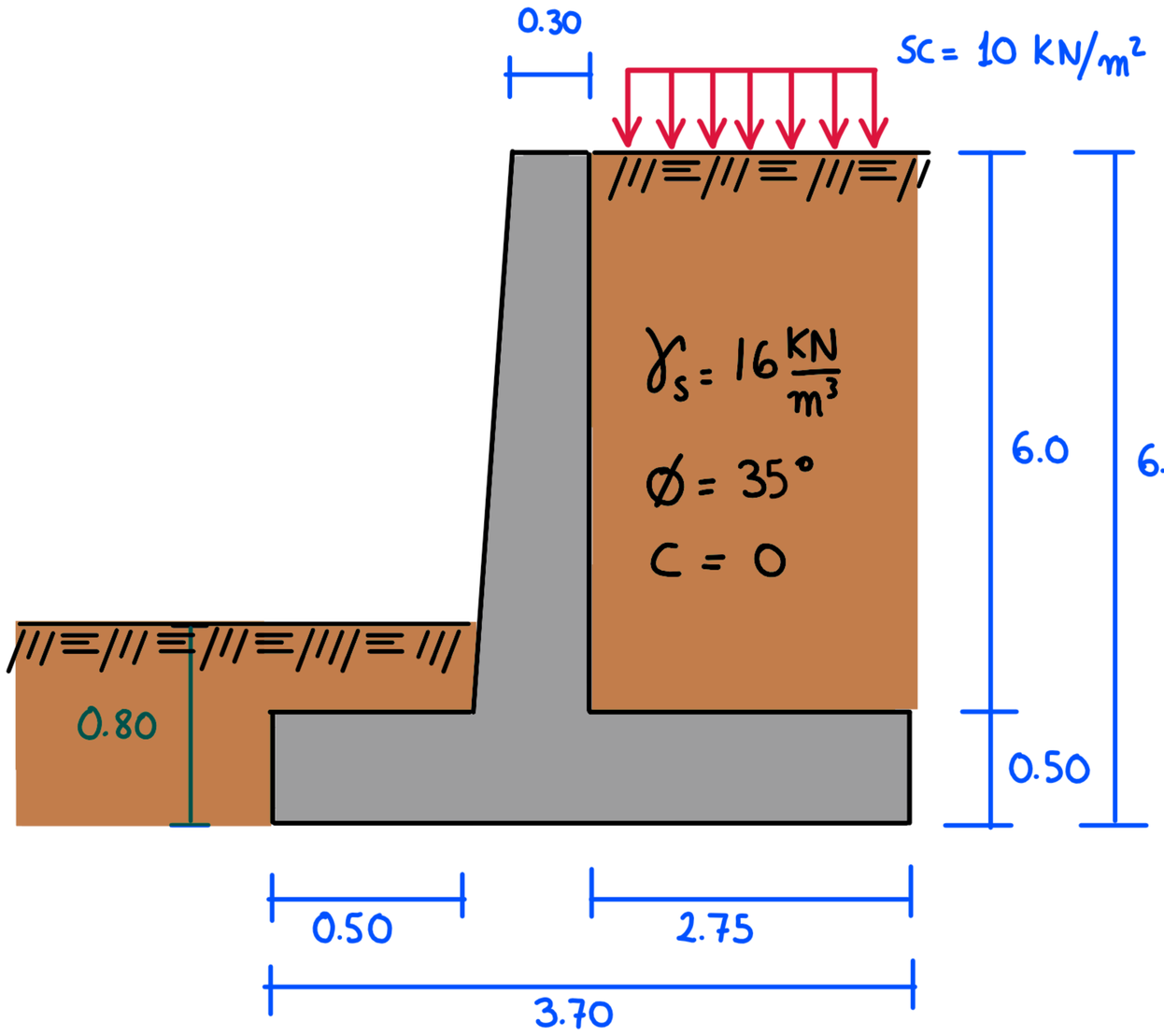
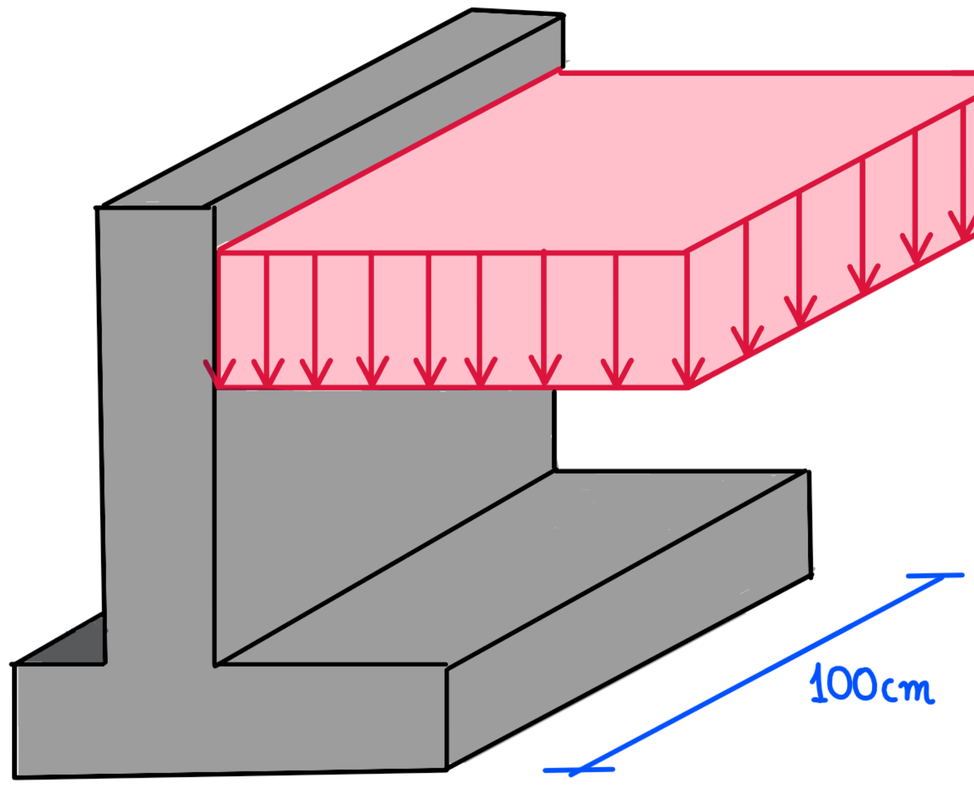
MURO DE CONTENCION



