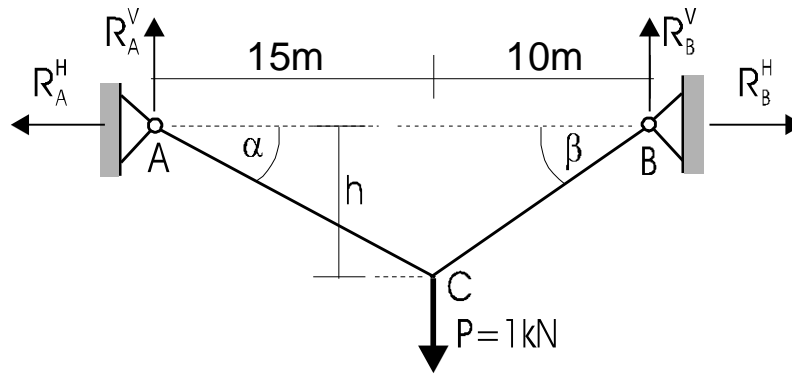


LANČANICE

PRIMJERI:

1). Uže duljine $L=30\text{m}$ opterećeno je koncentriranom silom $P=1\text{kN}$, crtež 9.2. Odredite sile u osloncima (reakcije) A i B.



Crtež 9.2.

RJEŠENJE:

$$\sum M_A = 0, \Rightarrow R_B^V \cdot 25 - 1 \cdot 15 = 0, \Rightarrow \underline{\underline{R_B^V = 0,6\text{kN}}},$$

$$\sum F_Y = 0, \Rightarrow \underline{\underline{R_A^V = 0,4\text{kN}}},$$

$$\text{s lijeva: } \sum M_C = 0, \Rightarrow -0,4 \cdot 15 + R_A^H \cdot h = 0, \quad (1)$$

$$\text{s desna: } \sum M_C = 0, \Rightarrow -0,6 \cdot 10 - R_B^H \cdot h = 0, \quad (2)$$

$$15^2 + h^2 = l_1^2 \Rightarrow h^2 = l_1^2 - 225, \quad (3)$$

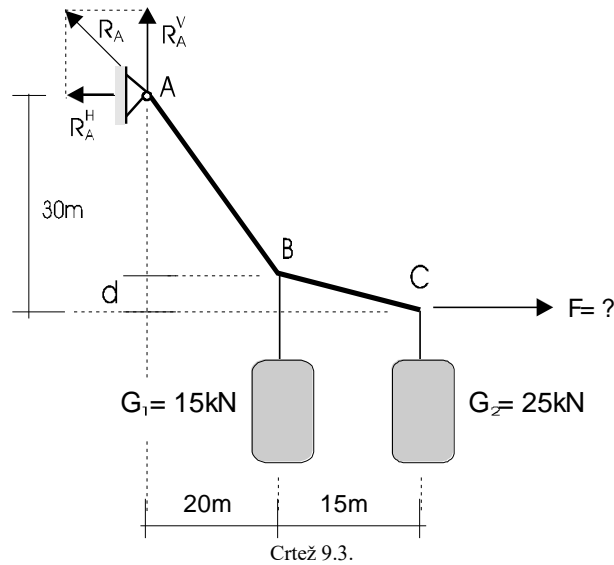
$$10^2 + h^2 = l_2^2 \Rightarrow h^2 = l_2^2 - 100, \quad (4)$$

$$l_1 + l_2 = 30, \Rightarrow l_2 = 30 - l_1, \quad (5)$$

$$\underline{\underline{l_1 = 17,08\text{m}}}, \underline{\underline{l_2 = 12,92\text{m}}}, \underline{\underline{h = 8,17\text{m}}},$$

$$\underline{\underline{R_A^H = 0,735\text{kN}}}, \underline{\underline{R_B^H = 0,735\text{kN}}}.$$

2). Uže je s jedne strane vezano u točki A, a s druge se vuče horizontalnom silom F , crtež 9.3. Odredite veličinu horizontalne sile F , visinu d , sile u pojedinim dijelovima užeta te ukupnu duljinu užeta, ako je uže u stanju ravnoteže.



$$\sum M_A = 0, \Rightarrow -G_1 \cdot 20 - G_2 \cdot 35 + F \cdot 30 = 0, \Rightarrow \underline{\underline{F = 39,17kN}},$$

$$\sum M_B^D = 0, \Rightarrow F \cdot d - G_2 \cdot 15 = 0, \Rightarrow \underline{\underline{d = 9,57m}},$$

$$\sum F_Y = 0, \Rightarrow -G_1 - G_2 + R_A^V = 0, \Rightarrow \underline{\underline{R_A^V = 35,00kN}},$$

