A TRAVELLING SAND PLUVIATOR TO RECONSTRUCT LARGE SOIL SPECIMENS

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ABSTRACT

This work describes a new travelling sand pluviator developed at LNEC to prepare multi-anchored sand retaining wall models to be tested on a shaking table. Calibration tests of the new travelling pluviator were performed, their results being essential to parameterize the device during the deposition process. The results show that the adopted drop heights are bellow the terminal falling height. A mathematical model is being developed and several tests will be carried out on a stationary pluviator to analyse the influence of drop height and flow rate on the relative density of the pluviated sand. Some results will be presented and discussed.

INTRODUCTION

An important issue in the preparation of soil specimens is process repeatability. In the study of multi-anchored retaining walls with dry sand deposit (specimen with 2,00 m long by 0,75 m wide and 1,75 m high) subjected to earthquake loads (Carvalho, 2012), several tests are to be performed. The repeatability of these experimental tests is, among others, affected by the preparation of the model. The aim of the study was the development of a sand pluviator able to prepare homogenous soil deposits in horizontal directions with relative densities between 70% and 85% and a minor density variation in the vertical direction.

Among several methods to reconstruct soil specimens (Bilé Serra, 1998) and taking into account the geometry of the soil sample, a travelling pluviation technique was chosen based on the advantages it shows when compared to others (Passalacqua, 1991; Fretti, 1995). The most important parameters that define the relative density are: drop height, flow rate and travelling velocity. The design of the pluviator was based on the optimization of those key parameters. The developed sand pluviator consists of a steel frame and a

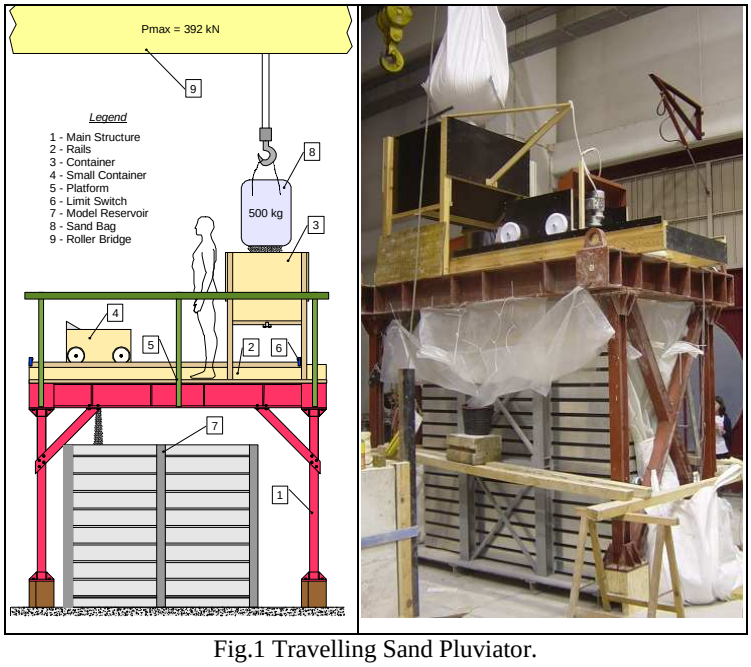

Fig.1 Travelling Sand Pluviator.

small container traveling on two rails at the top of the frame, moved by a worm gear motor driven by an electronic speed controller (Fig. 1).

RESULTS AND CONCLUSIONS

In order to achieve a relative density between 70% and 85%, several calibration tests were undertaken. The pluviator was positioned above the container and the first trials were made in an attempt to identify the critical drop height for SP49 sand. Therefore three Proctor moulds were properly identified, weighed and positioned within the empty container, at different levels, and then filled up by deposition of dry sand. As observed in Fig. 2, the pluviator was tested with three distinct apertures (4, 5 and 6 mm), which correspond to distinct flow rates, obtained at a constant travel speed of 10 cm/s.

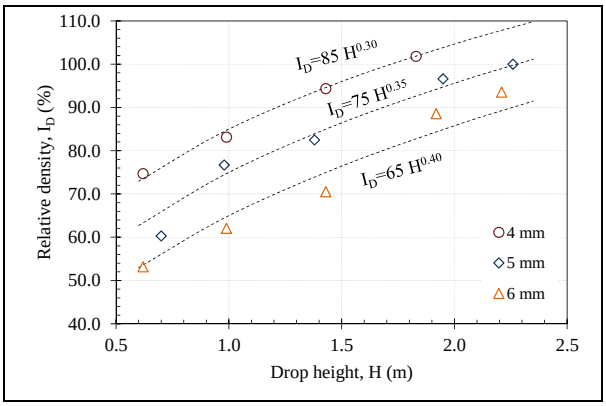

Fig. 2- Relative density versus drop height for different apertures (flow rates) obtained during the pluviator calibration tests at 10 cm/s (Carvalho, 2012).

This study shows that the relative density increases as the drop height increases, meaning that the terminal falling height was not reached. On the other hand the increase of flow rate leads to a reduction in relative densities. No significant differences were found in the relative density for the different velocities (of the small container) tested. This chart can be used to tune the pluviator parameters in order to achieve the desired specimen relative density. Since the specimen has always a considerable height, the aperture should be wider at the beginning and then decreased (by steps) as the specimen is being filled, in order to achieve a minor density variation in the vertical direction.

Further studies are being performed in order to analyze the influence of other parameters and some observed phenomena during the filling process. A mathematical model will be formulated and parameterized through several tests carried out on a smaller stationary pluviator. The influence of some parameters in the deposition process will be analysed through numerical simulations. On the other hand, the tests are intended to analyse the influence of the flow rate on the terminal falling height and on the relative density of the specimen. Several tests will be made at different drop heights and different flow rates. The aim of this study is to contribute to clarify the deposition process on the travelling pluviator.

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