Konstruktion B – m: Några typiska provuppgifter på G-nivå

1. — (Ingår ej i kursen.)

2. $\tau = \frac{V}{A}$, $A = l \cdot b$, $b = 50$ mm, $\tau = 15$ N/mm², $V = 22$ kN

$$\tau = \frac{V}{l \cdot b} \Rightarrow l = \frac{V}{\tau \cdot b} = \frac{22 \cdot 10^3}{15 \cdot 50} = 29{,}33 \text{ mm} < \underline{30{,}0 \text{ mm}}$$ (R)

3. Nitdiameter 13 mm ⇒ Nithålsdiameter 14 mm

a) $\tau = \frac{V}{A}$, $A = \pi \cdot r^2 = \pi \cdot \left(\frac{d}{2}\right)^2 = \frac{\pi d^2}{4}$, $d = 14$ mm, $V = 15$ kN

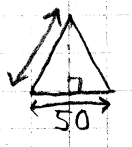
$$\tau = \frac{V}{\left(\frac{\pi d^2}{4}\right)} = \frac{4 \cdot V}{\pi \cdot d^2} = \frac{4 \cdot 15 \cdot 10^3}{\pi \cdot 14^2} = \underline{97{,}4 \text{ MPa}}$$

b) $$\sigma_H = \frac{F}{n \cdot t \cdot D} = \frac{15 \cdot 10^3}{1 \cdot 5 \cdot 14} = 214{,}3 \text{ MPa} \approx \underline{210 \text{ MPa}}$$

c) $\sigma = \frac{N}{A}$, $A = b \cdot t - D \cdot t = (b - D) \cdot t$

$$\sigma = \frac{15 \cdot 10^3}{(40 - 14) \cdot 5{,}0} = 115{,}4 \text{ MPa} \approx \underline{120 \text{ MPa}}$$

4. a) $\tau = \frac{V}{A}$



Pythagoras sats
$a^2 + b^2 = c^2$
$c = \sqrt{a^2 + b^2} = \sqrt{\left(\frac{50}{2}\right)^2 + 70^2} =$
$= 74{,}33$ mm

$A = \underbrace{(50 + 2c)}_{\text{omkretsen}} \cdot 3{,}0 = 595{,}98 \text{ mm}^2$

$\tau = 290 \text{ N/mm}^2$

$V = \tau \cdot A = 290 \cdot 595{,}98 = 172{,}8 \text{ kN} < \underline{0{,}18 \text{ MN}}$

b) $\sigma = \frac{N}{A}$, $A = \frac{b \cdot h}{2}$

$$\sigma = \frac{N}{\left(\frac{b \cdot h}{2}\right)} = \frac{2 \cdot N}{b \cdot h} = \frac{2 \cdot 172{,}8 \cdot 10^3}{50 \cdot 70} = 98{,}7 \text{ N/mm}^2 \approx \underline{99 \text{ MPa}}$$

5. —

6. —

7. —

8. —

9.

a) $M_{bmax} = F \cdot \frac{ab}{L}$ (belastningsfall [6])

$M_{bmax} = 830 \cdot \frac{0{,}75 \cdot (3{,}0 - 0{,}75)}{3{,}0} = 466{,}9 \text{ Nm} \approx \underline{0{,}47 \text{ kNm}}$

$M_b = M_{bmax}$

b) $\sigma_{bmax} = \frac{M_b}{W_b} = \frac{M_b}{\frac{B \cdot H^2}{6}} = \frac{6 M_b}{B \cdot H^2} = \frac{6 \cdot 466{,}9 \cdot 10^3}{120 \cdot 45^2} = 11{,}53 \text{ N/mm}^2 \approx$ (m → mm)

$\approx 12 \text{ N/mm}^2$

$= \underline{12 \text{ MPa}}$

$W_b = \frac{B \cdot H^2}{6}$

c)* $f = \frac{Fa^2b^2}{3EIL} = \frac{830 \cdot (0{,}75 \cdot 10^3)^2 \cdot ((3{,}0 - 0{,}75) \cdot 10^3)^2}{3 \cdot 8{,}0 \cdot 10^3 \cdot \left(\frac{120 \cdot 45^3}{12}\right) \cdot 3{,}0 \cdot 10^3} = 36{,}02 \text{ mm} \approx \underline{36 \text{ mm}}$

[6]

$I = \frac{B \cdot H^3}{12}$

* Ingår inte.

