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International Journal of Solids and Structures 41 (2004) 5761–5762

INTERNATIONAL JOURNAL OF SOLIDS and STRUCTURES

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Foreword

Granular mechanics special issue

Granular materials can be met everywhere in our daily life—sand, cereals, rock slides, agricultural products, pharmaceutical powders: all of them are collections of discrete macroscopic particles. Engineers often have to face problems about their mechanical behavior: when designing an underground structure or the foundation of a house in a loose soil, when building a silo to store a granular product, when analyzing the flow of ice blocks along a river etc., reliable methods are needed for the description of how a granular material will behave under different mechanical effects.

These materials often exhibit rich and complex phenomena that cannot suitably be described by classical continuum models. Though granular materials have been commonly used, handled and processed for millennia, their mechanical behavior is still far from being perfectly understood, and the recent methods for their theoretical or numerical modeling definitely need further developments. No wonder that intensive experimental, numerical and theoretical researches are going on all over the world in this field.

Granular mechanics is the science of understanding, describing and predicting the mechanical behavior of granular materials. *Granular dynamics* deals with phenomena related to quick particle motions (mixing, segregation, flows etc.), while the *quasi-static* analysis of granular materials focuses on that range of behavior where the motions are slow and the particles can be assumed to be in equilibrium. This special issue will deal with the latter subject.

In August 2003 an international meeting was held at TU Budapest on the Quasi-static Deformations of Particulate Materials (QuaDPM'03). Being based on presentations given at QuaDPM'03, the aim of this special issue is to give an overview on current trends and interests in the field of quasi-static granular mechanics. The issue contains 14 full-length referred papers:

- The first five papers focus on *fundamental questions of granular mechanics*. Rothenburg and Kruyt present a theory of critical state and of the evolution of coordination number, introducing simulation results related to the concept of critical anisotropy too. Satake suggests discrete-mechanical definitions for the state variables in random assemblies of circles and spheres. Kuhn and Bagi introduce different theoretical definitions for the measure of contact rolling, and discuss the role of particle rotations and contact rolling in numerical simulations on sheared assemblies. Luding derives a fabric and a stiffness tensor from contact-level quantities, then applies the results in computer simulations. Emeriault and Claquin propose a homogenization approach for assemblies of elliptical particles.
- The next two papers deal with the *force transmission* in granular assemblies. Goddard applies the concept of entropy maximization in the analysis of contact force statistics. Antony and Kuhn propose a promising fabric measure which is, according to their simulation results, correlated to the deviator stress.
- Four papers have a close relation to *continuum-mechanics*. Ng compares discrete element simulation results on elliptical particles to predictions given by the failure criteria of the Lade and Ogawa models. Gardiner and Tordesillas develop a micromechanically based micropolar theory for two-dimensional assemblies, and apply this theory for deriving predictions about shear band formation. Bauer et al.

0020-7683/$ - see front matter
doi:10.1016/j.ijsolstr.2004.05.056

describe the shear behavior with the help of an extended hypoplastic constitutive model. Taking into consideration the Second Law, Ván derives a constitutive theory with a fluid-like state space (leading to the Coulomb–Mohr failure criteria in the static limit).

- The last three papers are related to *practice-oriented* problems. Foo et al. compare the behavior of alumina aggregates in compaction processes to DEM and FEM simulation results. Nardin and Schrefler present ideas for the discrete element simulation of rock behavior, with a special emphasis on the contact model. Finally, Eiliazadeh et al. analyze the powder compaction process in pharmaceutical industry.

I hope that this special issue will not only provide a useful reference on current trends, but also serve as a catalyst to further advances in this challenging filed.

Finally, I would like to say thanks to the *International Journal of Solids and Structures* for providing the opportunity to publish this issue. The contribution of every author and the helpful recommendations of the referees are also greatly acknowledged.

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Available online 17 July 2004