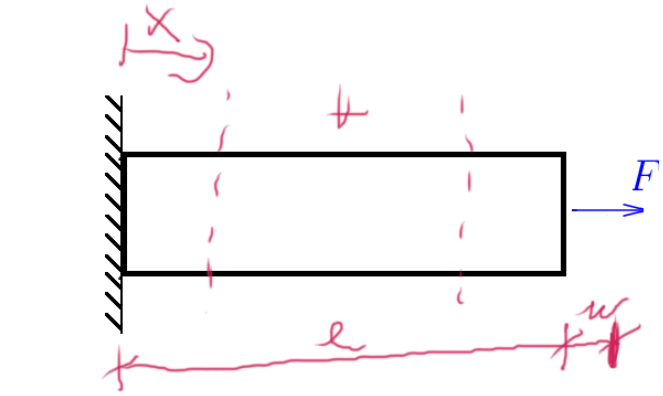


$$\sigma = E \cdot \varepsilon$$

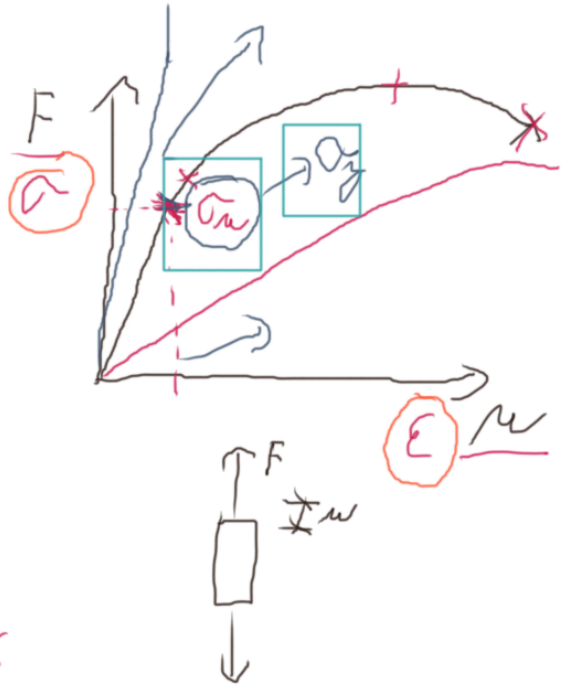
↳ Hookesches Gesetz

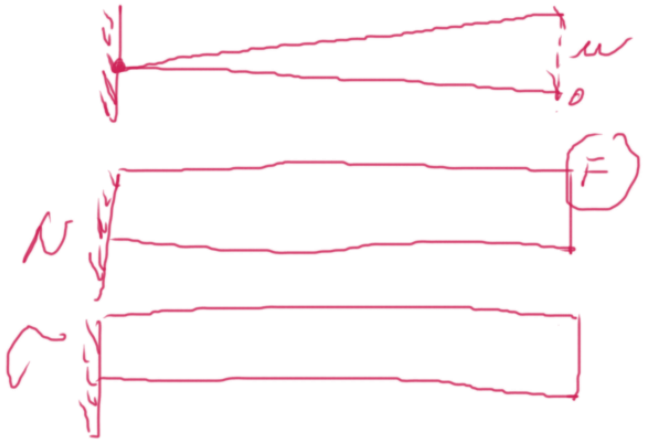
$$\frac{F}{A} = E \cdot \frac{w}{l}$$

$$w = \frac{F}{A \cdot E} \cdot l$$

$$\Rightarrow w(x) = \frac{F}{A \cdot E} \cdot x$$

$$w(x) = \int_0^l \frac{N(x)}{E \cdot A(x)} \, dx$$

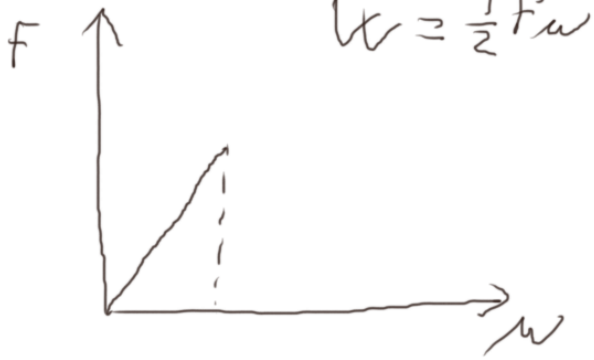




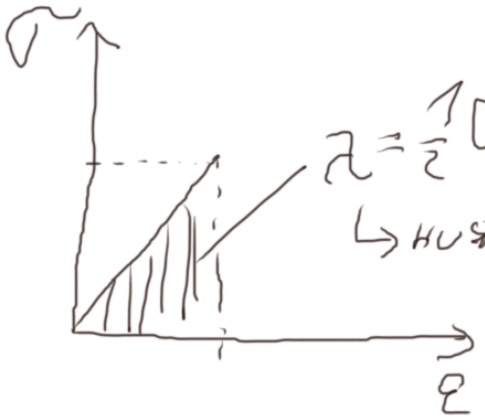
$$F = \frac{E \cdot A}{l} \cdot u$$

k – TUHOST ; $[k] = \frac{N}{m}$

$\delta = \frac{1}{k}$ δ – PODDAJNOST

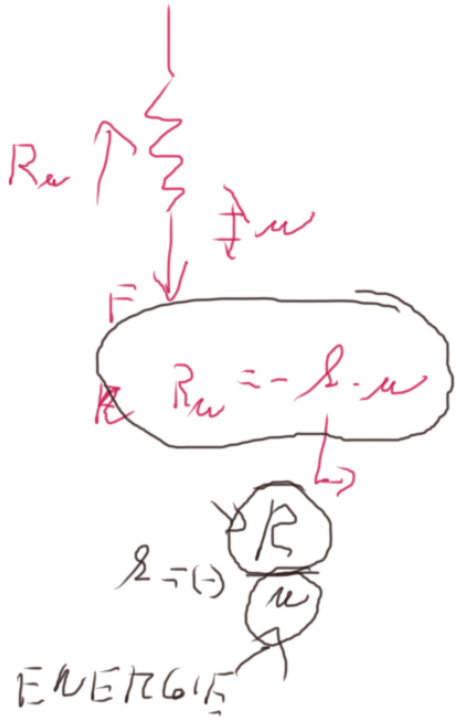


$W = \frac{1}{2} F u$

