**42.**

Problem 13.10E (HRW)

A beam is carried by three men, one man at one end and the other two supporting the beam between them on a crosspiece placed so that the load is equally divided among the three men. Where is the crosspiece placed? We can neglect the mass of the crosspiece.

Solution:

Let l be the length of the beam. The weight of the beam will act vertically downward at its middle. Let us assume that the crosspiece has been placed at a distance x from its right-hand end and let one of the men hold the beam at its left-hand end and the other two hold it with the crosspiece. As the weight is equally shared by each man the forces acting on the beam will be as shown in the line diagram.
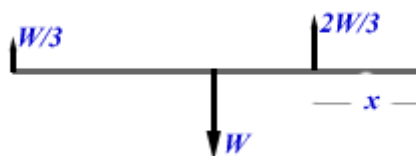
For the system to be in equilibrium the net torque on the system about any axis perpendicular to the plane of the diagram has to be zero, and also the net force acting on the beam has to be zero. Computing the torque about the left-hand end gives the equation

$$\tfrac{2}{3}W \times (l - x) = W \times \tfrac{1}{2}l,$$

or,

$$l - x = \tfrac{3}{4}l,$$

or,

$$x = \tfrac{1}{4}l.$$