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Finite Element Modelling of Composite Armor Against 7.62 mm Projectile Impact

Lei Peng[1,*], Jin Zhou[2], Xianfeng Zhang[3] and Zhongwei Guan[4,5]

[1]College of Architectural and Engineering, Guiyang University, Guiyang, 550005, China
[2]School of Mechanical Engineering, Xi'an Jiao Tong University, Xi'an, 710049, China
[3]School of Mechanical Engineering, Nanjing University Science & Technology, Xiaolingwei 200, Nanjing, 210094, China
[4]Advanced Materials Research Centre, Technology Innovation Institute, Abu Dhabi, UAE
[5]School of Mechanical Engineering, Chengdu University, Chengdu, 610106, China
[*]Corresponding Author: Lei Peng. Email: lei_peng2014@163.com

ABSTRACT

This paper presents the numerical modelling of the ballistic response of hybrid composite structures subjected to 7.62 mm projectile impact. This study focuses on the modelling of composites made of various materials, including ceramics, Ultra-High-Molecular-Weight Polyethylene (UHMWPE), Kevlar, and compressed wood, with fabrication of hybrid laminated structures that offer promising ballistic resistance capabilities. By employing a range of constitutive models and failure criteria, the finite element model simulates the ballistic behaviors of the constituent materials, facilitating a comprehensive understanding of their performance under high-velocity impacts. The core of the study lies in the comparison between the numerical simulations and experimental outcomes, aiming to validate the effectiveness and accuracy of the finite element (FE) models developed. This comparison reveals a significant correlation, especially in terms of capturing essential ballistic impact features such as deformation patterns, failure modes, back-face signatures, and the projectiles' residual velocities. These results underscore the potential of the FE models as invaluable tools in the design and optimization process of lightweight composite armor, aiming for an optimal balance between ballistic resistance and material weight. Furthermore, this research makes a contribution to the field of protective materials by enhancing the understanding of composite structures' ballistic performance. It offers a numerical approach for assessing the impact resistance of hybrid composite laminates, paving the way for the development of advanced protective solutions.

KEYWORDS

High-velocity impact; ballistic performance; composite laminates; finite element

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