Program B4 3.x Fast/WinWord
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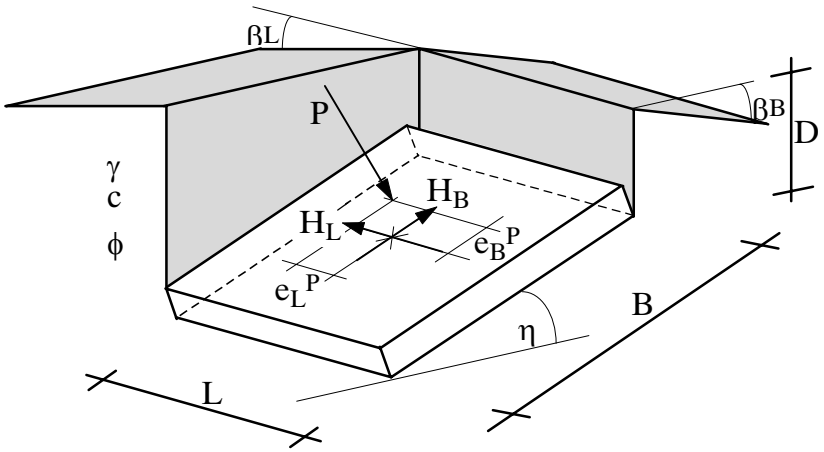
Študija dopustnih nosilnosti

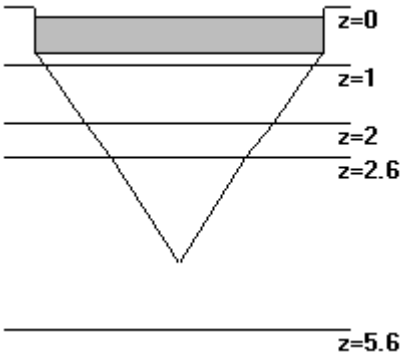
Maribor, 2. november 2002



Podani so štirje sloji. Njihove karakteristike so:

Sloj	Debelina m	c kN/m^2	ϕ ^{o}	γ kN/m^3
1	1.00000	20.0000	10.0000	18.5000
2	1.00000	25.0000	20.0000	19.0000
3	0.60000	30.0000	15.0000	19.5000
4	3.00000	35.0000	25.0000	18.5000

Temelj se nahaja v sloju 1
Globina klina H= 3.6390 m
ϕ_1= 21.283031574161
ϕ_1= 21.1527960867371



Izvedena širina temelja B= 4 m
Izvedena dolžina temelja L= 5 m
Minimalna globina temeljenja D=0.8 m

Prostorninska teža nad temeljem γ= 18.5 kN/m^3
Prostorninska teža pod temeljem γ'=18.802 kN/m^3

Strižni kot ϕ= 21.283^o F_ϕ= 1.5 $\phi_m = \arctan\left(\frac{\tan\phi}{F_\phi}\right) = 14.56^o$

Kohezija c= 30.603 kN/m^2 F_c= 2.5 $c_m = \frac{c}{F_c}$ = 12.2412 kN/m^2

Nagnjenost terena za temeljem v smeri širine B β_B= 0^o
Nagnjenost terena za temeljem v smeri dolžine L β_L= 0^o
Nagnjenost dna temelja v smeri širine B η= 0^o

Vertikalna komponenta sile P= 0 kN
Ekscentriciteta sile P v smeri širine B e_B^P= 0.000 m
Ekscentriciteta sile P v smeri dolžine L e_L^P= 0.000 m
Enakomerna zvezna obtežba q= 0 kPa
Celotna vertikalna obtežba $V = P + q \cdot B \cdot L =$ 0 kN

Ekscentriciteta sile V v smeri širine B $e_B^V = \frac{P}{V} \cdot e_B^P =$ 0.000 m

Ekscentriciteta sile V v smeri dolžine L $e_L^V = \frac{P}{V} \cdot e_L^P =$ 0.000 m

Koristna širina temelja $B' = B - 2 \cdot e_B^V =$ 4.000 m

Koristna dolžina temelja $L' = L - 2 \cdot e_L^V =$ 5.000 m

Horizontalna komponenta sile v smeri širine B H_B= 0 kN
Horizontalna komponenta sile v smeri dolžine L H_L= 0 kN

Rezultanta horizontalnih sil $H = \sqrt{H_B^2 + H_L^2} =$ 0.000 kN

Odpornostna sila na zdrs $F_{odp} = c \cdot B \cdot L + V \cdot \tan(\phi) =$ 244.824 kN

Sila se nahaja v jedru prereza!

