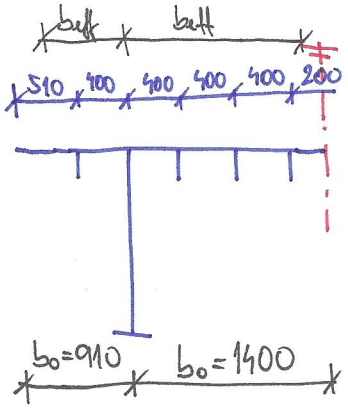
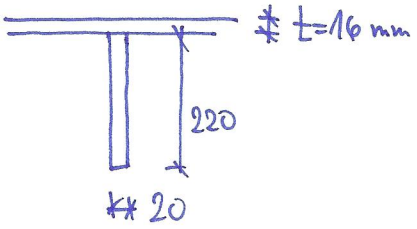
HORNÍ MOSTOVKA - SMYKOVÉ OCHABNUTÍ

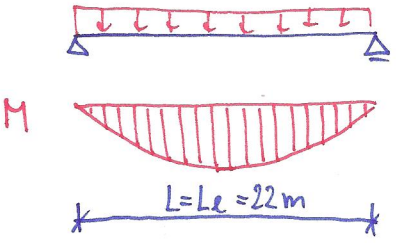


$$b_{eff} = \beta_{ult} \cdot b_0 = 0{,}932 \cdot 1400 = 1304 \text{ mm}$$

podélná výztuha



$$\alpha_0^* = \sqrt{\frac{A_{c,eff}}{b_0 \cdot t}} = \sqrt{\frac{63253}{1400 \cdot 16}} = 1{,}680$$

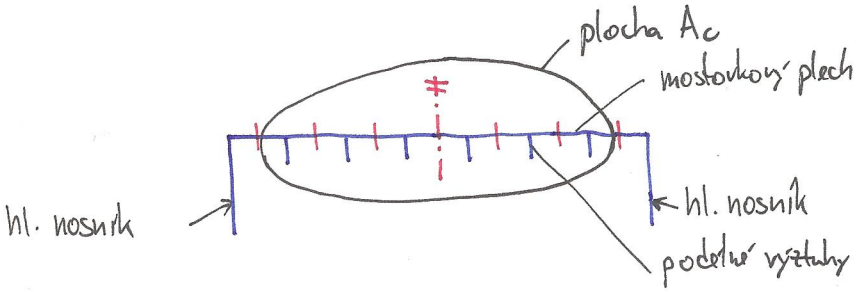


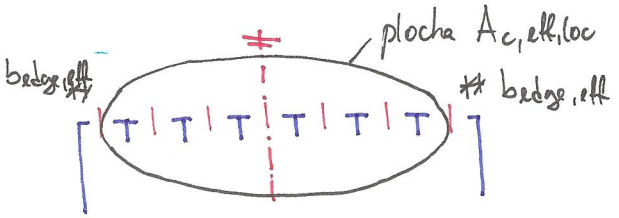
$$\chi = \frac{\alpha_0^* \cdot b_0}{L_e} = \frac{1{,}680 \cdot 1400}{22000} = 0{,}107$$

$$\beta_{ult} = \frac{1}{1 + 6{,}4 \cdot \chi^2} = \frac{1}{1 + 6{,}4 \cdot 0{,}107^2} = 0{,}932$$

▲ Účinná plocha tlačené zóny vyztužené stěny v důsledku boulení

$$A_{c,eff} = \rho_c \cdot A_{c,eff,loc} + \sum b_{edge,eff} \cdot t = 0{,}877 \cdot 64800 + 2 \cdot (200 \cdot 16) = 63253 \text{ mm}^2$$



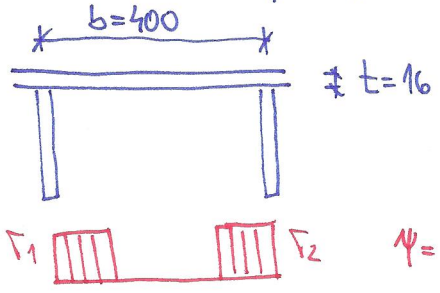


$$A_{c,eff,loc} = A_{s,eff} + \sum_c \rho_{loc} \cdot b_{c,loc} \cdot t$$

$$= 26400 + (2 \cdot 1 \cdot 200 + 5 \cdot 1 \cdot 400) \cdot 16 = 64800\ mm^2$$

$A_{s,eff} = 6 \times 20 \times 220 = 26400\ mm^2$ — plocha všech podélných výztuh v tlačené zóně (podélné výztuhy nebouli!)

