AXIAL PILE CAPACITY ANALYSIS

Project: Sample Project **Number:** AP-2026-005
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1. INPUT PARAMETERS

Parameter	Symbol	Value	Unit
Pile section	*Pile*	HP 14x73	
Pile type	*Type*	H Pile	
Embedded pile length	L	18.00	m
Pile width/diameter	D	0.3607	m
Pile depth (section)	d	0.3521	m
Pile perimeter	P	1.6300	m
Tip area	A_{tip}	0.090300	m^2
Cross-section area	A_s	0.013800	m^2
Medium sand (0.0-5.0 m)	*Layer*1	γ = 18.0 kN/m^3, φ = 30°	
Stiff clay (5.0-10.0 m)	*Layer*2	γ = 17.0 kN/m^3, c_u = 60 kPa	
Dense sand (10.0-20.0 m)	*Layer*3	γ = 19.5 kN/m^3, φ = 35°	
Groundwater depth	*GWT*	2.0	m
Analysis method	*Method*	Auto (Nordlund/Tomlinson)	
Factor of safety	*FS*	2.5	

1. SOIL PROFILE

Soil Layer Definition

#	Top (m)	Bottom (m)	Description	Type	Key Parameters
1	0.0	5.0	Medium sand	Cohesionless	γ = 18.0 kN/m^3, φ = 30°
2	5.0	10.0	Stiff clay	Cohesive	γ = 17.0 kN/m^3, c_u = 60 kPa
3	10.0	20.0	Dense sand	Cohesionless	γ = 19.5 kN/m^3, φ = 35°

Groundwater Table

GWTbelowgroundsurface

$GWT = 2.0$ m

Effective stress computed using buoyant unit weight below GWT.

1. PILE SECTION PROPERTIES

Pile Section

$$HP14x73(HPile)$$

$Perimeter, TipArea = \mathbf{P = 1.6300m, A_{tip} = 0.090300m^2}$

Pile Embedment

$$L = embeddedpilelength$$

$L = 18.00$ m

1. SKIN FRICTION

Combined Method (Nordlund + Tomlinson)

$$Cohesionless: f_s = K_\delta \times C_F \times \sigma'_v \times \sin(\delta+\omega)/\cos(\omega)(Nordlund) Cohesive: f_s = \alpha \times c_u(Tomlinson)$$

$$Q_s = \Sigma(f_s \times P \times \Delta L)$$

$Method = \mathbf{Auto(Nordlund/Tomlinson)}$

Nordlund (1963); Tomlinson (1971); FHWA GEC-12 Ch. 7-8

Per-Layer Skin Friction Breakdown

Depth (m)	Description	Method	σ'_v (kPa)	Q_s (kN)	% of Total
0.0-5.0	Medium sand	Nordlund	40.1	125.1	8%
5.0-10.0	Stiff clay	Tomlinson	78.5	234.7	15%
10.0-18.0	Dense sand	Nordlund	135.3	1,170.3	76%

Total Skin Friction

$$Q_s = \Sigma Q_{s,i} (sumoverall layers)$$

$$Q_s = 125.1 + 234.7 + 1170.3$$

$Q_s = \mathbf{1,530.1}$ kN

1. END BEARING

End Bearing (Nordlund — Cohesionless)

$$Q_t = \sigma'_{v,tip} \times N_q \times A_{tip} (limited by N_q)$$

$$Q_t = 174.0 \times N_q \times 0.090300$$

$Q_t = \mathbf{1,173.9}$ kN

Meyerhof (1976); FHWA GEC-12 Ch. 7

σ'_v at pile tip = 174.0 kPa.

