

VERIFICATION OF GENERALIZED SCALING RELATIONS FOR DYNAMIC CENTRIFUGE EXPERIMENTS

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Dynamic centrifuge tests for pile foundations are conducted to investigate the applicability of the generalized scaling relation proposed by Iai et al. (2005) (Figure 1 and Table 1). In the centrifuge tests, geometrical scale of a model pile foundation (prototype/centrifuge model) is set as 100 ($= \mu \eta$). Five combinations of scaling factors of virtual 1 g model (μ) and centrifuge model (η) are tested (Table 2). According to the combination of the scaling factors, values of flexural rigidity of a pile are determined in centrifuge model. Responses in prototype scale are compared each other for five pile foundation models tested under various centrifugal accelerations. Fairly good agreements are obtained for the amplitude of input displacement and input acceleration for all the cases, except the case of large input motion. Also for the case of lower centrifugal accelerations, the agreements are significant for the average amplitude of acceleration in soil. Not only the average amplitude of responses, but also bending moment profile of lower centrifugal accelerations shows fair agreements to justify the applicability of the generalized scaling relation.

Table 1 Generalized scaling factors for centrifuge model tests (Iai et al. 2005)

	Partitioned		Generalised
	Virtual 1G field μ =Prototype /virtual model	Centrifugal field η =Prototype /physical model	
Length	μ	η	$\mu\eta$
Density	1	1	1
Time	$\mu^{0.75}$	η	$\mu^{0.75} \eta$
Stress	μ	1	μ
Pore water pressure	μ	1	μ
Displacement	$\mu^{1.5}$	η	$\mu^{1.5} \eta$
Velocity	$\mu^{0.75}$	1	$\mu^{0.75}$
Acceleration	1	$1/\eta$	$1/\eta$
Strain	$\mu^{0.5}$	1	$\mu^{0.5}$
Bending moment	$\mu^{4.0}$	$\eta^{3.0}$	$\mu^{4.0} \eta^{3.0}$
Flexial rigidity	$\mu^{4.5}$	$\eta^{4.0}$	$\mu^{4.5} \eta^{4.0}$

Table 2. Scaling factors of virtual 1 g field and centrifugal field used in the experiments.

Case	Virtual 1G field	Centrifugal field
	μ	η
1	2.1	48.1
2	2.6	38.5
3	5.2	19.2
4	10.4	9.6
5	20.8	4.8

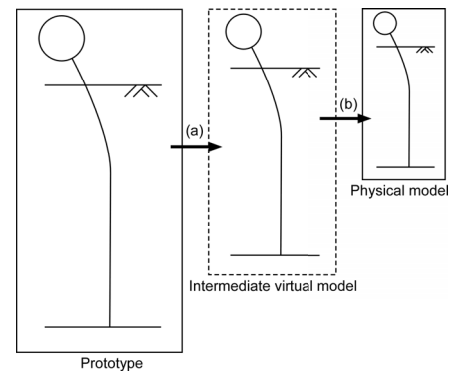


Figure 1. Concept of two stage scaling: (a) scaling relations for 1g field; (b) scaling relations for centrifugal field (modified after Iai et al., 2005).

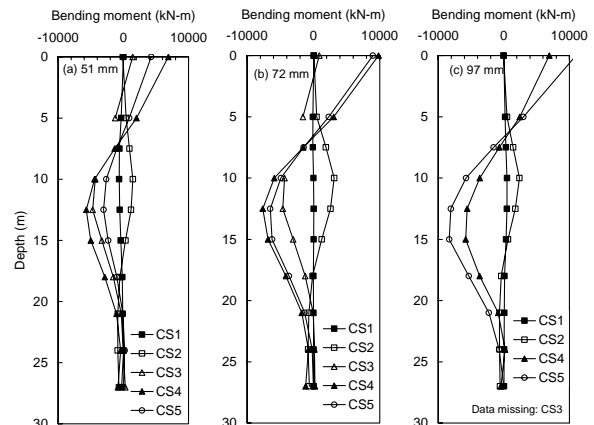


Figure 2. Vertical profile of bending moment when the pile head displacement is absolute maximum.