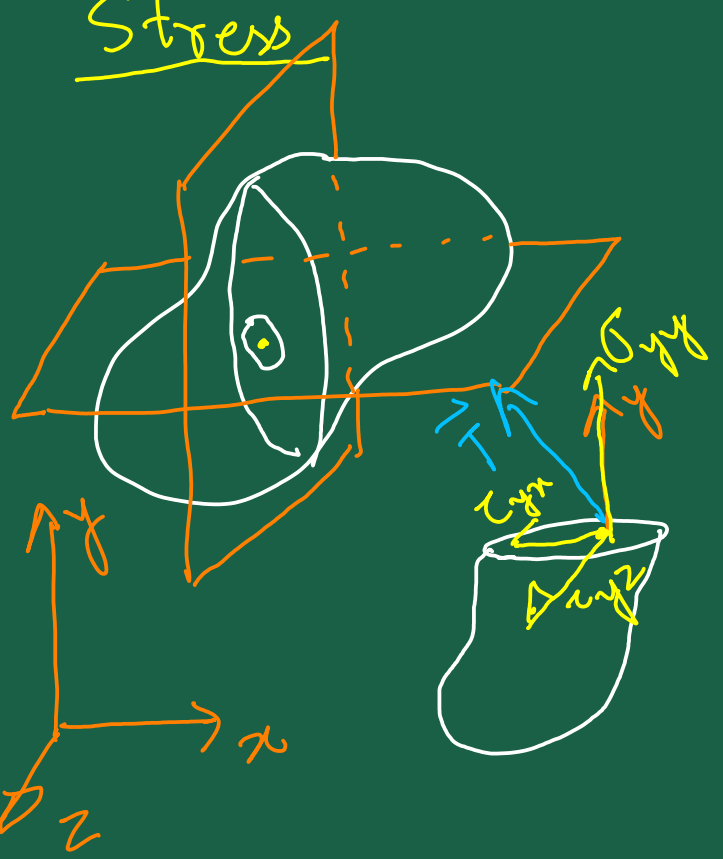
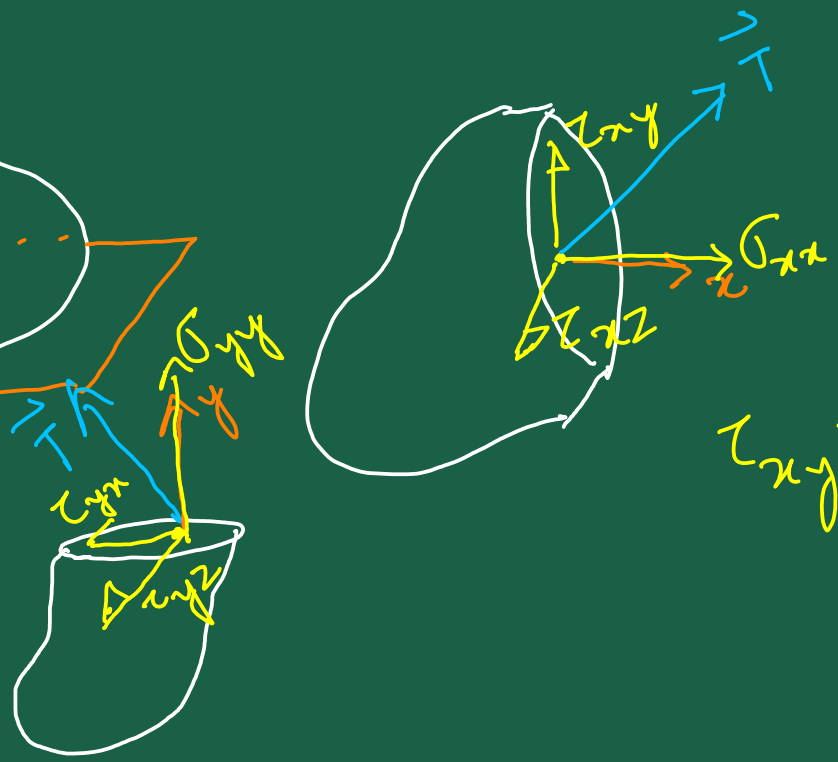
Stress



