PILE GROUP ANALYSIS

Project: Sample Project
Number: PG-2026-012
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1. INPUT PARAMETERS

Parameter	Symbol	Value	Unit
Number of piles	n	9	
Pile diameter/width	D	0.300	m
Vertical load (compression +)	V_z	2,700.0	kN
Moment about X-axis	M_x	200.0	kN-m
Moment about Y-axis	M_y	150.0	kN-m

1. PILE LAYOUT

Pile Coordinates (relative to cap centroid)

Pile	X (m)	Y (m)	Vertical
P1-1	-1.500	-1.500	Yes
P1-2	+0.000	-1.500	Yes
P1-3	+1.500	-1.500	Yes
P2-1	-1.500	+0.000	Yes
P2-2	+0.000	+0.000	Yes
P2-3	+1.500	+0.000	Yes
P3-1	-1.500	+1.500	Yes
P3-2	+0.000	+1.500	Yes
P3-3	+1.500	+1.500	Yes

Sum of Squared Distances

$$\Sigma x^2 = sum of x_i^2 for all piles \Sigma y^2 = sum of y_i^2 for all piles$$

$$\Sigma x^2 = (-1.500)^2 + (0.000)^2 + (1.500)^2 + (-1.500)^2 + ... \Sigma y^2 = (-1.500)^2 + (-1.500)^2 + (-1.500)^2 + (0.000)^2 + .$$

$$\Sigma x^2, \Sigma y^2 = \mathbf{\Sigma x^2 = 13.500 m^2, \Sigma y^2 = 13.500 m^2}$$

USACE EM 1110-2-2906, Ch. 4

Used in simplified elastic load distribution.

1. GROUP EFFICIENCY

Group efficiency not computed (Converse-Labarre parameters not provided: n_rows, n_cols, pile_diameter, spacing).

1. LOAD DISTRIBUTION (RIGID CAP)

Simplified Elastic Load Distribution

$$P_i = V_z/n \pm M_y \cdot x_i/\Sigma x^2 \pm M_x \cdot y_i/\Sigma y^2$$

$$P_i = 2{,}700.0/9 \pm 150.0 \cdot x_i/13.500 \pm 200.0 \cdot y_i/13.500$$

Method = **SimplifiedElastic**

USACE EM 1110-2-2906, Eq. 4-1

Assumes vertical piles, rigid cap, and elastic behavior.

Cap Displacements

DOF	Value	Unit
dx (lateral X)	0.000	mm
dy (lateral Y)	0.000	mm
dz (vertical)	0.000	mm
rx (rotation about X)	0.00000	mrad
ry (rotation about Y)	0.00000	mrad
rz (torsion about Z)	0.00000	mrad

1. INDIVIDUAL PILE FORCES & UTILIZATION

Per-Pile Axial Forces

Pile	X (m)	Y (m)	Axial (kN)	Type	Utilization
P1-1	-1.500	-1.500	+261.1	Comp	N/A
P1-2	+0.000	-1.500	+277.8	Comp	N/A
P1-3	+1.500	-1.500	+294.4	Comp	N/A
P2-1	-1.500	+0.000	+283.3	Comp	N/A

P2-2	+0.000	+0.000	+300.0	Comp	N/A
P2-3	+1.500	+0.000	+316.7	Comp	N/A
P3-1	-1.500	+1.500	+305.6	Comp	N/A
P3-2	+0.000	+1.500	+322.2	Comp	N/A
P3-3	+1.500	+1.500	+338.9	Comp	N/A

Maximum Pile Forces

$$Maxcompressionandtension from load distribution$$

$P_{\max}$ = **Compression = 338.9kN, Tension = 0.0kN**

Maximum Utilization Ratio

$$Utilization = P_{demand} / P_{capacity}$$

$UR_{\max}$ = **0.000**

FHWA GEC-12, Section 9.5

Capacity not specified; utilization ratio not computed.

