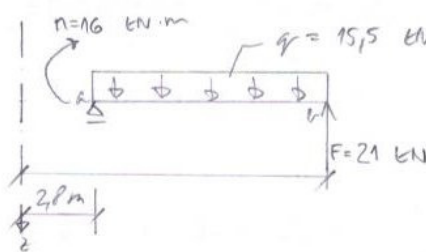
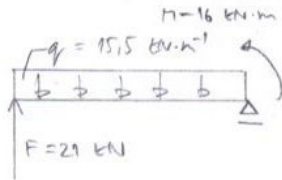
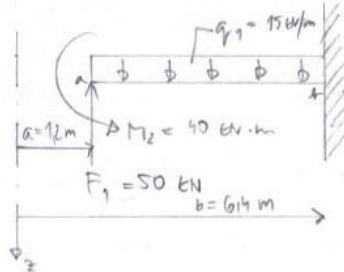
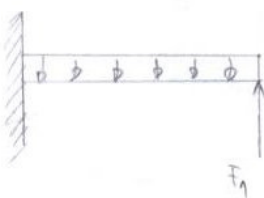


UYPOČÍTATE A UYRESLITE FUNKCIE PRIETÝBOV, POTOČENÍ, MERNÝCH OHYBOVÝCH MOMENTOV A MERNÝCH PRIEČNÝCH SÍL NA ROTACNE SYMETRICKEJ KRHOVEJ DOSKE S OTVOROM A S HRÚBKOU c ZATAŽENEJ ROTACNE SYMETRICKÝM ZATAŽENÍM PODĽA OBRÁZKA. $E = 20 \text{ GPa}$, $\nu = 0,3$

$\phi(z)$
07



$r = r_a \Rightarrow m_{ra} = -M = 16 \text{ kN}\cdot\text{m} \checkmark$
 $n_{ra} = \emptyset \checkmark$
 $r = r_b \Rightarrow t_{rz} = +F = 21 \text{ kN} \ominus$
 $m_{rb} = \emptyset$



$\mu = 0,3$
 $E = 20 \text{ GPa}$

Prietýb: $w(r) = C_1 + C_2 r^2 + C_3 \ln r + C_4 r^2 \ln r + \frac{q r^5}{65 D}$
 $D = \frac{E h^3}{12(1-\mu^2)}$

Potočenie: $\varphi(r) = \frac{dw}{dr} = 2C_2 r + C_3 \frac{1}{r} + C_4 r(2 \ln r + 1) + \frac{q r^3}{16 D}$

Merný ohybový moment: $m_\varphi(r) = -D \left[\frac{d^2 w}{dr^2} + \frac{\mu}{r} \cdot \frac{dw}{dr} \right]$

$m_r(r) = -D \left\{ 2(1+\mu) C_2 - \frac{(1-\mu)}{r^2} C_3 + [2(1+\mu) \ln r + 3+\mu] C_4 \right\} - \frac{q r^2}{16} (3+\mu)$

Merný ohybový moment: $m_\varphi(r) = -D \left[\frac{dw}{dr} + \frac{\mu}{r} \cdot \frac{d^2 w}{dr^2} \right]$

$m_\varphi(r) = -D \left\{ 2(1+\mu) C_2 + \frac{(1-\mu)}{r^2} C_3 + [2(1+\mu) \ln r + 1+3\mu] C_4 \right\} - \frac{q r^2}{16} (1+3\mu)$

herné priečne sily

$t_{rz}(r) = -D \left[\frac{d^3 w}{dr^3} + \frac{1}{r} \frac{d^2 w}{dr^2} - \frac{1}{r^2} \cdot \frac{dw}{dr} \right] = -D \frac{4}{r} C_3 - \frac{q r}{2}$