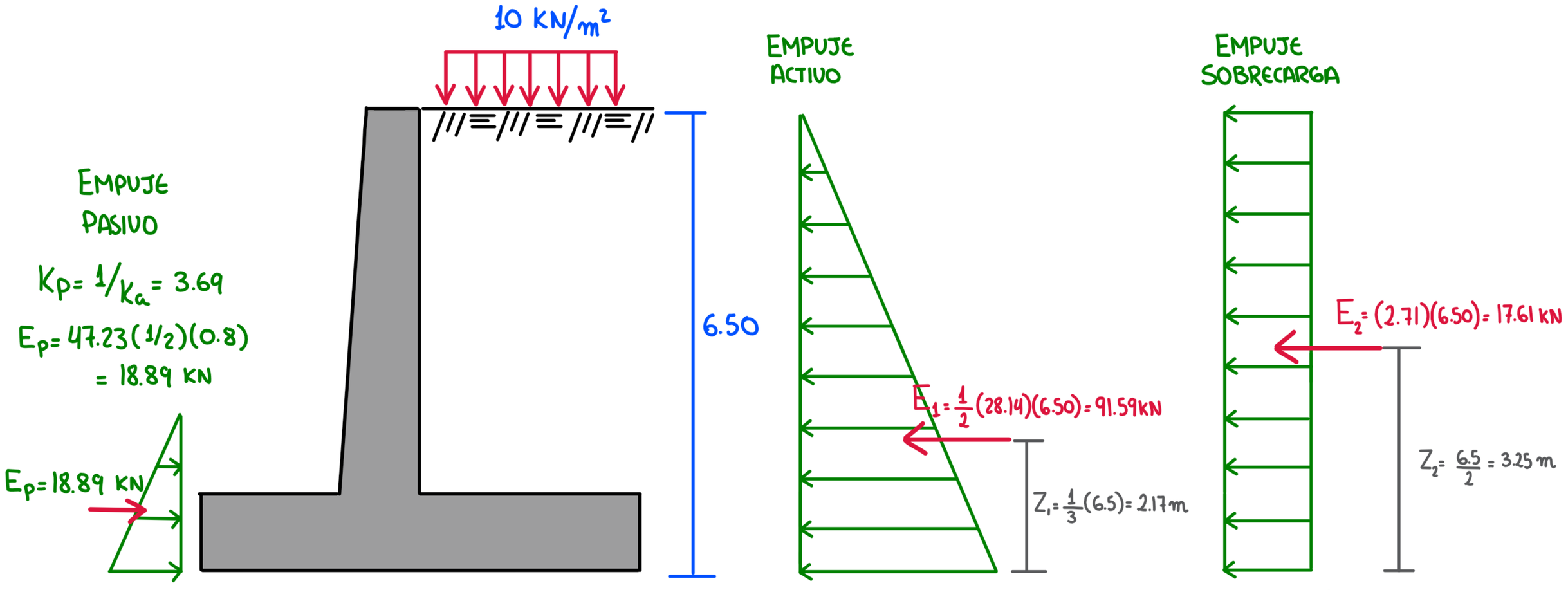


CALCULO DEL COEFICIENTE ACTIVO DE RANKINE

$$R_a = TAN^2\left(45° - \frac{\phi}{2}\right) = TAN^2\left(45° - \frac{35°}{2}\right) = 0.271$$

