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16/ENG03/027
Civil Engineering
ENG 281
Assignment 3

1) The power P dissipated in a resistor is given as in Equation (i)

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

If E = 200 volts and R = 8 ohms, find the change in P resulting from a drop of 5 volts in E and an increase of 0.2 ohm in R

Solution

$E = 200V$

$R = 8$ ohms

$\delta E = -5V$

$\delta R = 0.2$

$$\delta P = \frac{\partial P}{\partial E}\delta E + \frac{\partial P}{\partial R}\delta R$$

$$\frac{\partial P}{\partial E} = E^2R^{-1} = 2ER^{-1} = \frac{2E}{R}$$

$$\frac{\partial P}{\partial R} = E^2R^{-1} = -ER^{-2} = \frac{-E^2}{R^2}$$

$$\delta P = \frac{2E}{R}\delta E + -\frac{E^2}{R^2}\delta R$$

$$= \frac{2(200)}{8}(-5) + -\frac{(200)^2}{8^2}(0.2)$$

$$= -250 - 125$$

$$= -375 \text{ watts}$$

2) The deflection y at the centre of a circular plate suspended at the edge and uniformly loaded is given in Equation (2)

$$y = \frac{Kwd^4}{t^3}$$

where w = total load, d = diameter of plate, t = thickness and K is a constant.

Calculate the approximate ~~Solution~~ percentage change in y if w is increased by 3 percent, d is increased by 2½ per cent and t is increased by 4 percent.

Solution

$$y = \frac{Kwd^4}{t^3}$$

$$\delta y = \frac{\partial y}{\partial w}\delta w + \frac{\partial y}{\partial d}\delta d + \frac{\partial y}{\partial t}\delta t$$

$$\frac{\partial y}{\partial w} = \frac{Kwd^4}{t^3} = Kwd^4t^{-3} = Kd^4t^{-3} = \frac{Kd^4}{t^3}$$

$$\frac{dy}{dy}\frac{\partial y}{\partial d} = \frac{Kwd^3}{t^3} = Kwd^3t^{-3} = 4Kwd^3t^{-3} = \frac{4Kwd^3}{t^3}$$

$$\frac{\partial y}{\partial t} = \frac{Kwd^4}{t^3} = Kwd^4t^{-3} = -3Kwd^4t^{-4} = \frac{-3Kwd^4}{t^4}$$

$$\delta y = \frac{Kd^4}{t^3}\delta w + \frac{4Kwd^3}{t^3}\delta d - \frac{3Kwd^4}{t^4}$$

$$\delta w = \frac{\pm 3}{100} \quad \delta d = \frac{\pm 2.5}{100} \quad \delta t = \frac{\pm 4}{100}$$

$$\delta y = \frac{Kd^4}{t^3}\left[\frac{\pm 3w}{100}\right] + \frac{4Kwd^3}{t^3}\left[\frac{\pm 2.5d}{100}\right] - \frac{3Kwd^4}{t^3}\left[\frac{\pm 4}{100}\right]$$

$$\delta y = \frac{Kwd^4}{t^3}\left[\frac{3}{100} + \frac{10}{100} - \frac{12}{100}\right]$$

$$\delta y = \frac{kwd^4}{t^3}\left[\frac{1}{100}\right]$$

$$\delta y = y\left[\frac{1}{100}\right]$$

$$\delta y = 1\% y$$