ABSTRACT

Volume change in granular soils can be associated to shear strain, in contrast with elasticity theory, which says that volumetric and deviatoric part would be disconnect, it would mean that the only deformation volumetric occurs when there is compression, but this afirmation is not true for cohesionless soils, which under shear stresses experiments volumetric strain in addition to shear strain.

The main loading parameter controlling the cyclical behavior of a ground is the shear strain, because soil behaviour under cycles of isotropic loading is simpler, and strains are of recoverable nature after the first cycle. Previous experimental studies have demonstrated that if a sand is subjected to a vertical cyclic loading, when the dynamic stresses are small, no noticeable densification occurs for an acceleration lower than about 1g and when the dynamic stresses are small compared to the initial overburden pressure, there is still no noticeable densification . The existence of an optimal acceleration was detected too, it provides a maximum of compaction and it corresponds with an acceleration values between 1.5 and 2 g, without producing a significant increase of density for acceleration values lower than 1g. However, it was noted that shear stresses associated with horizontal accelerations may produce significant densification and resultant subsidence. It was ended that the compaction is more efficient applying shear stress instead of applying vertical stress.

Granular soils under cyclic shear loading experiment a volumetric strain associated to a shear strain. But in this volumetric strain in addition to shear strain there are other factors which have influence like cycles number of load repetition, relative density of the material and confinement level. Is possible to differentiate between many cycles of low shear strain amplitude and few cycles of larger shear strain amplitude as in the case of earthquakes. But the amplitude vibrations of the subsoil don't have to be as big as the corresponding for a earthquake to cause a compaction in the dry and noncohesive ground soil with the result of damages to structures. Vibrations caused by machine operation, vehicles traffic, subway, vibratory hammers, pile driving, etc., often has caused settlement which has caused building distortion and cracks. In many of these cases, the movements are cyclic in nature. Therefore, the cyclical requesting still being of small amplitude can induce settlement after certain cycles number.

In this thesis, has tried to study settlement in dry sands resulting from small amplitude of cyclic strains. An experimental study in an resonant column equipment has been developed. The resonant column testing consist on exciting torsionally a soil column, while the column soil is fixed at the bottom and free at the top, so that these oscillations are translated in a cyclic shear loading. The main utility of this equipment is determine the dynamic properties of a ground (shear modulus and damping factor), but the equipment has a vertical displacement transducer (LVDT), and allows us to obtain a continuous registry of the settlement seat experienced by the sample. One of the main difficulties of equipment is the preparation of a sand sample in the test chamber, but a manufacture methodology has been designed that allow us to obtain good condition for testing sand's sample. Since this experimental study has been able to analyze the influence of the number of cycles, the shear amplitude straint, the confinement and the relative density, in the vertical strain of a sand under cyclic shear.

Also in this thesis, has been carried out a complete survey about de different models of the dynamic behaviour of the ground, studying the endochronic model (Cuéllar et al,1977), which seems satisfactorily to simulate the settlement of a sand under cyclic shear, and from the testing results of the experimental study, it has done a calibration of the materials parameters of the endochronic model .