FONDAZIONI

Titolo nota 27/05/2015

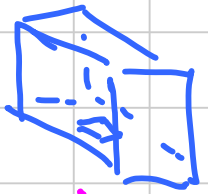
DIRETTE (PLINTI, TRAVI E PLATEE)

SU PALI

SUOLO ALLA WINKLER

K costante di sottofondo

$K_1 = 10 - 50 \ kg/cm^3$



$\uparrow \sigma = -kN$

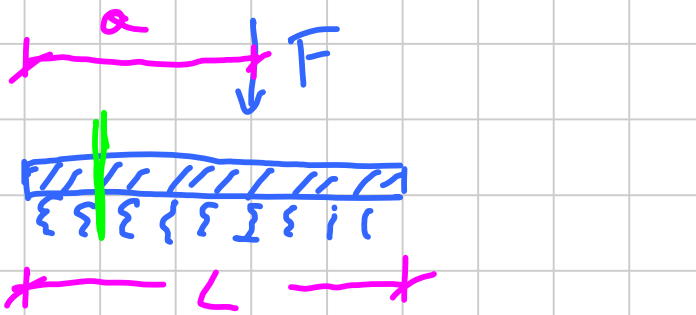
b dimensione trasversale (30 cm)

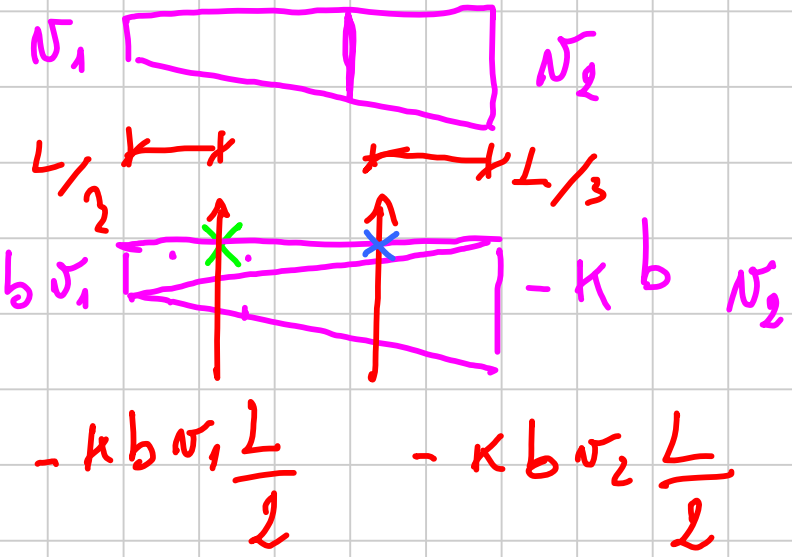
$$K = K_1 \left(\frac{B+b}{2B}\right)^2 \qquad \left[\frac{F}{L^2}\right] \qquad [L]$$

