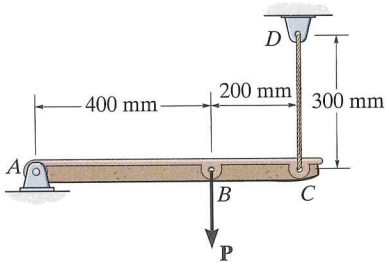
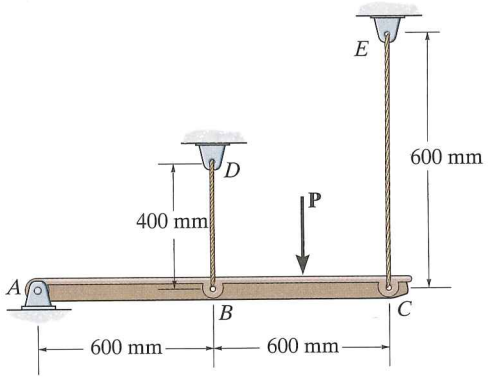
FUNDAMENTAL PROBLEMS

F2–1. When force **P** is applied to the rigid arm *ABC*, point *B* displaces vertically downward through a distance of 0.2 mm. Determine the normal strain developed in wire *CD*.



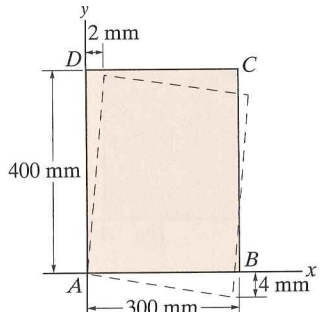
F2–1

F2–2. If the applied force **P** causes the rigid arm *ABC* to rotate clockwise about pin *A* through an angle of 0.02°, determine the normal strain developed in wires *BD* and *CE*.

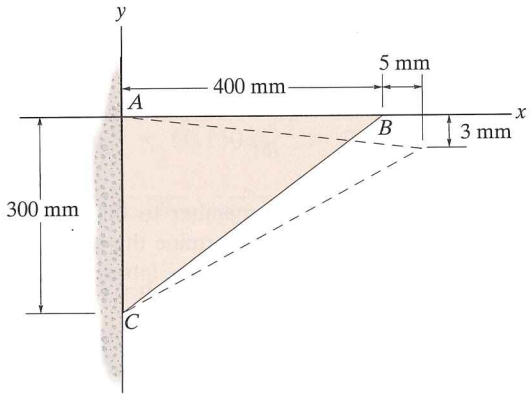


F2–2

F2–3. The rectangular plate is deformed into the shape of a parallelogram shown by the dashed line. Determine the average shear strain at corner *A* with respect to the *x* and *y* axes.

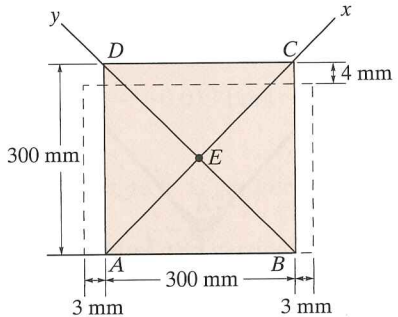


F2–4. The triangular plate is deformed into the shape shown by the dashed line. Determine the normal strain developed along edge *BC* and the average shear strain at corner *A* with respect to the *x* and *y* axes.



F2–4

F2–5. The square plate is deformed into the shape shown by the dashed line. Determine the average normal strain along diagonal *AC* and the shear strain of point *E* with respect to the *x* and *y* axes.

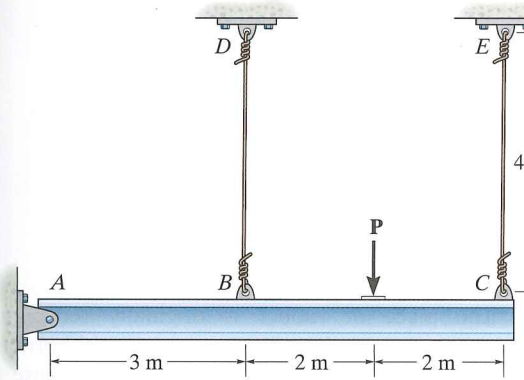


PROBLEMS

2–1. An air-filled rubber ball has a diameter of 6 the air pressure within it is increased until the diameter becomes 7 in., determine the average n strain in the rubber.

