**Prob. 1** The shape factor of a cross section under bending is the ratio $M_P / M_Y$. Determine the shape factor for the following cross sections:

(a) An equilateral triangle (all three sides are equal to $L$).
(b) Circular cross section with a radius $R$.

**Prob. 2** A beam with T cross section is under pure bending (see Fig. 1). $E = 200$ GPa, and the yield strength is $\sigma_Y = 240$ MPa.

(a) Determine the elastic neutral axis and the plastic neutral axis.
(b) Determine the yield moment $M_Y$, plastic moment $M_P$, and shape factor of the cross section.
(c) Determine the moment that produces $\varepsilon_x = -0.0012$ at the lower edge of the flange.

**Prob. 3** Construct three Mohr’s circles for the three cases using the two-point method:

a) Uniaxial tension
b) Uniaxial compression
c) Pure shear (no normal stresses)

**Prob. 4** 2D stress components are $\sigma_x = 30$ MPa, $\sigma_y = 0$ MPa, and $\tau_{xy} = 50$ MPa, determine

a) the principal stresses
b) the directions of the principal planes
c) the maximum shear stress
d) the tensile stress which, acting alone, would produce the same maximum shear stress
e) the shear stress which, acting along, would produce the same maximum tensile principal stress.
f) Plot Mohr’s circles for a), d), and e).