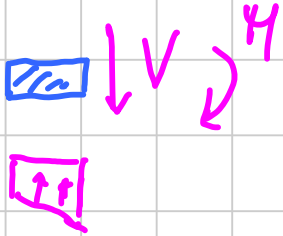
$$\downarrow$$

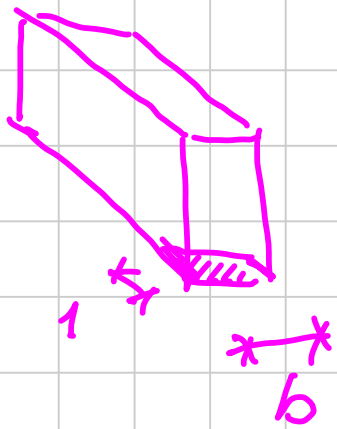
$$\frac{[F]}{[L^3]}$$

B dimensione fondazione



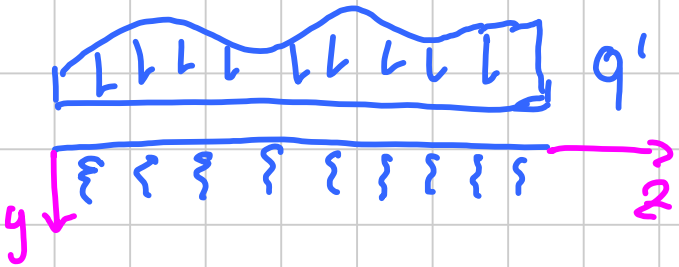






$$F\left(\frac{2}{3}L-a\right)-kbv_1\frac{L}{2}\frac{L}{3}=0$$

$$v_1=\frac{6F}{kb}\frac{\left(\frac{2}{3}L-a\right)}{L^2}$$



$-kb\,v(z)$

$v(z)$

$$\frac{dv}{dz} = -\varphi$$

$$\frac{d\varphi}{dz} = \frac{M}{EI}$$

$$\frac{dM}{dz} = V$$

$$\frac{dV}{dz} = -q$$

$$\frac{d^2 v}{dz^2} = -\frac{d\varphi}{dz} = -\frac{M}{EI}$$

$$\frac{d^3 v}{dz^3} = -\frac{1}{EI}\frac{dM}{dz} = -\frac{V}{EI}$$

$$\frac{d^4 v}{dz^4} = -\frac{1}{EI}\frac{dV}{dz} = \frac{q}{EI}$$

$$\frac{d^4 v}{dz^4} = \frac{q' - kbv}{EI}$$

$$\frac{d^4 w}{dz^4} + \frac{k b}{EI} w = \frac{q}{EI}$$

$$\lambda = \sqrt[4]{\frac{k b}{4 EI}}$$

$$\frac{d^4 w}{dz} + 4\lambda^4 w = \frac{q}{EI}$$

$$\frac{d^4 v}{dz^4} + \lambda^4 v = 0 \qquad v(z) = e^{\lambda z} \sin \lambda z$$

$$\frac{dv}{dz} = \lambda e^{\lambda z} \sin \lambda z + \lambda e^{\lambda z} \cos \lambda z$$

$$\frac{d^2 v}{dz} = \lambda^2 e^{\lambda z} \sin \lambda z + \lambda^2 e^{\lambda z} \cos \lambda z + \lambda e^{\lambda z} \cos \lambda z - \lambda^2 e^{\lambda z} \sin \lambda z$$

$$= 2\lambda^2 e^{\lambda z} \cos \lambda z$$

$$\frac{d^3 v}{dz} = 2\lambda^3 e^{\lambda z} \cos \lambda z - 2\lambda^3 e^{\lambda z} \sin \lambda z$$

$$\frac{d^4 v}{dz^4} = 2\lambda^4 e^{-\lambda z}\cos\lambda z - 2\lambda^4 e^{\lambda z}\operatorname{sen}\lambda z - 2\lambda^4 e^{\lambda z}\operatorname{sen}\lambda z + 2\lambda^4 e^{-\lambda z}\cos\lambda z$$

$$= -4\lambda^4 e^{-\lambda z}\operatorname{sen}\lambda z$$

$$-4\lambda^4 e^{\lambda z}\operatorname{sen}\lambda z + 4\lambda^4 e^{\lambda z}\operatorname{sen}\lambda z = 0$$

$v(z) = e^{\lambda z}\operatorname{sen}\lambda z$ $\qquad$ $v(z) = e^{\lambda z}\cos\lambda z$

$v(z) = e^{-\lambda z}\operatorname{sen}\lambda z$ $\qquad$ $v(z) = e^{-\lambda z}\cos\lambda z$

$$v(z) = c_1 e^{\lambda z}\operatorname{sen}\lambda z + c_2 e^{-\lambda z}\operatorname{sen}\lambda z + c_3 e^{\lambda z}\cos\lambda z + c_4 e^{-\lambda z}\cos\lambda z$$

$q' = const$

$$\frac{d^4 v}{dz^4} + \lambda^4 v = \frac{q}{EI}$$

$$v = \frac{q'}{\lambda^4 EI} = \frac{q'}{kb}$$

La soluzione generale della (13) è

$$v(z) = C_1\, e^{\lambda z} \sin\lambda z + C_2\, e^{\lambda z} \cos\lambda z + C_3\, e^{-\lambda z} \sin\lambda z + C_4\, e^{-\lambda z} \cos\lambda z$$

