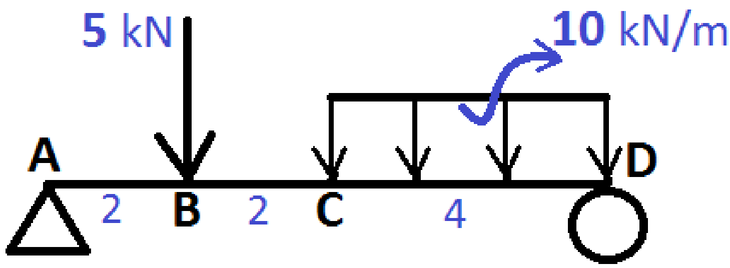
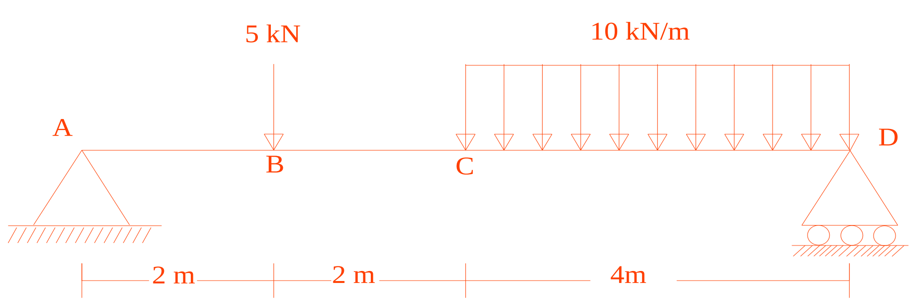
Lecture 4

Q. Find the deflection at C of the following simply-supported beam. Length is in meter. Given:

E= 200 GPa = $200*10^9$ Pa or N/m^2

Inertia, I= $400*10^6$ mm^4





Solution:

The equation we work with is $\Delta = \int \frac{M_0 \, M_1}{EI} dx$,

Where **M_o** = Bending moment distribution due to actual or real loading

M_1 = Bending moment distribution due to virtual or unit loading

E = modulus of elasticity of the material of beam

I = moment of inertia of beam section

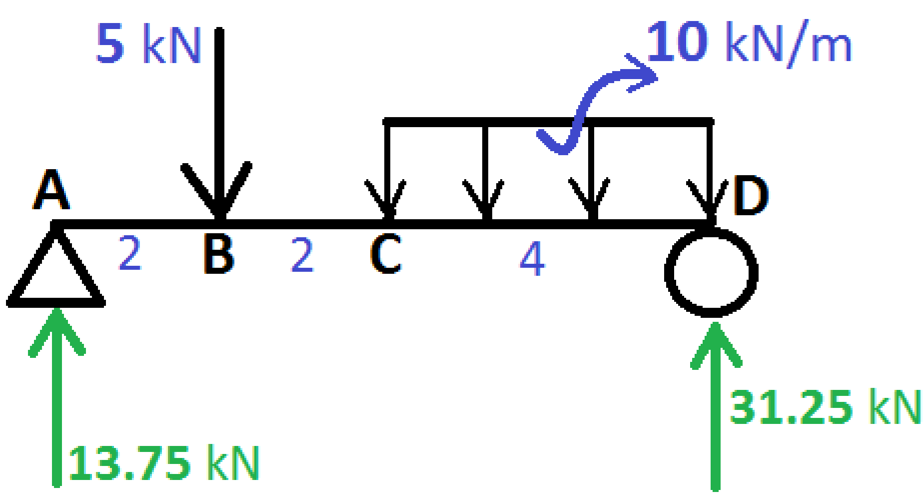
L = beam span

Δ_c = deflection at point C

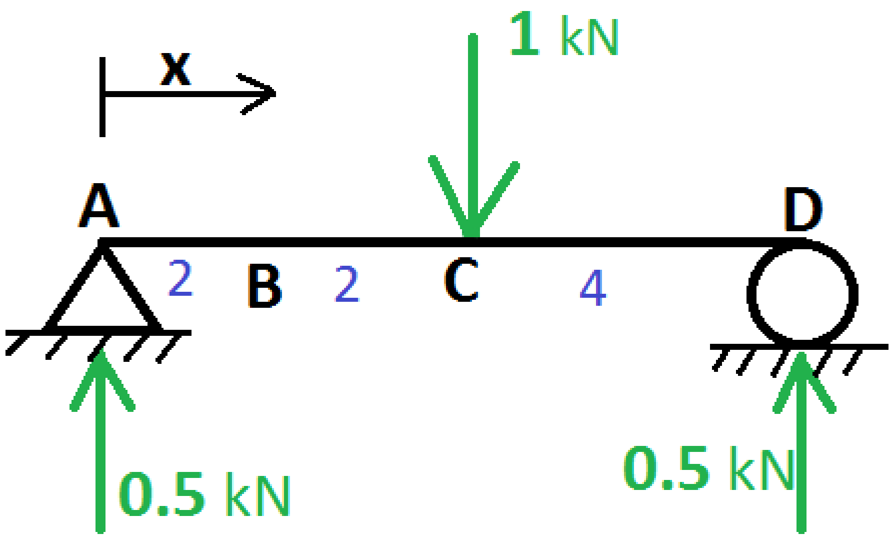
Inertia, I= $400*10^6$ mm^4

= $400*10^6 /(1000)^4$ m^4 = 0.0004 m^4

The diagram for M_0 is-



The diagram for M_1 is-



We know that $\Delta = \int \frac{M_0\, M_1}{EI}\, dx$

Hence,

EI Δ_C = $\int_0^{2\ \mathbf{A \to B}} (13.75x)(.5x)dx + \int_0^{2\ \mathbf{B \to C}} \{13.75(x+2) - 5x\}\{0.5(x+2)\}dx + \int_0^{4\ \mathbf{D \to C}} (31.25x - \frac{10x^2}{2})(0.5x)dx$

EI.Δ_C = $\int_0^{2\ A\to B} \{13.75 * x\}\{.5 * x\}\, dx + \int_0^{2\ B\to C} \{13.75 * (x+2) - 5 * x\}\{.5 * (x+2)\}\, dx$

$+ \int_0^{4\ D\to C} \{(31.25 * x) - 10x^2/2\}\{.5 * x\}\, dx$

= 18.33 + 111.67 + 173.33

= 303.33

$\therefore \boldsymbol{\Delta_c} = \frac{303}{EI}$ kN. m^3 = $\frac{303*1000\ N.m^3}{\left(200*\frac{10^9 N}{m^2}\right)*0.0004m^4} = 0.0038$ m

$= 3.8mm\ (\downarrow)$

Δ_C = 3.8 mm (downward).

Credit: Sama Ahmed

Wakil Ahmed

Edited by: Dr. Latifee, December 9, 2015