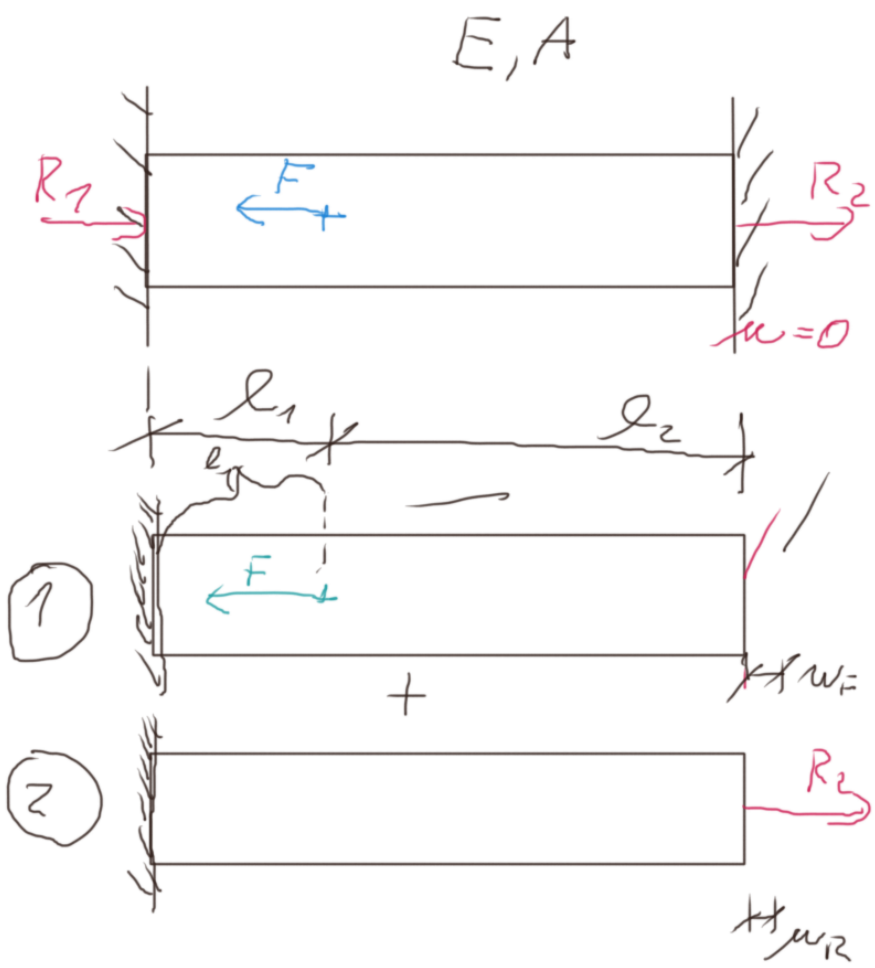


$a = \frac{1}{2} \sigma \cdot \varepsilon$

↳ HUSTOTA DEF ENERGIE



$R_u = -k \cdot u$



$$\rightarrow \boxed{R_1} + R_2 - F = 0$$

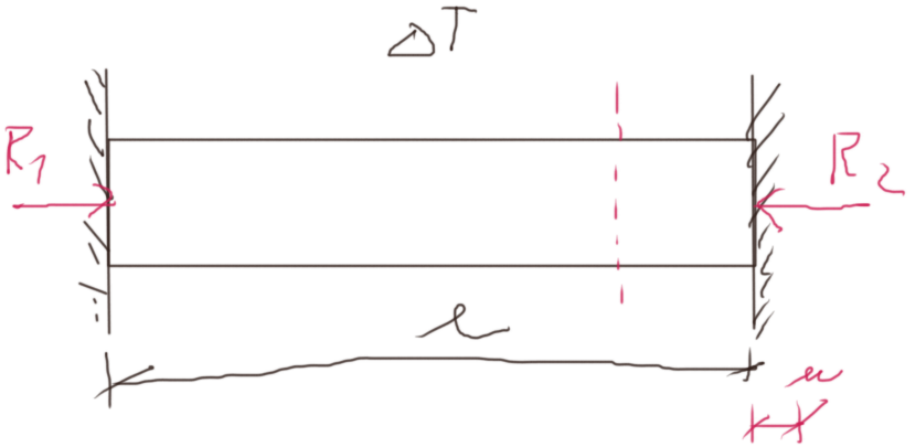
DEFORMAČNÍ PODMÍNKA

$$w_F + w_R = 0 \leftarrow$$

$$w_F = \frac{F}{A \cdot E} l_1 \uparrow$$

$$w_R = \frac{-R_2 (l_1 + l_2)}{A \cdot E} \uparrow$$

$$\rightarrow \boxed{R_2}$$



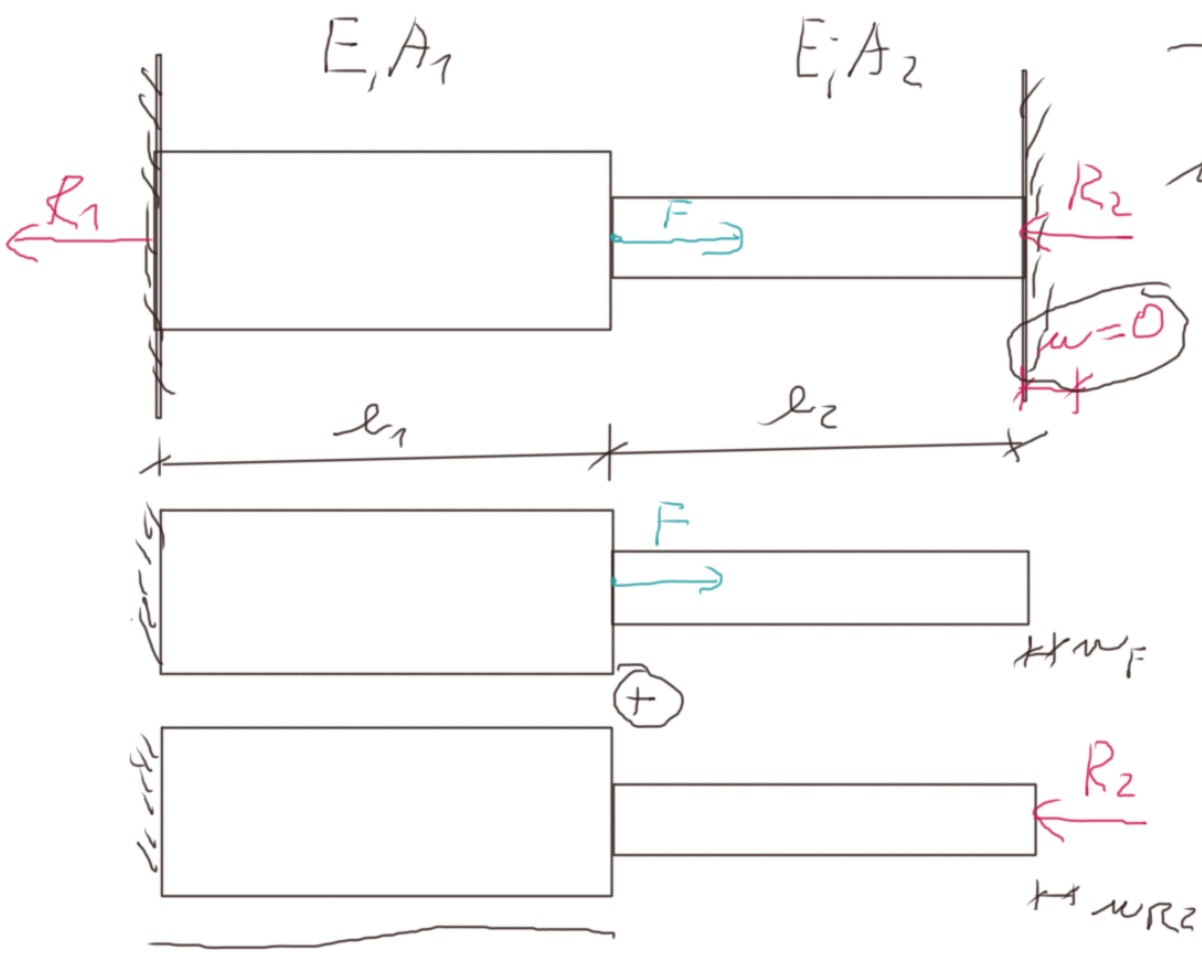
$u = \alpha_T \cdot \Delta T \cdot l$

↳ SOUČINITEL TEPLOTNÍ ROZTAŽNOSTI

$R_1 = R_2$

$u = 0$

$\alpha_T \cdot \Delta T \cdot l + \frac{N \cdot l}{E \cdot A} = 0 \rightarrow N$



