Accepted Manuscript

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PII: S1359-8368(16)30523-6

DOI: 10.1016/j.compositesb.2016.04.071

Reference: JCOMB 4270

To appear in: *Composites Part B*

Received Date: 18 February 2016

Revised Date: 21 April 2016

Accepted Date: 27 April 2016

Please cite this article as: Yang Y, Chen X, Study of energy absorption and failure modes of constituent layers in body armour panels, *Composites Part B* (2016), doi: 10.1016/j.compositesb.2016.04.071.

Study of energy absorption and failure modes of constituent layers in body armour panels

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This study aims to investigate ballistic resistant efficiency of individual layers in body armour panels in order to further understand the energy absorption and failure modes of the layers and the panel. Finite Element (FE) analysis, in conjunction of experimental methods, was used to quantify the ballistic responses of the individual layers under ballistic impact. Perforated and non-perforated ballistic tests and photographic morphology examination were employed in this study for layer and panel failure mechanisms. The results of the investigation revealed that the fabric layers at different positions in the panel exhibit different transverse deformation and stress distribution. In the perforated panel, energy absorption in each layer increases gradually from the front to the rear of the panel. Comparison with the stand-alone fabric layer revealed that the energy absorption efficiency of the front layers is lower than that of the rear for the perforated panels. Based on the failure modes of different fabric layers in a ballistic panel, it is possible that the construction of the panel be optimised for improved ballistic performance.

Keywords: A. Fabrics/textiles; B. Impact behaviour; C. Finite element analysis (FEA); B. Stress concentrations

1. Introduction

Body armour is widely used by armed services and law enforcement to prevent injuries caused by the penetrating projectiles to the users of body amour. The ballistic performance of body armour is highly dependent on the availability of ballistic fibre materials. The innovations of high performance fibres (such as nylon, aramid, and high modulus polyethylene) during the last century have greatly pushed forward the development of ballistic body armour. The use of such high performance fibres in