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Quarterly Newsletter No.7 – January 2014 **Visit us at www.geodynamics.net**

LSIT AND HSDPT TO IDENTIFY PILE FOUNDATION FAILURE – CASE STUDY

Low Strain Integrity Testing (LSIT) and High Strain Dynamic Pile Testing (HSDPT) has now become a routine for all major projects across India since these technologies provide useful information and are also quick, reliable and relatively inexpensive. Before 1998, it was common practice in India to perform conventional static load tests only on selected piles and the amount of testing normally ranged from 0.5% to 2% as per IS:2911 (Part:IV). However, in the current scenario, and 50-100% piles are being subjected to LSIT and 2%-5% of the piles are being subjected to HSDPT. Wherever the methods have been used correctly, it has resulted in improved QA as well as assessment of pile integrity which earlier was not possible due to limited information produced during conventional load testing.

As is known, LSIT is used to ascertain quality of pile shafts on site. Generally, the pulse echo method that uses only velocity measurement is widely used and recommended, although testing is also conducted by using an instrumented hammer in some countries to evaluate the stiffness near pile top. Today integrity testing is a part of code specifications of various countries in America, Europe, and Asia. It is also standardized as per ASTM D5882. In India, it is a part of the IS: 14893. High Strain Dynamic test is quite often used to replace conventional static testing on construction and infrastructure projects. The test has been found to be reliable, quick and inexpensive compared to static tests. It is standardized as per ASTM D4945 and various codes internationally. Currently it is one of the most widely used Non Destructive test worldwide to ascertain pile static capacity. Since these tests provide information regarding pile foundation failures in term of load carrying capacity or the pile integrity, these technologies have become quite popular in short span of time. Over the years, for many projects these tests have been used routinely to ensure better QA/QC at project sites.

At a project site in Northern India 1500mm and 1600mm diameter piles were installed. The depth of the piles ranged from 40m to 48m. The proposed construction method was top down construction and after the piling was completed, piles were partially exposed in order to serve as building columns. As described in geotechnical report, the soil at the site consists of alternating layers of clayey silt and sandy silt. A plot indicating variation of SPT along the depth is presented as Figure 1.

The design loads on the piles were estimated to be more than 1200tons implying an ultimate test load more than 3000 tons. As it was a fast track project, it was planned to continue construction activity without any testing. However, as recommended by us and the consultants, nominal testing was planned. Since it was top down construction, it was possible to test from top as a part of the piles was to be used as columns after excavation. Initially LSIT was done on some piles. GD team reported defects in some piles. A typical graph is presented as Figure 2. Other than those piles for tested for PIT, it was also decided to conduct HSDPT on select piles to confirm pile capacity and integrity. HSDPT was performed on selected piles for load carrying capacity assessment. Four pairs of strain gages and accelerometers were attached to the pile head at 90^0. A 35 ton hammer, largest used in the country till date was used for the testing. A picture showing HSDPT in progress is presented as Figure 3.

Three piles of 1600mm diameter and two piles of 1500mm diameter were selected for the dynamic testing. All the tested piles were unable to achieve the required test load and settlement of piles were more than 3mm per blow indicating piles have reached ultimate capacities. Three of the piles did not achieve even design load. Of the five piles tested, three piles reported major defect and may have been one of the causes of pile failures. Results of the HSDPT and CAPWAP analysis are summarized in Table 1 and a typical graphical output of CAPWAP is presented as Figure 4. An O-cell load test also indicated similar results. Since piles were unable to carry required load, safe load carrying capacity was revised and conservatively considered to be around 450tons–500tons. After excavating the piles to a certain required depth defects were visible as indicated by LSIT and HSDPT. Eventually piled raft foundation was adopted at the project site. For this project, PIT and HSDPT was very useful to assess pile integrity and capacity in order to take appropriate remedial actions.

