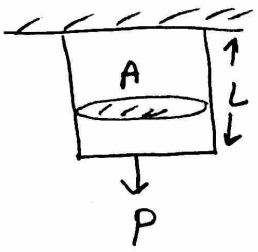
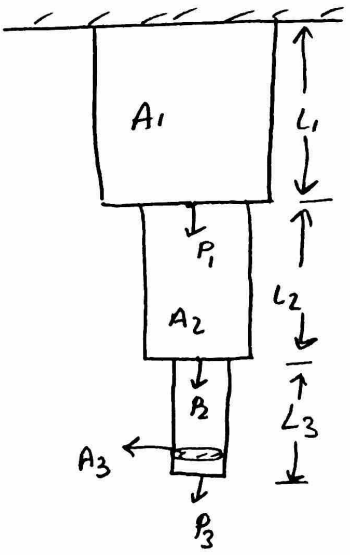
Deflection (δ)

$$\delta = \frac{PL}{AE}$$



In case of multibars (bodies)

$$\delta = \sum_{i=1}^{n} \frac{P_i L_i}{A_i E_i}$$



n = number of sections

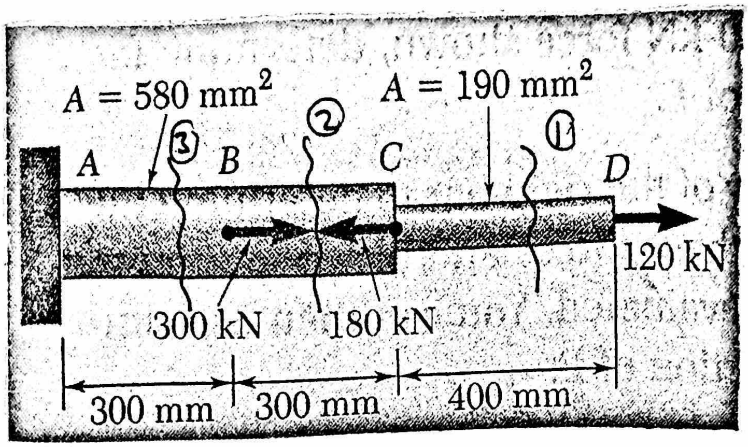
* We take sections in case of the change in

① Area
② Material
③ Load (Force)

Example

$E = 200\ GPa$

Find deflection at point D



Solution

$$\delta_D = \sum_{i=1}^{3} \frac{P_i L_i}{A_i E_i} = \frac{P_1 L_1}{A_1 E_1} + \frac{P_2 L_2}{A_2 E_2} + \frac{P_3 L_3}{A_3 E_3}$$

$$= \frac{1}{E}\left(\frac{P_1 L_1}{A_1} + \frac{P_2 L_2}{A_2} + \frac{P_3 L_3}{A_3}\right)$$

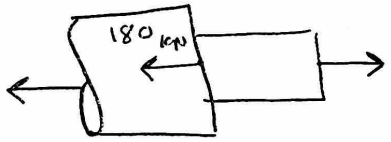
$$\Rightarrow \delta_D = \frac{1}{200\times10^9}\left(\frac{(120)(10^3)(400)(10^{-3})}{190\times10^{-6}} + \frac{(-60)(10^3)(300)(10^{-3})}{580\times10^{-6}} + \frac{(240)(10^3)(300)(10^{-3})}{580\times10^{-6}}\right)$$

$$\Rightarrow \delta_D = 1.729\ mm$$

Section ①

$L_1 = 400\ mm$, $A_1 = 190\ mm^2$

Section ②

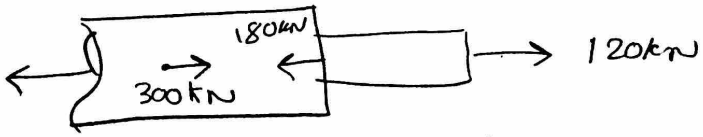


$+\rightarrow \sum F_x = 0 \Rightarrow 120 - 180 - P_2 = 0$

$\Rightarrow P_2 = -60\ kN$

$L_1 = 300\ mm$, $A_1 = 580\ mm^2$

Section ③



$\pm\rightarrow \sum F_x = 0 \Rightarrow 300 + 120 - 180 - P_3 = 0$

$P_3 = 240\ kN$ $L_3 = 300\ mm$ $A = 580\ mm^2$