

GROUND IMPROVEMENT ANALYSIS

Project: Sample Project **Number:** GI-2026-010
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1. INPUT PARAMETERS

Parameter	Symbol	Value	Unit
Analysis method	<i>Method</i>	Wick Drains (PVD)	
Drain spacing (c-c)	<i>s</i>	1.5	m
Layout pattern	<i>Pattern</i>	Triangular	
Equivalent drain diameter	<i>d_w</i>	0.066	m
Influence zone diameter	<i>d_e</i>	1.5750000000000002	m
Horizontal coeff. of consolidation	<i>c_h</i>	3.0	m ² /yr
Vertical coeff. of consolidation	<i>c_v</i>	1.0	m ² /yr
Vertical drainage path	<i>H_{dr}</i>	8.0	m
Analysis time	<i>t</i>	0.5	years
Smear zone ratio (d _s /d _w)	<i>s_r</i>	2.0	
Permeability ratio	<i>k_h/k_s</i>	2.0	

1. DRAIN GEOMETRY

Influence Zone Diameter

$$d_e = 1.05 \times s(\text{triangular}) d_e = 1.13 \times s(\text{square})$$

$$d_e = 1.05 \times 1.50$$

$$d_e = 1.575 \text{ m}$$

Barron (1948); Hansbo (1981)

Spacing Ratio

$$n = d_e/d_w$$

$$n = 1.575/0.0660$$

$$n = 23.9$$

1. DRAIN FUNCTION F(N)

Barron/Hansbo Drain Function

$$F(n) = \ln(n/s_r) + (k_h/k_s) \times \ln(s_r) - 0.75$$

$$F(n) = \ln(23.9/2.0) + 2.0 \times \ln(2.0) - 0.75$$

$$F(n) = 3.116$$

Hansbo (1981)

Includes smear zone correction.

1. DEGREE OF CONSOLIDATION

Radial Time Factor

$$T_r = c_h \times t / d_e^2$$

$$T_r = 3.00 \times 0.500 / 1.575^2$$

$$T_r = 0.6047$$

Radial Degree of Consolidation

$$U_r = 1 - \exp(-8 \times T_r / F(n))$$

$$U_r = 1 - \exp(-8 \times 0.6047 / 3.116)$$

$$U_r = 78.8 \%$$

Barron (1948); Hansbo (1981)

Vertical Time Factor

$$T_v = c_v \times t / H_{dr}^2$$

$$T_v = 1.00 \times 0.500 / 8.00^2$$

$$T_v = 0.0078$$

Vertical Degree of Consolidation

$$U_v \text{ from Terzaghi 1-D theory}$$

$$U_v = 10.0 \%$$

Combined Degree of Consolidation

$$U_{total} = 1 - (1 - U_v/100) \times (1 - U_r/100)$$

$$U_{total} = 1 - (1 - 10.0/100) \times (1 - 78.8/100)$$

$$U_{total} = 80.9 \%$$

Carrillo (1942) combined consolidation

1. RESULTS SUMMARY

Consolidation Summary

Parameter	Value
Drain spacing	1.50 m (triangular)
Spacing ratio n	23.9
F(n)	3.116
Radial consolidation U_r	78.8%
Vertical consolidation U_v	10.0%
Combined consolidation U_total	80.9%
Analysis time	0.50 years

1. FIGURES

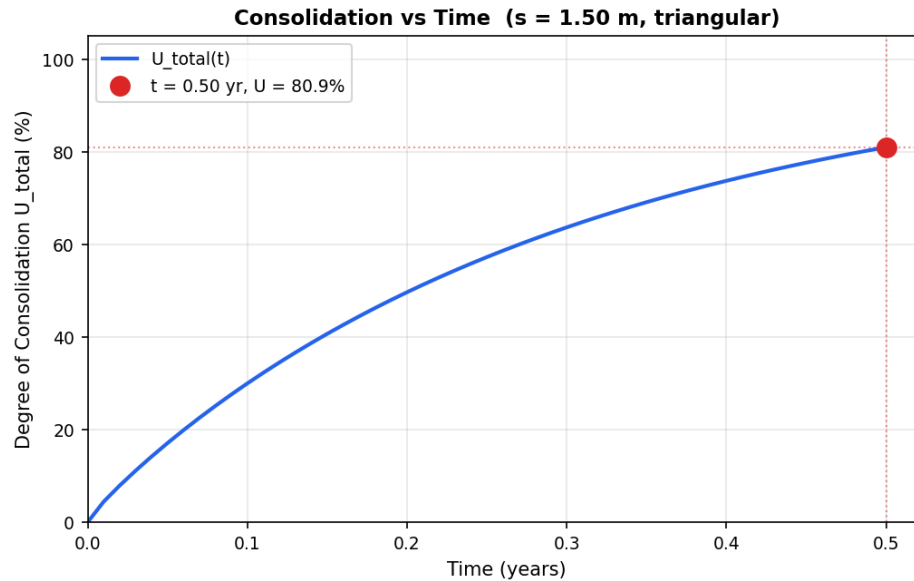


Figure 1: *

Figure 1: Combined degree of consolidation vs time for $s = 1.50$ m (triangular). At $t = 0.50$ yr, $U_{total} = 80.9\%$.

1. REFERENCES

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4. Priebe, H.J. (1995). "The Design of Vibro Replacement." Ground Engineering, Dec 1995, pp. 31-37.
5. Barron, R.A. (1948). "Consolidation of Fine-Grained Soils by Drain Wells." Trans. ASCE, Vol. 113, pp. 718-742.
6. Hansbo, S. (1981). "Consolidation of Fine-Grained Soils by Prefabricated Drains." Proc. 10th ICSMFE, Stockholm, Vol. 3.