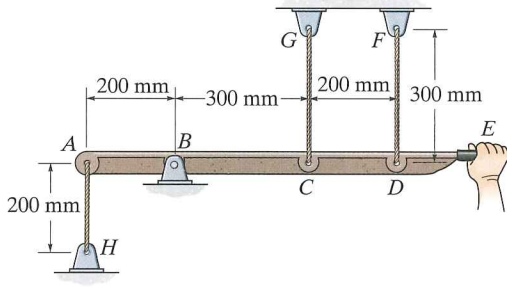
2–2. A thin strip of rubber has an unstretched len 15 in. If it is stretched around a pipe having an outer dia of 5 in., determine the average normal strain in the stri

2–3. The rigid beam is supported by a pin at *A* and *BD* and *CE*. If the load **P** on the beam causes the en be displaced 10 mm downward, determine the normal developed in wires *CE* and *BD*.



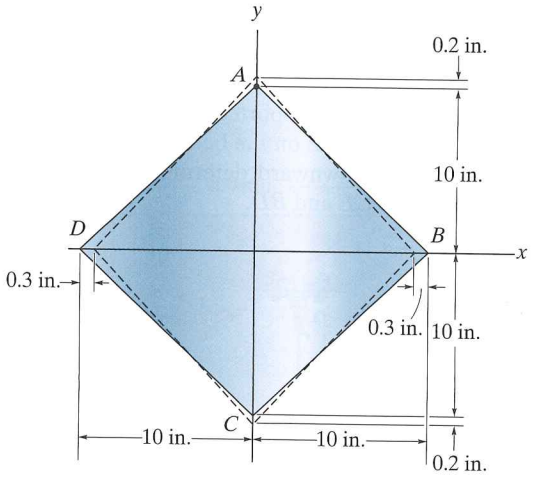
Prob. 2–3

*2–4. The force applied at the handle of the rigid causes the lever to rotate clockwise about the pin *B* th an angle of 2°. Determine the average normal developed in each wire. The wires are unstretched wh lever is in the horizontal position.



10. The corners of the square plate are given the splacements indicated. Determine the shear strain along e edges of the plate at A and B.

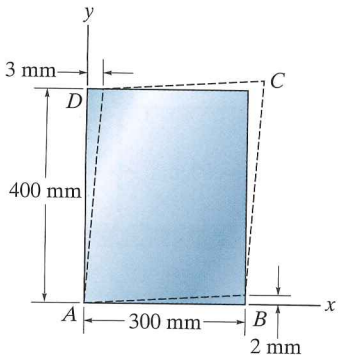
11. The corners of the square plate are given the splacements indicated. Determine the average normal ains along side AB and diagonals AC and DB.



Probs. 2–10/11

12. The piece of rubber is originally rectangular. termine the average shear strain γ_{xy} at A if the corners B D are subjected to the displacements that cause the ber to distort as shown by the dashed lines.

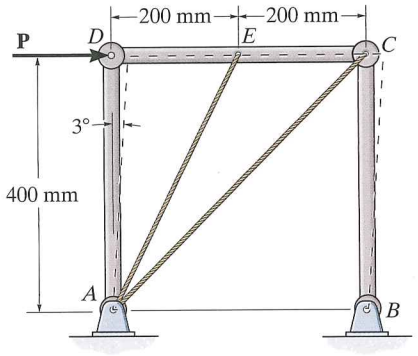
3. The piece of rubber is originally rectangular and jected to the deformation shown by the dashed lines. ermine the average normal strain along the diagonal and side AD.



Probs. 2–12/13

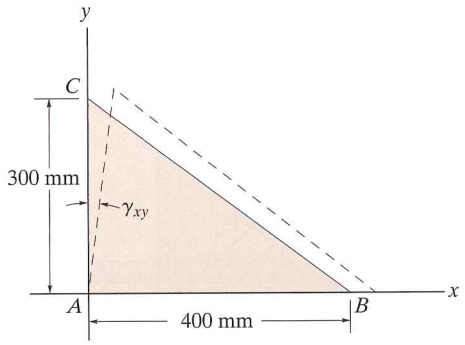
2–14. The force **P** applied at joint D of the square frame causes the frame to sway and form the dashed rhombus. Determine the average normal strain developed in wire AC. Assume the three rods are rigid.

