المحاضرة
6

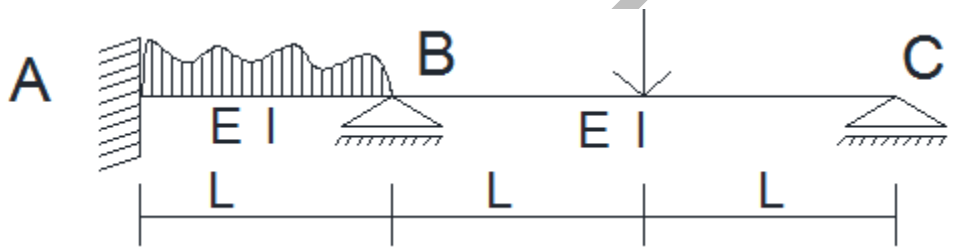
عدد الصفحات
8

كليّة الهندسة
السنة الثالثة
الفصل الأول
الدكتور اليغشي
9/10/2013

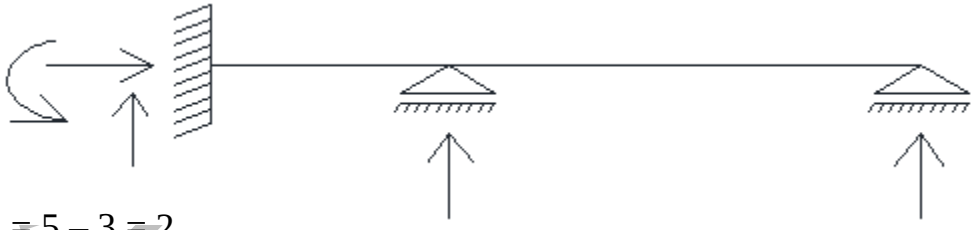
Procedures of the virtual work method for the analysis of indeterminate structure :

استخدام طريقة العمل الوهمي في تحليل المنشآت الغير مقررة :