2.7 CINE 1.7 cine

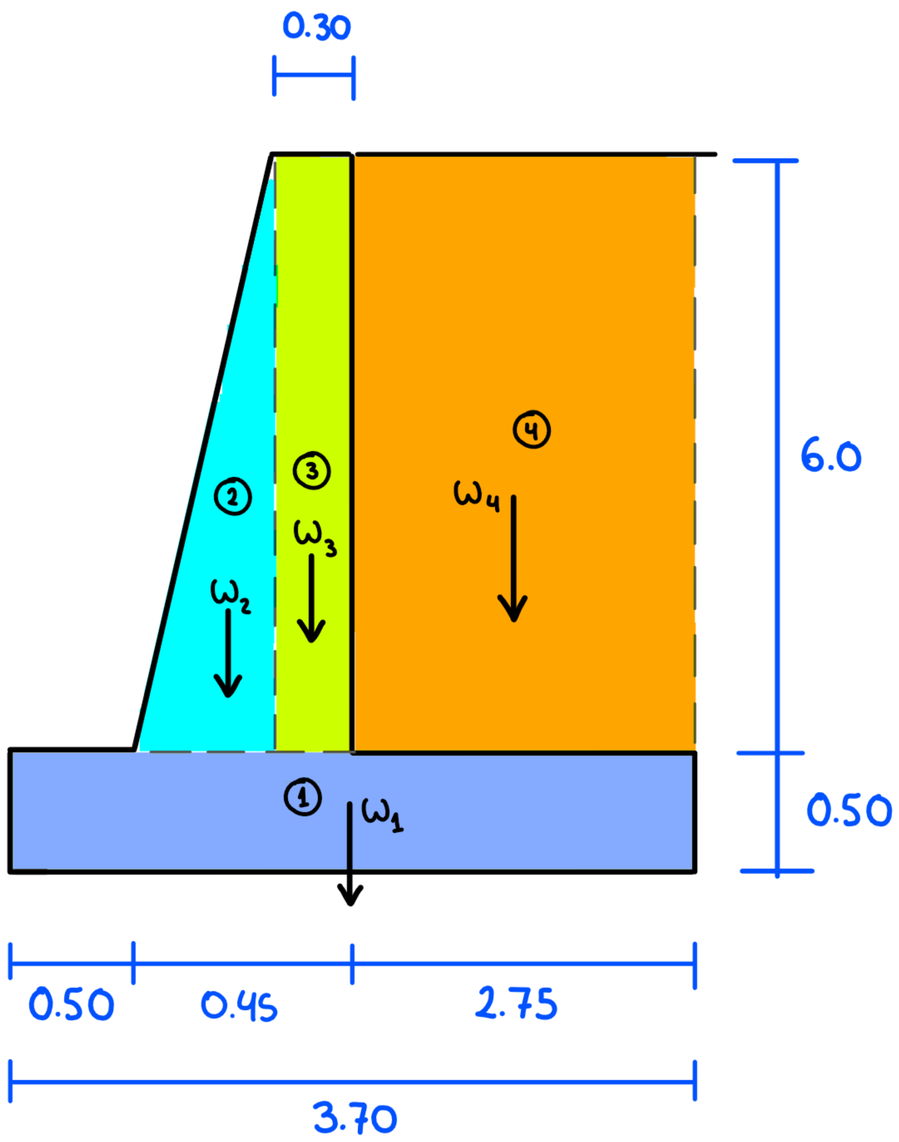
CALCULO DE LAS FUERZAS HORIZONTALTES



F_H (KN)	Z (m)	M_o (KN.m)
91.59	2.17	198.75
17.61	3.25	57.23

$\sum F_H = 109.2$ $\sum M_o = 255.98$

Calculo de las fuerzas verticales

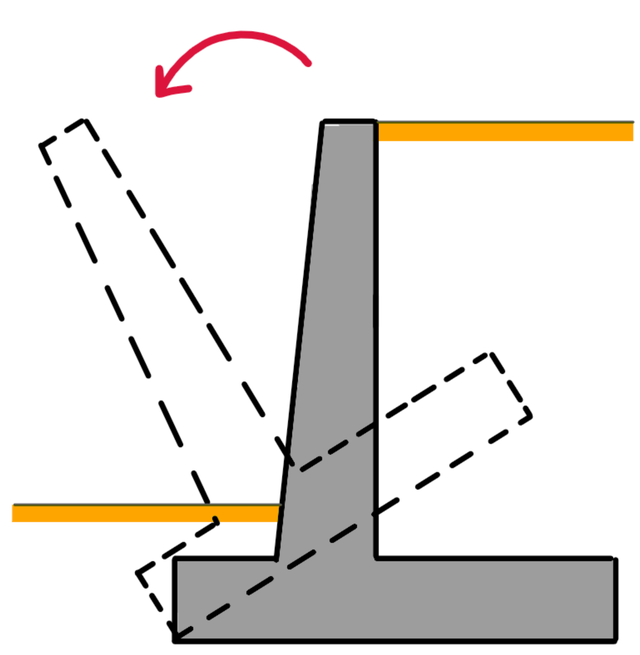


SECCION	AREA (m^2)	W_i (KN)
①	3.70(0.50) = 1.85	24(1.85) = 44.4
②	½(0.15)(6.0) = 0.45	24(0.45) = 10.8
③	0.30(6.0) = 1.80	24(1.80) = 43.2
④	2.75(6.0) = 16.50	16(16.50) = 264

F_v (KN)	Z (m)	M_R (KN.m)
44.4	1.85	82.14
10.8	0.60	6.48
43.2	0.80	34.56
264	2.325	613.80

$\sum F_H = 362.4$ $\quad\quad$ $\sum M_o = 736.98$

Revisión de factor de seguridad a vuelco

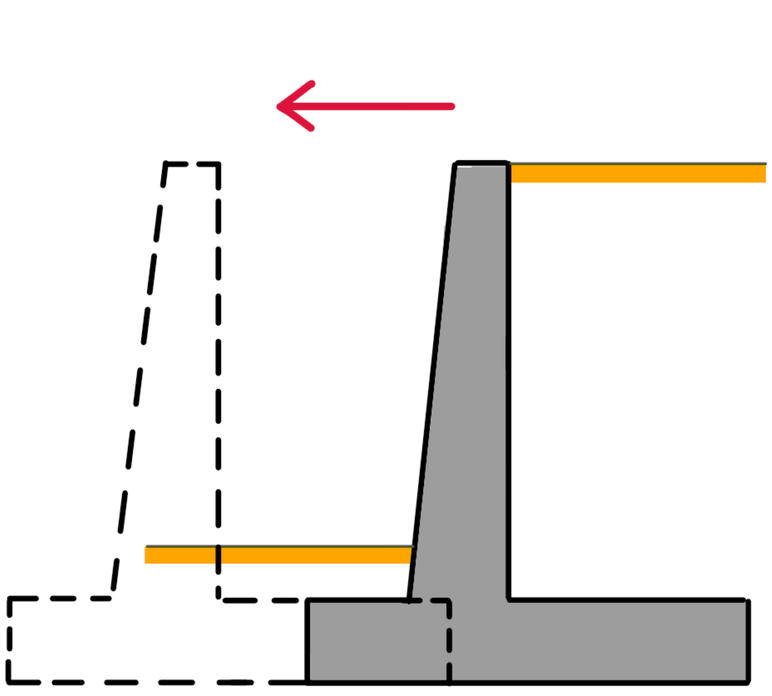


$$F_{sv} = \frac{\sum M_R}{\sum M_o}$$

$$= \frac{736.98}{255.98} = 2.88$$

$F_{sv} = 2.88 > 1.50$ ✓ OK!

Revisión del deslizamiento del muro



PARA CALCULAR EL ANGULO DE FRICCION SUELO ESTRUCTURA

$$K_1 = K_2 \simeq 2/3$$

$$\sum F_R = \sum F_V \, TAN(K_1 \phi_2) + B(\cancel{K_2} C_2^{\,0}) + E_p$$

$$= 362.4 \, TAN\left(\frac{2}{3} 35°\right) + 18.89 = 175.21 \text{ KN}$$

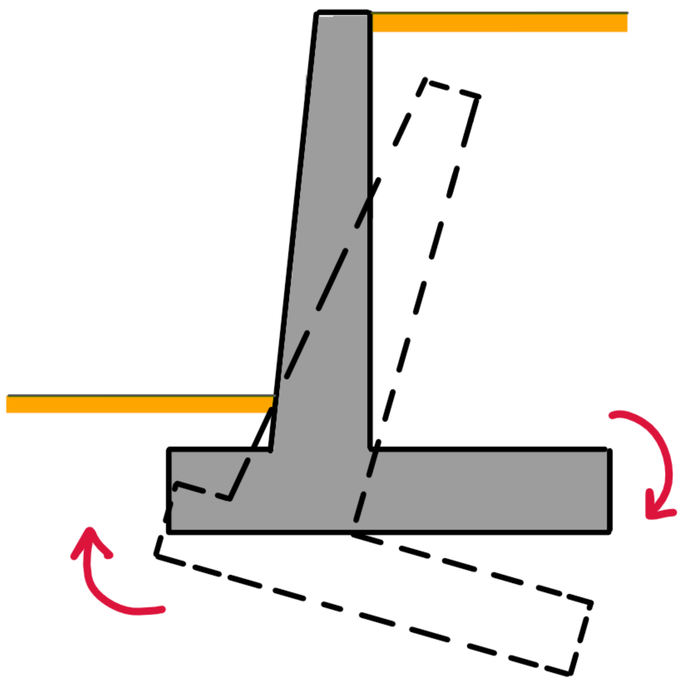
$$F_{sv} = \frac{\sum F_R}{\sum F_o} = \frac{175.21}{109.2} = 1.60 > 1.50$$ ✓ OK!

