Spread shallow foundation on sand

foundation level - 0,8 m
foundation height - 0,8 m

Loads:

characteristic vertical permanent 1000 kN
characteristic vertical variable 750 kN

Available ground data:

4 CPT soundings (q_c, f_s values)

Ground profile on the basis of CPT trend line:

I 0,8 ÷ 1,5 m ~~p~~ + bgl
II 1,5 ÷ 2,5 m ~~p~~ + bgl
III 2,5 ÷ 5,5 m ~~p~~ + bgl
IV 5,5 ÷ 6,8 m bgl.

} considered influence zone 2B

Settlement calculations on the basis of Schmeidmann theory where total vertical settlement is given by:

$$s = C_1 \cdot C_2 \cdot \Delta p \sum_1^n \frac{I_z}{C_3 E} \Delta z$$ where:

C_1 - correction for depth of embedment
C_2 - correction for creep
C_3 - correction for shape of footing

$C_1 = 1 - 0{,}5 (\sigma'_{v0} / \Delta p)$

$C_2 = 1 - 0{,}2 \log_{10} (10t)$ $t = 50$ y.

I_{zp} - peak value of strain distribution diagram

$I_{zp} = 0{,}5 + 0{,}1 (\Delta p / \sigma'_z)^{0{,}5}$

E - Equivalent Young's modulus $E = \alpha q_c$
$\alpha = 2$
Δp - net foundation pressure
~~B = 1,5 m~~
I_z - strain influence factor
Δz - thickness of sublayer

SLS

$\Delta p = 800$ kPa
$\sigma_z = 169$ kPa (on the basis PN)

$C_1 = 0,963$
$C_2 = 0,46$
$C_3 = 1,25$
$\gamma = 2$

(1) Assumed $B = 1,5$ m $\quad I_{zp} = 0,755$

Layer I
$\Delta z = 0,7$m
$I_z = 0,25$
$\bar{q}_c = 12306$ kPa
$E = 24612$ kPa

Layer II
$\Delta z = 1,0$m
$I_z = 0,75$
$\bar{q}_c = 14100$ kPa
$E = 28200$ kPa

Layer III
$\Delta z = 1,3$m
$I_z = 0,66$
$\bar{q}_c = 16650$ kPa
$E = 33180$ kPa

$s = 0,0045$ [m]

ULS

Design Aproach 2

factors combination A1 + M1 + R2

(A) $P_G = 1000$ kN
$P_Q = 750$ kN
$\gamma_G = 1,35$
$\gamma_Q = 1,5$

(M) $\gamma_x = 0,0$

(R) $\gamma_{R;v} = 1,4$

~~$E_d = \gamma_G \cdot \gamma_G$~~

$E_d = P_G \cdot \gamma_G + P_Q \cdot \gamma_Q = 2475\ kN / 1,5\ m^2 = 1100\ kPa$

$R_d = q_{ult} \cdot \gamma_{R;v}$

$q_{ult} = \bar{q}_c (B/C)(1 + D/B)$

$C = 12,2 \qquad D = 0,8$

$B = 1,5$

$\bar{q}_c = 13280$

$A = 3$ - factor of safety (recomended

$q_{ult} = 2503\ kPa$

$R_d = 2503 \cdot 1,4 = 3505\ kPa$

$R_d > E_d$ and $A = 3,18$

For $B = 1,5$

$\bar{q}_c = 13290$

$q_{ult} = 2396$

$R_d = 3355\ kPa$

$E_d = 1263\ kPa$

$A = 2,66$ - ULS not reached