$r = r_a \Rightarrow m_{ra} = -M = -40 \text{ kN}\cdot\text{m}/\text{m}'$

$t_{rz a} = +F = +50 \text{ kN}/\text{m}'$

$r = r_b \Rightarrow m_{rb} = \emptyset$

$\varphi_b = \emptyset$

$$D = \frac{Eh^3}{12(1-\mu)} = \frac{20 \cdot 10^6 \cdot 0,36^3}{12(1-0,3^2)} = 85450 \text{ EN} \cdot \text{m}^2$$

$$1. \quad r = 1,2 \text{ m} \quad ; \quad m_r(1,2) = -172 = -50 \text{ EN} \cdot \text{m}$$

$$-85450 \left\{ 2(1+0,3)C_2 - \frac{(1-0,3)}{1,2^2} C_3 + [2(1+0,3) \ln 1,2 + 3 + 0,3] C_3 \right\} -$$

$$- \frac{15 \cdot 1,2^2}{16} (3+0,3) = -50$$

$$2,6 C_2 - 0,486 C_3 + 3,773 C_3 = - \frac{35,535}{85450} = -4,16 \cdot 10^{-5}$$

$$2. \quad r = 1,2 \text{ m} \quad ; \quad t_{r2}(1,2) = F_1 = 50 \text{ EN}$$

$$-85450 \cdot \frac{2}{1,2} C_3 - \frac{15 \cdot 1,2}{2} = 50$$

$$-3,333 C_3 = \frac{57}{85450} = 6,905 \cdot 10^{-5}$$

$$3. \quad r = 6,5 \text{ m} \quad ; \quad w(6,5) = 0$$

$$C_1 + 6,5^2 \cdot C_2 + \ln 6,5 \cdot C_3 + 6,5^2 \cdot \ln 6,5 \cdot C_3 + \frac{15 \cdot 6,5^3}{64 \cdot 85450} = 0$$

$$C_1 + 40,96 \cdot C_2 + 1,856 C_3 + 76,033 C_3 = -56,077 \cdot 10^{-5}$$

$$4. \quad r = 6,5 \text{ m} \quad ; \quad \varphi(6,5) = 0$$

$$2 \cdot 6,5 \cdot C_2 + \frac{1}{6,5} C_3 + 6,5 (2 \cdot \ln 6,5 - 1) C_3 + \frac{15 \cdot 6,5^3}{16 \cdot 85450} = 0$$

$$12,8 C_2 + 0,156 C_3 + 30,167 C_3 = -28,767 \cdot 10^{-5}$$

$$\begin{bmatrix} 0 & 2,6 & -0,486 & 3,773 \\ 0 & 0 & 0 & -3,333 \\ 1 & 40,96 & 1,856 & 76,033 \\ 0 & 12,8 & 0,156 & 30,167 \end{bmatrix} \cdot \begin{Bmatrix} C_1 \\ C_2 \\ C_3 \\ C_4 \end{Bmatrix} = \begin{Bmatrix} 4,16 \\ 6,905 \\ -56,077 \\ -28,767 \end{Bmatrix} \cdot 10^{-5} \Rightarrow \begin{aligned} C_1 &= 17,028 \cdot 10^{-5} \\ C_2 &= 2,755 \cdot 10^{-5} \\ C_3 &= -9,987 \cdot 10^{-5} \\ C_4 &= -2,072 \cdot 10^{-5} \end{aligned}$$

$$w(r) = (17,028 + 2,755 r^2 - 9,987 \ln r - 2,072 r^2 \ln r + 0,027 r^3) \cdot 10^{-5}$$

$$\varphi(r) = (5,59 r - 9,987 \frac{1}{r} - 2,072 r (2 \ln r - 1) + 0,1097 r^3) \cdot 10^{-5}$$

$$m_r(r) = 2,781 - 59,259 \frac{1}{r^2} + 46,033 \ln r - 3,094 r^2$$

$$m_\varphi(r) = 27,568 + 59,259 \frac{1}{r^2} + 46,033 \ln r - 1,781 r^2$$

$$t_{r2}(r) = 70,821 \frac{1}{r} - 7,5 r$$

Wzrostkiel	10^{-3}	10^{-4}			
r	$w(r)$	$\varphi(r)$	$m_r(r)$	$m_\varphi(r)$	$t_{r2}(r)$
1,2	18,702	-4,857	-39,995	19,492	50,018
2,5	19,373	-3,957	10,587	12,963	9,578
3,8	9,355	-4,536	7,893	12,279	-7,863
5,1	3,277	-3,290	-10,533	3,387	-29,364
6,7	\emptyset	\emptyset	-15,505	-13,618	-36,933