Izračun po Terzaghiju - kvadratni temelji

Bowles, Foundations Analysis and Design, 5 th edition, 226-227

V računu upoštevam B= 4.00 in L= 5.00

Koeficienti N

$$a = e^{(0.75\cdot\pi-\phi/2)\cdot\tan\phi} = 1.7841$$

$$N_q = \frac{a^2}{2\cdot\cos^2(\pi/4+\phi/2)} = 4.2516$$

$$N_c = (N_q - 1)\cdot\cot\phi = 12.5208$$

$$K_{p\gamma} = 3\cdot\tan^2\left(\frac{\pi}{4}+\frac{\phi+33\cdot\pi/180}{2}\right) = 19.8972$$

$$N_\gamma = \frac{\tan\phi}{2}\cdot\left(\frac{K_{p\gamma}}{\cos^2\phi}-1\right) = 2.6280$$

Dopustna nosilnost

$$q_u = 1.3\cdot c\cdot N_c + \gamma\cdot D\cdot N_q + 0.4\cdot\gamma'\cdot B\cdot N_\gamma$$

= 199.250 + 62.923 + 79.058 = **341.232 kPa**

Izračun po Terzaghiju - pasovni temelji

Bowles, Foundations Analysis and Design, 5 th edition, 226-227

Dopustna nosilnost

$$q_u = c\cdot N_c + \gamma\cdot D\cdot N_q + 0.5\cdot\gamma'\cdot B\cdot N_\gamma$$

= 153.270 + 62.923 + 98.823 = **315.016 kPa**

Izračun po Meyerhofu

Bowles, Foundations Analysis and Design, 5 th edition, 226-227

Koeficienti N

$N_q = e^{\pi \cdot \tan\phi} \cdot \tan^2(\pi/4 + \phi/2) = 3.779$

$N_c = (N_q - 1) \cdot \cot\phi = 10.703$

$N_\gamma = (N_q - 1) \cdot \tan(1.4 \cdot \phi) = 1.033$

$K_p = \tan^2\left(\frac{\pi}{4} + \frac{\phi}{2}\right) = 1.672$

Koeficienti i - koeficienti rezultante koncentriranih sil

$\theta_B = \arctan\left(\frac{H_B}{V}\right) = 0.000$ $\theta_L = \arctan\left(\frac{H_L}{V}\right) = 0.000$

$i_{c,B} = i_{q,B} = \left(1 - \frac{\theta_B{}^o}{90^o}\right)^2 = 1.000$ $i_{c,L} = i_{q,L} = \left(1 - \frac{\theta_L{}^o}{90^o}\right)^2 = 1.000$

$i_{\gamma,B} = \left(1 - \frac{\theta_B{}^o}{\phi^o}\right)^2 = 1.000$ $i_{\gamma,L} = \left(1 - \frac{\theta_L{}^o}{\phi^o}\right)^2 = 1.000$

Koeficienti s in d - koeficienti oblike in globine temelja

$s_{c,L} = 1 + 0.2 \cdot K_p \cdot \frac{L}{B} = 1.267$ $s_{c,L} = 1 + 0.2 \cdot K_p \cdot \frac{L}{B} = 1.418$

$d_{c,L} = 1 + 0.2 \cdot \sqrt{K_p} \cdot \frac{D}{L} = 1.052$ $d_{c,L} = 1 + 0.2 \cdot \sqrt{K_p} \cdot \frac{D}{L} = 1.041$

$s_{q,L} = s_{\gamma,L} = 1 + 0.1 \cdot K_p \cdot \frac{L}{B} = 1.134$ $s_{q,L} = s_{\gamma,L} = 1 + 0.1 \cdot K_p \cdot \frac{L}{B} = 1.209$

$d_{q,L} = d_{\gamma,L} = 1 + 0.1 \cdot \sqrt{K_p} \cdot \frac{D}{L} = 1.026$ $d_{q,L} = d_{\gamma,L} = 1 + 0.1 \cdot \sqrt{K_p} \cdot \frac{D}{L} = 1.021$

