V: Stress-strain relations

1: Normal stress and normal strain

1.1: Introduction

- Using the **principle of superposition**, the individual effect can be added to give the combined effect.

1.2: Effect of ω_{xx}

- In 1-D, we have the relationship of the Young's Modulus:

$$E = \frac{\sigma_{xx}}{\varepsilon_{xx}}$$

- In 2-D, we have Passion's ratio:

$$\nu = -\frac{\varepsilon_{yy}}{\varepsilon_{xx}}$$

- Hence, we can get the value of ε_{xx} and ε_{yy} using σ_{xx} and E, ν.

1.3: Effect of σ_{yy}

- Same as σ_{xx}.

1.4: Combined effect of σ_{yy} and σ_{xx}

- $\varepsilon_{xx} = \frac{1}{E}(\sigma_{xx} - \nu\sigma_{yy})$
- $\varepsilon_{yy} = \frac{1}{E}(\sigma_{yy} - \nu\sigma_{xx}$
- What' more, the value of the principal strain can also be defined:

$$\varepsilon_1 = \frac{1}{E}(\sigma_1 - \nu\sigma_2)$$

$$\varepsilon_2 = \frac{1}{E}(\sigma_2 - \nu\sigma_1)$$

- The stress can also be got using normal strain:

$$\sigma_{xx} = \frac{E}{(1-\nu^2)}(\varepsilon_{xx} + \nu\varepsilon_{yy})$$

$$\sigma_{yy} = \frac{E}{(1-\nu^2)}(\varepsilon_{yy} + \nu\varepsilon_{xx})$$

- Same for the principal stresses:

$$\sigma_1 = \frac{E}{(1-\nu^2)}(\varepsilon_1 + \nu\varepsilon_2)$$

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

2: Shear stress and shear strain

$$G = \frac{\tau_{xy}}{\gamma_{xy}}$$

$$G = \frac{\tau_{max}}{\gamma_{max}}$$