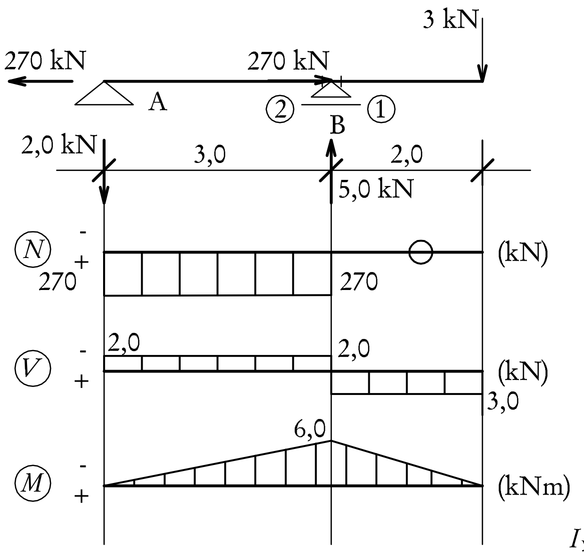
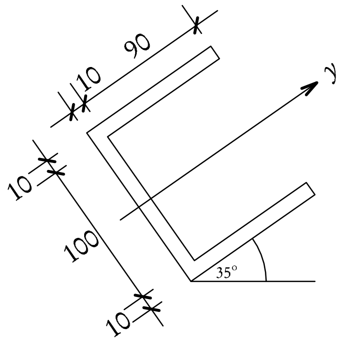
2.) Számítsuk ki a $\pm\sigma_{max}$ értékét rugalmas alapon! Rajzoljunk feszültségi ábrákat! Számítsuk ki a semleges tengelyek helyét is!





$A = 10*100*2 + 10*100 = \mathbf{3000\ mm^2}$

$y_s = \dfrac{2*10*100*50 + 10*100*5}{3000} = \mathbf{35\ mm}$

$I_y = \dfrac{100*120^3}{12} - \dfrac{90*100^3}{12} = \mathbf{6{,}9*10^6\ mm^4}$

$I_z = \dfrac{2*10*100^3}{12} + 2*10*100*15^2 + \dfrac{100*10^3}{12} + 10*100*30^2 = \mathbf{3{,}025*10^6\ mm^4}$

① keresztmetszet: Ferde hajlítás

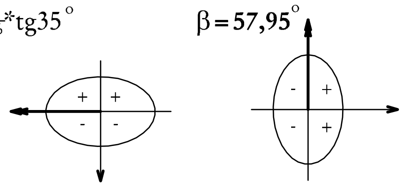
$M_y = 6{,}0*\cos 35^\circ = 4{,}915$ kNm

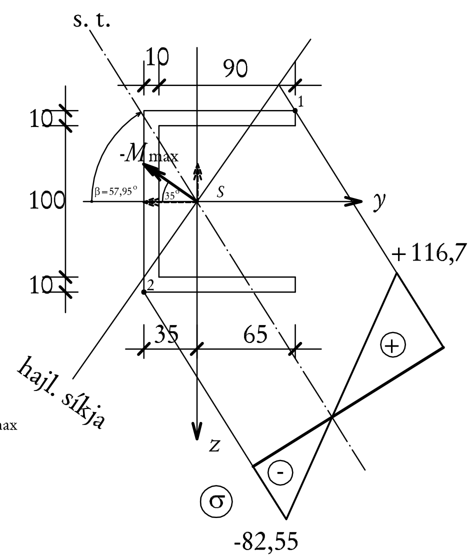
$M_z = 6{,}0*\sin 35^\circ = 3{,}441$ kNm

Semleges tengely:

$\mathrm{tg}\beta = \dfrac{I_y}{I_z}*\mathrm{tg}\alpha = \dfrac{6{,}9*10^6}{3{,}025*10^6}*\mathrm{tg}35^\circ$ $\qquad \mathbf{\beta = 57{,}95^\circ}$

$\sigma = \pm\dfrac{M_y}{I_y}*z \pm \dfrac{M_z}{I_z}*y$





$\sigma_1 = +\dfrac{4{,}915*10^6}{6{,}9*10^6}*60 + \dfrac{3{,}441*10^6}{3{,}025*10^6}*65 = +42{,}74 + 73{,}94 = +116{,}7\ \mathrm{N/mm^2}$

$\sigma_2 = -\dfrac{4{,}915*10^6}{6{,}9*10^6}*60 - \dfrac{3{,}441*10^6}{3{,}025*10^6}*35 = -42{,}74 - 39{,}81 = -82{,}55\ \mathrm{N/mm^2} = -\sigma_{max}$

② keresztmetszet: Kétirányban külpontos húzás

$N = +270{,}0$ kN

$M_y = 6{,}0*\cos 35^\circ = 4{,}915$ kNm

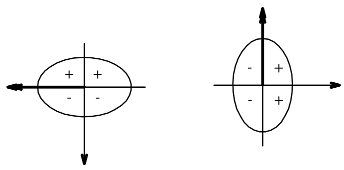
$M_z = 6{,}0*\sin 35^\circ = 3{,}441$ kNm

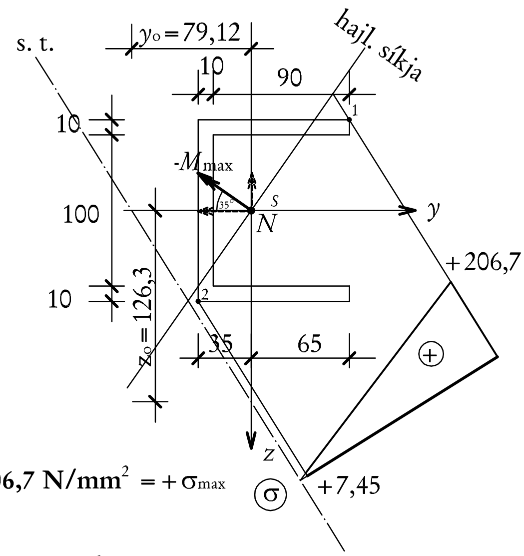
Semleges tengely:

$y_0 = -\dfrac{I_z*N}{A*M_z} = -\dfrac{3{,}025*10^6*270*10^3}{3000*3{,}441*10^6} = \mathbf{-79{,}12\ mm}$

$z_0 = -\dfrac{I_y*N}{A*M_y} = -\dfrac{6{,}9*10^6*270*10^3}{3000*4{,}915*10^6} = \mathbf{-126{,}3\ mm}$

$\sigma = +\dfrac{N}{A} \pm \dfrac{M_y}{I_y}*z \pm \dfrac{M_z}{I_z}*y$





$\sigma_1 = +\dfrac{270*10^3}{3000} + \dfrac{4{,}915*10^6}{6{,}9*10^6}*60 + \dfrac{3{,}441*10^6}{3{,}025*10^6}*65 = +90 + 116{,}7 = \mathbf{+206{,}7\ N/mm^2} = +\sigma_{max}$

$\sigma_2 = +\dfrac{270*10^3}{3000} - \dfrac{4{,}915*10^6}{6{,}9*10^6}*60 - \dfrac{3{,}441*10^6}{3{,}025*10^6}*35 = +90 - 82{,}55 = \mathbf{+7{,}45\ N/mm^2}$