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Mechatronics Engineering

Eng 281 Assignment

The hypotenuse of a right-angle triangle is denoted as 'c' and the other two sides are denoted as 'a' and 'b' $\pm 1.5\%$. Find the maximum possible error in calculating: b) the length of the hypotenuse

Solution.

$$A = \frac{1}{2} a \cdot b = \frac{a \cdot b}{2}$$

$$\frac{\partial A}{\partial a} = \frac{b}{2}, \quad \frac{\partial A}{\partial b} = \frac{a}{2}$$

$$\delta a = \pm \frac{3a}{200}, \quad \delta b = \pm \frac{3b}{200}$$

$$\delta A = \frac{\partial A}{\partial a} \cdot \delta a + \frac{\partial A}{\partial b} \cdot \delta b$$

$$= \frac{b}{2} \left(\pm \frac{3a}{200} \right) + \frac{a}{2} \left(\pm \frac{3b}{200} \right)$$

$$= \pm \frac{a \cdot b}{2} \left[\frac{3}{200} + \frac{3}{200} \right]$$

$$= \pm A \cdot \frac{3}{100}$$

$\therefore \delta A = 3$ percent of A .

$$C = \sqrt{a^2 + b^2} = (a^2 + b^2)^{1/2}$$

$$\frac{\delta C}{\delta a} = \frac{1}{2} (a^2 + b^2)^{-1/2} (2a)$$

$$= \frac{a}{\sqrt{a^2 + b^2}}$$

$$\frac{\delta C}{\delta b} = \frac{1}{2} (a^2 + b^2)^{-1/2} (2b)$$

$$= \frac{b}{\sqrt{a^2 + b^2}}$$

$$\delta a = \frac{\pm 3a}{200}, \quad \delta b = \frac{\pm 3b}{200}$$

$$\delta C = \frac{\delta C}{\delta a} \cdot \delta a + \frac{\delta C}{\delta b} \cdot \delta b$$

$$\delta C = \frac{a}{\sqrt{a^2 + b^2}} \left(\frac{\pm 3a}{200} \right) + \frac{b}{\sqrt{a^2 + b^2}} \left(\frac{\pm 3b}{200} \right)$$

$$= \frac{\pm 3}{200} \cdot \sqrt{a^2 + b^2}$$

$$= \frac{\pm 3}{200} \cdot C$$

$\delta C = 1.5$ percent of C .