2–15. The force **P** applied at joint D of the square frame causes the frame to sway and form the dashed rhombus. Determine the average normal strain developed in wire AE. Assume the three rods are rigid.



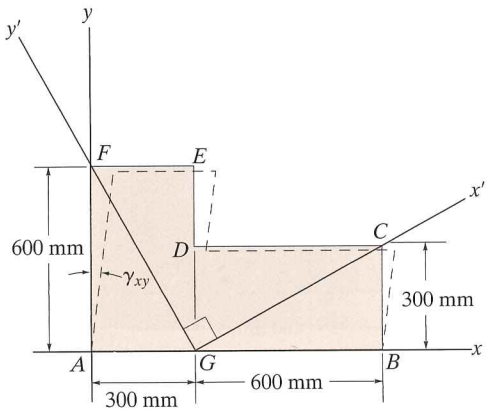
Probs. 2–14/15

***2–16.** The triangular plate ABC is deformed into the shape shown by the dashed lines. If at A, $\varepsilon_{AB} = 0.0075$, $\varepsilon_{AC} = 0.01$ and $\gamma_{xy} = 0.005$ rad, determine the average normal strain along edge BC.



Prob. 2–16

2–17. The plate is deformed uniformly into the shape shown by the dashed lines. If at A, $\gamma_{xy} = 0.0075$ rad., while $\epsilon_{AB} = \epsilon_{AF} = 0$, determine the average shear strain at point G with respect to the x' and y' axes.

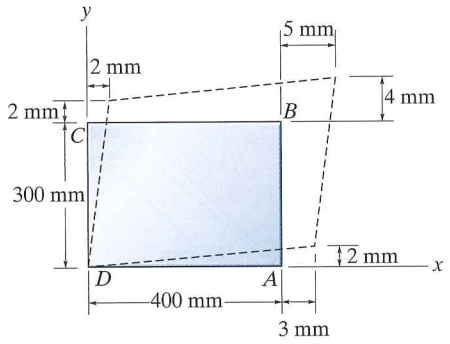


Prob. 2–17

2–18. The piece of plastic is originally rectangular. Determine the shear strain γ_{xy} at corners A and B if the plastic distorts as shown by the dashed lines.

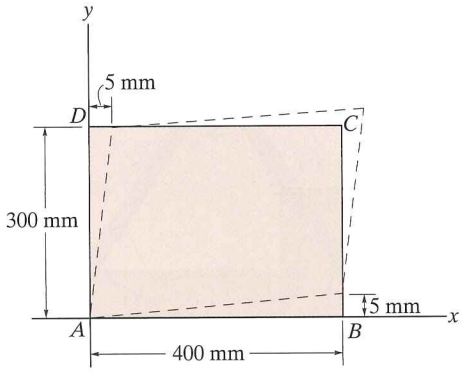
2–19. The piece of plastic is originally rectangular. Determine the shear strain γ_{xy} at corners D and C if the plastic distorts as shown by the dashed lines.

***2–20.** The piece of plastic is originally rectangular. Determine the average normal strain that occurs along the diagonals AC and DB.



Probs. 2–18/19/20

2–21. The rectangular plate is deformed into the shape of a parallelogram shown by the dashed lines. Determine the average shear strain γ_{xy} at corners A and B.

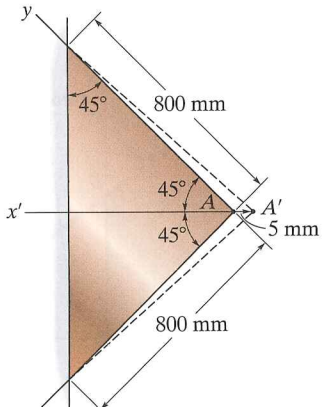


Prob. 2–21

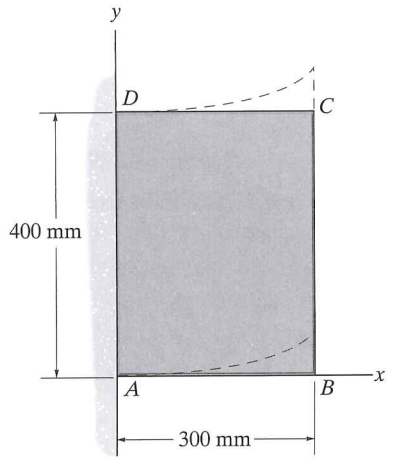
2–22. The triangular plate is fixed at its base, and its apex A is given a horizontal displacement of 5 mm. Determine the shear strain, γ_{xy}, at A.