Given : structure with applied loads

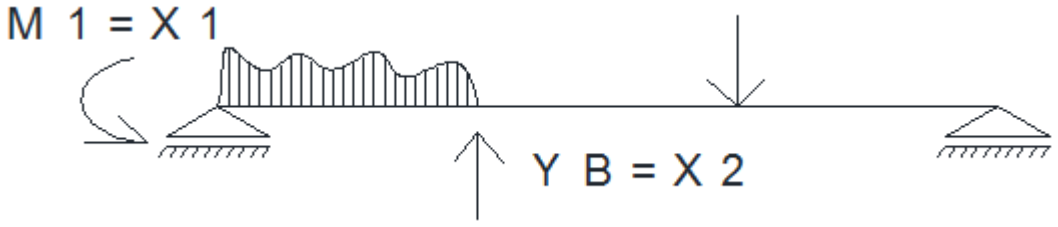


D.S = ? » F.S & redundants

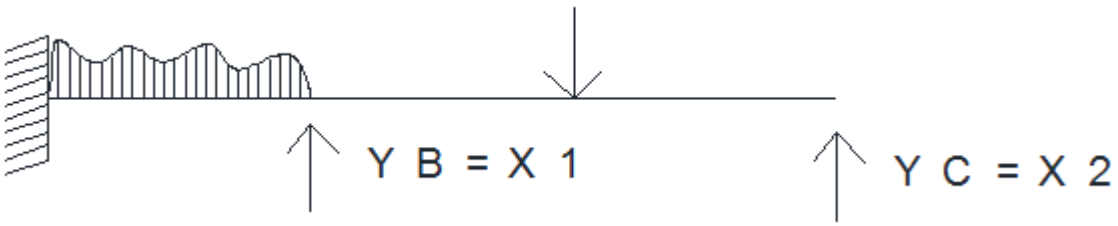


D.S = 5 – 3 = 2

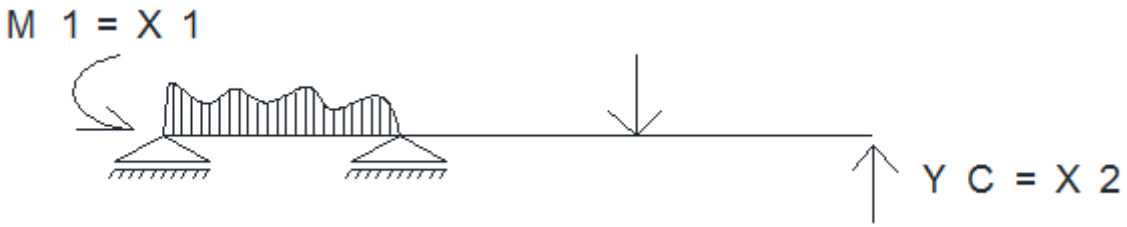
Choice 1 :



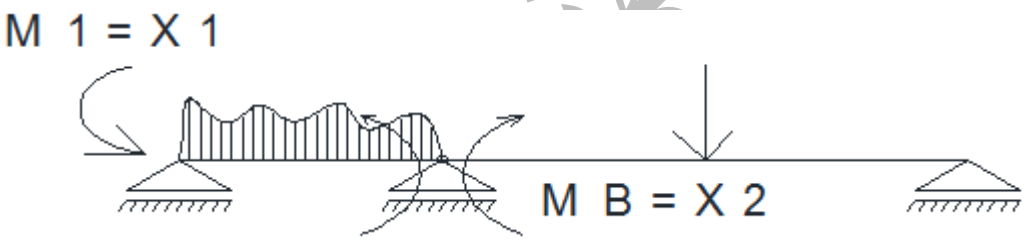
choice 2 :



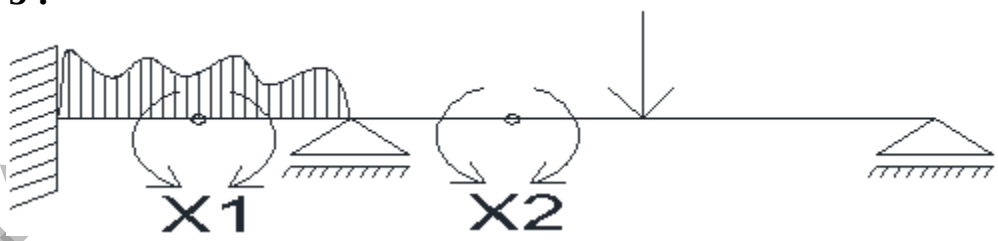
Choice 3 :



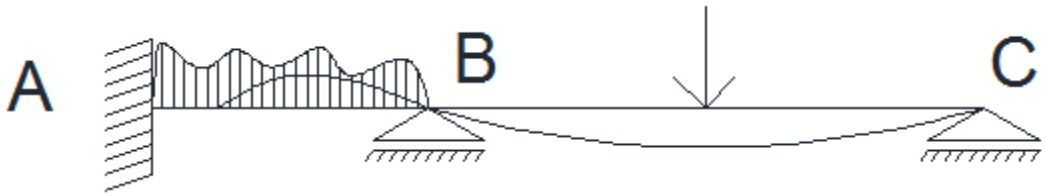
Choice 4 :



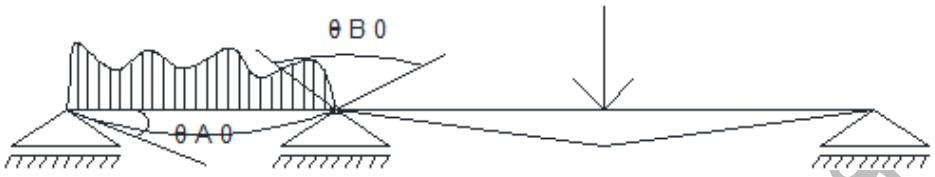
Choice 5 :



تكون الانتقالات على الشكل التالي تقريباً :

