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One-dimensional compression behaviour of non-plastic soils

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Abstract

The one-dimensional (1-D) compression behaviour of sands at stress levels that are high enough to induce significant particle breakage can be represented by a limiting compression curve (LCC) in the compression plane, i.e. void ratio (e) versus vertical effective stress (σ'_v). Results from previous studies have shown that the LCC reflects the combined effects of particle size distribution (PSD), particle shape, and mineralogy. Additionally, previous studies have reported that the mean particle size (D_{50}) also has an effect on the LCC. The current study focused on the effect that the broadness of the PSD and particle shape have on the LCC. To achieve this, variations in mineralogy were reduced by considering only quartzitic sands, and the PSDs had varying broadness but a constant D_{50}. Eleven soil types were tested, with particle shapes that varied from commercially manufactured spherical beads to angular filter sand. The results confirm the findings from previous studies regarding the way in which PSD and particle shape affect the LCC. Correlations are presented which allow for initial assessments of the LCC of quartzitic sands based on particle shape, PSD, and limit void ratios. The results also show that, when the LCC is modelled in a doubly logarithmic compression plane, there is a well-defined direct and linear correlation between its slope (ρ_c) and the reference vertical effective stress at a unit void ratio (σ'_r). Further testing is recommended to determine whether this correlation is affected by variations in D_{50}.