2–23. The triangular plate is fixed at its base, and its apex A is given a horizontal displacement of 5 mm. Determine the average normal strain ϵ_x along the x axis.

***2–24.** The triangular plate is fixed at its base, and its apex A is given a horizontal displacement of 5 mm. Determine the average normal strain $\epsilon_{x'}$ along the x' axis.



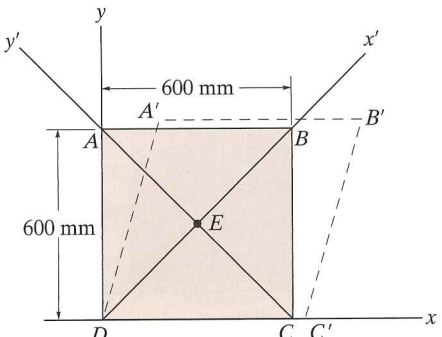
2–25. The square rubber block is subjected to a shear strain of $\gamma_{xy} = 40(10^{-6})x + 20(10^{-6})y$, where x and y are in mm. This deformation is in the shape shown by the dashed lines, where all the lines parallel to the y axis remain vertical after the deformation. Determine the normal strain along edge BC.



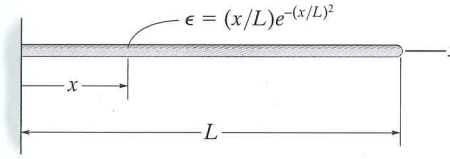
Prob. 2–25

2–26. The square plate is deformed into the shape shown by the dashed lines. If DC has a normal strain $\epsilon_x = 0.004$, DA has a normal strain $\epsilon_y = 0.005$ and at D, $\gamma_{xy} = 0.02$ rad, determine the average normal strain along diagonal CA.

2–27. The square plate is deformed into the shape shown by the dashed lines. If DC has a normal strain $\epsilon_x = 0.004$, DA has a normal strain $\epsilon_y = 0.005$ and at D, $\gamma_{xy} = 0.02$ rad, determine the shear strain at point E with respect to the x' and y' axes.



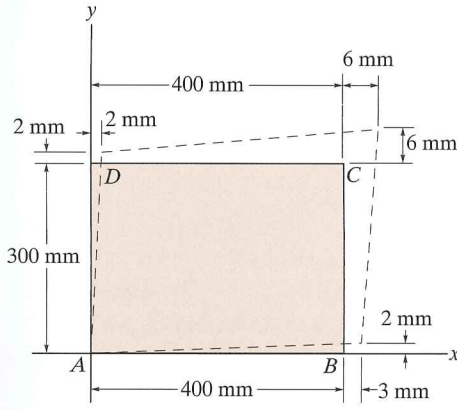
***2–28.** The wire is subjected to a normal strain defined by $\epsilon = (x/L)e^{-(x/L)^2}$. If the wire has a length L, determine the increase in its length.



Probs. 2–28

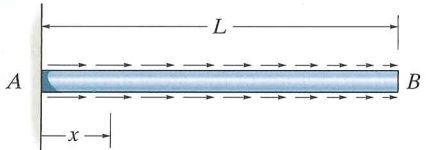
2–29. The rectangular plate is deformed into the shown by the dashed lines. Determine the average strain along diagonal AC, and the average shear corner A.

2–30. The rectangular plate is deformed into the shown by the dashed lines. Determine the average strain along diagonal BD, and the average shear corner B.



Probs. 2–29/30

2–31. The nonuniform loading causes a normal s the shaft that can be expressed as $\epsilon_x = kx^2$, wher constant. Determine the displacement of the end what is the average normal strain in the rod?



A tension test was performed on a steel specimen g an original diameter of 0.503 in. and a gauge length 00 in. The data is listed in the table. Plot the stress– diagram and determine approximately the modulus sticity, the ultimate stress, and the rupture stress. Use a of 1 in. = 15 ksi and 1 in. = 0.05 in./in. Redraw the -elastic region, using the same stress scale but a strain of 1 in. = 0.001 in.