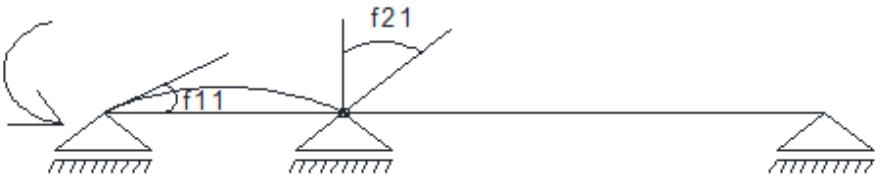


M 1 = X 1

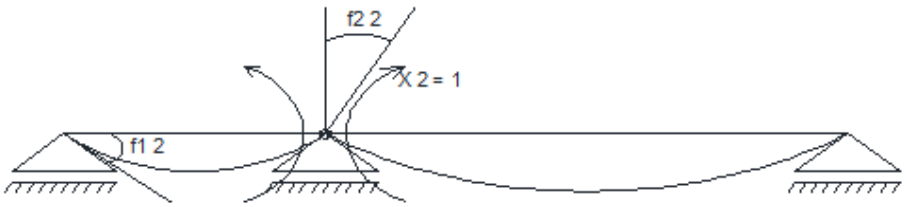


M 0

X 1 = 1



M 1



M 2

$$\partial_{10} = \int \frac{M_0 M_1}{EI} dx$$

$$\partial_{20} = \int \frac{M_0 M_2}{EI} dx$$

$$f_{11} = \int \frac{M_1 M_1}{EI} dx$$

$$f_{21} = \int \frac{M_1 M_2}{EI} dx$$

$$f_{22} = \int \frac{M_2 M_2}{EI} dx$$

$$\theta_A = \delta_{10} + f_{11}.x_1 + f_{12}.x_2 = 0$$

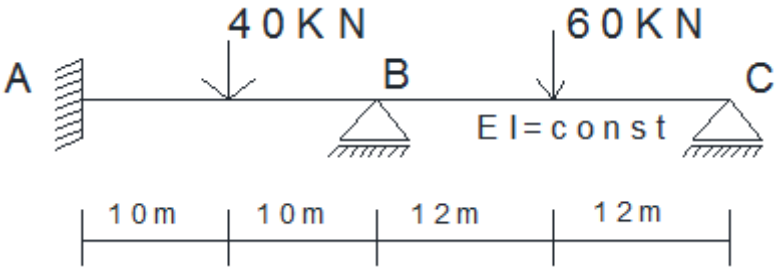
$$\widetilde{\theta_B} = \delta_{20} + f_{21}.x_1 + f_{22}.x_2 = 0$$

Soluation : $x_1 = known \ , \ x_2 = known$

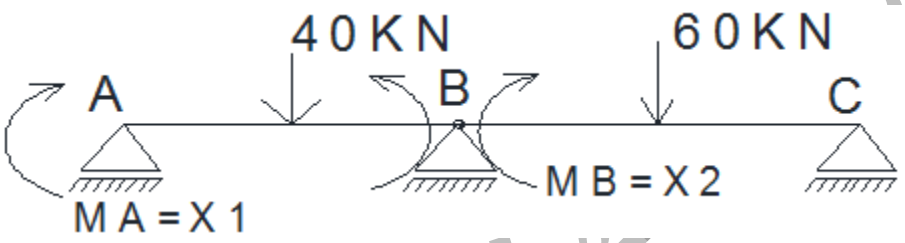
وبعدها نرسم مخطط عزم الانعطاف .

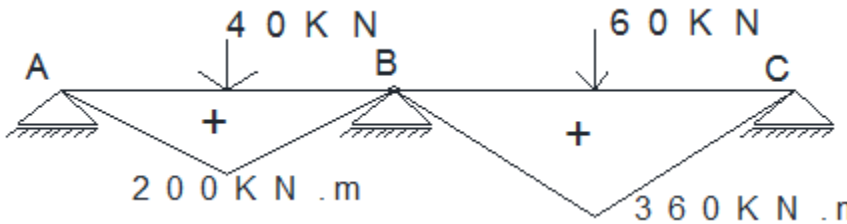
وبوجود المفصل في B نعتبر الجائز جائزين متصلين .

