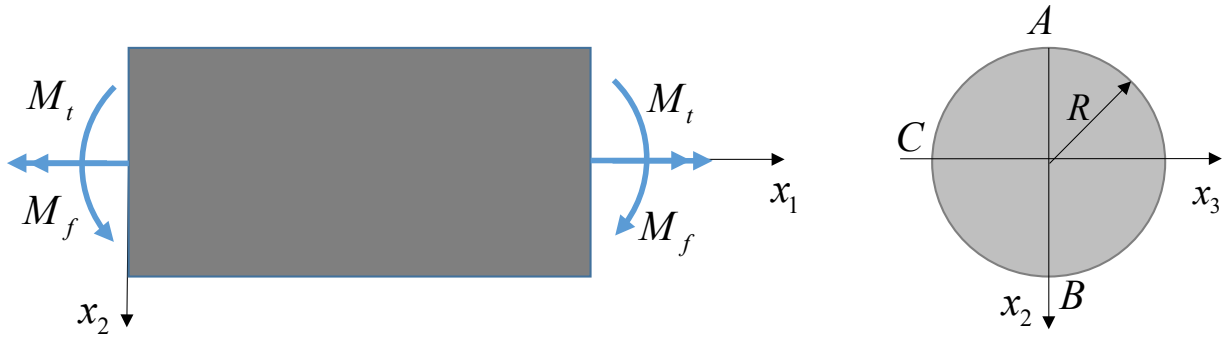
Exercise 1: A solid cylinder of radius *R*, is subjected to a bending moment M_f and a torque M_t (*R*=100mm, M_f=3000Nm; M_t=4000Nm).



Determine the components of the deviatoric stress tensor s_{ij} and the effective stress σ_e at points *A, B* and *C*. Comment on the results. Note that the stresses due to bending and torque are given by $\sigma = M_f x_2 / I$; $\tau = M_t r / I_p$ with I, I_p indicating the moments of inertia around the bending axis and the polar moment of inertia, respectively. For a circular cross-section we have, $I_p = 2I = \pi R^4 / 2$.

Exercise 2: Show that for the Prandtl – Reuss plastic strain increment relations,

$$d\varepsilon_{ij}^p = \frac{3}{2}\frac{d\varepsilon_p}{\sigma_e} s_{ij}$$

the plastic work increment can be expressed as,

$$dW^p = \sigma_e d\varepsilon_p$$

Where σ_e is the equivalent stress and $d\varepsilon_p$ the equivalent strain increment.

Exercise 3: An elastic perfectly plastic circular shaft of radius *R* is subjected to a torsional moment M_t at its ends. Determine the M_t at first yield and M_t for which there is an inner elastic core of radius *c*. Give a schematic of the stress distribution in both cases and comment on the results. The yield stress of the material in shear is *k*.