$$\rightarrow F - R_1 - R_2 = 0$$

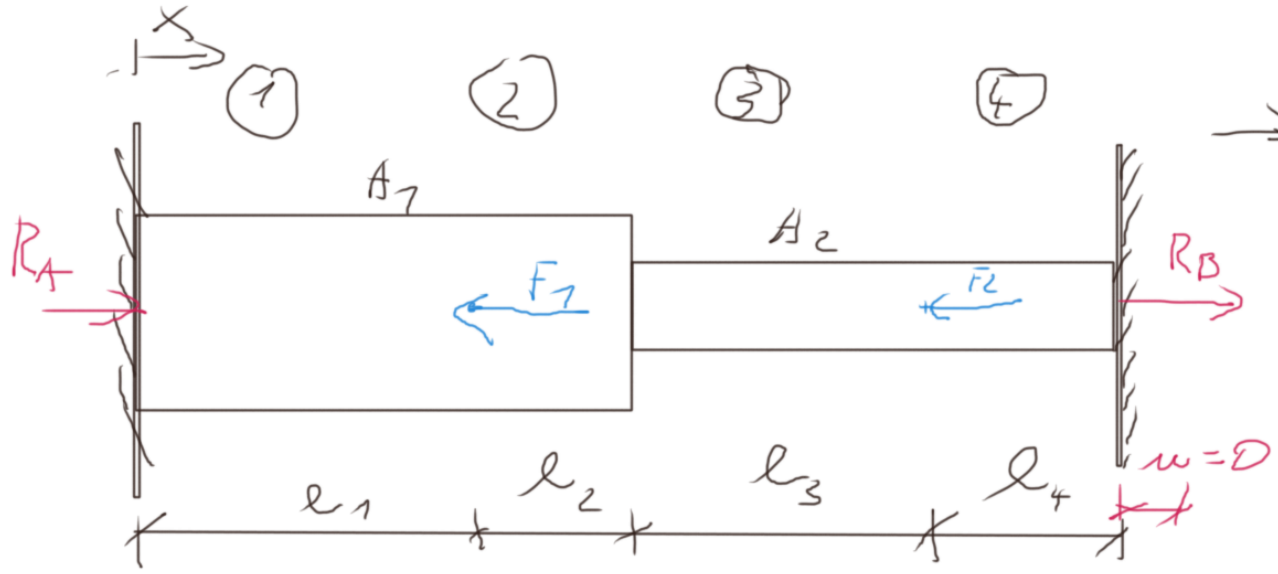
$$w_F + w_{R2} = 0$$

$$w_F = \frac{F \cdot l_1}{A_1 \cdot E} \quad \sigma_1$$

$$w_{R2} = \frac{-R_2 \cdot l_1}{A_1 \cdot E} - \frac{R_2 \cdot l_2}{A_2 \cdot E} \quad \sigma_1 \quad \sigma_2$$

$$F \cdot \sigma_1 - R_2 (\sigma_1 + \sigma_2) = 0$$

$$R_2 =$$



$$\rightarrow R_A - F_1 - F_2 + R_B = 0$$

$$R_B = -R_A + F_1 + F_2$$

$N_1 = -R_A$

$N_2 = -R_A + F_1 = R_B - F_2$

$N_3 = -R_A + F_1 = R_B - F_2$

$N_4 = -R_A + F_1 + F_2 = R_B$

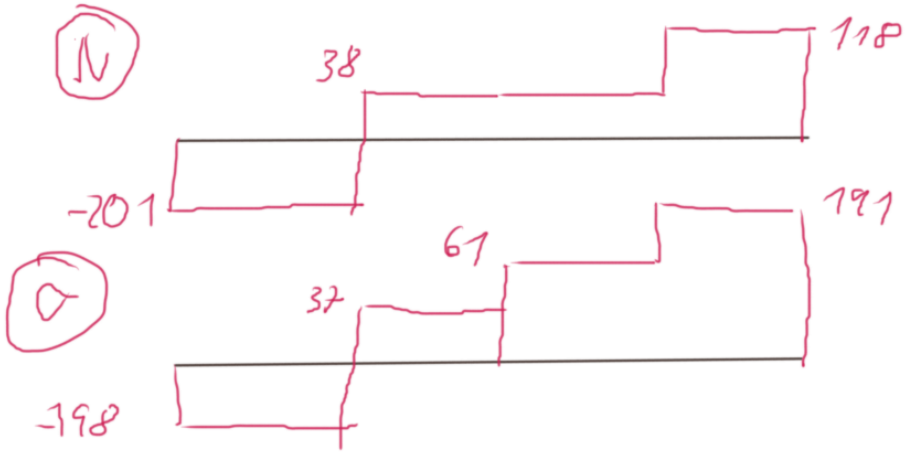
$$w = 0 = \Delta l_1 + \Delta l_2 + \Delta l_3 + \Delta l_4$$

