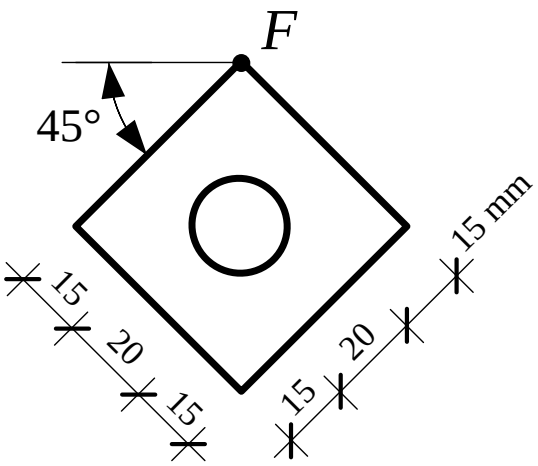
OTPORNOST MATERIJALA II **GRUPA "C"**

I turnus

1. klauzurni rad, 16. 04. 2008.

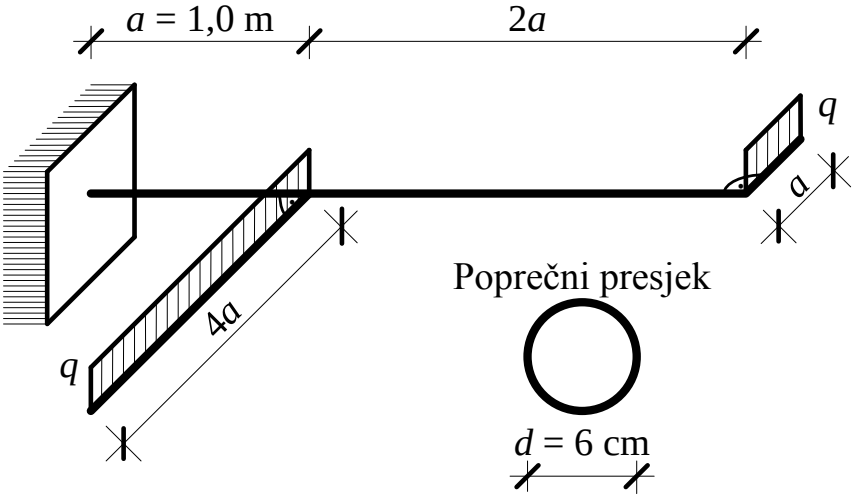
Ime i prezime :

1. Na štap zadanog poprečnog presjeka djeluje ekscentrična vlačna sila F = 20 kN prema slici. Primjenom jezgre poprečnog presjeka treba odrediti ekstremna normalna naprezanja u zadanom presjeku i nacrtati dijagram naprezanja u najviše napregnutom presjeku.

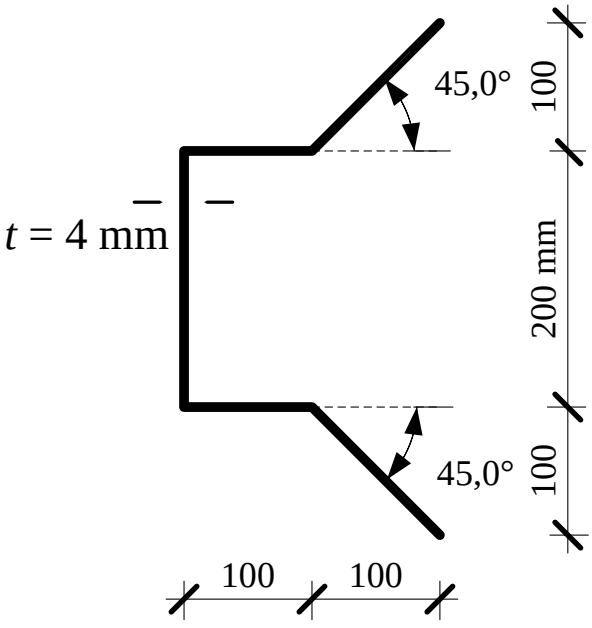


2. Štap konstantnog poprečnog presjeka promjera d = 6 cm nalazi se u horizontalnoj ravnini i opterećen je s vertikalnim opterećenjem kao što je prikazano na slici. Dopušteno naprezanje $\sigma_{dop} = 140\,MPa$.

Treba odrediti dopušteno opterećenje q prema teoriji potencijalne energije promjene oblika.



3. Treba odrediti položaj središta posmika otvorenog tankostijenog profila i nacrtati pripadni dijagram posmičnih naprezanja.



