

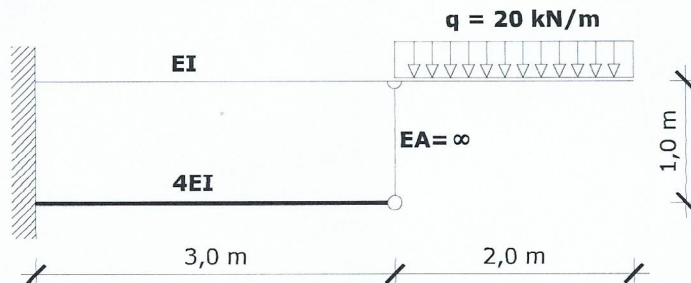


Ime i prezime:

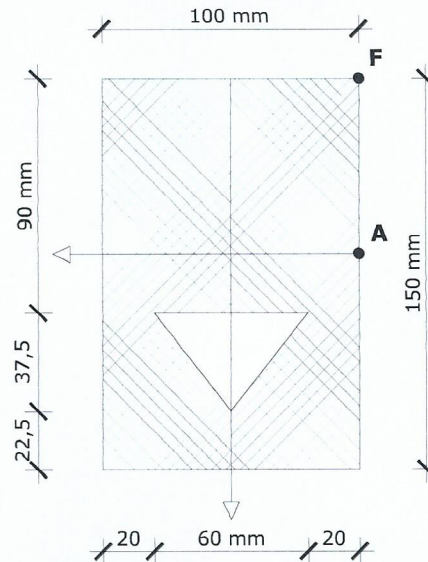
JANKO KOSEK

1.] Za zadani statički sustav na slici odrediti M, T i N dijagrame ako je

zadano: $E = 2 \cdot 10^5 \text{ MPa}$; $I = 8 \cdot 10^7 \text{ mm}^4$; $q = 20 \text{ kN/m}$; $EA = \infty$.



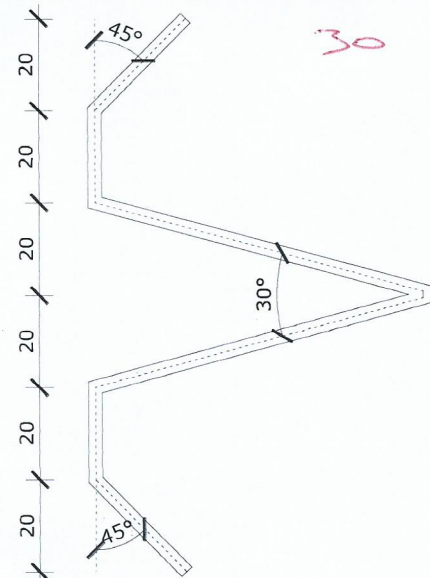
2.] Primjenom jezgre poprečnog presjeka potrebno je odrediti **iznos i smjer (vlačna ili tlačna) ekscentrične sile F** tako da **naprezanje u točki A iznosi $\sigma_A = -40 \text{ MPa}$ (tlak)**. Za dobiveni iznos sile nacrtati dijagram normalnih naprezanja u poprečnom presjeku. *Točka A nalazi se na glavnoj središnjoj osi tromosti presjeka.



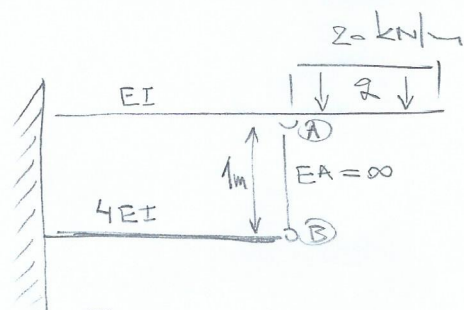
3.] Odrediti položaj **središta posmika** zadanog

poprečnog presjeka ako je debljina stjenke $t = 3 \text{ mm}$.

*Kote su u milimetrima.



1.



