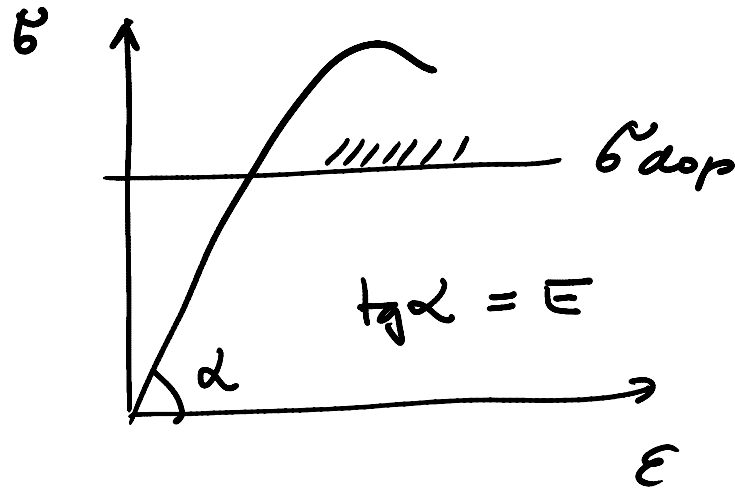


$$\sigma = \frac{F}{A}$$

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

U ZMETI



$$\sigma = E \cdot \epsilon$$

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

$\sigma$  PODAJNOST

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

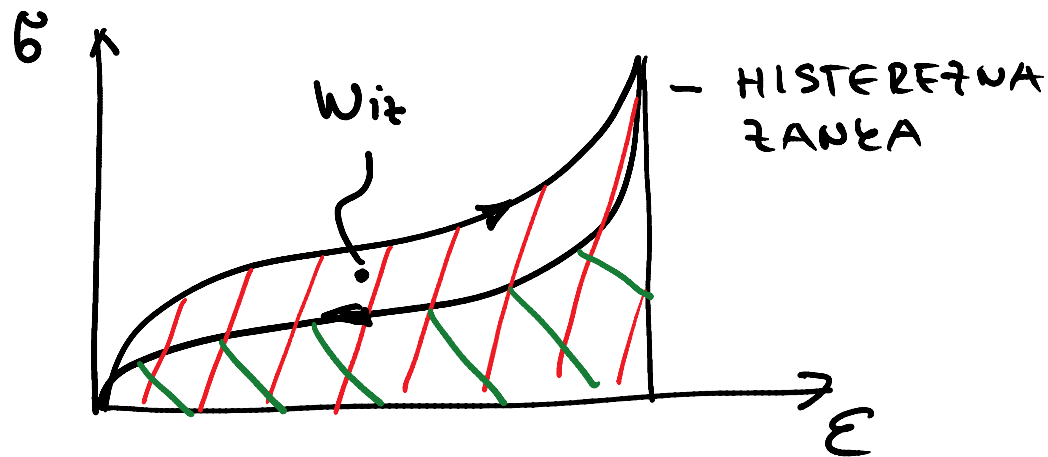
$f$  DEFORMACIJA

$$f = \sigma F$$

VELIKO PODAJNOST DOSEŽEMO + OBLIKOVANJEM UTMETI  
 OZIROMA Ž UPORABO MATERIALOU + NIŽKIM  $\epsilon$

JEŽLENE UTMETI

GUMIJASTE UTMETI



  $W_{do}$

  $W_{od}$

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

IZORISTEK

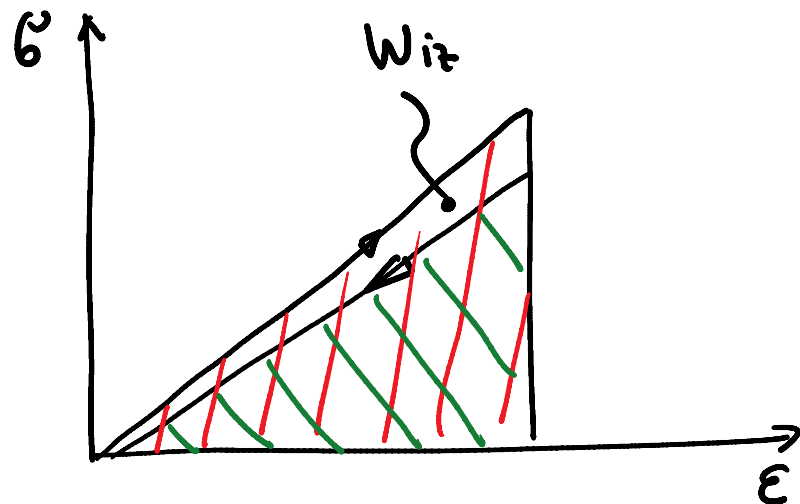
$$W_{do} = W_{od} + W_{iz}$$

$W_{iz} \uparrow$

GUMIJASTA UTMET  
 HIPERELASTIČNA

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

IHAJO NIŽEK  $\eta$  ZATO DOBRO DUŠIJO VIBRACIJE  
 JEYIENA U+MET



  $W_{as}$   
  $W_{od}$

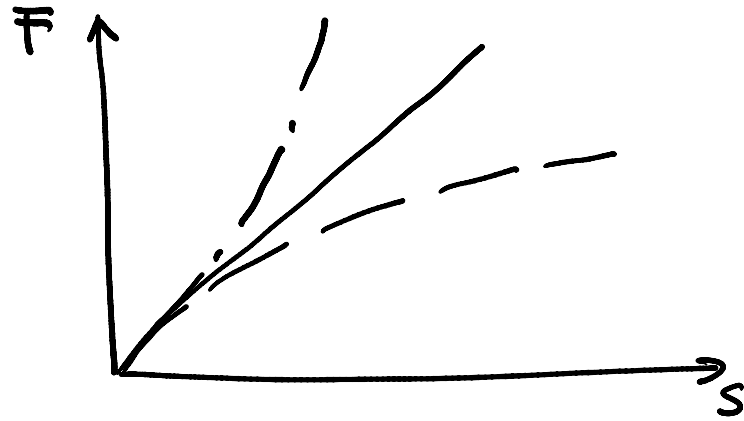
$W_{itz} \downarrow$   $\eta \uparrow$   
 SLABO DUŠIJO VIBRACIJE

