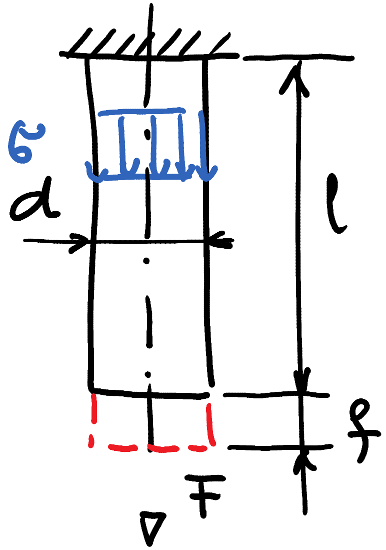
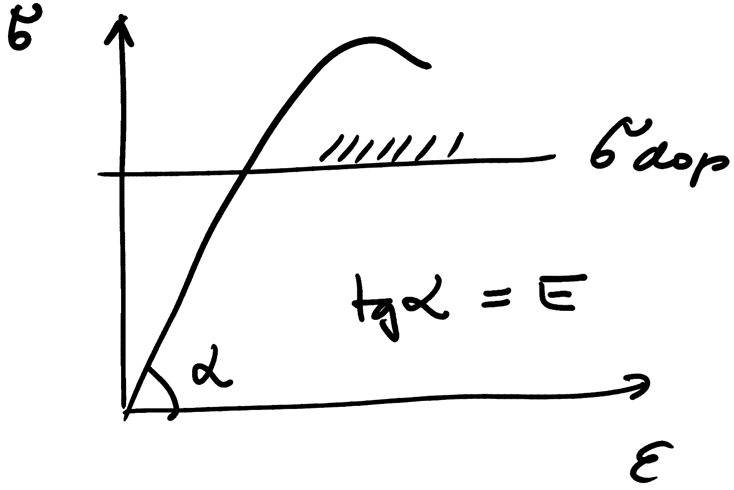
UZMETI





$$\sigma = \frac{F}{A}$$

$$\varepsilon = \frac{f}{l}$$

$$\sigma = E \cdot \varepsilon$$

$$\frac{F}{A} = E \frac{f}{l}$$

$$f = \frac{L}{AE} F$$

$$f = \delta F$$

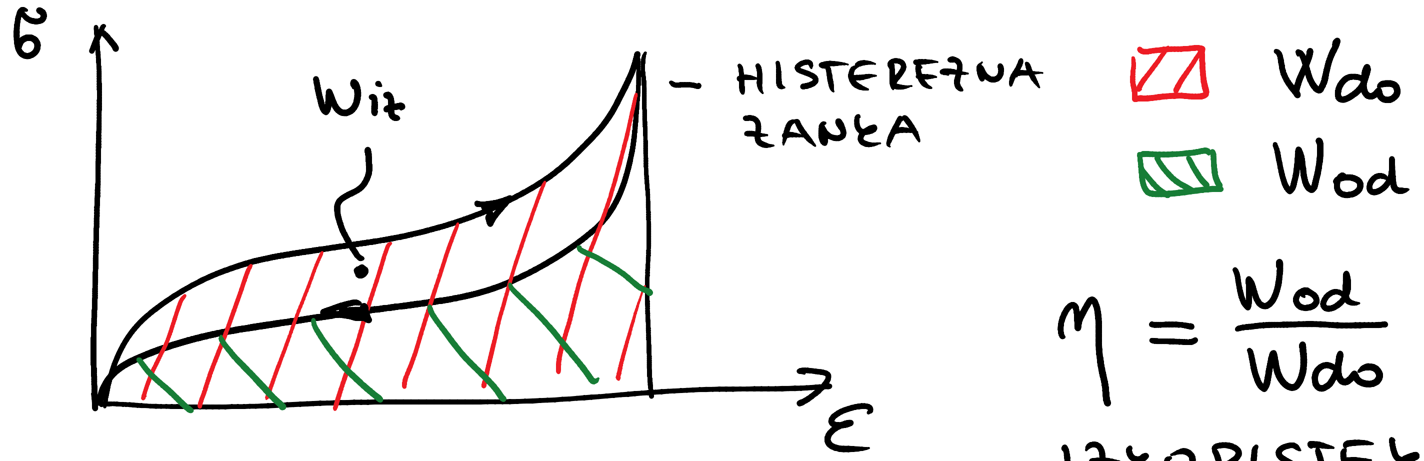
δ PODAJNOST

f DEFORMACIJA

VELIKO PODAJNOST DOSEŽEMO Z OBLIKOVANJEM VZMETI OZIROMA Z UPORABO MATERIALOV Z NIZKIM E

JEKLENE VZMETI

GUMIJASTE VZMETI



$$\eta = \frac{W_{od}}{W_{do}}$$

IZKORISTEK

$$W_{do} = W_{od} + W_{iz}$$

$W_{iz} \uparrow$

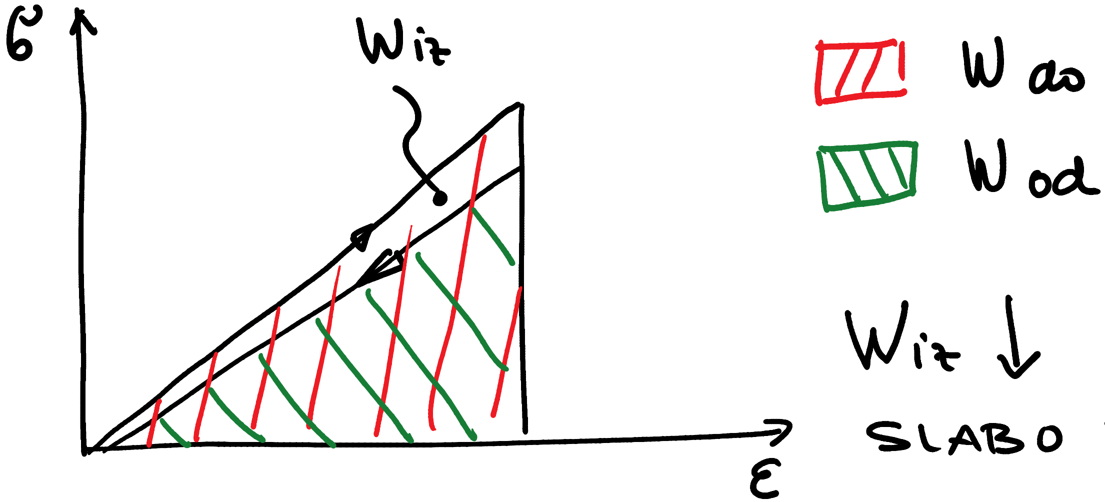
GUMIJASTA VZMET

HIPERELASTIČNA

$W_{iz} \rightarrow Q \rightarrow T \uparrow \qquad T \leq T_{dop}$

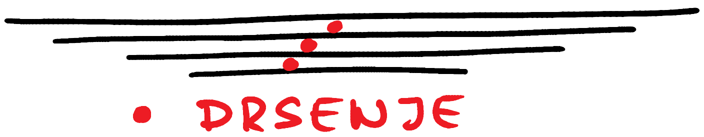
IMAJO NIZEK η ZATO DOBRO DUŠIJO VIBRACIJE