يطلب تحليل المنشأ المبين الخاضع للحمولات الخارجية ورسم مخطط عزم الانعطاف الناتج عن ذلك :

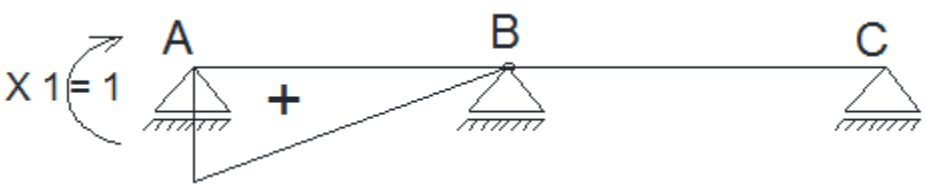


D.S = 5 – 3 = 2

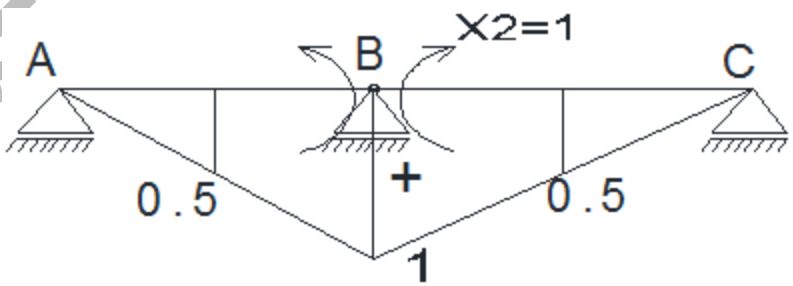




M 0



M 1



M 2

$$\partial_{10} = \int \frac{M_0 M_1}{EI} dx$$

$$\partial_{10} = \frac{1}{EI}\left[\frac{1}{2}(200)(20)(0.5)\right] = \frac{1000}{EI}$$

$$\partial_{20} = \int \frac{M_0 M_2}{EI} dx$$

$$\partial_{20} = \frac{1}{EI}\left\{\left[\frac{1}{2}(200)(20)(0.5)\right] + \left[\frac{360}{2} \times 24 \times 0.5\right]\right\} = \frac{3160}{EI}$$

$$f_{11} = \int \frac{M_1 M_1}{EI} dx$$

$$f_{11} = \frac{1}{EI}\left[\frac{(1)(1)}{3}(20)\right] = \frac{20}{3EI}$$

$$f_{12} = \int \frac{M_1 M_2}{EI} dx$$

$$f_{12} = \frac{1}{EI}\left[\frac{(1)(1)}{6}(20)\right] = \frac{10}{3EI} = f_{21}$$

$$f_{22} = \int \frac{M_2 M_2}{EI} dx$$

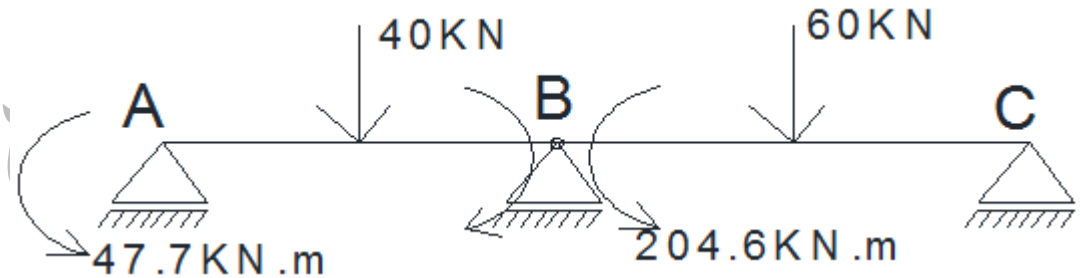
$$f_{22} = \frac{1}{EI}\left[\frac{(1)(1)}{3}(20) + \frac{(1)(1)}{3}(24)\right] = \frac{44}{3EI}$$