Koeficienta ekscentricitete obtežbe

$\phi > 0$ $R_{e,B} = 1 - \frac{2 \cdot e_B{}^V}{B} = 1.000$ $R_{e,L} = 1 - \frac{2 \cdot e_L{}^V}{B} = 1.000$

Dopustna nosilnost

$q_{u,L} = \left(c \cdot N_c \cdot s_{c,L} \cdot d_{c,L} \cdot i_{c,L} + \gamma \cdot D \cdot N_q \cdot s_{q,L} \cdot d_{q,L} \cdot i_{q,L} + 0.5 \cdot \gamma \cdot L \cdot N_\gamma \cdot s_{\gamma,L} \cdot d_{\gamma,L} \cdot i_{\gamma,L}\right) \cdot R_{e,B} \cdot R_{e,L}$

= (174.640 + 65.055 + 45.161)·1.000 = **284.856 kPa**

$q_{u,L} = \left(c \cdot N_c \cdot s_{c,L} \cdot d_{c,L} \cdot i_{c,L} + \gamma \cdot D \cdot N_q \cdot s_{q,L} \cdot d_{q,L} \cdot i_{q,L} + 0.5 \cdot \gamma \cdot L \cdot N_\gamma \cdot s_{\gamma,L} \cdot d_{\gamma,L} \cdot i_{\gamma,L}\right) \cdot R_{e,B} \cdot R_{e,L}$

= (193.447 + 69.022 + 58.931)·1.000 = **321.400 kPa**

Izračun po Hansenu

Bowles, Foundations Analysis and Design, 5 th edition, 226-227

Koeficienti N

$N_q = e^{\pi \cdot \tan\phi} \cdot \tan^2(\pi/4 + \phi/2) = 3.779$

$N_c = (N_q - 1) \cdot \cot\phi = 10.703$

$N_\gamma = 1.5 \cdot (N_q - 1) \cdot \tan\phi = 1.083$

Koeficienti d - koeficienti globine temelja

$d_{\gamma,B} = d_{\gamma,L} = 1$

za $D \le B$ $\quad d_{q,B} = 1 + 2 \cdot \tan\phi \cdot (1 - \sin\phi)^2 \cdot \frac{D}{B} = 1.058$

za $D \le L$ $\quad d_{q,L} = 1 + 2 \cdot \tan\phi \cdot (1 - \sin\phi)^2 \cdot \frac{D}{L} = 1.047$

za $D \le B$ $\quad d_{c,B} = 1 + 0.4 \cdot \frac{D}{B} = 1.080$

za $D \le L$ $\quad d_{c,L} = 1 + 0.4 \cdot \frac{D}{L} = 1.064$

Koeficienti i - koeficienti rezultante koncentriranih sil

$c_a = 12.241$

$ul = V + B \cdot L \cdot c_a \cdot \cot\phi = 942.738$

$2 \le \alpha_1 \le 5 \rightarrow \alpha_1 = 3.000 \quad 2 \le \alpha_2 \le 5 \rightarrow \alpha_2 = 4.000$

$i_{q,B} = \left[1 - \frac{0.5 \cdot H_B}{ul}\right]^{\alpha_1} = 1.000 \qquad i_{q,L} = \left[1 - \frac{0.5 \cdot H_L}{ul}\right]^{\alpha_1} = 1.000$

$i_{\gamma,B} = \left[1 - \frac{\left(0.7 - \frac{\eta}{450}\right) \cdot H_B}{ul}\right]^{\alpha_2} = 1.000 \qquad i_{\gamma,L} = \left[1 - \frac{0.7 \cdot H_L}{ul}\right]^{\alpha_2} = 1.000$

$i_{c,B} = i_{q,B} - \frac{1 - i_{q,B}}{N_q - 1} = 1.000 \qquad i_{c,L} = i_{q,L} - \frac{1 - i_{q,L}}{N_q - 1} = 1.000$

Koeficienti s - koeficienti oblike temelja

$s_{q,B} = 1 + \frac{B' \cdot i_{q,B}}{L'} \cdot \sin\phi = 1.201 \qquad s_{q,L} = 1 + \frac{L' \cdot i_{q,L}}{B'} \cdot \sin\phi = 1.314$