La derivata della (14) fornisce la rotazione sezione per sezione

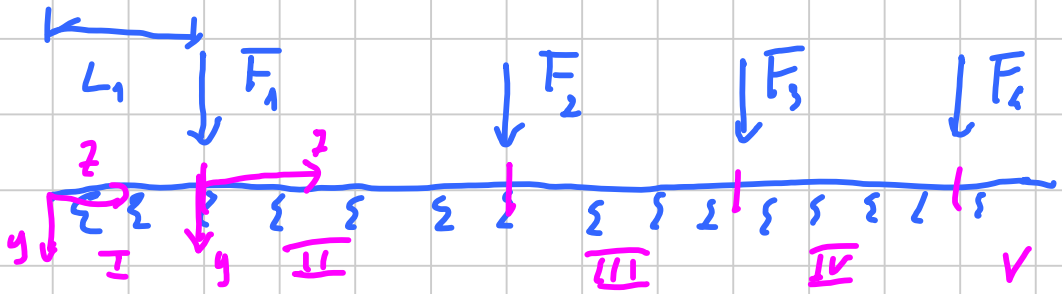
$$v'(z) = C_1\, \lambda\, e^{\lambda z} \left(\sin\lambda z + \cos\lambda z\right) + C_2\, \lambda\, e^{\lambda z} \left(-\sin\lambda z + \cos\lambda z\right) +$$
$$+ C_3\, \lambda\, e^{-\lambda z} \left(-\sin\lambda z + \cos\lambda z\right) + C_4\, \lambda\, e^{-\lambda z} \left(-\sin\lambda z - \cos\lambda z\right) = -\varphi$$

La derivata seconda è in relazione al momento flettente, ed è

$$v''(z) = 2\, C_1\, \lambda^2\, e^{\lambda z} \cos\lambda z - 2\, C_2\, \lambda^2\, e^{\lambda z} \sin\lambda z +$$
$$-2\, C_3\, \lambda^2\, e^{-\lambda z} \cos\lambda z + 2\, C_4\, \lambda^2\, e^{-\lambda z} \sin\lambda z = -\frac{M}{EI}$$

La derivata terza è legata al taglio

$$v'''(z) = 2\, C_1\, \lambda^3\, e^{\lambda z} \left(-\sin\lambda z + \cos\lambda z\right) + 2\, C_2\, \lambda^3\, e^{\lambda z} \left(-\sin\lambda z - \cos\lambda z\right) +$$
$$+ 2\, C_3\, \lambda^3\, e^{-\lambda z} \left(\sin\lambda z + \cos\lambda z\right) + 2\, C_4\, \lambda^3\, e^{-\lambda z} \left(-\sin\lambda z + \cos\lambda z\right) = -\frac{V}{EI}$$



$N^{I}(z)$ $N^{II}(z)$ $N^{III}(z)$ $N^{IV}(z)$ $N^{V}(z)$

c_i^{I} c_i^{II} c_i^{III} c_i^{IV} c_i^{V}

4 incognite per tratto

20 incognite

20 equazioni

I $z = 0$

$N^{I}(z=0) = 0$

$\frac{d^2 N^{I}(z=0)}{dz^2} = 0$

$\frac{d^3 N^{I}(z=0)}{dz^3} = 0$

$N^{I}(z = L_1) = N^{II}(z = 0)$

$\frac{dN^{I}(z=L_1)}{dz} = \frac{dN^{II}(z=0)}{dz}$

$$M^{I}(z=L_1) = M^{II}(z=0) \Rightarrow \frac{d^2 w^{I}}{dz^2}(z=L_1) = \frac{d^2 w^{II}}{dz^2}(z=0)$$

$$V^{I}(z=L_1) - V^{II}(z=0) = F_1 \qquad EI\left(\frac{d^3 w^{II}(z=0)}{dz^3} - \frac{d^3 w^{I}(z=L_1)}{dz^3}\right) = F_1$$

