

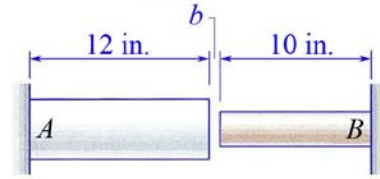
MEEG 3013

Name: _____
(Underline your last name.)

Test I ()

ID#: _____

1. (30%) At room temperature, a gap $b = 0.02$ in. exists between the aluminum rod A of 2-in. diameter ($\alpha_a = 13.1 \times 10^{-6}/^\circ\text{F}$, $E_a = 10.1 \times 10^6$ psi) and the steel rod B of 1.5-in. diameter ($\alpha_s = 6.5 \times 10^{-6}/^\circ\text{F}$, $E_s = 29 \times 10^6$ psi) as shown. If a temperature rise of ΔT occurs and the stress developed in the aluminum rod is $\sigma_a = -4$ ksi, determine the value of ΔT .



2. (30%) The horizontal shaft AD is attached to a fixed base at D and is subjected to the torques as shown, where $T_A = 200$ lb-ft and $T_B = 1500$ lb-ft. A 2-in.-diameter hole has been drilled into portion CD of the shaft. Knowing that the entire shaft is made of steel for which $G = 11.2 \times 10^6$ psi, determine the angle of twist ϕ_A at end A.

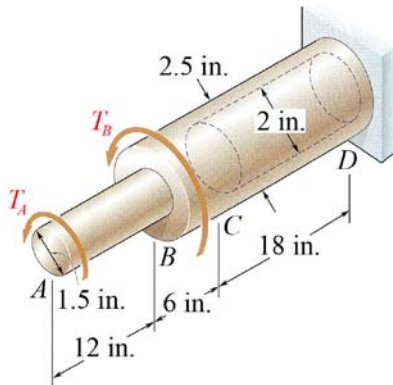


Fig. P2

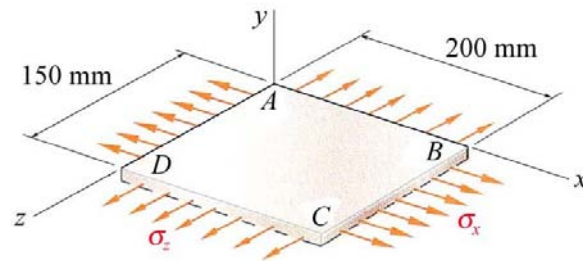


Fig. P3

3. A fabric used in air-inflated structures is subjected to a biaxial loading that results in normal stresses $\sigma_x = 150$ MPa and $\sigma_z = 180$ MPa. The properties of the fabric can be approximated as $E = 87$ GPa and $\nu = 0.34$. **Circle on this test sheet** the correct or nearest item for each of the following:
- A. (7%) The change in length of side AB is
(a) 0.220 mm. (b) 0.212 mm. (c) 0.204 mm. (d) 0.1963 mm. (e) 0.1885 mm. (f) 0.1807 mm. (g) 0.1729 mm.
- B. (7%) The change in length of side BC is
(a) 0.309 mm. (b) 0.291 mm. (c) 0.274 mm. (d) 0.257 mm. (e) 0.240 mm. (f) 0.222 mm. (g) 0.205 mm.
- C. (6%) The change in length of diagonal AC is
(a) 0.293 mm. (b) 0.297 mm. (c) 0.301 mm. (d) 0.305 mm. (e) 0.309 mm. (f) 0.313 mm.
4. (20%) Non-numerical problem.
- A. ④ Define *factor of safety* (*F.S.*).
- B. ⑥ Describe *Saint-Venant's principle*.
- C. ⑩ Write the **symbols**, **state the dimensions** (in terms of length, force, time, mass, temperature, or dimensionless, as appropriate), and give an *illustrative units*, if any, for each of the following:
- (a) modulus of rigidity, (b) Young's modulus,
(c) Poisson's ratio, (d) shearing strain,
(e) coefficient of thermal expansion.