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Evaluation of the Volume Measurement Optical Method Suitability for Determining the Relative Compaction of Soils

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Abstract

The goal of this paper is evaluation of the volume measurement optical method suitability for determining relative compaction of soils. The Structure for Motion technique was utilized in order to achieve the goal by making the three-dimensional models (with Bentley ContextCapture software). Created models were used in volume measurement of the pit-holes. The results were compared with the basic methods: the sand cone test and the water method. The laboratory tests were carried out in two stages. In the first stage, the optical method was tested in similar to operating conditions. Ten holes were made in the soil and the volumes were measured with three different methods. The results were compared and submitted for statistical analysis. Statistical analysis showed the potential of optical method. The second laboratory test focused on repeatability and accuracy of measurement. The volume of the vessel imitating a pit-hole was obtained. The results of the second stage showed that the optical method has better accuracy and lower statistical dispersion compared with sand method. On this basis it can be concluded that optical method of volume measurement has great potential in soil compaction testing.

Keywords: Relative Compaction; Volume Measurement; Structure for Motion; Photogrammetry; Context Capture.

1. Introduction

Relative compaction I_s is one of the most important parameters influencing the performance of embankments, soils foundations and subbase layers. One of the part of the measurement procedure is determining the volume of the pit-hole formed after taking a sample. This measurement is carried out by filling the pit-hole with a certain volume of another medium (e.g. water or sand). The test procedure is described in the standard [1]. The test result is then used to calculate the relative compaction by applying the following formula:

$$I_s = \frac{\rho_d}{\rho_{ds}} \tag{1}$$

Where:

ρ_d: Dry bulk density of the tested soil [g/cm^3],

ρ_{ds}: Maximum dry bulk density of the soil obtained in Proctor compaction [2] [g/cm^3],

$$\rho_d = \frac{M}{V(\frac{100+w}{100})} \tag{2}$$

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