Mechanics of Materials
CIVL 3322 / MECH 3322
Hooke's Law

THE UNIVERSITY OF MEMPHIS
Department of Civil Engineering

Hooke's Law

- Within the elastic region of the stress-strain diagram, stress is linearly proportional to strain
- That relationship was formalized by Robert Hooke in 1678

Hooke's Law

- In mathematical terms

$$\sigma = E\varepsilon$$

σ (sigma) is the axial/normal stress
E is the elastic modulus or the Young's modulus
ε (epsilon) is the axial/normal strain

Hooke's Law

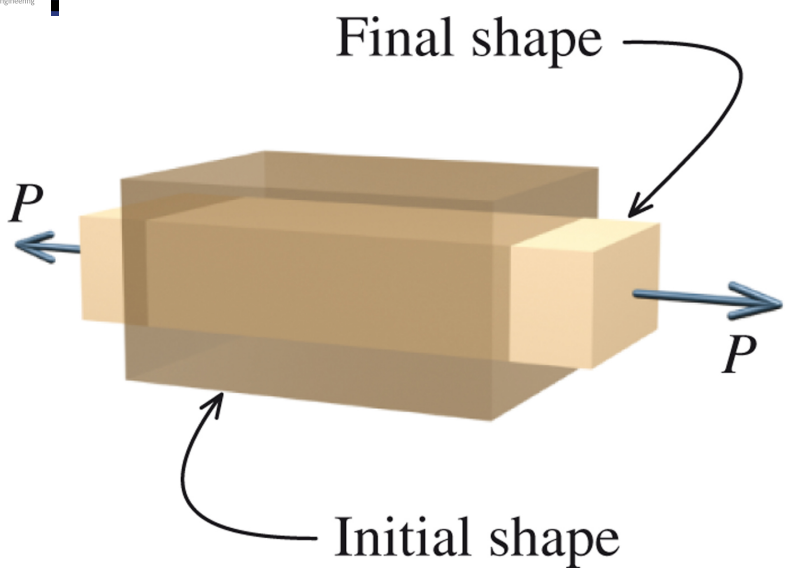
- For shear stress in the same region

$$\tau = G\gamma$$

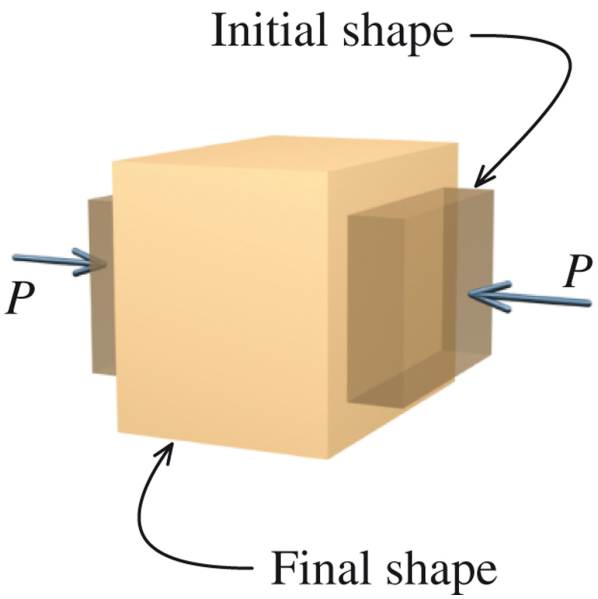
τ (tau) is the shear stress
G is the shear modulus or the modulus of rigidity
γ (gamma) is the shear strain

Poisson's Ratio

- As a material deforms along an axis due to an applied stress on that axis, the material also deforms along any axis lateral to the axis



F03_015_1



F03_015_2

Poisson's Ratio

- The strain developed in the lateral and axial directions have a fixed ratio based on the material
- The ratio is known as Poisson's Ratio

THE UNIVERSITY OF MEMPHIS
Department of Civil Engineering

Poisson's Ratio

- The Ratio is

$$\nu = -\frac{\varepsilon_{lat}}{\varepsilon_{axial}}$$

THE UNIVERSITY OF MEMPHIS
Department of Civil Engineering

Poisson's Ratio

- The Ratio is $\nu = -\frac{\varepsilon_{lat}}{\varepsilon_{axial}}$

v (nu) is Poisson's Ratio
E_{lat} is the strain in the lateral direction
E_{axial} is the strain in the axial/normal direction

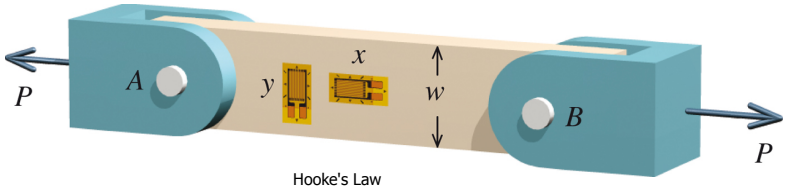
Poisson's Ratio

- Poisson's Ratio is also used in an expression relating the elastic modulus E to the shear modulus G

