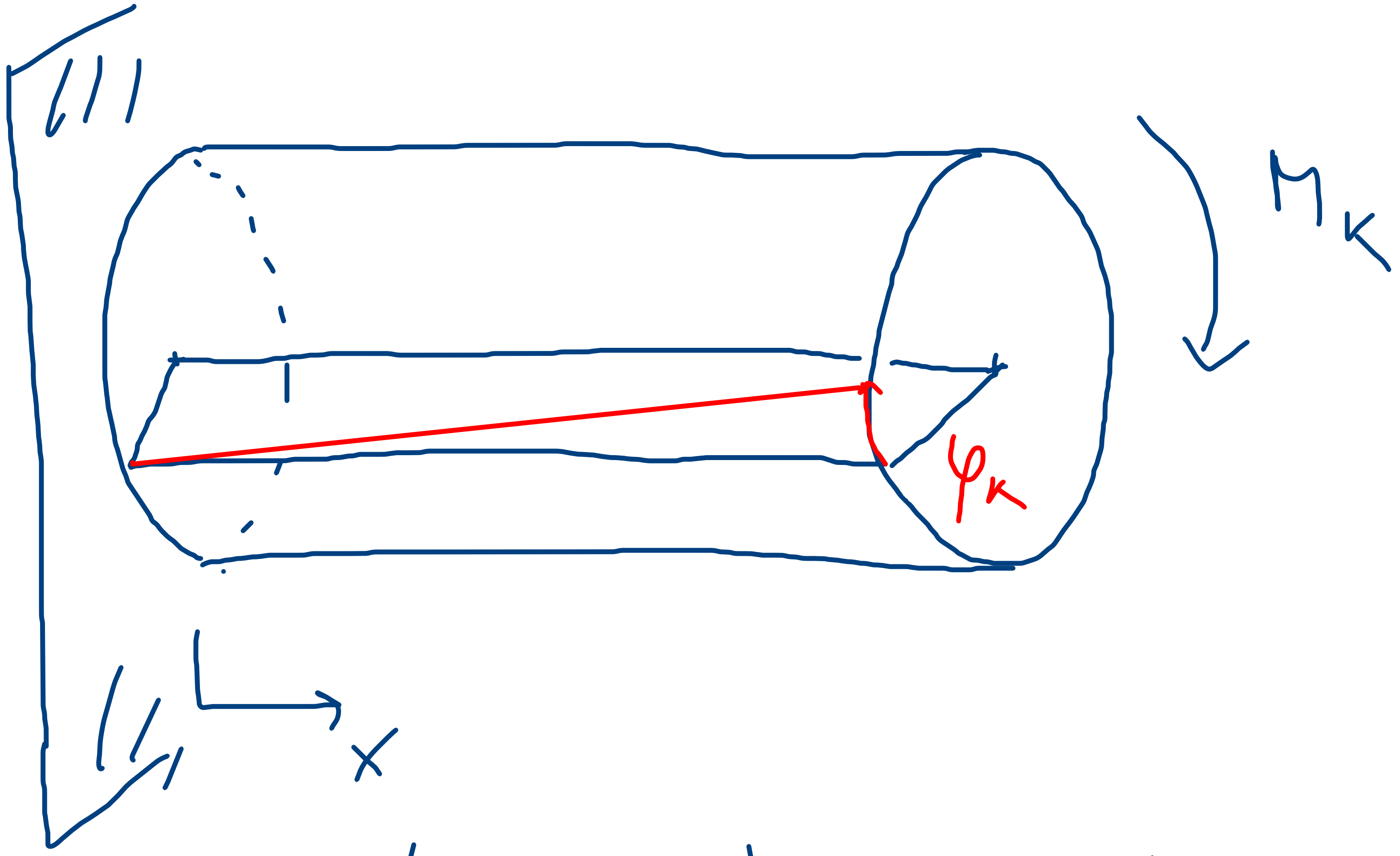
Krut kruhové prizmatické tyče

$\varphi_k(x)$



– DEFORMAČNÍ PŘEDPOKLADY

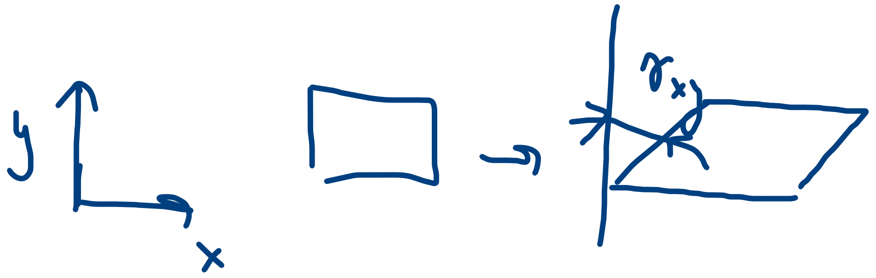
1) $\boxed{\varphi_k(x) = \vartheta_k\, x}$ $\quad \vartheta_k$ .. ZKRUT

