

## 3D textiles for composite reinforcements

R. Fangueiro<sup>1</sup>, Z. Mingxing<sup>2</sup>, H.Hong<sup>3</sup>, F. Soutinho<sup>1</sup>, P. Gonçalves<sup>1</sup>  
and M. de Araújo<sup>1</sup>

*1 University of Minho, Campus de Azurém, 4800-058 Guimaraes, Portugal.*

*2 College of Textiles Donghua University, Shanghai, China.*

*3 Institute of Textiles and Clothing, The Hong Kong Polytechnic University, China.*

### Abstract

This paper presents an overview on the last developments on 3D textile structures for composite reinforcements. The application of innovative 3D shaped weft-knitted preforms in GFRP tube joints is presented and discussed. Moreover, the mechanical behaviour of 3D hybrid basalt fiber reinforced composite material is also presented and discussed.

All textile techniques available, including weaving, braiding, non-wovens, knitting and stitching, are able to introduce fibers in the through-thickness direction originating 3D fabrics. However, the most common used techniques to produce 3D fibrous reinforcements for high mechanical performance composite materials are weaving and braiding due to the fiber orientation provided. Examples of 3D fabrics are presented in Figure 1.

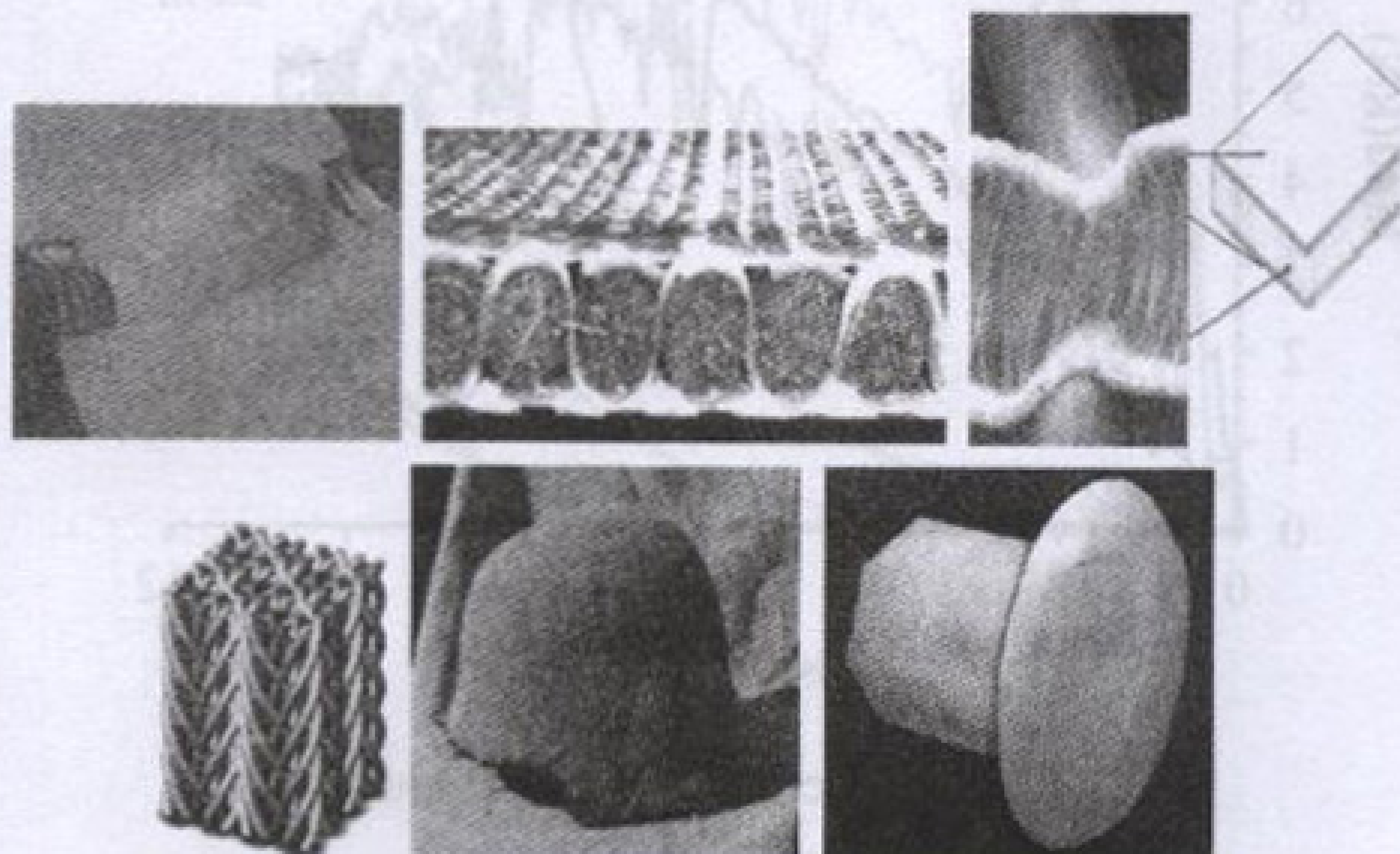


Fig. 1. Examples of 3D fabrics for composite reinforcements

Experimental work has been carried out at University of Minho to design weft-knitted fleecy fabrics for application in pipe connections produced with composite materials reinforced by 3D weft-knitted fabric preforms. The specifications of a T tube composite connexion have been established according to the information of the composites producer company involved in the project. The weft-knitted fleecy fabric has been optimized to perform a better mechanical performance, i. e., to increase the stiffness due to the use of straight fleece yarns. Special knitting techniques, developed by the authors, have been applied to produce 3D shaped preforms to be impregnated by using RTM techniques. A special mould has been produced according to the required geometry. The results of the mechanical tests performed on the final produced samples are presented, discussed and compared with those imposed in the initial specifications. Figure 2 presents the 3D knitted preform used along with the final composite piece.

The combination of different types of fabrics in a 3D composite reinforcement in order to design its