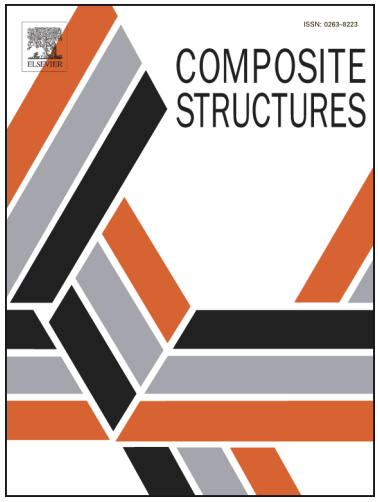

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M. Haghi Kashani, A. Hosseini, F. Sassani, F.K. Ko, A.S. Milani

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Understanding Different Types of Coupling in Mechanical Behaviour of Woven Fabric Reinforcements: A Critical Review and Analysis

M. Haghi Kashani[1], A. Hosseini[2,3], F. Sassani[2], F.K. Ko[3], A.S. Milani[1,*]

[1]Composites Research Network-Okanagan Laboratory, School of Engineering, University of British Columbia, Kelowna, BC, Canada

[2]Department of Mechanical Engineering, University of British Columbia, Vancouver, Canada

[3]Advanced Fibrous Materials Laboratory, University of British Columbia, Vancouver, Canada

* Corresponding author (abbas.milani@ubc.ca, Tell: +1-250-8079652)

Abstract

This study attempts to provide an improved insight into the significant role of inherent coupling in the mechanical behavior of woven fabric composites. In particular, applying yarns tension to postpone the wrinkling defect has now become a common technique in industry during shear forming of fabric reinforcements. Yet, in-depth understanding of this coupling characteristics is rather limited. The article first distinguishes between the meso-level (inherent) coupling and the macro-level coupling expressed by the general Hook's law. Then, specific types of inherent couplings are identified, including tension-tension, tension-shear, and shear-tension. A fixture capable of performing combined loadings was employed to characterize the coupling modes in a typical glass/polypropylene plain weave. Results revealed a highly dominant influence of tension-shear coupling on the effective mechanical properties of the fabric, followed by the tension-tension and shear-tension couplings. Discussions are made as to how these macro-level observations may be linked to underlying deformation mechanisms at lower material scales.

Keywords: woven fabrics; combined loading modes; mechanical behavior; coupling analyses.

1. Introduction

Since the rise of composite materials in 1960s, unidirectional (UD) fiber reinforced composites have caught the attention of most designers, mainly due to their high specific stiffness and strength values as well as relative simplicity in their analysis. Nevertheless, woven fabric reinforced composites have gradually become a superior alternative to the traditional UD composites, thanks to their superior formability and higher out-of-plane stiffness