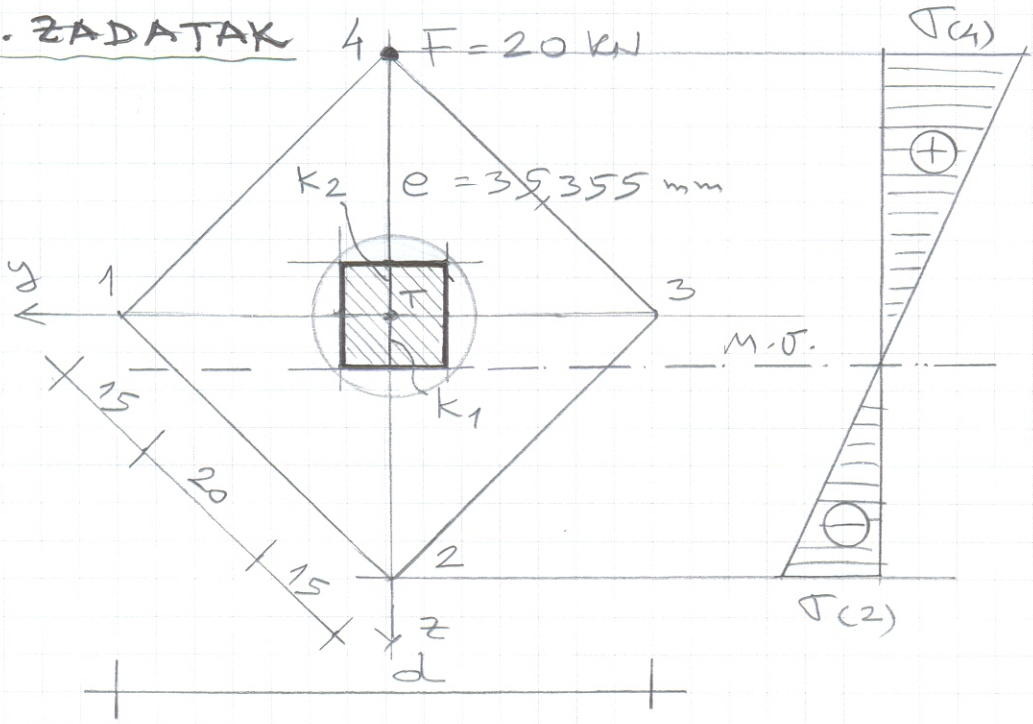
SVEUČILIŠTE U ZAGREBU
GRAĐEVINSKI FAKULTET
UNIVERSITY OF ZAGREB
FACULTY OF CIVIL ENGINEERING

Datum: 16.04.2008.

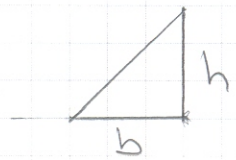
OTPORNOST MATERIJALA 2

1. KOLOKVIJ - GRUPA C

1. ZADATAK



$d = \sqrt{50^2 + 50^2} = 70,71$ mm



$A = 2185,84 \text{ mm}^2$

$J_y = J_z = 2 \cdot \frac{b \cdot h^3}{12} - \frac{D^4 \pi}{64} = 512,963 \cdot 10^3 \text{ mm}^4$

$i_y = i_z = \sqrt{\frac{J_y}{A}} = 15,32$ mm $\quad i_y^2 = i_z^2 = 234,66 \text{ mm}^2$

TOČKA ① $\quad y = +35,355$ mm $\quad z = \phi$

$a_y = -\frac{i_z^2}{y} = -6,64$ mm $\quad a_z = -\frac{i_y^2}{z} = \infty$

$\sigma_{max\,min} = \frac{F}{A}\left(1 \pm \frac{e}{k_{1,2}}\right) \quad e = 35,355 \text{ mm} = \overline{TF}$

$\sigma_{(1)} = \frac{F}{A}\left(1 + \frac{e}{k_1}\right) = \underline{+57,86 \text{ MPa}}$

$\sigma_{(2)} = \frac{F}{A}\left(1 - \frac{e}{k_2}\right) = \underline{-39,57 \text{ MPa}}$

Tel: _____ Fax: _____ GSM: _____ e-mail: _____

10000 Zagreb • Kačićeva 26 • CROATIA • Tel: +385 1 4639 222 • www.grad.hr

SVEUČILIŠTE U ZAGREBU
GRAĐEVINSKI FAKULTET
UNIVERSITY OF ZAGREB
FACULTY OF CIVIL ENGINEERING

Datum: 16.04.2008.

