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Aspects of the Mechanical Response of Randomly Reinforced, Chopped Fiber Strand, Polymeric Composites

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The modulus of randomly reinforced composites exhibits an unusually high scatter, which depends on the length of the measuring device. A high degree of scatter is also noted for the composite's strength. The random geometry was modeled by a random generation of the locations and orientations of fiber strands and projecting their configurations on sequentially stacked layers, until attaining the desired thickness of the structure. The stiffnesses of the modeled structure were evaluated by transforming the principal moduli of each randomly oriented strand into the common structural coordinates, while accounting for its volume fraction. In this manner it was possible to compute the well-known laminate-level stiffnesses A, B, and D. With these properties at hand it was possible to evaluate departures from isotropy and homogeneity in relation to sample size and spatial distances. Failure was modeled by means of a strand discount method, utilizing the Tsai-Hill failure criterion. The model provided detailed insights into the behavior of random reinforcement and its predictions were in good agreement with experimental data.

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