$$\sum F_X = 0, \Rightarrow F - R_A^H = 0, \Rightarrow R_A^H = 39,17kN,$$

$$S_{AB} = \sqrt{(R_A^H)^2 + (R_A^V)^2} = 52,53kN,$$

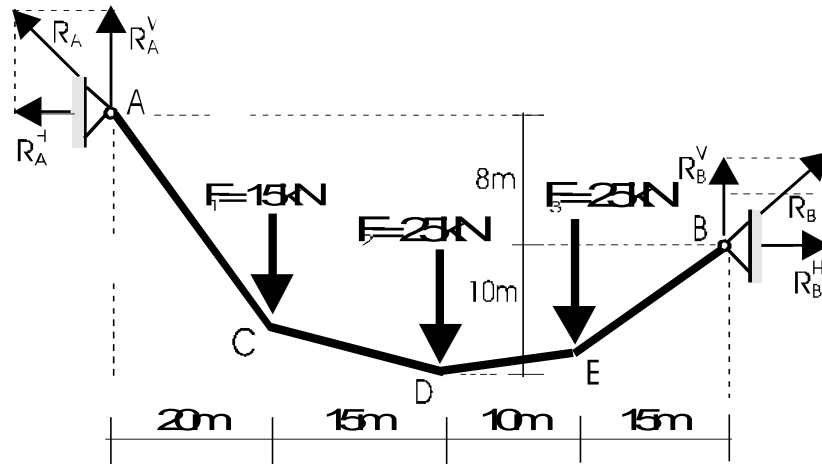
$$S_{BC} = \sqrt{(F)^2 + (G_2)^2} = 46,47kN,$$

$$l_{AB} = \sqrt{(30 - 9,57)^2 + 20^2} = 28,59m,$$

$$l_{BC} = \sqrt{9,57^2 + 15^2} = 17,79m,$$

$$L = 28,59 + 17,79 = 46,38m.$$

3). Uže vezano u točkama A i B opterećeno je koncentriranim silama u točkama C, D i E, crtež 9.4. Odredite sile u pojedinim dijelovima užeta i duljinu užeta.



Crtež 9.4.

RJEŠENJE:

$$\sum M_A = 0, \Rightarrow R_B^H \cdot 8 + R_B^V \cdot 60 - F_3 \cdot 45 - F_2 \cdot 35 - F_1 \cdot 20 = 0,$$

$$\sum M_D = 0, \Rightarrow -R_B^H \cdot 10 + R_B^V \cdot 25 - F_3 \cdot 10 = 0, \Rightarrow \underline{\underline{R_B^H = 43,28kN}}, \underline{\underline{R_B^V = 21,31kN}},$$

$$\sum F_x = 0, \Rightarrow \underline{\underline{R_A^H = 43,28kN}},$$

$$\sum F_y = 0, \Rightarrow \underline{\underline{R_A^V = 28,69kN}},$$

$$S_{AC} = \sqrt{(R_A^H)^2 + (R_A^V)^2} = 51,93kN,$$

$$S_{EB} = \sqrt{(R_B^H)^2 + (R_B^V)^2} = 48,24kN,$$

$$S_{CD} = \sqrt{(R_A^H)^2 + (R_A^V - F_1)^2} = 45,39kN,$$

$$S_{DE} = \sqrt{(R_B^H)^2 + (R_B^V - F_3)^2} = 44,73kN,$$

$$\text{slijeva: } \sum M_C^L = 0, \Rightarrow -R_A^V \cdot 20 + R_A^H \cdot y_C = 0, \Rightarrow y_C = 13,26m,$$

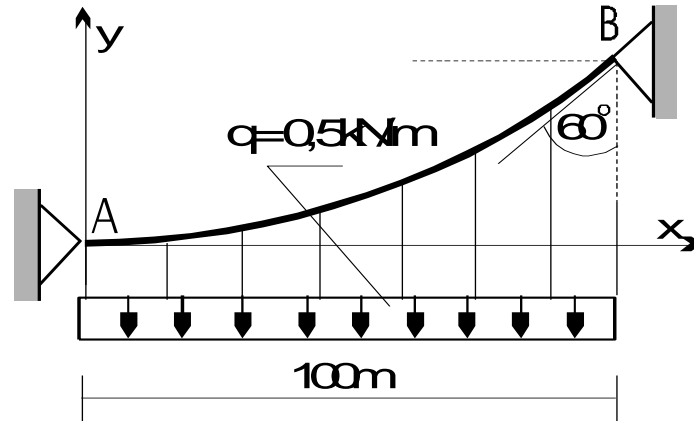
$$\text{desna: } \sum M_E^D = 0, \Rightarrow R_B^V \cdot 15 - R_B^H \cdot y_E = 0, \Rightarrow y_E = 7,39m,$$

$$l_{AC} = \sqrt{20^2 + 13,26^2} = 24m, \quad l_{CD} = \sqrt{15^2 + (18 - 13,26)^2} = 15,73m,$$

$$l_{DE} = \sqrt{10^2 + (10 - 7,39)^2} = 10,33m, \quad l_{EB} = \sqrt{15^2 + 7,39^2} = 16,72m,$$

$$L = 24 + 15,73 + 10,33 + 16,72 = 66,78m.$$

I). Uže vezano u točkama A i B opterećeno je kontinuiranim opterećenjem po horizontali, crtež 9.12. Odredite najveću silu u užetu.



