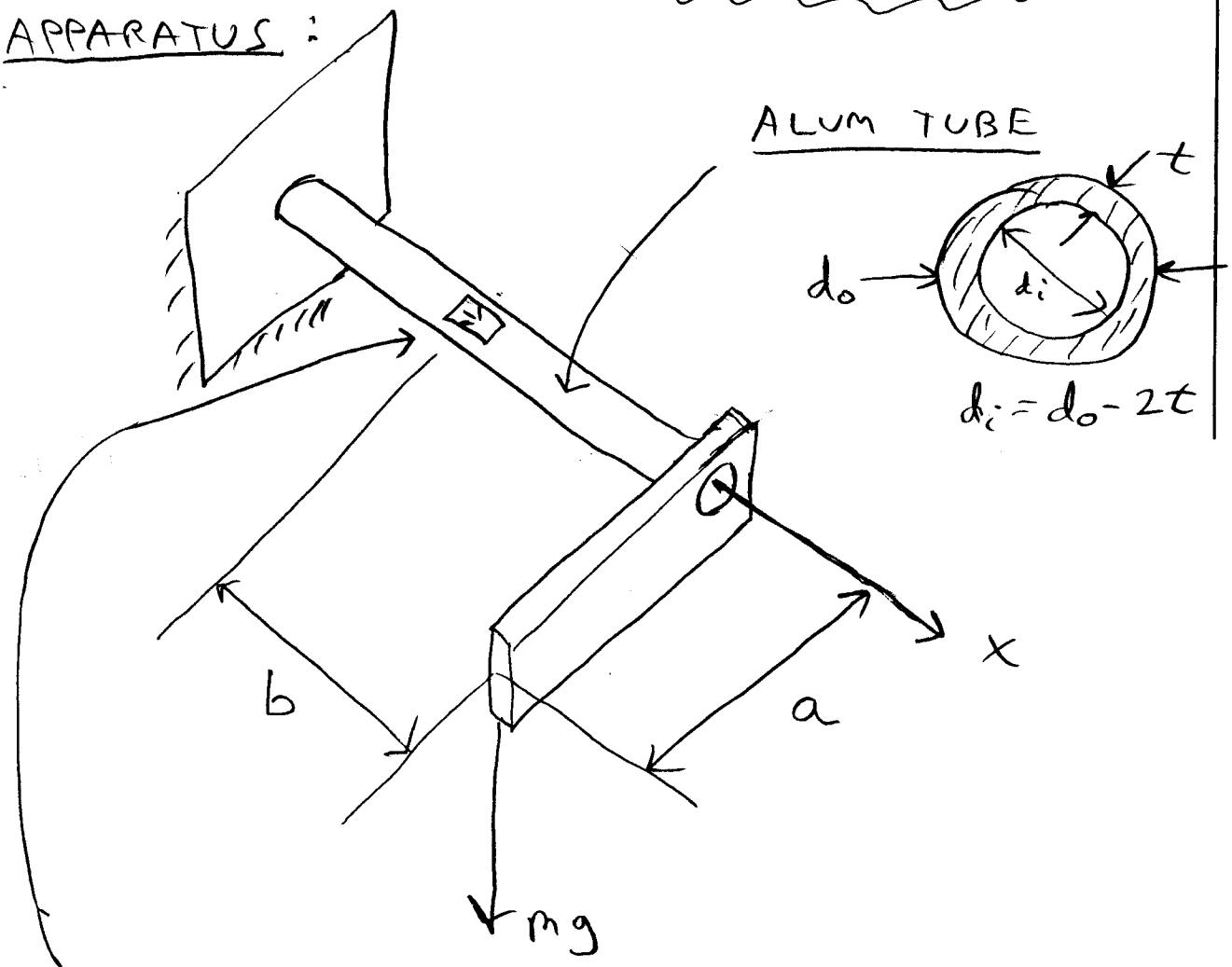
"FANCY SCALE"

STRAIN GAGE LAB : FIND $m_{ROSETTE}$ GIVEN $\varepsilon_1, \varepsilon_2, \varepsilon_3$