$s_{\gamma,B} = 1 - 0.4 \cdot \frac{B'}{L'} \cdot \frac{i_{\gamma,B}}{i_{\gamma,L}} \ge 0.6 \rightarrow s_{\gamma,B} = 0.680 \qquad s_{\gamma,L} = 1 - 0.4 \cdot \frac{L'}{B'} \cdot \frac{i_{\gamma,L}}{i_{\gamma,B}} \ge 0.6 \rightarrow s_{\gamma,L} = 0.600$

$s_{c,B} = 1 + \frac{N_q}{N_c} \cdot \frac{B'}{L'} \cdot i_{c,B} = 1.283 \qquad s_{c,L} = 1 + \frac{N_q}{N_c} \cdot \frac{L'}{B'} \cdot i_{c,L} = 1.441$

Koeficienti b - koeficienti nagiba dna temelja

$b_{q,B} = e^{(-2 \cdot \eta \cdot \tan\phi)} = 1.000 \quad b_{q,L} = 1.000$

$b_{\gamma,B} = e^{(-2.7 \cdot \eta \cdot \tan\phi)} = 1.000 \qquad b_{\gamma,L} = 1.000$

$b_{c,B} = 1 - \frac{\eta}{147^o} = 1.000 \quad b_{c,L} = 1.000$

Koeficienti g - koeficienti nagiba temeljnih tal

$g_{q,B} = g_{\gamma,B} = (1.0 - 0.5 \cdot \tan\beta_B)^5 = 1.000$ $\quad g_{q,L} = g_{\gamma,L} = (1.0 - 0.5 \cdot \tan\beta_L)^5 = 1.000$

$g_{c,B} = 1 - \frac{\beta_B}{147^o} = 1.000$ $\quad g_{c,L} = 1 - \frac{\beta_L}{147^o} = 1.000$

Dopustna nosilnost

$$q_{u,B} = c \cdot N_c \cdot s_{c,B} \cdot d_{c,B} \cdot i_{c,B} \cdot g_{c,B} \cdot b_{c,B} + \gamma \cdot D \cdot N_q \cdot s_{q,B} \cdot d_{q,B} \cdot i_{q,B} \cdot g_{q,B} \cdot b_{q,B} + 0.5 \cdot \gamma' \cdot B' \cdot N_\gamma \cdot s_{\gamma,B} \cdot d_{\gamma,B} \cdot i_{\gamma,B} \cdot g_{\gamma,B} \cdot b_{\gamma,B}$$

$$= 181.468 + 71.095 + 27.686 = \mathbf{280.249\ kPa}$$

$$q_{u,L} = c \cdot N_c \cdot s_{c,L} \cdot d_{c,L} \cdot i_{c,L} \cdot g_{c,L} \cdot b_{c,L} + \gamma \cdot D \cdot N_q \cdot s_{q,L} \cdot d_{q,L} \cdot i_{q,L} \cdot g_{q,L} \cdot b_{q,L} + 0.5 \cdot \gamma' \cdot L' \cdot N_\gamma \cdot s_{\gamma,L} \cdot d_{\gamma,L} \cdot i_{\gamma,L} \cdot g_{\gamma,L} \cdot b_{\gamma,L}$$

$$= 200.931 + 76.934 + 30.536 = \mathbf{308.402\ kPa}$$

Izračun po Hansenu

Šuklje, Mehanika tal, 1984, 218-225

Koeficienta N

$$N_q = e^{\pi \cdot \tan\phi} \cdot \tan^2(\pi/4 + \phi/2) = 3.779$$

$$N_\gamma = 1.5 \cdot (N_q - 1) \cdot \tan\phi = 1.083$$

Koeficienti d - koeficienti globine temelja

$$d_{\gamma,B} = d_{\gamma,L} = 1$$

za $D \le B$ $\quad d_{q,B} = 1 + 2 \cdot \tan\phi \cdot (1 - \sin\phi)^2 \cdot \frac{D}{B'} = 1.058$

za $D \le L$ $\quad d_{q,L} = 1 + 2 \cdot \tan\phi \cdot (1 - \sin\phi)^2 \cdot \frac{D}{L'} = 1.047$

