2. Maximum Shear Stress theory (M.S.S.T)

The Maximum **Shear Stress theory** states that failure occurs when the maximum **shear stress** from a combination of **principal stresses** equals or exceeds the value obtained for the **shear stress** at yielding in the uniaxial tensile test.

Maximum shear stress induced at a critical tensile point under tri-axial combined stress	$\leq$	Permissible shear stress

$$\text{Permissible shear stress} = \frac{\text{Yield strength in shear under tension test}}{\text{Factor of safety}}$$

$$\frac{S_{sy}}{FoS} = \frac{S_{yt}}{2\,FoS}$$

$$\tau_{max} = \frac{S_{sy}}{FoS} = \frac{S_{yt}}{2\,FoS}$$

For tri-axial state of stress,

$$\text{larger of}\left[\;\left|\frac{\sigma_1 - \sigma_2}{2}\right|,\;\left|\frac{\sigma_2 - \sigma_3}{2}\right|,\;\left|\frac{\sigma_3 - \sigma_1}{2}\right|\;\right] \leq \frac{S_{yt}}{2N}$$

$$\textbf{larger of}\left[\;|\sigma_1 - \sigma_2|,\;|\sigma_2 - \sigma_3|,\;|\sigma_3 - \sigma_1|\;\right] \leq \frac{S_{yt}}{N}$$

For Biaxial state of stress, $\sigma_3 = 0$

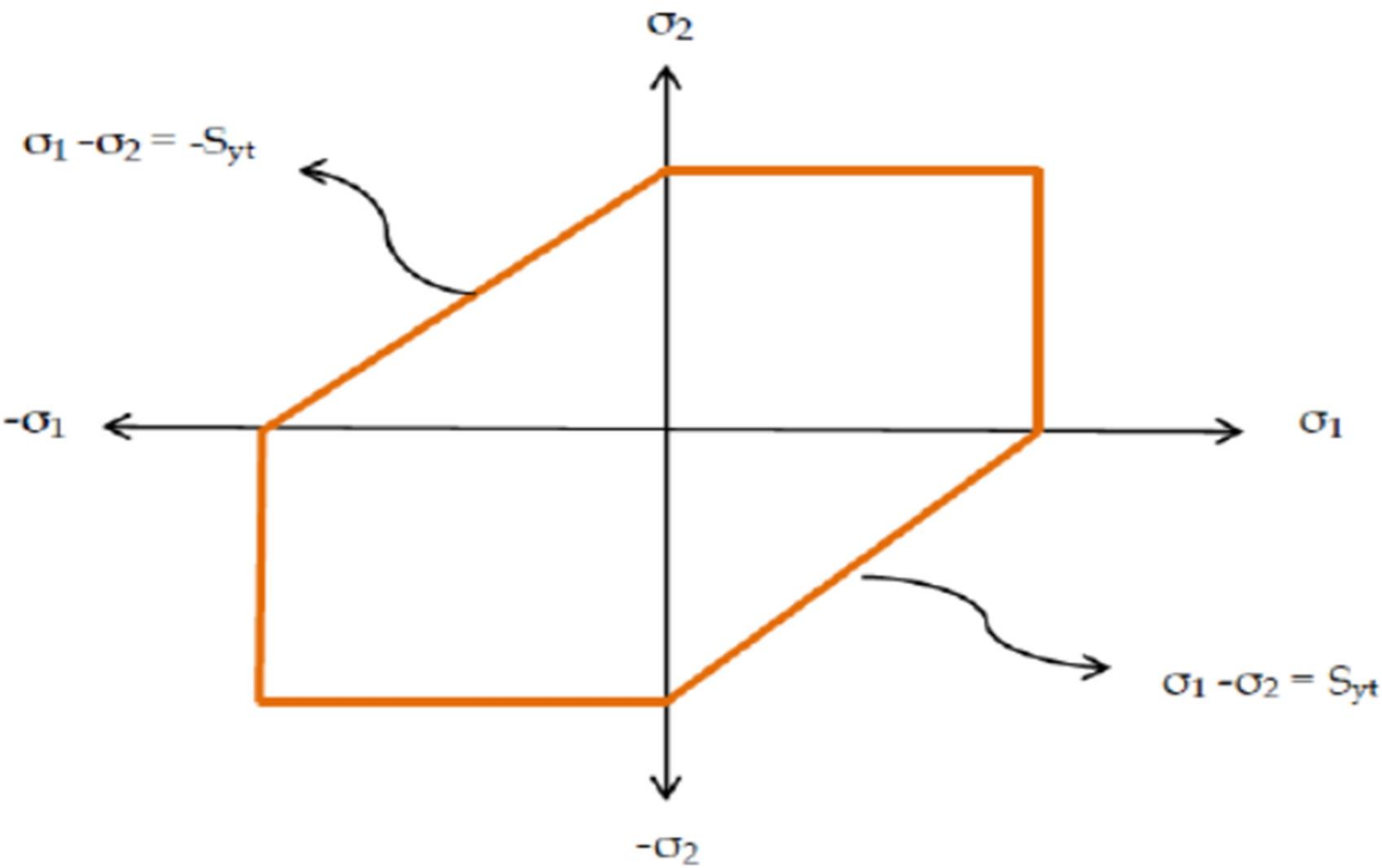
$$\left|\frac{\sigma_1}{2}\right| \text{ or } \left|\frac{\sigma_1 - \sigma_2}{2}\right| \leq \frac{S_{yt}}{2N}$$

1.M.S.S.T and M.P.S.T will give same results for ductile materials under uniaxial state of stress and biaxial state of stress when principal stresses are like in nature.