2) "SALÁMOVÁ HYPOTÉZA"

$$\sigma_{ij} = \begin{pmatrix} 0 & \tau_{xy} & \tau_{xz} \\ \tau_{xy} & 0 & 0 \\ \tau_{xz} & 0 & 0 \end{pmatrix} \qquad \varepsilon_{ij} = \begin{pmatrix} 0 & \gamma_{xy}/2 & \gamma_{xz}/2 \\ \gamma_{xy}/2 & 0 & 0 \\ \gamma_{xz}/2 & 0 & 0 \end{pmatrix}$$

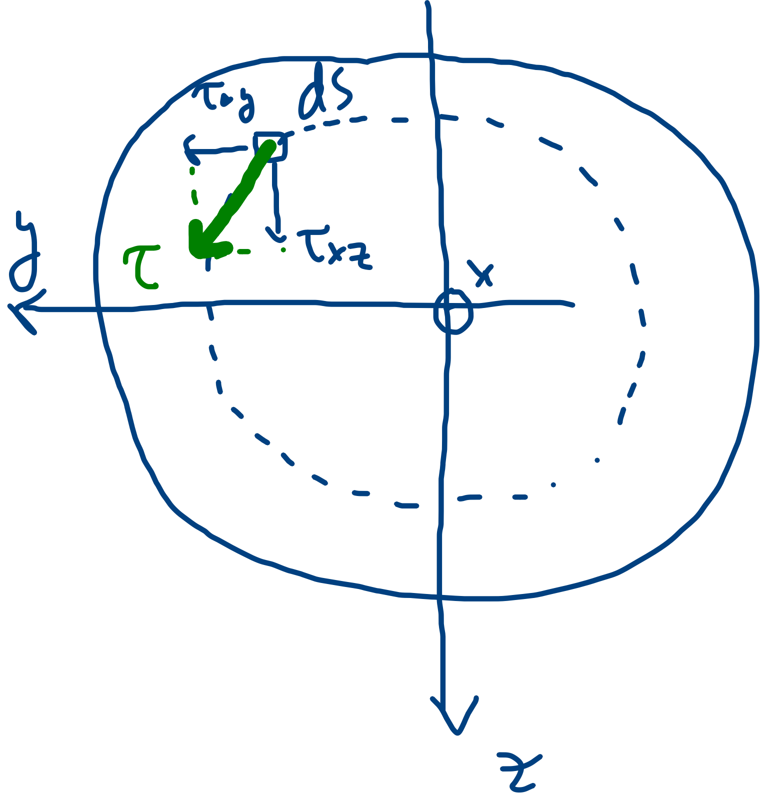
$$\rightarrow \boxed{\begin{array}{l} \gamma_{xy} = -z \cdot \vartheta_k \\ \gamma_{xz} = y \cdot \vartheta_k \end{array}} \boxed{\begin{array}{l} \tau_{xy} = -G\, z\, \vartheta_k \\ \tau_{xz} = G\, y\, \vartheta_k \end{array}}$$

$$\varepsilon_{xy} = \frac{\gamma_{xy}}{2}$$



γ_{xy} .. ZKOS

$G = \dfrac{E}{2(1+\mu)}$ ... MODUL VE SMYKU



$$\tau = \sqrt{\tau_{xy}^2 + \tau_{xz}^2} =$$

$$\tau^2 = G^2 z^2 \vartheta_k^2 + G^2 y^2 \vartheta_k^2 =$$

$$= G^2 \vartheta_k^2 (z^2 + y^2) \Rightarrow$$

$$\rightarrow \boxed{\tau = \vartheta_k G \cdot r}$$

$$\boxed{\begin{aligned} \gamma_{xy} &= -z \cdot \vartheta_k \\ \gamma_{xz} &= y \cdot \vartheta_k \end{aligned}} \quad \boxed{\begin{aligned} \tau_{xy} &= -G z \vartheta_k \\ \tau_{xz} &= G y \vartheta_k \end{aligned}}$$

$$\int dM = \int \tau \cdot dS \cdot r$$

$$M_k = \int \vartheta_k G \cdot r \cdot dS \cdot r = \vartheta_k G \underbrace{\int r^2 dS}$$

