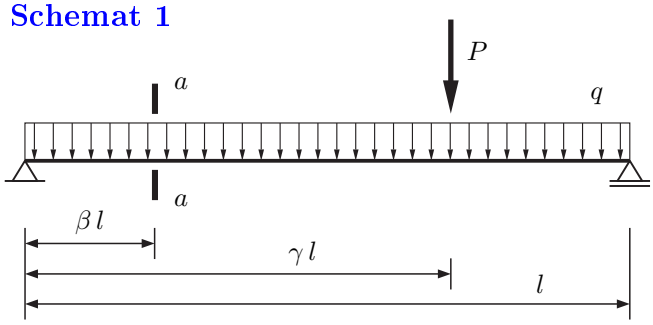
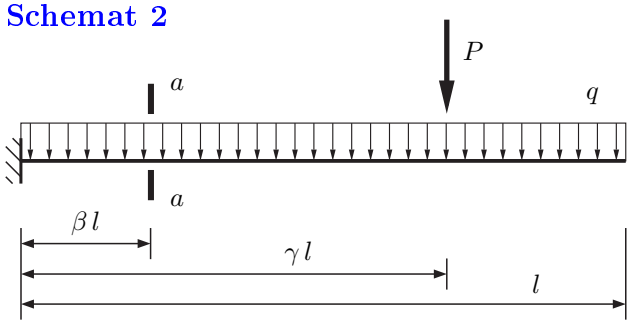
Schematy statyczne belek o przekroju cienkościennym

Schemat 1



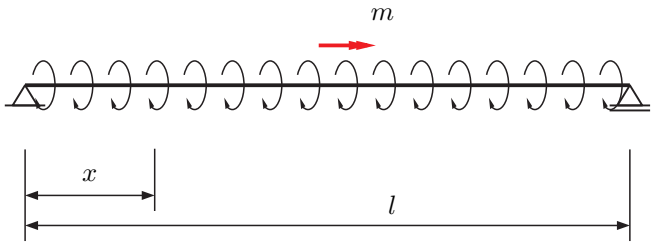
Schemat 2



Wzory na siły wewnętrzne dla skręcanego pręta cienkościennego

Obciążenie momentem rozłożonym

Schemat 1

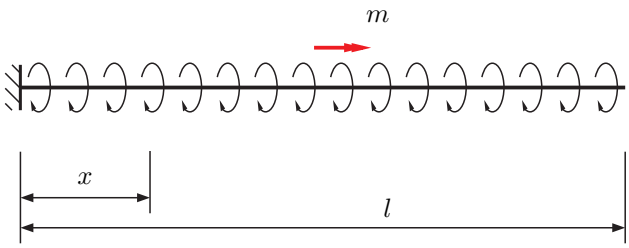


$$M_s = \frac{m}{\alpha}\left[\alpha\left(\frac{l}{2}-x\right) - \frac{\sinh\left(\alpha\left(\frac{l}{2}-x\right)\right)}{\cosh\left(\frac{\alpha\, l}{2}\right)}\right]$$

$$B = \frac{m}{\alpha^2}\left[1 - \frac{\cosh\left(\alpha\left(\frac{l}{2}-x\right)\right)}{\cosh\left(\frac{\alpha\, l}{2}\right)}\right]$$

$$M_\omega = \frac{m}{\alpha}\,\frac{\sinh\left(\alpha\left(\frac{l}{2}-x\right)\right)}{\cosh\left(\frac{\alpha\, l}{2}\right)}$$

Schemat 2



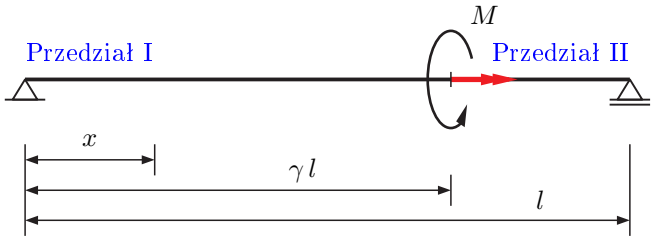
$$M_s = \frac{m}{\alpha \cosh(\alpha\, l)} \Big[\alpha(l-x)\cosh(\alpha\, l) + \sinh(\alpha x) - \alpha l \cosh\big(\alpha(l-x)\big)\Big]$$

$$B = -\frac{m}{\alpha^2 \cosh(\alpha\, l)} \Big[\alpha l \sinh\big(\alpha(l-x)\big) - \cosh(\alpha l) + \cosh(\alpha x)\Big]$$

$$M_\omega = \frac{m}{\alpha \cosh(\alpha\, l)} \Big[\alpha l \cosh\big(\alpha(l-x)\big) - \sinh(\alpha x)\Big]$$