  
 • DRSENJE

LISTNATA U+MET

$\eta \downarrow$  DOBRO DUŠI  
 VIBRACIJE

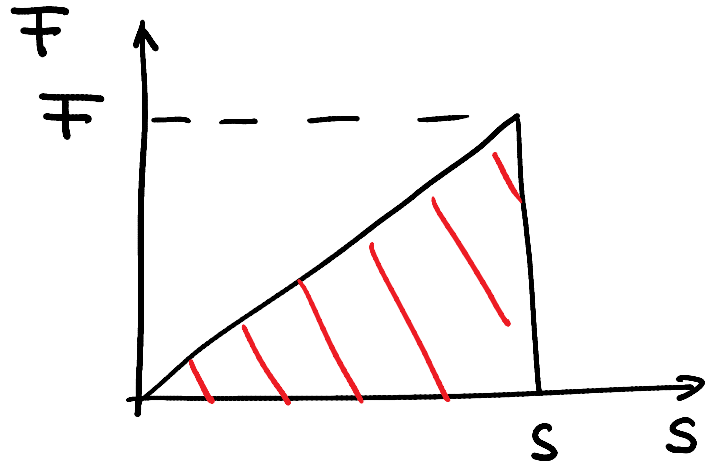
# ΧΑΡΑΚΤΗΡΙΣΤΙΚΑ ΥΓΜΕΤΙ



- .- PROGRESSIUNA
- LINEARNA
- .- DEGRESIUNA

# S ΠΟΥΕΣ ΥΓΜΕΤΙ

# VOLUMSKI IZKORISTEK

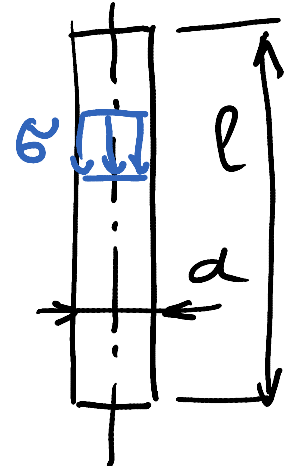


$$W_{do} = \frac{F \cdot s}{2}$$

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

$$\epsilon = \frac{s}{l}$$

$$\sigma = E \cdot \epsilon$$



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

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

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

$$V = A \cdot l$$

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

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

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

$$\eta_v = 1$$

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



ZA STRIŽNE  
UŽMETI

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



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



ZA UPOGIBNE  
UŽMETI

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



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

## VRSTE UŽMETI

UPOGIBNE  $\Delta$  X

UŽVOJNE  $\Delta$  X

TLAČNE X

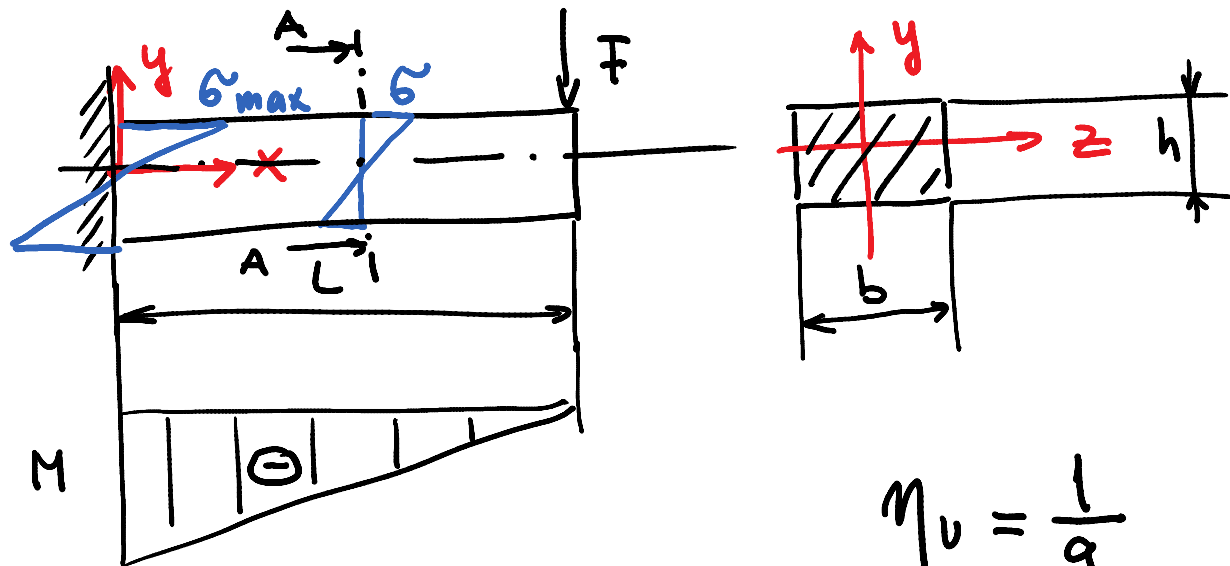
STRIŽNE X

MEMBRANSKE  $\Delta$

$\Delta$  KOVINSKE

X POLIMERNE

# UPOGIBNA KONTROLNA UZMET



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

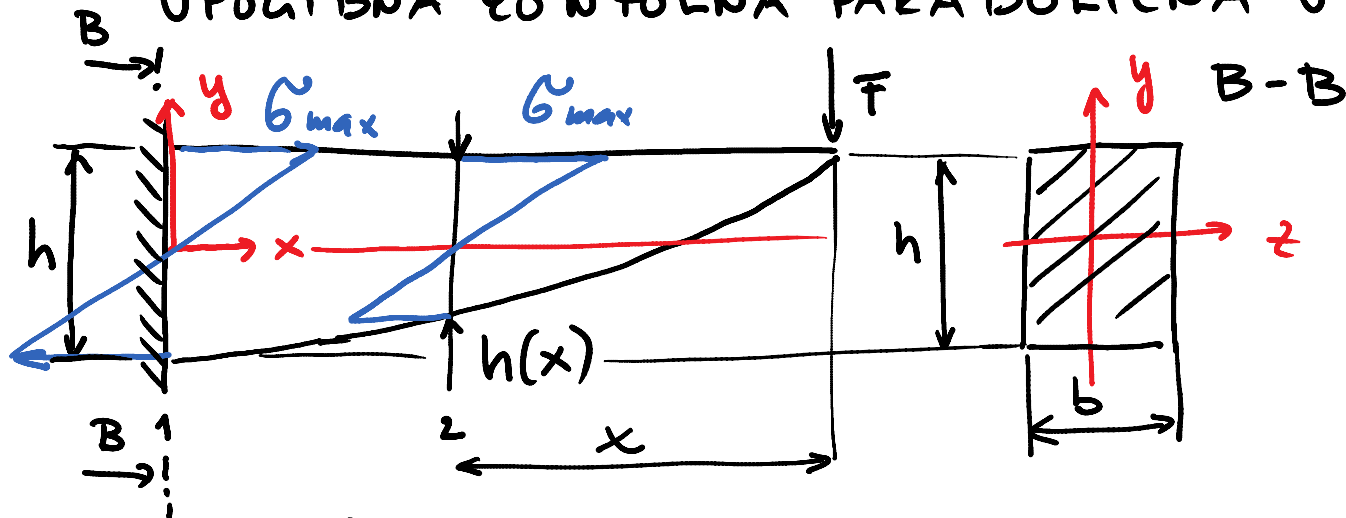
Free body diagram of a beam segment of length  $x$ . The forces and moments are:

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

$$T(x) = -F$$



# UPOGIBNA KONTROLNA PARABOLIČNA UŽMET



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

$$G_{max} = \frac{F \cdot L}{W_z} = \frac{F \cdot L \cancel{G}}{b h^2} = \frac{F \cdot x \cancel{G}}{b h(x)^2}$$

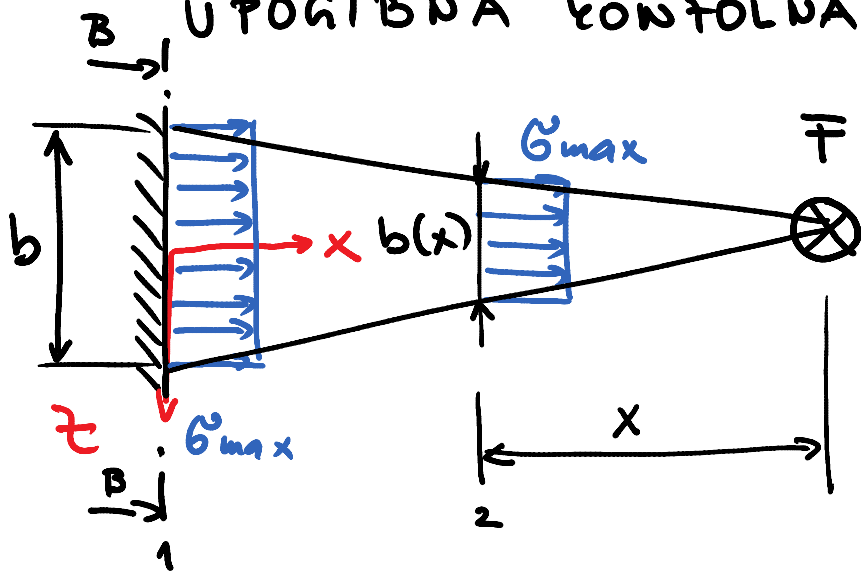
$$W_z = \frac{b \cdot h^2}{6}$$

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

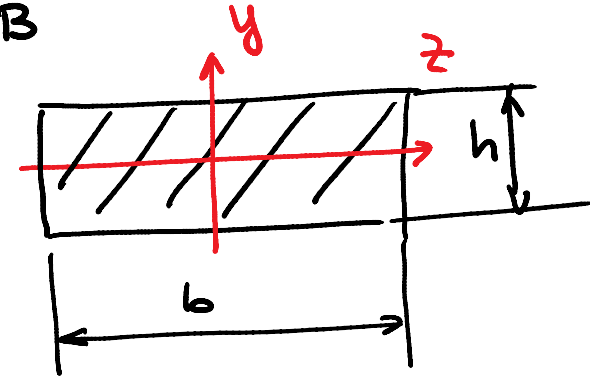
$$h(x)^2 = \frac{x}{L} h^2$$

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

UPOGIBNA KONTROLNA TRIKOTNA UZMET



B-B



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

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

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

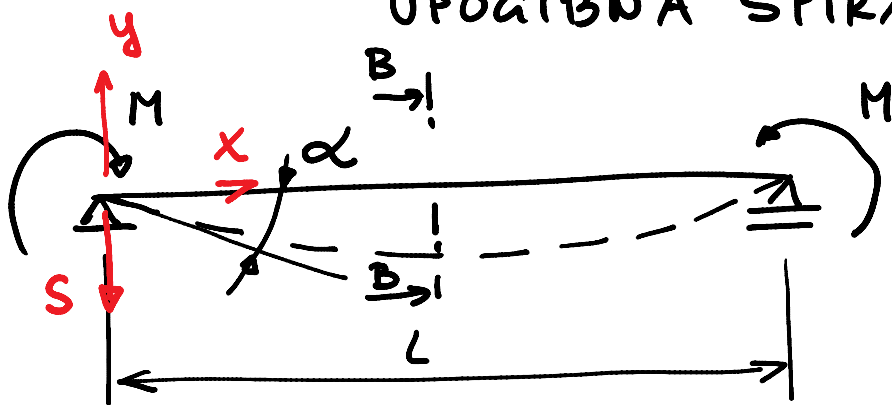
$$\eta_v = \frac{1}{3}$$

LISTNATA UPOGIBNA UZMET

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

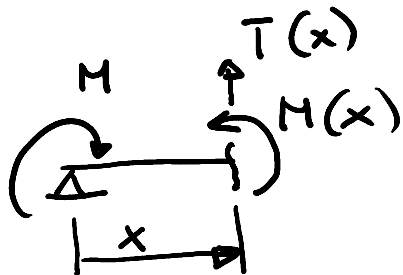
DO TU PREGLEDANU 30. 11. 2018

# UPOGIBNA SPIRALNA UŽMET



$$M = F \cdot r_a$$

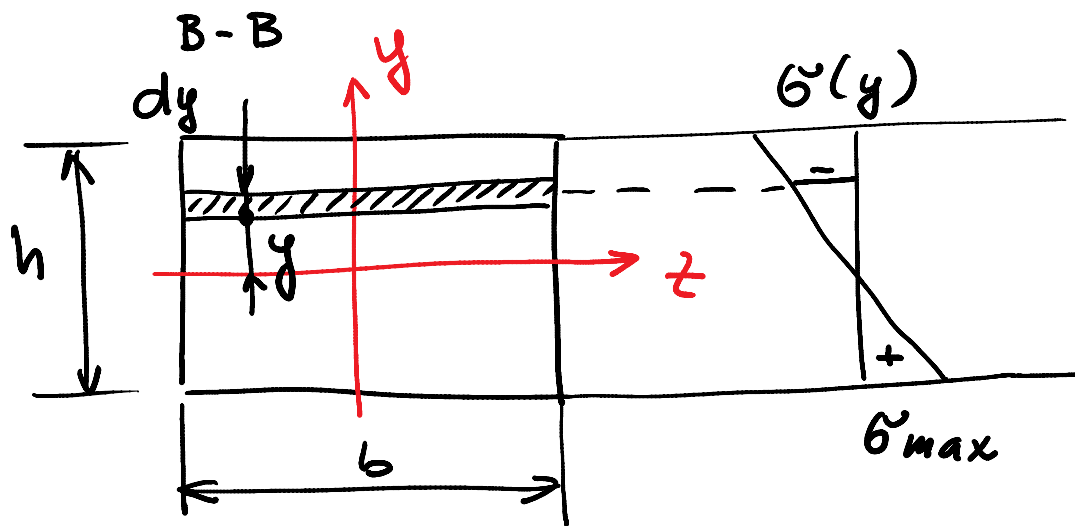
$$\varphi = 2\alpha$$



$$M(x) = M$$

$$T(x) = 0$$

$$dV = b \, dy \, l$$



$$\sigma_{max} = \frac{M}{I_z} \frac{h}{2}; \quad \sigma(y) = \frac{M}{I_z} y$$

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

R.P.  $x=0 \rightarrow S=0$   
 $x=L \rightarrow S=0$

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

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

$$C_2 = 0$$

$$0 = -\frac{M}{EI_z} \frac{L^2}{2} + C_1 \cdot L \quad | : L$$

$$C_1 = \frac{ML}{2EI_z}$$

$$S'(x=0) = \frac{ds}{dx} = \tan \alpha \approx \alpha = \frac{ML}{2EI_z} \quad F \cdot r_a$$

