

OTPORNOST MATERIJALA 2

2. PRIMJER 2. KOLOKVIJA

1. Za zadani sustav prikazan na slici treba primjenom principa o minimumu potencijalne energije deformacije odrediti i nacrtati dijagrame unutarnjih sila M , T , N .

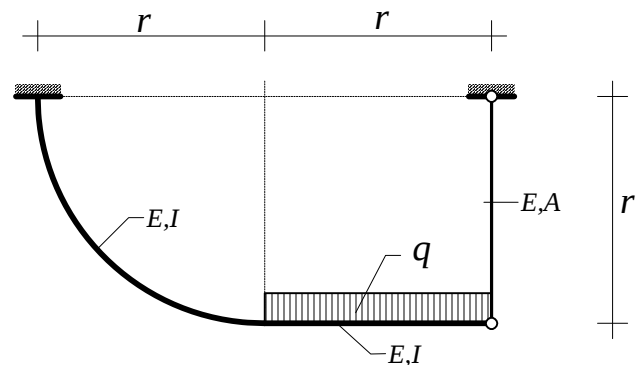
Zadano je: $E = 2,1 \cdot 10^5 \text{ MPa}$

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

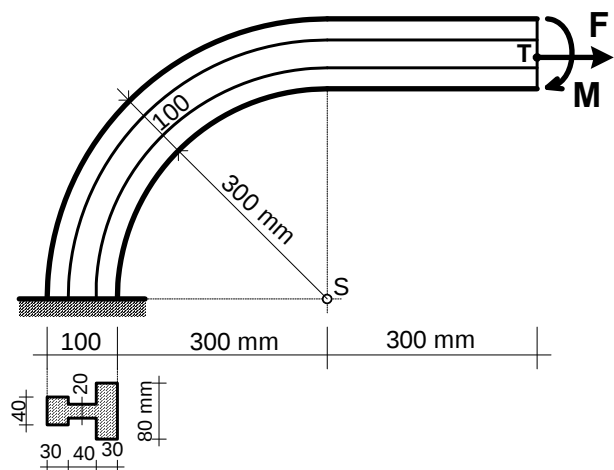
$$A = 800 \text{ mm}^2$$

$$q = 20 \text{ kN/m'}$$

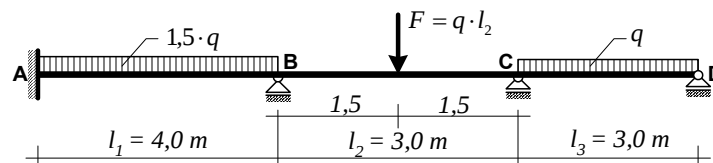
$$r = 2,0 \text{ m}$$



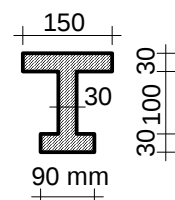
2. Za zakrivljeni štap opterećen prema slici treba izračunati najveća normalna naprezanja i nacrtati dijagram normalnih naprezanja u najviše napregnutom poprečnom presjeku.



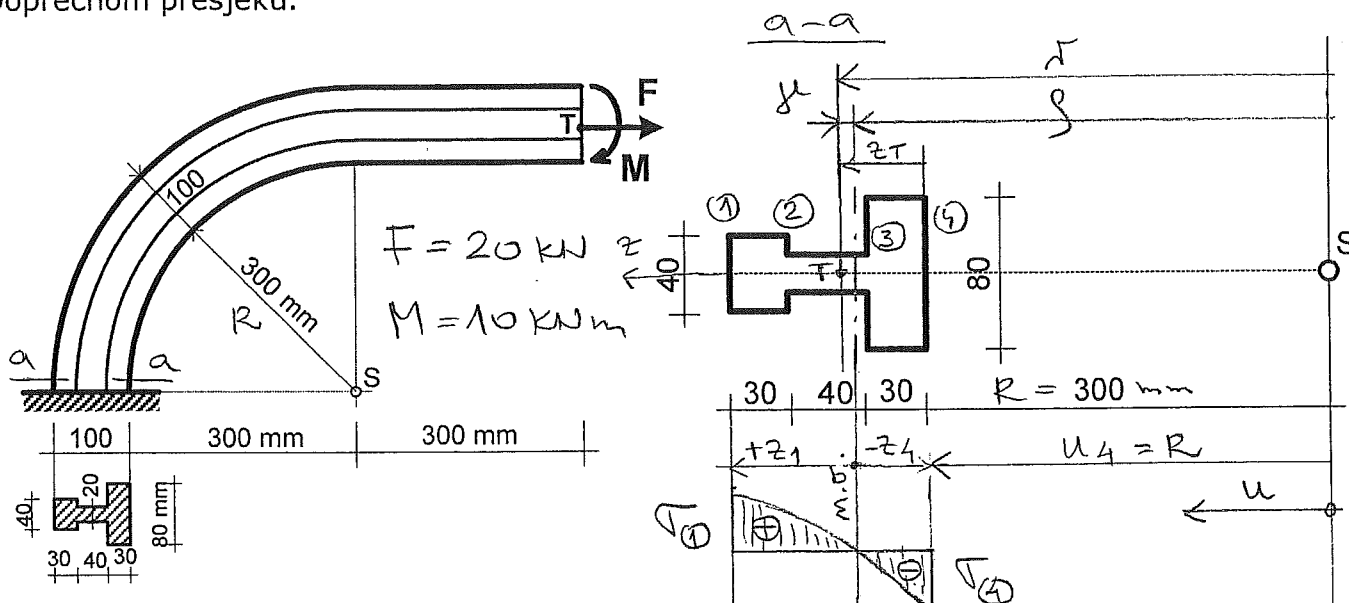
3. Za zadani sistem prikazan na slici treba po teoriji plastičnosti odrediti dopušteno opterećenje q , ako je granica tečenja materijala $\sigma_T = 220 \text{ MPa}$ i koeficijent sigurnosti $k = 1,8$.