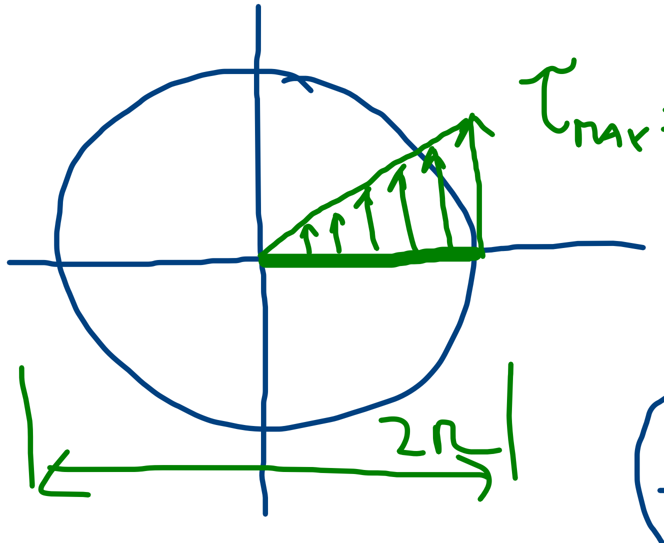
J_p ... POLÁRNÍ MOMENT SETRVAČNOSTI

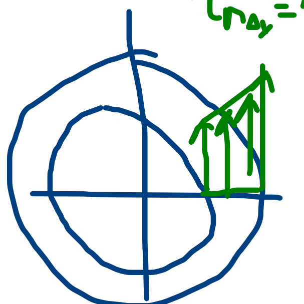
$$\boxed{\vartheta_k = \frac{M_k}{G \cdot J_p}} \rightarrow \frac{1}{r} = \frac{M_o}{E \cdot J_y}$$

