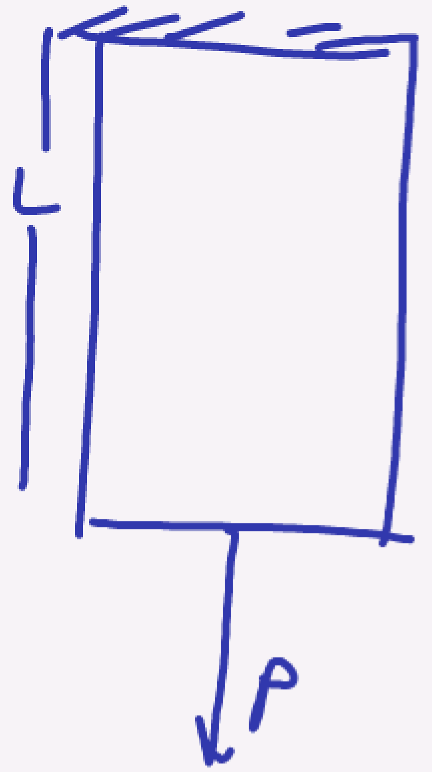
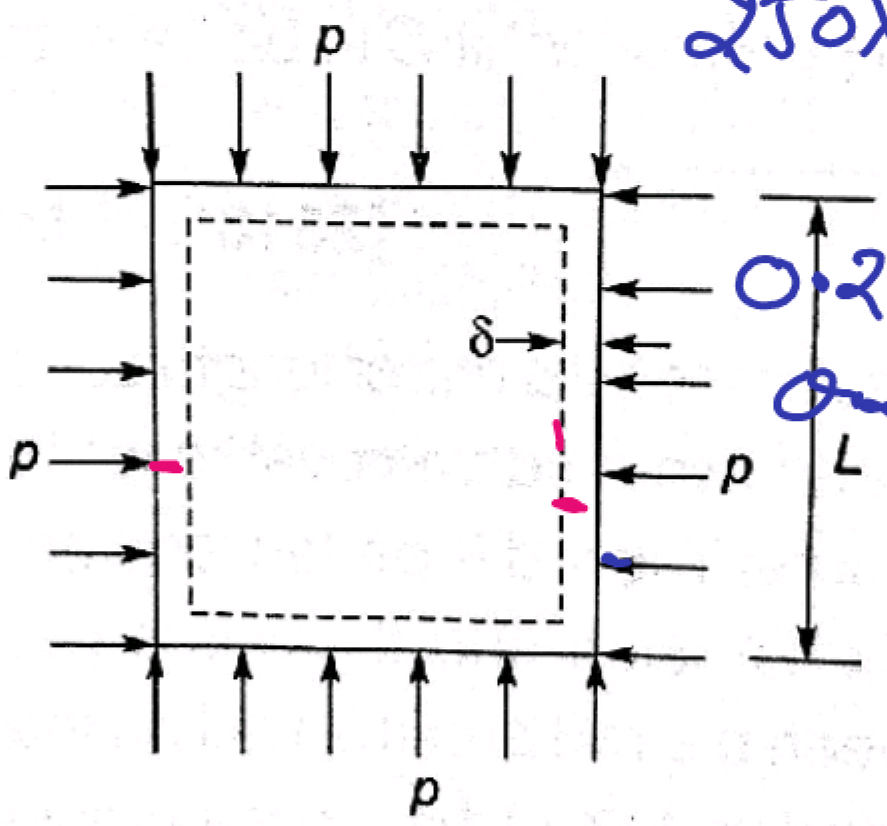
VOLUMETRIC STRAIN

$$\mu = \left| -\frac{\text{lateral strain}}{\text{longitudinal strain}} \right|$$



A square plate of dimension $L \times L$ is subjected to a uniform pressure load $p = 250$ MPa on its edges as shown in the figure. Assume plane stress conditions. The Young's modulus $E = 200$ GPa.

250×10^6 Pa



0.25×10^9 Pa

0.25 GPa

The deformed shape is a square of dimension $L - 2\delta$. If $L = 2$ m and $\delta = 0.001$ m, the Poisson's ratio of the plate material is________

