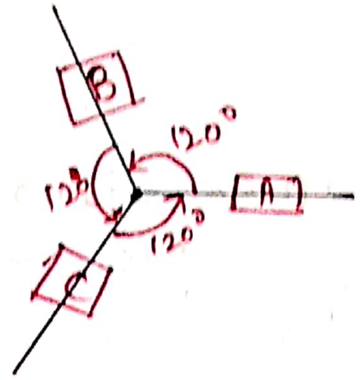
③ ## Star Strain Rossette



$\varepsilon_A = \varepsilon_{0^\circ}$

$\varepsilon_B = \varepsilon_{120^\circ}$

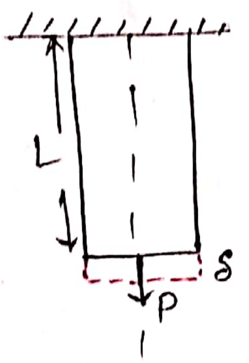
$\varepsilon_C = \varepsilon_{240^\circ}$

STRAIN ENERGY

Strain energy is defined as the energy absorption Capacity of a Component during its functionality.

Resilence Resilence is defined as the energy absorption Capacity of a Component in elastic region. [Also known as elastic recoverable energy.]

Toughness Toughness is defined as the energy absorption Capacity of a Component just before the fracture.



Work done by Load (P) $= \frac{1}{2} P \times \delta$

$$S.E = \frac{1}{2} P \times \delta$$

$$S.E = \frac{1}{2} P \times \frac{PL}{AE} \Rightarrow \frac{P^2 L}{2AE} \Rightarrow \frac{\sigma^2 A^{\cancel{2}} L}{2\cancel{A}E}$$

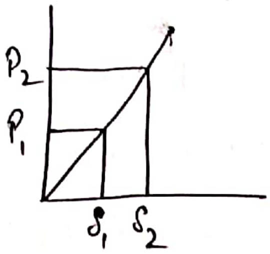
$$\Rightarrow \frac{\sigma^2 AL}{2E} \Rightarrow \frac{\sigma^2}{2E} \times \text{volume}$$

$$\frac{\sigma^2}{2E}\times \text{volume} \Rightarrow \frac{\sigma^2}{2\,\sigma/\varepsilon}\times \text{volume} \qquad \left[\begin{array}{l}\sigma \propto \varepsilon \Rightarrow \sigma = E\varepsilon \\ \text{So } E = \sigma/\varepsilon\end{array}\right]$$

$$\boxed{S.E = \frac{\sigma\varepsilon}{2}\times \text{volume}}$$

Resilence – ~~upto Elastic limit~~

Resilence
Body is in Elastic Region



$$\text{Resilience} = \frac{P_1 S_1}{2},\ \frac{P_2 S_2}{2}\ -\ -$$

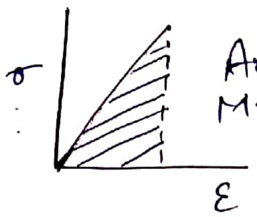
$$\text{Proof Resilience} = \frac{P_{E.L}\times S_{E.L}}{2}$$

Modulus of Resilience

$$M.R = \frac{\text{Resilience}}{\text{Volume}} \Rightarrow \frac{\frac{P_{E.L}\times S_{E.L}}{2}}{\text{Volume}}$$

$$M.R = \frac{\frac{P}{2}\times S_{EL}}{A\times L} \Rightarrow \boxed{\frac{P\times S}{2AL}}$$

$$M.R = \frac{\sigma \cancel{A}\times S_{E.L}}{2\times \cancel{A}\times L} = \boxed{\frac{\sigma_{EL}\times \varepsilon_{EL}}{2}}$$



Area Under the curve of Stress & Strain Curve.
M.R

Body is upto Elastic limit

Proof Resilience $\frac{P}{2}\delta \Rightarrow \frac{P\times PL}{2\ AE} \Rightarrow \frac{\sigma^2\times AL}{2E}$

