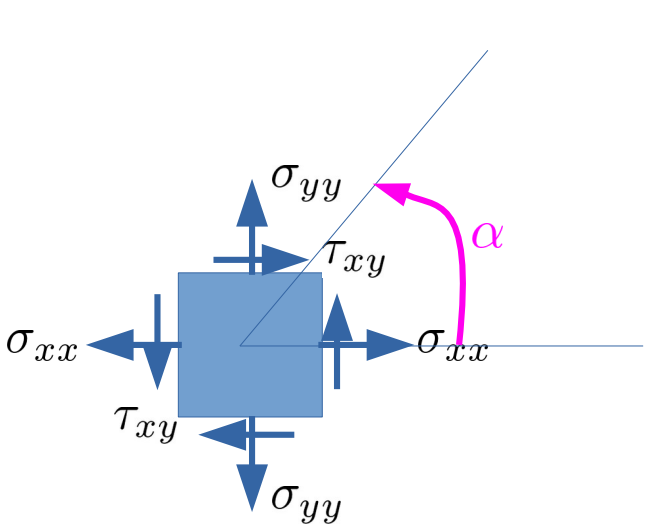
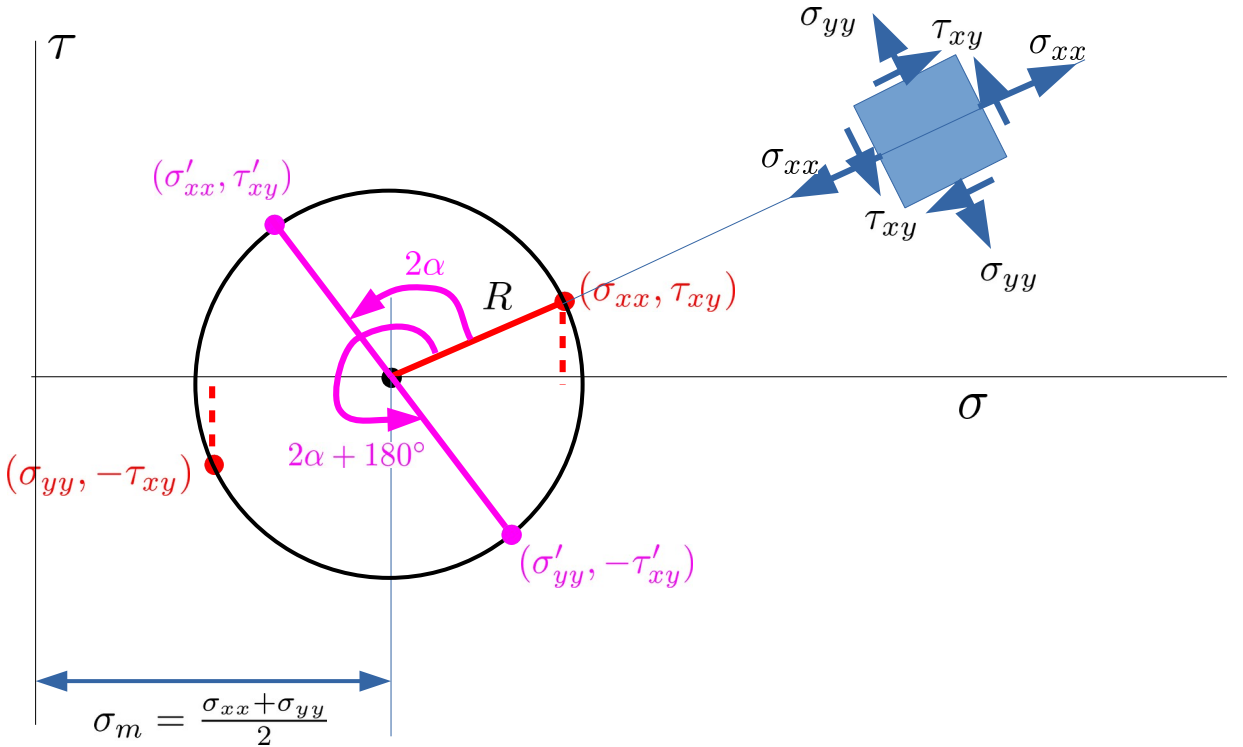
ME231: Solid Mechanics-I

