Maximum shear stress theory (ductile)

Maximum shear stress theory predicts failure in ductile materials based on the observation that ductile materials tend to yield along slip lines (Lüder lines) that are around 45° from the axis of an axially loaded strip in tension. The maximum shear stress is also nearly 45°. It is, therefore reasonable to assume that failure is caused by shear stress.

At 45°; $\tau_{max} = \dfrac{\sigma_1 - \sigma_3}{2}$. Therefore failure is predicted when

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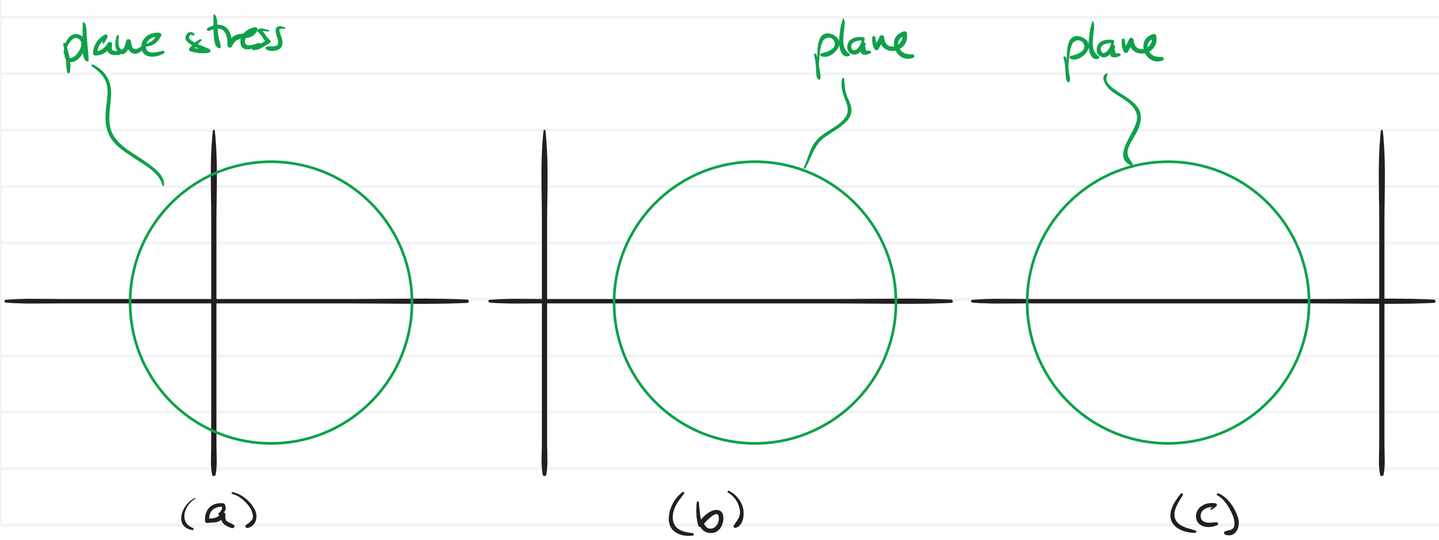
Recall that we must take care when analyzing plane-stress. The out-of-plane stress is 0, which may be the max or minimum normal stress, in some situations.



For this reason, when we find the normal plane stresses, we should call them σ_A + σ_B intead of σ_1 + σ_3 until we have determined which of the situations (a), (b), or (c), we have.

The nonyield evelope of plane stress is shown at right. Those elements stressed inside the envelope are considered not to fail.