2.M.S.S.T is not suitable under hydrostatic stress condition.

3.This theory is suitable for ductile materials and gives over safe design i.e. safe and uneconomic design.

M.S.S.T :- Hexagon



3. Maximum Distortion Energy theory or VONMISES AND HENCKY'S THEORY

The failure of mechanical component subjected to biaxial or tri axial stresses occurs , when strain energy of distortion per unit volume at any point in component becomes equal to strain energy of distortion per unit volume in standard specimen of tension test, when yielding starts .

$$U_{dis} = \frac{1+\mu}{6E}\left[(\sigma_1-\sigma_2)^2+(\sigma_2-\sigma_3)^2+(\sigma_3-\sigma_1)^2\right] -$$

$$U_{dis} = \frac{1+\mu}{3E}\sigma_{yp}^2$$

$$\frac{1+\mu}{6E}\left[(\sigma_1-\sigma_2)^2+(\sigma_2-\sigma_3)^2+(\sigma_3-\sigma_1)^2\right]=\left(\frac{1+\mu}{3E}\right)\sigma_{yp}^2$$

$$(\sigma_1-\sigma_2)^2+(\sigma_2-\sigma_3)^2+(\sigma_3-\sigma_1)^2=2\sigma_{yp}^2$$

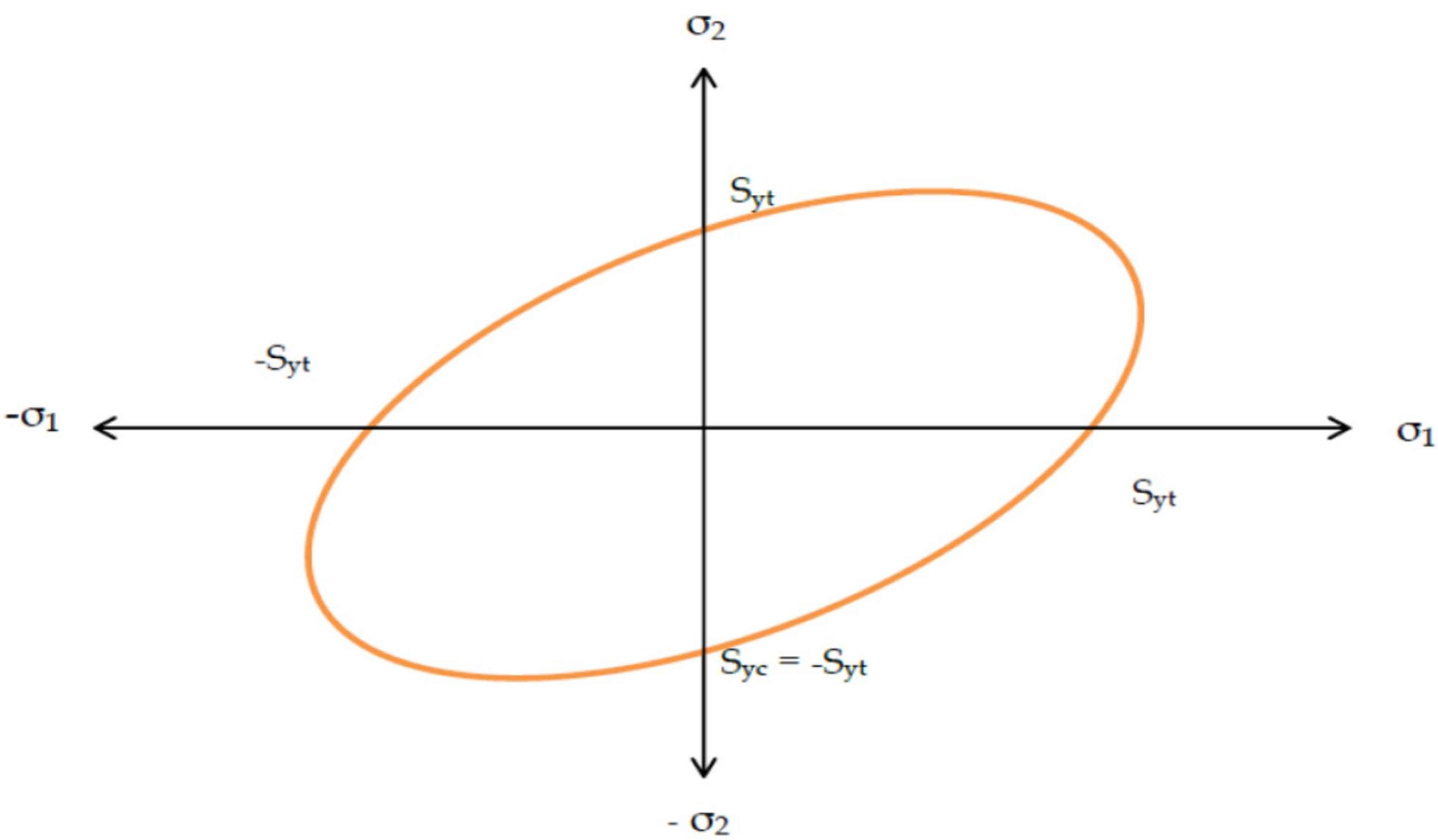
Plane stress

$\sigma_3 = 0$

$$\boxed{\sigma_1^2+\sigma_2^2-\sigma_1\sigma_2=\sigma_{yp}^2}$$

$$\sigma_1^2+\sigma_2^2-\sigma_1\sigma_2=S_{yt}^2$$

$\sigma_1^2 + + \sigma_2^2 -$


σ2
Syt
-Syt
-σ1
σ1
Syt
Syc = -Syt
- σ2