King Fahd University of Petroleum & Minerals
CIVIL ENGINEERING DEPARTMENT

CE 203 STRUCTURAL MECHANICS I

Second Semester 1433 / 2012 (**112**)

HOMEWORK NO. 5

- **Textbook Sections Covered: 4.4- 4.7**
- **Subject Material Covered:** Axially Loaded members: Statically Indeterminate & Thermal Stresses; Stress Concentration
- **DUE DATE: Monday 12-4-1433 (5-3-2012)**

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1) Determine the stresses in members AB (A = 80 mm^2, E = 70 GPa) and CD (A = 30 mm^2, E = 210 GPa) shown in Fig. P1. [Secs. 4.4 & 4.5)] (20 pts.)

2) In Fig. P2 shown, determine the stresses in BF and DG and the force in the spring if
   a- $\delta = 0$
   b- $\delta = 0.5$ mm (*before applying the load*)
   c- $\delta = 1.5$ mm (*before applying the load*) [Secs. 4.4 & 4.5)] (30 pts.)

3) A 12-mm-diameter steel rod, shown in Fig. P3, is welded to a rigid plate that is supported by a brass pipe whose outside diameter is 30 mm and whose inside diameter is 20 mm. The temperature is increased by 50° C in the steel and decreased by 40° C in the brass. If E_{ST} = 210 GPa, α_{ST} = 12 $(10)^{-6}$ / °C, and E_{BR} = 105 GPa, α_{BR} = 18 $(10)^{-6}$ / °C, determine
   a- the displacement of point *A;*
   b- the stress in the steel and in the brass. [Sec. 4.6)] (10 pts.)

4) Solve problem 4-78 (p. 156) in the textbook, but for *CB* let L = 0.4 m (instead of 0.5), D = 60 mm (instead of 50), and the material be red brass (instead of steel). Solve the problem by
   a- applying the load, then the temperature,
   b- applying the temperature, then the load,
   c- applying the load and temperature simultaneously.
   What conclusion can you make? Which method do you like? Why? [Sec. 4.6)] (25 pts.)

5) Determine the maximum allowable force *P* that can be applied on the plate (thickness = 10 mm) shown in Fig. P5 if the failure tensile stress is 150 MPa, and a factor of safety of 1.5 is needed. [Secs. 4.7] (15 pts.)