$$\Delta l_1 = \frac{N_1 \cdot l_1}{A_1 \cdot E}$$

$$\Delta l_2 = \frac{N_2 \cdot l_2}{A_1 \cdot E}$$

$$\Delta l_3 = \frac{N_3 \cdot l_3}{A_2 \cdot E}$$

$$\Delta l_4 = \frac{N_4 \cdot l_4}{A_2 \cdot E}$$



$l_1 = 1{,}2$ m

$l_2 = 0{,}6$ m

$l_3 = 1$ m

$l_4 = 0{,}8$ m

$F_1 = 240$ kN

$F_2 = 80$ kN

$d_1 = 36$ mm

$d_2 = 28$ mm

$E = 210$ GPa

$R_1 = 201{,}85$ kN

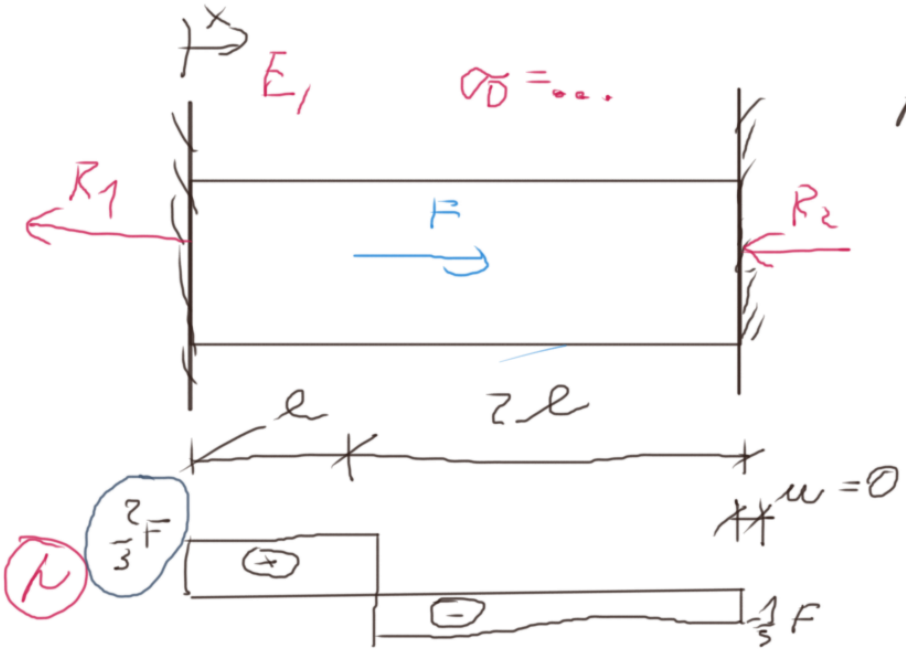
$R_2 = 118{,}15$ kN

$\sigma_1 = -198{,}3$ MPa — ТСФК

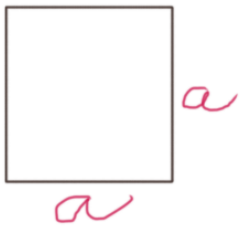
$\sigma_2 = 37{,}48$ MPa — ТАН

$\sigma_3 = 61{,}96$ MPa — ТАН

$\sigma_4 = 191{,}68$ MPa



$A = a^2$ → $a_{min} = ?$



$$-R_1 + F - R_2 = 0$$

$$u(3l) = 0$$

$$u_F + u_{R_2} = 0$$

