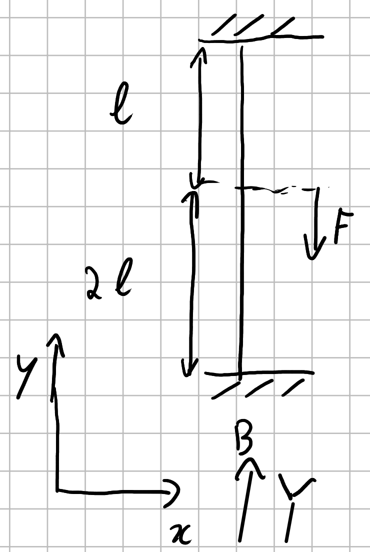


Compute the y component of the reaction force at B

Data

$l = 400$ mm

$EA = 7.2\ E7$ N

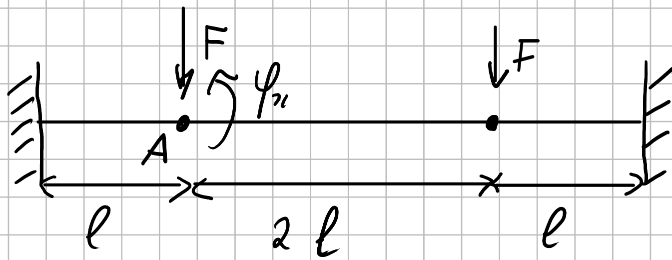
$F = 5000$ N

unit for result: N

$$k_1 = \frac{EA}{l} \qquad k_2 = \frac{EA}{2l}$$

$$(k_1 + k_2)\, v = -F \qquad v = \frac{-F}{k_1 + k_2}$$

$$Y = -k_2 v = \frac{k_2 F}{k_1 + k_2} = 1666{,}7 \text{ N}$$



Compute the rotation φ_x of point A

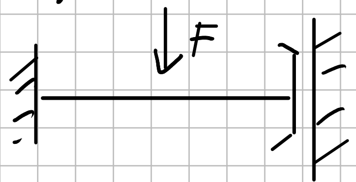
Data: $l = 1400$ mm

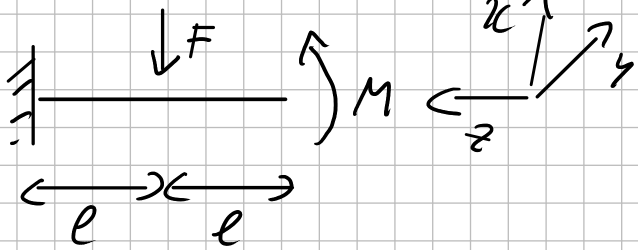
$F = 2500$ N

$EJ_{yy} = 6E10$ N mm^2

Unit for result: deg

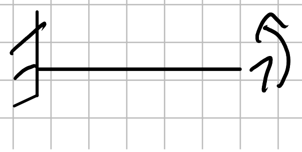
Symmetric structure and load





$0 < z < l \quad M_y = M$

$l < z < 2l \quad M_y = M + F(-z + l)$

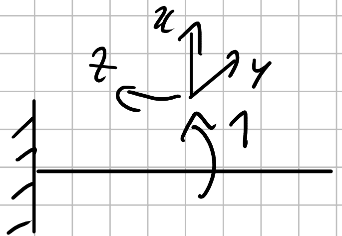


$\delta M_y = 1$

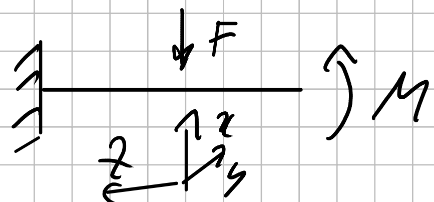
$$\int_0^{\ell} \delta M_y \frac{M_y}{EI_{yy}}\, dz + \int_{\ell}^{2\ell} \frac{\delta M_y M_y}{EI_{yy}}\, dz = 0$$

$$\frac{2M\ell}{EI_{yy}} - \left(+\frac{3}{2}\frac{F\ell^2}{EI_{yy}} - \frac{F\ell^2}{EI_{yy}}\right) = 0$$