Apuntes de Concreto Armado
Luis Enrique Maldonado

Revisión del factor de capacidad de carga

$$F_{scc} = \frac{q_u}{q_{max}}$$

- q_u: MEYERHOF, BRINCH HANSEN, ESTUDIO DE SUELO
- q_{max}: DISTRIBUCION LINEAL, DISTRIBUCION RECTANGULAR



CALCULO DE LA EXCENTRICIDAD

$$e = \frac{B}{2} - \bar{X} \qquad \bar{X} = \frac{\Sigma M_R - \Sigma M_O}{\Sigma F_v}$$

$$e = \frac{3.70}{2} - 1.327 \qquad \bar{X} = \frac{736.98 - 255.98}{362.4}$$

$$e = 0.523 \qquad \bar{X} = 1.327$$

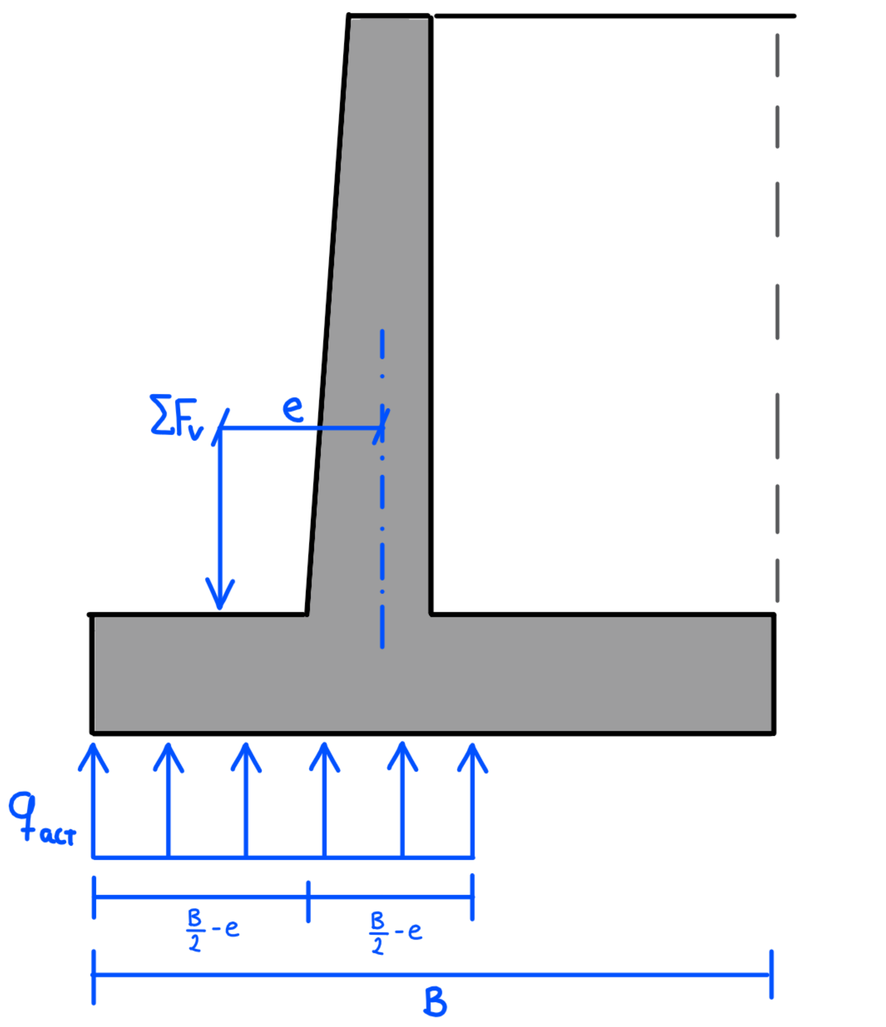
CASO DE DISTRIBUCION RECTANGULAR DE TENSIONES

METODO DE LOS LADOS EFECTIVOS $L = 1\,m$

$$q_{max} = q_{act} = \frac{\Sigma F_v}{(B-2e).L}$$

$$q_{act} = \frac{362.4}{(3.70 - 2(0.523))(1)} = 136.55\ KN/m^2$$

$$2\left(\frac{B}{2} - e\right) = 2\left(\frac{3.70}{2} - 0.523\right) = 2.654\ m$$

