[x=0, y=0]

[x=L, y=0]

[x=L, $\frac{dy}{dx}=0$]

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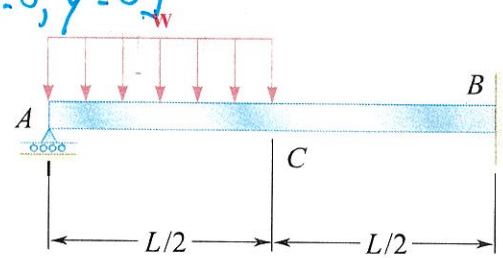
1/3

SUPER POSITION, CHARTS FOR BEAM DEFL.



For the uniform beam shown, determine

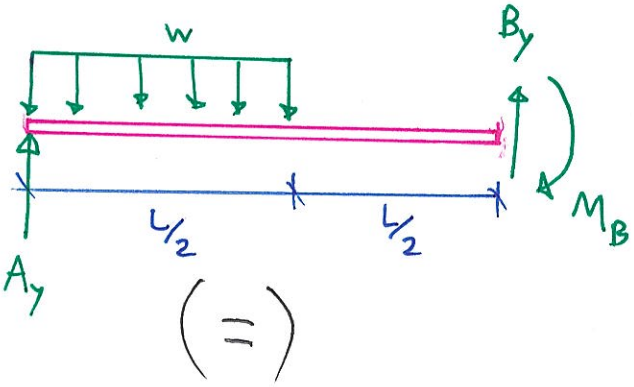
Part 1 out of 3

(*a*) the reaction at A,

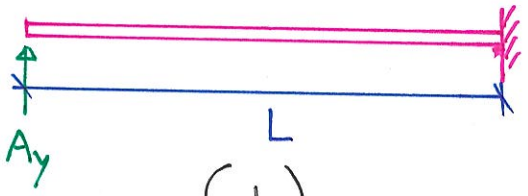
$R_A =$ ☐/☐ wL

- A. ↑
- B. ↓

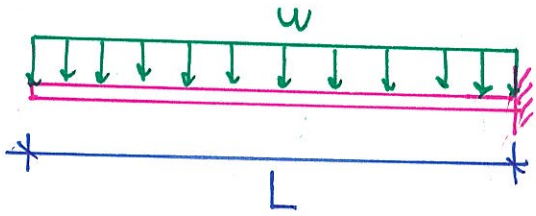
FBD:



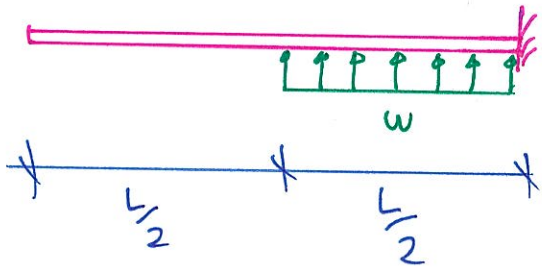
I



II



III



CASE 1:

$$y_A' = \frac{A_y L^3}{3EI}$$

CASE 2:

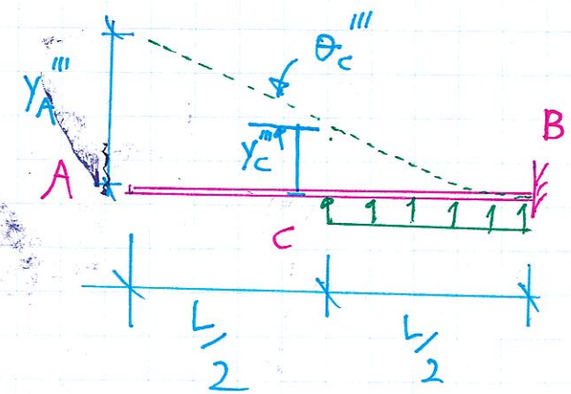
$$y_A'' = \frac{-wL^4}{8EI}$$

CASE 3:

$$y_A''' = y_c''' + \theta_c'''\left(\frac{L}{2}\right)$$

$$y_A''' = \frac{w\left(\frac{L}{2}\right)^4}{8EI} + \frac{w\left(\frac{L}{2}\right)^3}{6EI}\left(\frac{L}{2}\right)$$

$$y_A''' = \frac{7wL^4}{384EI}$$



$$y_A = y_A' + y_A'' + y_A'''$$

$$y_A = \frac{A_y L^3}{3EI} - \frac{wL^4}{8EI} + \frac{7wL^4}{384EI}$$

$$y_A = \frac{A_y L^3}{3EI} - \frac{wL^4}{8EI} + \frac{7wL^4}{384EI}$$

BNDY. COND.

$[x=0,\ y=0]$

$$0 = \frac{A_y L^3}{3EI} - \frac{wL^4}{8EI} + \frac{7wL^4}{384EI}$$

* $A_y = R_A$

$$\boxed{A_y = \frac{41}{128} wL}$$

$B_y \Rightarrow \Sigma F_y = 0$

$M_B \Rightarrow \Sigma M = 0$

Do not round intermediate calculations. Give your final answer(s) to three significant figures.