$$F\frac{l}{a^2 \cdot E} - \frac{R_2}{E}\left(\frac{l}{a^2} + \frac{2l}{a^2}\right) = 0$$

$$R_2 \frac{3l}{a^2} = F\frac{l}{a^2} \Rightarrow R_2 = \frac{1}{3}F$$

$$R_1 = \frac{2}{3}F$$

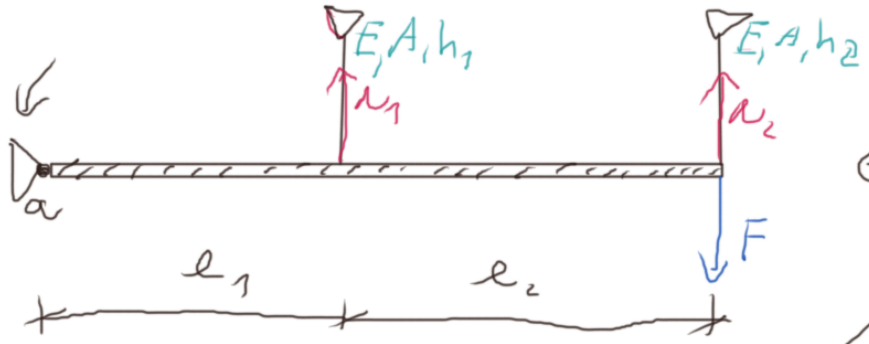
① $x \in \langle 0; l \rangle$ $u(x) = \frac{2F}{3E \cdot a^2} \cdot x$

② $x \in \langle l; 2l \rangle$ $u(x) = \frac{2F}{3Ea^2}x - \frac{F}{Ea^2}(x - l)$

$$u_{max} = \frac{2 \cdot F \cdot l}{3Ea^2}$$

σ_D $\sigma = \frac{2F}{3a^2}$

$$a = \sqrt{\frac{2F}{3\sigma_D}}$$



$$s = 3 - 2 - 2 \cdot 1 = -1$$

$$N_1 \cdot l_1 + N_2 \cdot (l_1 + l_2) - F \cdot (l_1 + l_2) = 0$$

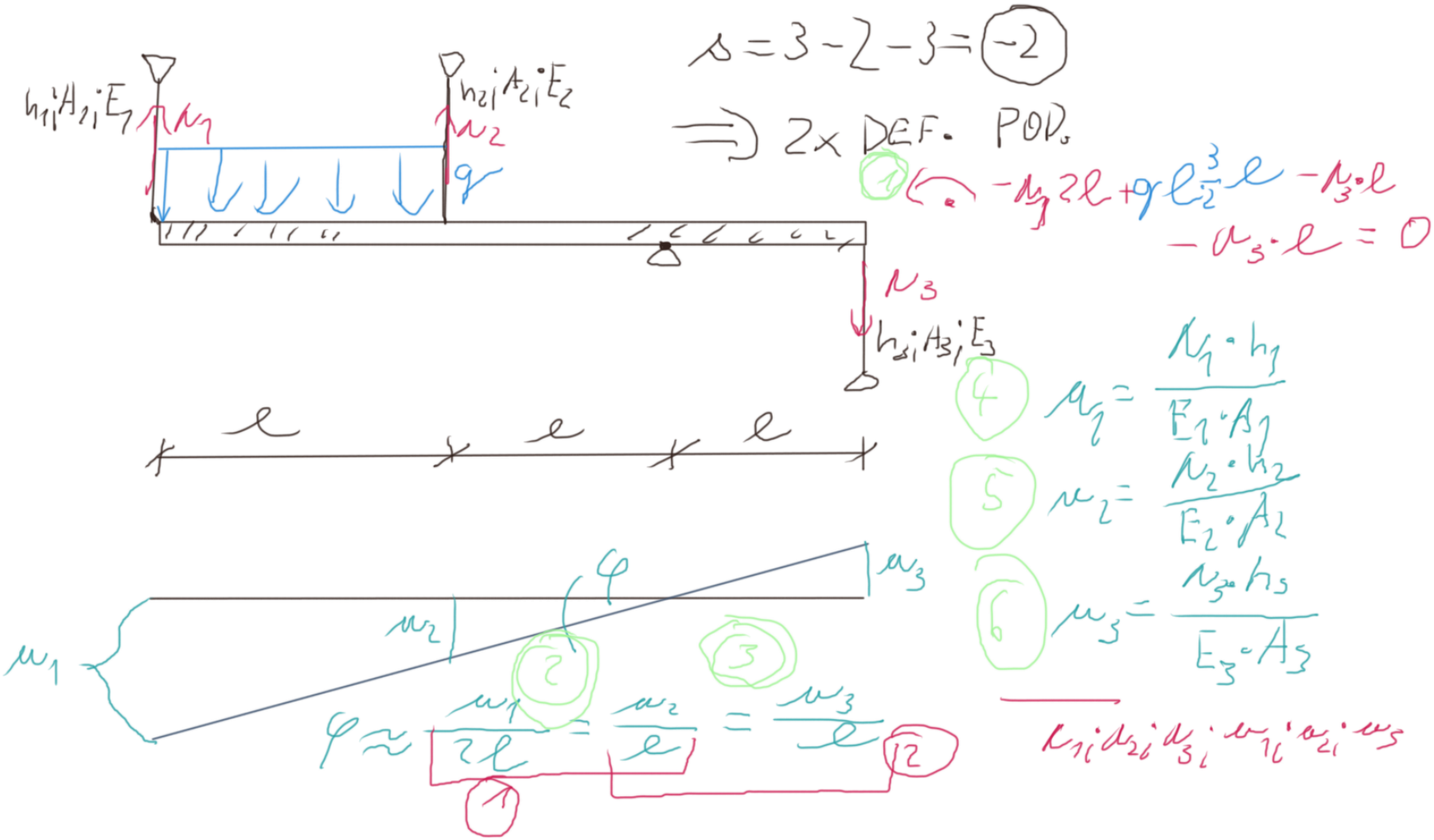
$$\varphi \approx \operatorname{tg}\varphi = \frac{w_1}{l_1} = \frac{w_2}{l_1 + l_2}$$ DEF. POV.