JEKLENA VZMET



$W_{iz} \downarrow \quad \eta \uparrow$

SLABO DUŠIJO VIBRACIJE

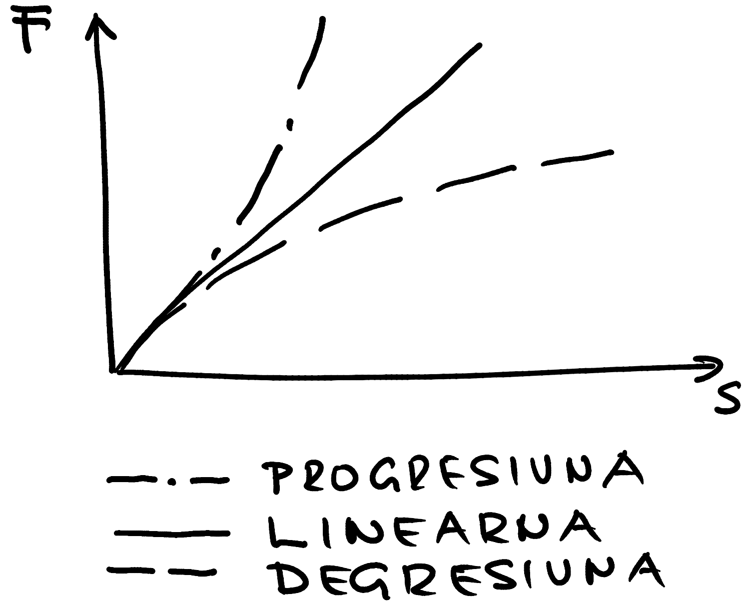


LISTNATA VZMET

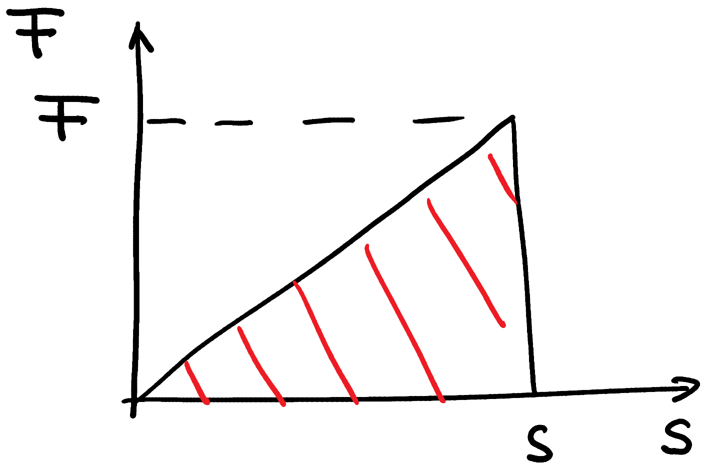
$\eta \downarrow$ DOBRO DUŠI VIBRACIJE

KARAKTERISTIKA VZMETI

S POVES VZMETI



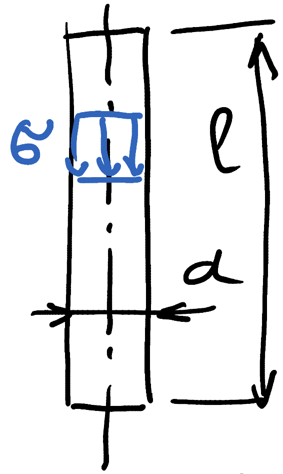
VOLUMSKI IZKORISTEK



$$W_{do} = \frac{F \cdot s}{2}$$

$$\sigma = \frac{F}{A} \qquad \varepsilon = \frac{s}{L}$$

$$\sigma = E \cdot \varepsilon$$



$$W_{do} = \frac{\sigma A \, \varepsilon \cdot l}{2} = \frac{\sigma \, V \, \sigma}{2E} = \frac{\sigma^2 V}{2E}$$

