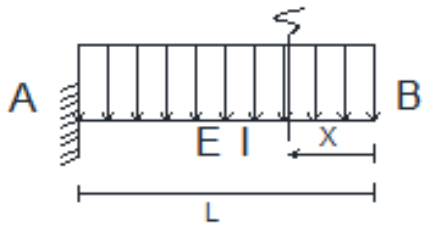
المحاضرة
4

عدد الصفحات
8

كليّة الهندسة
السنة الثالثة
الفصل الأول
الدكتور اليغشي
2/10/2013

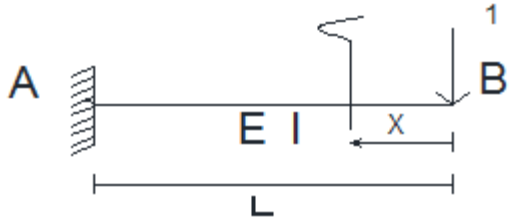
Example:



$y_B = ?$

$M(x) = \frac{-\omega x^2}{2}$

$M_1(x) = -1(x) = -x$



$$y_B = \int \frac{M_0 M_1 dx}{EI}$$

$$y_B = \frac{1}{EI}\int_0^L \left(\frac{-\omega x^2}{2}\right)(-x)dx$$

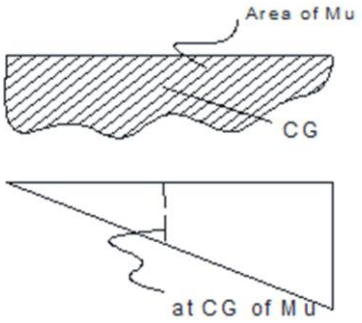
$$y_B == \frac{\omega}{2EI}\int_0^L x^3 dx$$

$$y_B = \frac{\omega L^4}{8EI} (\downarrow)$$

Graphical method for evaluating integral : $\int \frac{M_U . M_L}{EI} dx$

الطريقة التخطيطية من أجل إيجاد التكامل :

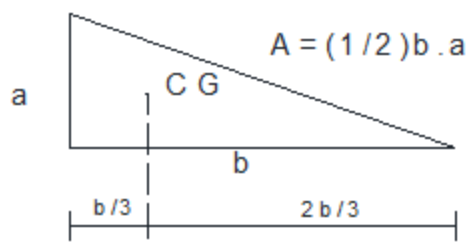
$$\int \frac{M_U . M_L}{EI} dx$$

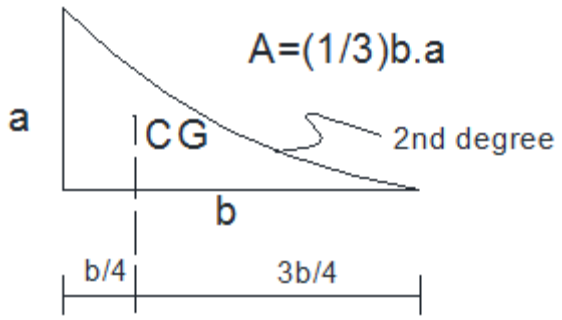


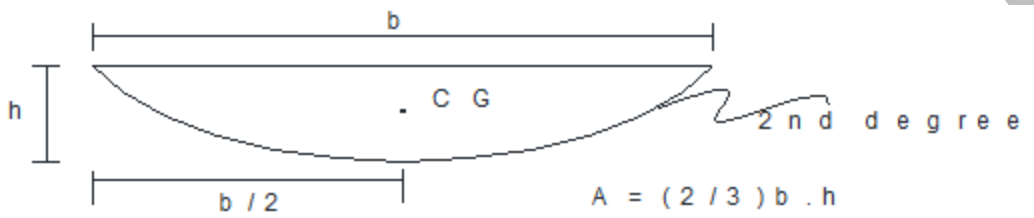
$$\int \frac{M_U . M_L}{EI} dx$$

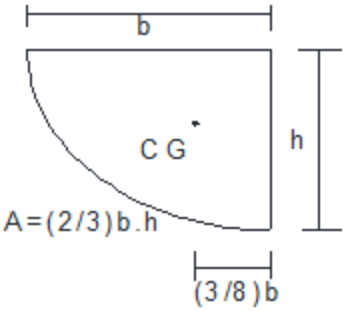
$$= \frac{1}{EI}[(area\ of\ M_U)X(value\ of\ M_L)]$$

Properties of some selected shaps :









condition (اشتراط) :

M_U can be of any shape
M_L linear and straight
or the integral can be divided straight lines in M_L

