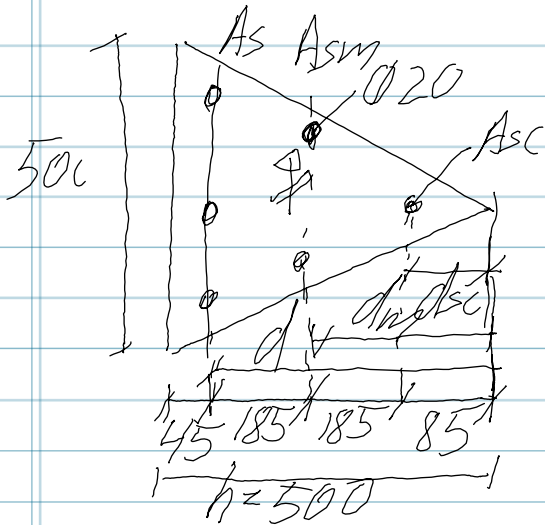


DTU Betonkonstruktioner

1/4



$$f_{cd} = 35 / 1,45 = 24,1 \text{ MPa}$$

$$f_{yd} = 500 / 1,2 = 417 \text{ MPa}$$

Punkt A (Traktflydning i armeringen)

$$N_{ed} = -(A_s \sigma_s + A_{sm} \sigma_{sm} + A_{sc} \sigma_{sc})$$

$$= -(A_s + A_{sm} + A_{sc}) f_y$$

$$= -6\pi (20/2)^2 \cdot 417 = -785,4 \cdot 10^3 \text{ N} = \underline{\underline{-785,4 \text{ kN}}}$$

$$M_{ed} = A_s \sigma_s (d - h/2) + A_{sm} \sigma_{sm} (d_m - h/2) - A_{sc} \sigma_{sc} (h/2 - d_m)$$

$$= 3\pi (20/2)^2 (455 - 500/2) \cdot 417$$

$$+ 2\pi (20/2)^2 \cdot 417 (270 - 500/2)$$

$$- \pi (20/2)^2 \cdot 417 (500/2 - 85)$$

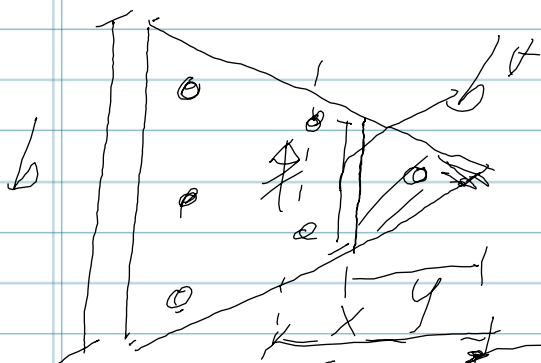
$$= 64,1 \cdot 10^6 \text{ Nmm} = \underline{\underline{64,1 \text{ kNm}}}$$

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DTU Beton Hønstrekkhorør

Punkt B (Ker begynn)

$$N_{rd} = 0 \text{ kN}$$



$$N = A_{cp} \cdot f_{cd} - A_s f_{yd} = 0$$

$$\Rightarrow A_{cp} = \frac{N + A_s f_{yd}}{f_{cd}}$$

$$= \frac{0 + 3\pi(20/2)^2 \cdot 417}{24,1}$$

$$= 16269 \text{ mm}^2$$

$$A_{cp} = \frac{1}{2} b \cdot y = \frac{1}{2} (b \cdot \frac{y}{x}) y$$

$$y = \sqrt{2 A_{cp} \cdot h/b} = \sqrt{2 \cdot 16269 \cdot 500/575}$$

$$= 168,2 \text{ mm} \Rightarrow x = y/\alpha = 168,2/0,8 = 210,2 \text{ mm}$$

$$\epsilon_s = \frac{\epsilon_{cu3}}{x} (d - x) = \frac{3,5\%}{210,2} (455 - 210,2) = 4,1\%$$

$$\epsilon_{yd} = \frac{f_{yd}}{E_s} = \frac{417}{2 \cdot 10^5} = 2,085\%$$

$$\epsilon_s = 4,1\% < \epsilon_{cu4} = 5\% = 50\%$$

$$\epsilon_s = 4,1\% < \epsilon_{cu4} = 5\% = 50\%$$

Flydning OK!

