SETTLEMENT ANALYSIS

Project: Sample Project
Number: SE-2026-004
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1. INPUT PARAMETERS

Parameter	Symbol	Value	Unit
Applied bearing pressure	q_{app}	120.0	kPa
Overburden pressure	q_0	30.0	kPa
Net applied pressure	q_{net}	90.0	kPa
Footing width	B	3.00	m
Footing length	L	3.00	m
Footing shape	*Shape*	square	
Stress distribution method	*Stress*	2:1	
Immediate settlement method	*Imm.Method*	elastic	
Elastic modulus (immediate)	E_s	15000	kPa
Poisson's ratio	ν	0.30	
Consolidation sublayers	N_{consol}	2	
Coefficient of consolidation	c_v	3.0000	m^2/yr
Drainage condition	*Drainage*	double	

1. APPLIED LOADING

Net Applied Pressure

$$q_{net} = q_{applied} - q_{overburden}$$

$$q_{net} = 120.0 - 30.0$$

$q_{net} = \mathbf{90.0}$ kPa

FHWA GEC-6, Section 8.2

1. IMMEDIATE SETTLEMENT

Elastic (Immediate) Settlement

$$S_e = q_{net} \times B \times (1 - \nu^2) / E_s \times I_w$$

$$S_e = 90.0 \times 3.00 \times (1 - 0.30^2) / 15000 \times 1.0$$

$S_e = \mathbf{16.38}$ mm

Timoshenko & Goodier; FHWA GEC-6, Eq. 8-1

I_w = 1.0 (flexible footing on surface)

1. PRIMARY CONSOLIDATION SETTLEMENT

Primary Consolidation Settlement (e-log(p) Method)

$$Case1(NC): S_c = [C_c/(1+e_0)] \times H \times log_{10}[(\sigma'_{v0} + \Delta\sigma)/\sigma'_{v0}] Case2(OC, staysOC): S_c = [C_r/(1+e_0)] \times H \times log$$

$S_c = \mathbf{48.59}$ mm

Terzaghi (1925); FHWA GEC-6, Eqs. 8-5 through 8-7

Stress Distribution Method

$$\Delta\sigma_z = q_{net} \times B \times L / [(B+z)(L+z)]$$

$Method = \mathbf{2:1}$

FHWA Soils & Foundations Reference Manual, Vol II, Section 8.3

Consolidation Settlement by Layer

#	Description	Depth (m)	H (m)	$\Delta\sigma$ (kPa)	OCR	S_c (mm)
1	Soft clay	3.00	3.00	22.5	1.20	45.18
2	Medium clay	6.00	3.00	10.0	1.25	3.41

Total consolidation: 48.59 mm

Consolidation — Soft clay (Case 3 (OC, exceeds preconsolidation))

$$S_c = [0.0500/(1+0.90)] \times 3.00 \times log_{10}[60.0/50.0] + [0.300/(1+0.90)] \times 3.00 \times log_{10}[72.5/60.0]$$

$$\Delta\sigma = 22.5kPaatdepth3.00m, OCR = 1.20$$

$S_c = \mathbf{45.18}$ mm

FHWA GEC-6, Eqs. 8-5 through 8-7

1. TOTAL SETTLEMENT SUMMARY

Total Settlement

$$S_{total} = S_{immediate} + S_{consolidation} + S_{secondary}$$

$$S_{total} = 16.38 + 48.59 + 0.00$$

$S_{total} = \mathbf{64.97}$ mm

Settlement Component Breakdown

Component	Settlement (mm)	Contribution (%)
Immediate	16.38	25%
Consolidation	48.59	75%
Secondary	0.00	0%
Total	64.97	100%

1. FIGURES

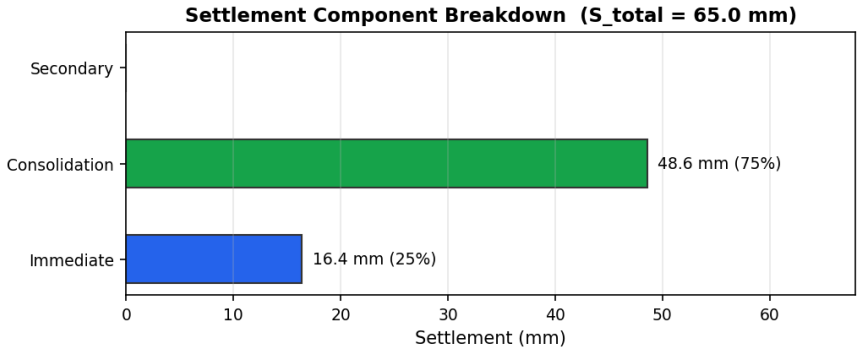

Figure 1: *

Figure 1: Contribution of immediate, consolidation, and secondary settlement components to total settlement (S_total = 65.0 mm).