$$M = +\frac{1}{4} F\ell$$



Cambio coordinate



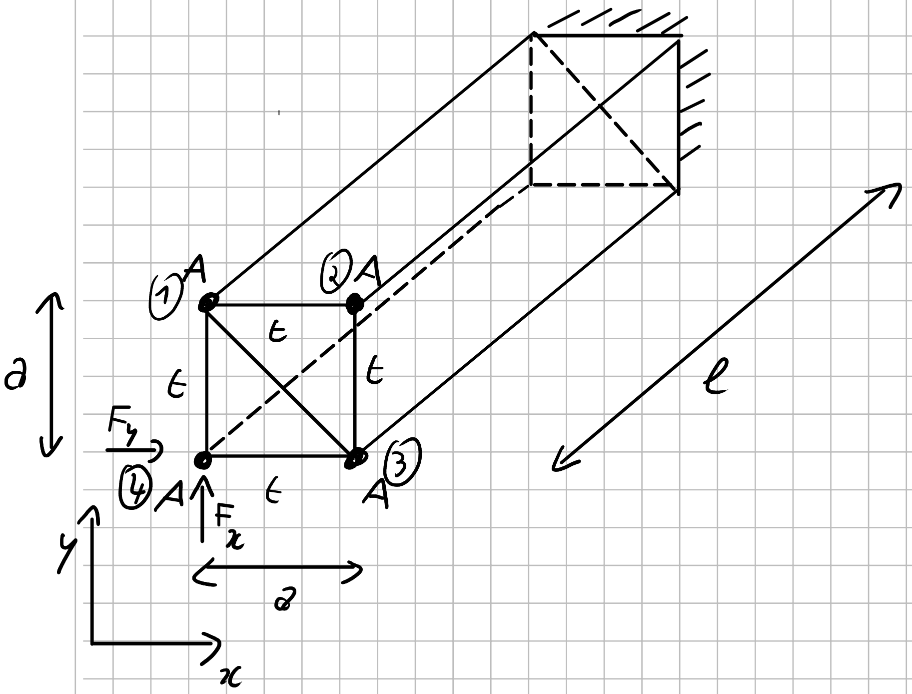
$0 < z < \ell \quad \delta M_y = 1$

$-\ell < z < 0 \quad \delta M_y = 0$

$0 < z < \ell \qquad M_y = M - Fz$

$$\frac{1}{EI_{yy}} \int_0^{\ell} \left(+\frac{1}{4}F\ell - Fz\right) dz = -\underbrace{\frac{1}{4}\frac{F\ell^2}{EI_{yy}}}$$

rad in deg $= -\frac{1}{4}\frac{F\ell^2}{EI_{yy}} \cdot \frac{180}{\pi} = -1,1698^\circ$



The semi-monocoque structure in the figure is loaded at point (4) by the concentrated forces F_x and F_y. Compute the axial stress σ_{zz} of stringer (1) at a distance of $l/2$ from the clamp.

