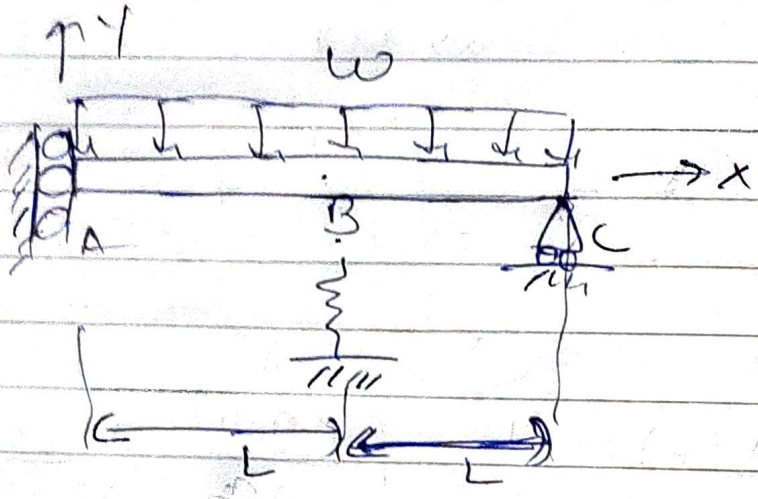
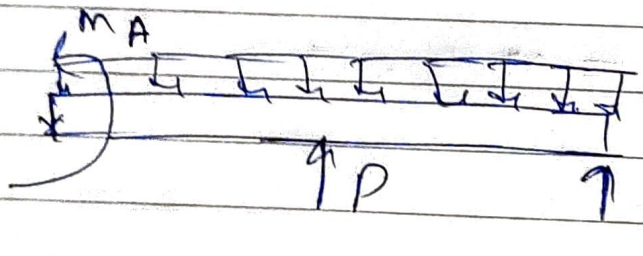
Roll No :- 19NA1008W



When gap is closed



$$R_C + P = w(2L)$$

$$R_C = 2Lw - P$$

$$M_A + PL * R_C(2L) = \int_0^{2L} w x \, dx$$

$$= w \frac{x^2}{2} \Big|_0^{2L}$$

$$= w \times \frac{(2L)^2}{2}$$

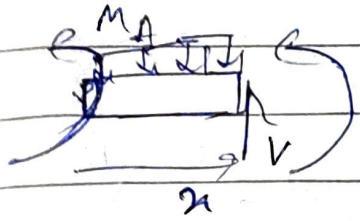
$$M_A + PL + R_C(2L) = 2wL$$

$$M_A + PL + (2wL - P)2L = 2wL$$

$$M_A + PL - 2PL + 4wL^2 = 2wL^2$$

$$M_A = -2wL^2 + PL$$

If $0 < x < L$



$$V = wx$$

$$M_A + Vx + M = \frac{wx^2}{2}$$

$$M = \frac{wx^2}{2} - Vx - M_A$$

$$= \frac{wx^2}{2} - wx^2 + 2wL^2 - PL$$

$$M = -\frac{wx^2}{2} + 2wL^2 - PL$$

$$EIv'' = -\frac{wx^2}{2} + 2wL^2 - PL$$

$$EIv' = -\frac{wx^3}{3\times 2} + \frac{2wL^2x}{2} - \frac{PLx^2}{2} + C_1$$

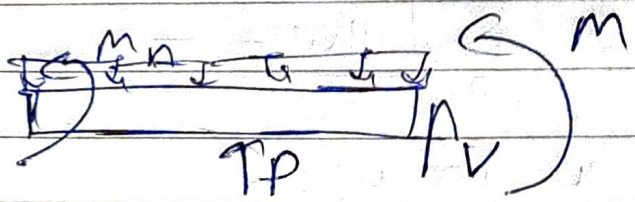
$$EIv = -\frac{wx^4}{2\times 3\times 4} + \frac{2wL^2x^2}{2} - \frac{PLx^3}{2\times 3} + C_1x + C_2$$

$$v'(0) = 0$$

$$C_1 = 0$$

$$EIv = \frac{+wx^4}{2\times3\times4} + \frac{2w^2L^2x^2}{2} - \frac{PLx^2}{2} + C_2$$