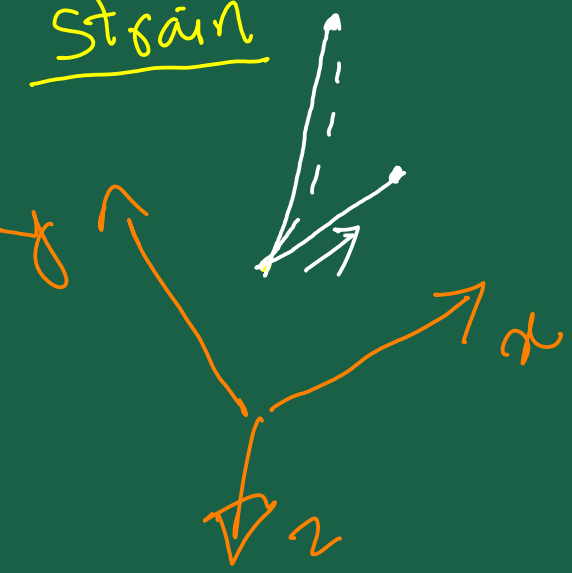


$$\lim_{A \to 0} \frac{\vec{F}}{A} = \vec{T}$$

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

$\theta_1 \approx \tan\theta_1 =$ ratio of lengths

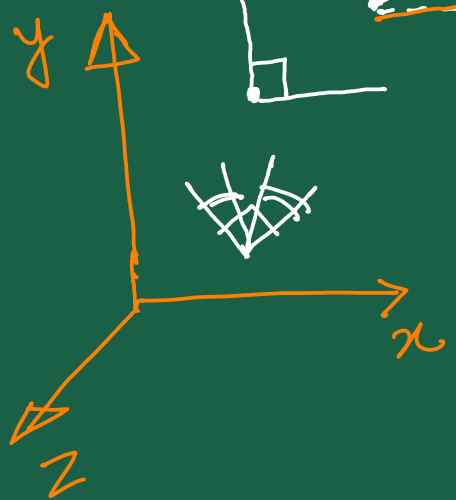
Strain



ε_{xx} ↑ Normal strain

$$\frac{\Delta l}{l}$$

Shear Strain



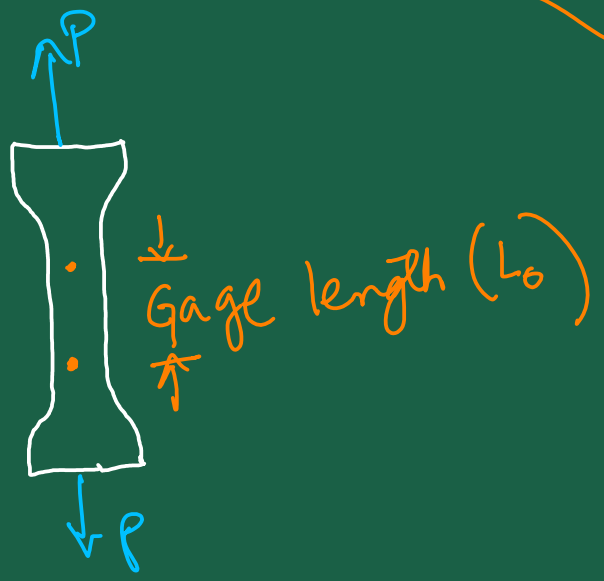