lokální boulení mezi výztuhami podélnými



$$\psi = \frac{\sigma_2}{\sigma_1} = 1{,}0$$

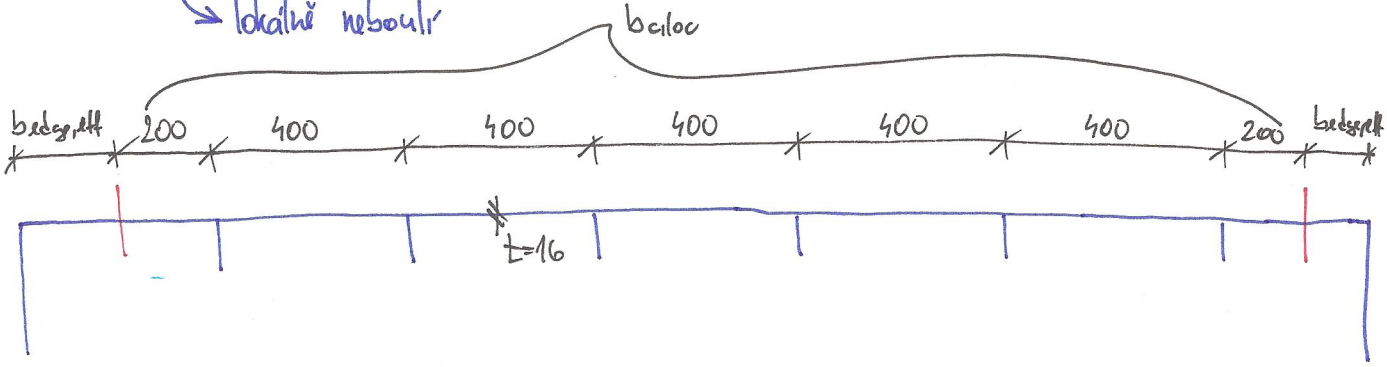
$$\bar{\lambda}_p = \sqrt{\frac{f_y}{\sigma_{cr}}} = \frac{\frac{b}{t}}{28{,}4 \cdot \varepsilon \cdot \sqrt{k_\sigma}} = \frac{\frac{400}{16}}{28{,}4 \cdot 0{,}814 \cdot \sqrt{4}} = 0{,}541$$

$$\varepsilon = \sqrt{\frac{235}{f_y}} = \sqrt{\frac{235}{355}} = 0{,}814$$

$k_\sigma = 4$ pro $\psi = 1$

$$\rho_{loc} = 1{,}0 \quad \text{pro} \quad \bar{\lambda}_p \le 0{,}5 + \sqrt{0{,}085 - 0{,}055 \cdot \psi} = 0{,}5 + \sqrt{0{,}085 - 0{,}055 \cdot 1} = 0{,}673$$

↳ lokálně neboulí



$$b_{edge,eff} = b_{edge} \cdot \rho_{loc} = 200 \cdot 1 = 200\ mm$$

▲ Výsledný součinitel boulení

$$\rho_c = (\rho - \chi_c)\cdot\xi\cdot(2-\xi) + \chi_c$$

$$= (1-0{,}877)\cdot 0\cdot(2-0) + 0{,}877 = 0{,}877$$

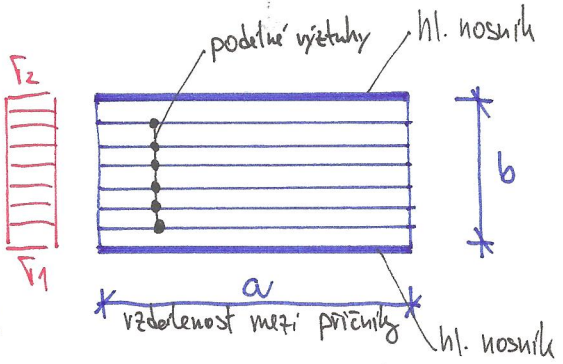
$$\xi = \frac{\bar{\lambda}_{cr,p}}{\bar{\lambda}_{cr,c}} - 1 = \frac{2049{,}63}{2148{,}62} - 1 = -0{,}046 \Rightarrow \xi = 0$$

- stěnové chování

$$\bar{\lambda}_{cr,p} = k_{\bar{\lambda},p}\cdot\bar{\lambda}_E = 330{,}37\cdot 6{,}20 = 2049{,}63\ \text{MPa}$$

$$\bar{\lambda}_E = \frac{\pi^2\cdot E\cdot t^2}{12\cdot(1-\nu^2)\cdot b^2} = 190000\left(\frac{t}{b}\right)^2 = 190000\left(\frac{16}{2800}\right)^2 = 6{,}20\ \text{MPa}$$

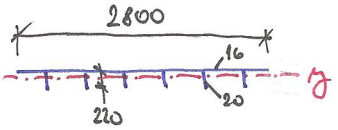
součinitel kritického napětí $k_{\bar{\lambda},p}$



$$\alpha = \frac{a}{b} = \frac{2200}{2800} = 0{,}786$$

$$\gamma = \frac{I_{sl}}{I_p} = \frac{3{,}39\cdot 10^8}{1{,}05\cdot 10^6} = 322{,}52$$

$$\psi = \frac{\bar{\lambda}_2}{\bar{\lambda}_1} = 1{,}0$$



$$I_{sl} = 3{,}39\cdot 10^8\ \text{mm}^4$$

$$I_p = \frac{b\cdot t^3}{12\cdot(1-\nu^2)} = \frac{b\cdot t^3}{10{,}92} = 1{,}05\cdot 10^6\ \text{mm}^4$$