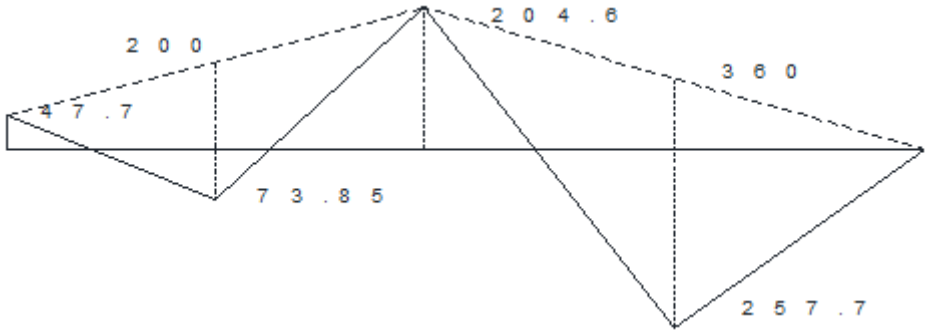
$$\frac{1000}{EI} + \frac{20}{3EI}.x1 + \frac{10}{3EI}.x2 = 0$$

$$\frac{3160}{EI} + \frac{10}{3EI}.x1 + \frac{44}{3EI}.x2 = 0$$

$$\gg x1 = -47.7KN.m$$

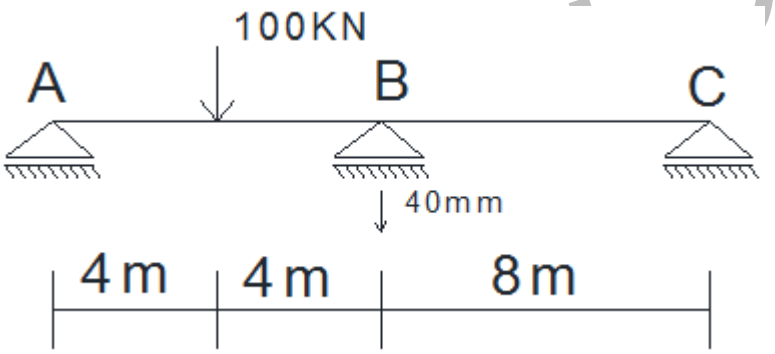
$$\gg x2 = -204.6KN.m$$





يطلب تحليل المنشأ المبين إذا خضع إلى الأحمال المبينة إضافة إلى هبوط المسند B بمقدار