So
P.R ↑ when σ ↑
P.R ↑ when E ↓
P.R ↑ when Length ↑.

$$\sigma_2 = \frac{E}{1-\mu^2}(\varepsilon_2 + \mu\varepsilon_1)$$

$$\sigma_2 = \frac{80\times10^3}{1-(0.3)^2}\left(0.35948\times10^{-3} + 0.3\times1.104051\times10^{-3}\right)$$

$$\sigma_2 = 61.6820 \text{ MPa}$$

$$\tau_{max} = \frac{109.745 - 61.6820}{2} = 24.03 \text{ MPa}$$

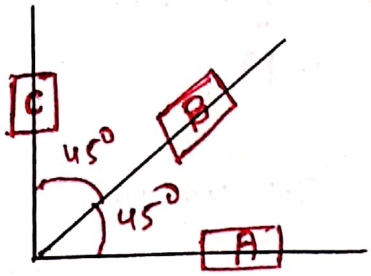
Strain Rosettes Strain Rosettes is defined as the arrangement of three strain gauges in three arbitrary directions. These strain gauges are used to meassure the normal strain in that direction.

Linear

Based upon the arrangement of strain gauges strain Rossettes are classified into

1. Rectangular Strain Rossette [$\theta = 45^\circ$].
2. Delta Strain Rossette [$\theta = 60^\circ$]
3. Star strain Rossette [$\theta = 120^\circ$].

1. Rectangular strain Rossette.



So

$$\varepsilon_n = \frac{1}{2}(\varepsilon_x+\varepsilon_y) + \frac{1}{2}(\varepsilon_x-\varepsilon_y)\cos 2\theta + \tau_{xy}\sin 2\theta$$

firstly for A

$$\varepsilon_n = \frac{1}{2}(\varepsilon_x+\varepsilon_y) + \frac{1}{2}(\varepsilon_x-\varepsilon_y)\cos 2(0) + \boxed{\underbrace{\tau_{xy}}_{\frac{\gamma_x}{2}}}\sin 2(0).$$

$$\varepsilon_n = \frac{1}{2}(\varepsilon_x-\varepsilon_y) + \frac{1}{2}(\varepsilon_x-\varepsilon_y) = \varepsilon_x$$

So $\boxed{\varepsilon_n = \varepsilon_x = \varepsilon_A}$

For B

$$[\varepsilon_n]_{\theta=45^\circ} = \frac{1}{2}(\varepsilon_x+\varepsilon_y) + (\varepsilon_x-\varepsilon_y)\cos 2(45) + \underbrace{\tau_{xy}}_{\frac{\gamma_{xy}}{2}}\sin 2(45)$$

$$[\varepsilon_n]_{\theta=45^\circ} = \frac{1}{2}(\varepsilon_x+\varepsilon_y) + \tau_{xy} \to \frac{\gamma_{xy}}{2}$$

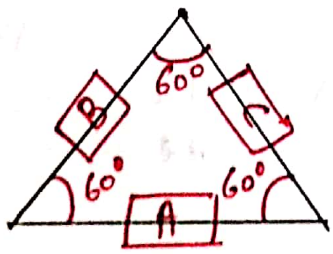
So $[\varepsilon_n]_{\theta=45^\circ} = \frac{1}{2}(\varepsilon_x+\varepsilon_y) + \frac{\gamma_{xy}}{2} = \varepsilon_B$

So $2\varepsilon_B = \varepsilon_x+\varepsilon_y+\gamma_{xy}$

& $\boxed{\gamma_{xy} = 2\varepsilon_B - \varepsilon_x - \varepsilon_y}$

& also $\boxed{\gamma_{xy} = 2\varepsilon_B - \varepsilon_A - \varepsilon_B}$

② Delta Strain Rossette



$\varepsilon_A = \varepsilon_{0^\circ}$

$\varepsilon_B = \varepsilon_{60^\circ}$

$\varepsilon_C = \varepsilon_{120^\circ}$