

CIV102F Quiz # 3: Friday AM October 2, 2020

Material Behaviour

The rigid beam ABC is supported by a pin at A and by wires BD and CE. The wires are made of piano wire, and have a diameter of 5 mm. A load P is applied as shown and causes the beam to rotate about point A in a clockwise direction. This rotation causes points B and C to displace downwards. Assume that the weight of the beam and wires is negligible compared to the load P.

Note that because the angles of rotation are small, the displacements at B and F are $\frac{3}{7}$ and $\frac{5}{7}$ that of point C (i.e. if point C moves 7 mm downwards, points B and F move downwards 3 mm and 5 mm respectively).

- What is the maximum allowable displacement at C if we wish to maintain a factor of safety against failure in the wires of 2.0?
- What are the forces in the two wires when failure occurs?
- Calculate the energy stored in the two wires when failure occurs and express your value in joules.
- Assuming that the initial length of cable CE remains 4 m long, what should the initial length of cable BD be so that both BC and CE fail simultaneously?
- Suppose we wanted to change the material used in wires BD and EC so that we could have very large rotations of the beam about point A before the wires break. What material would you choose, and what material property did you use to pick it? Assume that cost is not important.

