OPTIMIZATION OF SPLIT HOPKINSON TENSILE BAR AND EXPERIMENTAL CHARACTERIZATION OF 3D WOVEN COMPOSITE AT HIGH STRAIN RATE

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Carbon fibre textile composite has been increasingly employed in engineering applications for high performance, manufacturability and high specific energy absorption characteristic. Composite material have been applied to design energy absorption structures in automobile, aerospace and shipbuilding industries for lightweight and high-performance design [1]. During their service life, the structures undergo complex loading conditions, e.g., dynamic load. High strain rate loading is one of the possibilities in many of such applications. It has always been a case for concern that the mechanical properties of composite materials may be different at high strain rate loading compared with those at quasi-static loading. Thus, for effective use of composite material, it is essential to fully understand the mechanical behaviour under high strain rates and loading conditions.

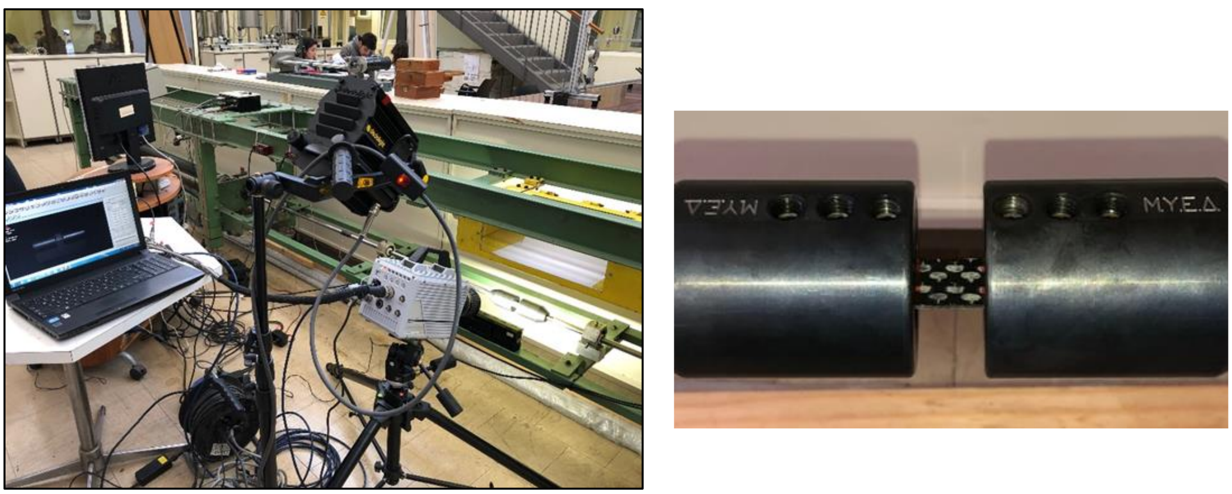

Figure 1. (Left) SHPB with high speed camera facility at the University of Patras. (Right) SHPB Tensile Fixture

The present work comprises for the optimization of the appropriate tensile fixture for Split Hopkinson Tensile Bar (SHTB) and for the derivation of tensile properties at high strain rate. For this study, a novel three dimensional (3D) woven composite of layer-to-layer architecture manufactured by vacuum assisted resin transfer moulding process in Ulster University is investigated for tensile properties under high strain rate testing. The testing device used is the Split Hopkinson Pressure Bar Tensile (SHPB) apparatus installed in the Laboratory of Technology and Strength of Materials of the University of Patras as shown in Fig.1. The specimen geometry is designed to suit the testing facility and to achieve the desired strain rates. 3D woven carbon epoxy laminate was characterized for tensile properties in 0° (longitudinal direction) and 90° (transverse direction). A high-speed camera is used for non-contacting deformation measurement technique referred to as DIC is used to conduct the image analysis by means of tracking the displacement field through comparison between the reference images and deformed images to obtain full-field strain distribution and capture the failure mechanisms. The experimental results are analyzed in terms of stress and strain curve, strain rate, failure modes for investigated material system.

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[1] J. Obradovic et al. (2012) "Lightweight design and crash analysis of composite frontal impact energy absorbing structures". Compos. Struct. **94**, 423-30.