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PROCEEDINGS

Bending Collapse of Easily Fabricated Single- and Multi-Cell Arched Beams

Xiong Zhang[1, 2,*], Jinkang Xiong[1] and Xinrong Fu[1]

[1]Department of Mechanics, School of Aerospace Engineering, Huazhong University of Science and Technology, Wuhan, Hubei, 430074, China

[2]Hubei Key Laboratory of Engineering Structural Analysis and Safety Assessment, Luoyu Road 1037, Wuhan, 430074, China

[*]Corresponding Author: Xiong Zhang. Email: zhangxiong@hust.edu.cn

ABSTRACT

Thin-walled beams are widely applied as energy-absorbing components in industrial products to meet the requirements of passive safety. Researchers have tried various approaches to improve the energy absorption efficiency of them. Recently, adopting arched beams was proposed by researchers to improve the crashworthiness of beams under transverse loads. Arched beams can switch the transverse forces to axial forces and were reported to show very much better crashworthiness performances than straight beams.

Although adopting arched beams is an effective way to improve the performance of beams under transverse loads, the fabrication of arched beams is more complex than that of straight beams. Arched beams with a perfect arc segment can be produced by casting or additive manufacturing, but the process is complex, and the costs are very high. In this paper, a simple three-point bending method is proposed for the fabrication of single- or multi-cell arched beams. Although an indentation or a concave is formed in the central region of the arched beams during fabrication, the beams show even better energy absorption performances than the perfect arched beams. Static and dynamic three-point bending tests of the fabricated arched beams are firstly carried out, and numerical simulations of the fabrication process and the subsequent bending collapse are then performed. The influences of the fabrication factors on the performances of the arched beams are investigated. Arched beams with tube filler and multi-cell sections can be easily fabricated by the proposed method, and the crashworthiness performances of these fabricated arched beams are significantly improved. In addition, the multi-cell arched beams fabricated by the present method exhibit excellent performances and outperform the arched beams with perfect arc segments.

KEYWORDS

Arched beams; multi-cell; transverse loads; forming effects; crashworthiness

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