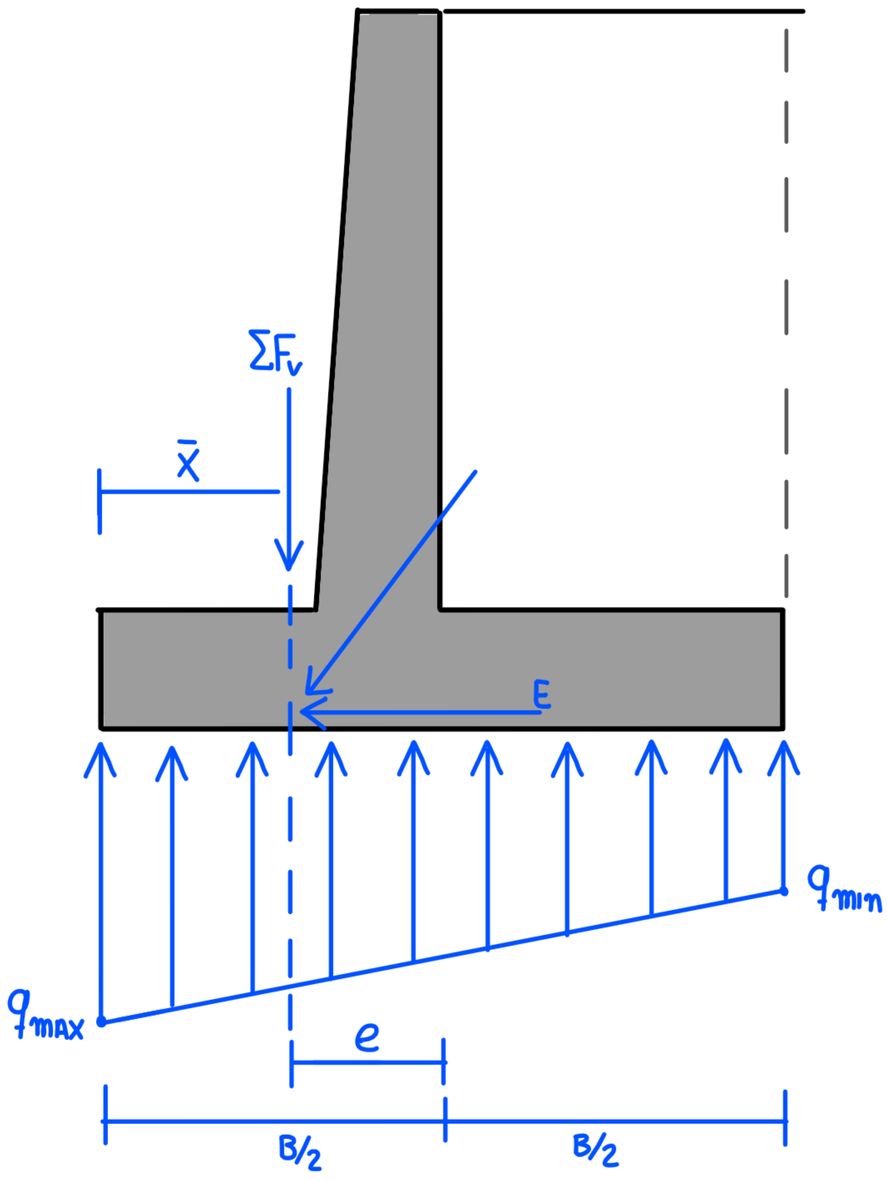


CASO DE DISTRIBUCION RECTANGULAR DE TENSIONES

CÁLCULO DE q_{max} y q_{min}

$$q_{max} = \frac{\Sigma F_v}{B}\left(1 + \frac{6e}{B}\right) = 181.01\ KPa$$

$$q_{min} = \frac{\Sigma F_v}{B}\left(1 - \frac{6e}{B}\right) = 14.88\ KPa$$



Apuntes de Concreto Armado
Luis Enrique Maldonado

CALCULO DE q_u (FACTORES DE FORMA = 1 → CIMIENTO CORRIDO)

$N = \Sigma F_V = 362.4\ KN$

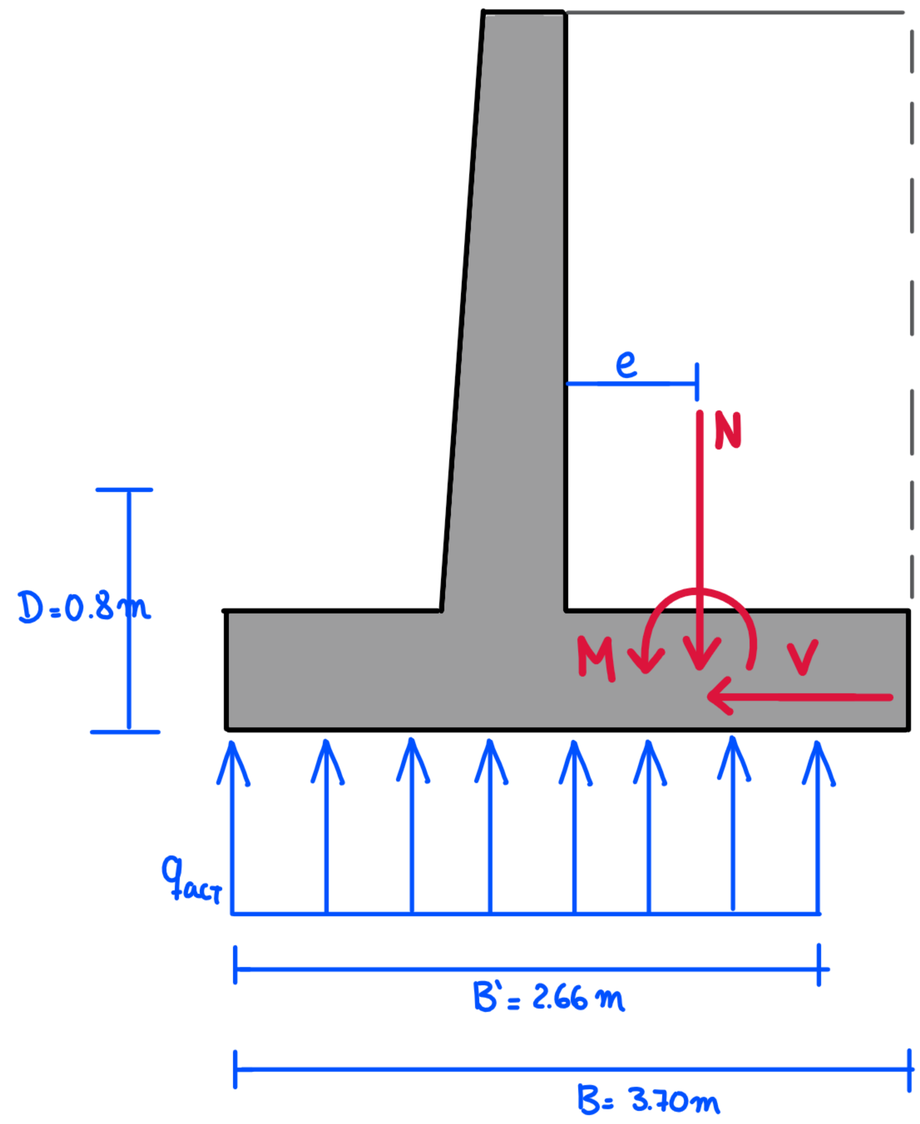
$V = FF_H - E_p = 109.2 - 18.89 = 90.31\ KN$

$M = N.e = 362.4 \times 0.523 = 189.52\ KN.m$

Be: MENOR ENTRE 1m y LONGITUD efectiva B'

Le: MAYOR ENTRE 1m y LONGITUD efectiva B'