[2016 : 2 Marks, Set-3]

$$\varepsilon_x = \frac{L_F - L_I}{L_I} = \frac{(L-2\delta)-L}{L}$$

$$= \frac{\cancel{L}-2\delta-\cancel{L}}{L} = -\frac{2\delta}{L}$$

$\mu = 0.2$

$$\varepsilon_x = \frac{\sigma_x}{E} - \frac{\mu\sigma_y}{E} - \cancel{\frac{\mu\sigma_z}{E}}\,0$$

$$-\frac{2\delta}{L} = \frac{-0.25}{200} + \frac{\mu(0.25)}{200}$$

$$\boxed{-\frac{2\times 0.001}{2} = \frac{-0.25}{200} + \frac{\mu(0.25)}{200}}$$

The Poisson's ratio for a perfectly incompressible linear elastic material is

(a) 1

(b) 0.5

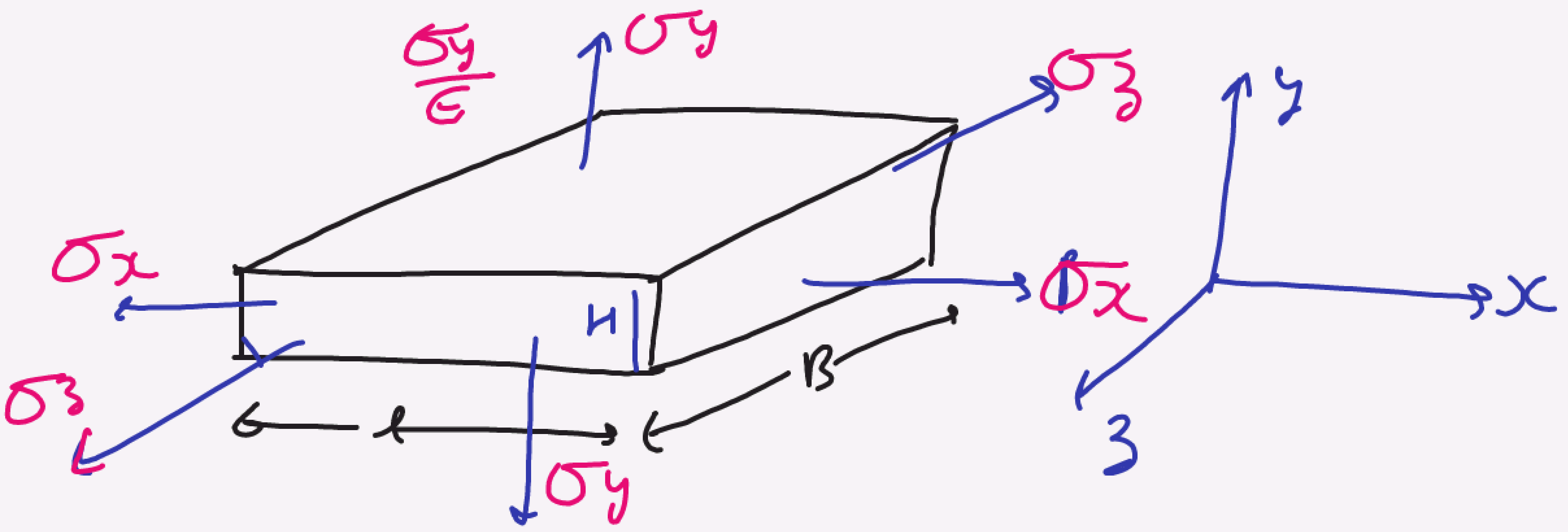
(c) 0

(d) infinity

[2017 : 1 Mark, Set-1]