$$A = \frac{\pi d^2}{4}$$

$$V = A \cdot l$$

$$W_{max} = \frac{\sigma_{max}^2 \cdot V}{2E} = W_{do}$$

$$\sigma = \sigma_{max}$$

$$W = \frac{1}{2E} \int_V \sigma^2 \, dV$$

$$\eta_v = \frac{W}{W_{max}}$$

$$\eta_v = 1$$

$$W_{max} = \frac{\tau_{max}^2 V}{2G}$$

ZA STRIŽNE UDARCE

$$W = \frac{1}{2G}\int_V \tau^2 dV$$

$$W_{max} = \frac{\sigma_{max}^2 V}{2E}$$

ZA UPOGIBNE UDARCE

$$W = \frac{1}{2E}\int_V \sigma^2 dV$$

$$\eta_V = \frac{W}{W_{max}}$$

VRSTE VZMETI

UPOGIBNE Δ X

VZVOJNE Δ X

TLAČNE X

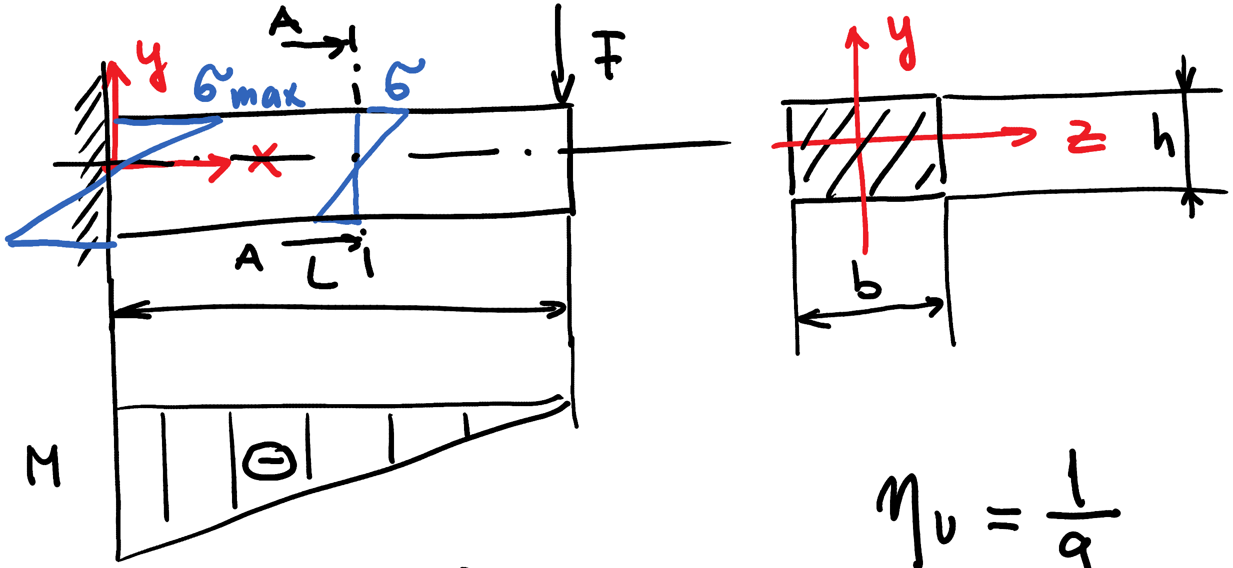
STRIŽNE X

MEMBRANSKE Δ

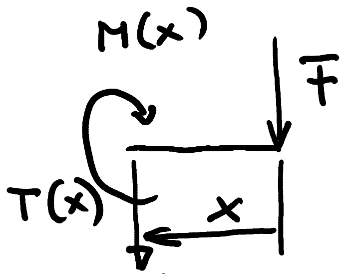
Δ KOVINSKE

X POLIMERNE

UPOGIBNA KONZOLNA VZMET



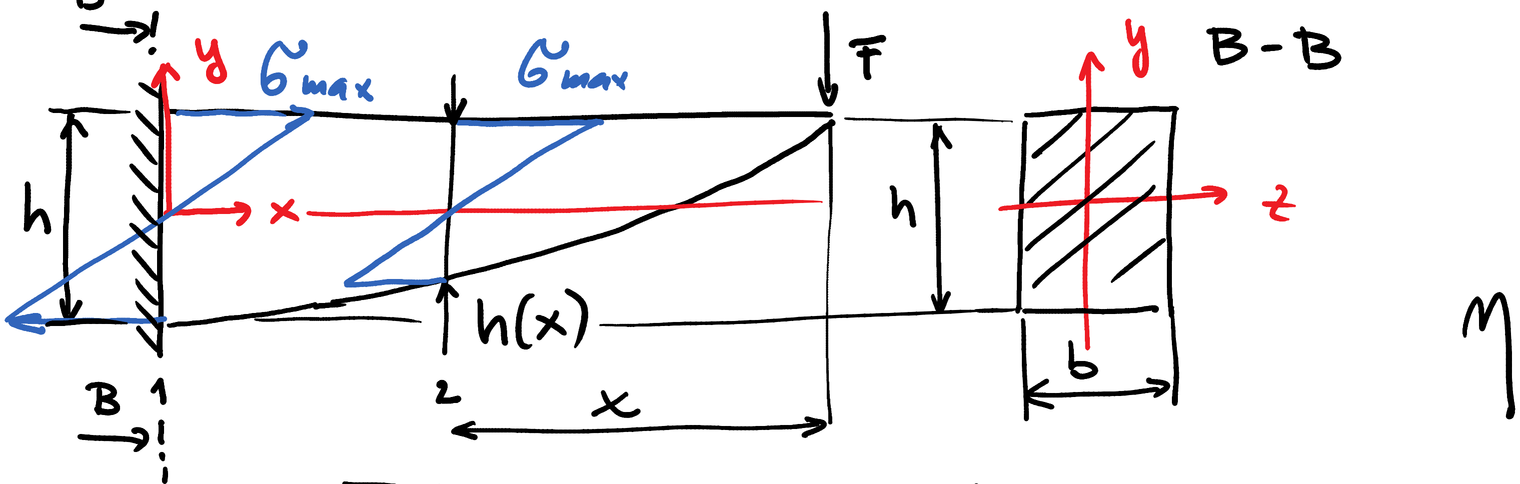
$$\eta_v = \frac{1}{9}$$



$$M(x) = -F \cdot x$$

$$T(x) = -F$$

UPOGIBNA KONZOLNA PARABOLIČNA VZMET



$$\eta_v = \frac{1}{3}$$

$$\sigma_{max} = \frac{F \cdot L}{W_z} = \frac{F \cdot L \, 6}{b \, h^2} = \frac{F \cdot x \, 6}{b \, h(x)^2}$$

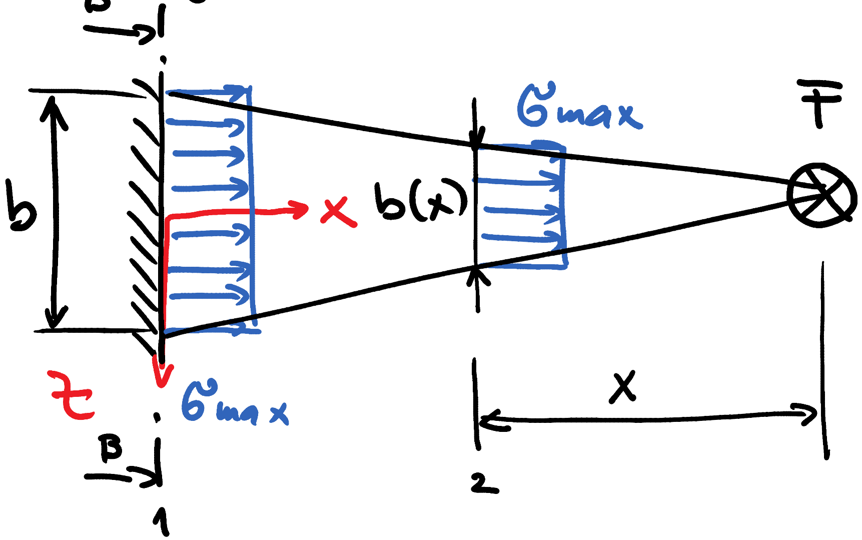
$$W_z = \frac{b \cdot h^2}{6}$$

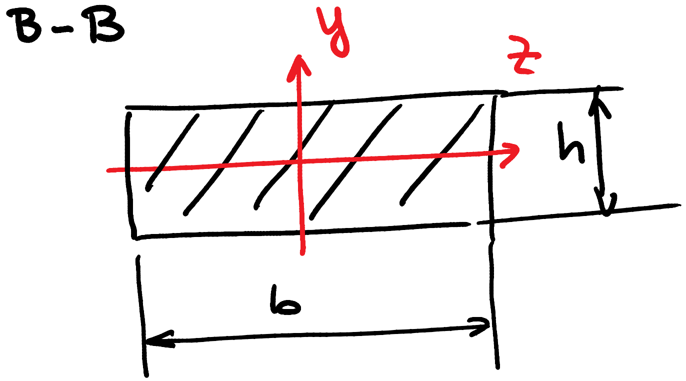
$$\frac{L}{h^2} = \frac{x}{h(x)^2}$$

$$h(x)^2 = \frac{x}{L} h^2$$

$$h(x) = \sqrt{\frac{x}{L}} \, h$$

UPOGIBNA KONZOLNA TRIKOTNA VZMET





$$\eta_v = \frac{1}{3}$$

$$\sigma_{max} = \frac{F \cdot L\, 6}{b\, h^2} = \frac{F \cdot x\, 6}{b(x)\, h^2}$$

