NWABUEZE IFESINACHI
15/ENG05/049
CIVIL ENGINEERING

Q1 The power P, dissipated in a resistor is given as in Equation 1

$$P = \frac{E^2}{R}$$

If E = 200 volts and R = ohms. Find the change in P resulting from a drop of 5 volts in E and an increase of 0.2 ohm.

Soltn:

$P = \frac{E^2}{R}$ $\quad E = 200V \quad R = 80 \text{ Ohms} \quad \Delta E = -5V$

$\partial R = 0.2 \text{ Ohms}$

$$\delta P = \frac{\partial P}{\partial E} \cdot \partial E + \frac{\partial P}{\partial R} \cdot \partial R \quad \text{———} (1)$$

$$\frac{\partial P}{\partial E} = \frac{2E}{R} \quad \text{———} (2)$$

$\partial E = -5V$

$$= \frac{-5}{200} \times 100\%$$

$$= -2.5\% \text{ of } E = \frac{-2.5E}{100}$$

$$\frac{\partial P}{\partial R} = \frac{-E^2}{R^2} \quad \text{———} (3)$$

$\delta R = 0.2$ Ohms $= \frac{0.2}{8} \times 100\% = 2.5\%$ of R

$= \frac{+2.5R}{100}$

$\delta p = \frac{2E}{R}\left(\frac{-2.5E}{100}\right) + \left(\frac{-E^2}{R^2}\right)\left(\frac{+2.5R}{100}\right)$

$\delta p = \frac{E^2}{R}\left(\frac{-2.5 \times 2}{100} - \frac{2.5}{100}\right.$

$\delta p = \frac{E^2}{R}\left(\frac{-5 - 2.5}{100}\right) = \frac{E^2}{R}\left(\frac{-7.5}{100}\right)$

But $P = \frac{E^2}{R}$

$\delta p = \frac{-7.5P}{100}$

Since $E = 200$ volts, $R = 8$ Ohms

$\therefore$ The actual change in P with respect to 5 volt in E and increase of 0.2 Ohms in R is:

$\delta p = \frac{-7.5p}{100} = \frac{-7.5}{100} \times \frac{E^2}{R}$

$\delta p = \frac{-7.5p}{100} \times \frac{200^2}{8} = -375$ watts

$= -375$ watts

$\therefore$ There was a decrease in the power dissipated.

2. The deflection y of the centre of a circular plate suspended at the edge and uniformly loaded is given in equation

$$y = \frac{kwd^4}{t^3} \quad \text{--- (2)}$$

Soltn:

Recall;

$$\partial y = \frac{\partial y}{\partial w}\cdot\partial w + \frac{\partial y}{\partial d}\cdot\partial d + \frac{\partial y}{\partial t}\cdot\partial t \quad \text{--- (3)}$$

$$\frac{\partial y}{\partial w} = \frac{kd^4(1)}{t^3} = \frac{kd^4}{t^3} \quad \text{--- (4)}$$

$$\partial w = \frac{+3}{100} \times w = \frac{+3w}{100} \quad \text{--- (5)}$$

$$\frac{\partial y}{\partial d} = \frac{4kwd^3}{t^3} \quad \text{--- (6)}$$

$$\partial d = \frac{+2.5}{100} \times d = \frac{+2.5d}{100} \quad \text{--- (7)}$$

$$\frac{\partial y}{\partial d} = \frac{4kwd^3}{t^3}$$

$$\frac{\partial y}{\partial t} = \frac{-3kwd^4}{t^4} \quad \text{--- (8)}$$

$$\partial t = \frac{+4}{100} \times t = \frac{+4t}{100} \quad \dots (9)$$

Substituting eqn 4, 5, 6, 7, 8, 9 into eqn 3

Equation 3 $\Rightarrow$

$$\partial y = \frac{kd^4}{t^3}\left(\frac{+3w}{100}\right) + \frac{4kwd^3}{t^3}\left(\frac{+2.5d}{100}\right) + \left(\frac{-3kwd^4}{t^3}\right)\left(\frac{4t}{100}\right)$$

$$\partial y = \frac{kwd^4}{t^3}\left(\frac{3}{100} + \frac{10}{100} - \frac{12}{100}\right)$$

But $y = \frac{kwd^4}{t^3}$

$$\partial y = y\left(\frac{3+10-12}{100}\right)$$

$$\partial y = y\left(\frac{3-2}{100}\right)$$

$$\partial y = y\left(\frac{1}{100}\right)$$

$$\partial y = \left(\frac{+1}{100}\right) \text{ of } y$$

$\therefore$ There was an approximate percentage increase in the deflection y where w is increased by 3 percent, d is increased by 2.5 percent, and T increased by 4 percent