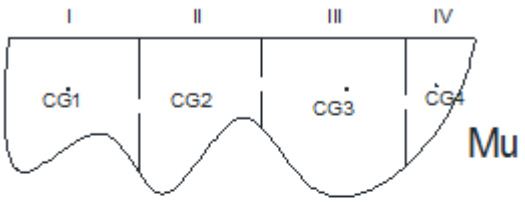
$$\int \frac{M_U M_L}{EI} dx$$

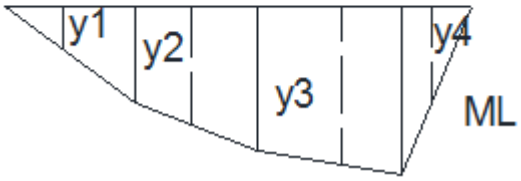
$$= \frac{1}{EI}[A_1 Y_1 + A_2 Y_2 + A_3 Y_3]$$

الترجمة:

M_U : ممكن أن يكون بأي شكل

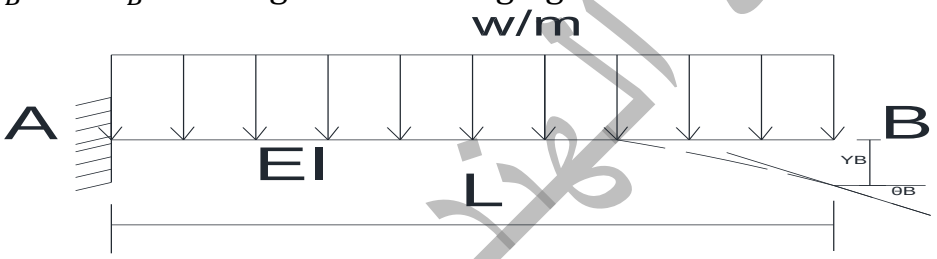
M_L : مستقيم ومستمر أو ممكن أن يتجزأ لأجزاء مستقيمة ومستمرة



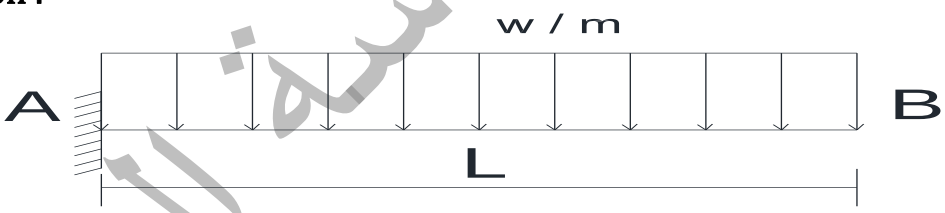


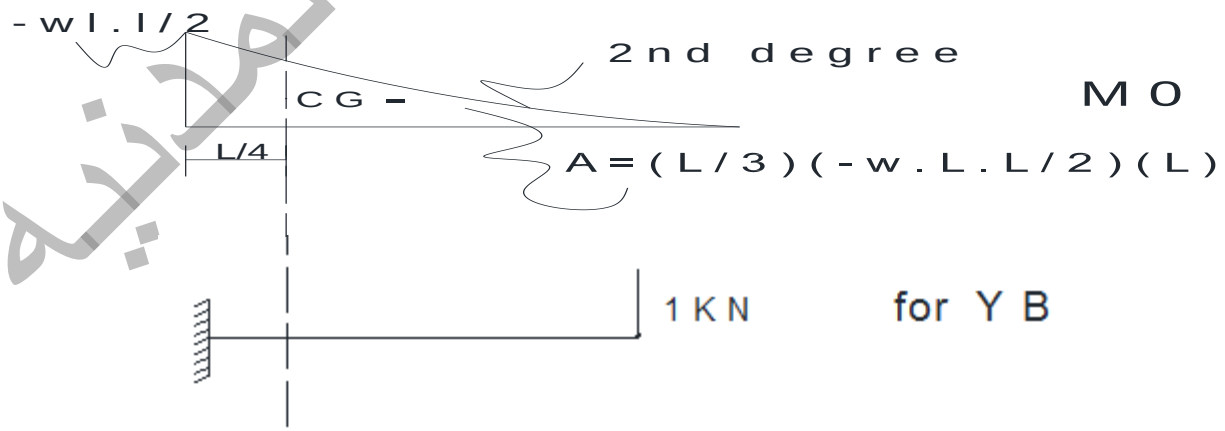
Example :

