ME231: Tutorial – II

August 14, 2020

Q.1: (a) A machine part carrying a load F terminates in a piston which fits into a cavity. Within the cavity are two linear springs arranged coaxial with each other. k_A and k_B denote the spring constants of the two springs in the cavity. When the springs are unloaded, each has the same length L. Determine how much of the load F is carried by the spring with constant k_A.

(b) Instead of two springs coaxial to each other, there are two springs in the cavity one over the other as shown in Fig.1(b).

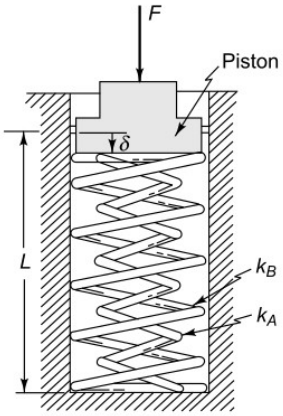


Fig. 1(a)

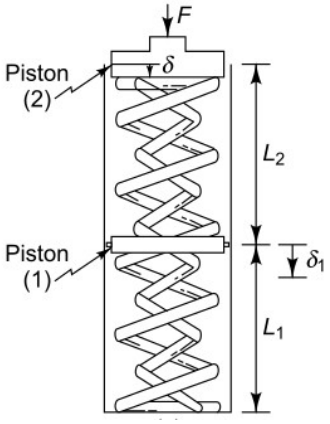
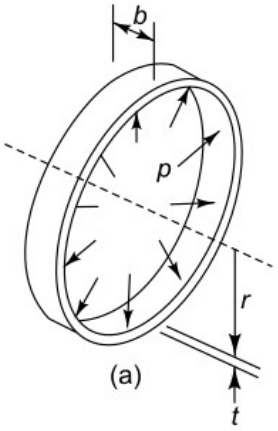
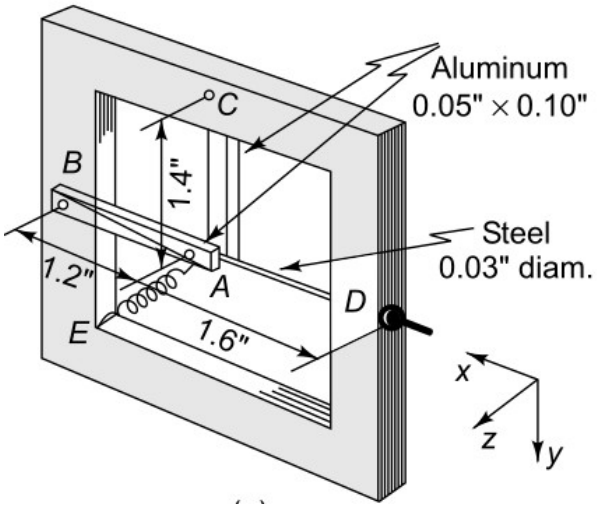


Fig. 1(b)

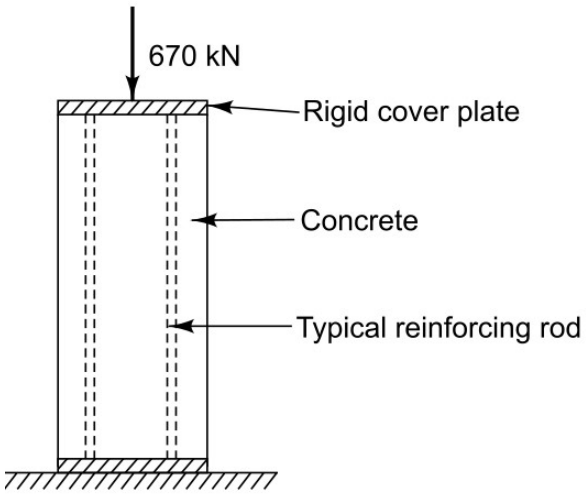
Q.2: A thin ring of internal radius r, thickness t, and width b is subjected to a uniform pressure p over the entire internal surface. Determine the forces in the ring. Also, determine the deformation of the ring due to the internal pressure.



Q:3: Figure shows an instrument suspension consisting of two aluminum bars and one steel rod mounted in a stiff frame, together with a spring EA which is inclined at 45° to BA. In assembly the nut on the steel rod at D is tightened so there is no slack in the line BAD, and then the spring EA is installed with sufficient extension to produce a force of 50 N. Find the deflection of the joint A (relative to the frame) caused by the spring loading.

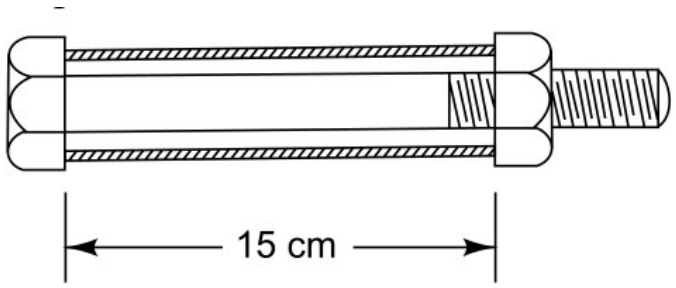


Q.4: A square reinforced-concrete pier 0.3 × 0.3 m in cross-section and 1.2 m high is loaded as shown in the figure. The concrete is strengthened by the addition of eight vertical 25 × 25 mm^2 steel reinforcing bars placed symmetrically about the vertical axis of the pier. Find the force/unit area in the steel and concrete and the deflection. For concrete, take $E = 17$ GN/m^2.

