DENSIFICATION OF HYDRAULIC SAND FILL BY VIBRO HAMMER AND QUALITY CONTROL BY CONE PENETRATION TEST :A CASE STUDY

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Master of Engineering

Department of Civil Engineering

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Thesis submitted in partial fulfillment of the requirements for the degree Master of Engineering in Foundation and Earth Retaining Systems

Department of Civil Engineering

University of Moratuwa

Sri Lanka

December 2013

DECLARATION

I do hereby declare that the work reported in this project report/thesis was exclusively carried out by me under the supervision of Prof H.A.S Thilakasiri, senior lecturer in Department of Civil Engineering, University of Moratuwa, Moratuwa. I describe the results of my own independent research expect where due references has been made in the text. No part of this project report/thesis has been submitted earlier or consequently for the same or any other degree.

Signature of the Candidate …… Date:……

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Signature of Supervisor …… Date:……

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Abstract

Densification of Hydraulic Sand Fill by Vibro Hammer and Quality Control by Cone Penetration Test

Ground improvement techniques are widely adopted in Sri Lanka and are increasingly being used for a vast variety of projects with particular emphasis on infrastructure projects such as roads, ports and harbors.

Ground improvement schemes work with the existing ground rather than bypassing it. They can be tailored to meet specific bearing capacity and/or settlement requirements and are generally much more cost-effective than other traditional methods such as piling. The process:

- Reduces foundation settlement
- Increases bearing capacity
- Mitigates liquefaction potential
- Provides slope stabilization
- Prevents earthquake-induced lateral spreading

Layer by layer compaction by means of roller or portable compactor is a widely used compaction method. However this method has limitations to undertake to a greater depths due to ground water problems that may be encountered. It is time consuming too.

Under such circumstances the deep vibro compaction method is superior to the roller compaction methods. Vibro techniques consist of large depth vibrators, typically about 300 to 500mm in diameters, which penetrate the ground to suitable depth. *Vibrocompaction* known also as *Vibroflotation* in some references and countries consist on the in-situ densification of loose granular soils, such as loose sand, gravel and hydraulic fills, using vibro compaction equipment but without the addition of granular material.

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Latest technology in deep vibro compaction method uses sophisticated depth vibrators and therefore using vibro compaction technique for ground improvement is limited for large scale construction projects considering of its high cost involved. Therefore the vibro compaction method needs to be customized using available resources in Sri Lanka to enable cost effective ground improvement technique tailor with small scale ground improvement requirements.

Field density by sand replacement method is a widely use quality control testing method to evaluate the degree of compaction of soil however has limitations to use for larger layer thicknesses and cannot cope with vibro compaction which compact large layers of soils.

Cone Penetration Test(CPT) method has several correlations to estimate the relative density of sand but no direct correlations available to estimate the degree of compaction compare to its maximum dry density. Therefore it is necessary to develop a correlation between relative density and degree of compaction and review the accuracy of available CPT relative density correlations prior to use CPT as a acceptable Q.C test method.

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This case study is focused on vibro compaction of reclamation sand in proposed road embankment adjacent to breakwater. Vibro compaction equipments were developed using available resources. A Pair of sheet piles were coupled together to develop the depth vibrator and sheet pile driving hammer was used as a driving force. Several vibro compaction trials were performed to evaluated the suitability of developed equipment and CPT test to estimate the degree of compaction achieved.

Finally the results of the research performed concluded that the vibro compaction equipment can be developed using available resources in Sri Lanka tailored to the scale of ground improvement and CPT can be used as a quality control test method to evaluate the degree of compaction.

To My Loving Mother

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