A tension test was performed on a steel specimen g an original diameter of 0.503 in. and gauge length 00 in. Using the data listed in the table, plot the -strain diagram and determine approximately the lus of toughness.

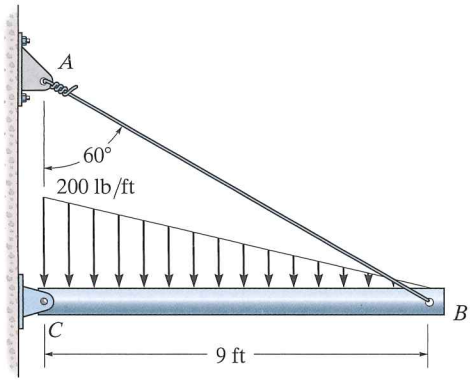
Load (kip)	Elongation (in.)
0	0
2.50	0.0009
6.50	0.0025
8.50	0.0040
9.20	0.0065
9.80	0.0098
12.0	0.0400
14.0	0.1200
14.5	0.2500
14.0	0.3500
13.2	0.4700

Probs. 3–4/5

A specimen is originally 1 ft long, has a diameter of and is subjected to a force of 500 lb. When the force eased from 500 lb to 1800 lb, the specimen elongates in. Determine the modulus of elasticity for the al if it remains linear elastic.

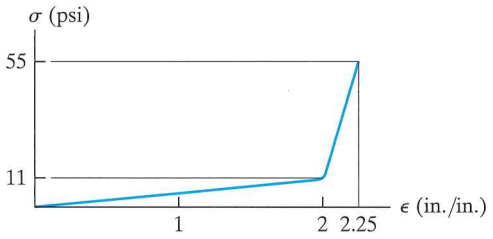
A structural member in a nuclear reactor is made of nium alloy. If an axial load of 4 kip is to be supported member, determine its required cross-sectional area. factor of safety of 3 relative to yielding. What is the n the member if it is 3 ft long and its elongation is .? $E_{zr} = 14(10^3)$ ksi, $\sigma_Y = 57.5$ ksi. The material has behavior.

***3–8.** The strut is supported by a pin at C and an A-36 steel guy wire AB. If the wire has a diameter of 0.2 in., determine how much it stretches when the distributed load acts on the strut.



Prob. 3–8

3–9. The σ–ϵ diagram for elastic fibers that make up human skin and muscle is shown. Determine the modulus of elasticity of the fibers and estimate their modulus of toughness and modulus of resilience.

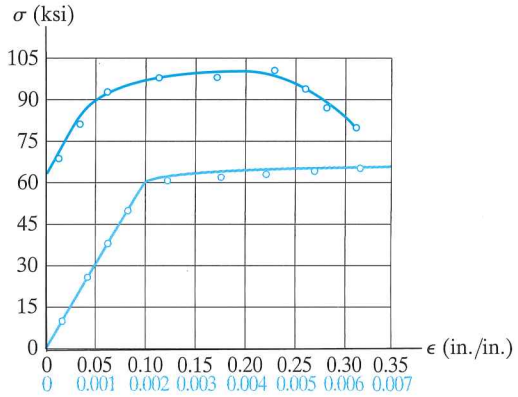


Prob. 3–9

3–10. The stress–strain diagram for a metal alloy having an original diameter of 0.5 in. and a gauge length of 2 in. is given in the figure. Determine approximately the modulus of elasticity for the material, the load on the specimen that causes yielding, and the ultimate load the specimen will support.

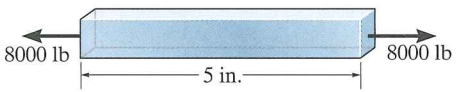
3–11. The stress–strain diagram for a steel alloy having an original diameter of 0.5 in. and a gauge length of 2 in. is given in the figure. If the specimen is loaded until it is stressed to 90 ksi, determine the approximate amount of elastic recovery and the increase in the gauge length after it is unloaded.

***3–12.** The stress–strain diagram for a steel alloy having an original diameter of 0.5 in. and a gauge length of 2 in. is given in the figure. Determine approximately the modulus of resilience and the modulus of toughness for the material.



