# Structural Analysis Test 3 Solution



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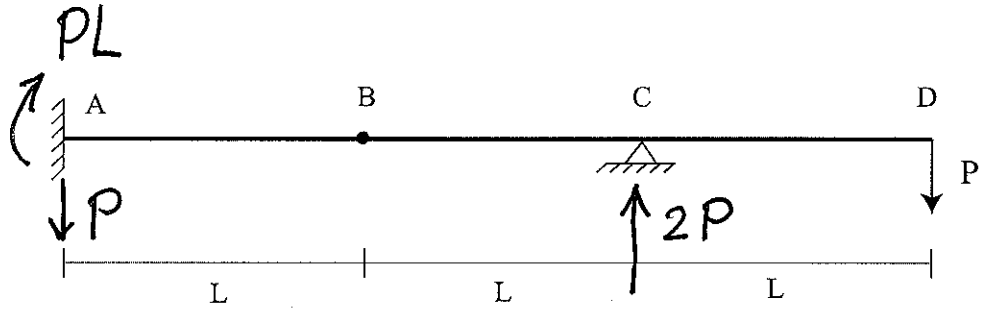
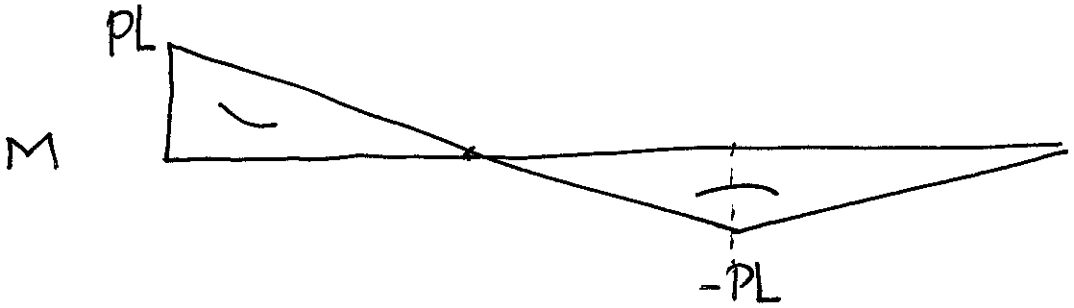
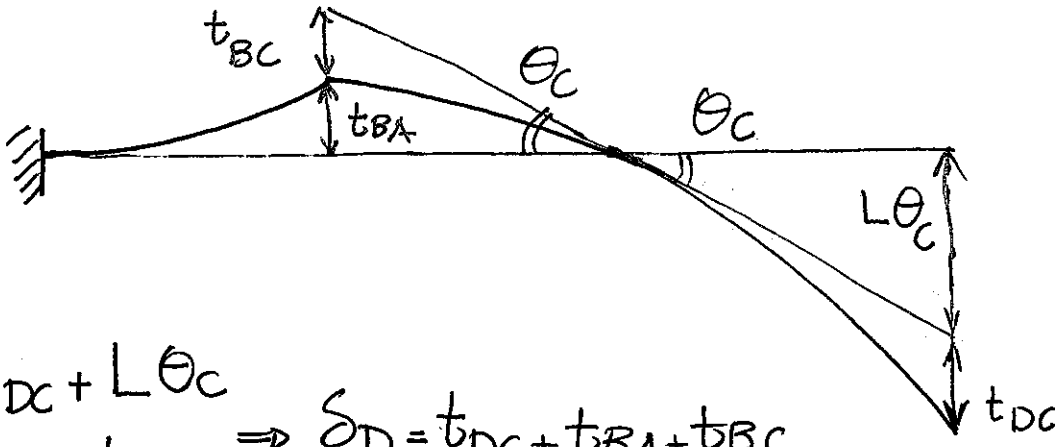
**Problem 1**

Find $\delta_D$. $EI$ is constant.