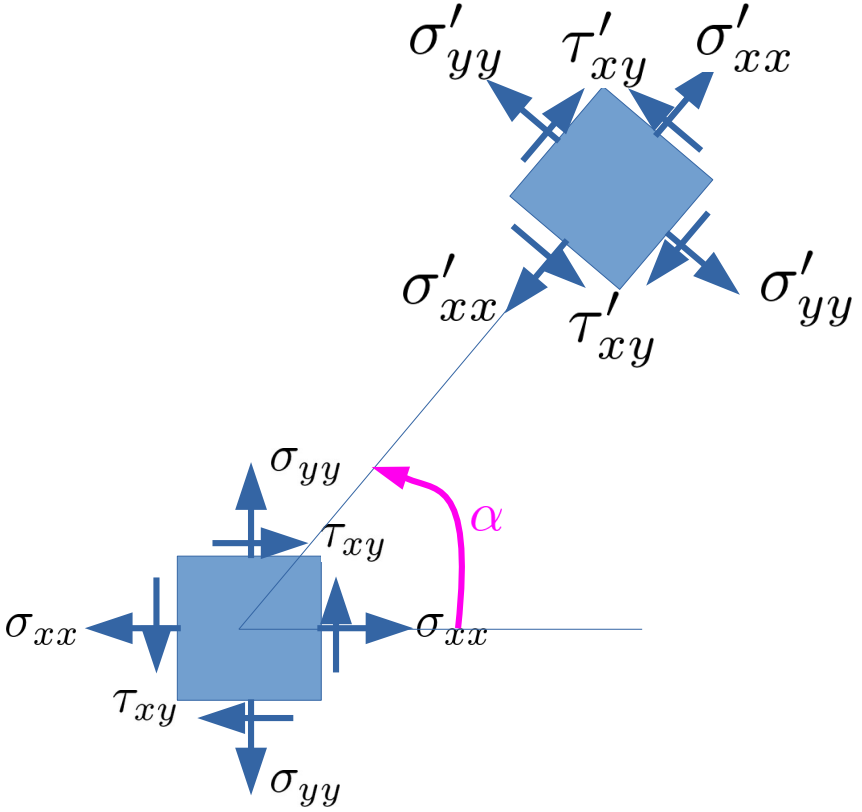
Stress and Strain

Steps to solve problems using Mohr's circle

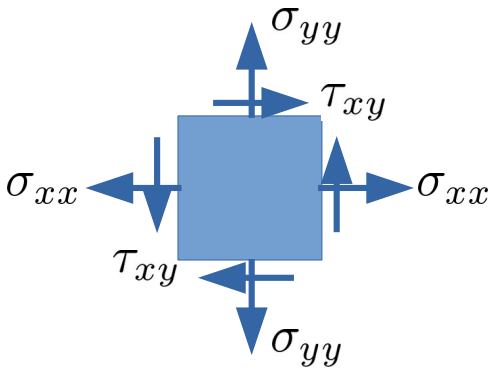
For the given state of stress, find the stresses for an element which is inclined at an angle α from x-axis.