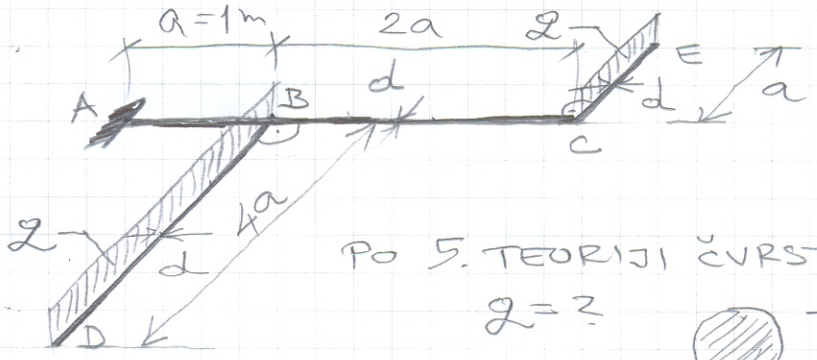
OTPORNOST MATERIJALA 2

1. KOLOKVIJ – GRUPA Ⓒ

2. ZADATAK

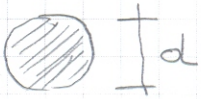
$d = 6$ cm

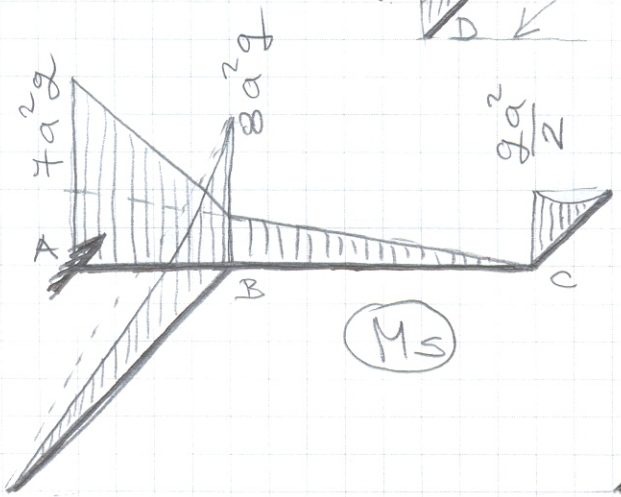
$\sigma_{DOP} = 140$ MPa

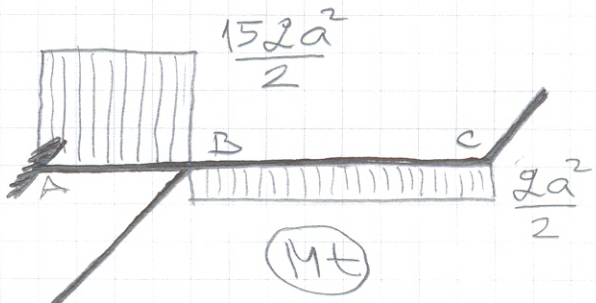


PO 5. TEORIJI ČVRSTOĆE

$q = ?$







$d = 6$ cm $\quad W_z = \frac{\pi \cdot d^3}{32} = 21205{,}75 \text{ mm}^3$

KRITIČNI PRESJEK JE PRESJEK Ⓐ !

$M_s^{(A)} = 7a^2 q$

$M_t^{(A)} = 7{,}5\, a^2 \cdot q$

$$\sigma_{ek} = \sqrt{\frac{1}{2}\left[(\sigma_1-\sigma_2)^2+(\sigma_2-\sigma_3)^2+(\sigma_3-\sigma_1)^2\right]} \le \sigma_{DOP}$$

$$\sigma_{ek} = \frac{1}{W_y}\sqrt{\left(M_s^{(A)}\right)^2 + 0{,}75\left(M_t^{(A)}\right)^2} \le \sigma_{DOP}$$

$$q \cdot a^2 \sqrt{7^2 + 0{,}75 \cdot 7{,}5^2} \le \sigma_{DOP} \cdot W_y$$

$$q \le \frac{\sigma_{DOP} \cdot W_y}{a^2 \cdot 9{,}5492} = \frac{140 \cdot 21205{,}75}{1000^2 \cdot 9{,}5492} = 0{,}311 \text{ N/mm}'$$

$$q = 311 \text{ N/m}$$

Tel: _____ Fax: _____ GSM: _____ e-mail: _____

10000 Zagreb • Kačićeva 26 • CROATIA • Tel: +385 1 4639 222 • www.grad.hr

SVEUČILIŠTE U ZAGREBU
GRAĐEVINSKI FAKULTET
UNIVERSITY OF ZAGREB
FACULTY OF CIVIL ENGINEERING

Datum: 16.04.2008.

