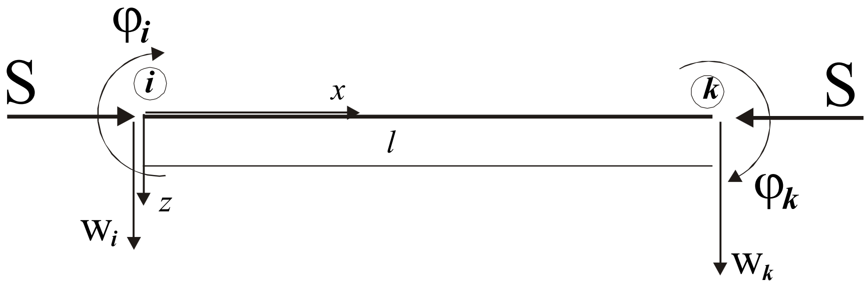
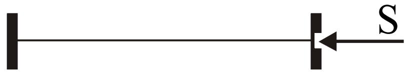
Funkcje kształtu belek zginanych z udziałem dużych sił osiowych



$$l\sqrt{\frac{|S|}{EJ}} = \begin{cases} \sigma & \text{gdy } S > 0 \\ \tilde{\sigma} & \text{gdy } S < 0 \end{cases}$$

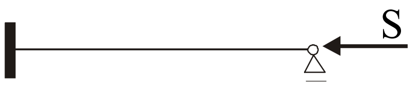
$$\xi = \frac{x}{l}$$



$$w(\xi) = w_i \rho_1(\xi) + l\varphi_i \omega_1(\xi) + w_k \rho_1(1-\xi) - l\varphi_k \omega_1(1-\xi)$$

$$\rho_1(\xi) = \begin{cases} \dfrac{1-\cos\sigma - \sigma(1-\xi)\sin\sigma + \cos(\sigma\xi) - \cos[\sigma(1-\xi)]}{2-2\cos\sigma - \sigma\sin\sigma} & \text{dla } \sigma > 0, \\ 1-3\xi^2+2\xi^3 & \text{dla } \sigma = 0, \\ \dfrac{1-ch\tilde{\sigma} + \tilde{\sigma}(1-\xi)sh\tilde{\sigma} + ch(\tilde{\sigma}\xi) - ch[\tilde{\sigma}(1-\xi)]}{2-2ch\tilde{\sigma} + \tilde{\sigma}\ sh\tilde{\sigma}} & \text{dla } \sigma = i\tilde{\sigma}. \end{cases}$$

$$\omega_1(\xi) = \begin{cases} \dfrac{\sigma\xi - \sin\sigma + \sigma(1-\xi)\cos\sigma + \sin(\sigma\xi) + \sin[\sigma(1-\xi)] - \sigma\cos[\sigma(1-\xi)]}{\sigma(2-2\cos\sigma - \sigma\sin\sigma)} & \text{dla } \sigma > 0, \\ \xi - 2\xi^2 + \xi^3 & \text{dla } \sigma = 0, \\ \dfrac{\tilde{\sigma}\xi - sh\tilde{\sigma} + \tilde{\sigma}(1-\xi)ch\tilde{\sigma} + sh(\tilde{\sigma}\xi) + sh[\tilde{\sigma}(1-\xi)] - \sigma ch[\tilde{\sigma}(1-\xi)]}{\tilde{\sigma}(2-2ch\tilde{\sigma} + \sigma\ sh\tilde{\sigma})} & \text{dla } \sigma = i\tilde{\sigma}. \end{cases}$$



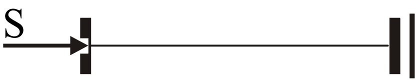
$$w(\xi) = w_i \rho_2(\xi) + l\varphi_i \omega_2(\xi) + w_k \rho_3(1-\xi)$$