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

$$I = 8 \cdot 10^7 \text{ mm}^4$$

$$W_A = W_B \quad (1)$$

$$W_{Aq} - W_{As} = W_{Bs} \quad (2)$$

$$\phi_1 = 120 \text{ kNm}^2 \quad \phi_2 = 180 \text{ kNm}^2$$

$$\overline{M}_{Aq} = 540 \text{ kNm}^3$$

$$W_{Aq} = \frac{\overline{M}_{Aq}}{EI} = 33,75 \text{ mm} \quad (3)$$

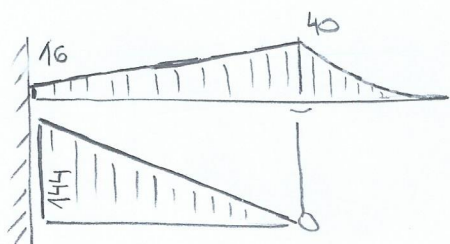
$$W_{Bs} = \frac{s \cdot L^3}{12EI} = 1,40625 \cdot 10^{-4} s \quad (4)$$

$$W_{As} = 4W_{Bs} = 5,625 \cdot 10^{-4} s \quad (5)$$

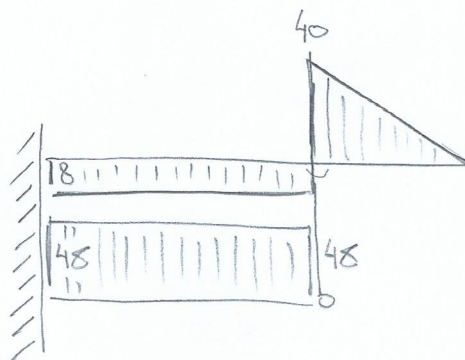
$$(3), (4), (5) \rightarrow (2)$$

$$33,75 - 5,625 \cdot 10^{-4} s = 1,40625 \cdot 10^{-4} s \rightarrow \underline{s = 48 \text{ kN}}$$

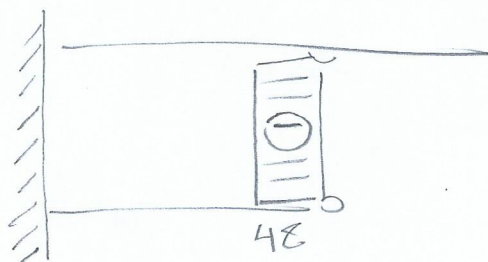
DIJAGRAMI:



M
kNm

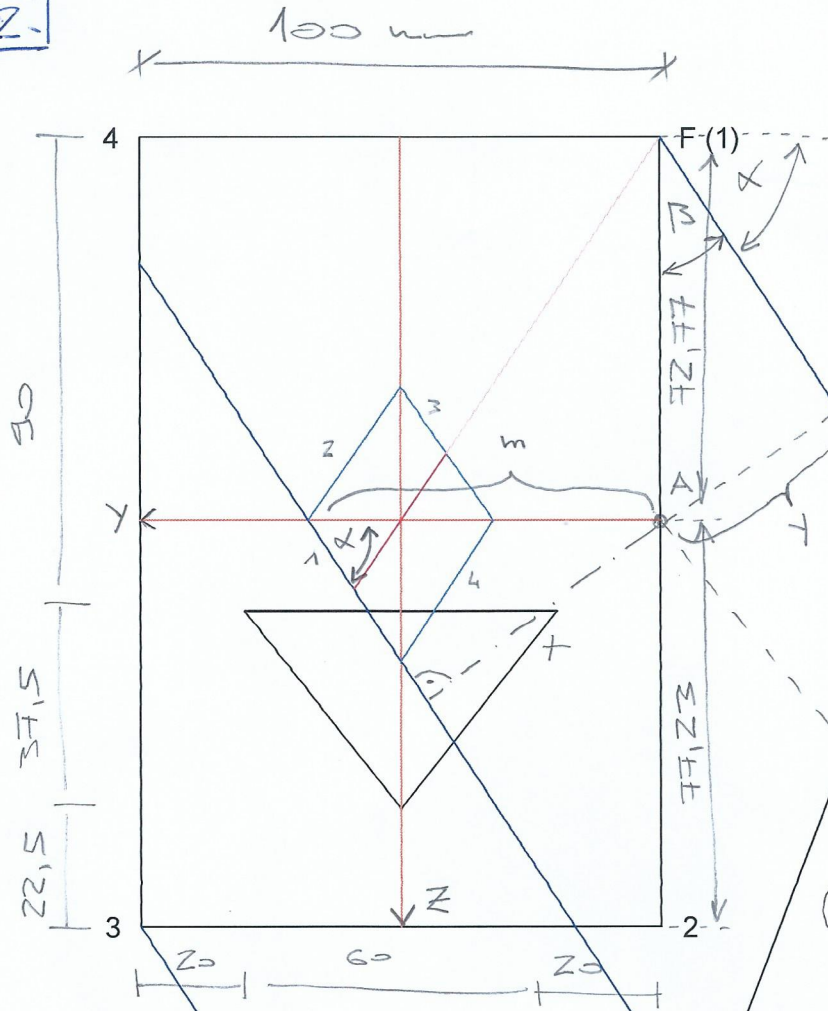


T
kN



N
kN

2.



$$\sigma_A = -40 \text{ MPa}$$

$$F = ?$$

$$A = 13875 \text{ mm}^2$$

$$Z_T = 77, Z_3 \text{ usw}$$

$$I_y = 271,173 \cdot 10^5 \text{ mm}^4$$

$$|z| = 123,313 \cdot 10^5 \text{ mm}^4$$

$$I_y^2 = 1954,4 \text{ mm}^2$$

$$17^2 = 888,7 \text{ mm}^2$$

$$m = 50 + 17,77$$

$$m = 67,77 \text{ mm}$$

$$\alpha y = -\frac{1z^z}{y}$$

$$a_z = -\frac{1}{z^2}$$

JEZGRA P.P.

TOEKA	y	z	ay	$\sqrt{az}$
F(1)	-50	-77,77	17,77	26,86
z	-50	77,23	17,77	-25,31

ОЦТАНО:

$$k_1 = 15,99 \text{ mm} \quad e = \sqrt{50^2 + 72,77^2}$$

$$L_3 = 15,52 \text{ mm} \quad L = 88,29 \text{ mm}$$

$$\Sigma^{(1)} = -\frac{F}{A} - \frac{F \cdot e}{k_1 \cdot A}$$

$$68,43 = \frac{F}{13875} + \frac{88,29 F}{15,99 \cdot 13875}$$

$$F = 145588,5 \text{ N}$$

$$F = 145,6 \text{ kN (TLAK)}$$

$$\frac{\Sigma A}{X} = \frac{\Sigma^{(1)}}{Z}$$

$$\Gamma^{(1)} = \Gamma_A \cdot \frac{Z}{X}$$

$$\sigma^{(1)} = -68.43 \text{ MPa}$$

$$\log x = \frac{26,86}{17,77}$$

$$\alpha = 59.5^\circ$$

$$X = \sin \alpha \cdot m$$

$$x = 56,5 \text{ mm}$$

$$B = 90 - x$$

$$\beta = 33,5$$

$$y = \sin \beta \cdot 72,77$$

$$y = 42,16 \text{ mm}$$

$$Z = x + y$$

$$Z = 96,66 \text{ mm}$$

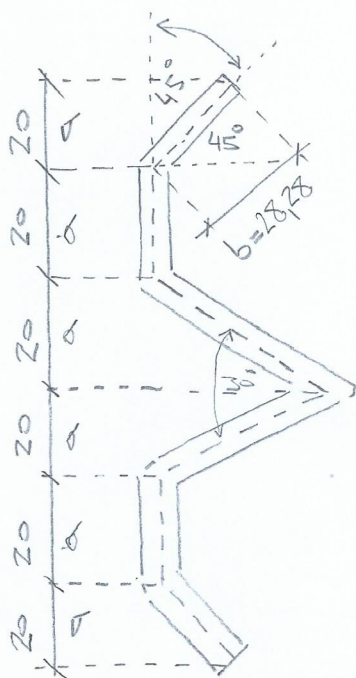
$$\Sigma^{(2)} = -\frac{F}{A} + \frac{F \cdot e}{k_2 \cdot A}$$

$$I^{(3)} = - \frac{145588,5}{13875} + \frac{145588,5 \cdot 88,29}{1552 \cdot 13875}$$

$$\sigma^{(2)} = 49,2 \text{ MPa}$$

3.

