

Chapter 2: Strain

Normal strain

$$\Sigma_{avg} = \frac{\Delta S' - \Delta S}{\Delta S}$$

→ Where $\Delta S'$: The new length
 ΔS : The original length

Unit: mm/mm كل وحدة طول مقدارها
من الـ mm

→ To find the new length:-
 $\Delta S' = \Delta S [1 + \Sigma_{avg}]$

Shear strain γ :-

$$\gamma_{xy@P} = \frac{\pi}{2} - \theta$$

Small strain rules :-

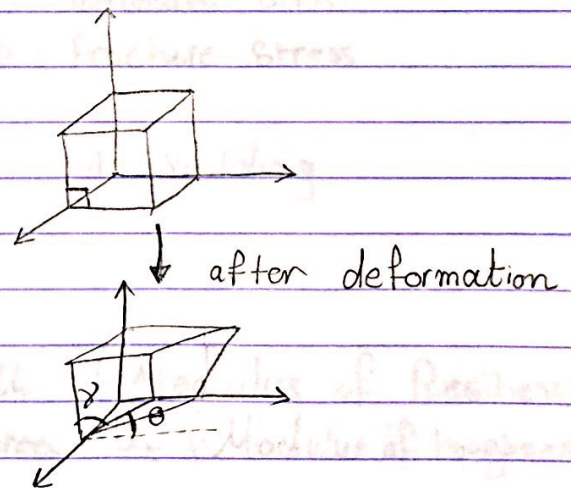
$$(1+\Delta)^n = 1 + n\Delta$$

θ : very small angle

$$\hookrightarrow \sin \Delta\theta = \Delta\theta$$

$$\hookrightarrow \cos \Delta\theta = 1$$

$$\hookrightarrow \tan \Delta\theta = \Delta\theta$$



Examples of chapter two

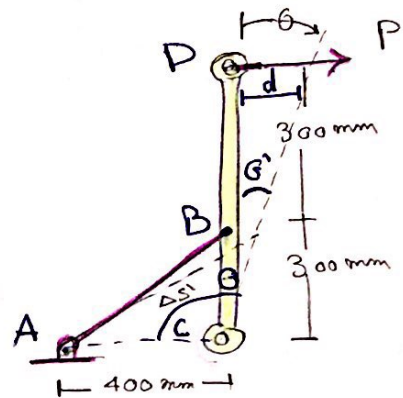
2-9:-

Strain = 0.0035

$$\Delta S' = \Delta S [1 + \Sigma]$$

$$\Delta S' = \sqrt{400^2 + 300^2} [1 + 0.0035]$$

$$\Delta S' = 501.75$$



Using cosine law :-

$$501.75 = \sqrt{(400)^2 + (300)^2 - 2(400)(300) \cos \theta}$$

$$\theta = 90.4185$$

$$\tan \theta' = \frac{d}{300} \Rightarrow d = 4.3827 \text{ mm}$$

$\pi \rightarrow 180$
1.565 \rightarrow

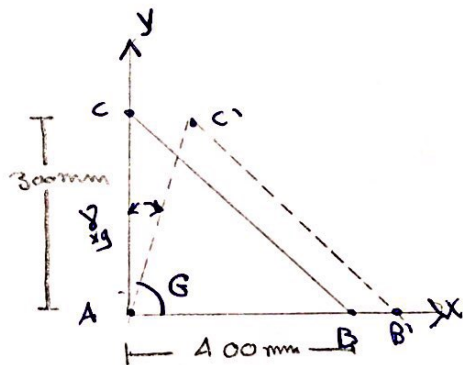
2-16:

$$\Sigma_{AB} = 0.0075$$

$$\Sigma_{AC} = 0.01$$

$$\gamma_{xy} = 0.005$$

$$\Sigma_{BC} = ??$$



$$\Delta AB' = \Delta AB (1 + \Sigma_{AB}) = (400)(1 + 0.0075)$$

$$\Delta AB' = 403$$

$$\Delta AC' = \Delta AC (1 + \Sigma_{AC}) = 300 (1 + 0.01)$$

$$\Delta AC' = 303$$

We need θ :-

$$\gamma_{xy} = \frac{\pi}{2} - \theta$$

$$\theta = 1.565 \text{ rad} =$$

$$BC' = \sqrt{(403)^2 + (303)^2 - 2(403)(303) \cos \theta}$$

$$\Delta BC' = 502.987$$

$$\Sigma_{BC'} = \frac{502.987 - 500}{500} = 0.00597 \text{ mm/mm}$$