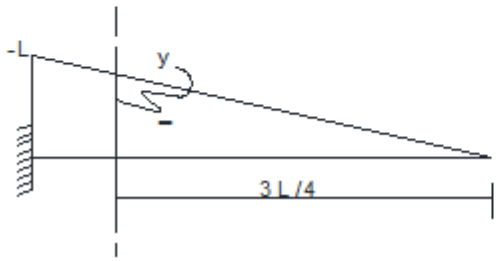
Find y_B *and* θ_B for the given overhanging beam :

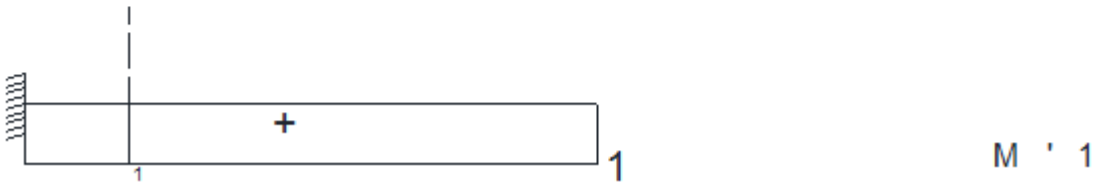


solution :









$$YB = \int \frac{M0M1}{EI} dx$$

$$YB = \frac{1}{EI}[AM0 \times YM1]$$

$$YB = \frac{1}{EI}\left[\left(\frac{-\omega L^3}{6}\right) \times \left(\frac{-3L}{4}\right)\right]$$

$$YB = \frac{1}{EI}\left(\frac{\omega L^4}{8}\right) = +\frac{\omega L^4}{8EI} \quad (\downarrow)$$

$$\theta B = \int \frac{M0M'1}{EI} dx$$

$$\theta B = \frac{1}{EI}\left[\left(\frac{-\omega L^3}{6}\right) \times (1)\right]$$

$$\theta B = \frac{1}{EI}\left[\left(\frac{-\omega L^3}{6}\right) \times (1)\right]$$

$$\theta B = \frac{-\omega L^3}{6EI}$$

$$\theta B = \frac{\omega L^3}{6EI} \quad O$$

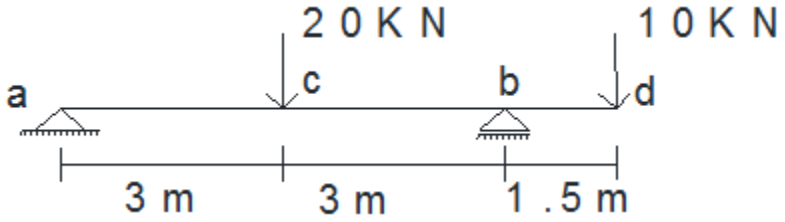
Example :

للمنشأ الظفري المبين بالشكل احسب الانتقالات الأفقية في النقطتين C,D وزاوية الدوران في B

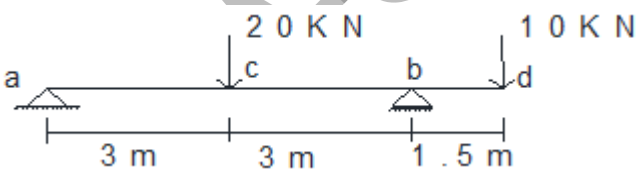
افرض $EI=40000KN.m^2$

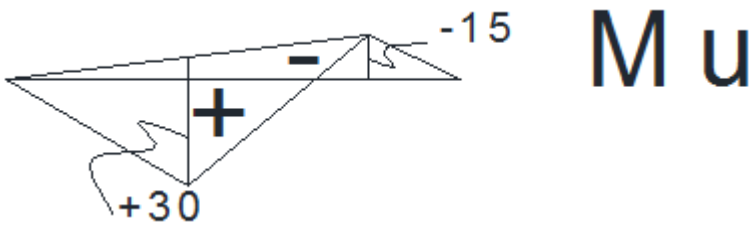
In English :

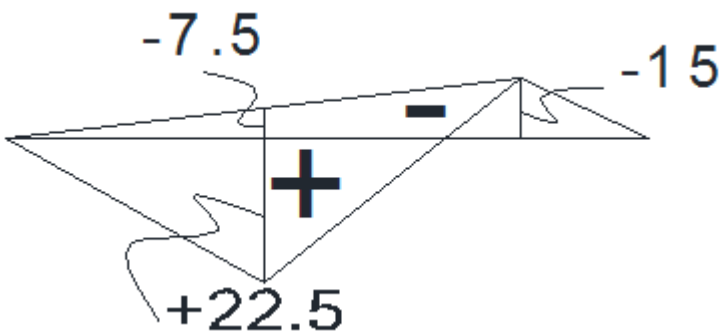
For the shoun overhanging beam calculate the displacement at points C,B and calculate the rotation point B suppose $EI=40000kn.m^2$.