1. ULTIMATE & ALLOWABLE CAPACITY

Ultimate Axial Capacity

$$Q_{ult} = Q_s + Q_t$$

$$Q_{ult} = 1,530.1 + 1,173.9$$

$Q_{ult} = \mathbf{2,704.0}$ kN

FHWA GEC-12, Eq. 7-1

Capacity Breakdown

Component	Value (kN)	Contribution (%)
Skin friction (Q_s)	1,530.1	57%

End bearing (Q_t)	1,173.9	43%
Ultimate (Q_ult)	2,704.0	100%

Allowable Axial Capacity

$$Q_{all} = Q_{ult}/FS$$

$$Q_{all} = 2,704.0/2.5$$

$Q_{all} = \mathbf{1,081.6}$ kN

1. FIGURES

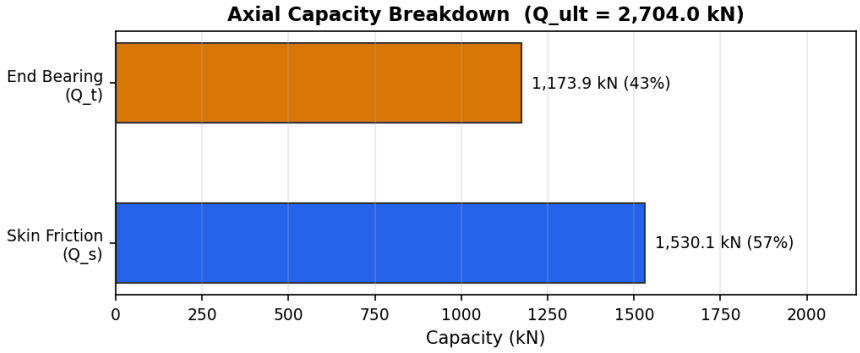

Figure 1: *

Figure 1: Skin friction vs end bearing contribution to ultimate axial capacity (Q_ult = 2,704.0 kN).

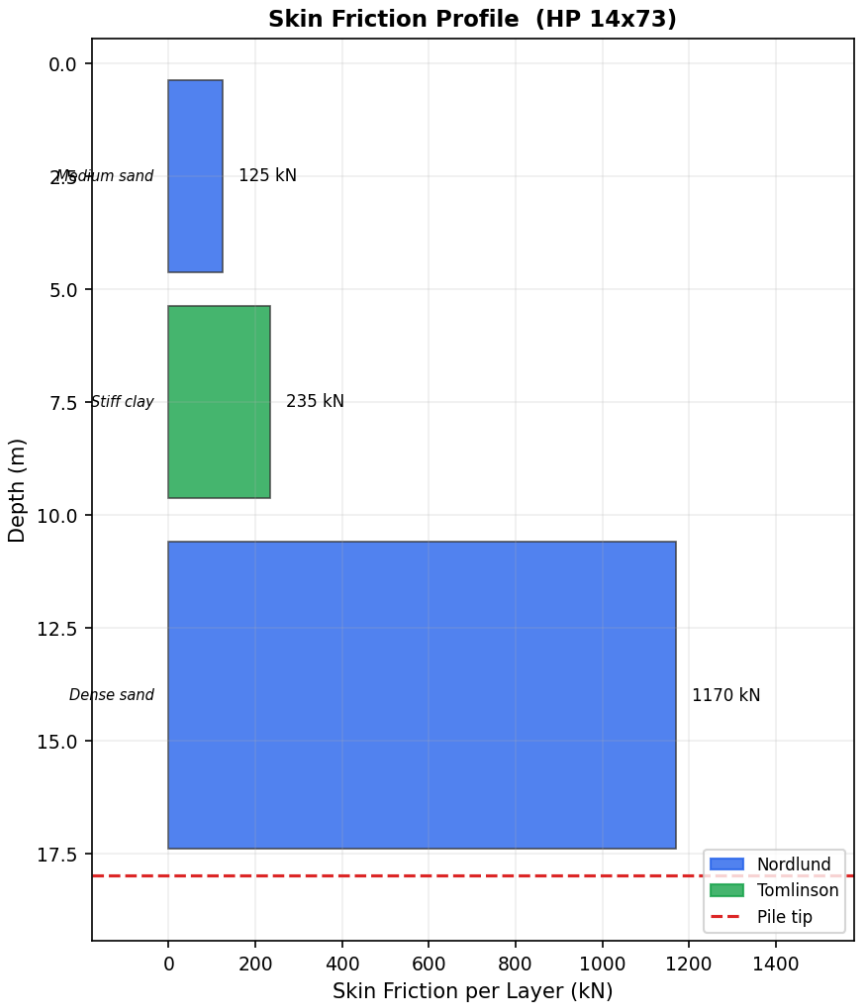

Figure 2: *

Figure 2: Per-layer skin friction distribution along the pile (L = 18.0 m, HP 14x73).

1. REFERENCES

1. FHWA GEC-12 (FHWA-NHI-16-009): Design and Construction of Driven Pile Foundations, Volumes I & II.
2. Nordlund, R.D. (1963). "Bearing Capacity of Piles in Cohesionless Soils." JSMFD, ASCE, Vol. 89, No. SM3, pp. 1-35.
3. Tomlinson, M.J. (1971). "Some Effects of Pile Driving on Skin Friction." Behaviour of Piles, ICE, London, pp. 107-114.
4. Burland, J.B. (1973). "Shaft Friction of Piles in Clay — A Simple Fundamental Approach." Ground Engineering, Vol. 6, No. 3, pp. 30-42.
5. Meyerhof, G.G. (1976). "Bearing Capacity and Settlement of Pile Foundations." JGED, ASCE, Vol. 102, No. GT3, pp. 197-228.
6. API RP 2GEO (2014). Geotechnical and Foundation Design Considerations.