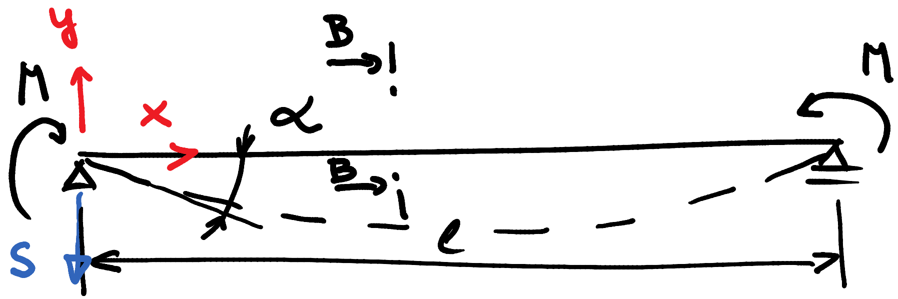
$$\frac{L}{b} = \frac{x}{b(x)}$$

$$b(x) = \frac{x}{L}\, b$$

LISTNATA UPOGIBNA UTMET

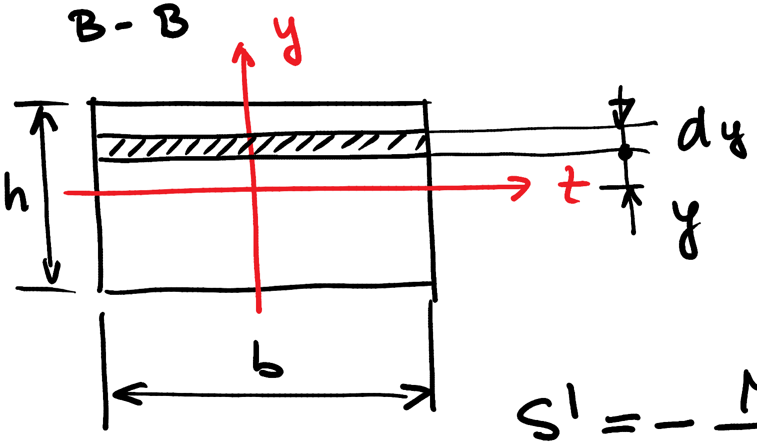
$\eta_v \approx \frac{1}{3}$ GLEJ SLIKOVNO GRADIVO

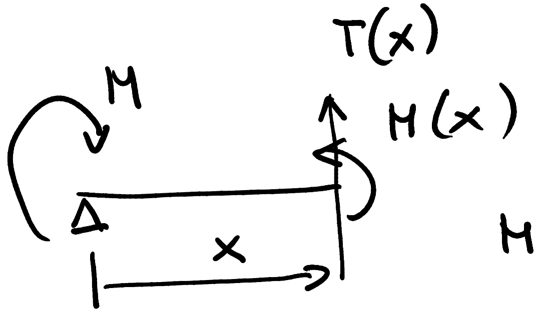
UPOGIBNA SPIRALNA VZMET



$$M = F \cdot r_a$$

$$\varphi = 2 \cdot \alpha$$





$$M(x) = M$$

$$s'' = -\frac{M(x)}{EI_z}$$

$$s' = -\frac{M}{EI_z} x + C_1$$

$$s = -\frac{M}{EI_z} x^2 \frac{1}{2} + C_1 x + C_2$$

R.P.

$x = 0$; $s = 0$

$x = l$; $s = 0$

$$C_2 = 0$$

$$\emptyset = -\frac{M}{EI_z}\frac{\ell^{\cancel{2}}}{2} + C_1 \cdot \cancel{\ell} \qquad C_1 = \frac{M\ell}{2EI_z}$$

$$s'(x=\emptyset) = tg\alpha \approx \alpha = C_1 \qquad s' = \frac{ds}{dx} = tg\alpha$$

$$\alpha = \frac{\ell \cdot M}{2EI_z} \qquad 2\alpha = \varphi$$

$$M = F \cdot r_a$$

$$\frac{\varphi}{\cancel{2}} = \frac{\ell\, r_a}{\cancel{2}EI_z} F$$

$$\varphi = \frac{\ell \cdot r_a}{EI_z} F$$

$$\frac{\ell \cdot r_a}{EI_z} = \delta$$

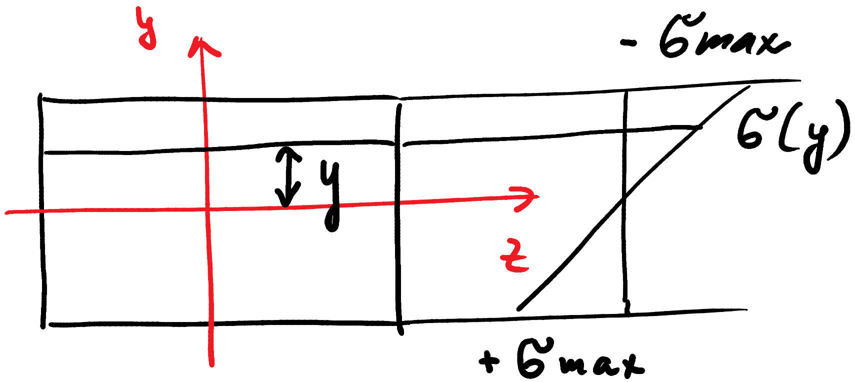
$$W_{max} = \frac{\sigma_{max}^2 V}{2E}$$

$$\sigma_{max} = \frac{M}{W_z} = \frac{M}{I_z}\frac{h}{2} \quad ; \quad W_z = \frac{b \cdot h^2}{6}$$

$$W_{max} = \frac{M^2 V h^2}{I_z^2 \, 8E}$$

$$dV = b \, dy \, l \quad ; \quad \sigma(y) = \frac{M}{I_z} y$$

$$W = \frac{1}{2E} \int_V \sigma^2 dV = \frac{b l M^2}{2E I_z^2} \int_{-\frac{h}{2}}^{\frac{h}{2}} y^2 \, dy = \frac{b l M^2}{2 E I_z^2} \frac{1}{3} \Big(\underbrace{\frac{h^3}{8} + \frac{h^3}{8}}_{\frac{h^3}{4}} \Big)$$