$$w_1 = \frac{N_1 \cdot h_1}{E \cdot A}$$

$$w_2 = \frac{N_2 \cdot h_2}{E \cdot A}$$

$$\frac{N_1 \cdot h_1}{E \cdot A \cdot l} = \frac{N_2 \cdot h_2}{E \cdot A \cdot (l_1 + l_2)}$$

$$N_1 = \frac{N_2 \cdot h_2 \cdot l}{(l_1 + l_2) h_1}$$



$$s = 3 - 2 - 3 = -2$$

$\Rightarrow$ 2x DEF. POD.

(1) $\circlearrowleft_A \quad -N_3 \cdot 2l + q\,l\,\frac{3}{2}l - N_3 \cdot l - N_3 \cdot l = 0$

(4) $w_1 = \frac{N_1 \cdot h_1}{E_1 \cdot A_1}$

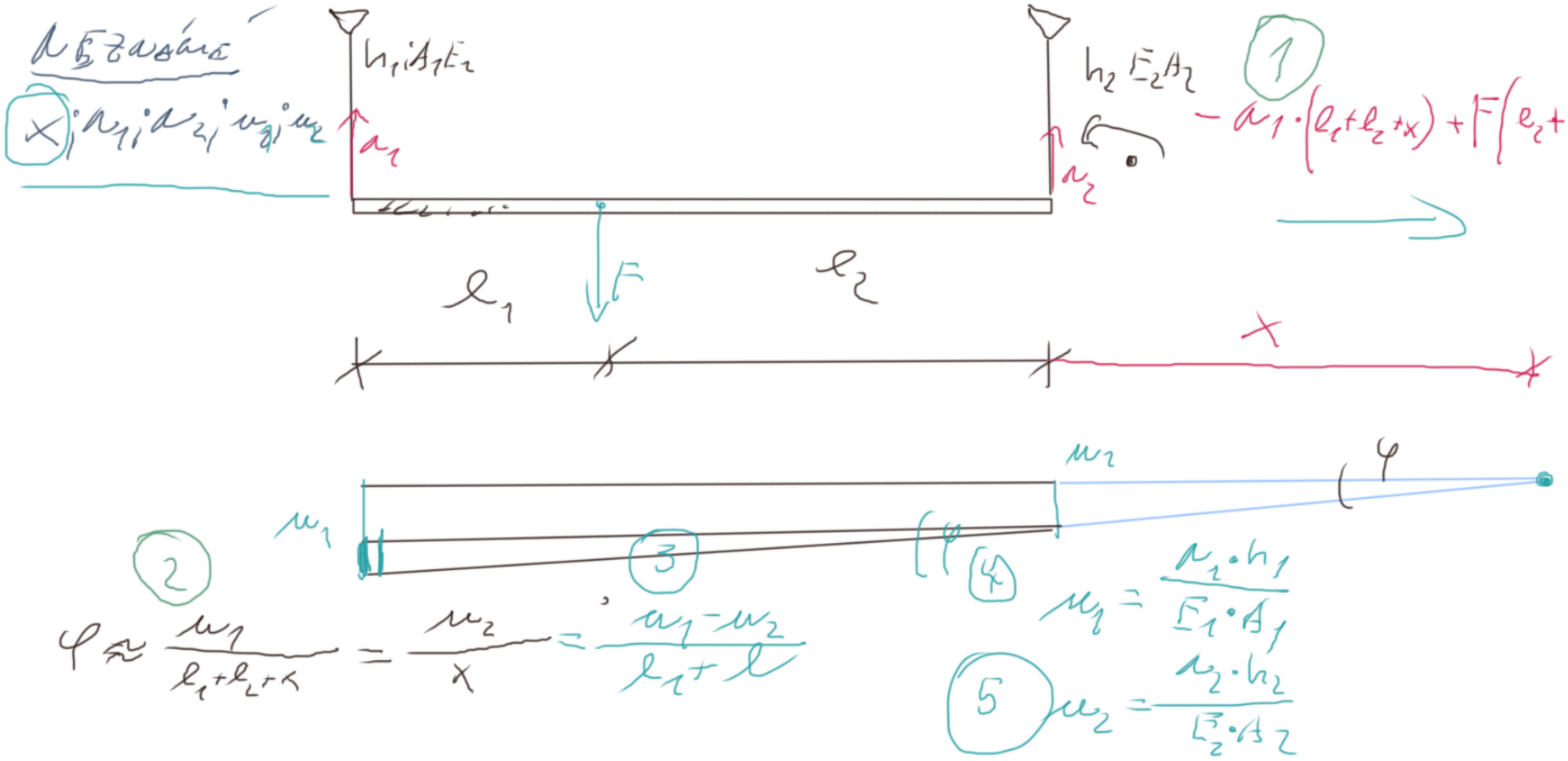
(5) $w_2 = \frac{N_2 \cdot h_2}{E_2 \cdot A_2}$