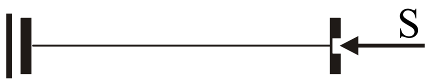
$$w(\xi) = w_i \rho_3(\xi) + w_k \rho_2(1-\xi) - l\varphi_k \omega_2(1-\xi)$$

$$\rho_2(\xi) = \begin{cases} \dfrac{-\sigma(1-\xi)\cos\sigma + \sin[\sigma(1-\xi)]}{\sin\sigma - \sigma\cos\sigma} & \text{dla } \sigma > 0, \\ 1 - \dfrac{3}{2}\xi^2 + \dfrac{1}{2}\xi^3 & \sigma = 0, \\ \dfrac{-\tilde{\sigma}(1-\xi)ch\tilde{\sigma} + sh[\tilde{\sigma}(1-\xi)]}{sh\tilde{\sigma} - \tilde{\sigma}\ ch\tilde{\sigma}} & \sigma = i\tilde{\sigma}. \end{cases}$$

$$\omega_2(\xi)=\begin{cases}\dfrac{-(1-\xi)\sin\sigma+\sin[\sigma(1-\xi)]}{\sin\sigma-\sigma\cos\sigma} & \text{dla } \sigma>0,\\ \xi-\dfrac{3}{2}\xi^2+\dfrac{1}{2}\xi^3 & \text{dla } \sigma=0,\\ \dfrac{-(1-\xi)sh\tilde{\sigma}+sh[\tilde{\sigma}(1-\xi)]}{sh\tilde{\sigma}-\tilde{\sigma}ch\tilde{\sigma}} & \text{dla } \sigma=i\tilde{\sigma}.\end{cases}$$

$$\rho_3(\xi)=\begin{cases}\dfrac{-\sigma(1-\xi)\cos\sigma+\sin\sigma-\sin(\sigma\xi)}{\sin\sigma-\sigma\cos\sigma} & \text{dla } \sigma>0,\\ 1-\dfrac{3}{2}\xi+\dfrac{1}{2}\xi^3 & \text{dla } \sigma=0,\\ \dfrac{-\tilde{\sigma}(1-\xi)ch\tilde{\sigma}+sh\tilde{\sigma}-sh(\tilde{\sigma}\xi)}{sh\tilde{\sigma}-\tilde{\sigma}\, ch\tilde{\sigma}} & \text{dla } \sigma=i\tilde{\sigma}.\end{cases}$$



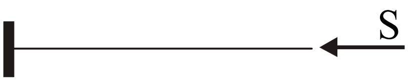


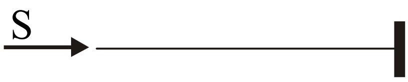
$$w(\xi)=w_i+l\varphi_i\omega_3(\xi)+l\varphi_k\omega_4(\xi)$$

$$w(\xi)=w_k-l\varphi_i\omega_4(1-\xi)-l\varphi_k\omega_3(1-\xi)$$

$$\omega_3(\xi)=\begin{cases}\dfrac{-\cos\sigma+\cos[\sigma(1-\xi)]}{\sigma\sin\sigma} & \text{dla } \sigma>0,\\ \xi-\dfrac{1}{2}\xi^2 & \text{dla } \sigma=0,\\ \dfrac{ch\tilde{\sigma}-ch[\tilde{\sigma}(1-\xi)]}{\tilde{\sigma}\, sh\tilde{\sigma}} & \text{dla } \sigma=i\tilde{\sigma}.\end{cases}$$

$$\omega_4(\xi)=\begin{cases}\dfrac{1-\cos(\sigma\xi)}{\sigma\sin\sigma} & \text{dla } \sigma>0,\\ \dfrac{1}{2}\xi^2 & \text{dla } \sigma=0,\\ \dfrac{-1+ch(\tilde{\sigma}\xi)}{\tilde{\sigma}\, sh\tilde{\sigma}} & \text{dla } \sigma=i\tilde{\sigma}.\end{cases}$$





$$w(\xi)=w_i+l\varphi_i\omega_5(\xi)$$

$$w(\xi)=w_k-l\varphi_k\omega_5(1-\xi)$$

$$\omega_5(\xi)=\begin{cases}\dfrac{\sin\sigma-\sin[\sigma(1-\xi)]}{\sigma\cos\sigma} & \text{dla } \sigma>0,\\ \xi & \text{dla } \sigma=0,\\ \dfrac{sh\tilde{\sigma}-sh[\tilde{\sigma}(1-\xi)]}{\tilde{\sigma}\, ch\tilde{\sigma}} & \text{dla } \sigma=i\tilde{\sigma}.\end{cases}$$

$$w(\xi)=w_i(1-\xi)+w_k\xi$$