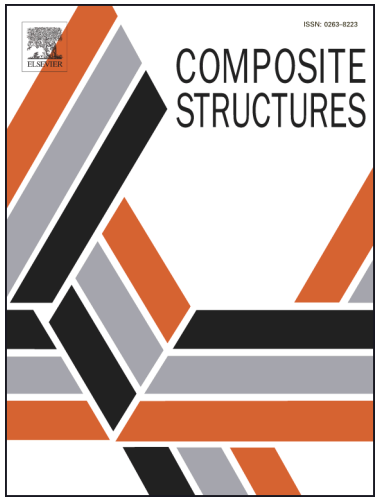

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RELEVANT FACTORS IN THE DESIGN OF COMPOSITE BALLISTIC HELMETS

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ABSTRACT

In this paper, the design methodology of composite ballistic helmets has been enhanced considering biomechanical requirements by means of finite element analysis. Modern combat helmets lead to a new type of non-penetrating injury, the Behind Helmet Blunt Trauma (BHBT), generated by the deformation of the inner face of the helmet, the so-called backface deformation (BFD). Current standard testing methodologies use BFD as the main measure in ballistic testing. Nonetheless, this work discusses the relationship between this mechanical parameter and the head trauma (BHBT) by studying different head injury criteria. A numerical model consisting of a helmet and a human head is developed and validated with experimental data from literature. The consequences of non-penetrating high-speed ballistic impacts upon the human head protected by an aramid combat helmet are analysed, concluding that the existing testing methodologies fail to predict many types of head injuries. The influence of other parameters like bullet velocity or head dimensions is analysed. Usually, a single-sized helmet shell is manufactured and the different sizes are adjusted by varying the foam pad thickness. However, one of the conclusions of this work is that pad thickness is critical to avoid BHBT and must be considered in the design process.

Key words: Combat helmet design; ballistic standards; human head model; head injury criteria

Abbreviations

ACH	Advanced Combat Helmet
BFD	Back Face Deformation
BHBT	Behind Helmet Blunt Trauma
BPT	Brain Pressure Tolerance
CSDM	Cumulative Strain Damage Measure
CSF	Cerebrospinal Fluid
CT	Computed Tomography
DAI	Diffuse Axonal Injury
DDM	Dilatation Damage Measure
FE	Finite Element
FMJ	Full Metal Jacket
HIC	Head Injury Criterion
ICP	Intracranial Pressure
PASGT	Personnel Armour System Ground Troops
PMHS	Post-Mortem Human Specimen