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:

$$E = rac{\sigma_{xx}}{arepsilon_{xx}}$$

• In 2-D, we have Passion's ratio:

$$u = -rac{arepsilon_{yy}}{arepsilon_{xx}}$$

• 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}

$$m{\cdot} \;\; arepsilon_{xx} = rac{1}{E}(\sigma_{xx} -
u\sigma_{yy})$$

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

• What' more, the value of the principal strain can also be defined:

$$arepsilon_1 = rac{1}{E}(\sigma_1 -
u \sigma_2)$$

$$arepsilon_2 = rac{1}{E}(\sigma_2 -
u \sigma_1)$$

• The stress can also be got using normal strain:

$$\sigma_{xx} = rac{E}{(1-
u^2)}(arepsilon_{xx} +
u arepsilon_{yy})$$

$$\sigma_{yy} = rac{E}{(1-
u^2)}(arepsilon_{yy} +
u arepsilon_{xx})$$

• Same for the principal stresses:

$$\sigma_1 = rac{E}{(1-
u^2)}(arepsilon_1 +
u arepsilon_2)$$

$$\sigma_2 = rac{E}{(1-
u^2)}(arepsilon_2 +
u arepsilon_1)$$

2: Shear stress and shear strain

$$G=rac{ au_{xy}}{\gamma_{xy}}$$

$$G = rac{ au_{max}}{\gamma_{max}}$$