11th. World Congress on Computational Mechanics (WCCM XI)
5th. European Conference on Computational Mechanics (ECCM V)
6th. European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

DISCRETE MODELING OF STRAIN ACCUMULATION IN GRANULAR SOILS UNDER CYCLIC LOADING

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Key words: *Granular soils, cyclic loading, strain accumulation, discrete element method*

Granular soils accumulate strain when subjected to repeated dynamic loading such as traffic induced vibrations. This kind of loading is usually of low amplitude and relatively high frequency and involves a large number of cycles. Granular soils under the foundation of buildings may settle differentially, causing structural damage.

This paper presents a study of strain accumulation in granular soils using the Discrete Element Method (DEM) that models granular media as assemblies of distinct pseudo-rigid frictional particles. These assemblies are confined by a rigid parallelepiped and are subjected to cyclic triaxial excitations controlled in terms of static stress state, stress amplitude and frequency. The DEM is found to be suitable in modeling cyclic loading tests on granular samples, particularly those with high frequency. Moreover, it enables a micro-mechanical investigation of the strain accumulation phenomenon. This would not be easy in laboratory experiments.

A series of cyclic loading tests are performed on a loose and a dense granular assembly composed of spherical particles with a uniform grain size distribution. The influence of the sample density, the static stress state, the amplitude and frequency of the cyclic excitation on strain accumulation is analyzed. The study shows that the strain accumulates much more strongly in the loose sample than in the dense one. The strain accumulation increases as the deviatoric level of the static stress state and the amplitude of the cyclic excitation increase. However, the frequency of the cyclic excitation has little effect on the strain accumulation. At the microscopic scale, this phenomenon is accompanied by a dissipative process caused by frictional sliding between particles. Moreover, the granular internal structure evolves slightly as the strain accumulates. The above findings will be helpful in developing a constitutive law to predict strain accumulation in granular soils subjected to vibrations.