COMMUNICATION SKILLS
Master of Science in Computational Mechanics
Master Métodos Numéricos en Ingeniería

A CRITICAL REVIEW OF ARROYO, M., 2018, 'SOIL CRUSHING VIA DEM', CIMNE SEMINAR

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1 INTRODUCTION

Soil is a complex material which real behaviour is difficult to characterize. The complexity is because the soil behaviour depends on many factors, such as anisotropy, stress level, non-linear stress-strain response, and others. Generally soil particles are consider unbreakable. However, sand can experience important particle breakage in compression or shearing [1]. Particle crushing involves variation in soil grading. Arroyo (2018) [2] explores soil crushing phenomenon with discrete-element method (DEM). His presentation aimed to provide information about a DEM model designed to simulate particle crushing and show its performance with a virtual calibration chamber. Arroyo (2018) divides the research in three sections. The first part gives a background about the previous work related with DEM in soil characterization and the relevance of crushing in geotechnical problems. The second part is the model description and gives some aspects as breakage criteria and sparcing procedure. The last part report some applications and results of the model.

Cone penetration test (CPT) is one of the most extensive used tool to characterize soil in field. Physical testing as calibration chambers is a source to obtain correlations and infer soil properties. However, calibration chamber testing is expensive and difficult to carry on. This is one of the reason to employ DEM to evaluate soil response. O'Sullivan (2011) states two principal motivations to use DEM as a tool in geomechanics. First, it is useful with problems that involves large displacements to get a better understanding of failure mechanisms. The second motivation coincides with Arroyo (2018) that DEM is a useful tool to supplement laboratory experiments and permits to analyse the material response at a particle scale. Previous works indicate good fitting between the results in a virtual calibration chamber and physical calibration chamber.

Arroyo (2018) also explains the relevance of particle crushing in geotechnical applications. Rock fill dams, railway ballast and pile construction may involves grain size distribution changes. This changes are proof that crushing happens. Follow the evolution of grain distribution is difficult. This confirm DEM as a useful tool to evaluate crushing.

2 DEM CRUSHING MODEL

The importance of the model is to establish breakage criteria and how the particles break. There are two approaches to model crushing via DEM that are the bonded agglomerates and the multigenerational. This research used the multigerational approach because captures better the evolution of the grain size distribution and has less computational cost. The Russell-Wood failure criterion was employed. When the particles reach the failure criteria it is important to define the splitting configuration. Apollonian split criteria was selected because limits the grain size distribution with a fractal dimension approximately of 2.5. It is important to point that crushing does not conserve mass which is acceptable because the formed finer particles or 'dust' have lesser influence than larger particles. However, the 'dust' is take in account for evaluate porosity evolution.

3 APPLICATIONS

Arroyo (2018) discuss two principal applications. Soil behaviour and response is explained through well known critical state soil mechanics. However, crushing effect may affect considerably the contracting or dilating behaviour. Finally the DEM model was compared with a very crushable sand. The numerical model fitted well the physical testing results.

4 CONCLUSIONS

The DEM crushing model shows good fitting with physical experiments.

Computational cost is the principal constraint of DEM analyses. It limits the usage of realistic particle geometry and a realistic number of particles. Arroyo uses spheric particle and the failure criteria of the particles should be reviewed with different geometrical shapes.

REFERENCES

[1] O'Sullivan, C. *Particulate Discrete Element Modelling*. Spon Press (2011).

[2] Arroyo, M. (2018, Nov 16) CIMNE Seminar "Soil crushing via DEM", by Marcos Arroyo. *CIMNE Seminar* (2018)