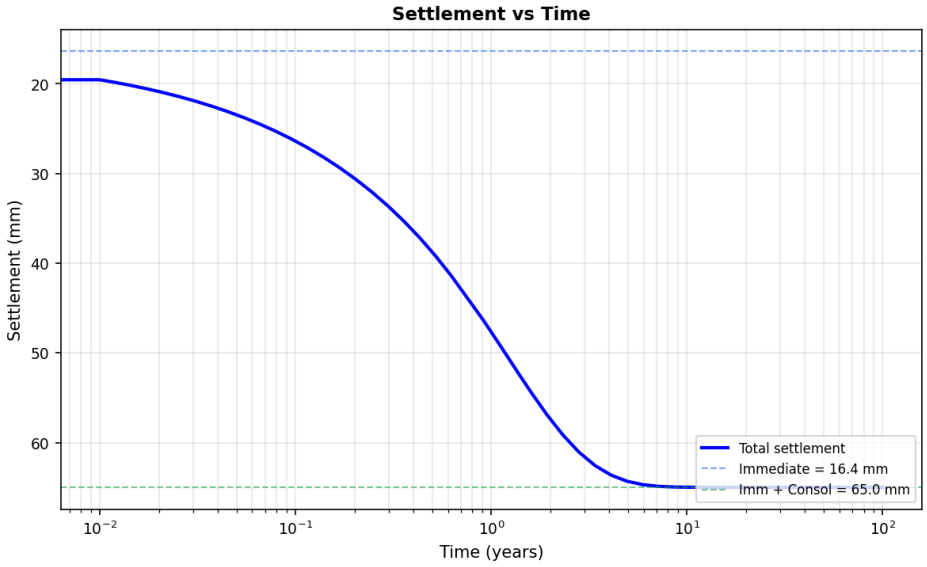

Figure 2: *

Figure 2: Settlement vs time curve. Immediate settlement = 16.4 mm occurs at t = 0. Primary consolidation settlement = 48.6 mm develops over time.

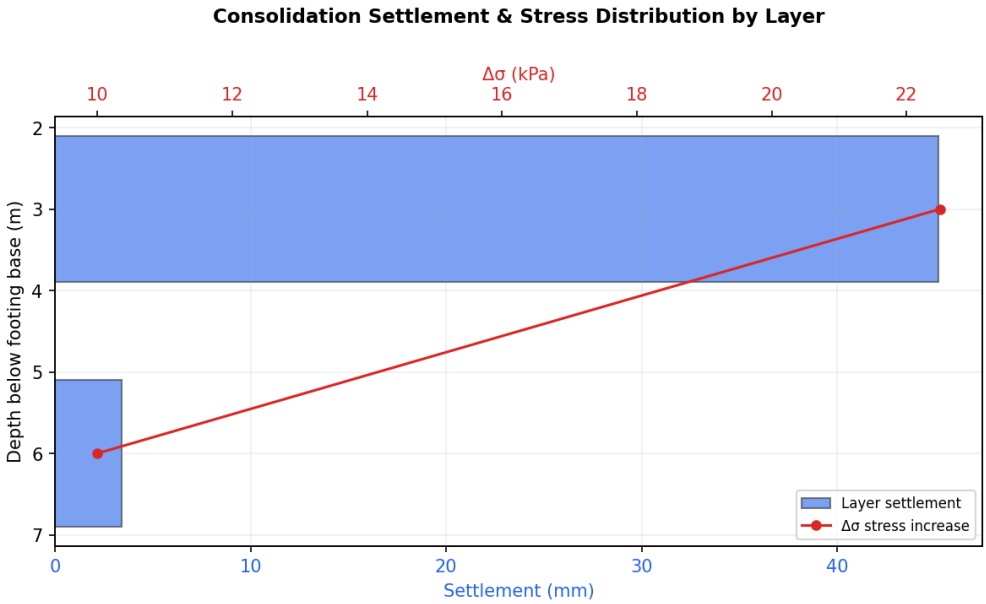

Figure 3: *

Figure 3: Per-layer consolidation settlement and stress increase distribution with depth.

1. REFERENCES

1. FHWA GEC-6 (FHWA-IF-02-054): Shallow Foundations, Chapter 8.
2. Terzaghi, K. (1925). "Erdbaumechanik auf Bodenphysikalischer Grundlage." Deuticke, Vienna.

3. Schmertmann, J.H. et al. (1978). "Improved Strain Influence Factor Diagrams." JGED, ASCE, Vol. 104, No. GT8, pp. 1131-1135.
4. Timoshenko, S.P. & Goodier, J.N. (1970). Theory of Elasticity, 3rd Ed. McGraw-Hill.
5. Mesri, G. (1973). "Coefficient of Secondary Compression." JSMFE, ASCE, Vol. 99, No. SM1, pp. 123-137.
6. USACE EM 1110-1-1904: Settlement Analysis.