1st European Conference on Crashworthiness of Composite Structures – ECCCS-1
19-21st November 2019, Queen's University Belfast
www.qub.ac.uk/sites/ecccs-1

Improvement of mechanical performance in 3D woven composites by modification of weave parameters

Monali Dahale[a*], Geoffrey Neale[a], Cormac Mcgarrigle[a], John Kelly[a], Edward Archer[a], Eileen Harkin-Jones[a], and Alistair McIlhagger[a]

a: Engineering Research Institute, Ulster University, Shore Road, Newtownabbey, Co. Antrim, BT37 0QB, United Kingdom

* Presenting author: m.dahale@ulster.ac.uk

The application of 3D woven composites in advanced structural components is limited by the lack of understanding of the influence of weaving parameters on the final architecture and mechanical properties of composites. This paper investigates the effect of weave parameters on the mechanical properties such as tension, compression, flexure and Izod impact energy in 3D woven layer-to-layer carbon/epoxy composite structures. The purpose of this paper is to develop fundamental understanding of the link between the textile and composite material within the layer-to-layer 3D weave architectures without any need to rethread the entire loom. Two different weave parameters (weft density and float length) are considered in this study. The 3D fabrics, manufactured using a Jacquard loom, are fabricated in three different weft densities: 4, 10 & 16 wefts/cm with a constant warp density of 12 ends/cm from T700S-50C-12K carbon fibre. The weft density with superior mechanical properties is further used for the float length change iteration (Figure 1). The warp and the weft density are kept constant in all the three-float length variation. In the weft density iteration, improvements in mechanical properties in the weft direction with the increase in the weft density was a direct result of an increase in the fibre content of the load bearing yarns. However, unexpected improvements in the warp direction are due to a less distorted architecture, decreased crimp, fewer resin rich areas, increased binding points/unit cell. The failure modes in lower weft density specimens induced by larger resin rich areas around the binder turns, created areas of stress concentration which impacted the mechanical properties. The failure mechanisms varied with different types of weave structure (with float length & weft density variation) under different loading. This study has helped in deriving a relationship between the defined weave parameters and the mechanical properties of this 3D woven layer-to-layer warp interlock carbon/epoxy composites.

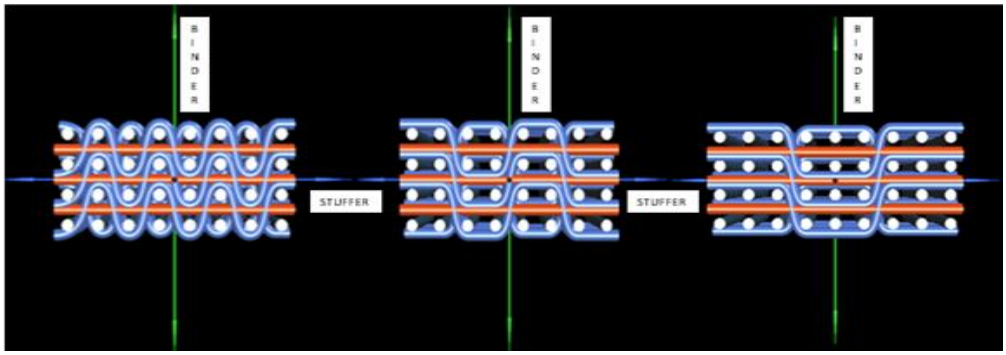

Figure 1: Diagram representing three different float lengths in the 3D woven layer-to-layer architecture