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The Effect of Composite Hybridization on the Back Face Deformation of Armor Plates

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Abstract : Personal protection systems have been used in several forms for centuries. The need for light-weight composite structures has been in great demand due to their weight and high mechanical properties ratios in comparison to heavy and cumbersome steel plates. In this regard, lighter ceramic plates with a backing plate made of high strength polymeric fibers, mostly aramids, are widely used for protection against ballistic threats. This study aims to improve the ballistic performance of ceramic/composite plates subjected to ballistic impact by reducing the back face deformation (BFD) measured after each test. A new hybridization technique was developed in this investigation to increase the energy absorption capabilities of the backing plates. The hybridization consists of combining different types of aramid fabrics with different linear densities of aramid fibers (Dtex) and areal densities with an epoxy resin to form the backing plate. Therefore, several composite structures architectures were prepared and tested. For better understanding the effect of the hybridization, a serial of tensile, compression, and shear tests were conducted to determine the mechanical properties of the homogeneous composite materials prepared from different fabrics. It was found that the hybridization allows the backing plate to combine between the mechanical properties of the used fabrics. Aramid fabrics with higher Dtex were found to increase the mechanical strength of the backing plate, while those with lower Dtex found to enhance the lateral wave dispersion ratio due to their lower areal density. Therefore, the back face deformation was significantly reduced in comparison to a homogeneous composite plate.

Keywords : aramid fabric, ballistic impact, back face deformation, body armor, composite, mechanical testing
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