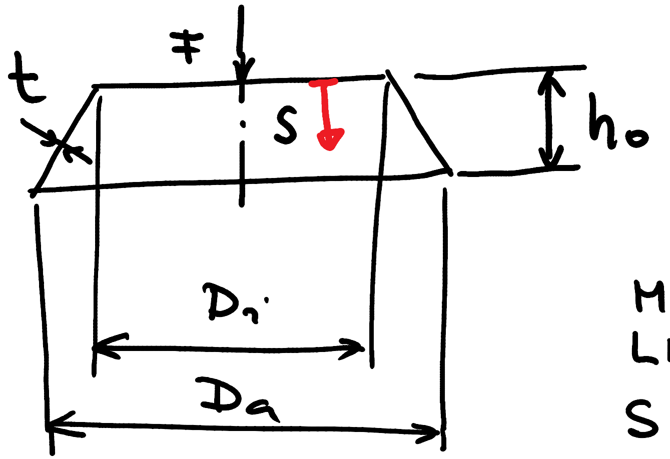
$$W = \frac{b l M^2 h^3}{24 E I_z^2}$$

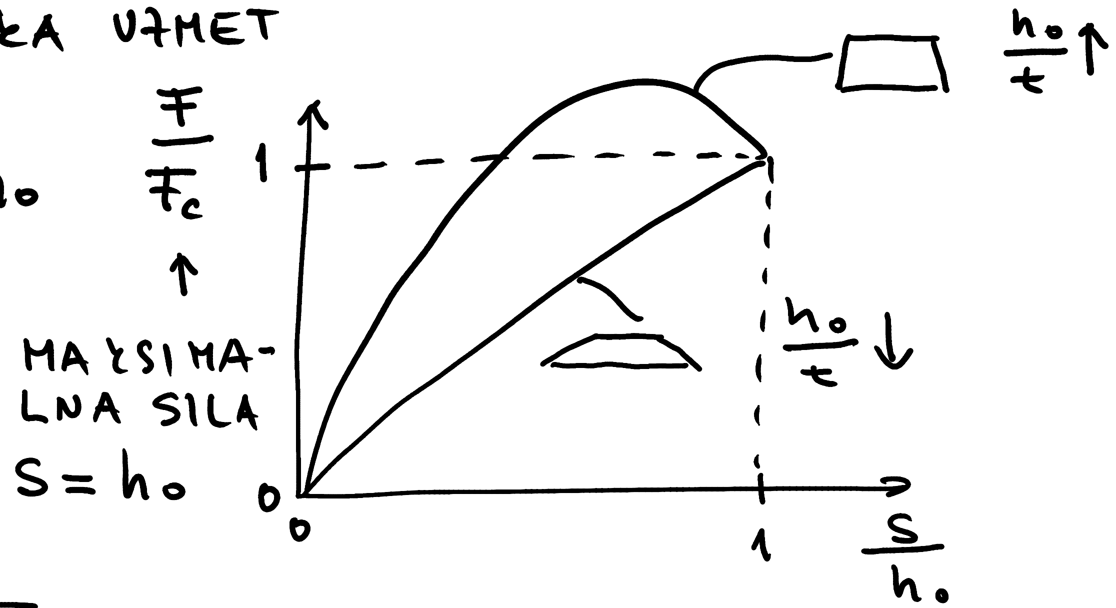
$$W = \frac{M^2 V h^2}{I_z^2 \, 24 E}$$

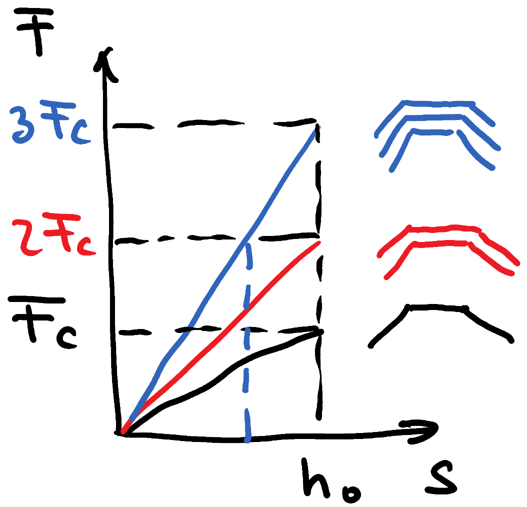
$$V = b l h$$

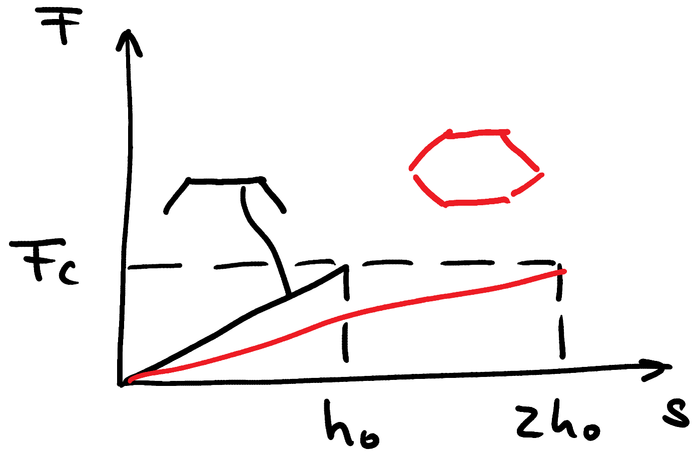
$$\eta_v = \frac{W}{W_{max}} = \frac{8}{24} = \frac{1}{3}$$

