Ministry of Higher Education
Giza Higher Institute for Eng. & Tech.
Civil Engineering Department
Course Name: **Theory of Structures (3)**
Course Code : **CIV 301**

Academic Year : **2015-2016**
Semester : **First**
Level : **3rd**
Time : **½ Hours**
Date : **8 / 11 / 2015**
Examiner: ***Dr. M. Abdel-Kader***

Quiz Answer

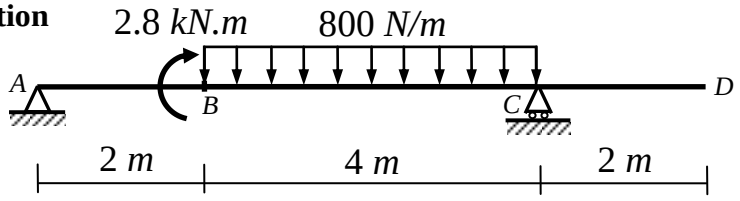
Question (1): (10 Marks)

For the shown beam, using the **double integration method**, determine:

(a) the deflection at *B*
(b) the deflection at *D*
(c) the slope at *D*

and sketch the elastic curve of the beam.

$EI = 0.45\times10^6\ N.m^2$



Solution:

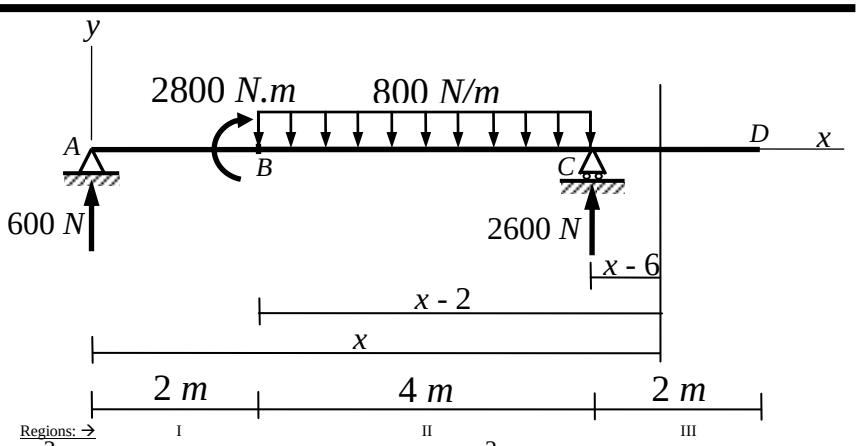
Reactions:

$A_y(6) + 2800 - 800\times4(2) = 0$

$\rightarrow A_y = 600\ N$

$600 + C_y - 800\times4 = 0$

$\rightarrow C_y = 2600\ N$



$$M = 600x_{I} + 2800(x-2)^0 - 800(x-2)^2/2_{II} + 2600(x-6) + 800(x-6)^2/2_{III}$$

$$EI\,y'' = 600x_{I} + 2800(x-2)^0 - 400(x-2)^2_{II} + 2600(x-6) + 400(x-6)^2_{III}$$

$$EI\,y' = 300x^2_{I} + 2800(x-2) - 400(x-2)^3/3_{II} + 1300(x-6)^2 + 400(x-6)^3/3_{III} + C_1$$

$$EI\,y = 100x^3_{I} + 1400(x-2)^2 - 100(x-2)^4/3_{II} + 1300(x-6)^3/3 + 100(x-6)^4/3_{III} + C_1 x + C_2$$

Boundary Conditions:

At $x = 0$, $y = 0 \rightarrow C_2 = 0$

At $x = 6\ m$, $y = 0 \rightarrow 0 = 100(6)^3 + 1400(4)^2 - 100(4)^4/3 + 6C_1 \rightarrow C_1 = -5911.11\ N\cdot m^3$

So, the general equation of the deflection y at any distance x is,

$$EI\,y = 100x^3_{I} + 1400(x-2)^2 - 100(x-2)^4/3_{II} + 1300(x-6)^3/3 + 100(x-6)^4/3_{III} - 5911.11x$$

(a) the deflection at *B* (*x*=2): in Region I:

$EI\,y_B = 100(2)^3 - 5911.11(2) = -11022.22$

$y_B = -11022.22 / 450000 = -0.0245\ m = -24.5\ mm = \boxed{24.5\ mm \downarrow}$

(b) the deflection at *D* (*x*=8): in Region III:

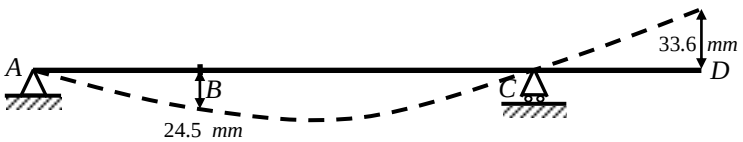
$EI\,y_D = 100(8)^3 + 1400(6)^2 - 100(6)^4/3 + 1300(2)^3/3 + 100(2)^4/3 - 5911.11(8) = +15111.12$

$y_D = -15111.12 / 450000 = -0.03358\ m = +33.6\ mm = \boxed{33.6\ mm \uparrow}$

(c) the slope at *D* (*x*=8): in Region III:

$EI\,y'_D = 300(8)^2 + 2800(6) - 400(6)^3/3 + 1300(2)^2 + 400(2)^3/3 - 5911.11 = +7555.56$

$\theta_D = y'_D = +7555.56 / 450000 = \boxed{+0.0168\ rad = +0.96^o}$ ↻



Elastic curve