Koeficienti i - koeficienti rezultante koncentriranih sil

$$\chi_B = \frac{H_B}{V + B' \cdot L' \cdot c \cdot \cot\phi} = 0.000 \qquad \chi_L = \frac{H_L}{V + B' \cdot L' \cdot c \cdot \cot\phi} = 0.000$$

$$i_{q,B} = [1 - 0.5 \cdot \chi_B]^5 = 1.000 \qquad i_{q,L} = [1 - 0.5 \cdot \chi_L]^5 = 1.000$$

$$i_{\gamma,B} = [1 - 0.7 \cdot \chi_B]^5 = 1.000 \qquad i_{\gamma,L} = [1 - 0.7 \cdot \chi_L]^5 = 1.000$$

Koeficienti s - koeficienti oblike temelja

$$s_{q,B} = 1 + \frac{B'}{L'} \cdot \sin\phi = 1.201 \qquad s_{q,L} = 1 + \frac{L'}{B'} \cdot \sin\phi = 1.314$$

$$s_{\gamma,B} = 1 - 0.4 \cdot \frac{B'}{L'} \ge 0.6 \rightarrow s_{\gamma,B} = 0.680 \qquad s_{\gamma,L} = 1 - 0.4 \cdot \frac{L'}{B'} \ge 0.6 \rightarrow s_{\gamma,L} = 0.600$$

Koeficienti b - koeficienti nagiba dna temelja

$$b_{q,B} = e^{(-2 \cdot \eta \cdot \tan\phi)} = 1.000 \quad b_{q,L} = 1.000$$

$$b_{\gamma,B} = e^{(-2.7 \cdot \eta \cdot \tan\phi)} = 1.000 \qquad b_{\gamma,L} = 1.000$$

Koeficienti g - koeficienti nagiba temeljnih tal

$$g_{q,B} = g_{\gamma,B} = (1.0 - 0.5 \cdot \tan\beta_B)^5 = 1.000 \qquad g_{q,L} = g_{\gamma,L} = (1.0 - 0.5 \cdot \tan\beta_L)^5 = 1.000$$

Dopustna nosilnost

$$q_{u,B} = 0.5 \cdot \gamma' \cdot B' \cdot N_\gamma \cdot s_{\gamma,B} \cdot d_{\gamma,B} \cdot i_{\gamma,B} \cdot b_{\gamma,B} \cdot g_{\gamma,B} + (\gamma \cdot D + c \cdot \cot\phi) \cdot N_q \cdot s_{q,B} \cdot d_{q,B} \cdot i_{q,B} \cdot b_{q,B} \cdot g_{q,B} - c \cdot \cot\phi$$

$= \quad 27.686 \quad + \quad 297.527 \quad - \quad 47.137 \quad = \quad$ **278.076 kPa**

$$q_{u,L} = 0.5 \cdot \gamma' \cdot L' \cdot N_\gamma \cdot s_{\gamma,L} \cdot d_{\gamma,L} \cdot i_{\gamma,L} \cdot b_{\gamma,L} \cdot g_{\gamma,L} + (\gamma \cdot D + c \cdot \cot\phi) \cdot N_q \cdot s_{q,L} \cdot d_{q,L} \cdot i_{q,L} \cdot b_{q,L} \cdot g_{q,L} - c \cdot \cot\phi$$

$= \quad 30.536 \quad + \quad 321.965 \quad - \quad 47.137 \quad = \quad$ **305.363 kPa**

Izračun po Vesiću

Bowles, Foundations Analysis and Design, 5 th edition, 226-227

Koeficienti N

$N_q = e^{\pi \cdot \tan\phi} \cdot \tan^2(\pi/4 + \phi/2) = 3.779$

$N_c = (N_q - 1) \cdot \cot\phi = 10.703$

$N_\gamma = 2 \cdot (N_q + 1) \cdot \tan\phi = 2.482$

Koeficienti d - koeficienti globine temelja

$d_{\gamma,B} = d_{\gamma,L} = 1$

za $D \le B$ $\quad d_{q,B} = 1 + 2 \cdot \tan\phi \cdot (1 - \sin\phi)^2 \cdot \frac{D}{B} = 1.058$

za $D \le L$ $\quad d_{q,L} = 1 + 2 \cdot \tan\phi \cdot (1 - \sin\phi)^2 \cdot \frac{D}{L} = 1.047$

za $D \le B$ $\quad d_{c,B} = 1 + 0.4 \cdot \frac{D}{B} = 1.080$

za $D \le L$ $\quad d_{c,L} = 1 + 0.4 \cdot \frac{D}{L} = 1.064$

Koeficienti i - koeficienti rezultante koncentriranih sil

$c_a = 12.241$

$ul = V + B \cdot L \cdot c_a \cdot \cot\phi = 942.738$

$m_B = \frac{2 + B/L}{1 + B/L} = 1.556 \quad m_L = \frac{2 + L/B}{1 + L/B} = 1.444$

