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We Build your Life

المحاضرة الثانية

(أ. الطويل)

المشاورات

الدكتور: محمد الفيس

عدد الصفحات: 3

التاريخ: 10/1/2011

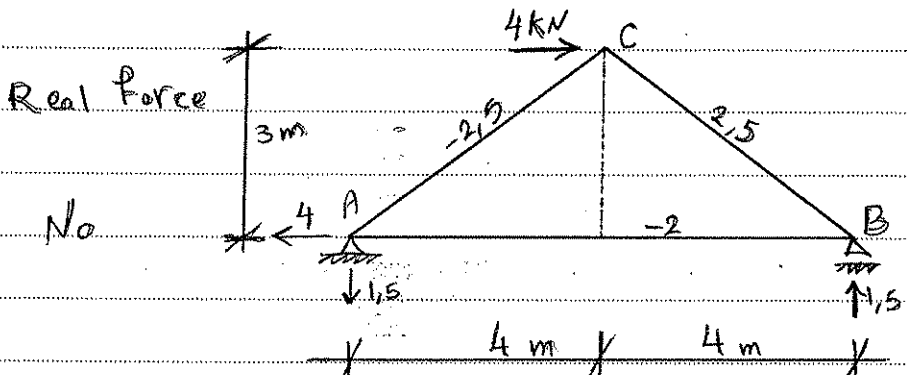
عبارة الهندسة المدنية

Method of virtual work:

$$1. \Delta = \sum \frac{N_0 n l}{EA}$$

1) Determine the vertical displacement of joint c.

$$E = 200 \text{ GPa} = \text{kN/mm}^2, A = 400 \text{ mm}^2$$

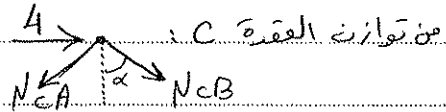


الحل: نكتب القوى المحورية للكل من الأمام عن القوى الخارجية.

$$\sum x_i = 0 \Rightarrow x_A = 4 \text{ kN}$$

$$\sum M_A = 0 \Rightarrow y_B \cdot 8 - 4 \cdot 3 = 0 \Rightarrow y_B = 1.5 \text{ kN}$$

$$\sin \alpha = 0.8, \cos \alpha = 0.6$$



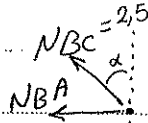
$$\sum y_i = 0 \Rightarrow N_{CB} \cos \alpha + N_{AC} \cos \alpha = 0 \Rightarrow N_{CB} = -N_{AC}$$

$$\sum x_i = 0 \Rightarrow N_{CB} \sin \alpha + 4 - N_{AC} \sin \alpha = 0 \Rightarrow N_{CB} = \frac{2}{\sin \alpha}$$

$$N_{CB} = \frac{2}{0.8} = 2.5 \text{ kN}, N_{AC} = -2.5 \text{ kN}$$



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من توازن العقدة B

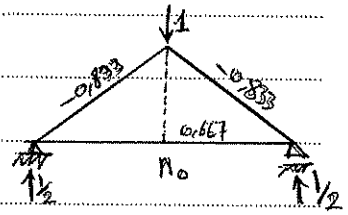
$$\sum \alpha_i = 0 \Rightarrow N_{BC} \sin \alpha + N_{BA} = 0 \quad \uparrow 1,5$$

$$\Rightarrow N_{BA} = -2,5 \cdot 0,8 = -2 \text{ kN}$$

$$1 \delta_c (W) = \frac{\sum N_{0n} L}{EA}$$

$$= \frac{-2,5(-0,833) \cdot 5}{EA} + \frac{-2,5(-0,833) \cdot 5}{EA} + \frac{-2(0,667) \cdot 8}{EA}$$

$$= -1,3 \times 10^{-4} \text{ m} \quad ; EA = 8 \times 10^4 \text{ kN}$$



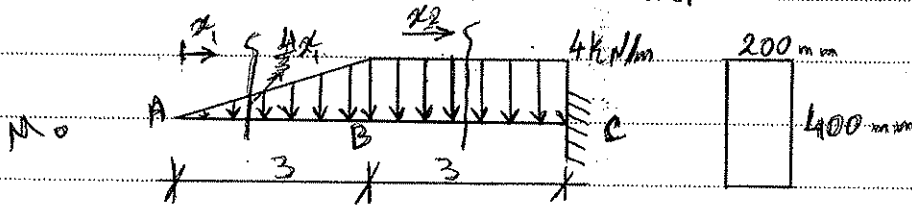
## Beams and Frams :

الأمثلة والتمارين

$$1 \Delta = \int \frac{M_0 M}{EI} dx$$

Example:

Determine the vertical displacement of A

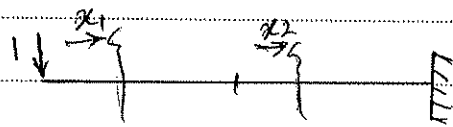


$$1 \delta_A (W) = \int \frac{M_0 m}{EI} dx$$

$$= \frac{1}{EI} \int_0^3 \underbrace{\left( -x \left( \frac{4}{3} x \right) \left( \frac{x_1}{2} \right) \right)}_{m_0} \underbrace{(-x_1)}_M dx_1$$

$$+ \frac{1}{EI} \int_0^3 \left[ \underbrace{\left( \frac{-4,3}{2} \right) (1+x_2)}_{m_0} + \underbrace{(-4x_2) \left( \frac{x_2}{2} \right)}_M \right] \underbrace{[-1(3+x_2)]}_M dx_2$$

$$\delta_A (W) = 1,506 \times 10^{-3} \text{ m}$$



$$I = 0,2 \cdot 0,4^3$$

$$I = 0,667 \times 10^{-4} \text{ m}^4$$

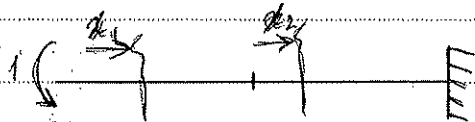
$$E = 200 \text{ GPa}$$

Determine the rotation at A:

$$\theta_A = \int \frac{M_o M}{EI} dx$$

$$\theta_A = \frac{1}{EI} \int_0^3 (-x \cdot \frac{4x}{3} \cdot \frac{1}{2} \cdot \frac{x}{3}) dx + \frac{1}{EI} \int_0^3 \left[ \left( \frac{-4 \cdot 3}{2} \right) (1+x_2) + (-4x_2 \cdot \frac{x_2}{2}) \right] \times [-1(-1)] dx_2$$

$$\Rightarrow \theta_A = 3.169 \times 10^{-4} \text{ rad}$$



Problem:

Determine the vertical displacement of C:  
Neglect axial force and shear in ABC

$$E = 200 \text{ GPa}$$

تحديد انحراف العقول العمودية والزاوية

$$NBD \cos \alpha \cdot (3) - 20(6) = 0$$

$$NBD = 50 \text{ kN}$$

$$NBD = \frac{6}{3 \cos \alpha} = 2.5 \text{ kN}$$

$$\delta_c(v) = \frac{50(2.5)}{EA} (5) + \frac{1}{EI} \int_0^3 (-20x_1)(-x_1) dx_1 + \frac{1}{EI} \int_0^3 \left[ (-20)(3+x_2) + NBD \cos \alpha x_2 \right] \cdot \left[ -1(3+x_2) + NBD \cos \alpha x_2 \right] dx_2$$