$$\alpha = \frac{\varphi}{2}$$

$$\frac{\varphi}{2} = \frac{L r_a}{2EI_z} \quad F$$

$$\varphi = \frac{L \cdot r_a}{EI_z} \quad F$$

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

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

$$\sigma_{\max} = \frac{M h}{I_z 2} ; \quad \sigma = \frac{M}{I_z} y$$

$$dV = dy bl$$

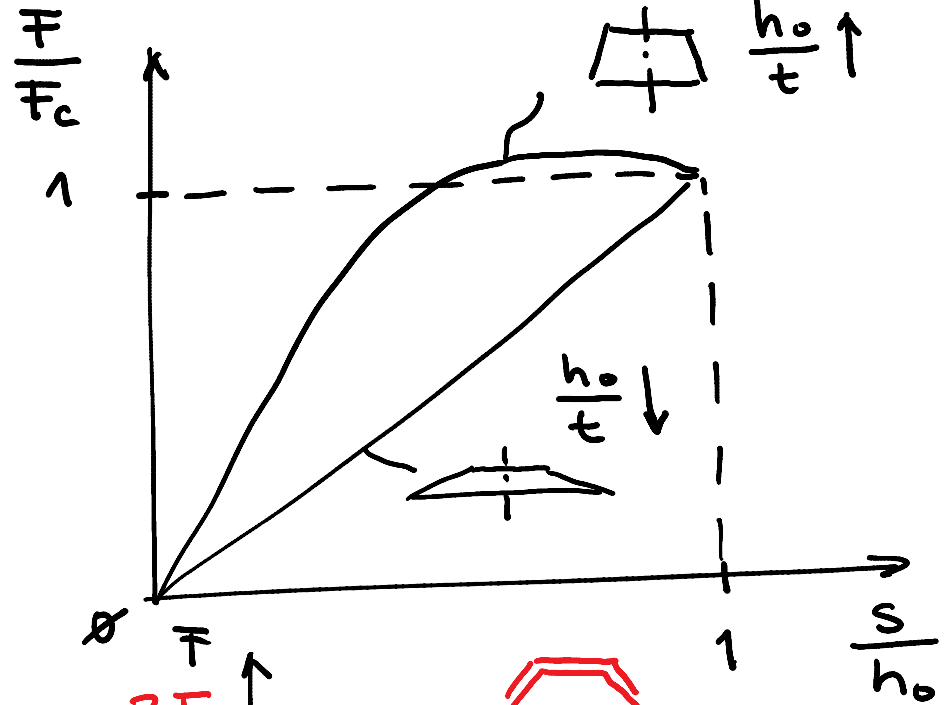
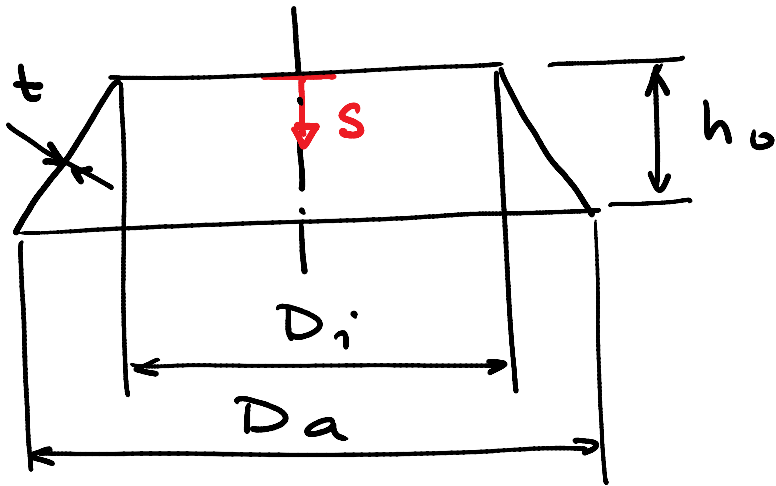
$$W = \frac{1}{2E} \int_V \sigma^2 dV = \frac{M^2 bl}{2E I_z^2} \int_{-\frac{h}{2}}^{\frac{h}{2}} y^2 dy$$

$$= \frac{M^2 bl}{I_z^2 2E 3} y^3 \Big|_{-\frac{h}{2}}^{\frac{h}{2}}$$

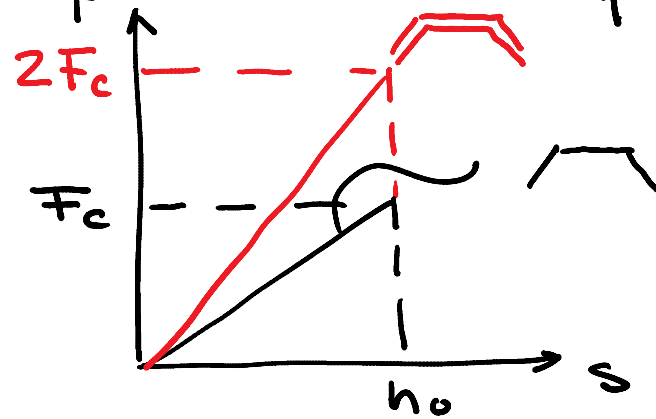
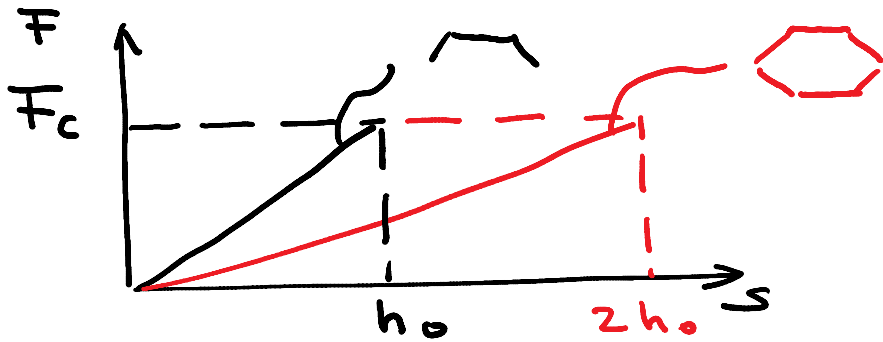
$$= \frac{M^2 bl}{I_z^2 6E} \left( \frac{h^3}{8} + \frac{h^3}{8} \right) = \frac{M^2 bl h^3}{I_z^2 24E} = \frac{M^2 h^2 V}{I_z^2 24E}$$