E = 200 GPa , I = 500 × 10^6 mm^4 40mm

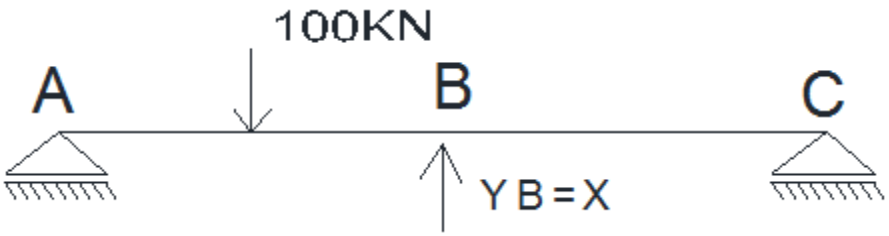


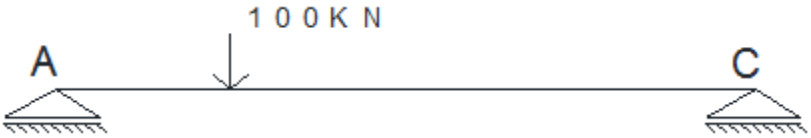
$E = 200\ GPa$

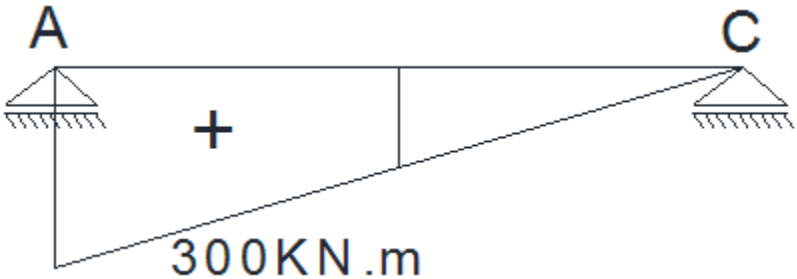
$I = 500 \times 10^6 mm^4$

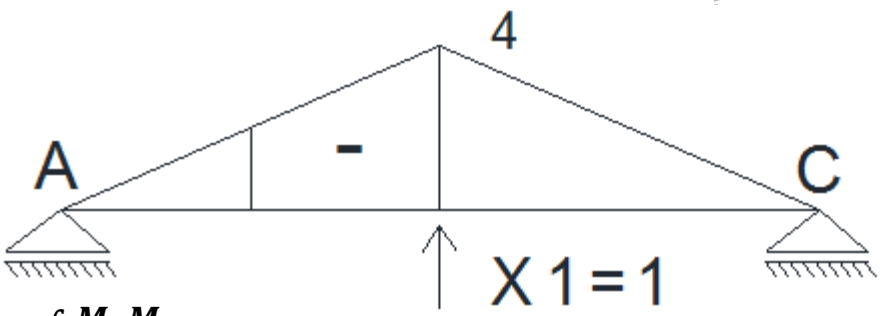
$D.S = 4 - 3 = 1$

في حال وجود هبوط في المسند لا بد من أن يكون رد الفعل الشاقولي الموافق للهبوط أحد المجاهيل الفائضة في الحل .









M1

$$\partial_{10} = \int \frac{M_0 M_1}{EI} dx$$

$$\partial_{10} = \frac{1}{EI}\left\{\frac{(300)(-2)}{3}(4) + \left[\frac{(300)(-2)}{3} + \frac{(200)(-4)}{3} + \frac{(300)(-4)}{6} + \frac{(200)(-2)}{6}\right] \times 4 + \frac{(200)(-4)}{3}(8)\right\}$$

$$\partial_{10} = \frac{-5866.67}{EI}$$

$$f_{11} = \int \frac{M_1 M_1}{EI} dx$$

$$f_{11} = \frac{1}{EI}\left[\frac{(4)(4)}{3}(8) + \frac{(4)(4)}{3}(8)\right] = \frac{85.33}{EI}$$

EI = ?

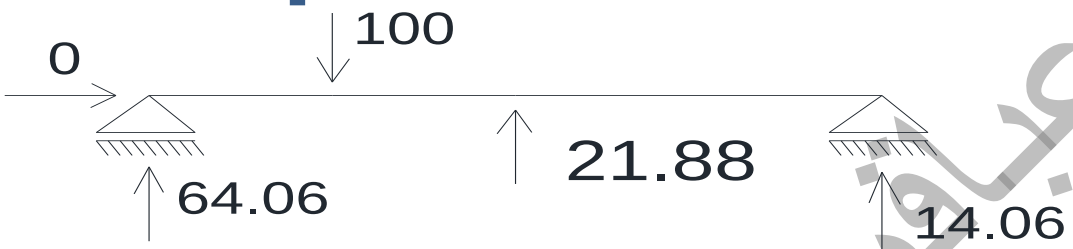
$$E = 200 \times 10^9 \frac{N}{m^2} = 200 \times 10^6 \frac{KN}{m^2}$$

$$EI = 200 \times 10^6 \times 500 \times 10^6 \times 10^{-12} = 100000\ KN.m^2$$

Compatibility equation at B :

$$-0.04 = \frac{-5866.67}{10^5} + \frac{85.33}{10^5}.x1$$

» $x1 = 21.88\ KN$ ↑



B .M .D