GATE

$$\epsilon_V = \frac{\sigma_x + \sigma_y + \sigma_z}{E}(1-2\mu)$$



$$\sigma = \varepsilon E$$

$$\varepsilon = \frac{\sigma}{E}$$

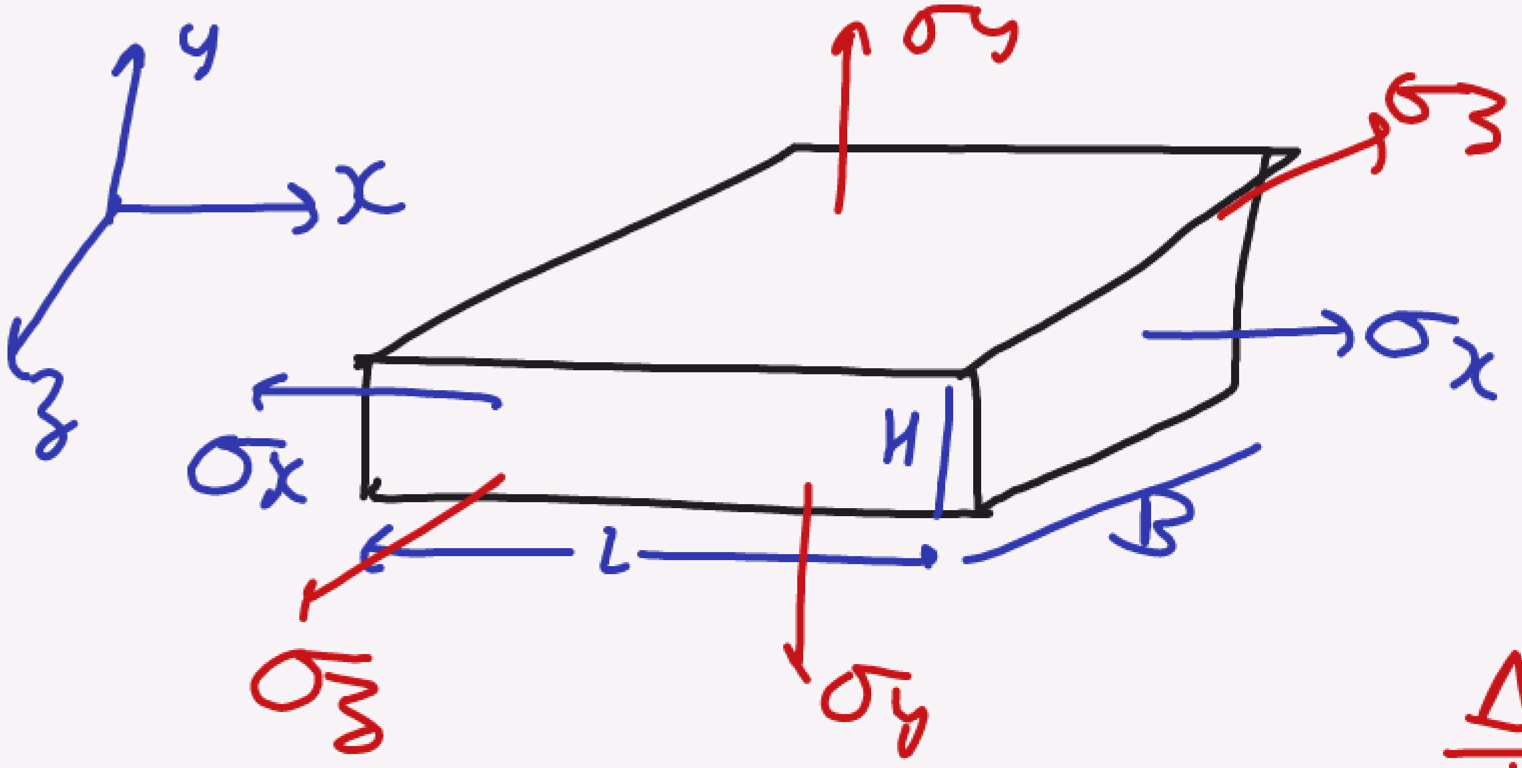
$$\varepsilon_x = \frac{\sigma_x}{E}$$

$$\varepsilon_x = \frac{\sigma_x}{E} - \frac{\mu \sigma_y}{E} - \frac{\mu \sigma_z}{E}$$

$$\varepsilon_y = \frac{\sigma_y}{E} - \frac{\mu \sigma_x}{E} - \frac{\mu \sigma_z}{\sigma}$$

$$\varepsilon_z = \frac{\sigma_z}{E} - \frac{\mu \sigma_x}{E} - \frac{\mu \sigma_y}{\sigma}$$

VOLUMETRIC STRAIN OF A RECTANGULAR BODY



$$V = LBH$$

$$\Delta V = BH(\Delta L) + LH(\Delta B) + LB(\Delta H)$$

$$\frac{\Delta V}{V} = \frac{\cancel{BH}(\Delta L)}{L\cancel{BH}} + \frac{\cancel{LH}(\Delta B)}{\cancel{L}B\cancel{H}} + \frac{\cancel{LB}(\Delta H)}{\cancel{LB}H}$$

$$\varepsilon_V = \varepsilon_L + \varepsilon_B + \varepsilon_H$$

$$\boxed{\varepsilon_V = \varepsilon_x + \varepsilon_z + \varepsilon_y}$$

$$\boxed{\varepsilon_v = \varepsilon_x + \varepsilon_y + \varepsilon_z}$$

$$\varepsilon_x = \frac{\sigma_x}{E} - \frac{\mu\sigma_y}{G} - \frac{\mu\sigma_z}{E}$$

$$\varepsilon_y = \frac{\sigma_y}{E} - \frac{\mu\sigma_x}{E} - \frac{\mu\sigma_z}{E}$$

$$\varepsilon_z = \frac{\sigma_z}{E} - \frac{\mu\sigma_x}{E} - \frac{\mu\sigma_y}{E}$$