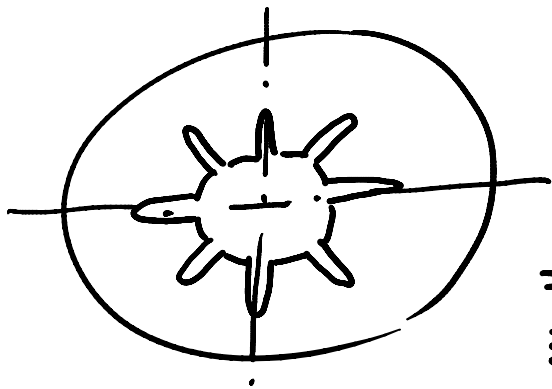
$$\eta_v = \frac{8}{24} = \frac{1}{3}$$

# UPOGIBNA MEMBRANA U7MET

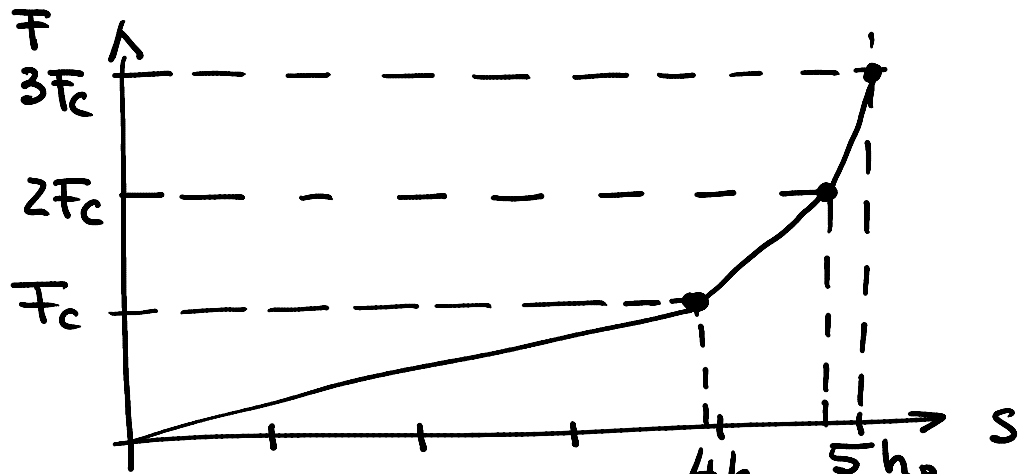
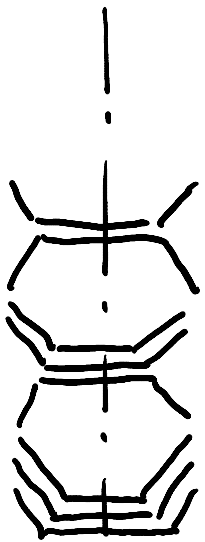


$F_c$  - SILA, KI U7MET STISNE ZA  $S = h_0$





AUTOMOBILSĒA VĒMET (SĒIOTĒA)  
 IMA DEGRESIUNO ĶARAKTERISTIKO

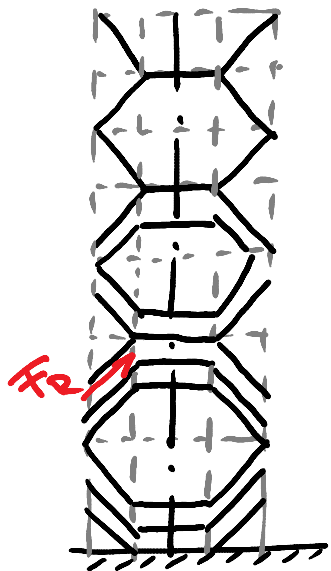


$$F_c : S = 3h_0 + \frac{h_0}{2} + \frac{h_0}{3} = \frac{18+3+2}{6} h_0 = \frac{23}{6} h_0$$

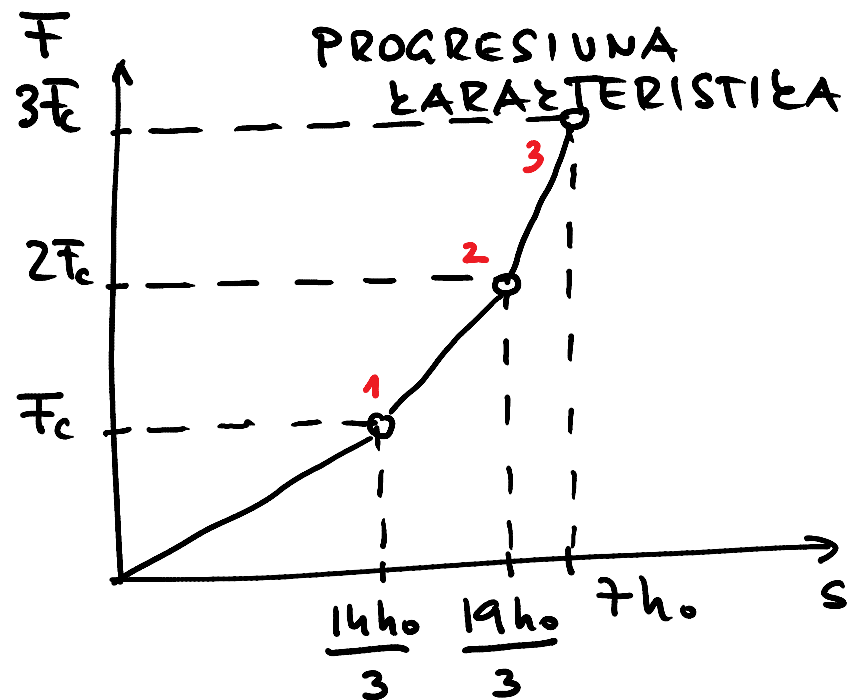
$$2F_c : S = 3h_0 + h_0 + \frac{2}{3} h_0 = \frac{28}{6} h_0$$