$q = (16).(0.8) = 12.8\ KN/m^2$



Calculo de la capacidad del suelo Brinch Hansen

$N_q = e^{\pi TAN\phi} . TAN^2(45+\phi/2) = 33.296$

$N_c = (N_q - 1)\cot\phi = 46.124$

$N_\gamma = 1.5(N_q - 1)TAN\phi = 33.92$

$S_\gamma = 1 - 0.4\frac{Be}{Le} = 0.852$

$S_q = 1 + \frac{Be}{Le} TAN\phi = 1.258$

$S_c = 1 + \left(\frac{N_q}{N_c}\right)\left(\frac{Be}{Le}\right) = 1.267$

$d_\gamma = 1$

$d_q = 1 + 2TAN\phi(1 - SEN\phi)^2.\left(\frac{D}{B}\right) = 1.05$

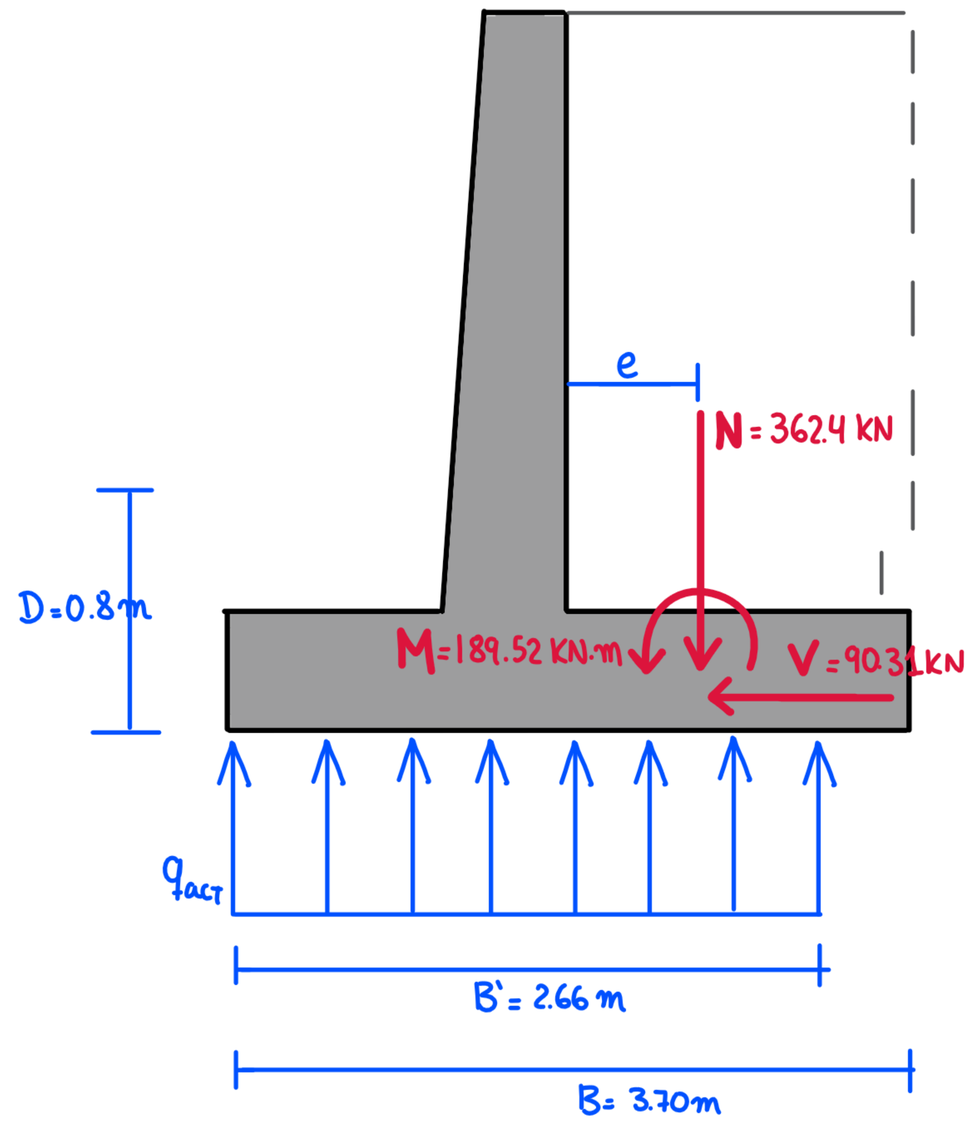
$d_c = 1 + 0.4\left(\frac{D}{B}\right) = 1.086$

$g_\gamma = g_q = g_c = 1$

$i_\gamma = \left[1 - \left(\frac{0.7V}{N + Be\,Le\,C\cot\phi}\right)\right]^5 = 0.383$

$i_q = \left[1 - \left(\frac{0.5V}{N + Be\,Le\,C\cot\phi}\right)\right]^5 = 0.516$