$\theta_1 + \theta_2 = \gamma_{xy}$

↑ shear strain

Nominal or engineering stress/strain

$$\sigma = \frac{P}{A_0}$$

A_0: Original area



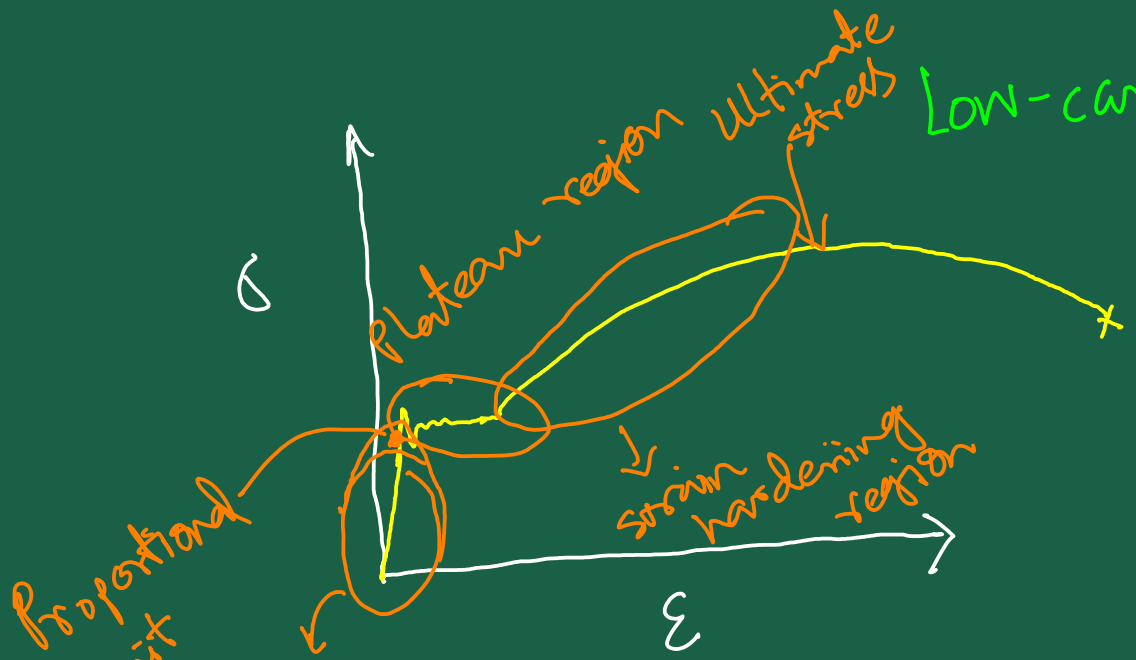
$$\frac{L - L_0}{L_0}$$

True stress/strain

$$\bar{\sigma} = \frac{P}{A}$$

A: Current area

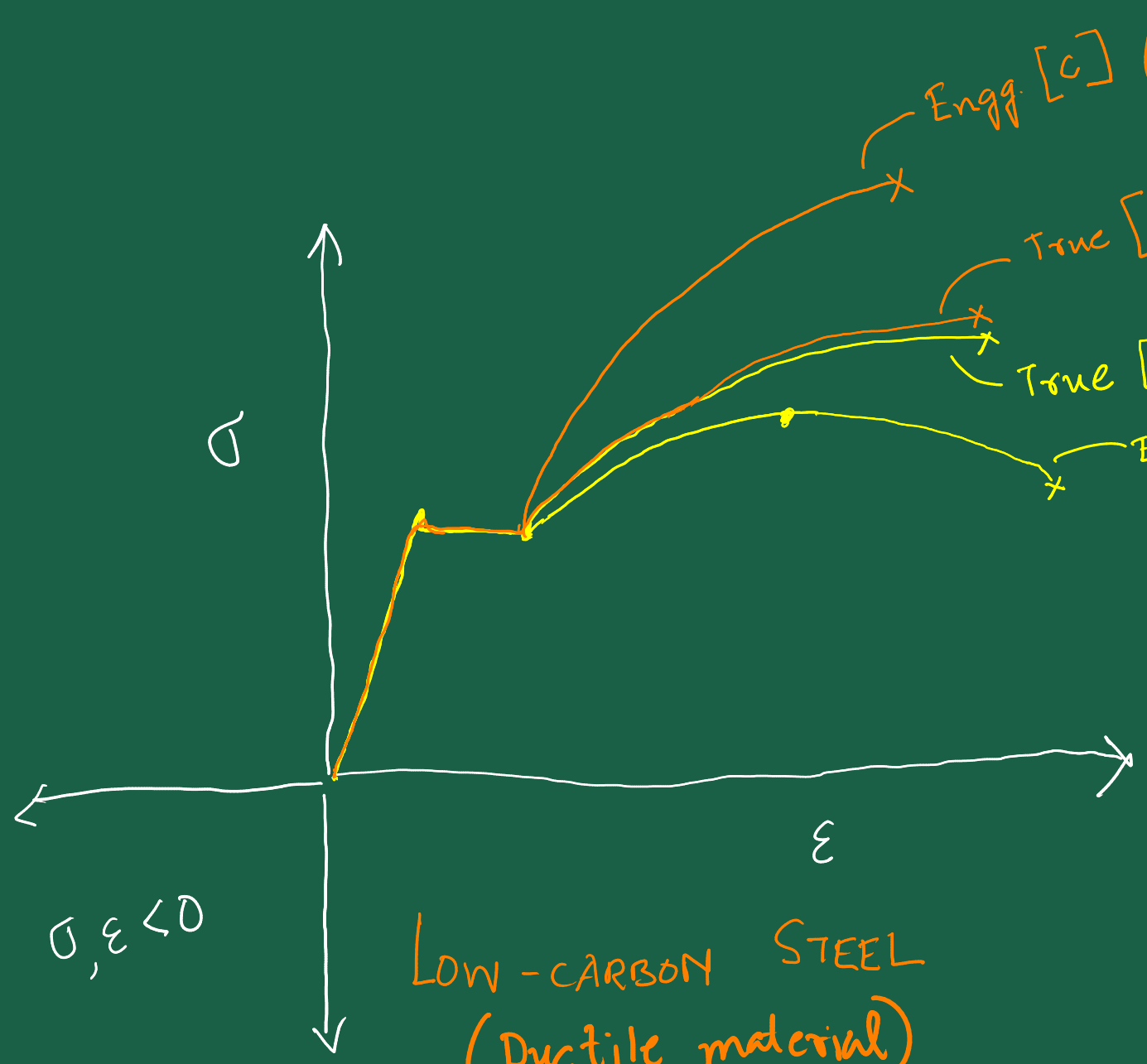
$$\varepsilon = \int_{L_0}^{L_f} \frac{dL}{L} = \ln \frac{L_f}{L_0}$$