$i_{q,B} = \left[1 - \frac{H_B}{ul}\right]^{m_B} = 1.000 \qquad i_{q,L} = \left[1 - \frac{H_L}{ul}\right]^{m_L} = 1.000$

$i_{\gamma,B} = \left[1 - \frac{H_B}{ul}\right]^{m_B+1} = 1.000 \qquad i_{\gamma,L} = \left[1 - \frac{H_L}{ul}\right]^{m_L+1} = 1.000$

$i_{c,B} = i_{q,B} - \frac{1 - i_{q,B}}{N_q - 1} = 1.000 \qquad i_{c,L} = i_{q,L} - \frac{1 - i_{q,L}}{N_q - 1} = 1.000$

Koeficienti s - koeficienti oblike temelja

$s_{q,B} = 1 + \frac{B}{L} \cdot \tan\phi = 1.208 \qquad s_{q,L} = 1 + \frac{L}{B} \cdot \tan\phi = 1.325$

$s_{\gamma,B} = 1 - 0.4 \cdot \frac{B}{L} \ge 0.6 \rightarrow s_\gamma = 0.680 \qquad s_{\gamma,L} = 1 - 0.4 \cdot \frac{L}{B} \ge 0.6 \rightarrow s_\gamma = 0.600$

$s_{c,B} = 1 + \frac{N_q}{N_c} \cdot \frac{B}{L} = 1.283 \quad s_{c,L} = 1 + \frac{N_q}{N_c} \cdot \frac{L}{B} = 1.441$

Koeficienti b - koeficienti nagiba dna temelja

$b_{q,B} = b_{\gamma,B} = (1 - \eta \cdot \tan\phi)^2 = 1.000 \qquad b_{q,L} = b_{\gamma,L} = 1.000$

$b_{c,B} = 1 - \frac{2 \cdot \beta_B}{5.14 \cdot \tan\phi} = 1.000 \qquad b_{c,L} = 1 - \frac{2 \cdot \beta_L}{5.14 \cdot \tan\phi} = 1.000$

Koeficienti g - koeficienti nagiba temeljnih tal

$g_{q,B} = g_{\gamma,B} = (1.0 - \tan\beta_B)^2 = 1.000$ $\quad g_{q,L} = g_{\gamma,L} = (1.0 - \tan\beta_L)^2 = 1.000$

$g_{c,B} = i_{q,B} - \frac{1 - i_{q,B}}{5.14 \cdot \tan\phi} = 1.000$ $\quad g_{c,L} = i_{q,L} - \frac{1 - i_{q,L}}{5.14 \cdot \tan\phi} = 1.000$

Dopustna nosilnost

$$q_{u,B} = c \cdot N_c \cdot s_{c,B} \cdot d_{c,B} \cdot i_{c,B} \cdot g_{c,B} \cdot b_{c,B} + \gamma \cdot D \cdot N_q \cdot s_{q,B} \cdot d_{q,B} \cdot i_{q,B} \cdot g_{q,B} \cdot b_{q,B} + 0.5 \cdot \gamma' \cdot B \cdot N_\gamma \cdot s_{\gamma,B} \cdot d_{\gamma,B} \cdot i_{\gamma,B} \cdot g_{\gamma,B} \cdot b_{\gamma,B}$$

$= 181.468 + 71.490 + 63.477 =$ **316.435 kPa**

$$q_{u,L} = c \cdot N_c \cdot s_{c,L} \cdot d_{c,L} \cdot i_{c,L} \cdot g_{c,L} \cdot b_{c,L} + \gamma \cdot D \cdot N_q \cdot s_{q,L} \cdot d_{q,L} \cdot i_{q,L} \cdot g_{q,L} \cdot b_{q,L} + 0.5 \cdot \gamma' \cdot L \cdot N_\gamma \cdot s_{\gamma,L} \cdot d_{\gamma,L} \cdot i_{\gamma,L} \cdot g_{\gamma,L} \cdot b_{\gamma,L}$$

$= 200.931 + 77.544 + 70.011 =$ **348.487 kPa**