Additive Manufacturing (AM) continues to gain popularity for its ability to produce complexly-shaped final use components that are impractical to manufacture by traditional methods; however, additive manufactured parts contain complex mesostructures that result in directionally-dependent mechanical properties that have yet to be fully characterized. This effort demonstrates a framework of experimental and analytical methods needed to characterize the uniaxial monotonic behavior of fused deposition modeling PLA using tensile and compressive experiments on specimens printed at various orientations. Based on experimental results, the asymmetry and anisotropy of tensile and compressive response were analyzed for a candidate material. Specimens from different orientations underwent microscopy and failure surface analysis to correlate test data. The material was observed to exhibit tetragonal behavior with tensile-compressive asymmetry. To help validate the model, a component-level study was performed. A newly-developed square donut (i.e., prismatic torus) was printed in multiple orientations, tested, and compared to simulations. The experimental and simulated results show a strong correlation. Based on the collection of results, analysis, and computations, this work demonstrates a practice that can be used to characterize similar materials for use in components.

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The public is welcome to attend.