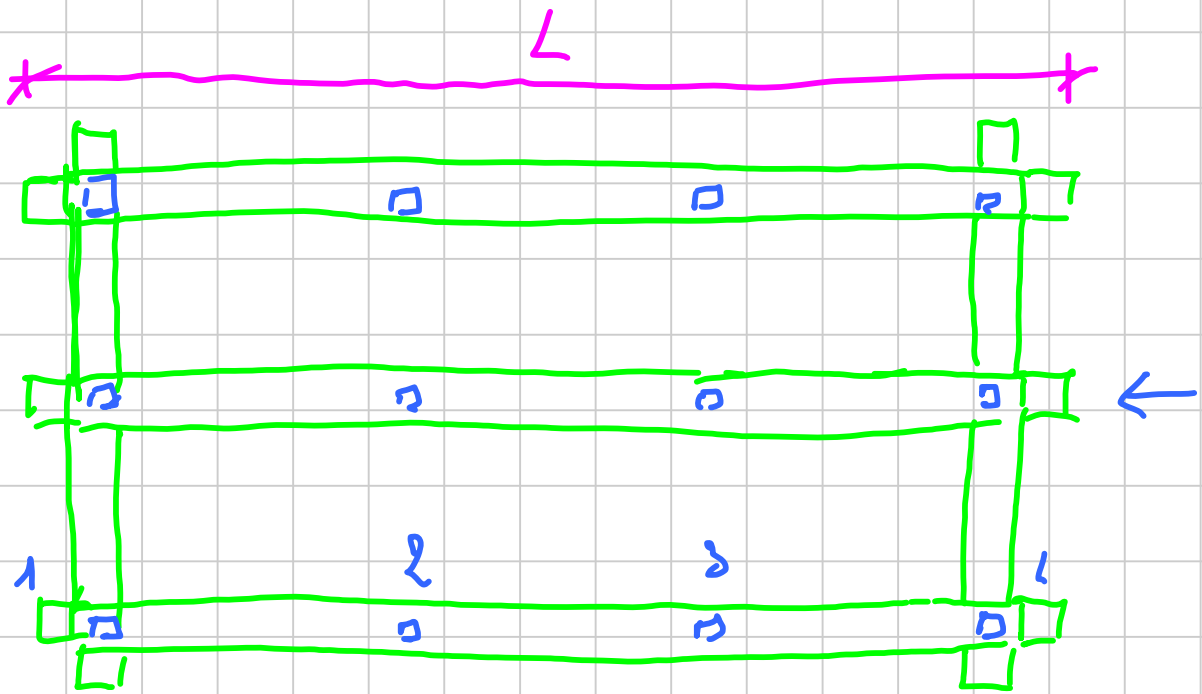
$$V(z)$$

$$\sigma(z) = \kappa V(z)$$

$$M(z) = -EI \frac{d^2 V(z)}{dz^2}$$

$$V(z) = -EI \frac{d^3 V(z)}{dz^3}$$

TRAVE DI FONDAZIONE



APPROCCIO 2

$\gamma_g G_k$ $\gamma_q Q_k$ $\gamma_g = 1,3$ $\gamma_q = 1,5$

γ peso specifico terreno

