declare(s) no conflicts of interest to report regarding the present study.