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# A CALIBRATION OF AN AIR PLUVIATION SYSTEM USED TO RECONSTITUTE LARGE SPECIMENS OF SAND

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**ABSTRACT:** In physical modeling of geotechnical problems, the difficulty in preparing uniform deposits of granular soil or simulating the in-situ soil conditions increases as the size of the testing box increases. Special care should be provided to the soil preparation process in order to maintain trusted results in a repeated manner. In addition to striving to obtain reliable results, the method used, including the time spent and human effort expended, must be taken into consideration. In this study, a carefully designed and fabricated air pluviation apparatus is used to rain the sand uniformly and homogeneously over the area of the box. Many distinctive features were adopted in the design of the apparatus, such as emptying the box and restoring the sand automatically and getting rid of the dust outside the testing room, which both contribute positively to the health and productivity of the workers and to the quality of the job. In order to prepare a calibration database for a specific type of sand, a series of calibration tests was carried out to measure the density of sand with respect to the height of drop (HD) and the opening size of the perforated plate. It is found that the value of critical HD that achieves the maximum density depends on the porosity of the perforated plate, with a direct relationship between them. The porosity is also the critical factor that determines the density of sand at a certain value of HD. The obtained density can be increased by reducing the opening sieve size for a specific drop height.

*Keywords: Sand pluviation; Sand density, Laboratory tests, Height of drop; Uniform samples.*

## 1. INTRODUCTION

One of the major difficulties that geotechnical researchers face when conducting laboratory tests is obtaining the required density of sand in the testing box. The challenge increases when this density is to be maintained in a repeated manner for all parameters that are planned to be investigated. The accurate preparation of sand deposit leads to a precise prediction of the response of model tests in both 1-g and centrifuge modelling. A variety of procedures were suggested to control the soil density in laboratory tests. In order to gain a high level of confidence in results, the design of the density control apparatus should meet the following requirements:

- The ability to distribute the sand evenly and uniformly over the whole area of the box.
- A wide range of the desired densities or natural states of sand is guaranteed.
- It is preferable that the whole process or, at least, some important steps should be performed automatically and, as much as possible, free of human errors. Experiments that involve repeatedly filling and emptying a test box with sand are stressful for laboratory workers, which may increase the possibility of human errors.

Filling and emptying the testing box for repeated tests should be carried out within a short time and a minimum of human effort.

In addition, simplicity in the design of the apparatus is desired. Although several studies have been performed taking into account most of the above requirements, literature indicates that no standard method for sand preparation with a specific procedure has yet been adopted. However, air pluviation is one of the most widely used techniques to reconstitute granular soil [1-5]. This is due to its ability to provide the important components required for a successful sand preparation system. In this method, sand with a predetermined gradation is allowed to be poured from a constant or variable height into the container. Authors in [6] showed that the pluviation method is preferable when compared to the tamping technique when triaxial samples are required. Literature shows that the air pluviation can be classified into three distinguished procedures:

- A nozzle or a funnel with a certain diameter is used to pour the sand over the area of interest [7-9].
- A curtain moves back and forth continuously until the testing box is filled [10, 11].
- A sieve or a set of sieves rain the sand evenly over the cross-sectional area of the box [12, 13].

The sand fall height can be fixed, changed manually or changed automatically while the sand deposit is built up.

A general view of the previous research shows that extreme densities (very loose and very dense) can be