$L < x < 2L$



$$P + V = wx$$
$$V = wx - P$$

$$M_A + \frac{PL}{2} + Vx + M = \frac{wx^2}{2}$$

$$M = \frac{wx^2}{2} - \frac{PL}{2} - Vx - M_A$$

$$M = \frac{wx^2}{2} - \frac{PL}{2} - (wx - P)x$$
$$- \left(-2wL^2 + PL\right)$$

$$M = \frac{wx^2}{2} - \frac{PL}{2} - wx^2 + Px$$
$$+ 2wL^2 - PL$$

$$M = -\frac{wx^2}{2} + 2wL^2 - \frac{3PL}{2} + Px$$

$$EIV'' = \frac{-wx^2}{2} + 2wL^2 - \frac{3}{2}PL + P_4$$

$$EIV' = \frac{-wx^3}{2\times3} + 2wL^2x - \frac{3PLx}{2} + \frac{Px^2}{2} + C_1$$

$$EIV = \frac{-wx^4}{2\times3\times4} + \frac{(2wL^2)x^2}{2} - \left(\frac{3}{2}PL\right)\frac{x^2}{2} + \frac{Px^3}{2\times3} + D_1x + D_2$$

$$V(2L) = 0$$

$$\frac{-w(2L)^4}{2\times3\times4} + \frac{(2wL^2)(2L)^2}{2} - \left(\frac{3}{2}PL\right)\frac{(2L)^2}{2} + \frac{P(2L)^3}{2\times3} + D_1(2L) + D_2 = 0$$

$$\frac{-w\times16L^4}{2\times3\times4} + (wL^2\times4L^2) - \left(\frac{3}{2}PL\right)2L^2 + \frac{P\,8L^3}{2\times3} + D_1(2L) + D_2 = 0$$

$$\frac{-2wL^4}{3} + 4wL^4 - 3PL^3 + \frac{4PL^3}{3} + D_1(2L) + D_2 = 0$$

$$\frac{10}{3}wL^4 - \frac{5}{3}PL^3 + C_1(2L) + C_2 = 0$$

$$C_2 = \frac{5}{3}PL^3 - \frac{10}{3}wL^4 - D_1 2L$$

$$V'(L+) = V'(L-)$$

$$V(L+) = V(L-)$$

$$-\frac{wL^3}{3\times2} + 2wL^3 - PL^2$$

$$= \frac{-wL^3}{2\times3} + 2wL^3$$

$$-\frac{3}{2}PL^2 + \frac{PL^2}{2} + D_1$$

$$-\frac{3}{2}PL^2 + \frac{PL^2}{2} + C_1 = -PL^2$$

$$-PL^2 + D_1 = -PL^2$$

$$D_1 = 0$$

$$D_2 = \frac{5}{3}PL^3 - \frac{10}{3}wL^4$$

$$V(L+) = V(L-)$$

$$\frac{-wL^4}{4\times3\times2} + \frac{2w^2L^2L^2}{2} = \frac{PL^3}{2} + C_2$$

$$= \frac{-w(L)^4}{4\times3\times2} + 2w^2L^2\left(\frac{L^2}{2}\right)$$

$$-\left(\frac{3}{2}PL\right)\frac{L^2}{2} + \frac{PL^3}{2\times3} + D_1 + D_2$$

$$-\frac{PL^2}{2} + C_2 = -\frac{3}{4}PL^3 + \frac{PL^3}{2\times3} + D_2$$

$$-\frac{PL^2}{2} + C_2 = \frac{-3}{4}PL^3 + \frac{-PL^3}{6} + \frac{5}{3}PL^3 - \frac{10}{3}wL^4$$

