COMPARISON BETWEEN EMPIRICAL, NUMERICAL AND PRACTICAL COMPRESSION CAPACITY OF ROCK SOCKETED BORED AND CAST IN-SITU PILE: A CASE STUDY

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

Supervised by
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DECLARATION

I declare that this is my own work and this thesis 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 text.

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The above candidate has carried out research for the Master's thesis under my supervision.

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Prof. U. G. A. Puswewala Date

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Abstract

The development of tall structures as a rapidly developing trend in Colombo-Sri Lanka is evident during the recent past due to the high land prices. These tall structures require to be founded on strong substrata and piling is the most popular method that has been used as the foundation for these tall buildings. In Colombo area having found bed rock at shallow depth around 15m to 20m, always design engineers tend to specify the rock socketed end bearing piles without much considering the load carrying mechanism of the pile. It is evident that Sri Lankan design engineering community has a tendency to disregard the pile shaft skin friction resistance, mostly due to the existence of bentonite slurry within borehole during concreting. Therefore, load carrying capacity of such piles is determined completely based on the end bearing from the bed rock. In addition to that in most standards and codes of practice, the pile load carrying capacity correlations are given for specific soil types i.e. sand, clay, gravel. However in local context it is hard to find such conditions and almost all the soils are residual soils having both $c, \emptyset$ values.

In this research, different correlations for pile load capacity and its variations are evaluated. A detail comparison is conducted between the compression capacity of piles obtained from different empirical/semi-empirical methods, numerical methods such as FEM and in-situ testing i.e. MLT and HSDLT against the code of practices and local guide lines.

KEY WORDS: Empirical, Semi-empirical, Correlations, FEM, Pile load capacity, Skin friction, End bearing, Rock socket, MLT, HSDLT.

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ABBREVATIONS

c	-	Cohesion or Cohesive Strength (kPa)
E_m	-	Elastic modulus of rock mass
g	-	Gravitational acceleration (~9.81 mS^{-2})
f_s	-	Unit soil skin friction capacity of pile shaft
f_r	-	Unit rock socket skin friction capacity of pile shaft
j	-	Rock mass factor
q_b	-	End bearing capacity of pile
m_i	-	Hoek-Brown constant for intact rock
m_b	-	Hoek-Brown constant for broken rock mass
$N_{corr.}$	-	Corrected SPT N value.
$N_{uncorr.}$ Or $N_{field.}$	-	Uncorrected field SPT N value.
p_a	-	Atmospheric pressure (101 kPa)
σ'_{vm}	-	Vertical effective overburden pressure.
ν	-	Poisson's ratio
ψ	-	Dilatancy angle
ϕ	-	Friction angle
γ'	-	Effective unit weight
γ_w	-	Unit weight of water
CR	-	Core Recovery
DVL	-	Design Verification Load
SWL	-	Specified Working Load
MLT	-	Maintained Load Test
HSDLT	-	High Strain Dynamic Load Test
MSL	-	Mean Sea Level
RQD	-	Rock Quality Designation
RMR	-	Rock Mass Rating
UCS Or q_c Or σ_c	-	Uni-axial Compressive Strength of rock(=Unconfined Compressive Strength of intact rock)
HK	-	Hong Kong
BS	-	British Standards
CIDA	-	Construction Industry Development Authority
GSI	-	Geological Strength Index