Data

$l = 4000$ mm

$F_x = 5000$ N

$F_y = 1000$ N

$A = 1000$ mm^2

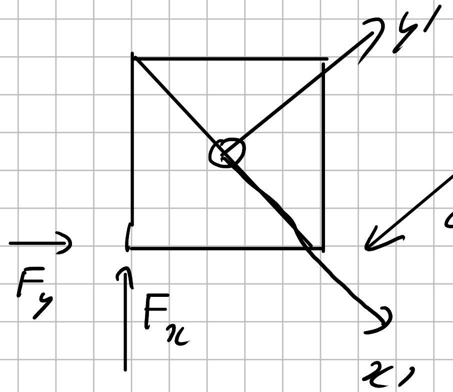
$a = 200$ mm

$t = 1$ mm

$E = 72000$ MPa

$\nu = 0{,}3$

Unit for result: MPa



$$F_{x'} = -\frac{F_x}{\sqrt{2}} + \frac{F_y}{\sqrt{2}}$$

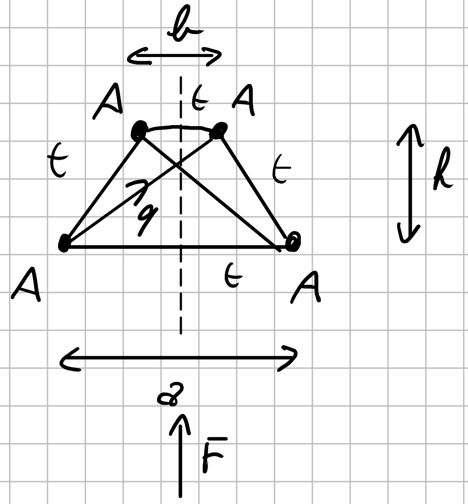
$$F_{y'} = \frac{(F_x + F_y)}{\sqrt{2}}$$

$$d = \frac{a}{\sqrt{2}}$$

$$I_{y'y'} = 2A\,d^2 = A\,a^2$$

$$M_{y'} = -F_{x'} \cdot \frac{l}{2}$$

$$\sigma_{zz} = \frac{M_{y'}}{I_{y'y'}}(-d) = \frac{(-F_x + F_y)}{4A}\,\frac{l}{a} = -20\ \text{MPa}$$



The symmetric three cells semi-monocoque cross section in the figure is loaded by the force F in the plane of symmetry.

Compute the flux q

Data

$A = 2000 \ mm^2$

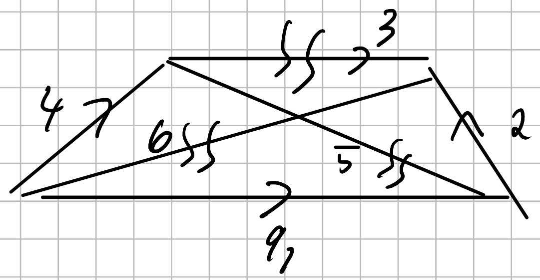
$a = 200 \ mm$

$b = 100 \ mm$

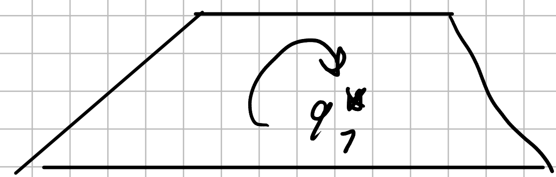
$h = 100 \ mm$

$F = 5000 \ N$

$t = 1 \ mm$



3 cells q^0 :



$q_1^0 = \varnothing$ ~~for~~ for symmetry

$$q_2^* = q_3^*$$

$$q'_1 = 0$$

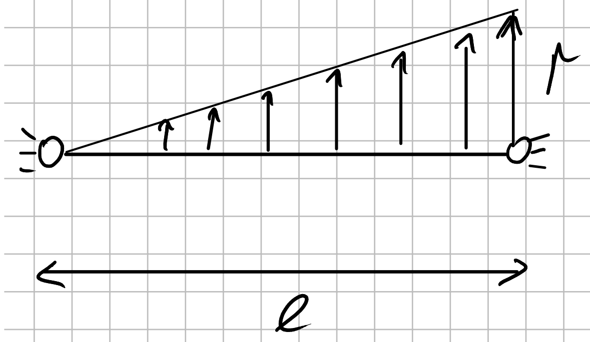
$$q'_2 = q'_4 = \frac{F}{2h}$$

$$\dot{\theta}_i = 0 \quad \text{for symmetry} \qquad \Omega_2 = \frac{ah}{2}$$

$$\dot{\theta}_2 = \frac{1}{ah}\left(\frac{-\,l_4\, q'_4}{t} + \frac{(l_5 + l_4)\, q_2^*}{t} \right)$$

$$l_4 = \sqrt{\left(\frac{a-b}{2}\right)^2 + h^2} \qquad l_5 = \sqrt{\left[a - \left(\frac{a-b}{2}\right)\right]^2 + h^2}$$

$$q_2^* = \frac{l_4\, q'_4}{l_5 + l_4} = 9{,}5696 \ \text{N/mm}$$



The beam in the figure is loaded by a linearly-varying force per unit of length. Resort to a displacement-based approach and using the simplest possible polynomial approximation in order to estimate the vertical displacement in the middle of the beam.