$$M_{rd} = A_s f_{yd} (d - h/2) + A_{cp} f_{cd} (h/2 - \frac{2}{3} y)$$

$$= 3\pi(20/2)^2 \cdot 417 (455 - 500/2)$$

$$+ 16269 \cdot 24,1 (500/2 - \frac{2}{3} \cdot 168,2)$$

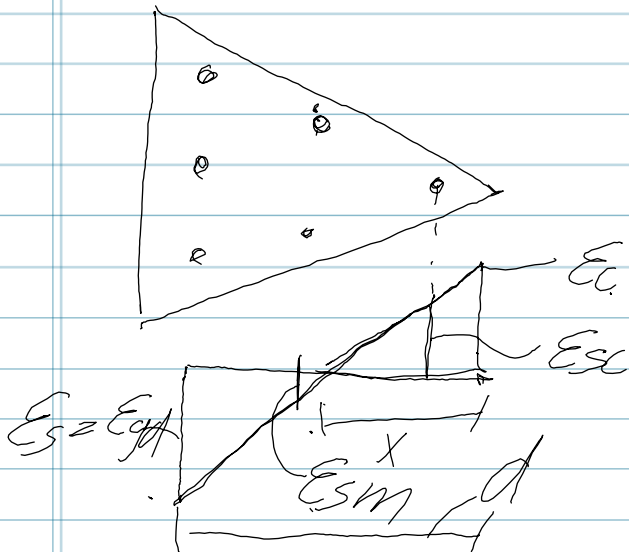
$$= 134,6 \cdot 10^6 \text{ Nmm} = 134,6 \text{ kNm}$$

(All stenger med (iteration i Excel))
 $\Rightarrow M_{rd} = 158,4 \text{ kNm}$

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DTU Betonkonstruktioner

Punkt C ($E_c = E_{c3}$, $E_s = E_{yd}$)



$$\sigma_s = E_s \epsilon_s \leq f_{yd}$$

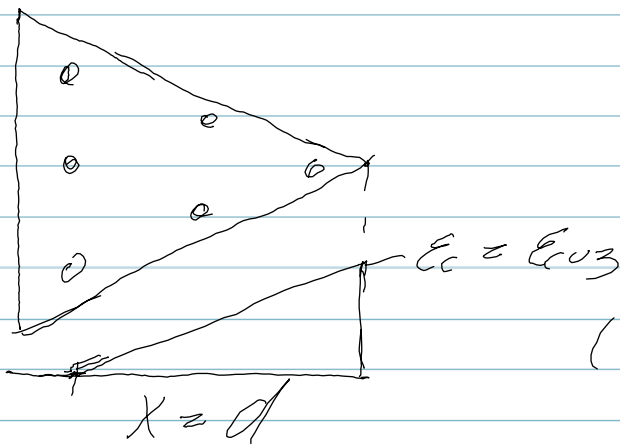
$$|\sigma_{sm} = E_s \epsilon_{sm}| \leq f_{yd}$$

$$E_c = E_{c3} \quad \sigma_{sc} = E_s \epsilon_{sc}$$

$$(Iteration i \times 50^\circ \quad E_s = E_{yd})$$

$$\Rightarrow N_{rd} = 484,4 \text{ kN} \quad M_{rd} = 172,4 \text{ kNm}$$

Punkt D ($E_c = E_{c3}$, $E_s = 0$)



$$(Iteration i \times 50^\circ \quad E_s = 0)$$

$$\Rightarrow N_{rd} = 2148,7 \text{ kN} \quad M_{rd} = 31,5 \text{ kNm}$$

DTU Betonkonstruktører

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Punkt E (jern tryktoejning, $E \equiv E_{c3}$)

$$E_{c3} = 2900 = E_s = E_{sc} = E_{sm}$$

$$\Rightarrow \sigma_s = \sigma_{sm} = \sigma_{sc} = 2900 \cdot 2 \cdot 10^{-5} = 400 \text{ MPa} \leq f_{yp}$$

$$= 417 \text{ MPa}$$

$$N_{rd} = \frac{1}{2} b \cdot h \cdot f_{cd} + (A_s + A_{sc} + A_{sm}) \cdot \sigma_s$$

$$= \frac{1}{2} \cdot 575 \cdot 500 \cdot 24,1 + 6\pi(20/2)^2 \cdot 400$$

$$= 4223,8 \cdot 10^3 \text{ N} = \underline{4223,8 \text{ kN}}$$

$$M_{rd} = \frac{1}{2} b h f_{cd} \left(h/2 - \frac{2}{3} h \right) - A_s \cdot \sigma_s (d - h/2)$$

$$- A_{sm} \sigma_{sm} (d_{sm} - h/2)$$

$$+ A_{sc} \sigma_{sc} (h/2 - d_{sc})$$

$$= \frac{1}{2} \cdot 575 \cdot 500 \cdot 24,1 \left(500/2 - \frac{2}{3} \cdot 500 \right)$$

$$- 3\pi(20/2)^2 \cdot 400 (455 - 500/2)$$

$$- 2\pi(20/2)^2 \cdot 400 (270 - 500/2)$$

$$+ \pi(20/2)^2 \cdot 400 (500/2 - 85)$$

$$= -227,6 \cdot 10^6 \text{ Nmm} = \underline{-227,6 \text{ kNm}}$$

Punkt	$N_{rd} \text{ (kN)}$	$M_{rd} \text{ (kNm)}$
A	-785,4	64,1
B	0	137,6 (158,4)
C	4844	172,4
D	2178,7	3,5
E	4223,8	-227,6