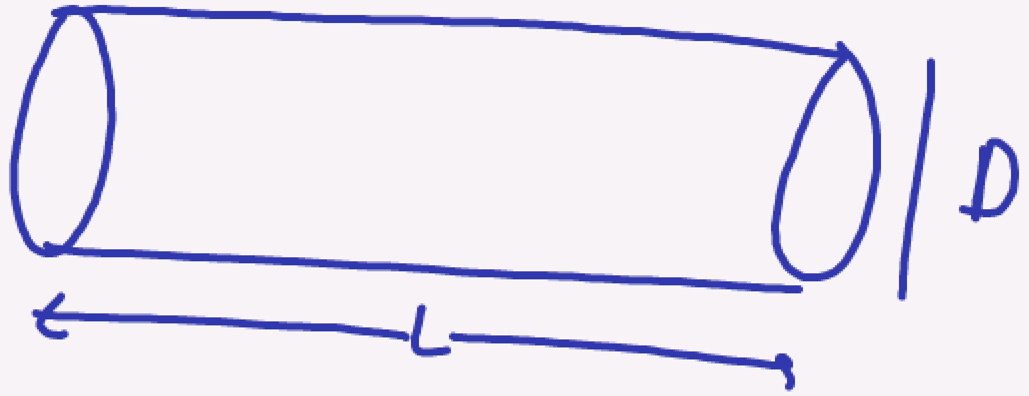
$$\varepsilon_v = \frac{1}{E}(\sigma_x + \sigma_y + \sigma_z) - \frac{2\mu\sigma_x}{E} - \frac{2\mu\sigma_y}{E} - \frac{2\mu\sigma_z}{E}$$

$$\varepsilon_v = \left(\frac{\sigma_x + \sigma_y + \sigma_z}{E}\right) - \frac{2\mu}{E}(\sigma_x + \sigma_y + \sigma_z)$$

$$\boxed{\varepsilon_v = \frac{\sigma_x + \sigma_y + \sigma_z}{E}(1 - 2\mu)} \#$$

CYLINDRICAL BODY :-

$$\boxed{\epsilon_V = \epsilon_l + 2\epsilon_D}$$



$$V = \frac{\pi}{4} D^2 \times L$$

$$\Delta V = \frac{\pi}{4} D^2 \times (\Delta L) + \frac{\pi}{4} \times (L) \times 2D \times (\Delta D)$$

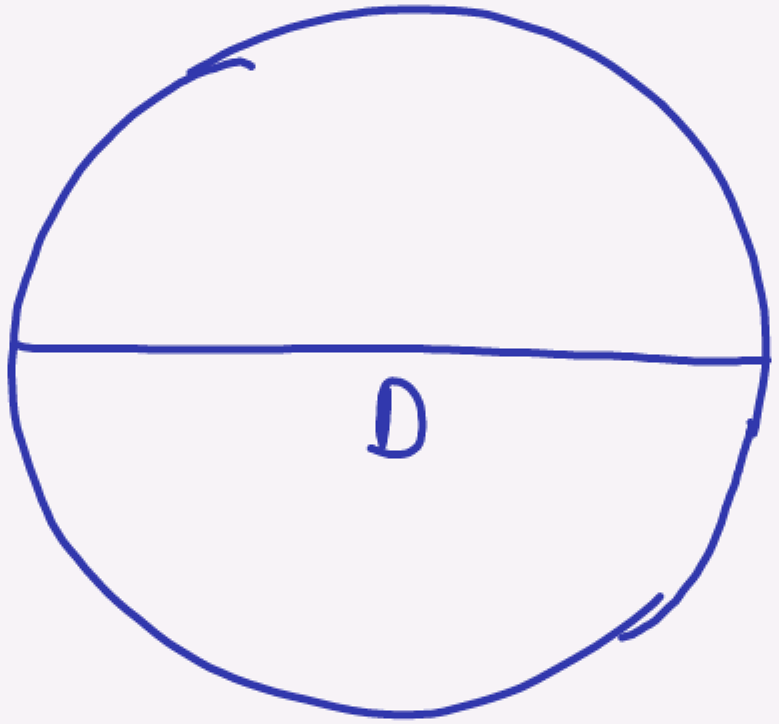
$$\frac{\Delta V}{V} = \frac{\cancel{\frac{\pi}{4}} \cancel{D^2} \times (\Delta L)}{\cancel{\frac{\pi}{4}} \cancel{D^2} \times L} + \frac{\cancel{\frac{\pi}{4}} \times \cancel{L} \times 2 \times \cancel{D} \times \Delta D}{\cancel{\frac{\pi}{4}} \times D^{\cancel{2}} \times \cancel{L}}$$

SPHERICAL BODY :-

$$\boxed{V = \frac{\pi}{6} D^3}$$

$$\Delta V = \frac{\pi}{6} \times 3D^2 \times (\Delta D)$$

$$\frac{\Delta V}{V} = \frac{\cancel{\frac{\pi}{6}} \times 3\cancel{D^2} \times (\Delta D)}{\cancel{\frac{\pi}{6}} \times \cancel{D^3}}$$



$R = D/2$

$$V = \frac{4}{3} \pi R^3$$

$$V = \frac{4}{3} \pi \times \left(\frac{D}{2}\right)^3$$

$$V = \frac{\cancel{4}}{3} \pi \times \frac{D^3}{\cancel{8}\,2}$$

$$\boxed{\varepsilon_V = 3 \varepsilon_D}$$

THIN CYLINDER