Modeling Dynamic Load Plate Test Using A New Innovative Device

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Abstract

In the present paper the mechanical modeling of the dynamic load plate test with a new innovative device, namely Dynamic Load Cylinder (DLC), is presented. The DLC can be employed in construction sites in order to clarify the degree of compaction of the soil layers and to evaluate their bearing capacity estimating the dynamic modulus of soil. The motion of the device is characterized by a mass-spring system. The mechanical models developed are intended to provide simple and efficient formulations, which allow a large number of numerical simulations at low expenses. The results are statistically analyzed indicating that the R_1 (the first rebound of falling weight after the dynamic loading of soil in new device) correlates relatively well with the Clegg value (ASTM D 5874 – 95) for both the laboratory and field tests. It is also shown that the obtained dynamic modulus of elasticity from DLC is in good agreement with published results of the $E_{SEIS-MOD}$ achieved from CBR test.

Keywords: Compaction control, Dynamic Load Cylinder (DLC), Dynamic modulus of elasticity

1. INTRODUCTION

The Dynamic Load Cylinder Device (DLC) is an innovative field test method, which provides the dynamic modulus of soils and filled materials within earth structures. This device is suitable to provide the degree of compaction and to evaluate the dynamic modulus of the tested soil layer. The DLC is light and it can be carried and operated by a single person. Consequently, the quality control of the compacted soil layers can be significantly improved. Results of large-scale in-situ tests at precisely defined soil conditions have been analyzed. Measured data of conventional compaction control methods (ASTM Standard D 1556-90: Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method & ASTM D 5874 – 95: Clegg impact soil tester) have been in agreement with the results from the DLC test. In this paper simple mechanical models are described, which represent the main effects of the DLC – soil interaction. The motion of the coupled DLC - soil system can be shown by linear springs, viscous dampers and point masses. These studies are to be supplemented by outcomes from extensive numerical simulations by *MSC Visual Nastran* Software.

2. BACKGROUND

Clegg Impact Hammer & CBR

The Clegg Hammer (also called the Clegg Impact Soil Tester) consists of a compaction hammer operating with a shape and a size conforming to the modified Proctor hammer within a vertical guide tube. When the 4.5 kg hammer drop on a soil surface from a fixed height (45 cm) and strikes the soil surface, a precision accelerometer mounted on the hammer feeds its output to a digital readout unit. The unit registers the deceleration in units of Impact Value (CIV). The CIV data correlated exponentially well with the CBR results. A general best-fit model ($CBR = .1691 \times CIV^{1.695}$) was developed that can reliably predict the CBR values from CIV data. An ASTM standard covers the determination of the Impact Value (CIV) of the soil. The first version of the Clegg Hammer was developed by Dr. Baden Clegg in Australia and was named 'The Clegg Impact Soil Tester. It was first introduced at the 8th Australian Road Research Conference in 1976. Since then, it has been widely used by consultants and contractors in several compaction control applications in the world.