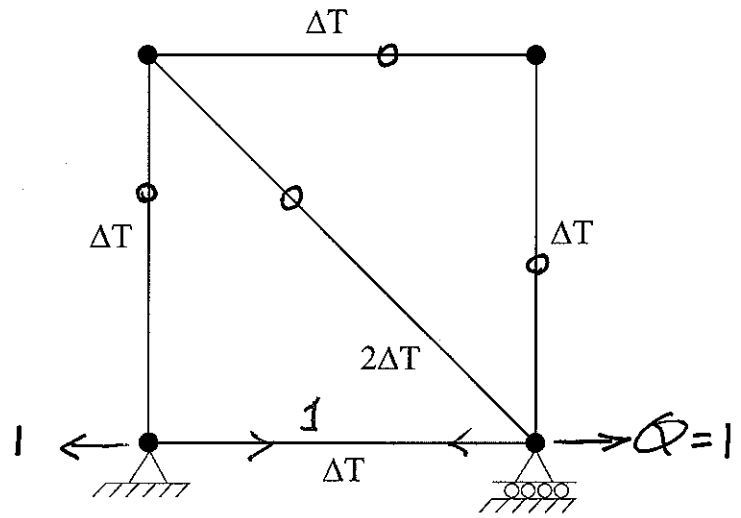




$$\delta_D = t_{DC} + L\theta_C$$
$$L\theta_C = t_{BA} + t_{BC}$$
$$\Rightarrow \delta_D = t_{DC} + t_{BA} + t_{BC}$$
$$= 3\left(\frac{1}{2} L \times PL \times \frac{2}{3} L\right)\frac{1}{EI}$$
$$= \frac{PL^3}{EI}$$

## Problem 2

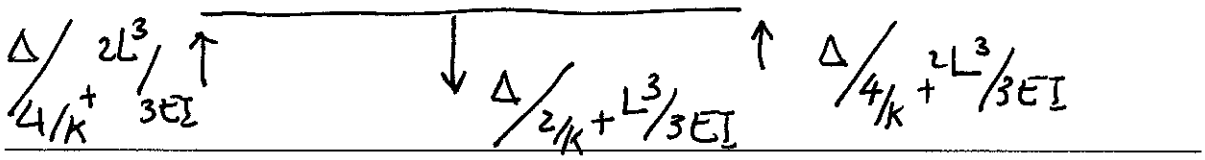
Using the method of virtual work find the displacement of the right support. All members have Young's modulus $E$, cross sectional area $A$ and coefficient of thermal expansion $\alpha$. All horizontal and vertical members have lengths $L$. Change of temperature for each member is shown in the figure.




$$Q\times\delta = 1\times\delta = \delta = \sum F_Q \Delta L_P$$

$$= 1\times(\alpha L\ \Delta T)$$

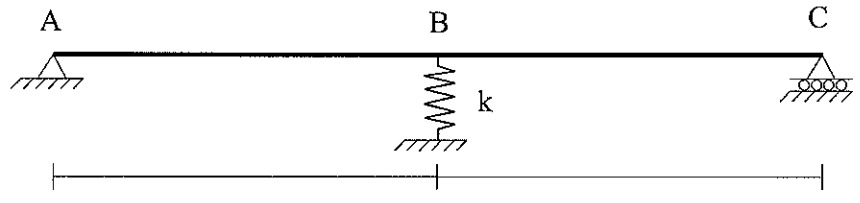
$$\Rightarrow \delta = \alpha L \Delta T$$




**Problem 3**

There is a support settlement (downwards) at $C$ with magnitude $\Delta$. Using flexibility method find all the reactions. $EI$ is constant.

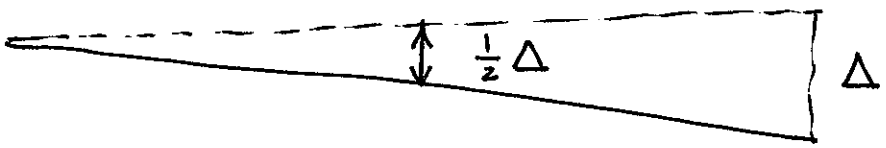
$$\Delta_B = \delta_{B0} + R_B \delta_{BB} \Rightarrow -\frac{1}{2}\Delta = 0 + R_B\left(\frac{1}{k} + \frac{L^3}{6EI}\right) \Rightarrow R_B = -\frac{\Delta}{\frac{2}{k} + \frac{L^3}{3EI}}$$




$R_B$ ← primary unknown

primary structure

$\delta_{B0} = 0$ because there are no external force.




$$\delta_{BB} = \frac{(1)^2}{k} + 2\int_0^L \frac{(-\frac{1}{2}x)^2 dx}{EI} = \frac{1}{k} + \frac{L^3}{6EI}$$