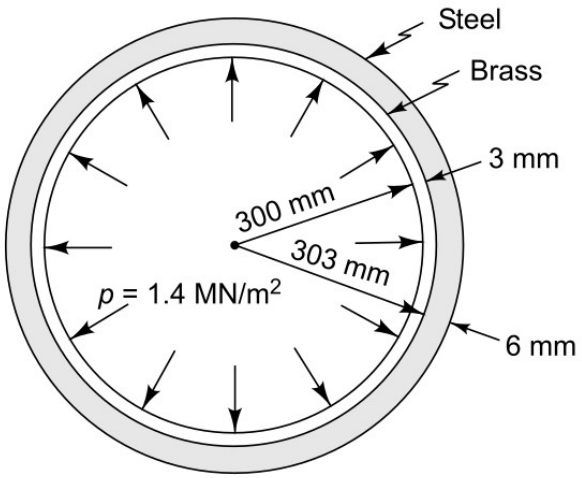


Q.5: A bolt is threaded through a tubular sleeve, and the nut is turned up just tight by hand as shown. Using wrenches, the nut is then turned further, the bolt being put in tension and the sleeve in compression. If the bolt has 5 threads per cm, and the nut is given an extra quarter turn (90°) by the wrenches, estimate the tensile force in the bolt if

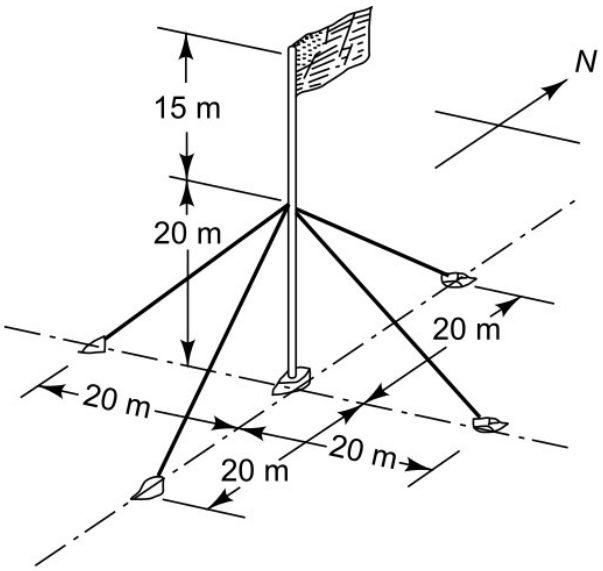
both the bolt and sleeve are of steel and the cross-sectional areas are Bolt area = 6 cm^2 , Sleeve area = 4 cm^2.



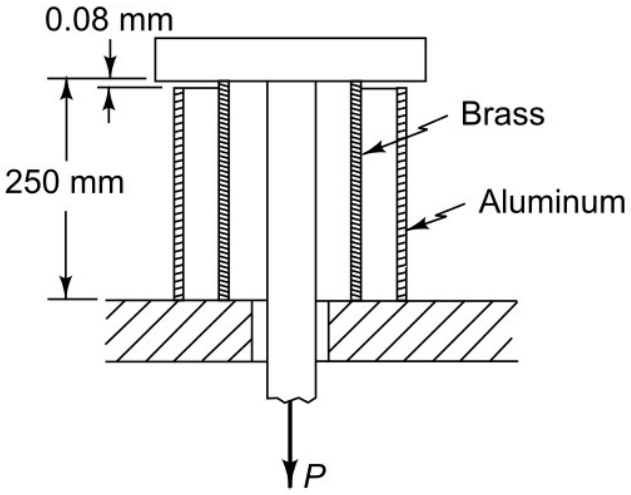
Q.6: A composite hoop consists of a brass hoop of 300-mm internal radius and 3 mm thickness, and a steel hoop of 303-mm internal radius and 6-mm radial thickness. Both hoops are 6-mm thick normal to the plane of the hoop. If a radial pressure of 1.4 MN/m^2 is put in the brass hoop, estimate the tangential forces in the brass and steel hoops.



Q.7: A 35-m flagpole is made of 20-cm diameter steel pipe. It is attached to its foundation by a ball-and-socket joint and is supported in the upright position by four 1 cm- diameter high-strength steel wires, as shown in the sketch. When there is no wind, the tension in the wires is negligible. In a hurricane the wind blows hard from the south, and its effect can be represented by a horizontal force of 5 kN at the mid-height of the pole. Estimate how far the top of the pole moves from its original position, which was vertically above the base.



Q.8: In a particular machine it is necessary to have a very stiff spring with a "kink" in the load-deflection curve. The suggested design consists of a 150-mm-diameter brass cylinder with a 6.25-mm wall thickness and a 250-mm-diameter aluminum cylinder with 6.25-mm wall thickness, the aluminum cylinder being made 0.08 mm shorter than the brass cylinder. Sketch accurately the graph of the load-deflection relation for this spring.



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