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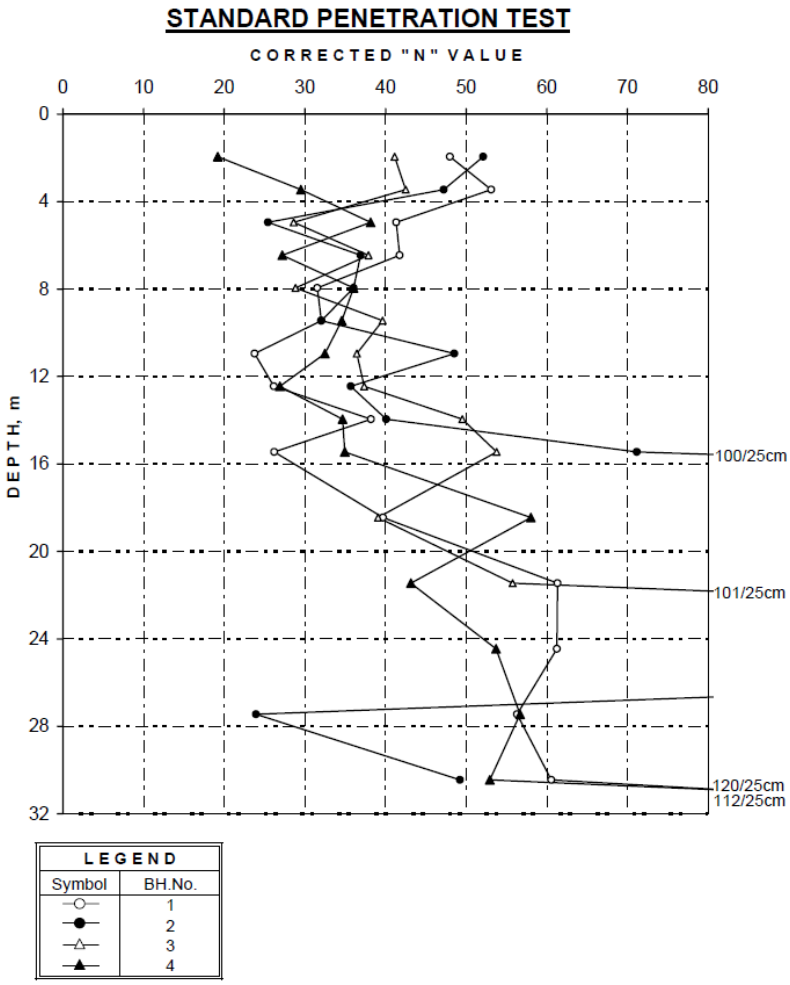

Figure 1 Variation of SPT along the depth

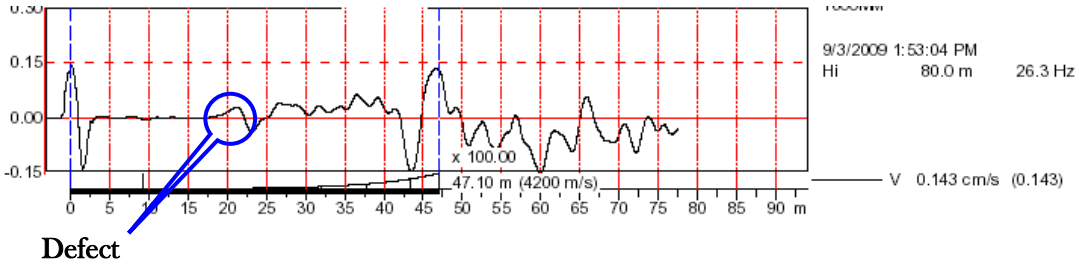

Figure 2 LSIT data indicating defect in the pile

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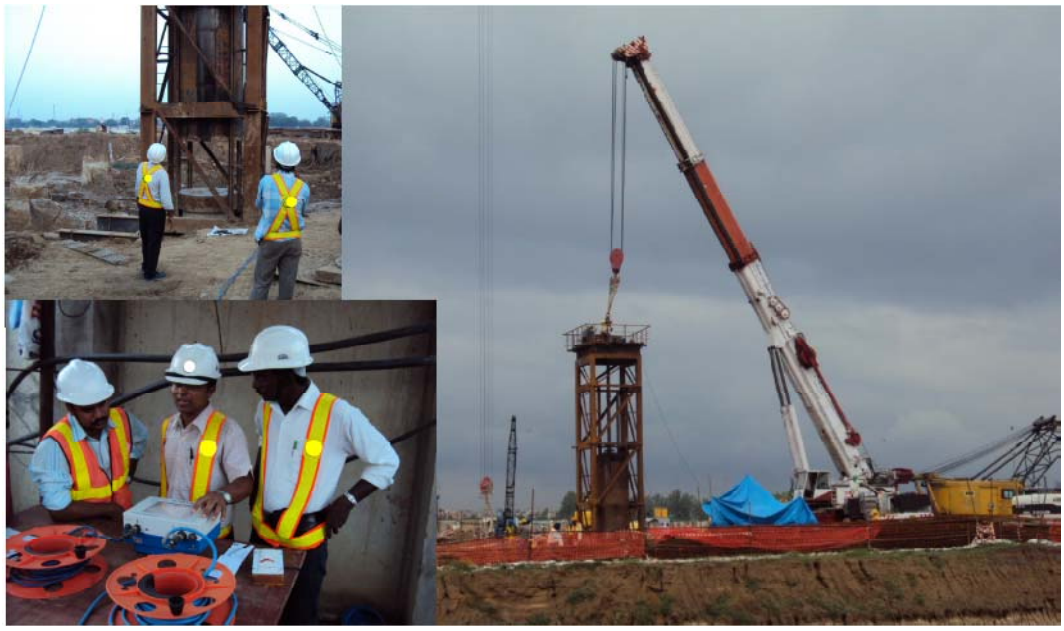

