Mechanics of Materials I:

Fundamentals of Stress & Strain and Axial Loading

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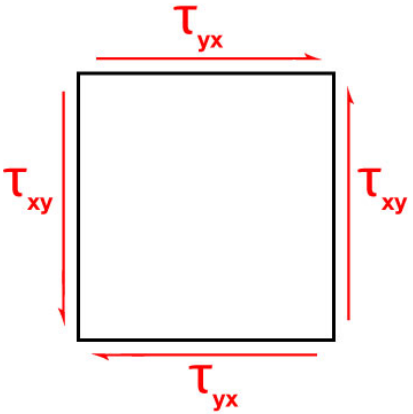
Module 39 Learning Outcome

- Show that E, G, and γ are related (not independent) for isotropic material

Recall Pure Shear



By Equilibrium:

$$\tau_{xy} = \tau_{yx} = \tau$$

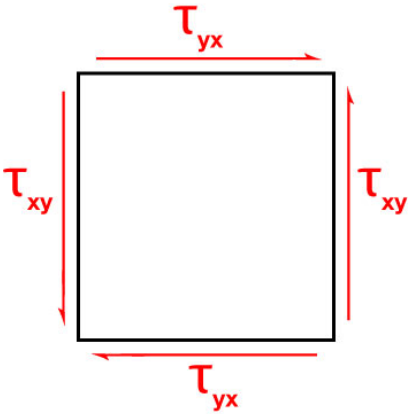
Hooke's Law in Shear

(valid for linear elastic region):

$$\tau = G\gamma$$

G = Modulus of Rigidity
(Shear Modulus)

Recall Pure Shear



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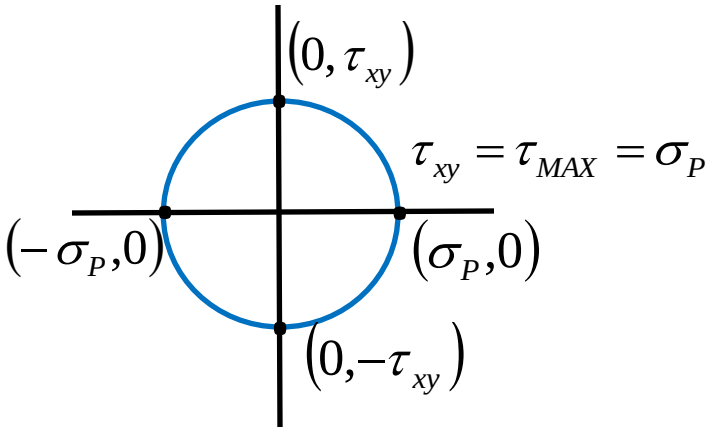
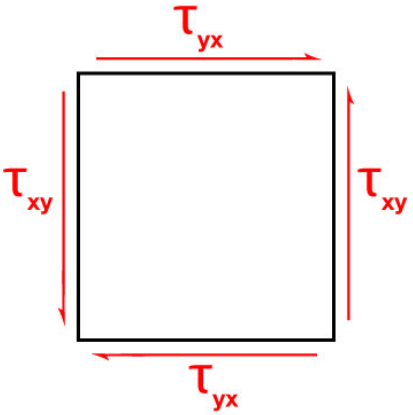
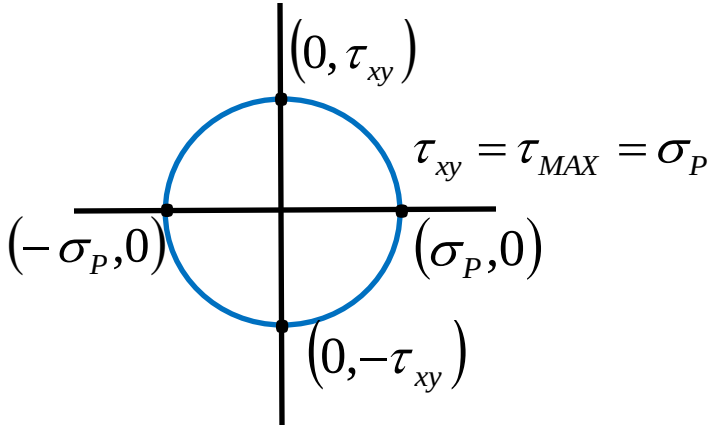
Mohr's Circle - Stress