$i_c = i_q - \left(\frac{1 - i_q}{N_q - 1}\right)$

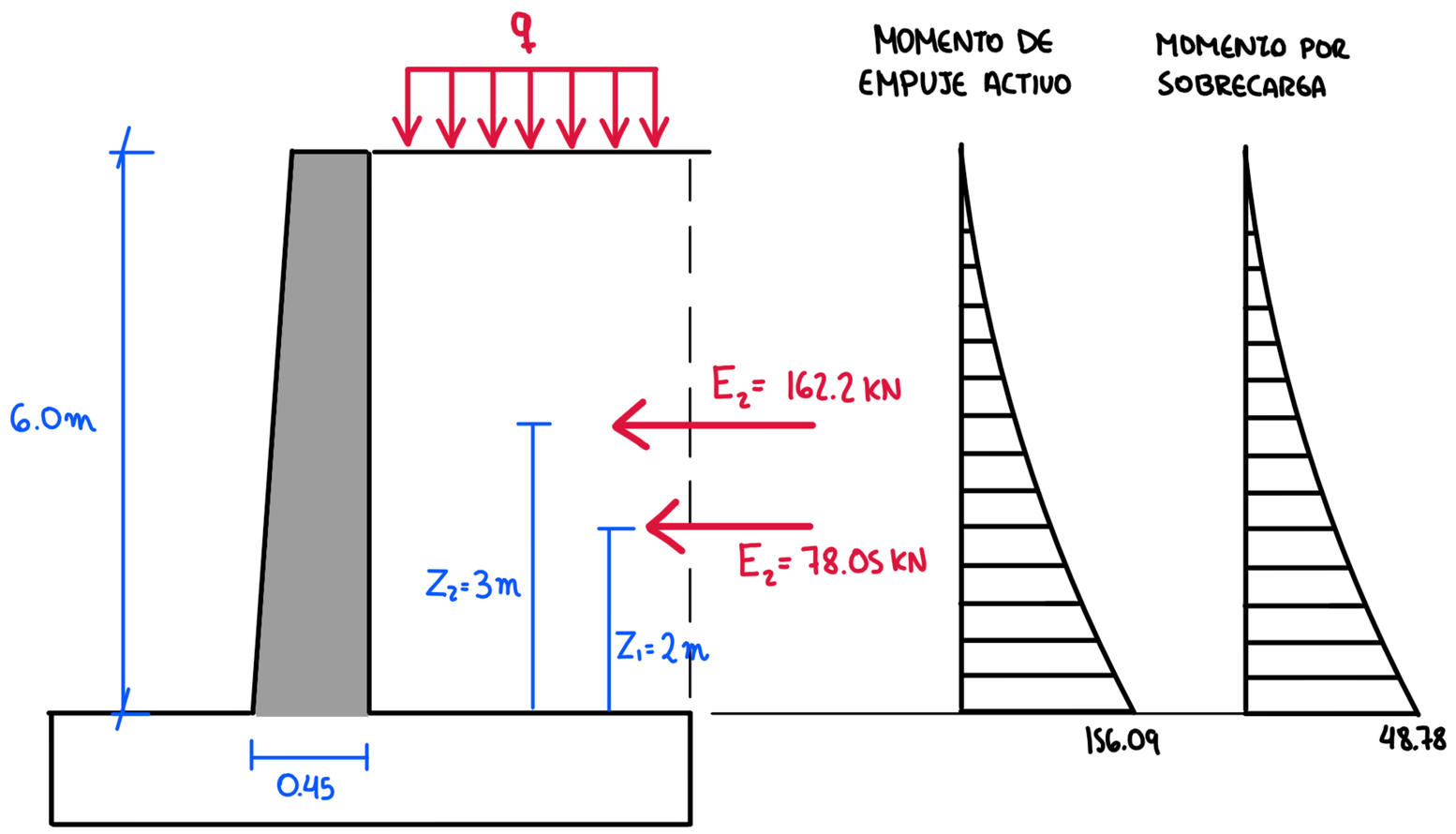


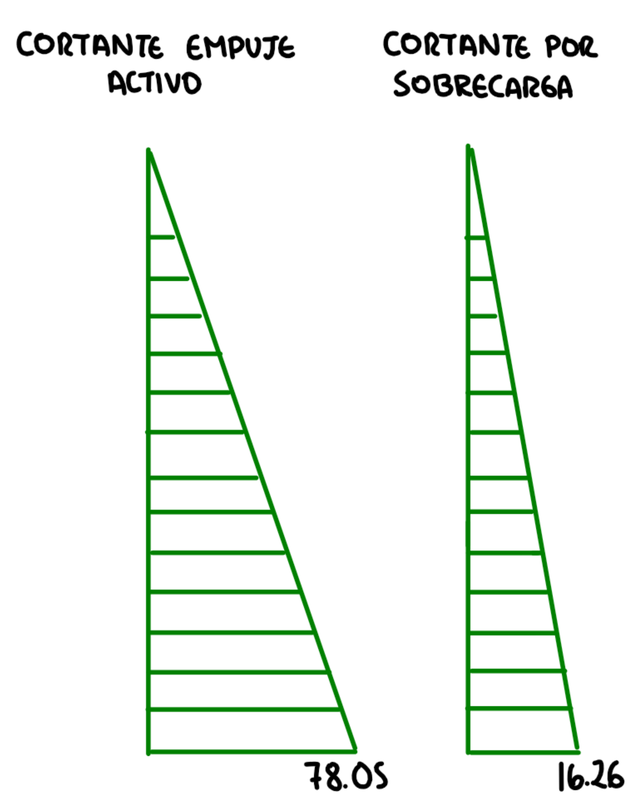
$q_u = cN_cS_cd_ci_cg_c + qN_qS_qd_qi_qg_q + \frac{1}{2}\gamma B' N_\gamma S_\gamma d_\gamma i_\gamma g_\gamma$

$q_u = 527\ KN/m^2$

$F_{scc} = \frac{q_u}{q_{max}} = \frac{527}{136.55} = 3.86 > 3$ ✓ OK!

Diseño de la Pantalla





EMPUJE DEL SUELO E_1

$$E_1 = \frac{1}{2}(16)(6.0)^2(0.271) = 78.048 \text{ KN}$$

$$Z_1 = \frac{6}{3} = 2\,m$$

EMPUJE POR SOBRECARGA

$$E_2 = 10(6)(0.271) = 16.26 \text{ KN}$$

$$Z_2 = \frac{6}{2} = 3\,m$$

REVISION POR CORTANTE

$$V_u = 1.6(78.05 + 16.26) = 150.89 \text{ KN}$$

$$d = 45 - 5 - \frac{1.6}{2} = 39.2 \text{ cm}$$

$$V_c = 0.17\sqrt{f'_c}\,bd = 305.4 \text{ KN}$$

$$\phi V_c = 0.75(305.4) = 229.05 \text{ KN}$$

$\phi V_c > V_u$ ✓ OK!

CALCULO DE LA ARMADURA VERTICAL DE LA PANTALLA

$$M_u \leq \phi M_n \qquad M_u = 1.6(204.87) = 327.79 \text{ KN}$$

$$\frac{Mu}{\phi} = 0.85 f'_c \beta_1 c b \left(h - \frac{\beta_1 c}{2}\right) \qquad \frac{Mu}{\phi} = \frac{327.79}{0.9} = 364.211 \text{ KN}$$

(KN.mm)

$$3642100000 = 0.85(21)(0.85)(1000)c\left(392 - \frac{0.85c}{2}\right)$$

$$c = 65.95 \text{ mm}$$

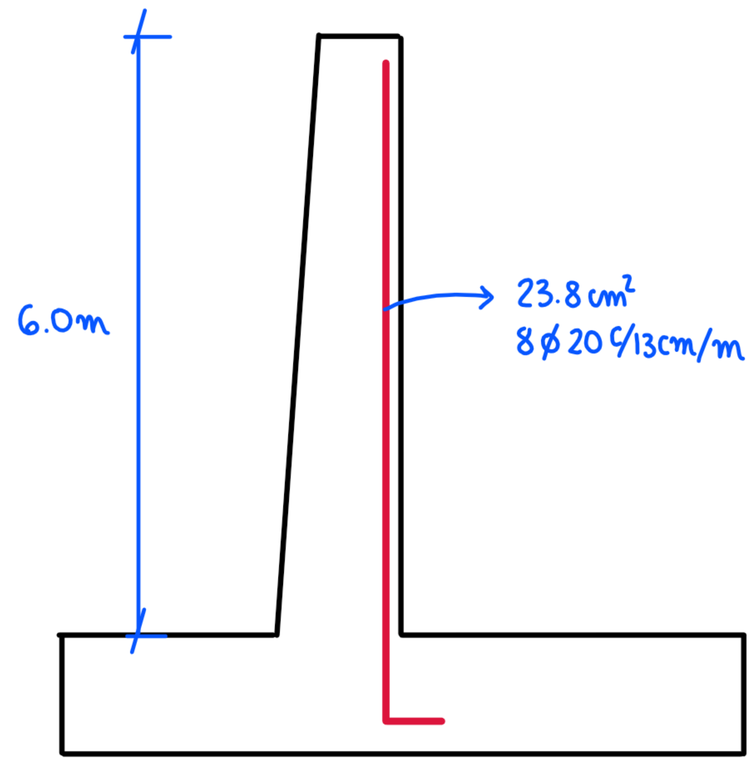
$$\varepsilon_s = 0.003\left(\frac{39.2 - 6.59}{6.59}\right) = 0.0148$$

$$A_s = \frac{0.85 f'_c \beta_1 c b}{f_y} = 0.085\frac{(21)}{4200}(0.85)(6.59)(1000) = 23.8\,cm^2$$

