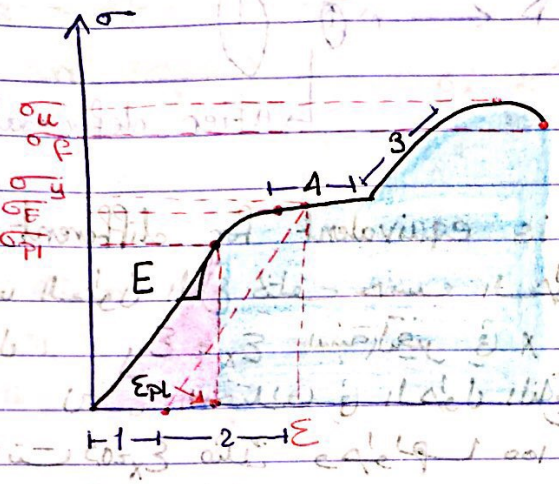
Chapter 3: Mechanical properties of materials

Engineering stress-strain Diagram :-



E: slope of linear Region.

σ_{Pl}: propotional limit stress
Below it and at it, Hook's law is applied.
↳ $\sigma = E\varepsilon$

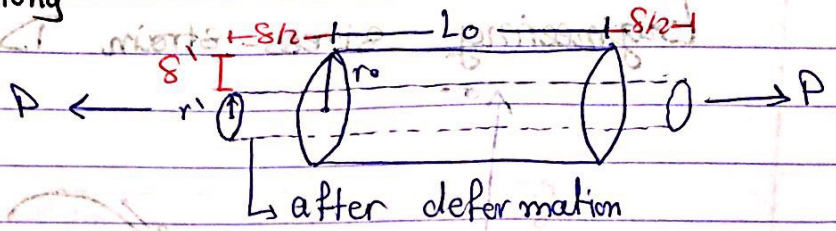
σ_E: Elastic stress
σ_y: yield stress
σ_u: ultimate str
σ_F: Fracture stress

1: permenant strain
2: recovered strain
3: Strain Hardening
A: Yielding

→ PurPle Region: Area = U_r (Modulus of Resilience)
→ PurPle + Blue Regions: Area = U_t (Modulus of Toughness)

Poisson's Ratio: (υ)

$$\upsilon = -\frac{\varepsilon_{lat}}{\varepsilon_{long}} = \frac{-\delta'/r_o}{\delta/L_o}$$



Note: ε_{lat} is equivalent for different axis

• لكن الطول الناتج يختلف حسب الطول الأصلي

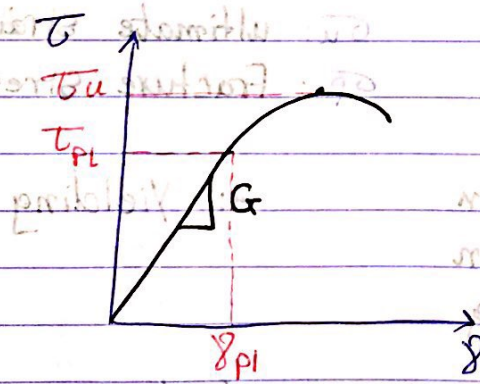
↳ مثال: $\varepsilon_x = \varepsilon_y$ سنة التغير في x و y متساوية

لكن: الاختلاف في الطول الناتج

← لو كانت $\varepsilon_x = 0.5$ مثلاً وطولها 100 يرجع 50

واذا كان طول y = 200 يرجع 100

• Shear stress and Shear strain:



$$\tau = G\gamma$$

• The Relation between E and G:-

$$G = \frac{E}{2(1+\upsilon)}$$

10.6: Generilized How'ks law [Normal Stress]

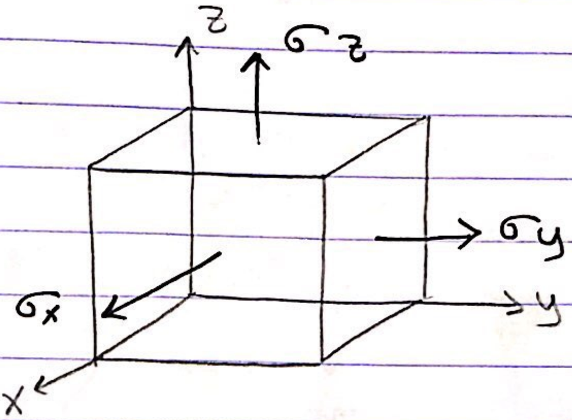
*** Triaxial stress:-**

We take each direction;

Ex: X direction

σ_x is positive

σ_y, σ_z are negative



Superposition Method:

$$\varepsilon_x' \Rightarrow \sigma_x = +\frac{\sigma_x}{E}$$
$$\varepsilon_x'' \Rightarrow \sigma_y = -\frac{\sigma_y}{E}\upsilon$$
$$\varepsilon_x''' \Rightarrow \sigma_z = -\frac{\sigma_z}{E}\upsilon$$

Stress in the required direction

$$\varepsilon_x = \varepsilon_x' + \varepsilon_x'' + \varepsilon_x''' = \frac{1}{E}\left[\sigma_x - \upsilon(\sigma_y + \sigma_z)\right]$$

مجموع ال stresses في ال lateral axis (يتم تعويض الإشارات كما هي)

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