$t = 3 \text{ mm}$



$$I_y = \left[\frac{t}{\sin 45^\circ} \cdot \frac{1}{12} \cdot a^3 + \frac{t}{\sin 45^\circ} \cdot 20 \cdot 50^2 \right] \cdot 2 +$$

$$+ \left[\frac{t \cdot a^3}{12} + t \cdot a \cdot 30^2 \right] \cdot 2 +$$

$$+ \left[\frac{t}{\sin 15^\circ} \cdot \frac{1}{12} \cdot a^3 + \frac{t}{\sin 15^\circ} \cdot 20 \cdot 10^2 \right] \cdot 2$$

$$I_y = 2 \cdot (214960,46) + 2 \cdot (56000) +$$

$$+ 2 \cdot (30909,63)$$

$$I_y = 603740,18 \text{ mm}^4$$

$$I_y = 603,74 \cdot 10^3 \text{ mm}^4$$

1. Dio

$$S_y = 3 \cdot s_1 \cdot \left(60 - \frac{1}{2} s_1 \cdot \sin 45^\circ \right) = 180 s_1 - 1,06 s_1^2 \text{ (mm}^3 \text{)}$$

$$T = \frac{T}{I_y \cdot t} \cdot (180 s_1 - 1,06 s_1^2)$$

$$T_1 = \int_0^b \frac{T}{I_y \cdot t} (180 s_1 - 1,06 s_1^2) \cdot t \cdot ds_1 = \frac{T}{I_y} \left[180 \frac{b^2}{2} - 1,06 \frac{b^3}{3} \right]$$

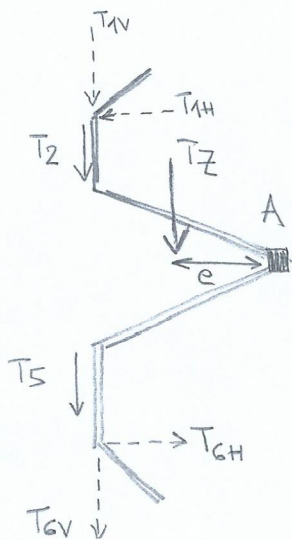
$$T_1 = 0,106 T_Z \quad T_6 = 0,106 T_Z$$

2. Dio

$$S_y = 3 \cdot 2828 \cdot 50 + 3 \cdot s_2 \cdot \left(40 - \frac{s_2}{2} \right) = 4242 + 120 s_2 - 1,5 s_2^2$$

$$T_Z = \int_0^a \frac{T_Z}{I_y \cdot t} \cdot (4242 + 120 s_2 - 1,5 s_2^2) \cdot t \cdot ds_2 = \frac{T}{I_y} \cdot \left[4242 a + 120 \frac{a^2}{2} - 1,5 \frac{a^3}{3} \right]$$

$$T_Z = 0,1737 T_Z \quad T_5 = 0,1737 T_Z$$



$$\tan 15^\circ = \frac{a}{x}$$

$$x = 74,64 \text{ mm}$$

$$T_Z \cdot e = 2 \cdot T_{1V} \cdot 74,64 + 2 \cdot T_{1H} \cdot 40 + 2 \cdot T_Z \cdot 74,64$$

$$T_Z \cdot e = 2 \cdot \sin 45^\circ \cdot 0,106 T_Z \cdot 74,64 + 2 \cdot \cos 45^\circ \cdot 0,106 T_Z \cdot 40 + 2 \cdot 0,1737 T_Z \cdot 74,64$$

$$e = 11,19 + 5,996 + 25,93$$

$$e = 43,11 \text{ mm}$$