$$\boxed{\tau(r) = \vartheta_k \cdot G \cdot r = \frac{M_k}{J_p} \cdot r}$$

$$\downarrow$$

$$\sigma = \frac{M_o}{J_y} \cdot z$$



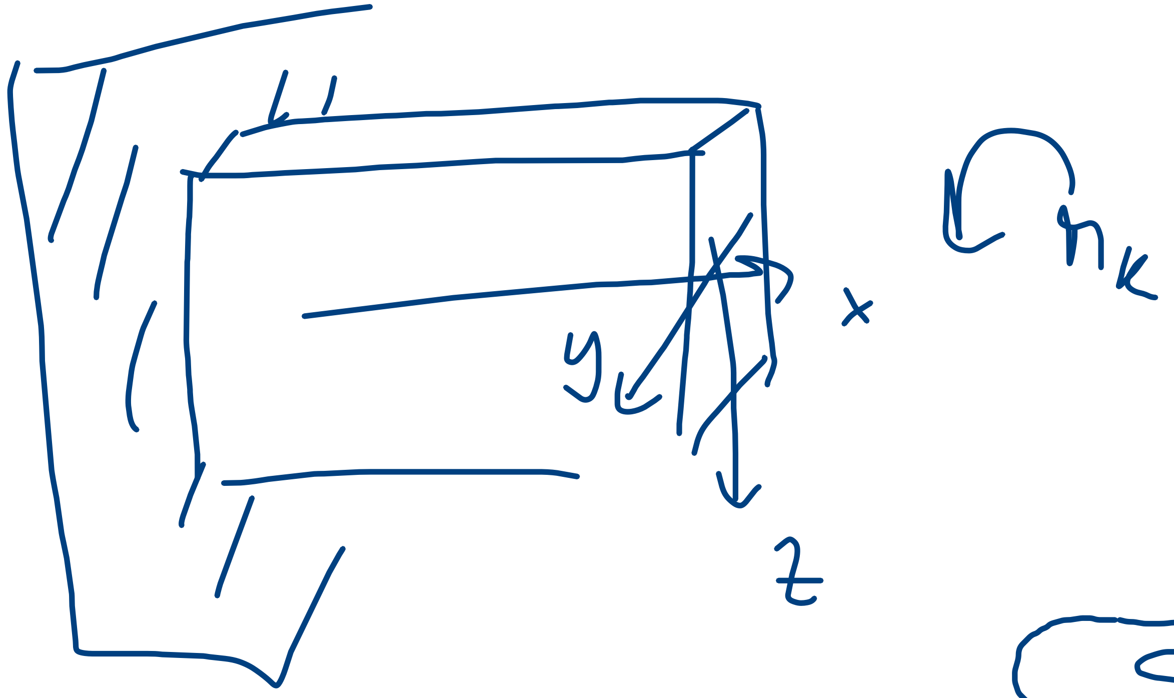


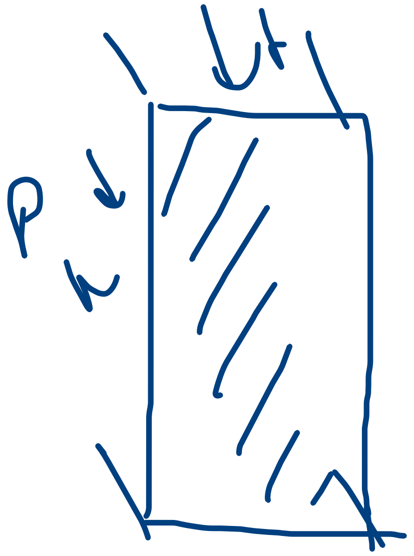
$$J_p = \frac{\pi R^4}{2} \quad \text{... tyč}$$

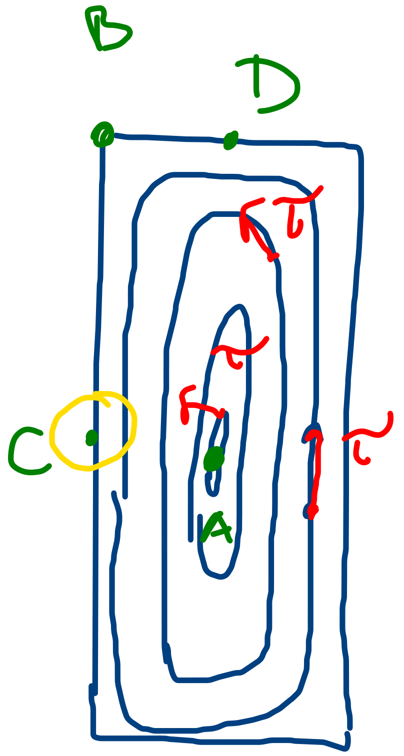
$$J_p = \frac{\pi R_1^4}{2} - \frac{\pi R_2^4}{2} \quad \text{... trubky}$$