Crtež 9.12.

RJEŠENJE:

$$y = ax^2 + bx + c, \text{ ishodište u tjemenu!} \Rightarrow y = ax^2,$$

$$\text{za } x = 100\text{m} \Rightarrow y' = 2ax = \text{tg}30^\circ, \quad 2a \cdot 100 = 0,577, \Rightarrow a = 0,0029,$$

$$y = 0,0029x^2, \Rightarrow \text{za } x = 100\text{m} \Rightarrow y = 29\text{m},$$

$$\dot{y} = 2 \cdot 0,0029x,$$

$$\dot{y} = 0,0058x,$$

$$\ddot{y} = 0,0058,$$

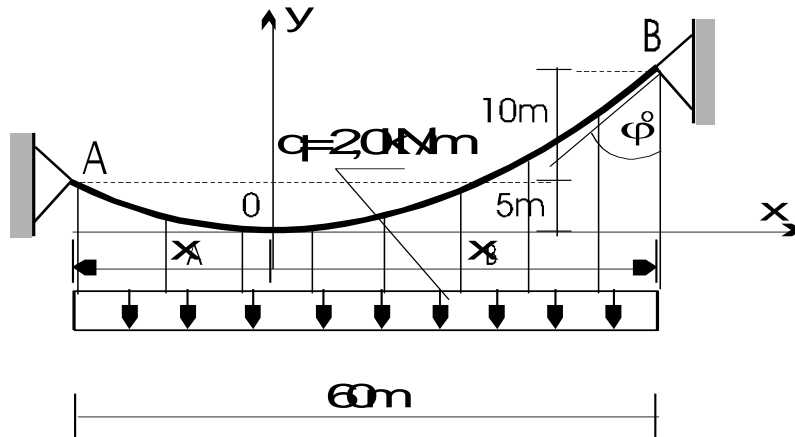
$$\ddot{y} = \frac{q}{H} \Rightarrow 0,0058 = \frac{q}{H}, \Rightarrow H = \frac{0,5}{0,0058} = 86,21\text{kN},$$

$$S = \frac{H}{\cos\varphi},$$

$$\varphi_{MAX} \Rightarrow S_{MAX}, \quad \varphi_{MAX} = 30^\circ,$$

$$S_{MAX} = \frac{86,21}{\cos 30^\circ} = 99,55\text{kN}.$$

2). Uže opterećeno kontinuiranim opterećenjem po horizontali vezano je tako da su oslonci u točkama A i B na različitim visinama, crtež 9.13. Ako je ishodište koordinatnog sustava postavljeno u tjemenu, odredite najveću silu u užetu.



Crtež 9.13.

RJEŠENJE:

$$y = ax^2 + bx + c, \text{ ishodište u tjemenu!} \Rightarrow y = ax^2,$$

$$-x_A + x_B = 60, \Rightarrow x_B = 60 + x_A,$$

$$\text{za } x = x_A \Rightarrow y = 5\text{m} \Rightarrow 5 = a \cdot x_A^2, \Rightarrow a = \frac{5}{x_A^2},$$

$$\text{za } x = x_B \Rightarrow y = 15\text{m} \Rightarrow 15 = a \cdot x_B^2, \Rightarrow 15 = a \cdot (60 + x_A)^2,$$

$$15 = 3600 \cdot \frac{5}{x_A^2} + 120 \cdot \frac{5}{x_A^2} \cdot x_A + \frac{5}{x_A^2} \cdot x_A^2, \Rightarrow -10x_A^2 + 600x_A + 18000 = 0,$$

$$Rj.^2 \quad x_A = -21,96\text{m}, \Rightarrow a = \frac{5}{(-21,96)^2} = 0,0104, \Rightarrow \underline{\underline{y = 0,0104x^2}},$$

$$y = 0,0104x^2,$$

$$\dot{y} = 2 \cdot 0,0104x,$$

$$\dot{y} = 0,0208x, \quad \dot{y} = \operatorname{tg} \varphi, \text{ za } x = x_B = 38,04\text{m}, \Rightarrow \varphi_{\text{MAX}} = 38,35^\circ,$$

$$\ddot{y} = 0,0208, \quad \ddot{y} = \frac{q}{H}, \Rightarrow H = \frac{2}{0,0208} = 96,15\text{kN},$$

$$S_{\text{MAX}} = \frac{H}{\cos \varphi_{\text{MAX}}}, \Rightarrow S_{\text{MAX}} = \frac{96,15}{\cos 38,35^\circ} = 123,46\text{kN}.$$