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Dynamic Response on Textile Materials under Transverse Impact

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ABSTRACT

Textile materials, such as Dyneema and Kevlar, are the major raw materials for state of the art military or personal security armor vests. However, in impact experiments, actual observed penetration speed is much lower than theoretically predicted penetration speed. Each armor vest is composed of high performance yarns which are woven together to form fabrics, which when stacked together form a vest. Understanding penetration behavior of yarns is essential to evaluate the performance of fabric, which will be useful for the design of better vests. The project is composed of three parts: static experiments, dynamic yarn experiments and dynamic fabric experiments. In the static experiments, several types of textile materials will be loaded onto MTS testing machine under slow and constant speed by different projectiles, such as Fragment Simulating Projectile, Hemispherical Nose Projectile and Blade Projectile. Secondly, a powder gun will be used to provide high speed impact conditions. Several yarns will be impacted at high velocities and imaged simultaneously using a high speed camera. Finally, aforementioned experimental conditions will be utilized for fabrics experiments. At this preliminary phase of the investigation, only expected results are being reviewed. In the yarn experiments, impact angle, between impacted region (shear wave propagation region) and impacting region (transvers wave propagation region), is expected to be approximately constant. In the fabric experiments, the goal is to acquire the range of the penetration speeds for different types of textile materials with different number of layers. The acquired data will yield a strong background database for further improvement and adjustment in personal vest design.

KEYWORDS: Dynamic response, Textile material, Transverse Impact, Ballistic Armor Vest Design, High Speed Impact