A Multiscale Projection Method for Analysis of Fiber Kinking in Fiber Reinforced Polymers

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ABSTRACT

Fiber reinforced polymer composites undergo different localized failure mechanisms such as matrix micro cracking, delamination and kink band formation. These failure modes have a significant influence on the in-service performance of the composite material. For instance kink band formation is considered as the most critical factor in the design for compressive strength of unidirectional fiber reinforced composites. Due to the high dimension difference between the domain of local effect and the real engineering part, such as composite laminate, the application of multiscale techniques based on the global-local analysis is preferable over homogenization techniques for making an admissible prediction of the failure behaviour. In the present work a multiscale projection method [1] is further developed to capture fiber kinking phenomenon in unidirectional fiber layers. The method is based on the partitioning of the domain into fine and coarse scale parts. While the fine scale domain is discretized with the details of the microstructure, e.g. fibers, matrix, and their interface, the coarse scale domain is considered as a homogenized orthotropic material. The coupled equation systems based on application of boundary condition from coarse scale to fine scale and projection of micro effects from the fine scale domain to the coarse scale [2] are solved concurrently until the formation of kink band.

REFERENCES

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