A DEM INVESTIGATION OF THE EFFECT OF PARTICLE-SIZE-DISTRIBUTION ON ONE-DIMENSIONAL COMPRESSION

N.H.Minh*[1], Y.P.Cheng[2]

[1]School of Engineering, Nazarbayev University, Astana, Kazakhstan; *minh.nguyen@nu.edu.kz
[2]Department of Civil, Environmental and Geomatic Engineering, University College London, UK

INTRODUCTION.

The behaviour of granular materials is affected by the sample's particle size distribution (PSD). Different particle size distributions can be obtained in the laboratory as a result of particle breakage, which occurs in the form of catastrophic splitting during the compression or a shearing of uniformly graded samples.

METHODOLOGY.

An original PSD usually evolves toward a more well-graded final distribution. Figure 1a shows that the particle size distributions of real sands (G1, G2) have different levels of uniformity and that these initial distributions evolve toward different final PSDs after one-dimensional compressions (Fig. 1b).

RESULTS AND DISCUSSION.

For granular soils subjected to many thousands of per cents of shear strain, a critical grading was also found at which no possible further particle breakage occurred. The critical grading can be plotted as a straight line in the double-log scale, thus indicating a power-law distribution with a fractal dimension $D = 2.57$ [1]. Altuhafi and Coop [2] conducted an oedometer test on granular soils artificially prepared with critical grading (CG in Fig. 1) and did not observe significant particle breakage for these soils; rather, the particle surface roughness was, instead, reduced. In this work, DEM simulations using the PFC3D version 4.0 were conducted. Assemblies of spherical particles with different particle size distributions but no particle breakage were subjected to one-dimensional (1D) compressions.

CONCLUSIONS.

The effect of particle size distribution on packing characteristics and compressive behaviour was investigated through micromechanical analyses.

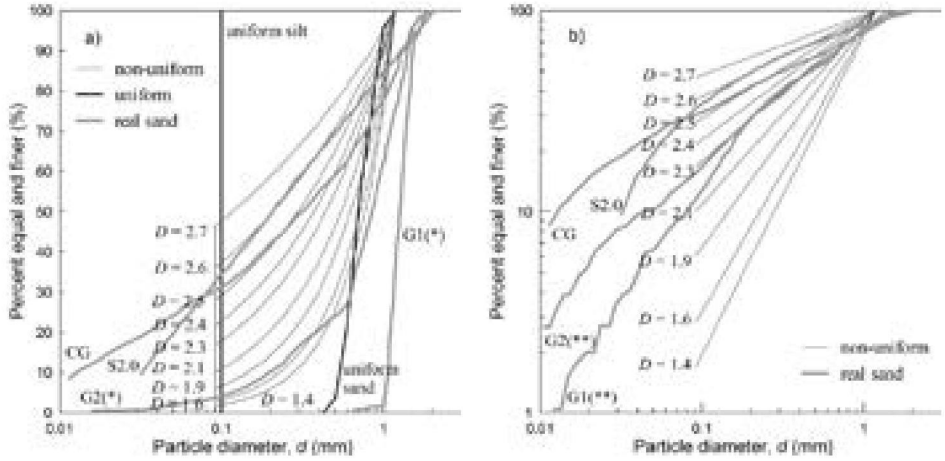

Figure 1. *Particle size distributions of DEM samples plotted a) in semi-log scale and b) in double-log scale; CG and S2.0 are the particle size distributions that did not show any significant particle breakage in compression test.*

REFERENCES.

1. Coop M.R., Sorensen K.K., Freitas T.B., Georgoutsos G. (2004). Particle breakage during shearing of a carbonate sand. Géotechnique, 54(3): 157-163.
2. Altuhafi F.N., Coop M.R. (2011). Changes to particle characteristics associated with the compression of sands. Géotechnique, 61(6): 459 –471.