(6) $w_3 = \frac{N_3 \cdot h_3}{E_3 \cdot A_3}$

$N_1, N_2, N_3, w_1, w_2, w_3$

(2) (3) $\varphi \approx \frac{w_1}{2l} = \frac{w_2}{l} = \frac{w_3}{l}$ (12)

(1)



Neznámé

(X) a_1, a_2, v_1, u_2

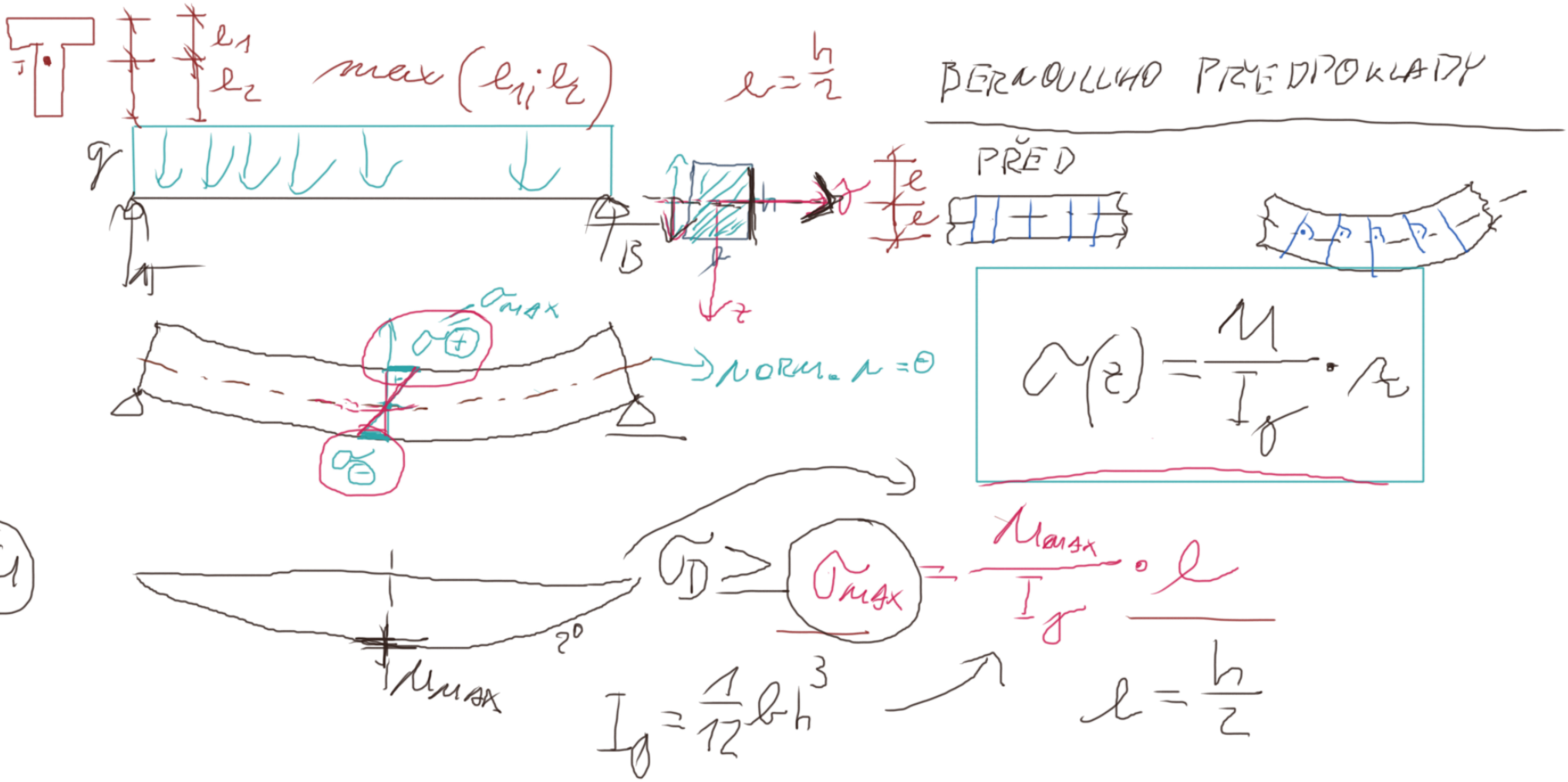
(1) $-a_1 \cdot (l_1 + l_2 + x) + F(l_2 + x) - a_2 \cdot (x) = 0$

(2) $\varphi \approx \frac{u_1}{l_1 + l_2 + x} = \frac{u_2}{x}$

(3) $= \frac{a_1 - u_2}{l_1 + l}$

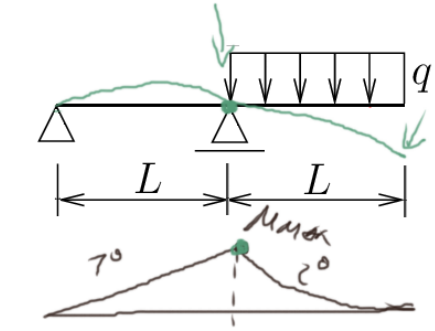
(4) $u_1 = \frac{a_1 \cdot h_1}{E_1 \cdot A_1}$