$$3F_c : S = 5h_0$$



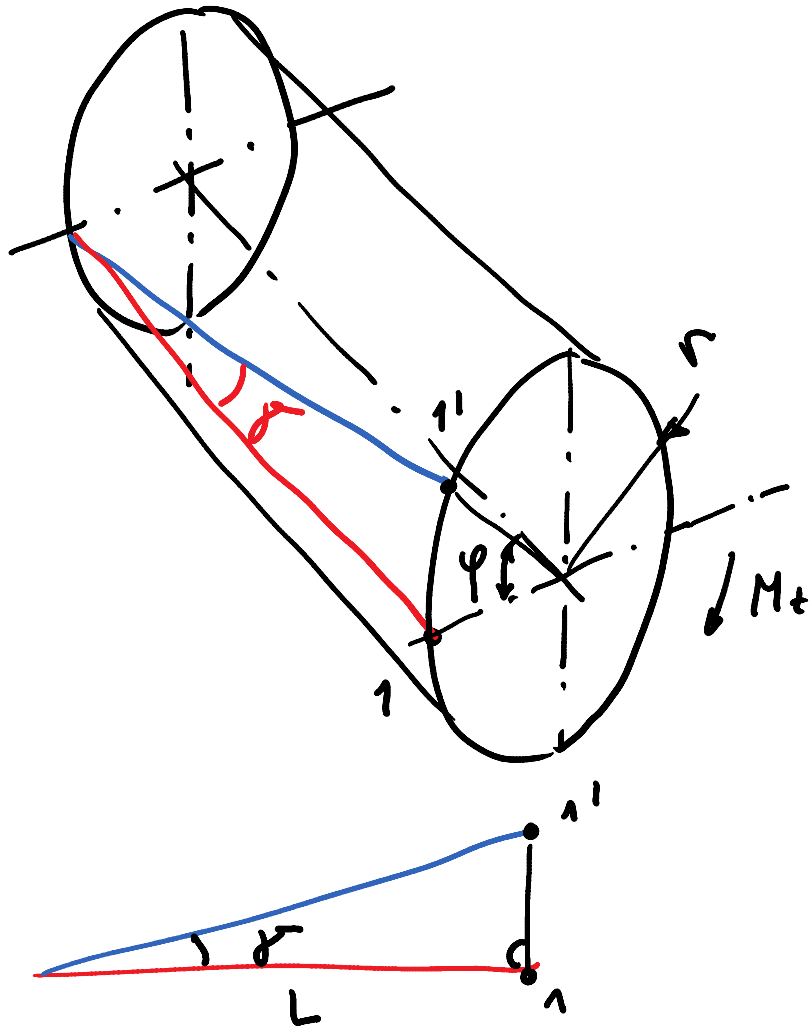


<sup>1</sup> $F_c$	<sup>2</sup> $2F_c$	<sup>3</sup> $3F_c$
$h_0$	$h_0$	$h_0$
$h_0$	$h_0$	$h_0$
$h_0$	$h_0$	$h_0$
$\frac{1}{2}$ $h_0$	$h_0$	$h_0$
$\frac{1}{2}$ $h_0$	$h_0$	$h_0$
$\frac{1}{3}$ $h_0$	$\frac{2}{3}$ $h_0$	$h_0$
$\frac{1}{3}$ $h_0$	$\frac{2}{3}$ $h_0$	$h_0$
$\frac{14 h_0}{3}$	$\frac{19 h_0}{3}$	$\frac{21 h_0}{3}$



DOBRO DUŠIJO VIBRACIJE

# VAUOJNA PALIČNA VŤMET



$$\begin{aligned} \gamma &= \varphi \cdot r \\ \tan \delta &= \frac{\gamma}{r} \approx \delta \end{aligned}$$

$$\sigma = G \cdot \delta$$

$$\sigma = \frac{M_t}{W_{po}} \cdot r$$

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

$$\varphi = \frac{L}{W_{po} \cdot G} M_t$$

$$\varphi = \frac{L}{I_{po} \cdot G} M_t$$

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

$$\tau_{\max} = \frac{M_t}{I_{p0}} \cdot r$$

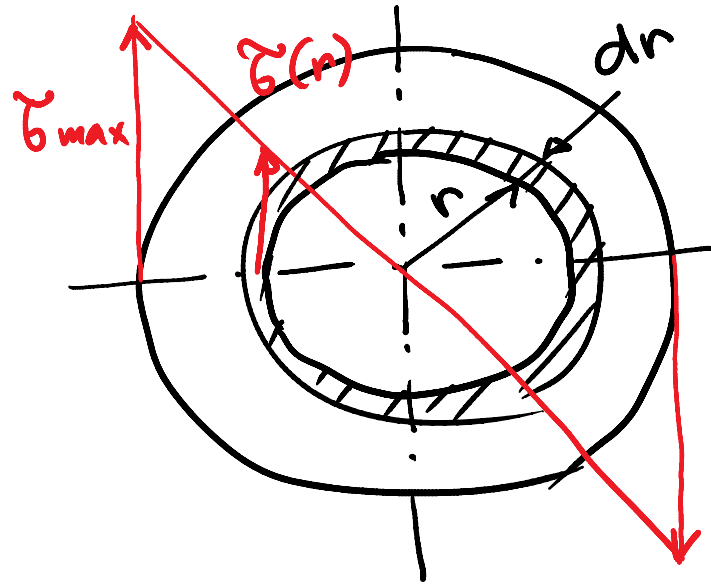
$$W_{\max} = \frac{\tau_{\max}^2 V}{2G} = \frac{M_t^2 V r^2}{2G I_{p0}^2}$$

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

$$= \frac{2\pi l M_t^2}{2G I_{p0}^2} \int_0^r r^2 dr$$

$$= \frac{M_t^2 \pi l r^4}{4G I_{p0}^2} = \frac{M_t^2 V r^2}{4G I_{p0}^2}$$

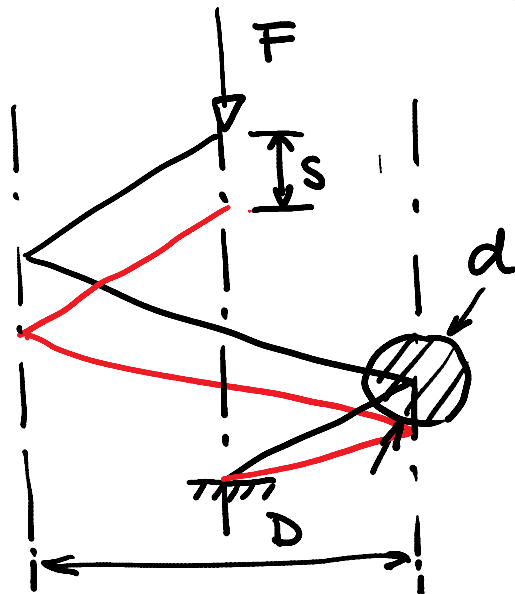
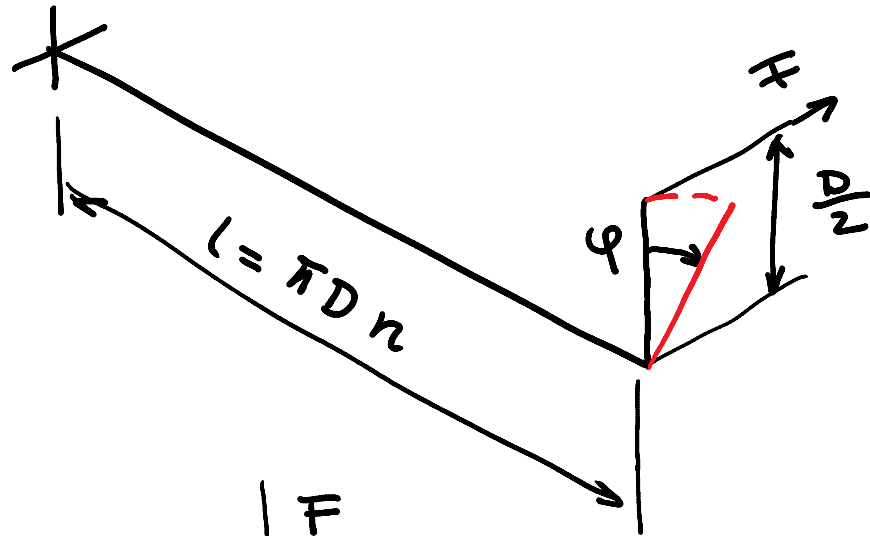
$$\eta_v = \frac{2}{4} = \frac{1}{2}$$



