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15/ENG03/033
CIVIL ENGINEERING
ENG 381

1) $\frac{d^2y}{d\theta^2} + 4\frac{dy}{d\theta} + 5y = 6\sin\theta$

Convert into a homogenous equation

$\frac{d^2y}{d\theta^2} + 4\frac{dy}{d\theta} + 5y = 0$

$m^2 + 4m + 5 = 0$

$a=1, b=4, c=5$

$m = \frac{-4 \pm \sqrt{4^2 - 4\times1\times5}}{2\times1} = m = \frac{-4 \pm \sqrt{-4}}{2}$

$m = \frac{-4 \pm 2j}{2}$

$m = -2 \pm j$

$C.F = y = e^{-2\theta}(A\cos\theta + B\sin\theta)$

$y = C\cos\theta + D\sin\theta$

$\frac{dy}{d\theta} = -C\sin\theta + D\sin\theta$

$-C\cos\theta - D\sin\theta + 4(-C\sin\theta + D\cos\theta) + 5(C\cos\theta + D\sin\theta) = 6\sin\theta$

$-C\cos\theta - D\sin\theta - 4C\sin\theta + 4D\cos\theta + 5C\cos\theta + 5D\sin\theta = 6\sin\theta$

$-C + 4D + 5C = 0$

$-D + 4C + 5D = 6$

$+4C + 4D = 0$ ——— (1)

$4C + 4D = 6$ ——— (2)

$8D = 6$

$D = 6/8 = 3/4$

Substitute $D = 3/4$ into eqn 2

$-4C + 4(3/4) = 6$

$-4C + 3 = 6$

$-4C = 3$

$C = -3/4$

$y = -3/4\cos\theta + 3/4\sin\theta$

$y = e^{-2\theta}(A\cos\theta + B\sin\theta) - 3/4\sin\theta$

$$y = e^{-2\theta}(A\cos\theta + B\sin\theta) + 3/4(\sin\theta - \cos\theta)$$

at steady state

$$\frac{dy}{dx} = 0 \quad \text{and} \quad \theta = \alpha$$

$$y = e^{-2\theta}(A\cos\theta + B\sin\theta) + 3/4(\sin\theta - \cos\theta)$$

$$\frac{dy}{dx} = (B\cos\theta - A\sin\theta) - 2e^{-2\theta}(A\cos\theta + B\sin\theta) + 3/4(\sin\theta - \cos\theta)$$

$$\frac{dy}{dt} = e^{-2\alpha}(B\cos\alpha - A\sin\alpha) - 2e^{-2\alpha}(A\cos\alpha + B\sin\alpha) + 3/4(\sin\alpha - \cos\alpha)$$

$$\frac{dy}{d\theta} = 3/4(\sin\alpha - \cos\alpha)$$

$$\frac{dy}{d\theta} = 3/4(\sin\theta - \cos\theta)$$

2) $$EI\frac{d^2y}{dx^2} = \frac{w}{2}(L-x)^2$$

$$EI\frac{d^2y}{dx^2} = 0$$

$$EIm^2 = 0$$

$$m^2 = 0 = m = \pm\sqrt{0} = 0$$

$$m_1 = m_2 = 0$$

$$y = e^{\alpha x}(A + Bx)$$

$$CF \div y = A + Bx$$

$$y = Rx^2 + Sx^3 + Tx^4$$

$$\frac{dy}{dx} = 2Rx + 3Sx^2 + 4Tx^3$$

$$\frac{d^2y}{dx^2} = 2R + 6Sx + 12Tx^2$$

$$EI(2R + 6Sx + 12Tx^2) = w/2(L-x)^2$$

$$2REI + 6SxEI + 12Tx^2EI = w/2(L^2 - 2Lx + x^2)$$

$$4REI + 12SxEI + 24Tx^2EI = wL^2 - 2wLx + wx^2$$

$$24TEI = w$$

$$T = \frac{w}{24EI}$$

$$12SEI = -2wL$$

$$S = \frac{-2wL}{24EI}$$

$$y=\left[\frac{WL^2}{4EI}\right]x^2-\left[\frac{WL}{6EI}\right]x^3+\left[\frac{W}{24EI}\right]x^4$$

$$y=\frac{WL^2x^2}{4EI}-\frac{WLx^3}{6EI}+\frac{Wx^4}{24EI}$$

$$y=\frac{6WL^2x^2-4WLx^3+Wx^4}{24EI}$$

$$y=\frac{6WL^2x^2-4WLx^3+Wx^4}{\cdot 24EI}$$

$$P.I \div y=\frac{W}{24EI}\left[6L^2x^2-4Lx^3+x^4\right]$$

$$y=A+Bx+\frac{W}{24EI}\left[6L^2x^2-4Lx^3+x^4\right]$$

at $x=0$, $y=0$, $\frac{dy}{dx}=0$

$$0=A+B(0)+\frac{W}{24EI}\left[12L^2(0)-12L(0)^2+4(0)^3\right]$$

$$B=0$$

When $A=B=0$

$$y=0+0x+\frac{W}{24EI}\left(6L^2x^2-4Lx^3+x^4\right)$$

$$y=\frac{W}{24EI}\left(6L^2x^2-4x^3+x^4\right)$$

When $x=L$

$$y=\frac{W}{24EI}\left(6L^4-4L^4+L^4\right)$$

$$y=\frac{W}{24EI}\left(3L^4\right)$$

$$y=\frac{WL^4}{8EI}$$