Krut v případě nekruhových průřezů

MEMBRÁNOVÁ ANALOGIE

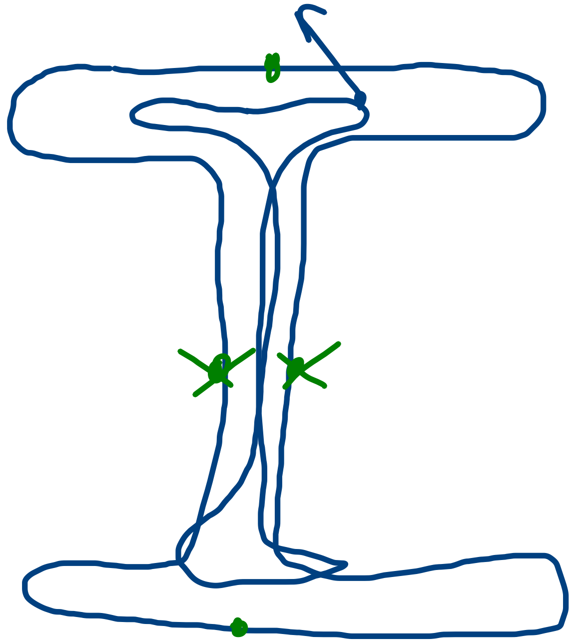




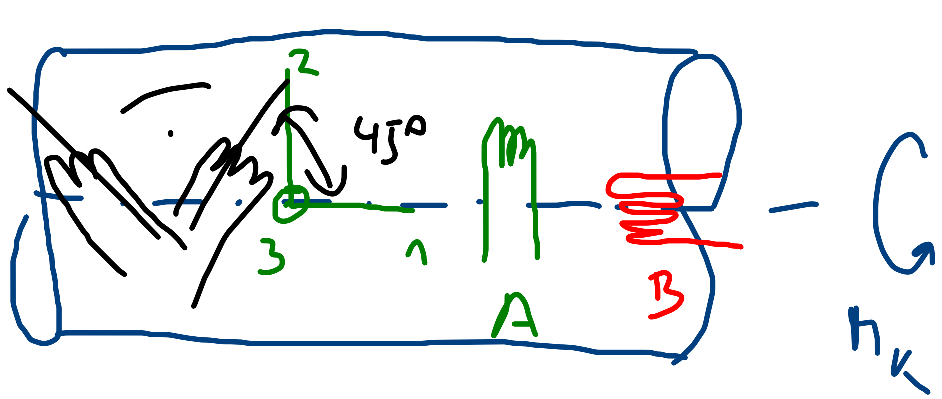


1) NAPĚTÍ MÁ SMĚR TEČNÝ K VRSTEVNICI

2) VELIKOST NAPĚTÍ JE ÚMĚRNÁ GRADIENTU



Měření deformace při krutu kruhové tyče



$$\sigma_{ij} = \begin{pmatrix} 0 & \tau_{xy} & \tau_{xz} \\ \tau_{xy} & 0 & 0 \\ \tau_{xz} & 0 & 0 \end{pmatrix}$$

$$\tau_{xy} = -\vartheta_k G z$$

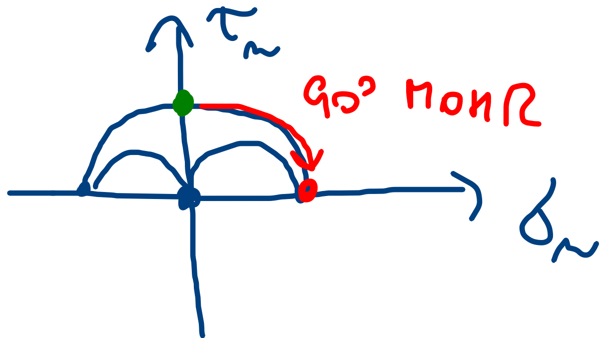
$$\tau_{xz} = +\vartheta_k G y$$

$$\varepsilon_{ij} = \begin{pmatrix} 0 & \gamma_{xy}/2 & \gamma_{xz}/2 \\ .. & 0 & 0 \\ .. & 0 & 0 \end{pmatrix}$$

$$\begin{vmatrix} -\lambda & \tau_{xy} & \tau_{xz} \\ \tau_{xy} & -\lambda & 0 \\ \tau_{xz} & 0 & -\lambda \end{vmatrix} = -\lambda(\lambda^2) + \tau_{xy}^2 \lambda + \tau_{xz}^2 \lambda = -\lambda^3 + \lambda\,(\underbrace{\tau_{xy}^2 + \tau_{xz}^2}_{\tau}) = \lambda(\tau^2 - \lambda^2) = \lambda(\tau - \lambda)(\tau + \lambda) = 0$$

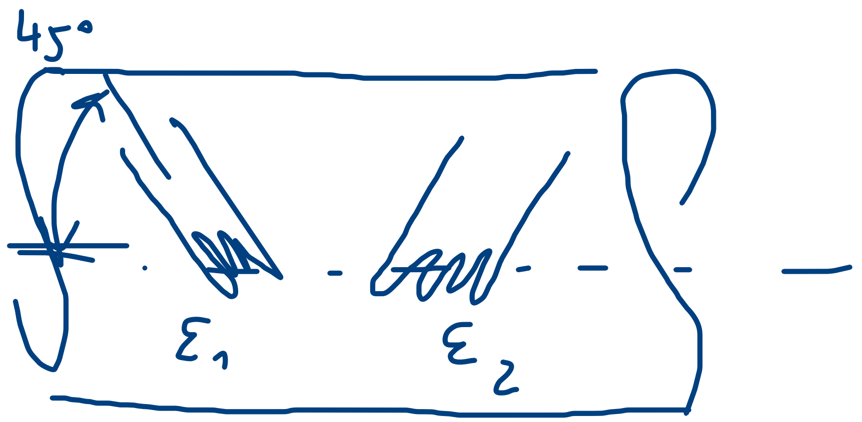
$$\tau = \frac{M_k}{J_p} \cdot R$$

$$\left.\begin{aligned} &\rightarrow \lambda_1 = 0 \\ &\rightarrow \lambda_2 = -\tau \\ &\rightarrow \lambda_3 = +\tau \end{aligned}\right\} \sigma_{ij} = \begin{pmatrix} \tau & 0 & 0 \\ 0 & -\tau & 0 \\ 0 & 0 & 0 \end{pmatrix}$$



