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The dependence of granular plasticity on particle shape. KIERAN MURPHY, HEINRICH JAEGER, University of Chicago — Granular materials plastically deform through reworking an intricate network of particle-particle contacts. Some particle rearrangements have only a fleeting effect before being forgotten while others set in motion global restructuring. How particle shape affects local interactions and how those, in turn, influence the nature of the aggregate's plasticity is far from clear, especially in three dimensions. Here we investigate the remarkably wide range of behaviors in the yielding regime, from quiescent flow to violent jerks, depending on particle shape. We study this complex dependence via uniaxial compression experiments on aggregates of 3D-printed particles, and complement stress-strain data with simultaneous x-ray videos and volumetric strain measurements. We find power law distributions of the slip magnitudes, and discuss their universality. Our data show that the multitude of small slips serves to gradually dilate the packing whereas the fewer large ones accompany significant compaction events. Our findings provide new insights into general features of granular materials during plastic deformation and highlight how small changes in particle shape can give rise to drastic differences in yielding behavior.

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