$$\delta = \frac{\Sigma A_{sl}}{A_p} = \frac{6\cdot 20\cdot 220}{2800\cdot 16} = 0{,}589$$

$$k_{\bar{\lambda},p} = \frac{2\cdot\left((1+\alpha^2)^2+\gamma(1-1)\right)}{\alpha^2\cdot(\psi+1)\cdot(1+\delta)} = \frac{2\cdot\left((1+0{,}786^2)^2+322{,}52-1\right)}{0{,}786^2\cdot(1+1)\cdot(1+0{,}589)} = 330{,}37$$

pro $\alpha = 0{,}786 \le \sqrt[4]{\gamma} = \sqrt[4]{322{,}52} = 4{,}238$

poměrná štíhlost stěny

$$\bar{\lambda}_p = \sqrt{\frac{\beta_{A,c} \cdot f_y}{\sigma_{cr,p}}} = \sqrt{\frac{1.355}{2049,63}} = 0,416$$

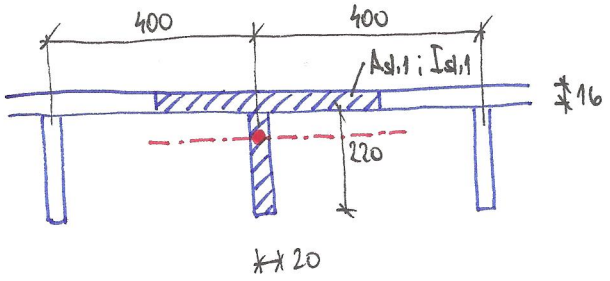
$$\beta_{A,c} = \frac{A_{c,eff,loc}}{A_c} = \frac{64800}{64800} = 1,0$$

$$A_c = 6 \times 20.220 + 2400.16 = 64800 \text{ mm}^2$$

$$\rho = 1,0 \quad \text{pro} \quad \bar{\lambda}_p = 0,416 \leq 0,5 + \sqrt{0,085 - 0,055 \cdot \psi} = 0,673 \quad \text{pro } \psi = 1,0$$

- průřezové chování

$$\sigma_{cr,c} = \frac{\pi^2 \cdot E \cdot I_{sl,1}}{A_{sl,1} \cdot a^2} = \frac{\pi^2 \cdot 210000 \cdot 5{,}419 \cdot 10^7}{10\,800 \cdot 2200^2} = 2148{,}62 \text{ MPa}$$



$$A_{sl,1} = 400 \cdot 16 + 20 \cdot 220 = 10\,800 \text{ mm}^2$$

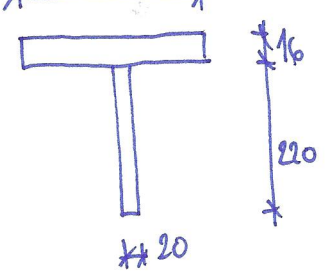
$$I_{sl,1} = 5{,}419 \cdot 10^7 \text{ mm}^4$$

poměrná průřezová štíhlost pro vyztužený stěny

$$\bar{\lambda}_c = \sqrt{\frac{\beta_{A,c} \cdot f_y}{\sigma_{cr,c}}} = \sqrt{\frac{1{,}0 \cdot 355}{2148{,}162}} = 0{,}406$$

$$\beta_{A,c} = \frac{A_{sl,1,eff}}{A_{sl,1}} = \frac{10\,800}{10\,800} = 1{,}0$$

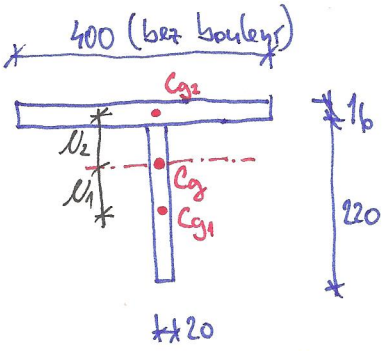
$\rho_{loc} \cdot 400 = 1{,}0 \cdot 400 = 400 \Rightarrow A_{sl,1} = A_{sl,1,eff}$



$$\phi = 0{,}5\left[1 + \alpha_e \cdot (\bar{\lambda}_c - 0{,}2) + \bar{\lambda}_c^2\right] =$$

$$\alpha_e = \alpha + \frac{0{,}09}{\frac{i}{e}} = 0{,}49 + \frac{0{,}09}{\frac{70{,}8}{69{,}9}} = 0{,}579$$

$$i = \sqrt{\frac{I_{sl,1}}{A_{sl,1}}} = \sqrt{\frac{5{,}419 \cdot 10^7}{10\,800}} = 70{,}8 \text{ mm}$$



$$e = \max\{e_1 ; e_2\} = \max\{48{,}1 ; 69{,}9\} = 69{,}9 \text{ mm}$$

$$\phi = 0{,}5\left[1 + 0{,}579 \cdot (0{,}406 - 0{,}2) + 0{,}406^2\right] = 0{,}642$$

$$\chi_c = \frac{1}{\phi + \sqrt{\phi^2 - \bar{\lambda}_c^2}} = \frac{1}{0{,}642 + \sqrt{0{,}642^2 - 0{,}406^2}} = 0{,}877$$