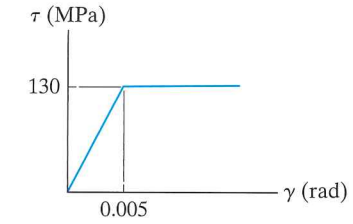
Probs. 3–10/11/12

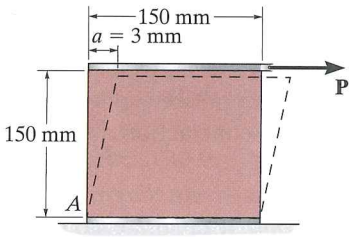
3–13. A bar having a length of 5 in. and cross-sectional area of 0.7 in.^{2} is subjected to an axial force of 8000 lb. If the bar stretches 0.002 in., determine the modulus of elasticity of the material. The material has linear-elastic behavior.



Prob. 3–13

–16. A 20-mm-wide block is bonded to rigid plates at its
p and bottom. When the force **P** is applied the block
forms into the shape shown by the dashed line. If
= 3 mm and **P** is released, determine the permanent shear
ain in the block.

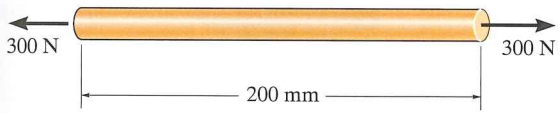




F3–16

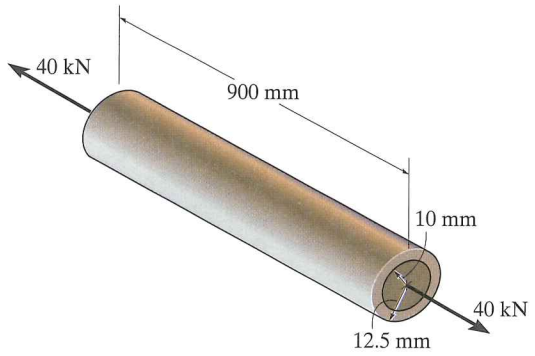
PROBLEMS

3–25. The acrylic plastic rod is 200 mm long and 15 mm in diameter. If an axial load of 300 N is applied to it, determine the change in its length and the change in its diameter. $E_p = 2.70$ GPa, $\nu_p = 0.4$.



Prob. 3–25

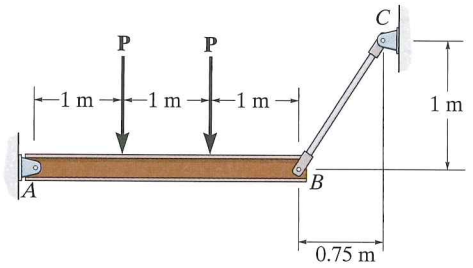
3–26. The thin-walled tube is subjected to an axial force of 40 kN. If the tube elongates 3 mm and its circumference decreases 0.09 mm, determine the modulus of elasticity, Poisson's ratio, and the shear modulus of the tube's material. The material behaves elastically.



Prob. 3–26

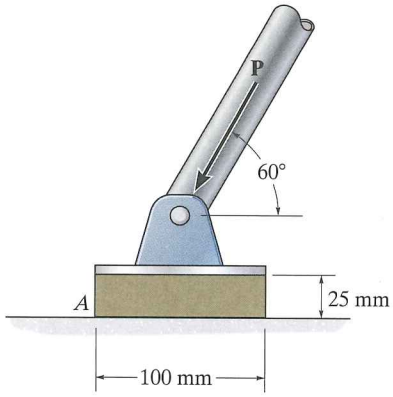
3–27. When the two forces are placed on the beam, the diameter of the A-36 steel rod BC decreases from 40 mm to 39.99 mm. Determine the magnitude of each force **P**.

***3–28.** If $P = 150$ kN, determine the elastic elongation of rod BC and the decrease in its diameter. Rod BC is made of A-36 streel and has a diameter of 40 mm.



Probs. 3–27/28

3–29. The friction pad A is used to support the member, which is subjected to an axial force of $P = 2$ kN. The pad is made from a material having a modulus of elasticity of $E = 4$ MPa and Poisson's ratio $\nu = 0.4$. If slipping does not occur, determine the normal and shear strains in the pad. The width is 50 mm. Assume that the material is linearly elastic. Also, neglect the effect of the moment acting on the pad.



Prob. 3–29