Obciążenie momentem skupionym

Schemat 1



Przedział I

$$M_s = \frac{-M}{2\sinh(\alpha\, l)} \Big[2\,(\gamma-1)\sinh(\alpha\, l) - \sinh\big(\alpha((\gamma-1)\, l + x)\big) + \sinh\big(\alpha((1-\gamma)\, l + x)\big)\Big]$$

$$B = \frac{-M}{\alpha\, \sinh(\alpha\, l)} \cdot \sinh\big(\alpha\,(\gamma-1)\, l\big) \cdot \sinh(\alpha\, x)$$

$$M_\omega = \frac{-M}{\sinh(\alpha\, l)} \cdot \sinh\big(\alpha\,(\gamma-1)\, l\big) \cdot \cosh(\alpha\, x)$$

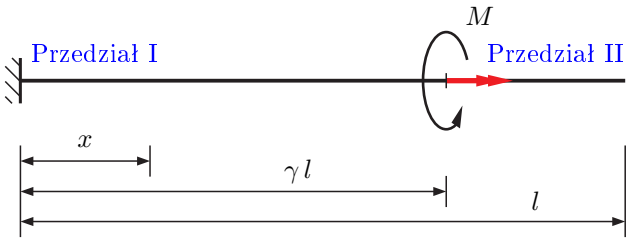
Przedział II

$$M_s = \frac{M}{2} \left[-2\,\gamma + \frac{1}{\sinh(\alpha\, l)} \Big[\sinh\big(\alpha((1+\gamma)\, l - x)\big) + \sinh\big(\alpha((\gamma-1)\, l + x)\big)\Big]\right]$$

$$B = \frac{M}{\alpha\, \sinh(\alpha\, l)} \cdot \sinh(\alpha\, \gamma\, l) \cdot \sinh\big(\alpha\,(l-x)\big)$$

$$M_\omega = \frac{-M}{\sinh(\alpha\, l)} \cdot \sinh(\alpha\, \gamma\, l) \cdot \cosh\big(\alpha\,(l-x)\big)$$

Schemat 2



Przedział I

$$M_s = \frac{M}{\cosh(\alpha\, l)} \sinh\left(\frac{\alpha\, x}{2}\right) \left[2\, \sinh\Big(\alpha\, \Big(l - \frac{x}{2}\Big)\Big) - \sinh\left(\frac{\alpha\big(x - 2l(\gamma - 1)\big)}{2}\right) + \right.$$
$$\left. + \sinh\left(\frac{\alpha\big(x + 2l(\gamma - 1)\big)}{2}\right)\right]$$

$$B = \frac{-M}{2\,\alpha\, \cosh(\alpha\, l)} \Big[2\, \sinh\big(\alpha(l - x)\big) + \sinh\big(\alpha(l\,(\gamma - 1) + x)\big) - \sinh\big(\alpha(l\,(1 - \gamma) + x)\big)\Big]$$

$$M_\omega = \frac{M}{2\, \cosh(\alpha\, l)} \Big[2\, \cosh\big(\alpha(l - x)\big) - \cosh\big(\alpha(l\,(\gamma - 1) + x)\big) + \cosh\big(\alpha(l\,(1 - \gamma) + x)\big)\Big]$$

Przedział II

$$M_s = \frac{2M}{\cosh(\alpha\, l)} \cdot \cosh\big(\alpha(l - x)\big) \cdot \left[\sinh\left(\frac{\alpha\, \gamma\, l}{2}\right)\right]^2$$

$$B = \frac{2M}{\alpha\, \cosh(\alpha\, l)} \cdot \sinh\big(\alpha(l - x)\big) \cdot \left[\sinh\left(\frac{\alpha\, \gamma\, l}{2}\right)\right]^2$$

$$M_\omega = -\frac{2M}{\cosh(\alpha\, l)} \cdot \cosh\big(\alpha(l - x)\big) \cdot \left[\sinh\left(\frac{\alpha\, \gamma\, l}{2}\right)\right]^2$$