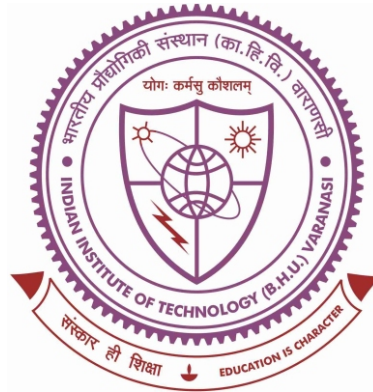


Numerical and Experimental Analysis of Load-Sharing Behaviour in Piled-Raft Foundations



Thesis submitted in partial fulfillment for the
Award of the Degree of
Doctor of Philosophy

by

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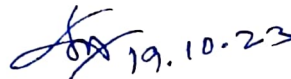
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Dedicated
to
the Soul of my Grandfather

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List of Symbols

Q_{PR}	load bearing capacity of piled raft
Q_P	load resisted by piles
Q_R	load resisted by raft
α_{pr}	piled raft coefficient / load-sharing ratio
α_p	load-sharing ratio
B_r	width of raft
L_p	length of piles
w_{avg}	average settlement
w_{raft}	raft settlement
Δw	elastic compression of the piles
F_D	correction factor
I_c	influence factor
h_i	thickness for i^{th} layer
q	average pressure exerted on the raft
n_s	number of soil layers
d_{eq}	equivalent pile diameter
E_{eq}	modulus of elasticity of the pier
A_g	gross area of pile group
E_s	modulus of elasticity of soil
E_r	modulus of elasticity of raft
E_p	modulus of elasticity of piles
A_p	total cross-sectional area of piles
R	aspect ratio
n_p	number of piles
s_p	pile spacing
L_p	length of piles

K_{rs}	relative raft-soil stiffness of rectangular raft
L	length of rectangular raft
B	breadth of rectangular raft
K_{rc}	relative raft-soil stiffness of circular raft
a	radius of raft
t	thickness of raft
P_{crit}	critical load
P_c	actual column load
$W(P)$	overall displacement due to point load P
$W_1(P)$	displacement at cap-soil interface
$W_2(P)$	displacement at pile-soil interface
ρ_i	displacement at any element i
I_{ij}	displacement at i due to shear on element j
I_{ib}	displacement at i due to shear at base b
I_{ik}	displacement at i due to shear on annulus k
α_r	interaction factor (Davis and Poulos, 1972)
d_c	cap diameter
d	pile diameter
ρ_1	settlement of single pile cap unit per unit load
w_r	settlement of raft
w_p	settlement of pile group
k_p	stiffness of pile
k_r	stiffness of raft
α_{pr}	pile-raft interaction factor
α_{rp}	raft-pile interaction factor
r_m	radius of influence
r_o	radius of pile
ζ	parameter signifying the effect of relative homogeneity and pile geometry
P_u	ultimate load bearing capacity of piles

X	raft share of load (Poulos, 2001a)
P_0	design load
P_{pu}	ultimate pile capacity
Q_1	reduced load
f	nodal force vector
Δ	nodal displacement vector
K^r	stiffness matrix of raft
K^p	stiffness matrix of piles
K^s	stiffness matrix of soil
K	stiffness matrix of piled-raft
w_{pk}	vertical displacement of pile K
w_{rpM}	vertical displacement of raft spring M in consideration of pile interaction
w_{rm}	vertical displacement of raft spring M without pile interaction
δ_1	displacement of pile spring due to unit load
P_{pJ}	load on pile spring J
P_{pK}	load on pile spring K
α_{KJ}	pile-soil-pile interaction factor of pile J on pile K
β_{KM}	pile-soil-pile interaction factor of pile K on raft spring M
Q_M	load on raft spring M
ρ_{1M}	displacement of raft spring due to unit load
$[D_p]$	finite-difference coefficient matrix
D	plate bending stiffness
$\{\Delta\rho_r\}$	incremental raft displacement vector
$\{\Delta q\}$	incremental loading vector
$\{\Delta p\}$	incremental contact pressure vector
$\{\Delta S_0\}$	incremental free-field movement vector
$E_s(z)$	elastic modulus of soil at depth z
$E_s(0)$	elastic modulus of soil at loaded surface
λ	rate of increase of modulus with depth

Q_{PR}	ultimate bearing capacity of piled raft
Q_R	ultimate bearing capacity of raft
Q_{PG}	ultimate bearing capacity of pile group
α'	pile-sharing factor proposed by Akinmusuru (1980)
N_{60}	adjusted blow count observed using Standard Penetration Test
E_{sand}	elastic modulus of sand
σ	normal stress
ϵ	normal strain
$\epsilon_{xx}, \epsilon_{yy}, \epsilon_{zz}$	strain along x -axis, y -axis and z -axis, respectively
ϕ	angle of internal friction or friction angle
c	soil cohesion
ψ	dilatancy angle
τ_f	shear stress on failure plane
σ_f	normal stress on failure plane
f	friction factor
α	empirical coefficient (α -method)
c_u	undrained shear strength
K	earth coefficient
σ'_z	effective vertical stress at depth z
δ	soil-pile friction angle
d_p	diameter of piles
t_r	thickness of raft
s	central settlement of raft
ΔW	additional settlement of a pile caused by an adjacent pile
r_r	diameter of raft
r_p	diameter of pile
w_{pr}	settlement of piled-raft foundation
η	CPRF efficiency factor