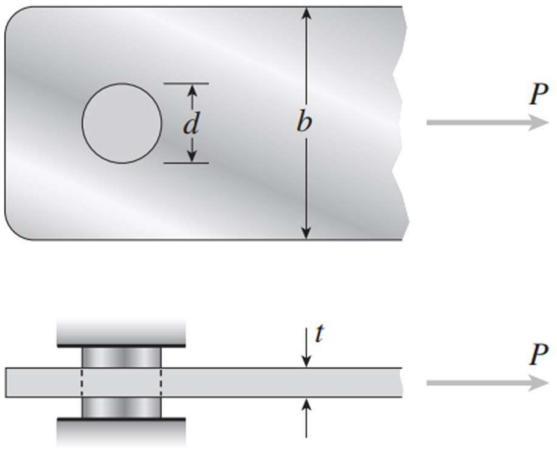
Question 1 A flat bar of width b 60 mm and thickness t 10 mm is loaded in tension by a force P (see figure). The bar is attached to a support by a pin of diameter d that passes through a hole of the same size in the bar. The allowable tensile stress on the net cross section of the bar is $_T$ 140 MPa, the allowable shear stress in the pin is $_S$ 80 MPa, and the allowable bearing stress between the pin and the bar is $_B$ 200 MPa.

(a) Determine the pin diameter d_m for which the load P will be at maximum.

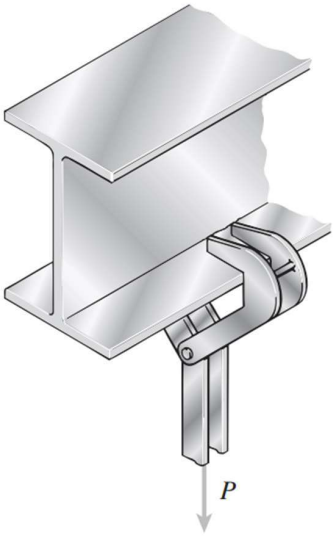
(b) Determine the corresponding value P_{max} of the load.

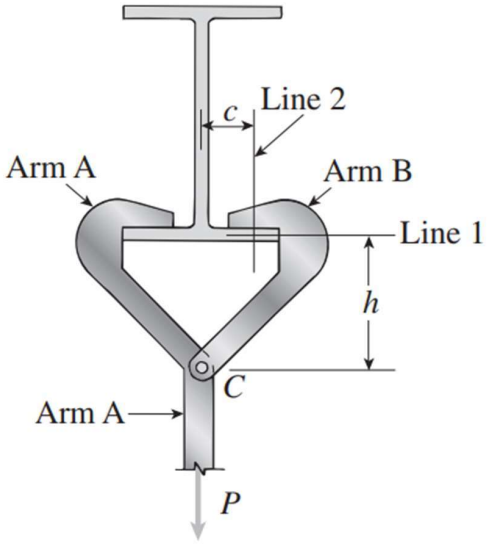


Question 2 The clamp shown in the figure is used to support a load hanging from the lower flange of a steel beam. The clamp consists of two arms (A and B) joined by a pin at C. The pin has diameter d 12 mm. Because arm B straddles arm A, the pin is in double shear.

Line 1 in the figure defines the line of action of the resultant horizontal force H acting between the lower flange of the beam and arm B. The vertical distance from this line to the pin is h 250 mm. Line 2 defines the line of action of the resultant vertical force V acting between the flange and arm B. The horizontal distance from this line to the centerline of the beam is c 100 mm. The force conditions between arm A and the lower flange are symmetrical with those given for arm B.

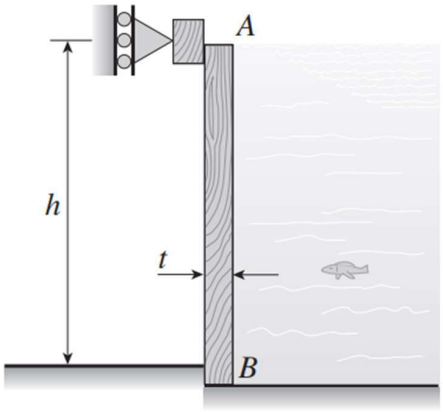
Determine the average shear stress in the pin at C when the load P 18 kN.





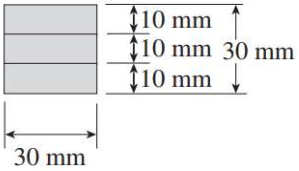
Question 3 A small dam of height h 2.0 m is constructed of vertical wood beams AB of thickness t 120 mm, as shown in the figure. Consider the beams to be simply supported at the top and bottom.

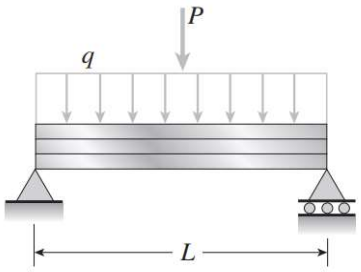
Determine the maximum bending stress $_{max}$ in the beams, assuming that the weight density of water is 9.81 kN/m3.



Problem 5.8-8 A laminated plastic beam of square cross section is built up by gluing together three strips, each 10 mm × 30 mm in cross section (see figure). The beam has a total weight of 3.2 N and is simply supported with span length $L = 320$ mm.

Considering the weight of the beam, calculate the maximum permissible load P that may be placed at the midpoint if (a) the allowable shear stress in the glued joints is 0.3 MPa, and (b) the allowable bending stress in the plastic is 8 MPa.

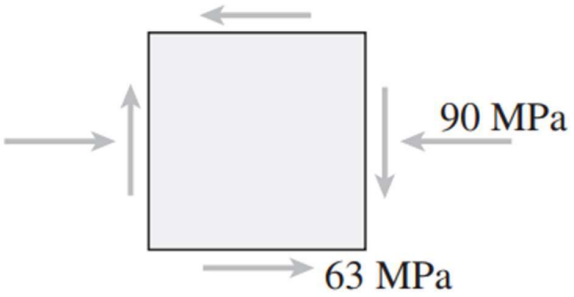




Question 5 A propeller shaft subjected to combined torsion and axial thrust is designed to resist a shear stress of 63 MPa and a compressive stress of 90 MPa (see figure).

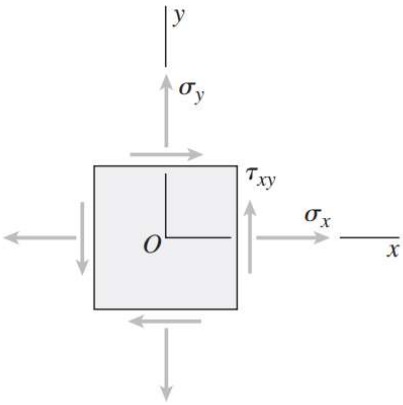
(a) Determine the principal stresses and show them on a sketch of a properly oriented element.

(b) Determine the maximum shear stresses and associated normal stresses and show them on a sketch of a properly oriented element.



Problems 7.4-10 through 7.4-15 An element in *plane stress* is subjected to stresses σ_x, σ_y, and τ_{xy} (see figure).

Using Mohr's circle, determine the stresses acting on an element oriented at an angle θ from the x axis. Show these stresses on a sketch of an element oriented at the angle θ. (*Note:* The angle θ is positive when counterclockwise and negative when clockwise.)



Data for 7.4-14 $\sigma_x = 31$ MPa, $\sigma_y = -5$ MPa, $\tau_{xy} = 33$ MPa, $\theta = 45°$