1. FIGURES

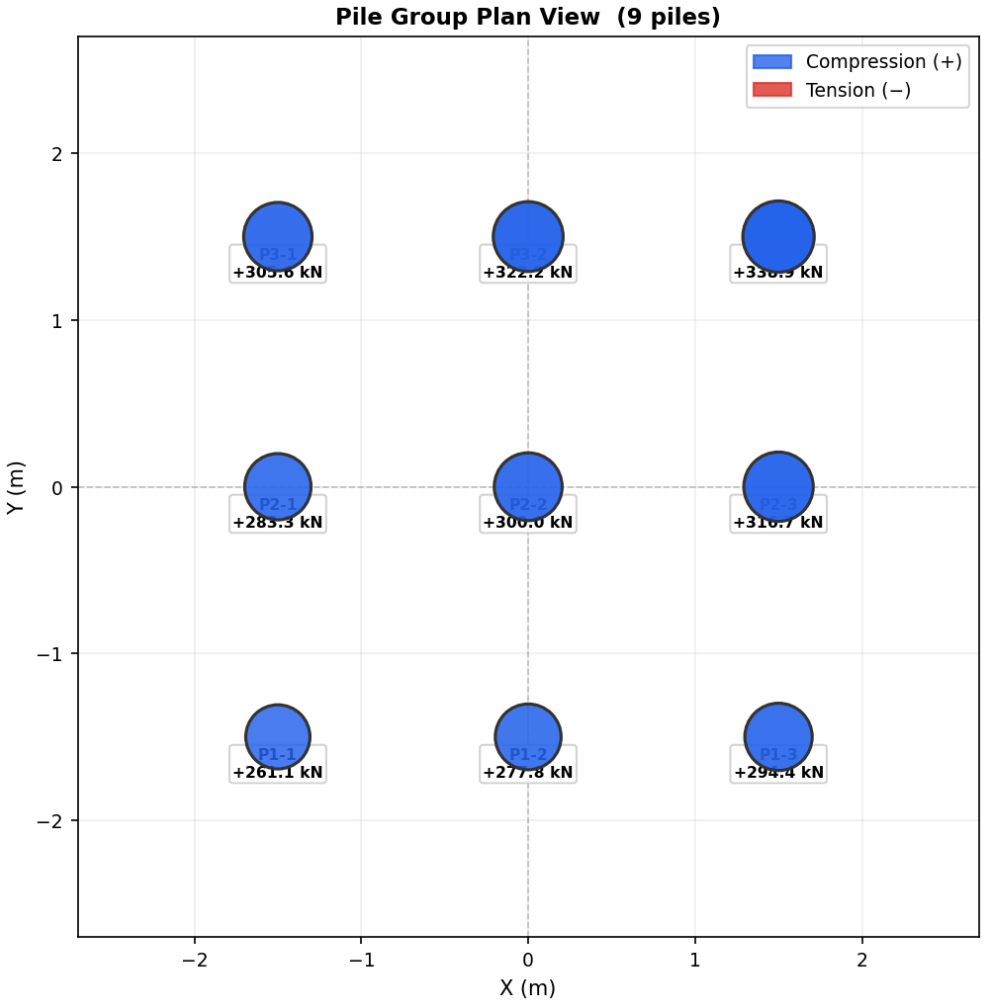

Figure 1: *

Figure 1: Plan view of pile group layout showing axial force distribution (9 piles). Circle size and color indicate load magnitude. Positive = compression, negative = tension.

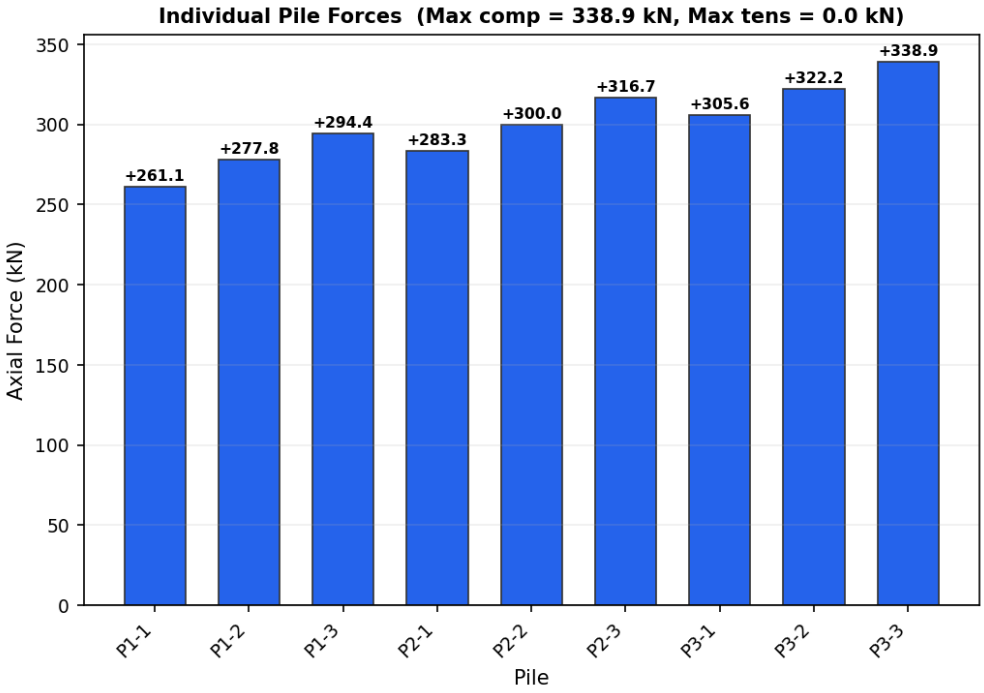

Figure 2: *

Figure 2: Axial force per pile. Max compression = 338.9 kN, max tension = 0.0 kN.

1. REFERENCES

1. FHWA GEC-12 (FHWA-NHI-16-009): Design and Construction of Driven Pile Foundations, Volumes I & II, Chapter 9 — Group Effects.
2. USACE EM 1110-2-2906: Design of Pile Foundations.
3. CPGA User's Guide (USACE ITL-89-4, Hartman et al., 1989). Computer Program for the Analysis of Pile Groups with Rigid Caps.
4. Converse, F.J. (1962). "Foundations Subjected to Dynamic Forces." In Foundation Engineering, G.A. Leonards (ed.), McGraw-Hill.
5. Reese, L.C. & Van Impe, W.F. (2001). Single Piles and Pile Groups Under Lateral Loading. Balkema.
6. Brown, D.A., Morrison, C. & Reese, L.C. (1988). "Lateral Load Behavior of Pile Group in Sand." JGED, ASCE, Vol. 114, No. 11.