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

$$\tau(r) = \frac{M_t}{I_{p0}} r$$

# UZVOJNA VIJAČNA VŤHET



$n$  ŠTEVILO EFEKTIVNIH  
NAVOJEV

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

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

$$\varphi = \frac{L}{I_{p0} \cdot G} M_t$$

$$\varphi = \frac{2S}{D} = \frac{\pi D n F D}{I_{p0} G 2}$$

$$S = \frac{\pi D^3 n}{4 I_{p0} G} F$$

- NEDEFORMIRANA VŤHET

- DEFORMIRANA VŤHET

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

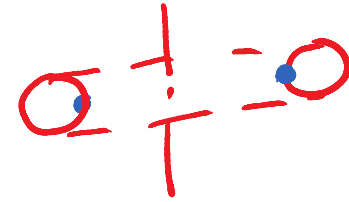
$n_t$  SKOPNO ŠTEVILO NAVOJEV

$$n_t = n + 2 \quad - \quad \text{HLADNO PEOBLIKOVANA UZMET}$$

$$n_t = n + 1,5 \quad - \quad \text{TOPLO PEOBLIKOVANA UZMET}$$

$n_t$  IZBIRAMO ZOT 3,5, 4,5, 5,5, ...

VREDNOTENJE UZUOJNE VIJAČNE VUHETI  
NA STATIČNO NOSILNOST



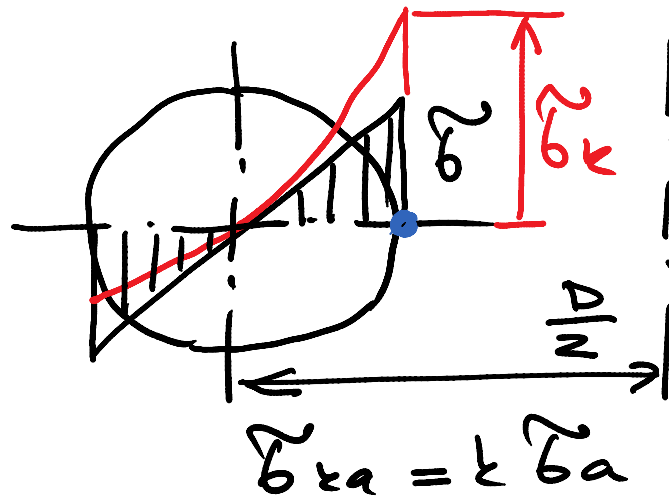
$$\sigma = \frac{M_t}{W_{p0}} \leq \sigma_{dop} \quad \leftarrow \quad \sigma = \sigma_{max}$$

$$\sigma_c = \frac{M_{tc}}{W_{p0}} \leq \sigma_{cdop}$$

C - BLOKIRANA DOLŽINA  
UHETI

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

DINAMIČNA NOSILNOST



$$\sigma_k = k \sigma$$

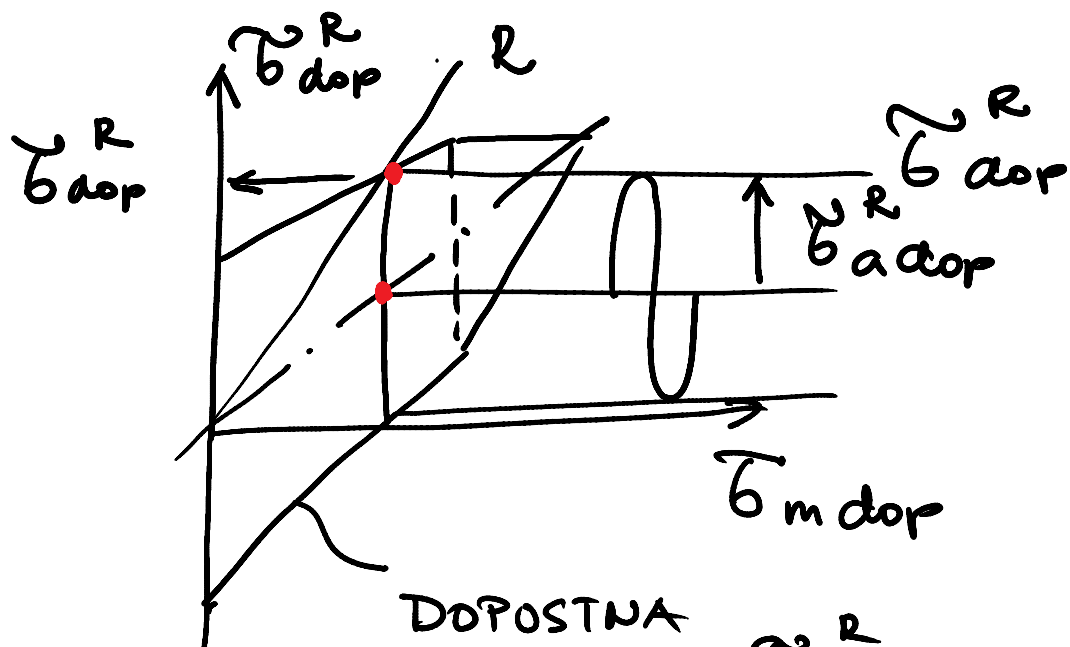
UPOŠTEVA KONCENTRACIJO

NA PETOSTI ŽARADI

UŠRILJENOSTI ŽICE

$$\sigma_k \leq \sigma_{dop}^R$$

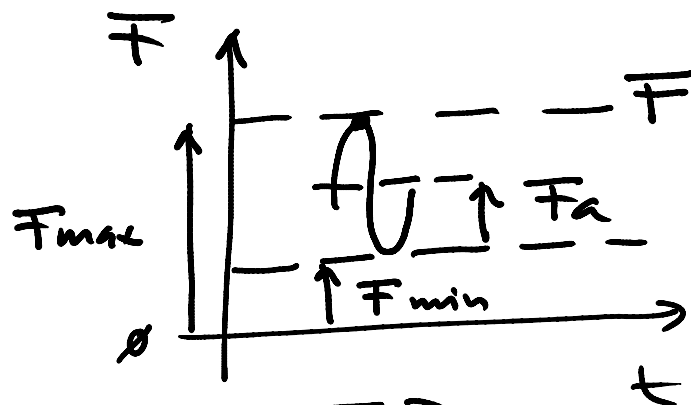
$$\sigma_{ka} \leq \sigma_{da}^R$$



DOPOSTNA  
NAPETOST  $\sigma_{dop}^R$

$$\sigma_{dop}^R = \frac{\sigma_{obl}^R \cdot b_1 \cdot b_2}{\beta \cdot \epsilon \cdot \gamma}$$