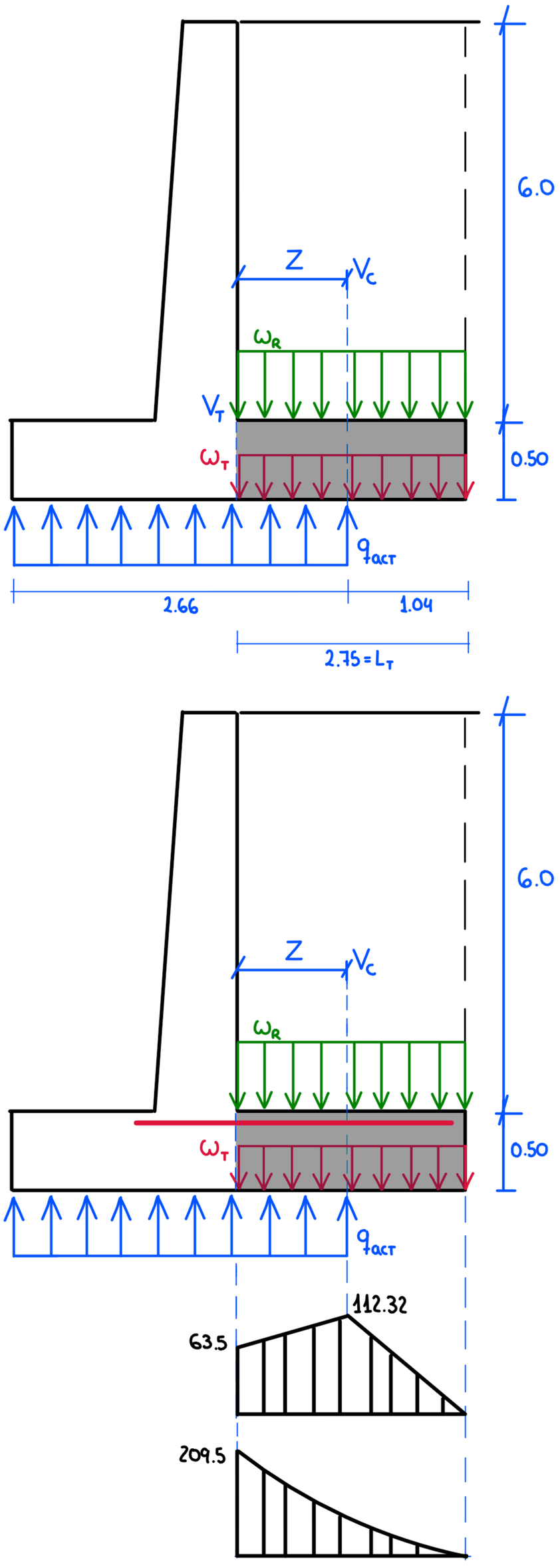
$$@ = \frac{(100)\,3.14}{23.8} = 13.2 \text{ cm}$$

$8\phi 20$ c/13 cm/m

$$N_b = \frac{23.8}{3.14} = 7.58 \simeq 8 \text{ BARRAS}$$



Diseño del Talón



REVISION POR CORTANTE

$$\phi V_c \geq V_u$$

$$d = 50 - 5 - \frac{1.6}{2} = 44.2\ cm$$

$$\omega_R = \gamma_s \cdot h = 96\ KN/m$$

$$\omega_T = \gamma_H \cdot h_f = 12\ KN/m$$

$$V_T = \omega_R(L_T) + \omega_T(L_T) - q_{act}(Z) = 63.5\ KN$$

$$V_c = \gamma_s \cdot h \cdot (L_T - Z) + \gamma_H \cdot h \cdot (L_T - Z) = 112.32\ KN$$

$$V_u = 1.6(112.32) = 179.71\ KN$$

$\phi V_c \geq V_u$ ✓ OK!

CALCULO DE LA ARMADURA DEL TALON

$$M_u = 1.6\left(264 * \frac{275^2}{2} + 33 * \frac{27.5^2}{2} - 136 * \frac{1.71^2}{2}\right)$$

$$M_u = 1.6(209.5) = 335.27\ KN.m$$

$$\frac{Mu}{\phi} = 0.85 f'_c \beta_1 cb\left(d - \frac{\beta_1 c}{2}\right)$$

$$\frac{335270000}{0.9} = 0.85(21)(0.85)(1000)c\left(442 - \frac{0.85c}{2}\right)$$

$$\rightarrow c = 5.89\ cm$$

$$A_s = 0.85\frac{f'_c}{f_y}\beta_1 b = 0.85\frac{21}{4200}(0.85)(5.89)(100) = 21.28\ cm^2$$

$$@ = \frac{(100)(3.14)}{21.28} = 14.76 \simeq 14\ cm$$

$$Nb = \frac{21.28}{3.14} = 6.7 \qquad 8\ \phi\ 20\ c/14\ cm/m$$

$$\omega_{RP} = 1.6(0.8 - 0.5)(0.5) = 2.4\ KN$$

$$\omega_p = 24(0.50)(0.50) = 6\ KN$$

$$M_p = 2.4\left(\frac{0.5}{2}\right) + 6\left(\frac{0.5}{2}\right) - 136.55\left(\frac{0.5^2}{2}\right) = -15.0\ KN.m$$

$$M_u = 1.6(15) = 24\ KN.m$$

$$\frac{Mu}{\phi} = 0.85 f'_c \beta_1 cb\left(d - \frac{\beta_1 c}{2}\right) \rightarrow c = 5.89\ cm$$

$$A_s = 0.85\frac{f'_c}{f_y}\beta_1 b = 1.30\ cm^2 < A_{s\,min}$$

$$A_{s\,min} = \frac{1.4}{f_y} b.d = 15\ cm^2$$