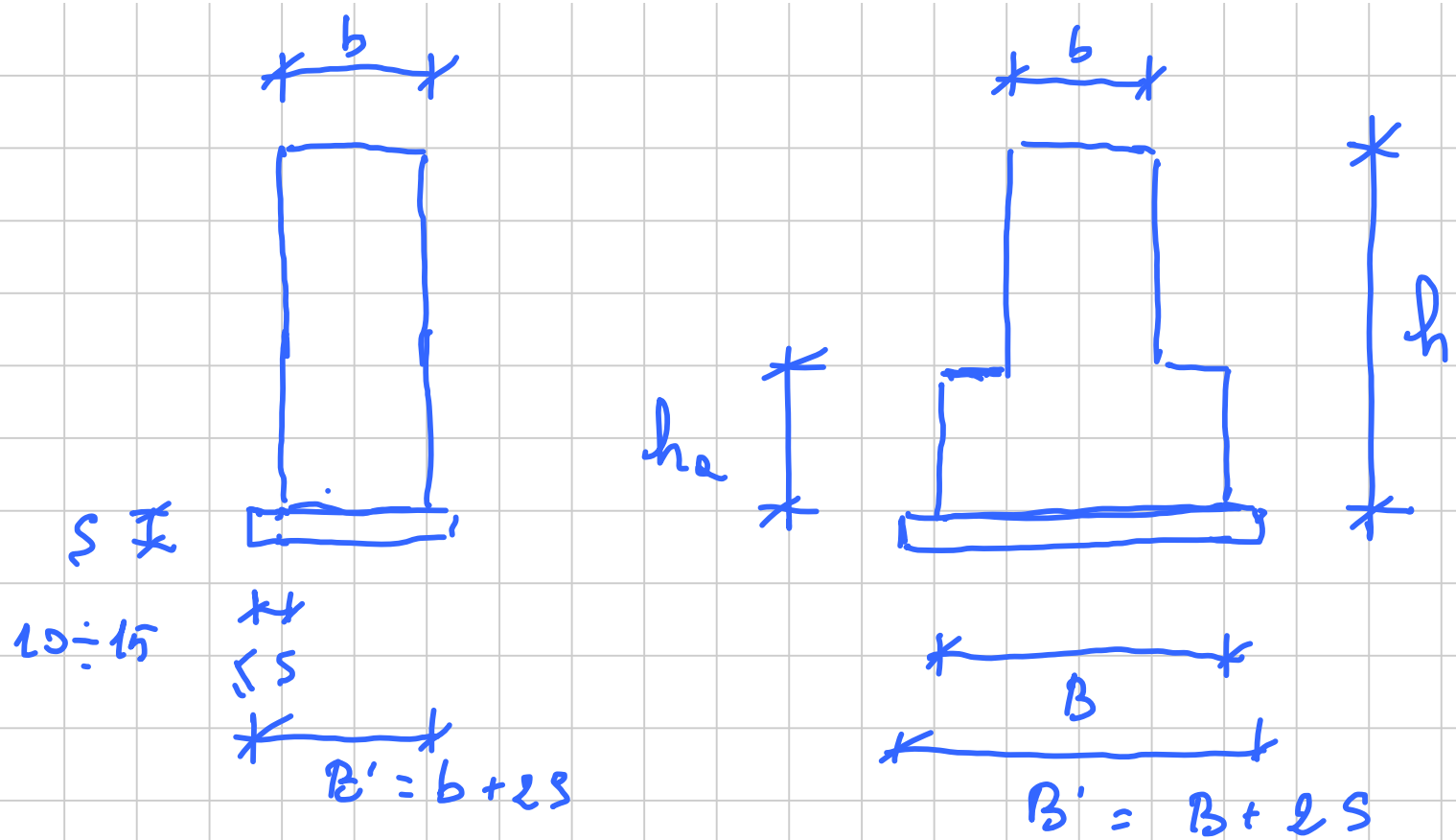
ϕ angolo di resistenza a taglio terreni e rocce prove

c_u coesione non drenata terreni a grana fine

$\Downarrow$

$q_{lim}/2,3$ resistenze strutturali $\alpha_{cc} f_{cn}/\gamma_c$

f_{yk}/γ_s


b
S I
10÷15
≤ s
B' = b + 2s
b
h
h_a
B
B' = B + 2s

4) h ?