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



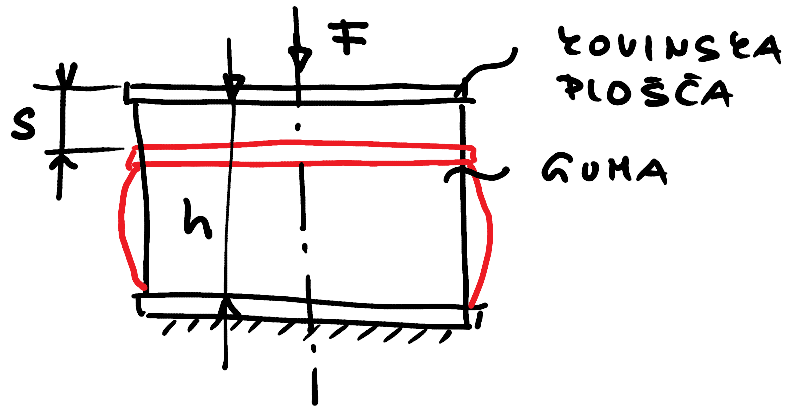
$$\sigma = \frac{F \cdot D}{2 W_p}$$

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

$$R = \frac{F_{min}}{F_{max}} = \frac{F - 2F_a}{F}$$

# GUMIJASTE UŽMETI

## TLAČNA UŽMET



PODAJNOST  $\delta = \frac{h}{AE}$

$$\eta_v = 1$$

$$\sigma = E \cdot \epsilon$$

$$\sigma = \frac{F}{A} - \text{PREZET UŽMETI}$$

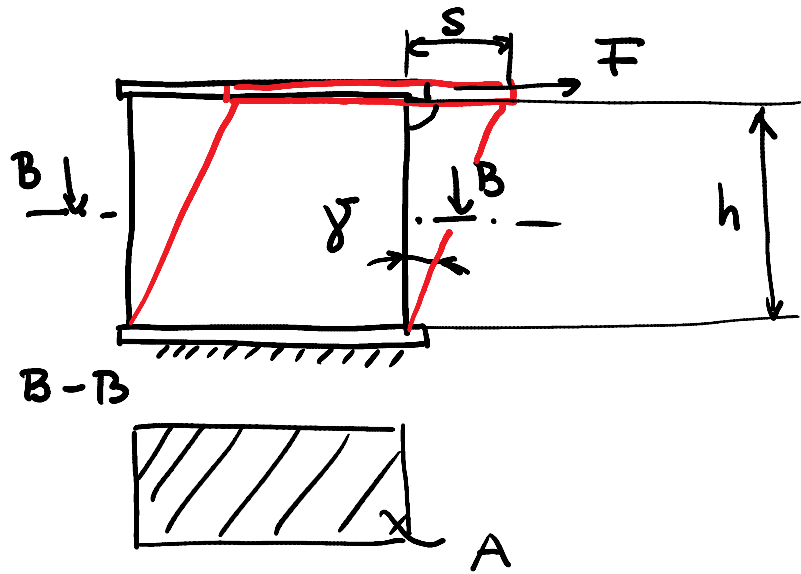
$$\epsilon = \frac{s}{h}$$

$$\frac{F}{A} = E \frac{s}{h}$$

$$s = \frac{h}{AE} F$$



# STRIŽNA PRIZMATIČNA UZMET



$$\gamma = \frac{h}{AG}$$

$$\eta_v = 1$$

$$\tan \gamma = \frac{s}{s} = \gamma$$

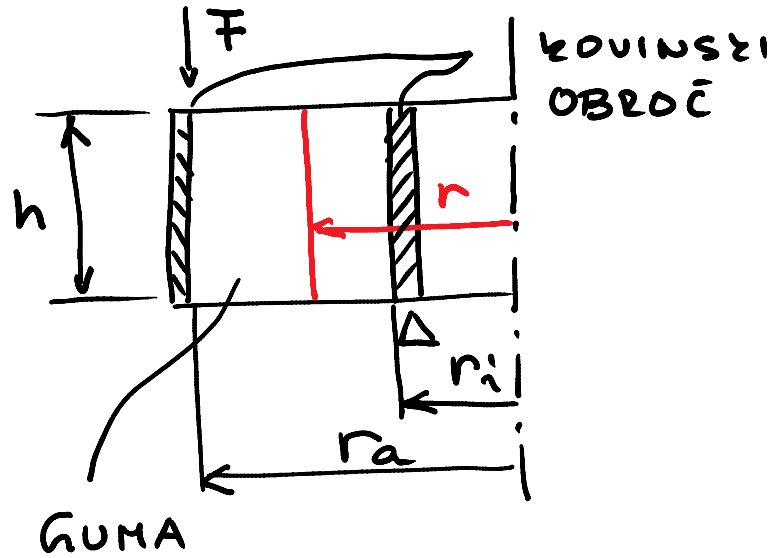
$$\tau = G \cdot \gamma$$

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

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

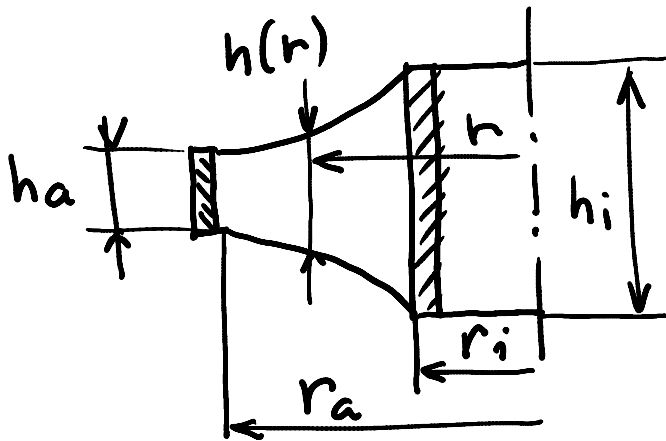
$$s = \frac{s}{AG} F$$

# STRIŽNA KOLUTNA VŮHĚT



$$\eta_v < 1$$

$$\tilde{\sigma}(r) = \frac{F}{2\pi r h}$$



$$\tilde{\sigma}(r_i) = \frac{F}{2\pi r_i h_i} = \frac{F}{2\pi r h(r)}$$

$$r h(r) = r_i h_i$$

$$h(r) = \frac{r_i}{r} h_i$$

$$\eta_v = 1$$