1-14. A random force P is applied to the beam and causes a downward displacement at C. The measured displacement follows the distribution $d \sim N(12, 0.2^2)$ mm. Determine the distributon of the normal strain in wire BE.

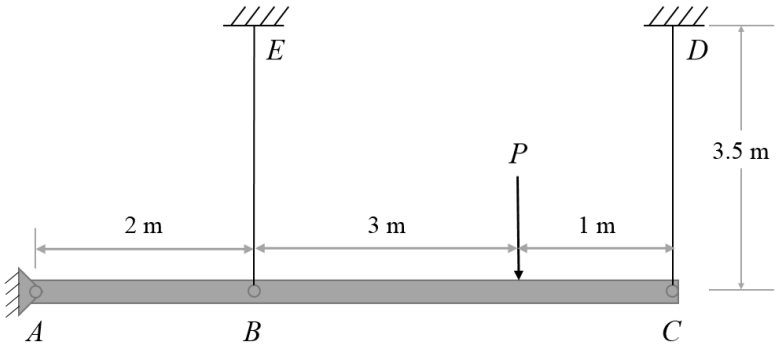
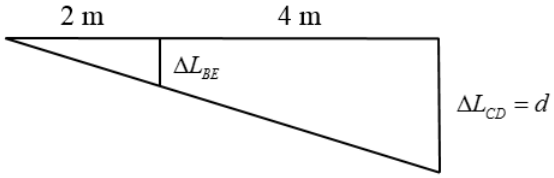


Fig. 1.14

Solution

Solve for the change in length of wire BE.



$$\frac{\Delta L_{BE}}{L_{AB}} = \frac{\Delta L_{CD}}{L_{AC}} = \frac{d}{L_{AC}}$$

$$\Rightarrow \Delta L_{BE} = \frac{L_{AB}}{L_{BC}} d$$

Next, solve for the normal strain in wire BE.

$$\varepsilon_{BE} = \frac{\Delta L_{BE}}{L_{BE}} = \frac{L_{AB}}{L_{AC} L_{BE}} d$$

$$\mu_{\varepsilon_{BE}} = \frac{L_{AB}}{L_{AC} L_{BE}} \mu_d = \frac{2}{(6)(3.5)}(0.012) = 0.00114$$

$$\sigma_{\varepsilon_{BE}} = \sqrt{\left(\frac{L_{AB}}{L_{AC} L_{BE}}\right)^2 \sigma_d^2} = \sqrt{\left(\frac{2}{(6)(3.5)}\right)^2 \left(2 \times 10^{-4}\right)^2} = 1.90 \times 10^{-5}$$

Then

$$\varepsilon_{BE} \sim N\left(0.00114, \left(1.90\times10^{-5}\right)^2\right)$$ **Ans.**