Data $\quad \ell = 3000$ mm

$p = 4$ N/mm

$EI_{xx} = 6E11$ N mm^2

Unit for result: mm

$v = c\, z(z-\ell) \qquad \delta v = \delta c\, z(z-\ell)$

$p = \dfrac{p}{\ell} \cdot z$

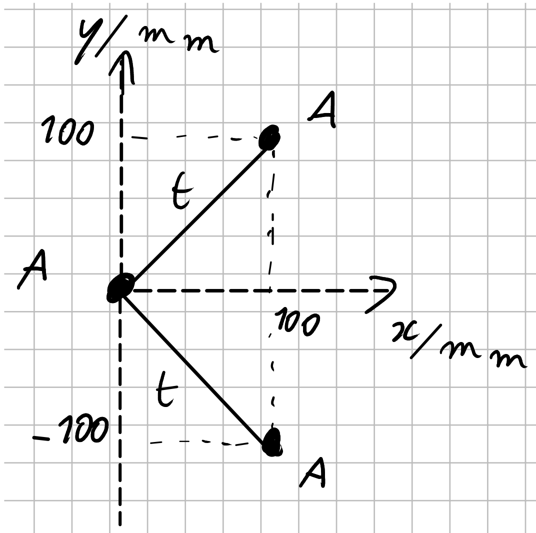
$$v'' = 2c \qquad \delta v'' = 2\delta c$$

$$\int_0^{\ell} \delta c \; 4EI \; c \, dz = \int_0^{\ell} \delta c \left(z^3 - z^2 \ell \right) \frac{p}{\ell} \, dz$$

$$4EI \ell c = -\frac{1}{12} \ell^3 p$$

$$c = -\frac{1}{48 EI} \ell^2 p$$

$$v\left(\frac{\ell}{2}\right) = \frac{1}{192 EI} \ell^4 p = 2{,}8125 \text{ mm}$$



Consider the open semi-monocoque cross section model sketched in the figure. Comput the x position of the shear center.

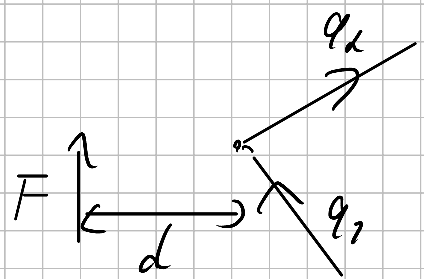
Data. $t = 1$ mm

$A = 100$ mm

$E = 72\,000$ MPa

$\nu = 0{,}3$

Unit for result : mm



$$q_1 = q_2 = \frac{F}{200}$$

$$M(0) = F \cdot d = 0$$

$$\Rightarrow d = 0 \text{ mm}$$

- The assumption of plane strain implies that a component of stress is null
  - False
- The essential boundary conditions are satisfied in a weak sense by the Principle of Virtual Work
  - False
- According to the semi-monocoque model, the axial stress σ_{zz} in the panels can be computed from the axial derivative of the shear stress
  - False
- The shear stress transmitted by a glued connection is
  - higher at the extremities
  - lower at the extremities
  - constant
  - described by a $\sin$ function
  - described by a $\cos$ function
  - described by a quadratic polynomial function
  - none of the above
- The bearing stress is related to
  - glued connections
  - riveted connections
  - the average shear stress in a semi-monocoque cross-section subject to constant torsional moment
  - the through-the-thickness shear stress in a Timoshenko shell model
  - the through-the-thickness shear stress in a Mindlin shell model
  - none of the above
- The transverse shear deformability for a thin-walled beam
  - is null
  - is generally larger with respect to a corresponding (same dimensions and bending stiffness) compact section
  - is generally smaller with respect to a corresponding (same dimensions and bending stiffness) compact section
  - is equal to that of a corresponding (same dimensions and bending stiffness) compact section
  - can be neglected
  - none of the above