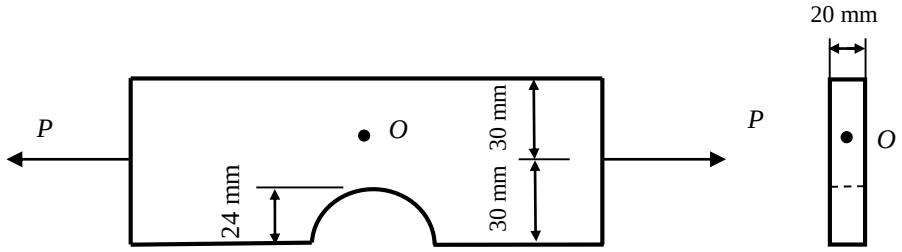
6-5. A mechanical component is subject to a random force $P \sim N(8, 0.5^2)$ kN. There is a circular groove in the component as shown in the figure. Neglect the effect of stress concentration. Determine the distribution of the maximum tensile stress.



Solution:

The distance between *P* and *O* is

$$(0.03) - (0.06 - 0.024)/2 = 0.012\,\text{m}$$

Let *M* denote the moment developed in the component, then

$$\sum M = 0;\quad M - P(0.012) = 0;\quad M = 0.012P$$

The maximum tensile stress is given by

$$S_{max} = \frac{P}{A} + \frac{Mc}{I} = \frac{P}{(0.018\times 2)(0.02)} + \frac{P(0.012)(0.018)}{\left(\frac{1}{12}(0.02)(0.018\times 2)^3\right)} = \left(4.17\times 10^3\right)P$$

Since $P \sim N(8, 0.5^2)$ kN, we have

$$\mu_{S_{max}} = \left(4.17\times 10^3\right)\mu_P = 33.33\,\text{MPa}$$

$$\sigma_{S_{max}} = \left(4.17\times 10^3\right)\sigma_P = 2.08\,\text{MPa}$$

Thus, the maxmium tensile stress follows a normal distribution of $S_{max} \sim N(33.33, 2.08^2)$ MPa.

Ans.