Ultimate stress → Strength

$$\frac{\sigma}{\varepsilon} = E$$

Engineering stress - engineering strain diagram



LOW-CARBON STEEL
(Ductile material)

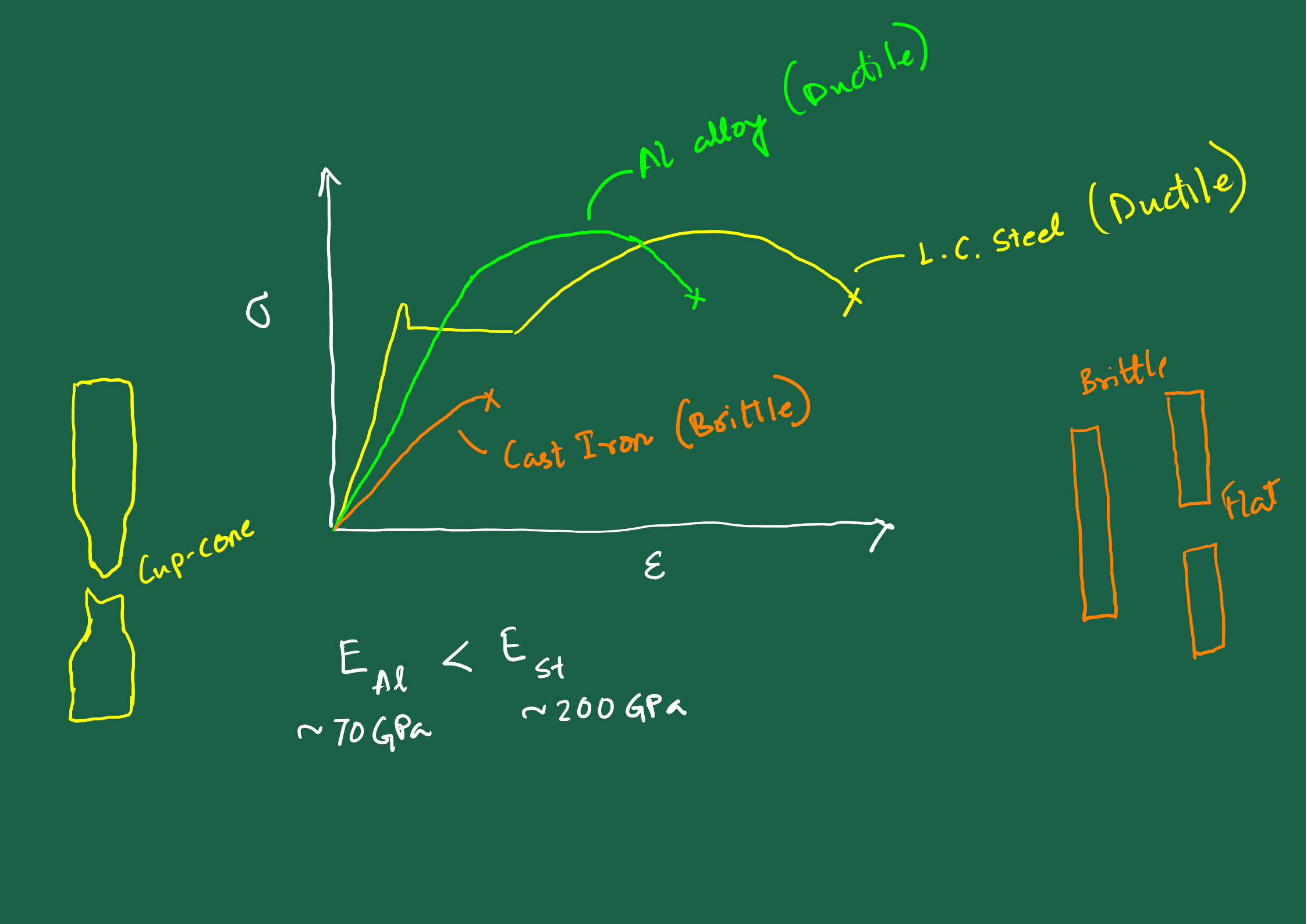
Tensile

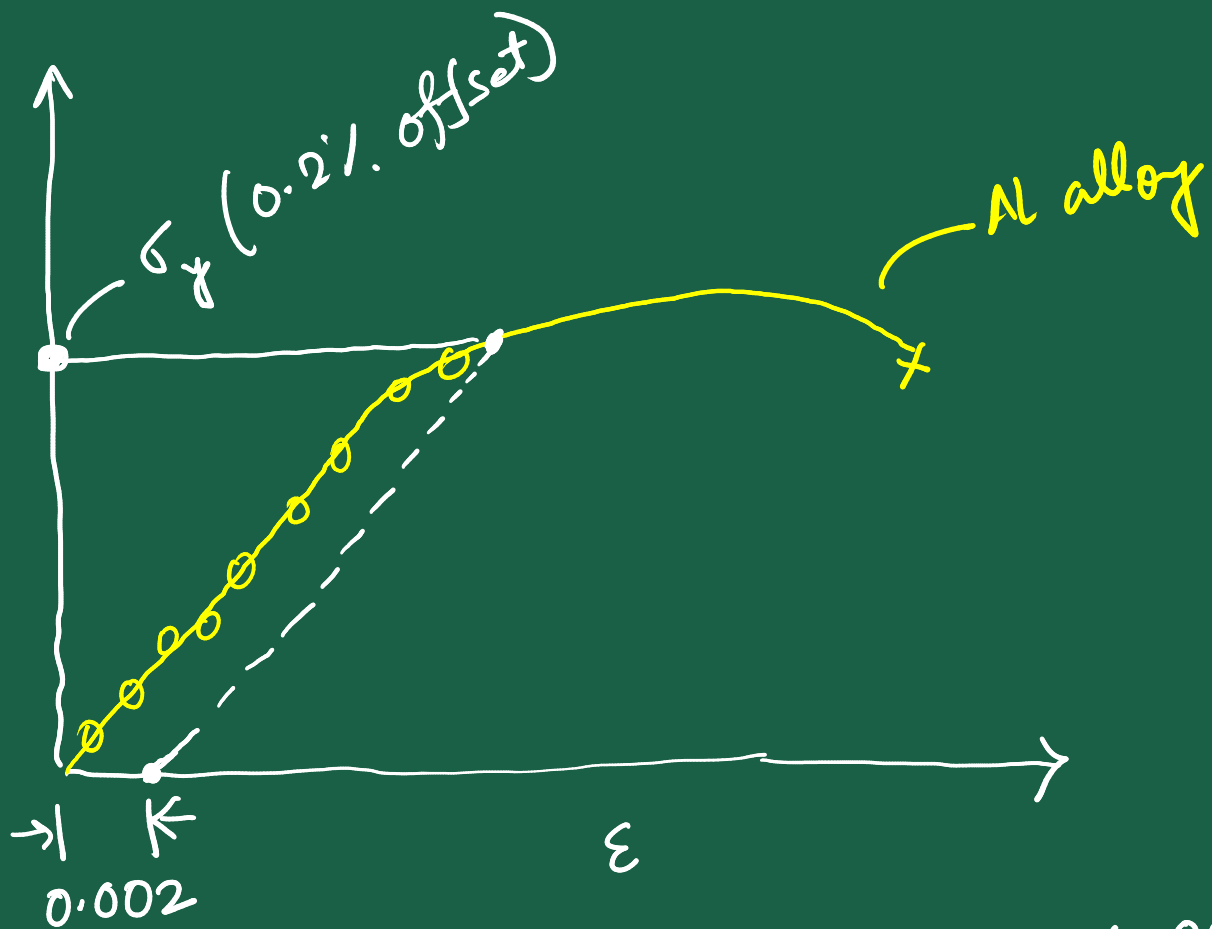
$$\sigma_t = \frac{F}{A}$$

$$\sigma_e = \frac{F}{A_0}$$

$A < A_0$

$\sigma_t > \sigma_e$


Al alloy (Ductile)
L.C. Steel (Ductile)
Cast Iron (Brittle)
σ
ε
Cup-cone
Brittle
Flat
$E_{Al} < E_{st}$
~ 70 GPa
~ 200 GPa



σ_y ↑ Yield

Offset : 0.2 % strain → $\varepsilon = 0.002$

0.4 % " → $\varepsilon = 0.004$