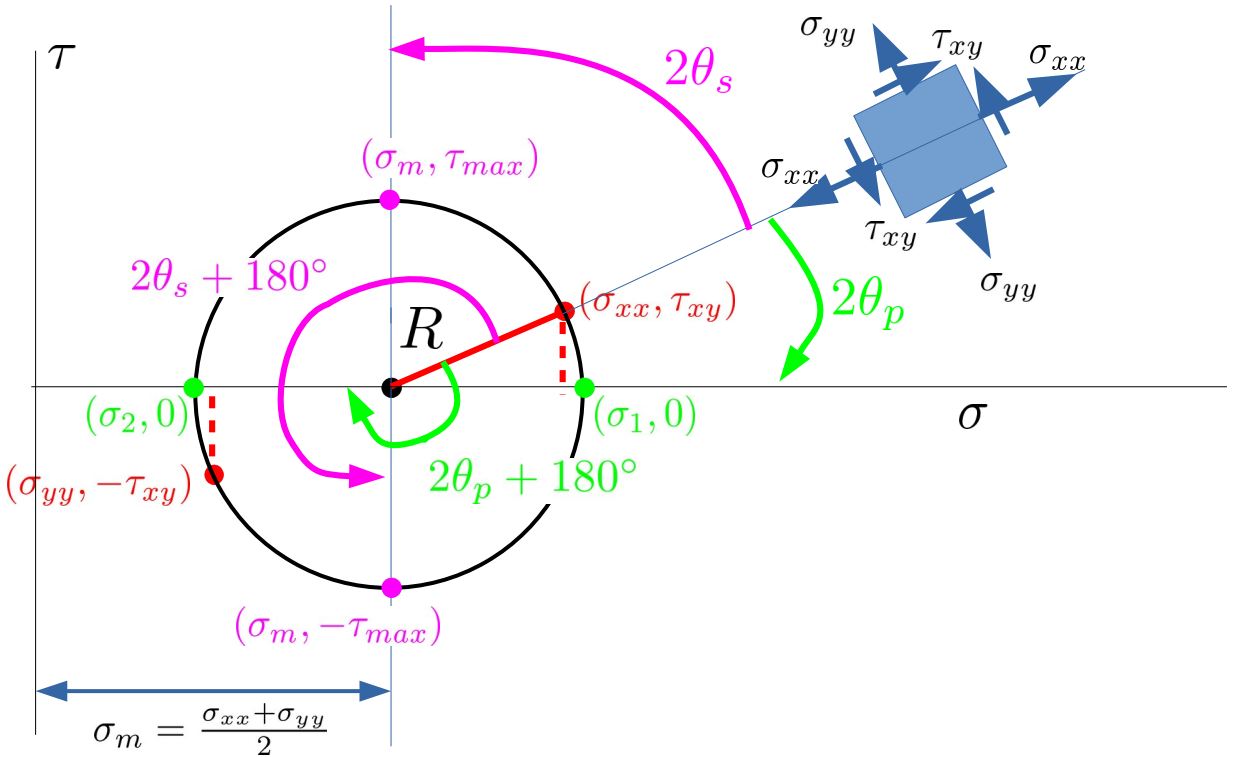


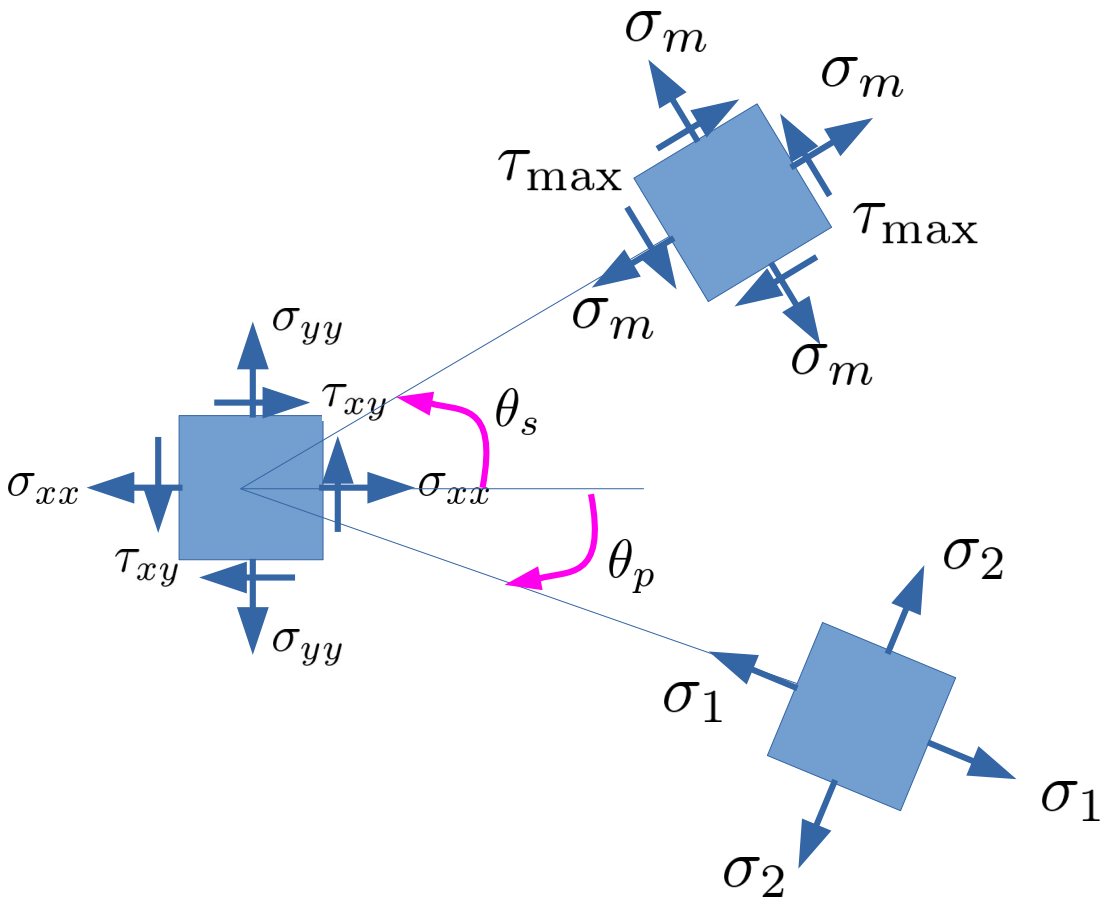



σ'_{yy}
τ'_{xy}
σ'_{xx}
σ'_{xx}
τ'_{xy}
σ'_{yy}
σ_{yy}
τ_{xy}
α
σ_{xx}
σ_{xx}
τ_{xy}
σ_{yy}