MEMBRANSKA VZMET

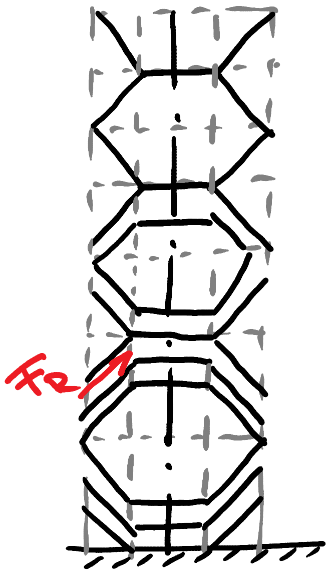




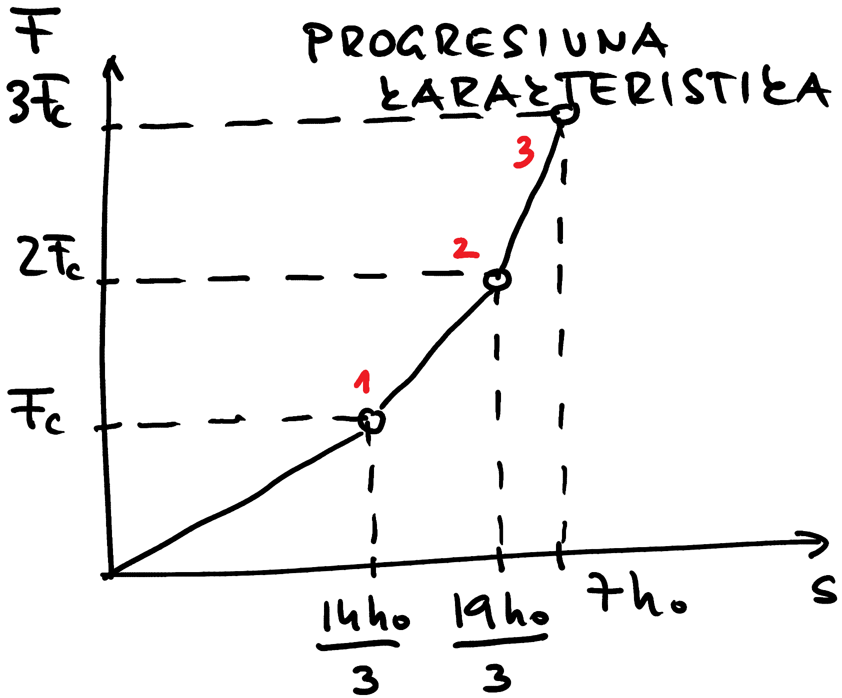




PREDPOSTAVIMO, DA JE KARAKTERISTIKA LINEARNA

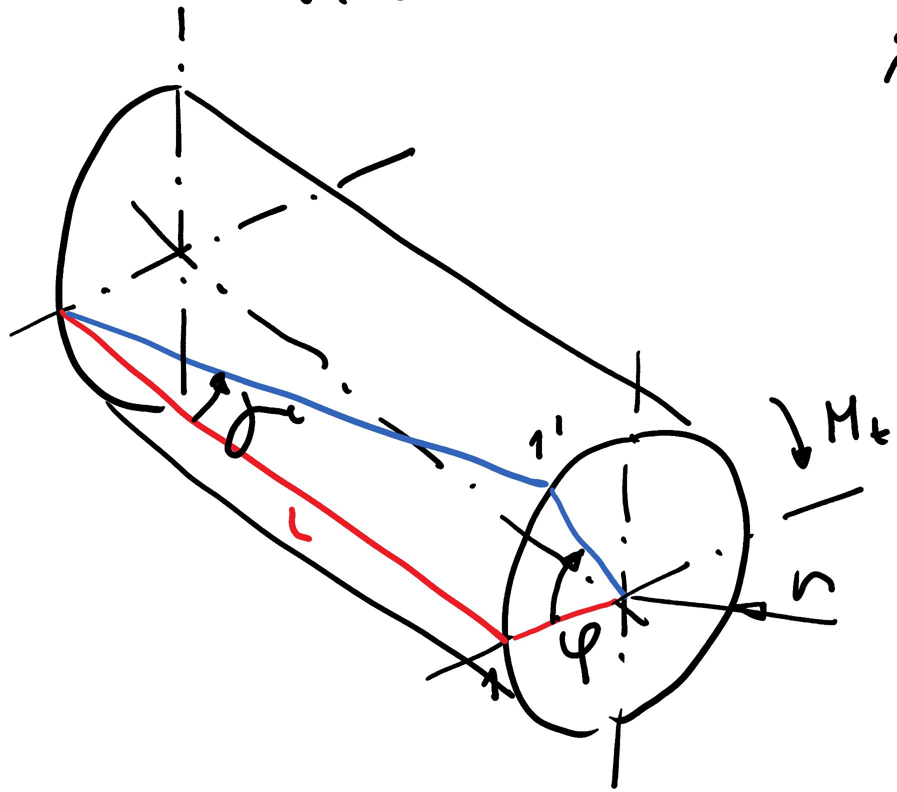


1 F_c	2 $2F_c$	3 $3F_c$
h_0	h_0	h_0
h_0	h_0	h_0
h_0	h_0	h_0
$\frac{1}{2}\ h_0$	h_0	h_0
$\frac{1}{2}\ h_0$	h_0	h_0
$\frac{1}{3}\ h_0$	$\frac{2}{3}\ h_0$	h_0
$\frac{1}{3}\ h_0$	$\frac{2}{3}\ h_0$	h_0
$\frac{14\,h_0}{3}$	$\frac{19\,h_0}{3}$	$\frac{21\,h_0}{3}$