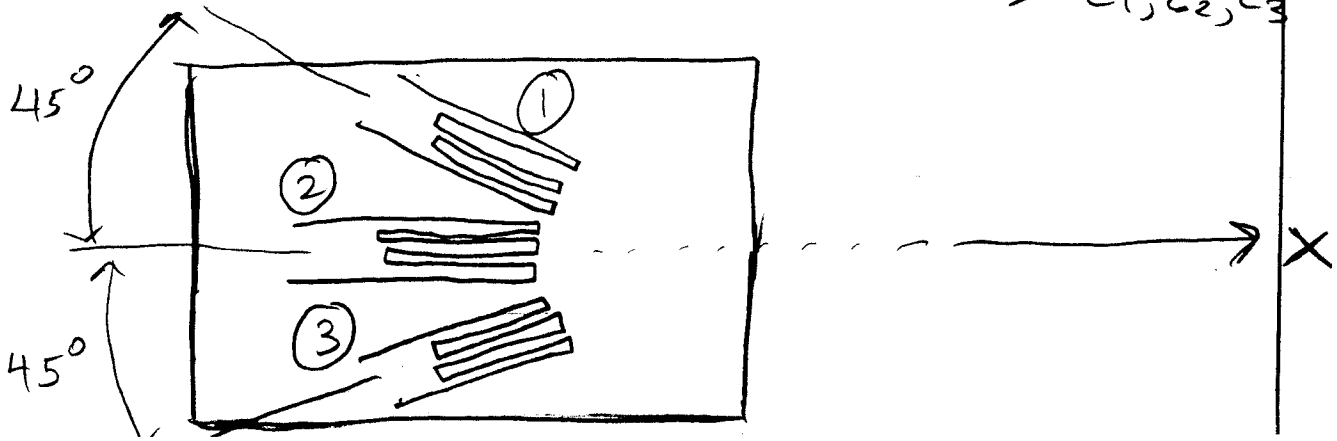
APPARATUS :



RECTANGULAR STRAIN GAGE ROSETTE

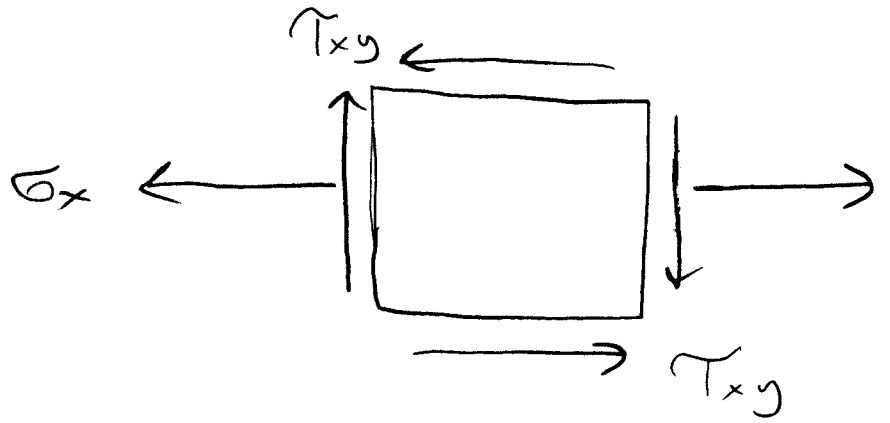
(MOUNTED ON TOP OF TUBE)

TOP VIEW :



$\Rightarrow \varepsilon_1, \varepsilon_2, \varepsilon_3$

THEORETICAL STATE OF STRESS:



BENDING

$$\sigma_x = \frac{Mc}{I}$$

$M = mgb$ (bending moment)

$c = d_o/2$ (dist. from N.A.)

$$I = \frac{\pi}{64}(d_o^4 - d_i^4)$$ (area mom. of inertia of section)

$$\sigma_x = \frac{mgbd_o}{2I}$$

TORSION

$$\tau_{xy} = \frac{Tc}{J}$$

$T = mga$ (torque)

$J = 2I$ (polar area moment of inertia for section)