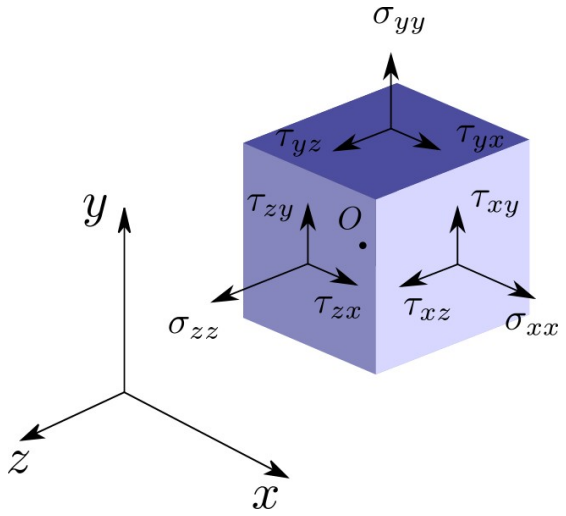
For a given state of stress, find the principal stresses and maximum shear stresses and inclination of principal planes and planes of maximum shear stresses.



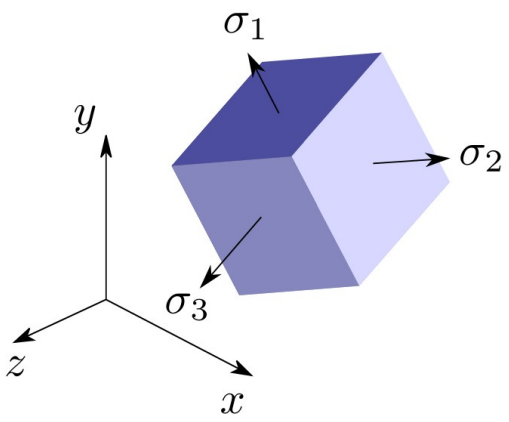


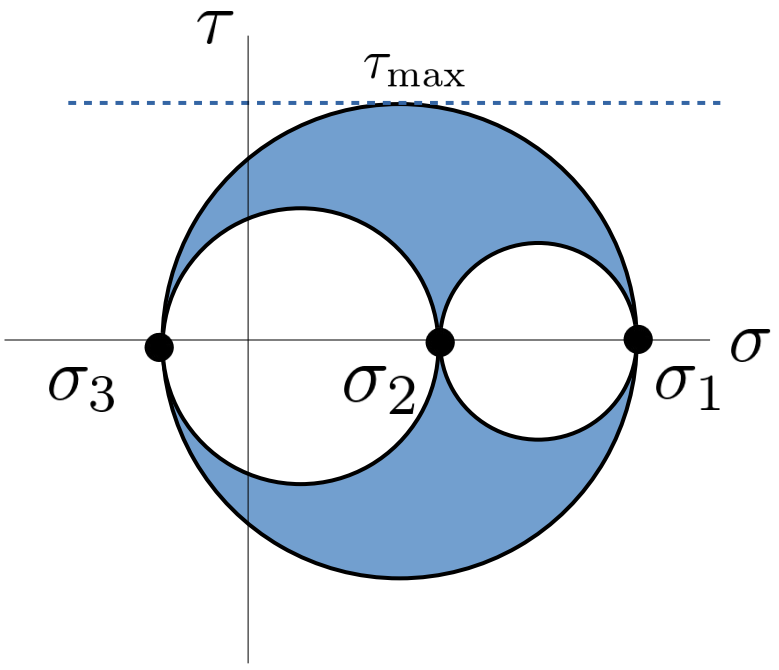

σ_m
σ_m
$\tau_{\max}$
$\tau_{\max}$
σ_m
σ_m
σ_{yy}
τ_{xy}
θ_s
σ_{xx}
σ_{xx}
τ_{xy}
θ_p
σ_{yy}
σ_2
σ_1
σ_1
σ_2

For a general 3D state of stress



For a general three dimensional state of stress there exist three mutually perpendicular plane at which shear stresses are zero. These are called **principal planes** and normal to these planes are called **principal axes**. Normal stresses on these planes are called **principal stresses**.





$$\tau_{\max} = \frac{\sigma_{\max} - \sigma_{\min}}{2}$$

Generally principal stresses are ordered as,

$\sigma_1 > \sigma_2 > \sigma_3$, then

$$\tau_{\max} = \frac{\sigma_1 - \sigma_3}{2}$$

Examples

Draw the Mohr's circle for following cases.