Figure 3 HSDPT in progress using 35ton hammer

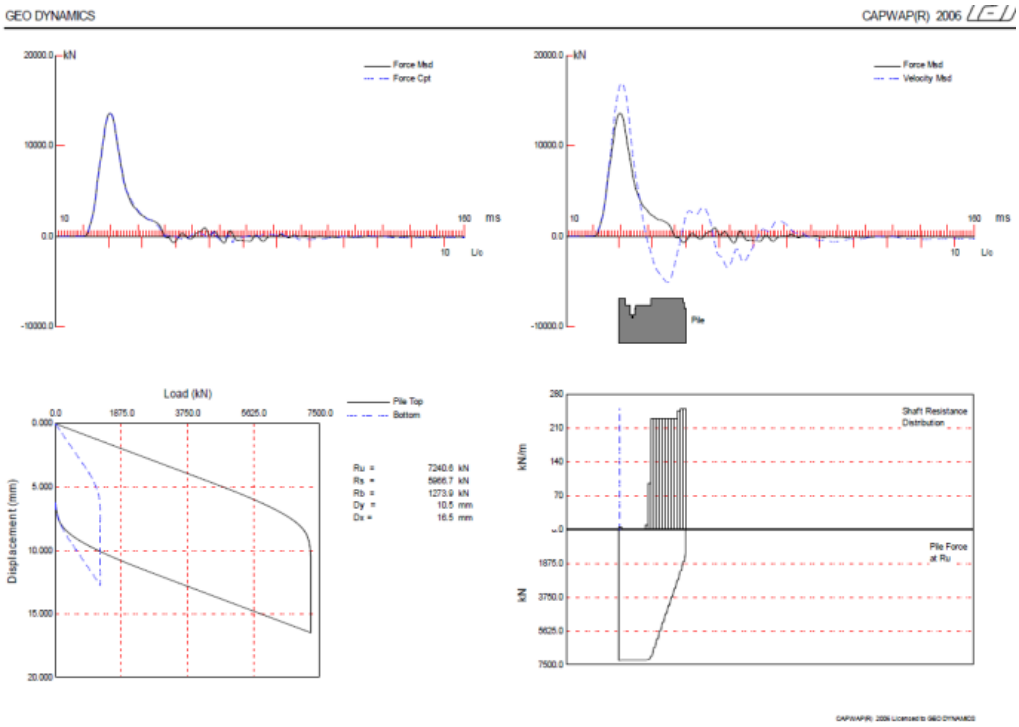

Figure 4 CAPWAP output

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Table 1 CAPWAP results for the HSDPT

Sr. No.	Pile Diameter (mm)	Pile Length (m)	Design Load (Tons)	Ultimate Pile Capacity (Tons)	Set (mm)	Defect	Defect Location
1	1500	48	1242	1810	3	Major	Upper 9m
2	1500	44.5	1242	837	9	Minor	17m-22m
3	1600	48	1423	852	4	Major	Upper 12m
4	1600	48	1423	2064	4	Minor	22m
5	1600	46	1423	722	6	Major	6m-12m

GEO DYNAMICS' PRESENCE AT DFI CONFERENCE MUMBAI

Mr. Ravikiran Vaidya was one of the speakers for the one day pre-conference workshop on "Large Diameter Rock Socketed Piles". Mr. Vaidya presented a lecture on inspection and QA/QC of bored piles. Furthermore, he also presented a paper in the conference on "Guidelines for successful High Strain Dynamic Load Tests & Low Strain Integrity Tests for Bored Piles" which was jointly written by Garland Likins, President, Pile Dynamics, Inc., USA and Mr. Vaidya.

Geo Dynamics put up a stall at the DFI Conference in Mumbai which was held in November 2013. Geo Dynamics displayed range of equipment including PDA, PIT, GPR, UPV, Rebound Hammer etc. We received overwhelming response from the attendees and would like to thank to the people who took time to visit our stall.

TRAINING SESSIONS

Training Programs were conducted for a Kuwait based company on Crosshole Sonic Logging Testing. Also, three day training was undertaken for Vietnamese Engineers on Wave Equation Analysis of Piles (WEAP). Geo Dynamics as always was at the forefront for providing trainings for various corporate companies and consultants across the India.

GEO DYNAMICS WISHES YOU A VERY HAPPY NEW YEAR!

May 2014 brings you happiness, success, peace, & togetherness of your family & friends!

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