90° MOHR ⇔ 45° REALITA

Měření deformace při krutu kruhové tyče



$$\sigma_{ij} = \begin{pmatrix} \tau_{max} & 0 & 0 \\ 0 & -\tau_{max} & 0 \\ 0 & 0 & 0 \end{pmatrix}$$

$$\sigma_1 = \tau_{max} = \frac{M_K}{J_p} \cdot R$$

$$\sigma_2 = -\tau_{max}$$

$$G = \frac{E}{2(1+\mu)}$$

$$J_p = \frac{\pi R^4}{2}$$

ROVINNÁ NAPJATOST :

$$\varepsilon_1 = \frac{1}{E}(\sigma_1 - \mu\sigma_2) = \frac{1}{G\cancel{(1+\mu)}2}\overbrace{(\tau_{max} + \mu\,\tau_{max})}^{\tau_{max}\cancel{(1+\mu)}} = \frac{\tau_{max}}{2G} = \frac{M_K\,R}{2G\,J_p} \Rightarrow$$

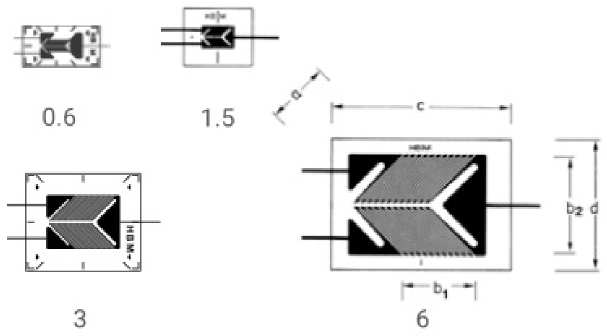
$$\varepsilon_2 = \frac{1}{E}(\sigma_2 - \mu\sigma_1) = -\varepsilon_1$$

$$\boxed{\varepsilon_1 = \frac{M_K}{\pi G R^3} \qquad \varepsilon_2 = -\frac{M_K}{\pi G R^3}}$$

=XY2x

Temperature response matched to customer's choice see page 16

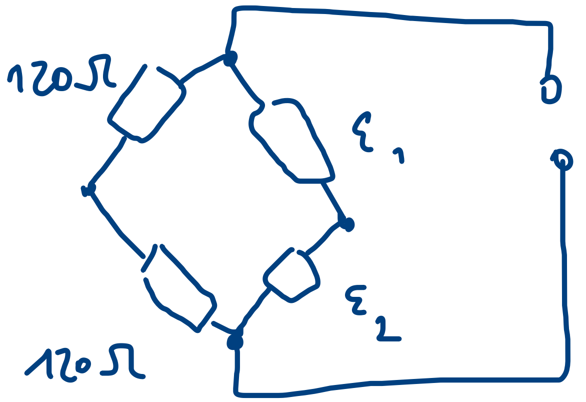
Illustrations show actual size (indicated: grid length in mm)



Steel	Alu
1-XY21-1.5/120	
1-XY21-3/120	
1-XY21-6/120	
1-XY21-1.5/350	
1-XY21-3/350	
1-XY21-6/350	

(*) Maximum excitation v… value is printed on the…
(#) Types are only availab…

Contents per package: 5 pcs.



$$\frac{\Delta U_a}{U_c} = \frac{k_D}{4}(\varepsilon_1 - \varepsilon_2 + \cancel{\varepsilon_3} - \cancel{\varepsilon_4})$$

$$\rightarrow \Delta U_a = U_c \frac{k_D}{2}\varepsilon = \underbrace{\frac{U_c\,k_D}{2\pi G R^3}}_{C_s} M_K$$

PŮLMOST
- 2x SIGNÁL
- TEPLOTNÍ KOMPENZACE
- KOMPENZACE NA OHYB, TAH/TLAK