315f The Effect of Particle Shape on Granular Stress

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Previous discrete element modeling efforts have shown the effect of particle shape on granular flow rates, bulk density and stress profiles in various flow configurations (hoppers, mixers, etc.) However, to date there has been no systematic investigation of particle shape on granular flow in a simple configuration, such as planar shear flow. Such a systematic investigation in a simple flow configuration is necessary in order to derive constitutive relations for continuum-based models of granular flow which incorporate the effect of particle shape. In the present work, two classes of two-dimensional non-spherical particles (clusters and chains of varying aspect ratios), all with the same equivalent enclosed area, are simulated with a hard sphere collision model in planar shear flow induced by Lees-Edwards periodic boundaries. The granular stress for these various particle shapes is then determined as a function of the solids volume fraction and the coefficients of restitution and friction for the particles. The results indicate that these variables along with particle shape cause significant variations in the flow features of the granular material and the resulting solid stresses. For example, we show that the kinetic stress decreases and the collisional stress increases above that of a single disk as the chain length increases for the elongated particles. In addition, the kinetic stress increases and approaches a single disk as the number of clustered particles increase. The collisional stress initially increases beyond that of a single disk as the number of clustered particles increase.