Influence of stress anisotropy on stress distributions in gap-graded soils

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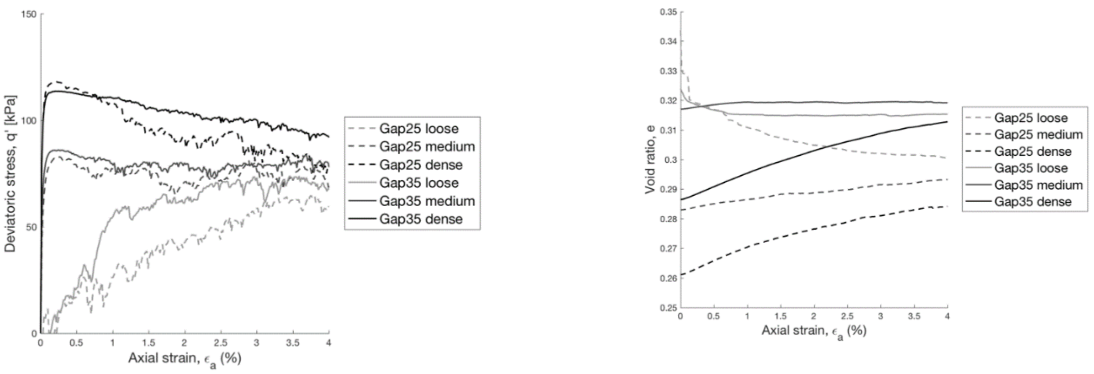
The behaviour of gap graded soils comprising non-plastic finer grains (sand or silt) mixed with a coarser sand or gravel fraction is relevant to improve understanding of internal instability under seepage loading (a form of internal erosion) as well as stress:deformation responses.. Shire et al. (2014) showed that discrete element method (DEM) simulations can inform understanding of the distribution of stress between the finer and coarser grains in ideal isotropic samples. Conventional understanding is that there is a threshold fines content differentiating fines and coarse-dominated behaviour (e.g. Zuo & Baudet 2015). However the DEM data generated by Shire et al. showed that at low fines contents (FC< FC^{*}) the average stress transmitted by the finer grains is less than the applied stress, for FC>FC^{+} the fines play a key role in stress transmission and for FC^{*}<FC< FC^{+}, the proportion of stress in the finer grains depends on the sample density.

Granular materials experience volume change during shear and the material fabric also evolves. This contribution shows that this evolution in the material structure further complicates the distribution of stress between the finer and coarser grained particles. The data analyzed were generated in a series of constant *p'* DEM triaxial test simulations. Two fines contents were considered: 25% and 35%. The simulation data generated for the denser samples indicate that a sample can transition from being fines dominated (with the fines transmitting a significant proportion of the applied stress) to coarse- dominated as the material dilates during shear deformation. The anisotropy of the coarse-coarse contact network exceeds the overall contact force anisotropy; this indicates that the deviator stress is transmitted through a strong force network passing through the coarse-coarse contacts supported by the fine-coarse contacts.



(a) (b)

Figure 1 Overall response (a) deviator stress versus axial strain (b) void ratio versus axial strain

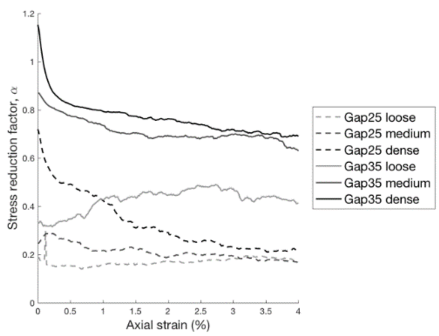


Figure 2: Proportion of stress in finer grains versus axial strain

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References

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Zuo, L. & Baudet, B.A., 2015. Determination of the transitional fines content of sand-non plastic fines mixtures. *Soils and Foundations*, 55(1), pp.213–219. Available at: http://dx.doi.org/10.1016/j.sandf.2014.12.017.