10.

a) $M_{bmax} = F \cdot L$, $F = mg$

↑ belastningsfall [2]

$M_{bmax} = mgL = 65 \cdot 9{,}82 \cdot 0{,}85 = 542{,}55 \text{ Nm} \approx \underline{0{,}54 \text{ kNm}}$

b) $\sigma_{bmax} = \frac{M_b}{W_b} = \frac{542{,}55 \cdot 10^3}{2{,}225 \cdot 10^3} = 243{,}81 \text{ N/mm}^2 = \underline{240 \text{ N/mm}^2}$

$W_b = \frac{\pi(D^4 - d^4)}{32 \cdot D} = \frac{\pi(35^4 - (35 - 2 \cdot 3{,}0)^4)}{32 \cdot 35} = 2{,}225 \cdot 10^3 \text{ mm}^3$

c)* $f = \frac{F \cdot L^3}{3EI} = \frac{mgL^3}{3EI} = \frac{65 \cdot 9{,}82 \cdot (0{,}85 \cdot 10^3)^3}{3 \cdot 2{,}1 \cdot 10^5 \cdot 38{,}94 \cdot 10^3} = 15{,}98 \text{ mm} = \underline{16{,}0 \text{ mm}}$

$E = 2{,}1 \cdot 10^5 \text{ MPa}$

$I = \frac{\pi(D^4 - d^4)}{64} = \frac{\pi(35^4 - (35 - 2 \cdot 3{,}0)^4)}{64} = 38{,}94 \cdot 10^3 \text{ mm}^4$

* Ingår inte

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11. $\sigma_{bmax} = \frac{M_b}{W_b} = \frac{\frac{F \cdot L}{4} + \frac{m_g g L^2}{8}}{W_b} < 85 \text{ N/mm}^2$

Sätt in m_g och W_b för olika balkar.
IPE 140 ⇒ 83,48 N/mm²

Belastningsfall [5] + [10]

[5] $M_{bmax5} = \frac{FL}{4}$

[10] $M_{bmax10} = \frac{QL}{8} = \frac{qL^2}{8}$

$\Big\}$ $M_{bmax} = \frac{F \cdot L}{4} + \frac{qL^2}{8}$, $q = m_g g$

$1 \text{ cm}^3 = 1000 \text{ mm}^3$

$\dim[m_g] = \text{kg/m} = 10^{-3} \text{ kg/mm}$

Konstruktion B-m: Några typiska provuppgifter på G-nivå

12. a) $M_{bmax} = \frac{QL}{8} = \frac{mgL}{8} = \frac{296 \cdot 9,82 \cdot 1600}{8} = 581344$ Nmm

$M_b = M_{bmax}$ ← belastningsfall [10]

$\sigma_{bmax} = \frac{M_b}{W_b}$

$W_b = W_x = \frac{B \cdot H^2}{6} = \frac{63 \cdot 95^2}{6} = 94762,5$ mm³

$\sigma_{bmax} = \frac{M_b}{W_b} = \frac{581344}{94762,5} = 6,13$ N/mm²

b)*

$f = \frac{5QL^3}{384EI} = \frac{5 \cdot 296 \cdot 9,82 \cdot 1600^3}{384 \cdot 8,0 \cdot 10^3 \cdot 4501218,75} = 4,3$ mm

$I = I_x = \frac{B \cdot H^3}{12} = \frac{63 \cdot 95^3}{12} = 4501218,75$ mm⁴

$E = 8,0 \cdot 10^3$ N/mm²

*Ingår ej

13.* Belastningsfall [5]

$M_{bmax} = \frac{F \cdot L}{4} = \frac{430 \cdot 900}{4} = 96750$ Nmm

$M_b = M_{bmax}$

$\sigma_{bmax} = \frac{M_b}{W_b} = \frac{96750}{17,0 \cdot 10^3} = 5,69$ N/mm²

$W_b = 17,0$ cm³ $= 17,0 \cdot 10^3$ mm³ ← VKR 70×70×3,0

$\sigma = \frac{N}{A} = \frac{430}{8,00 \cdot 10^2} = 0,5375$ N/mm²

$\sigma_{tot} = \sigma_{bmax} + \sigma = 5,69 + 0,5375 \approx 6,23$ N/mm² (undertanten)

* Ingår ej

Vi har dessutom snittmetoden och Steiners sats.
Se läroboken för övningar på detta.