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

Problem P3.4

- A 0.75-in.thick rectangular bar is subjected to a tensile load P by pins at A and B as shown. The width of the bar is w = 3.0 in. Strain gages bonded to the specimen measure the following strains in the longitudinal (x) and traverse (y) directions: ε_x = 840με, ε_y = -250με

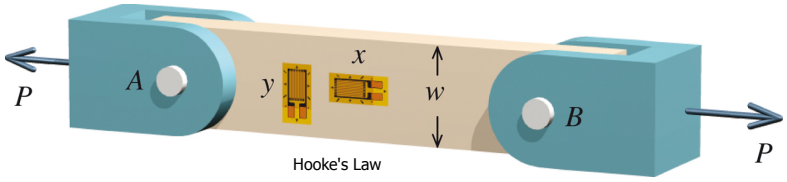


THE UNIVERSITY OF MEMPHIS
Department of Civil Engineering

Problem P3.4

- A 0.75-in.thick rectangular bar is subjected to a tensile load P by pins at A and B as shown. The width of the bar is w = 3.0 in. Strain gages bonded to the specimen measure the following strains in the longitudinal (x) and traverse (y) directions: ε_x = 840με, ε_y = -250με

(a) Determine Poisson's ratio for this specimen

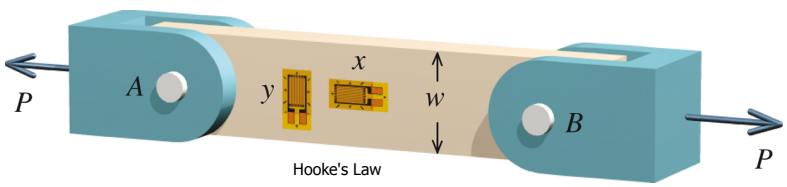


THE UNIVERSITY OF MEMPHIS
Department of Civil Engineering

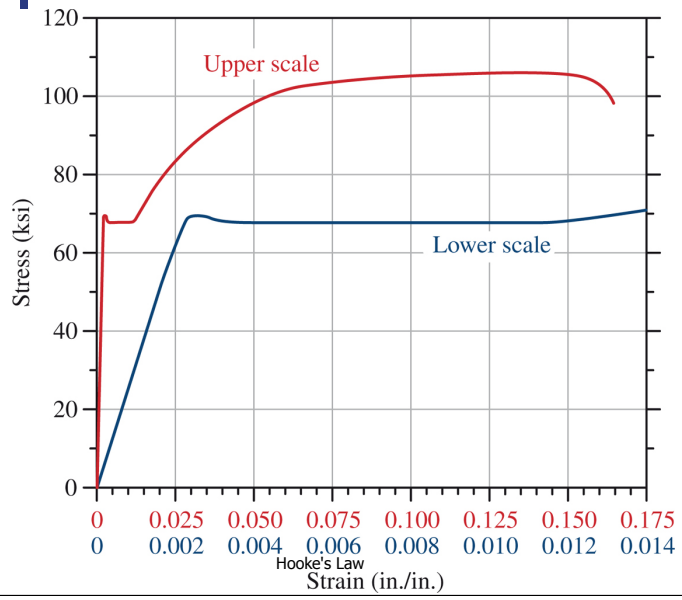
Problem P3.4

- A 0.75-in.thick rectangular bar is subjected to a tensile load P by pins at A and B as shown. The width of the bar is w = 3.0 in. Strain gages bonded to the specimen measure the following strains in the longitudinal (x) and traverse (y) directions: ε_x = 840με, ε_y = -250με

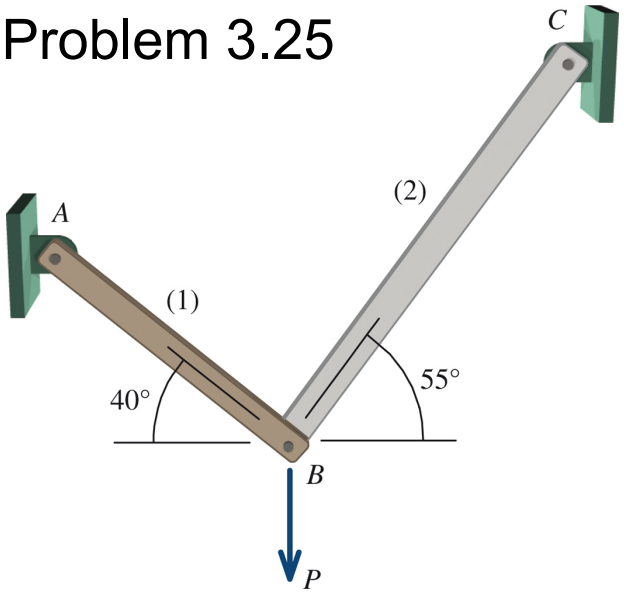
(b) If the measured strains were produced by an axial load of P = 32 kips, what ist he modulus of elasticity for this specimen?



Problem P3.16 (Clicker)



Problem 3.25



THE UNIVERSITY OF MEMPHIS
Department of Civil Engineering

Homework

- P 3.15
- P 3.22
- P 3.24