DOBRO DUŠIJO VIBRACIJE

VZVOJNA PALIČNA VZMET



$$\widehat{11'} = r\cdot\varphi \cong l\cdot\gamma$$

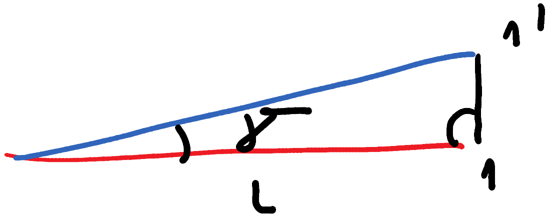
$$\tau = G\cdot\gamma$$

$$\tau = \frac{M_t}{W_{po}} \quad ; \quad \gamma = r\,\varphi\,\frac{1}{l}$$

$$\frac{M_t}{W_{po}} = G\,\frac{r}{l}\,\varphi$$

$$\varphi = \frac{l\,M_t}{W_{po}\,r\cdot G}$$

$$\varphi = \frac{l}{I_{po}\,G}\,M_t$$

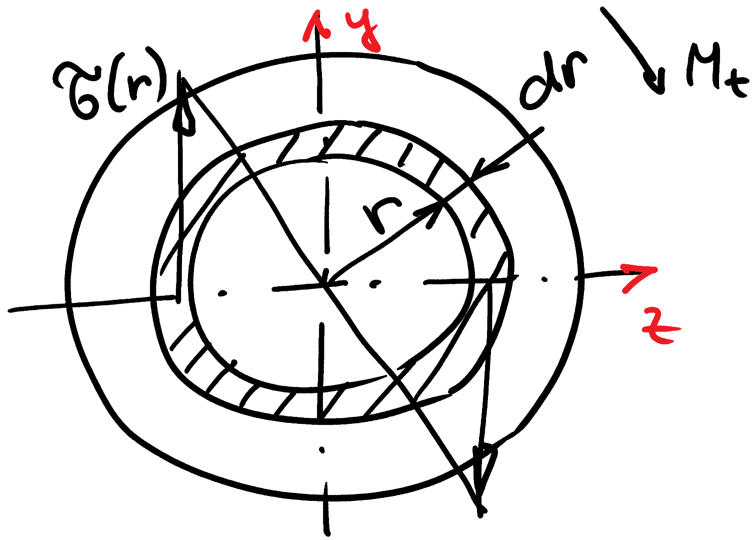


$$\operatorname{tg}\gamma = \frac{\widehat{11'}}{L} \cong \gamma$$

$$W_{max} = \frac{\tau_{max}^2 \cdot V}{2G}$$

$$\tau_{max} = \frac{M_t}{W_{po}} = \frac{M_t\, r}{I_{po}}$$

$$W_{max} = \frac{M_t^2 r^2 V}{I_{po}^2 \, 2G}$$



$$W = \frac{1}{2G} \int_V \tau^2 \, dV$$

$$= \frac{1}{2G} \frac{M_t^2 \, 2\pi l}{I_{po}^2} \int_0^r r^3 \, dr$$

$$dV = 2\pi r \, dr \, l$$

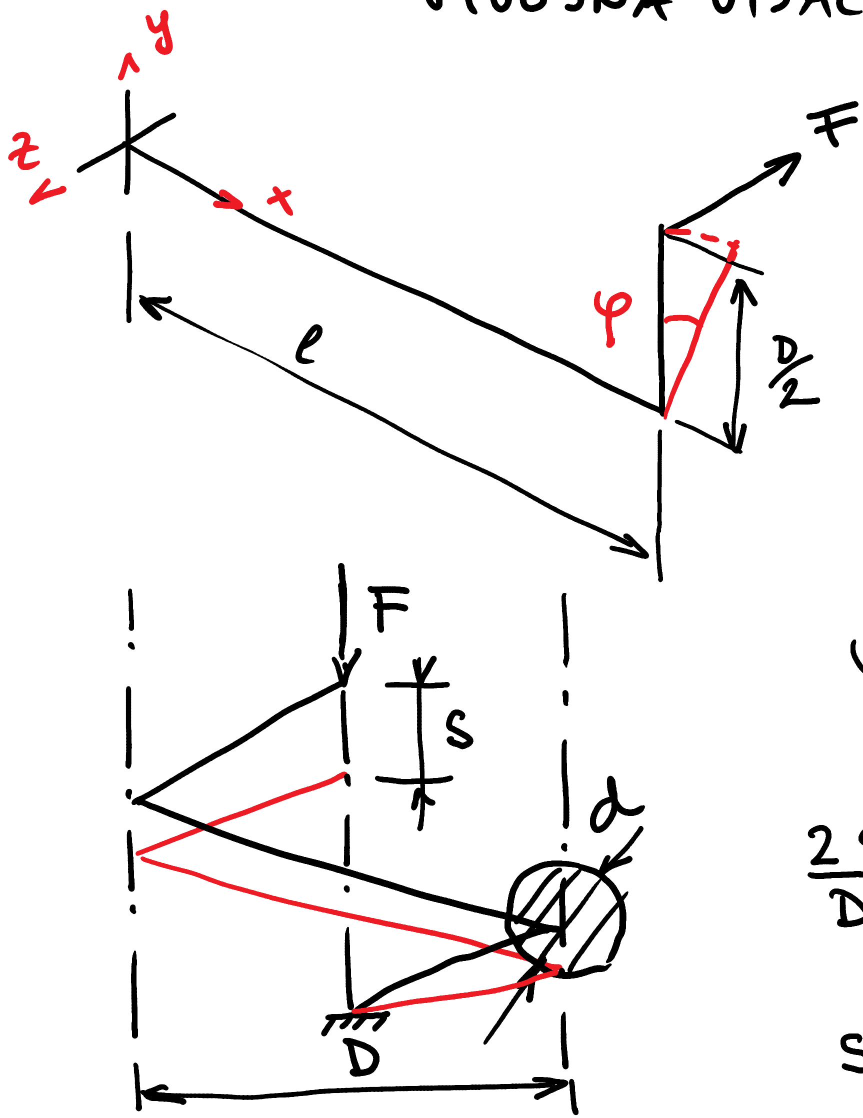
$$= \frac{M_t^2 \pi l}{G I_{po}^2} \frac{r^4}{4}$$

$$\tau(r) = \frac{M_t}{I_{po}} r$$

$$= \frac{M_t^2 r^2 V}{I_{po}^2 \, 4G}$$

$$\eta_v = \frac{2}{4} = \frac{1}{2}$$

VZVOJNA VIJAČNA VZMET



$$l = \pi D n$$

n – ŠTEVILO EFEKTIVNIH NAVOJEV VZMETI

$$M_t = F \cdot \frac{D}{2}$$

$$s = \varphi \cdot \frac{D}{2}$$

$$\varphi = \frac{l}{I_{po} G} M_t$$

$$\frac{2s}{D} = \frac{\pi D n}{I_{po} G} \frac{D}{2} F$$

$$s = \frac{\pi D^3 n}{4 I_{po} G} F$$

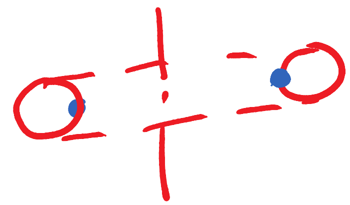
$$\eta_v = \frac{1}{2}$$

$n_t = n + 2$ HLADNO PREOBLIKOVANA UZMET

$n_t = n + 1,5$ TOPLO PREOBLIKOVANA UZMET

$$n_t = 3,5 \ , \ 4,5 \ , \ 5,5 \ , \ldots$$

VREDNOTENJE VZVOJNE VIJAČNE VZMETI NA STATIČNO NOSILNOST



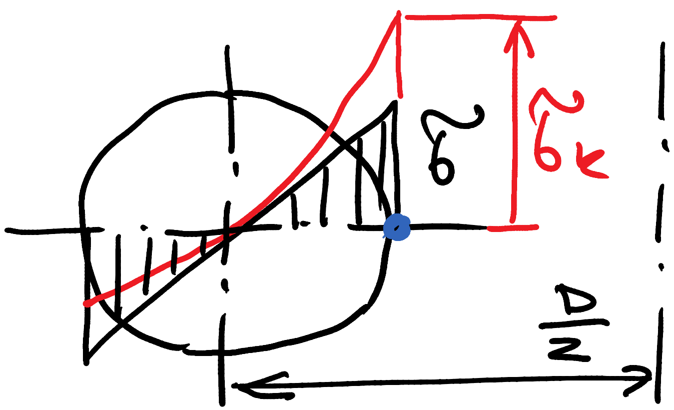
$$\tau = \frac{M_t}{W_{po}} \leq \tau_{dop} \quad \leftarrow \quad \tau = \tau_{max}$$