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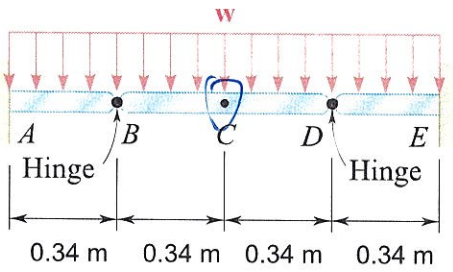
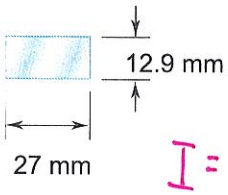




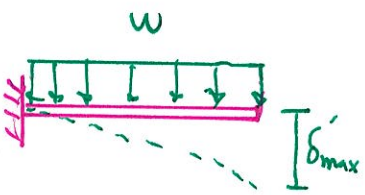
$I = \frac{1}{12}(27\ mm)(12.9\ mm)^3$

$= 4830\ mm^4$

A central beam BD is joined at hinges to two cantilever beams AB and DE. All beams have the cross section shown. For the loading shown, determine the largest w so that the deflection at C does not exceed 2.6 mm. Use $E = 200$ GPa.

$w_{max} =$ [ ] N/m

I

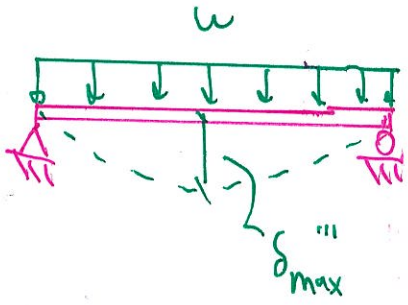


$\delta'_{max} = \frac{-wL^4}{8EI}$

II

$\delta''_{max} = \frac{-PL^3}{3EI} = \frac{-wL^4}{3EI}$

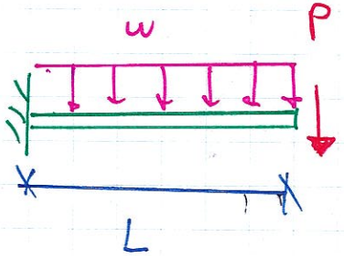
III

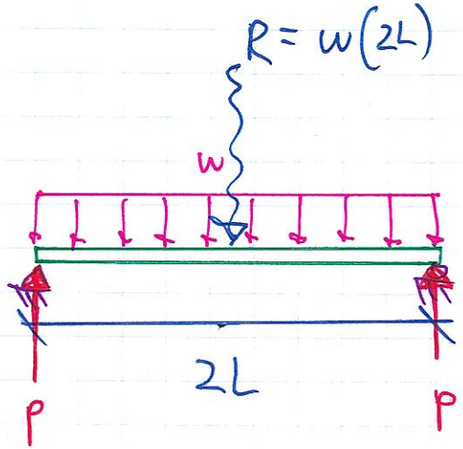


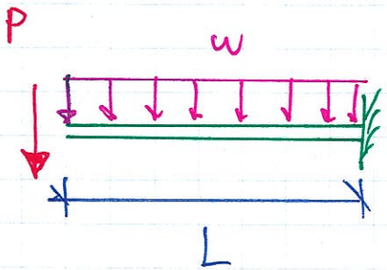
$\delta'''_{max} = \frac{-5wL^4}{384EI}$

$\delta_{max} = \delta'_{max} + \delta''_{max} + \delta'''_{max} = \delta_C$

FBDs

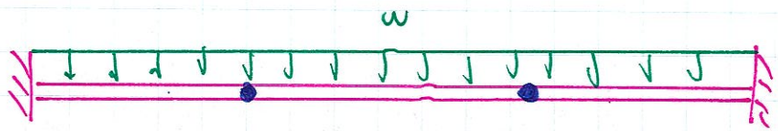




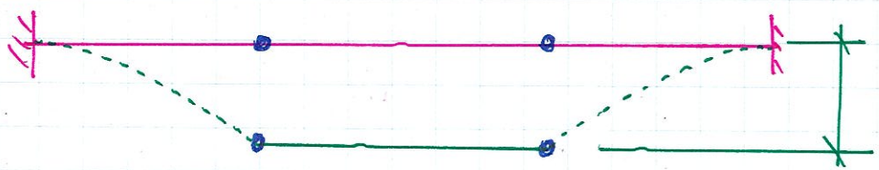


$$+\uparrow \sum F_y = 2P - w(2L) = 0$$

$$P = wL$$



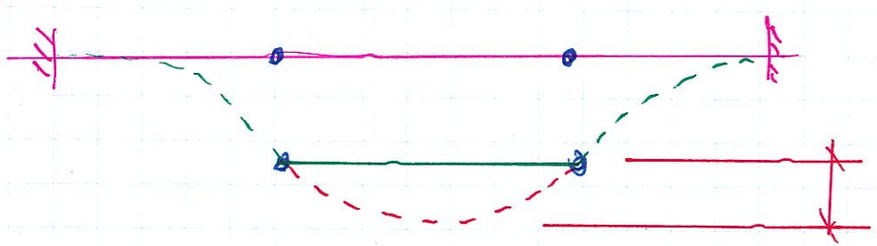
STEP 1: Cant. Bms. Defl.



$\delta = \delta_{max}' + \delta_{max}''$

*Assuming Middle Section Does not Deform (i.e. Rigid)

STEP 2: Middle Defl.



$\delta = \delta_{max}'''$

$$\delta_{max} = \frac{wL^4}{8EI} + \frac{wL^4}{3EI} + \frac{5wL^4}{384EI}$$

$$2.6^{mm} = \frac{\downarrow w}{(200\text{E}3\ MPa)(4830\ mm^4)}\left[\frac{(340^{mm})^4}{8} + \frac{(340^{mm})^4}{3} + \frac{(340^{mm})^4(5)}{384}\right]$$

$$w = 0.3987\ ^{N}/_{mm}$$

$$\boxed{w = 398.7\ ^{N}/_{m}} \rightarrow 400\ ^{N}/_{m}$$