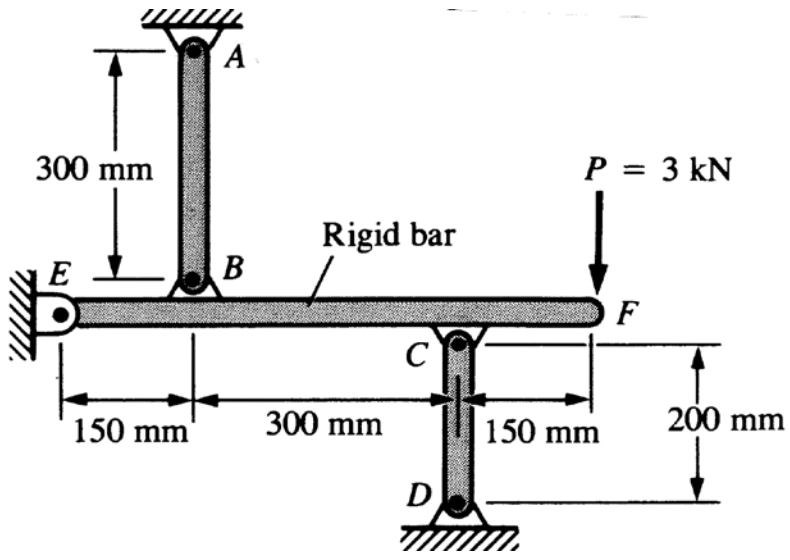

Fig. P1

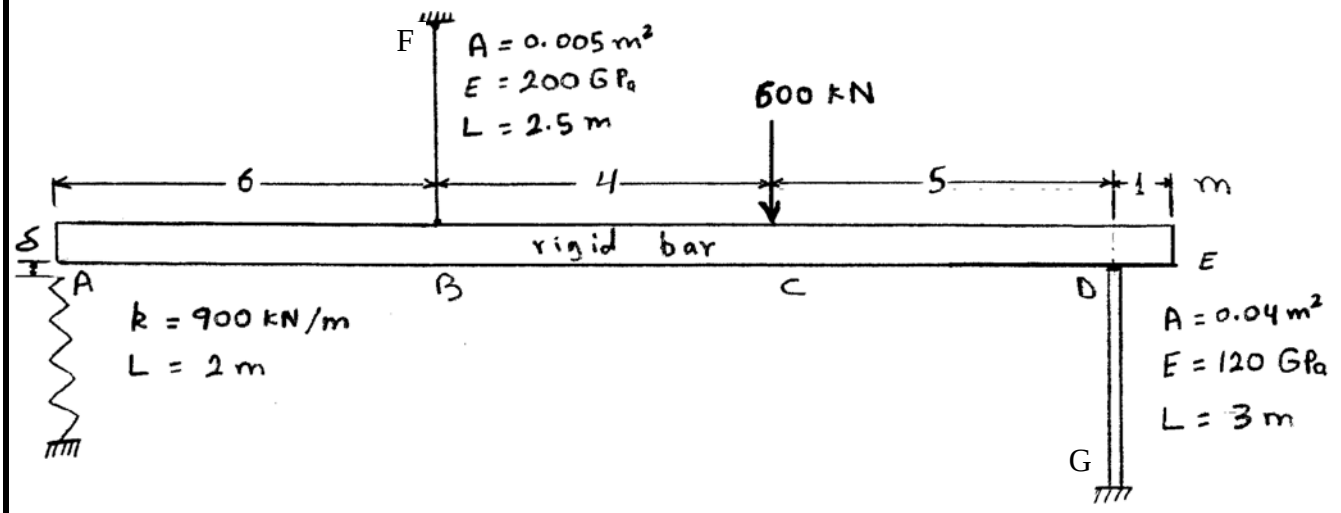

Fig. P2

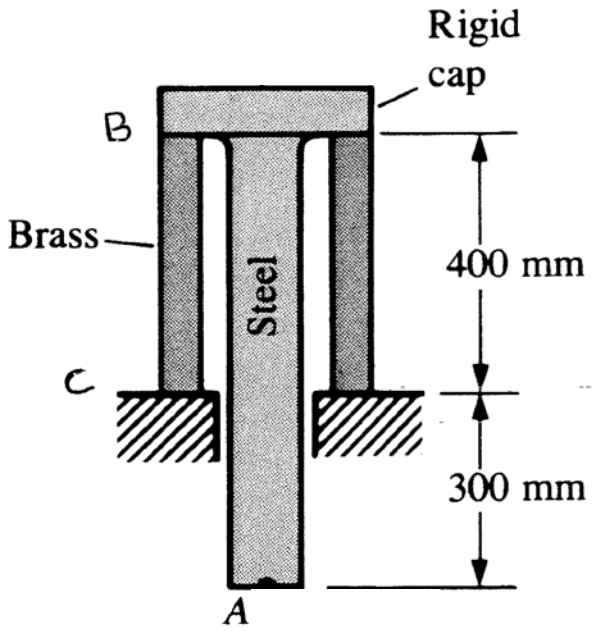

Fig. P3

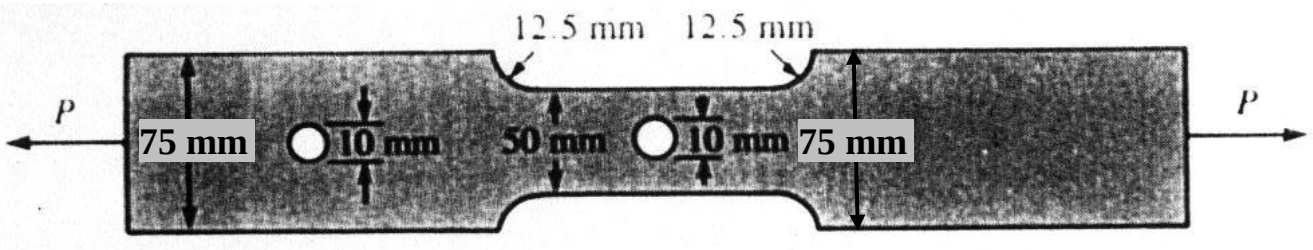

Fig. P5