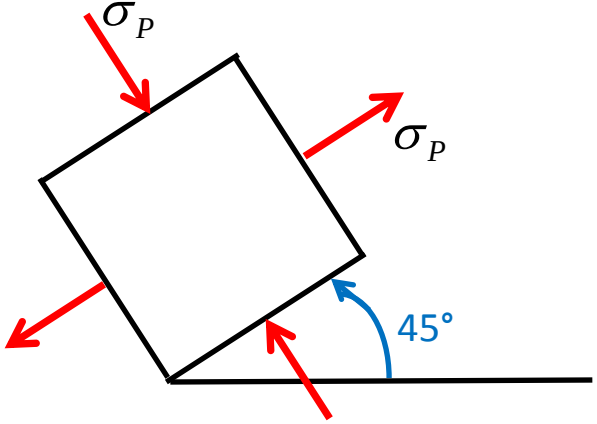


Recall Pure Shear

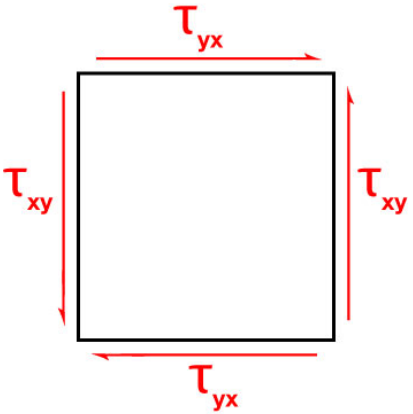


Mohr's Circle - Stress

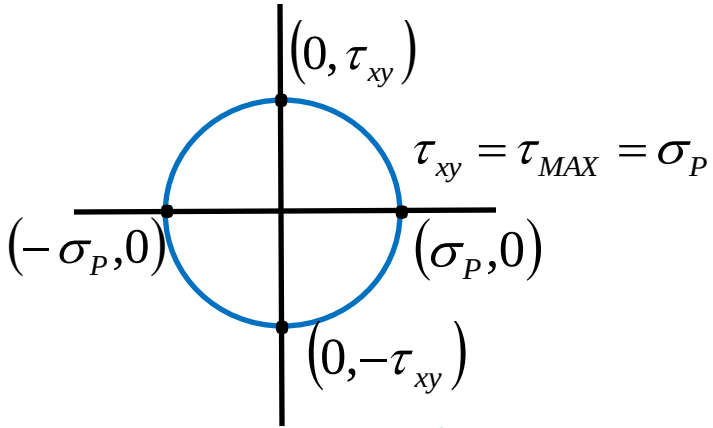


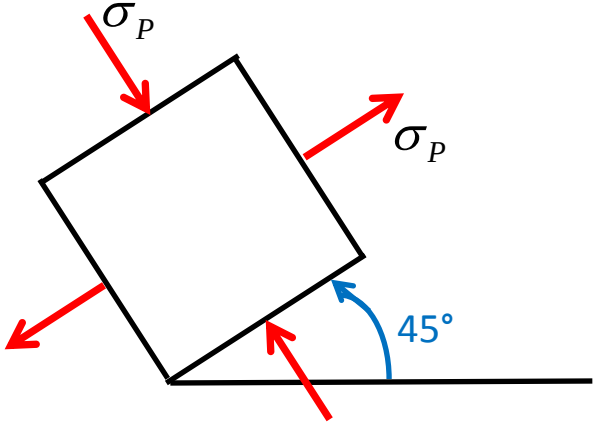


Recall Pure Shear

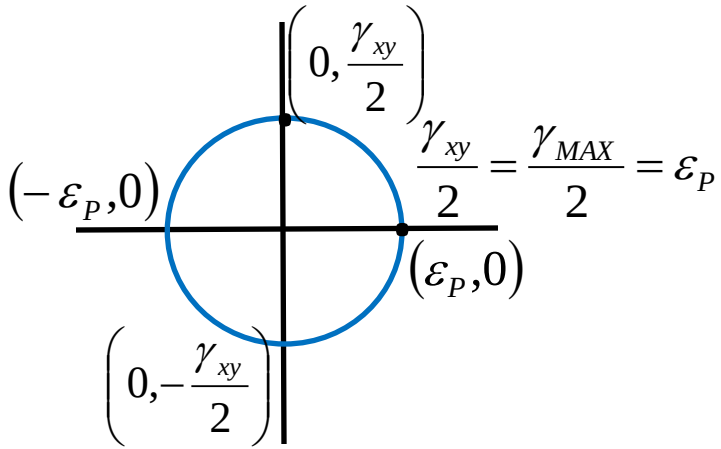


Mohr's Circle - Stress

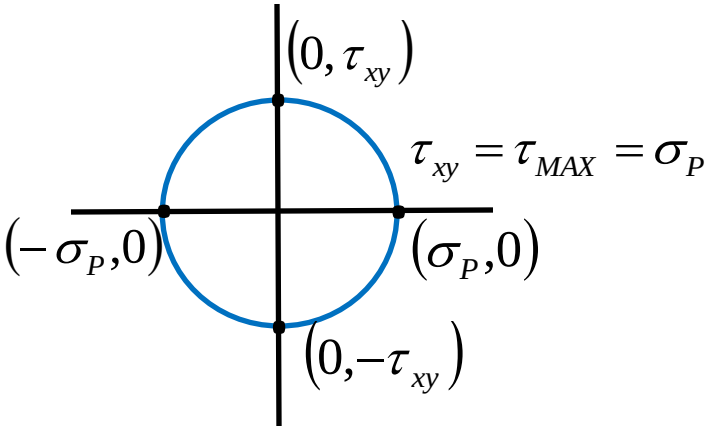




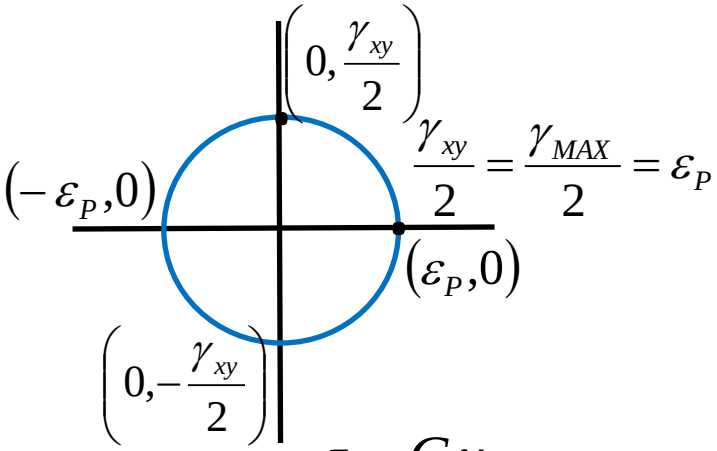
Mohr's Circle - Strain



Mohr's Circle - Stress



Mohr's Circle - Strain



$$\tau = G\gamma$$

$$\tau_{MAX} = G\gamma_{MAX} = G(2\varepsilon_P)$$

Generalized Hooke's Law for Biaxial Stress-Strain

$$\sigma_x = \frac{E}{1-\upsilon^2}\left(\varepsilon_x + \upsilon\varepsilon_y\right)$$

$$\sigma_P = \frac{E}{1-\upsilon^2}\left(\varepsilon_P + \upsilon\varepsilon_P\right) = \tau_{MAX}$$

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

$$E = 2(1+\upsilon)G$$

E, G, and γ are related (not independent) for isotropic material