

KUNDE SHARDN SEPINDEN

7/ENG03/032

CIVIL ENGINEERING

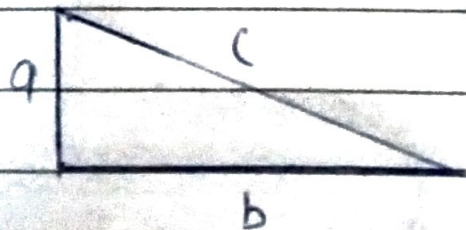
ENG 281

### Assignment

The hypotenuse  $c$  of a right angled triangle is denoted as  $c$  and the other ~~as~~ two sides are denoted as  $a$  &  $b$  if the possible error of measuring each of  $a$  and  $b$  is  $\pm 1.5\%$ , find the maximum possible error in calculating

- The area of the triangle.
- The length of the hypotenuse.

Solution



$$\text{Area of triangle} = \frac{1}{2}ab$$

$$\Rightarrow A = \frac{1}{2}ab$$

$$\text{Let } A = (a, b)$$

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

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

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

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

$$= \frac{ab}{2} \left( \pm \frac{1.5}{100} \right) + \frac{ab}{2} \left( \pm \frac{1.5}{100} \right)$$

$$= \pm \frac{ab}{2} \left( \frac{1.5}{100} \right) + \left( \pm \frac{ab}{2} \right) \left( \frac{1.5}{100} \right)$$

$$= \pm \frac{ab}{2} \left( \frac{1.5}{100} + \frac{1.5}{100} \right)$$

$$= \pm \frac{ab}{2} (0.015 + 0.015)$$

$$= \pm \frac{0.03ab}{2}$$

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

$$\Rightarrow \delta A = \pm 0.03A$$

b)  $c^2 = a^2 + b^2$

$$\Rightarrow c = \sqrt{a^2 + b^2}$$

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

let  $c = f(a, b)$

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

$$\frac{\partial c}{\partial a}$$



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

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

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

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

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

$$= \frac{1}{\sqrt{a^2 + b^2}} \left( \frac{\pm 1.5}{100} a^2 \right) + \frac{1}{\sqrt{a^2 + b^2}} \left( \frac{\pm 1.5}{100} b^2 \right)$$

$$= \pm \frac{1}{\sqrt{a^2 + b^2}} (0.015 a^2 + 0.015 b^2)$$

$$= \pm \frac{1}{\sqrt{a^2 + b^2}} \cdot 0.015 (a^2 + b^2)$$

$$= \pm \frac{1}{C} \cdot 0.015 C^2$$

$$= \pm 0.015 C$$