

# **Rebar for Plastics – A Novel Approach to Part Optimization with Hybrid Length-Scale Composites**

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## **ABSTRACT**

Conventional design methodologies are divided between isotropic approaches (metals and randomly oriented discontinuous composites) and laminate-based anisotropic approaches. This bifurcation of methodologies has largely aligned with historical manufacturing processes; however, recent development of hybrid length-scale composites require a novel approach to fully unlock the capabilities of these novel materials. In hybrid length-scale composites, unidirectional tape assemblies are combined with conventional plastic molding processes such as injection molding, compression molding, or thermoforming to create a structural or semi-structural component that is more cost efficient than a pure laminate.

This presentation provides an overview of the Rebar for Plastics® design methodology, which leverages various micro-and macro-mechanical concepts to maximize performance and minimize cost in hybrid length-scale composites. Rather than using material properties as a fixed input in part design, stiffness, strength, and toughness can be tuned independently and in parallel with part geometry, based on overall performance targets for the component and the relative ratios of unidirectional tapes and molded plastic in the part. A representative case study will illustrate key optimization concepts associated with hybrid length-scale composites, while also providing a comparison against more conventional isotropic and laminate-based methodologies. The case study will also showcase a woven composite lattice structure created from unidirectional thermoplastic tapes that is suitable for high volume manufacturing.

Keywords: Hybrid structures, Design methodologies, Composite metamaterials, Micromechanics

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### **Learning Objectives:**

Attendees will gain an understanding of hybrid-length scale composites, including advantages and disadvantages.

Attendees will be educated on several micro-and macro-mechanical material theories suitable for use with hybrid length-scale composites.