POPREČNI PRESJEK



2. Za zakrivljeni štap opterećen prema slici treba izračunati najveća normalna naprezanja i nacrtati dijagram normalnih naprezanja u najviše napregnutom poprečnom presjeku.



$$A = 4400 \text{ mm}^2 \quad r = R + z_T = 340,45 \text{ mm}$$

$$z_T = 40,45 \text{ mm} \quad r/h = 3,40 < 5 \quad \text{š.v.z.}$$

$$\bar{y} = \frac{A}{80 \cdot \ln \frac{330}{300} + 20 \cdot \ln \frac{370}{330} + 40 \cdot \ln \frac{400}{370}} = 337,6438 \text{ mm}$$

$$y = r - \bar{y} = 2,8062 \text{ mm} \quad S_y = A \cdot y = 12347,28 \text{ mm}^3$$

$$M_{a-a} = F \cdot r + M = +16,809 \text{ kNm}$$

$$z_1 = +62,36 \text{ mm}$$

$$z_2 = +32,36 \text{ mm}$$

$$z_3 = -7,64 \text{ mm}$$

$$z_4 = -37,64 \text{ mm}$$

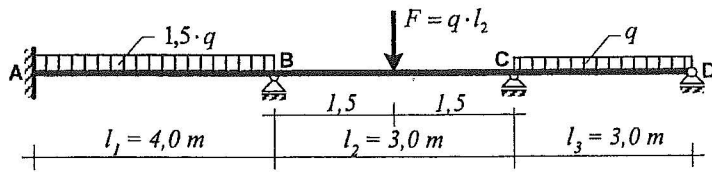
$$\sigma_1 = \frac{M}{S} \frac{z_1}{u_1} = +212,23 \text{ MPa}$$

$$\sigma_2 = +119,06 \text{ MPa}$$

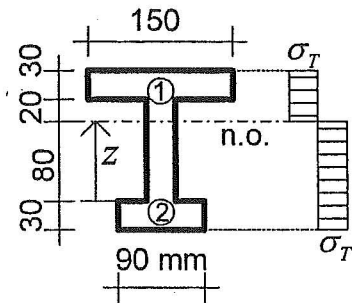
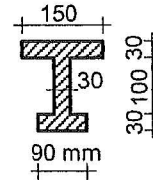
$$\sigma_3 = -31,52 \text{ MPa}$$

$$\sigma_4 = -170,80 \text{ MPa}$$

3. Za zadani sistem prikazan na slici treba po teoriji plastičnosti odrediti dopušteno opterećenje q , ako je granica tečenja materijala $\sigma_T = 220 \text{ MPa}$ i koeficijent sigurnosti $k = 1,8$.



POPREČNI PRESJEK



$$A = 10200 \text{ mm}^2$$

$$\frac{A}{2} = 30 \cdot 90 + z \cdot 30 \Rightarrow z = 80 \text{ mm}$$

$$W_{pl} = S_1 + S_2 = 163500 + 352500 = 516000 \text{ mm}^3$$

$$M_{pl} = \sigma_T \cdot W_{pl} = 220 \cdot 516000 = 113,52 \text{ kNm}$$

$$q_{pl} = \frac{2}{3} \cdot \frac{M_{pl}}{l_2} = 75,68 \text{ kN/m}' \Rightarrow q_{dop} = \frac{q_{pl}}{k} = 42,04 \text{ kN/m}'$$

