UPLIFT CAPACITY OF HELICAL PILES ON RESIDUAL SOIL

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DECLARATION

I declare that this is my own work and this dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text. I retain the right to use this content in whole or part in future works (such as articles or books).

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The above candidate has carried out research for the Master of Engineering in Geotechnical Engineering dissertation under my supervision. I confirm that the declaration made above by the student is true and correct.

Prof. L.I.N. De Silva

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ABSTRACT

Utilizing helical piles in foundation construction associated with compressive, tensile and lateral loads of power transmission towers are increasingly used by many countries all over the world. Lesser installation time, lesser manpower, lesser involvement of machinery and ability to use just after installation, can be identified as certain reasons for the popularity for helical piles compared to other foundation types. Further, helical piles which are more versatile and environmentally friendly, can be removed, reused and recycled as and when necessary.

The installation torque required to install helical piles correlates with their load-bearing capacity, resistance to uplift forces, and ability to withstand lateral loads. In this research, ultimate uplift values of helical piles were calculated and the correlation between installation torque and uplift capacity of helical piles in residual soil were investigated. Residual soil subsurface was selected for this research, since such terrains are more common in Sri Lanka.

Accordingly, three transmission tower locations (AP14, AP27 & AP47) consisting of residual soil, along Monaragala-Wellawaya power transmission line were selected and three helical piles were driven with measured depth and torque values. Also, three uplift load tests were conducted measuring the load and the deflection. For these tests, SS175 lead w/200 mm, 250 mm & 300 mm helices and RS3500.300 (88.9 mm diameter x 7.6 mm wall) extensions were used manufactured by CHANCE under Hubbell Power Systems, inc. USA were used.

The findings reveal that the correlation (K_t) between installation torque and uplift capacity of helical piles on residual soil is 29 m^{-1}. The FEM analysis was conducted with the help of PLAXIS 3D software, and the results were validated through the aforementioned tests. Accordingly, PLAXIS 3D FEM can be used to calculate the uplift capacity of helical piles on residual soil, and the mechanism of failure of helical piles on residual soil during uplift was identified as cylindrical shear. Furthermore, it is revealed that there is a certain association between SPT N and the installation Torque of helical piles on residual soil.

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LIST OF ABBREVIATIONS

AP	Angle Point
SS	Square Section
RS	Round Section
33kV	33,000.00 Volt
AC	Acceptance Criteria
ICC-ES	International Code Council – Evaluation Service
ACSE	American Society of Civil Engineers
PLAXIS	Plasticity Axi-Symetry
3D	Three Dimensional
FEM	Finite Element Model
ASTM	American Society for Testing and Materials
SPT	Standard Penetration Test

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