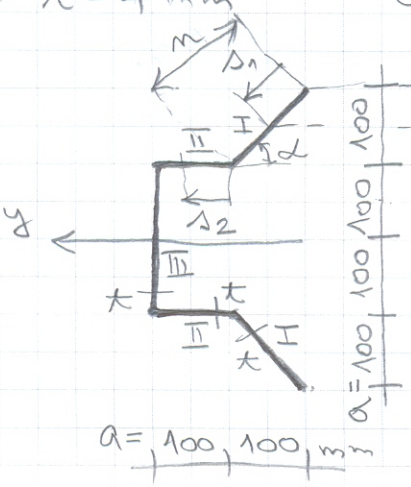
OTPORNOST MATERIJALA 2

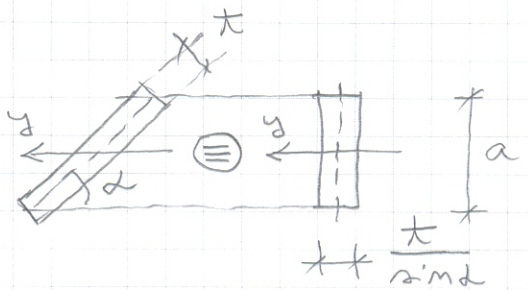
1. KOLOKVIJ – GRUPA Ⓒ

3. ZADATAK

$t = 4\ mm$

$$\tau = \frac{T_z \cdot S_y}{J_y \cdot t}$$





$$J_y = 2\left(\frac{t}{\sin\alpha}\cdot\frac{100^3}{12} + \frac{t}{\sin\alpha}\cdot 100\cdot 150^2 + \frac{100\cdot 4^3}{12} + 100\cdot 4\cdot 100^2\right) + \frac{4\cdot 200^3}{12}$$

$$J_y = 37{,}063\cdot 10^6\ mm^4$$

Ⓘ $$S_y^I = s_1\cdot t\,(200 - \tfrac{1}{2}s_1\cdot\sin\alpha) = 800\,s_1 - 1{,}414\,s_1^2$$

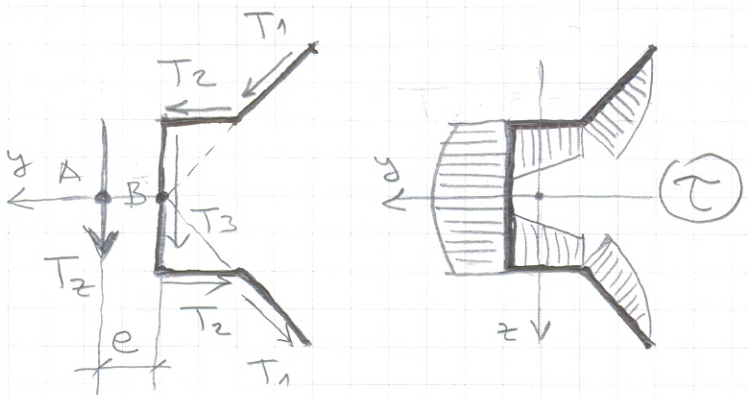
$$\tau_I = \frac{T_z}{J_y\cdot t}\,(800\,s_1 - 1{,}414\,s_1^2)$$

$$T_1 = \int_0^m \tau_1\cdot t\cdot ds_1 = \frac{T_z}{J_y}\int_0^{m=141{,}4}(800\,s_1 - 1{,}414\,s_1^2)\,ds_1 = \underline{0{,}1798\cdot T_z}$$

Ⓘⓘ $$S_y^{II} = S_y^I + s_2\cdot t\cdot 100 = 141{,}4\cdot 4\cdot 150 + s_2\cdot t\cdot 100$$

$$S_y^{II} = 84840 + 400\,s_2$$

$$\tau_{II} = \int_0^{100}\tau_{II}\cdot t\cdot s_2 = \frac{T_z}{J_y}\int_0^{100}(84840 + 400\,s_2)\,ds_2 = \underline{0{,}2828\,T_z}$$



$$\Sigma M_B = \emptyset \quad T_z\cdot e = T_2\cdot 200$$

$$\underline{e = 56{,}56\ mm}$$

Tel: _____ Fax: _____ GSM: _____ e-mail: _____

10000 Zagreb • Kačićeva 26 • CROATIA • Tel: +385 1 4639 222 • www.grad.hr