$$\tau_c = \frac{M_{tc}}{W_{po}} \leq \tau_{c\,dop}$$

C – BLOKIRANA DOLŽINA VZMETI

$$M_{tc} = \frac{F_c \cdot D}{2}$$

DINAMIČNA NOSILNOST



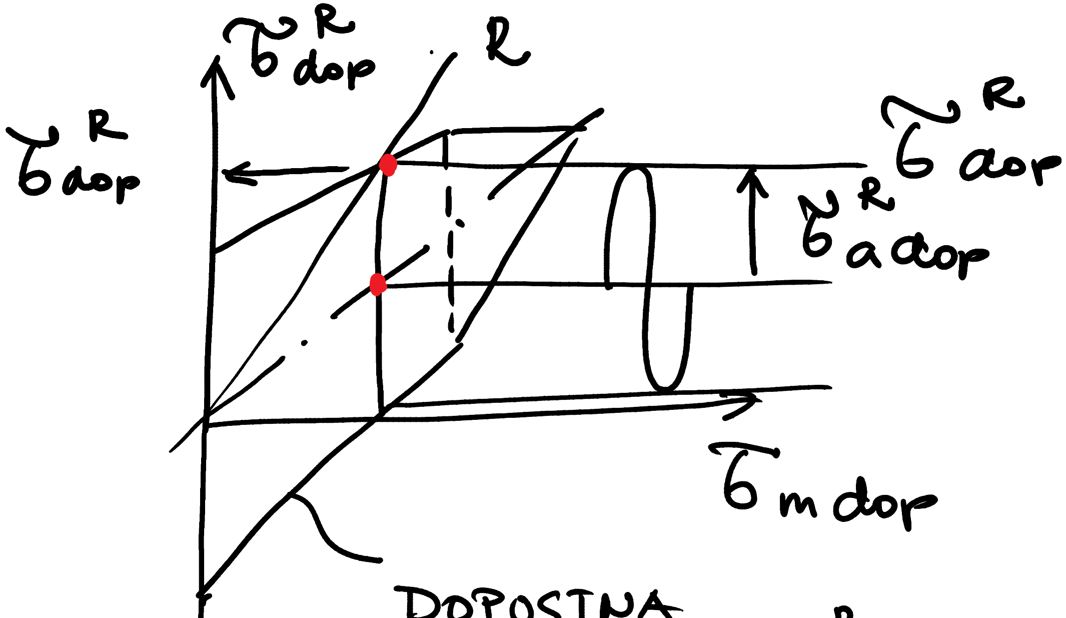
$$\tau_k = k\,\tau$$

k – UPOŠTEVA KONCENTRACIJO NAPETOSTI ZARADI UKRIVLJENOSTI ŽICE

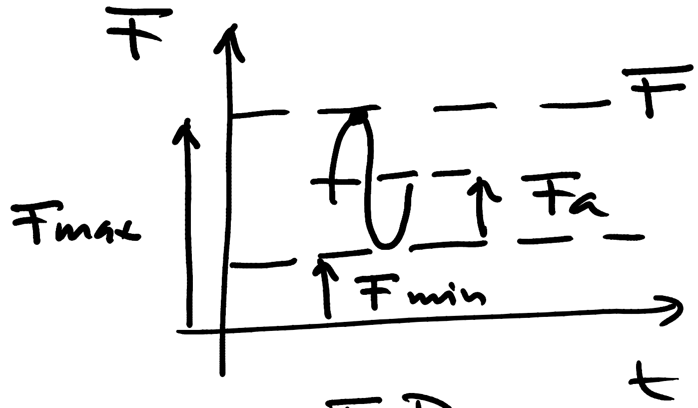
$$\tau_k \leq \tau^{R}_{dop}$$

$$\tau_{ka} = k\,\tau_a$$

$$\tau_{ka} \leq \tau^{R}_{a\,dop}$$



DOPOSTNA NAPETOST τ^R_{dop}



$$\tau = \frac{F \cdot D}{2 W_p}$$

$$\tau_a = \frac{F_a \cdot D}{2 W_p}$$

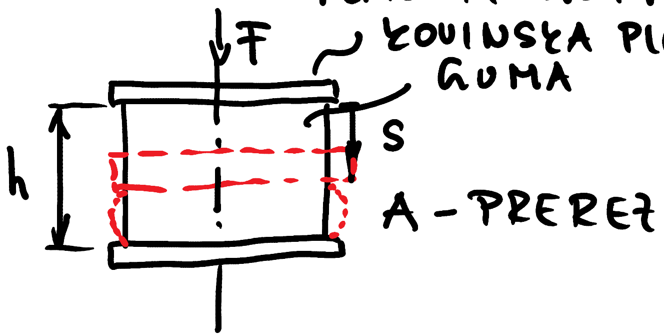
τ^R_{obl}

$$\tau^R_{dop} = \frac{\tau_D^R \cdot b_1 \, b_2}{\beta_k \, \nu}$$

$$R = \frac{\tau_{min}}{\tau_{max}} = \frac{F_{min}}{F_{max}}$$

$$M_t = \frac{F \cdot D}{2}$$

TLAČNA GUMIJASTA VZMET

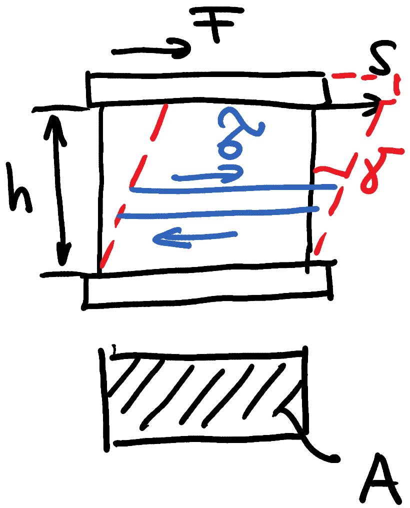


$$\sigma = E \cdot \varepsilon$$

$$\frac{F}{A} = E\,\frac{s}{h} \;\rightarrow\; s = \boxed{\frac{h}{AE}}\,F \qquad \frac{h}{AE} = \delta$$

$$\sigma_{max} = \frac{F}{A} \qquad \eta_v = 1$$

STRIŽNA PRIZMATIČNA GUMIJASTA VZMET



$$\tau = G \cdot \gamma$$

$$\operatorname{tg}\gamma = \frac{s}{h} \cong \gamma$$

$$\tau = \frac{F}{A}$$

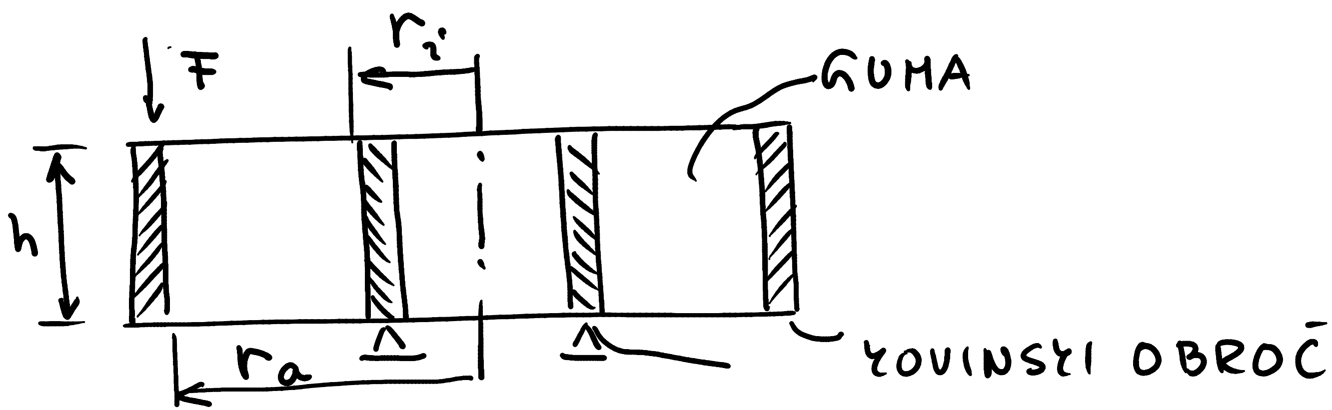
$$\frac{F}{A} = G \cdot \frac{s}{h}$$

$$s = \boxed{\frac{h}{AG}}\,F \qquad \frac{h}{AG} = \delta$$

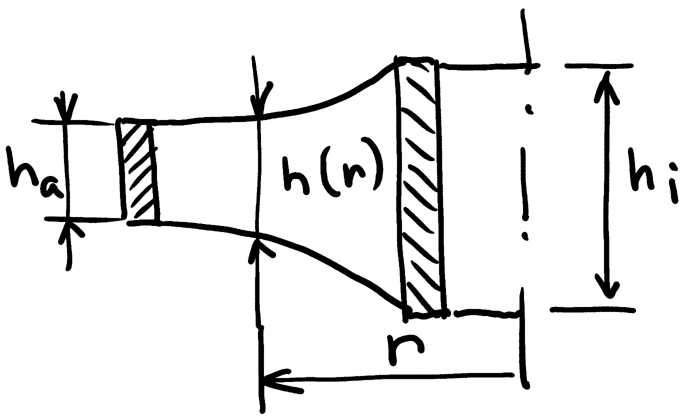
$$\tau_{max} = \frac{F}{A}$$

$$\eta_v = 1$$

KOLUTNA STRIŽNA GUMIJASTA UZMET



KAKO NAJ SE SPREMINJA VIŠINA UZMETI, DA BO $\eta_v = 1$?



PREDPOSTAVIMO, DA POZNAMO h_i, r_i IN r_a

IŠČEMO h_a IN $h(r)$

D.N.