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17/ENG03/024

Civil Engineering

ENG 281 - Engineering Mechanics Assignment

Answer

1.
$$\text{Area} = \frac{1}{2} b \times h$$

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

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

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

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

$$\delta a = \frac{\pm 1.5a}{100}$$

$$\delta b = \frac{\pm 1.5b}{100}$$

$$\therefore \delta A = \frac{b}{2} \left(\frac{\pm 1.5a}{100} \right) + \frac{a}{2} \left(\frac{\pm 1.5b}{100} \right)$$

$$\delta A = \frac{ab}{2} \left(\frac{\pm 3}{100} \right)$$

but $\frac{ab}{2} = A$

$$\therefore \delta A = \frac{\pm 3}{100} (A)$$

\therefore Change in area is $\pm 3\%$ when change in a and b is $\pm 1.5\%$

$$b.) \quad h = \sqrt{a^2 + b^2}$$

$$\Delta h = \frac{\partial h}{\partial a} \cdot \Delta a + \frac{\partial h}{\partial b} \cdot \Delta b$$

$$\text{let } h = \sqrt{u}$$

$$\text{where } u = a^2 + b^2$$

$$\frac{\partial u}{\partial a} = 2a$$

$$\frac{\partial u}{\partial b} = 2b$$

$$\frac{\partial h}{\partial u} = \frac{1}{2} u^{-1/2}$$

$$\therefore \frac{\partial h}{\partial a} = \frac{1}{2} u^{-1/2} \times 2a$$

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

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

$$\frac{\partial h}{\partial b} = \frac{1}{2} u^{-1/2} \times 2b$$

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

$$\Delta a = \pm 1.5a$$

$$\Delta b = \pm 1.5b$$

$$\Delta h = \frac{\partial h}{\partial a} \cdot \Delta a$$

$$+ \frac{\partial h}{\partial b} \cdot \Delta b$$

$$= \frac{a}{\sqrt{a^2 + b^2}} \left(\frac{\pm 1.5a}{100} \right) + \frac{b}{\sqrt{a^2 + b^2}} \left(\frac{\pm 1.5b}{100} \right)$$

$$= \frac{\pm 1.5a^2}{100\sqrt{a^2+b^2}} + \frac{\pm 1.5b^2}{100\sqrt{a^2+b^2}}$$

$$= \frac{\pm 3}{100} \left(\frac{a^2+b^2}{\sqrt{a^2+b^2}} \right)$$

$$= \frac{\pm 3}{100} (\sqrt{a^2+b^2})$$

$$\text{but } h = \sqrt{a^2+b^2}$$

$$\therefore \delta h = \frac{\pm 3}{100} (h)$$

\therefore Change in h is $\pm 3\%$ when there is a change of $\pm 1.5\%$ in the "a" and "b"