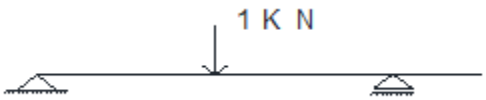


soluation :

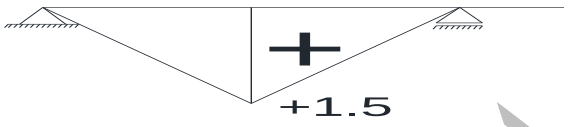






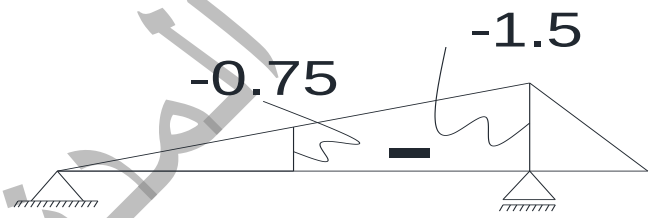


for Y c



M1

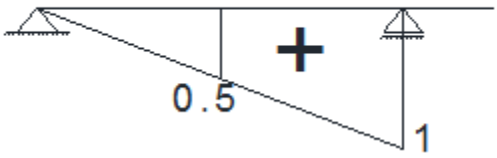
for Yd



M'1

for θ B

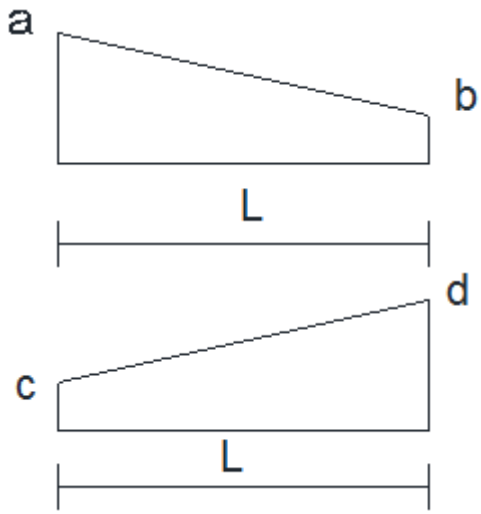
M "1



rule #2 :

$$\int \frac{M_u M_L}{EI} dx$$

$$= \frac{1}{EI}\left\{\left[\frac{ac}{3} + \frac{bd}{3} + \frac{ad}{6} + \frac{bc}{6}\right] \times L\right\}$$



$$Yc = \int \frac{M_0 M_1}{EI} dx$$

$$Yc = \frac{1}{40000}\left\{\left[\frac{(-7.5)(1.5)}{3} \times 3\right] + \left[\frac{(30)(1.5)}{3} \times 3\right] + \left[\frac{(-7.5)(1.5)}{3} \times 3\right] + \left[\frac{(-15)(1.5)}{6} \times 3\right] + \left[\frac{(30)(1.5)}{3} \times 3\right]\right\}$$

$$Yc = 1.4 \times 10^{-3} m = 1.4mm\ (\downarrow)$$

$$Y_D = \int \frac{M_0 M'_1}{EI} dx$$

$$Y_D = \frac{1}{40000}\left\{\left[\frac{(-15)(-1.5)}{3}\times 6\right]+\left[\frac{(30)(-0.75)}{3}\times 3\right]+\left[\frac{(30)(-0.75)}{3}\times 3\right]+\left[\frac{(30)(-1.5)}{6}\times 3\right]+\left[\frac{(-1.5)(1.5)}{3}\times 1.5\right]\right\}$$

$$Y_D = -2.8\times 10^{-4} m = 0.28mm\ (\uparrow)$$

$$\theta B = \int \frac{M_0 M''_1}{EI}\,dx$$

$$\theta B = \frac{1}{40000}\left\{\left[\frac{(-1.5)(1)}{3}\times 6\right]+\left[\frac{(30)(0.5)}{3}\times 3\right]+\left[\frac{(30)(0.5)}{3}\times 3\right]+\left[\frac{(30)(1)}{6}\times 3\right]\right\}$$

$$\theta B = 3.75\times 10^{-4} rad\ (\circlearrowleft)$$