

Betonnkonstruktivitet, maj 15. oppg 1 ^{1/2}

Spm 1

$$M_{midt} = \frac{1}{8} p L^2 + \frac{1}{4} P_1 L - P_2 a$$
$$= \frac{1}{8} \cdot 30 \cdot 6^2 + \frac{1}{4} \cdot 480 \cdot 6 - 120 \cdot 2 = 615,0 \text{ kNm}$$

⑤

Spm 2

V_i beregner materialparametre

$$f_{cd} = f_{cu} / \gamma_c = 25 / 1,43 = 17,48 \text{ MPa}$$

$$f_{yd} = f_{yk} / \gamma_s = 500 / 1,2 = 416,7 \text{ MPa}$$

$$E_{yd} = f_{yd} / \epsilon_s = 416,7 / 2 \cdot 10^{-3} = 2,08 \cdot 10^5$$

$$E_{cu} = 5\% \text{ (Klasse B stål)}$$

$$E_{cu3} = 3,5\%$$

Krav for normalt armeret tværsnit

$$E_{yd} \leq E_s \leq E_{cu}$$

hvor

$$E_s = \frac{E_{cu3}}{\lambda} (d - x)$$

$$x = \gamma / \lambda \quad \text{hvor } \lambda = 0,8$$

$$\gamma = \frac{A_s f_{yd}}{b \cdot f_{cd}} \text{ (ligning)}$$

V_i finner

Trærsnit	a	b	c	d	e
y (mm)	48,49	18,18	72,73	113,6	163,6
x (mm)	60,61	22,73	90,91	142,0	207,5
E_s	$1,18 \cdot 10^{-2}$ OK	$6,81 \cdot 10^{-3}$ Under- armeret	$1,06 \cdot 10^{-2}$ OK	$7,96 \cdot 10^{-3}$ OK	$1,03 \cdot 10^{-2}$ Over- armeret

①, ②, ③

Spm 3

$$f_{cu} = 25 \text{ MPa} \Rightarrow \alpha = 25 \text{ (Langtids)} \\ \text{Tab 4.1}$$

$$S_f(x) = b x \cdot \frac{x}{2} - \alpha A_s (d - x) = 0 \Rightarrow \\ x = 288,7 \text{ mm}$$

Kontrol

$$S_f(x) = 300 \cdot 288,7 \cdot 288,7/2 \\ - 25 \cdot 477 (24/2)^2 \cdot (565 - 288,7) \\ = 1,250 \cdot 10^7 - 1,250 \cdot 10^7 = 0$$

$$I_f(x) = \frac{1}{12} b x^3 + b x (x/2)^2 + \alpha A_s (d - x)^2 \\ = \frac{1}{12} \cdot 300 \cdot 288,7^3 + 300 \cdot 288,7 \cdot (288,7/2)^2 \\ + 25 \cdot 477 (24/2)^2 (565 - 288,7)^2 \\ = 5,860 \cdot 10^9 \text{ mm}^4$$

$$EI = EC \cdot I_f = \frac{EC}{\gamma} I_f = \frac{2 \cdot 10^5}{25} \cdot 5,860 \cdot 10^9 \\ = 4,688 \cdot 10^{13} \text{ Nm}^2$$

$$v = \frac{5}{386} \frac{PL^4}{EI} = \frac{5}{386} \cdot \frac{15 \cdot 6000^4}{4,688 \cdot 10^{13}} = 5,4 \text{ mm} \\ \textcircled{6}$$