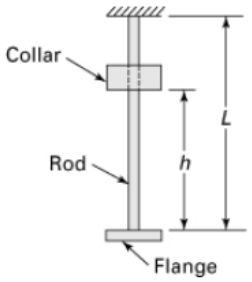
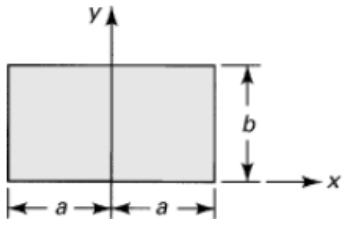
Homework 6

1) A sliding collar of $m = 80\ kg$ falls onto a flange at the bottom of a vertical rod. Calculate the height h through which the mass m should drop to produce a maximum stress in the rod of $350\ MPa$. The rod has length $L = 2m$, cross-sectional area $A = 250\ mm^2$, and modulus of elasticity $E = 105\ GPa$.

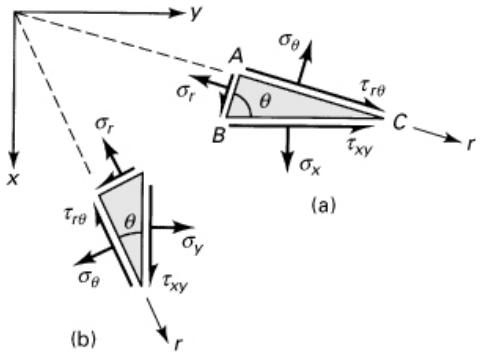


2) If the given stress field acts in the thin plate shown and p is a known constant, determine the values of the constant c's so that edges $x = \pm a$ are free of shearing stress and no normal stress acts on edge $x = a$.

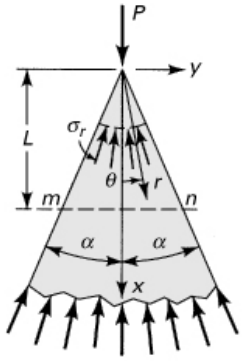
$$\sigma_x = pyx^3 - 2c_1xy + c_2y$$
$$\sigma_y = pxy^3 - 2px^3y$$
$$\tau_{xy} = -\tfrac{3}{2}px^2y^2 + c_1y^2 + \tfrac{1}{2}px^4 + c_3$$



3) Verify that Eqs. (3.37) in the text are determined from the equilibrium of forces acting on the elements shown (below left; Fig. P3.26).



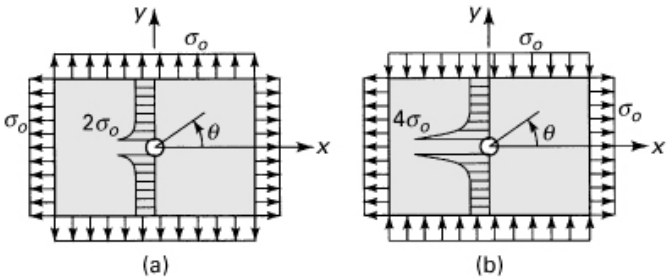
Problem 3



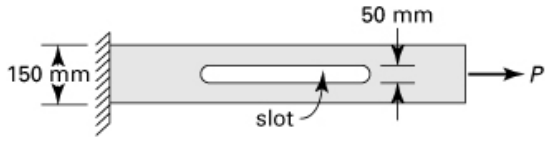
Problem 4

4) Consider the pivot (above right) of unit thickness subject to force $P = 1\ N$ per unit thickness at its vertex. Plot the values of σ_x, σ_y, and τ_{xy} as a function of θ (in deg) at section m-n a distance $L = 1\ m$ from the apex using Eq'ns. (3.37) and (3.43). Also plot σ_x using the elementary (mechanics of materials) approach for comparison. Take $\alpha = 15°$.

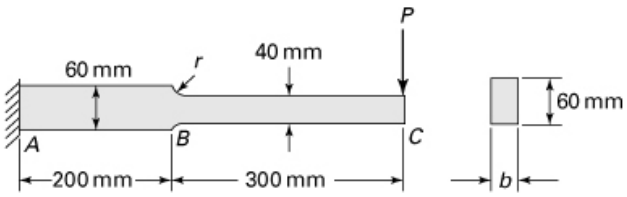
5) Verify the results shown by employing Eq. (3.55b) and the method of superposition.



6) A $20\ mm$-thick steel bar with a slot ($25\ mm$ radii at ends) is subjected to an axial load P, as shown. What is the maximum stress for $P = 180\ kN$? Use Appendix D to estimate the value of the K.



7) The figure depicts a filleted cantilever spring. Find the largest bending stress for two cases: (a) the fillet radius is $r = 5\ mm$; (b) the fillet radius is $r = 10\ mm$. Given: $b = 12\ mm$ and $P = 400\ N$.



8) The shaft shown has the following dimensions: $r = 20\ mm$, $d = 400\ mm$, and $D = 440\ mm$. The shaft is subjected simultaneously to a torque $T = 20\ kN \cdot m$, a bending moment $M = 10\ kN \cdot m$, and an axial force $P = 50\ kN$. Calculate at the root of the notch (a) the maximum principal stress, (b) the maximum shear stress, and (c) the octahedral stresses.