esistenza

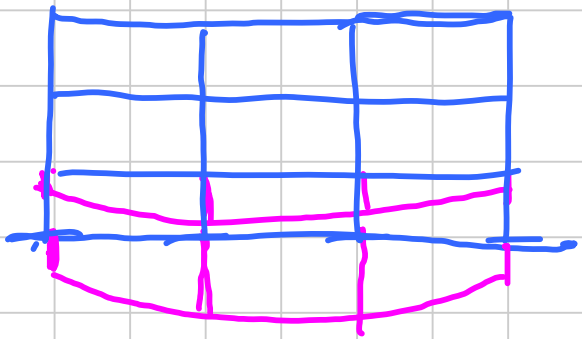
$$V_{max} = 0.6\, F_{max}$$

$$V_{max} = V_{Rd,max} = 0.9\, d\, b_w\, f'_{cd}\, \frac{\cot\vartheta}{1+\cot^2\vartheta}$$

$$h = d + e$$

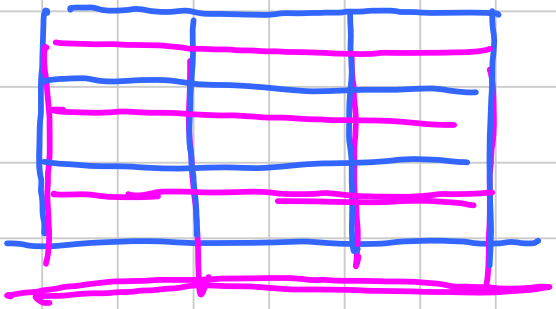
$$\cot\vartheta = 2$$

1) $h = ?$



$$I_f \geq 1 \sum I_i$$

2-gi idea

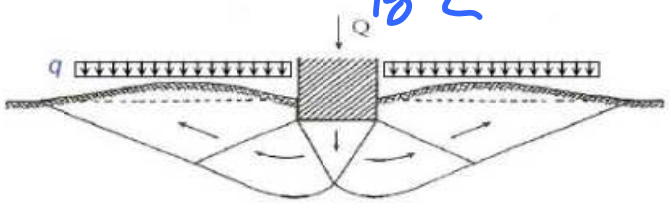


$$I_g = \frac{b\,h^3}{12}$$

$$I_g = 1{,}5\,\frac{b\,h^3}{12}$$

2) $B' = ?$

$$\sigma_t = \frac{\sum F_i}{B'L} = \frac{q_{lim}}{2.3}$$



Rottura generale

Per striscia continua di larghezza B'

condizioni drenate (terreni a grana grossa)

$\phi' = 28° - 32°$

$\gamma = 18 - 20$ KN/m³

Carico limite, in condizioni drenate

$$Q_{lim} = N_c c' + 0.5 N_\gamma B' \gamma + N_q q$$

$$N_q = e^{\pi \tan\phi'} \tan^2(\pi/4 + \phi'/2)$$

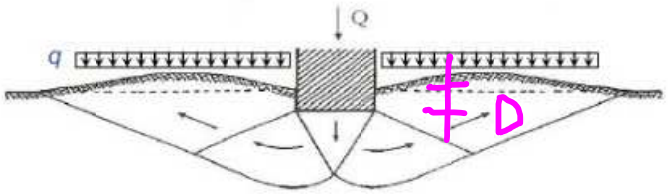
$$N_c = (N_q - 1)\cot\phi'$$

$$N_\gamma = 2(N_q - 1)\tan\phi'$$

Per terreni a grana grossa in genere si assume c'=0

2) $B' = ?$

$$\sigma_t = \frac{\sum F_i}{B'L} = \frac{q_{lim}}{2,3}$$



Rottura generale

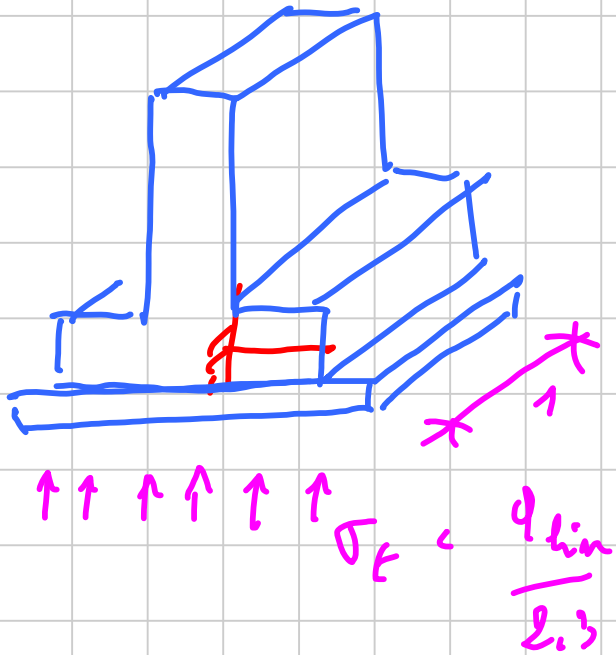
condizioni non drenate
(terreni a grana fine)

