One-Day Short Course On "High Strain Dynamic Pile Testing and Analysis On Deep Foundation"

by Ir. Liew Shaw Shong

GEOTECHNICAL ENGINEERING TECHNICAL DIVISION

IT was a great honour for the Geotechnical Engineering Technical Division of IEM, to have a team of internationally recognized dynamic pile testing experts – Mr. Garland Likins, Mr. Ryan Allin and Ir. Richard Yu – deliver a one-day course on "High Strain Dynamic Pile Testing and Analysis On Deep Foundation" at Tan Sri Prof. Chin Fung Kee Auditorium, Wisma IEM on 2nd September 2013. The short course, chaired by Ir. Mun Kwai Peng, was attended by 144 participants.

The course started with an introductory background on dynamic pile testing development and a comparison with other pile testing methods. All methods are closely linked, with definition of failure criterion and also the validation process in line with the design philosophy. The use of impact wave travelling through the pile shaft by application of wave propagation theory to yield useful physical engineering behaviours of the installed pile was briefly explained.

First module gives basics of wave mechanics on the following aspects:

a. Wave propagation
b. Wave equation and solution
c. Proportionality Law: Forces in a pile are a function of pile impedance and particle velocity
d. Wave speed (square root of ratio between Young modulus and density of pile)
e. Upward and downward travelling wave: Pile forces (stress and strain) are proportional to positive particle velocity in a downward travelling stress wave and also an upward travelling stress wave
f. Restraint effects of pile toe (fixed end and free end): Pile toe force can reach twice force at top
g. Effects to travelling wave with soil resistance
h. Case-Goble capacity
i. Case damping factor (Separation of dynamic and static resistances)
j. Impact stress (Momentum collision impact, Ram mass effect). A few salient points on impact stress can be summarised below:
    i. Impact stress is a function of impact velocity.
    ii. Tension stresses can be equal to compressive stresses in free and fixed end pile.
    iii. Compressive stresses at pile toe can be twice those at impact.
    iv. High ram mass causes higher top stress than at impact at wave return.
    v. Stresses at a point along pile are the sum of the stresses in upward and downward wave.

k. Energy (Hammer performance assessment from transformation of potential energy to kinetic energy to derived rated energy of impact, and finally transferred energy onto pile).

Second module provides the basic practice of dynamic pile testing with following issues highlighted:

a. Potential problems: Lack of knowledge, pressure on tester from piling contractor, poor understanding of end user to the test and interpretation.

b. Dynamic Measurement and Analysis Proficiency test (on data acquisition, data quality, data interpretation and data communication) are recommended to testers. Specifying agencies can set their own requirements on the rank and validity period of this proficiency test for the field tester and office signatory for the test report.

c. Location of sensors: At least 2 pile diameter/width below pile head for uniform impact stress.

Third module on Application of PDA and CAPWAP in pile design verification: Provision of various pile tests including dynamic pile tests in enhancing design confidence and design safety factor under the various design codes was discussed. Application of dynamic pile test results on potential pile capacity relaxation with time was presented.

Fourth module on PDA Workshop: (i) Compression and tensile stresses measured at pile top and assessing the calculated at pile body and toe, (ii) Real time beta value indicating pile integrity, (iii) hammer performance and appropriate hammer energy for productivity, and (iv) Method of end of drive and retriked pile capacity assessment (RSP, RMX and RSU).

Fifth module on models, procedures and parameter for CAPWAP. Measurements are done on impact load and the responded movements of pile, but the parameters on soil model system interacting with the tested pile are unknown. CAPWAP deploys iterative signal matching algorithm on damping resistance, resistance distribution and soil stiffness at both shaft and toe to reverse analyse the soil parameters with acceptably match quality. The CAPWAP output consists of total capacity, shaft and toe resistances, stiffness of soil at pile-soil interface, damping properties of soil, and static load-settlement curve emulating very quick static load test.

The short course ended at 5.00 p.m. with the presentation of mementoes and certificates of appreciation to the speakers. A group photo was also taken. ■

Group photo of the GETD committee and the lecturers (From left: Ir. Liew Shaw Shong, Mr. Garland Likins, Ir. Mun Kwai Peng, Mr. Ryan Allin, Ir. Richard Yu, Ir. Lee Peir Tien and Engr. Dr Gue Chang Shin)

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