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under Bias Extension and Picture Frame Tests**

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**ABSTRACT**

An analytical-experimental study of the shear wrinkling behavior of plain-woven composite preforms under Bias Extension Test (BET) and Picture Frame Test (PFT) modes is presented. Unintentionally induced tension in the PFT has been regarded in a large portion of the literature as the source of delay in fabric wrinkling initiation as compared to the BET. Through this study, however, it is demonstrated that shear within yarns – known as intra-yarn shear – could be another cause of the delayed wrinkling in PFT, even when the tension level in yarns is kept at zero. To better explain this hypothesis, an analytical model has been developed and the meso-level nature of wrinkle formation in the BET and PFT is compared. Analytical equations are provided to predict both the fabric locking and wrinkling onsets under these characterization tests, and verified experimentally on a carbon fiber plain woven fabric.

**Keywords:** Woven Fabric Composites, Wrinkling, Multi-Scale Analysis, Bias Extension Test, Picture Frame Test.

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