$$C_2 = \frac{-10}{3}wL^4 + PL^3\left(\frac{-3}{4} + \frac{1}{6} + \frac{5}{3} + \frac{1}{2}\right)$$

$$C_2 = \frac{-10}{3}wL^4 + PL^3\left(\frac{1}{6} + \frac{10}{6} + \frac{2}{4} - \frac{3}{4}\right)$$

$$= \frac{-10}{3}wL^4 + PL^3\left(\frac{11}{6} - \frac{1}{4}\right)$$

$$= \frac{-10}{3}wL^4 + PL^3\left(\frac{44-6}{24}\right)$$

$$= \frac{-10}{3}wL^4 + PL^3\left(\frac{38}{24}\right)$$

$$C_2 = \frac{-10}{3}wL^4 + PL^3\left(\frac{19}{12}\right)$$

$-3+1 = -2$

$\frac{-4}{2}$

$$V(L) = \frac{-wL^4}{24 \times 3 \times 4} + \frac{2wL^2x^2}{2} - \frac{PL.L^2}{2} + \left(\frac{-10}{3}wL^4\right) + PL^3\left(\frac{19}{12}\right)$$

$$= wL^4\left(\frac{-1}{24} + 1 - \frac{10}{3}\right) + PL^3\left(\frac{19}{12} - \frac{1}{2}\right)$$

$$V(L) = wL^4\left(\frac{-1}{24} - \frac{7}{3}\right) + PL^3\left(\frac{19-6}{12}\right)$$

$$V(L) = \frac{-57}{24} wL^4 + PL^3\left(\frac{13}{12}\right)$$

By spring

$$P = kx$$

$$P = k[\delta + V(L)]$$

$$P = k\delta - \left(\frac{57}{24} wL^4\right)k + Pk L^3\left(\frac{13}{12}\right)$$

$$P\left(1 - \frac{13kL^3}{12}\right) = k\delta - \left(\frac{57}{24} wL^4\right)k$$

$$P = \frac{k\delta - \frac{57}{24} wL^4 k}{1 - \frac{13kL^3}{12}}$$

So:-

$$ETV = -\frac{wx^4}{4x3x4} + \frac{2w^2L^2x^2}{2} - \frac{PLx^2}{2} + C_2 + \left(\frac{-wx^4}{24x3x4}\right) + \frac{2w^2L^2x^2}{2} - \left(\frac{3}{2}PL\right)\left(\frac{x^2}{2}\right) + \frac{Px^3}{2x3} + P_2$$

$$EIV = -\frac{wx^4}{3\times4} + 2w^2L^2 - \frac{PLx^2}{2} + C_2 - \frac{3}{4}PLx^2 + \frac{Px^3}{6} + D_2$$

$$EIV = \frac{-wx^4}{3\times4} + 2w^2L^2x^2 - \frac{PLx^2}{2} - \frac{10}{3}wL^4 + PL^3\left(\frac{19}{12}\right) - \frac{3}{4}PLx^2 + \frac{Px^3}{6} + \frac{5}{3}PL^3 - \frac{10}{3}wL^4$$

$$EIV = \frac{-wx^4}{3\times4} - \frac{PLx^2}{2} - \frac{3}{4}PLx^2 + \frac{Px^3}{6} + 2w^2L^2x^2 + PL^3\left(\frac{19}{12} + \frac{5}{3}\right) + wL^4\left(-\frac{20}{3}\right)$$

$\frac{2+3}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

$$EIV = \frac{-wx^4}{3\times4} - \frac{5PLx^2}{4} + \frac{Px^3}{6} + 2w^2L^2x^2 + PL^3\left(\frac{39}{12}\right) + wL^4\left(-\frac{20}{3}\right)$$

$\frac{19}{12} + \frac{20}{3}$

$\frac{39}{12}$

here

$$P = \frac{K\delta - \frac{5}{24}wL^4K}{1 - \frac{13}{12}KL^3}$$