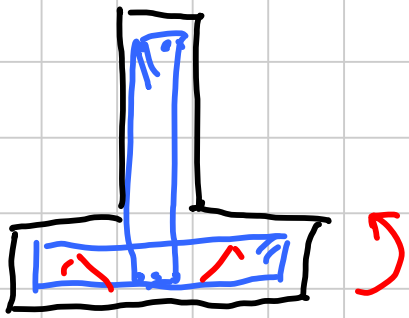
Per striscia continua
di larghezza B

Carico limite, in condizioni non drenate

$$Q_{lim} = (2+\pi)\, c_u + q$$

$q = \gamma D$



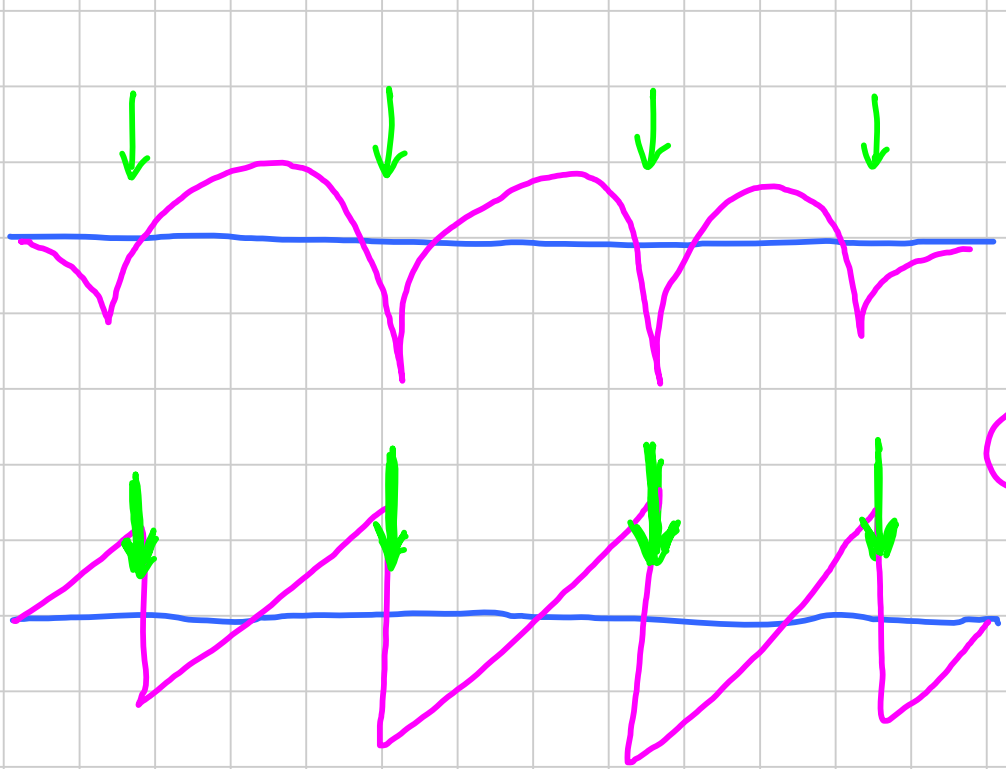


$q = \sigma_t \times 1$

$M_{max} = \frac{b\,d^2}{2 \cdot 2}$

$h_e = d + c$

$V_{max} = V_{Rd,c}$



2 schemi di calcolo

K_1 — 10 Kg/cm³

K_1 — 50 Kg/cm³