(5) $u_2 = \frac{a_2 \cdot h_2}{E_2 \cdot A_2}$


e1
e2
max (e1 ; e2)
e = h/2
BERNOULLIHO PŘEDPOKLADY
PŘED
q
A
B
h
e
e
z
σmax
σ+
σ−
NORM. N = 0
σ(z) = M/I_y · z
M
σD ≥ σmax
Mmax/I_y · e
e = h/2
Mmax
I_y = 1/12 b h^3

$\sigma_D = \dots$ | L | q

$a_{min} = ?$



$M_{max} = -\frac{1}{2} q l^2$

$I_y = \frac{1}{12} a^4$

$\sigma_D = \frac{|M_{max}|}{I_y} l$

$\sigma_D = \frac{|M_{max}|}{\frac{1}{12} a^4} \cdot \frac{a}{2}$ | $\sigma_D = \frac{6|M_{max}|}{a^3}$

$a^3 = \frac{3 q l^2}{\sigma}$

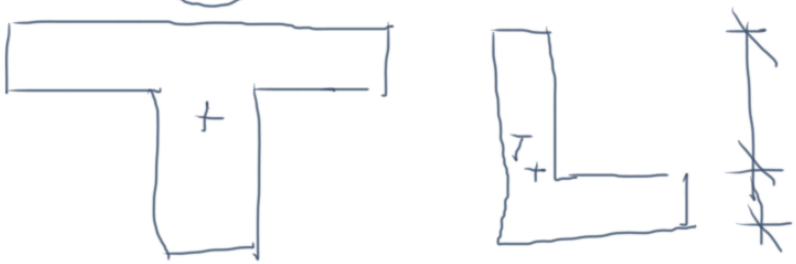
$$a = \sqrt[3]{\frac{3 q l^2}{\sigma}}$$

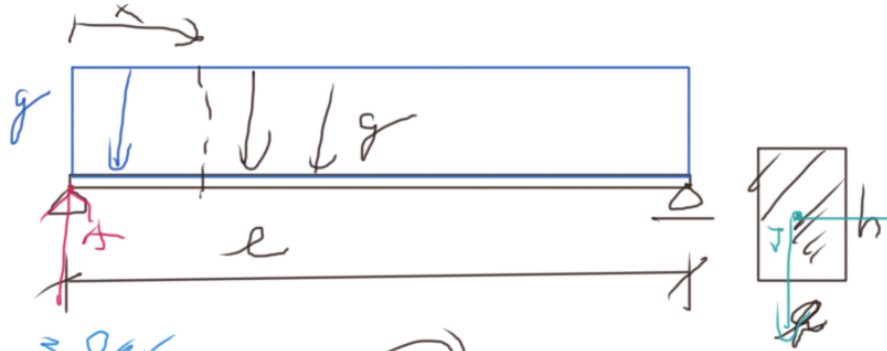
$$\sigma_{MAX} = \frac{M_{MAX}}{I_\sigma} \cdot e$$

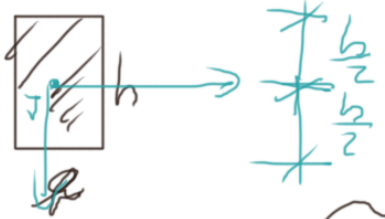
$$\sigma_{MAX} = \frac{M_{MAX}}{W}$$

W – PRŮŘEZOVÝ MODUL

$$W = \frac{I_\sigma}{e}$$







$\frac{l}{h} = \frac{2}{3}$ $\quad h_{min} = ?$

$q = 3\ kN/m$

$l = 2\ m$

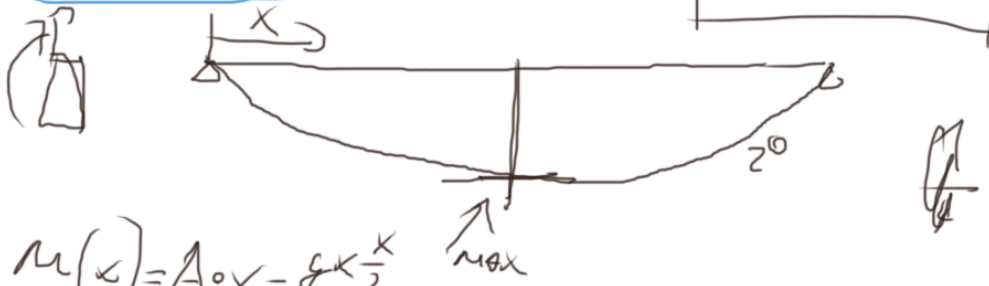
$\sigma = 130\ MPa$

$\sum M_A = 0 \quad A \cdot l - q \cdot l \frac{l}{2} = 0$

$A = \frac{1}{2} q l$

$\sigma = \frac{M_y}{I_y} \cdot z \quad \rightarrow \quad z = \frac{h}{2}$

$M_{max} = \frac{1}{8} q l^2$



$I_y = \frac{1}{12} b h^3$

$M(x) = A \cdot x - q x \frac{x}{2}$

$M\left(\frac{l}{2}\right) = A \cdot \frac{l}{2} - q \frac{l}{2} \cdot \frac{l}{4} = \frac{1}{2} q l \frac{l}{2} - \frac{1}{8} q l^2$