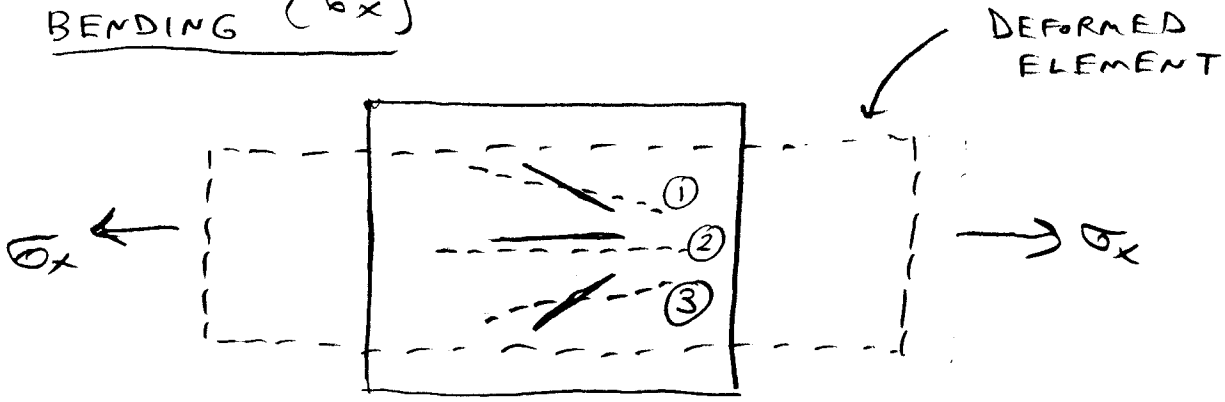
$$\tau_{xy} = \frac{mgad_o}{4I}$$

NOTE: $\sigma_x = \left(\frac{2b}{a}\right)\tau_{xy}$

SO FOR $2b > a$, BENDING IS DOMINANT FACTOR

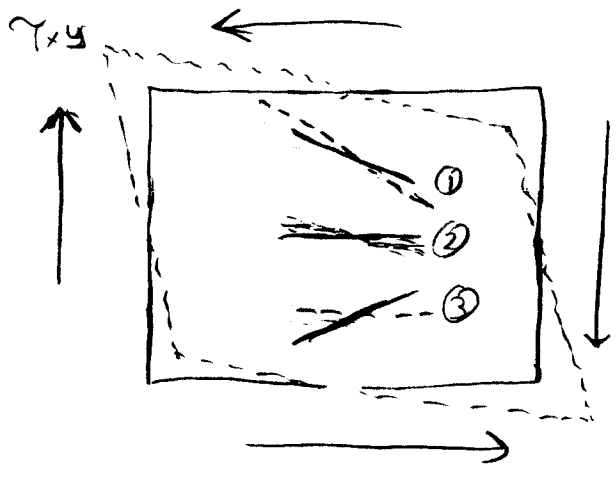
STRAINS RESULTING FROM STRESSES

DUE TO BENDING (σ_x)



$$\varepsilon_2 > \varepsilon_1 = \varepsilon_3 > 0 \quad (\text{ALL IN TENSION})$$

DUE TO TORSION (τ_{xy})



$\varepsilon_1 > 0$ (TENSION)

$\varepsilon_2 \tilde{=} 0$ ($\neq 0$ SINCE GAGE HAS FINITE SIZE (BUT CLOSE))

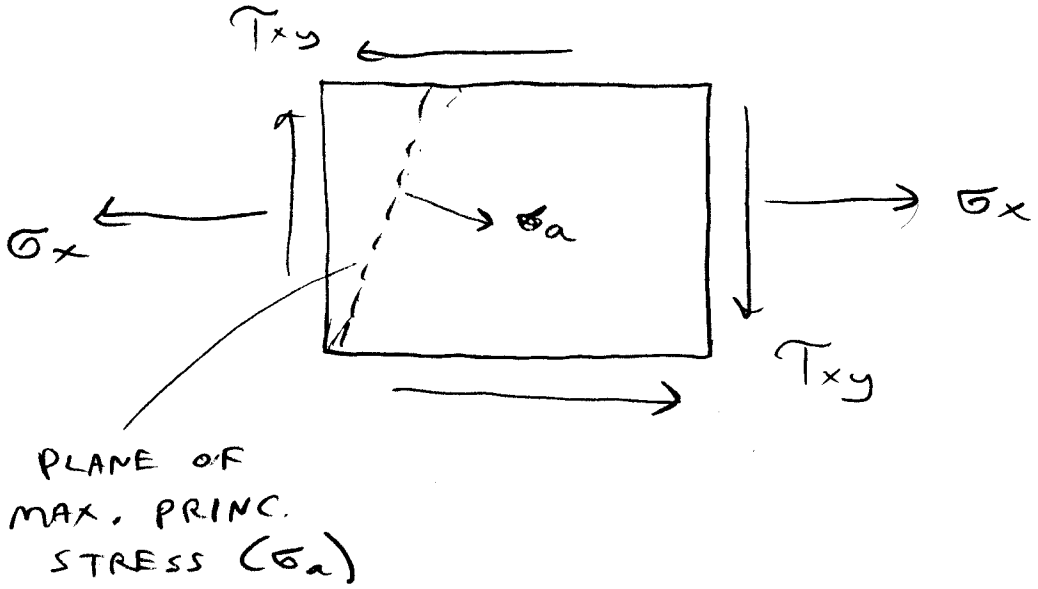
$\varepsilon_3 < 0$

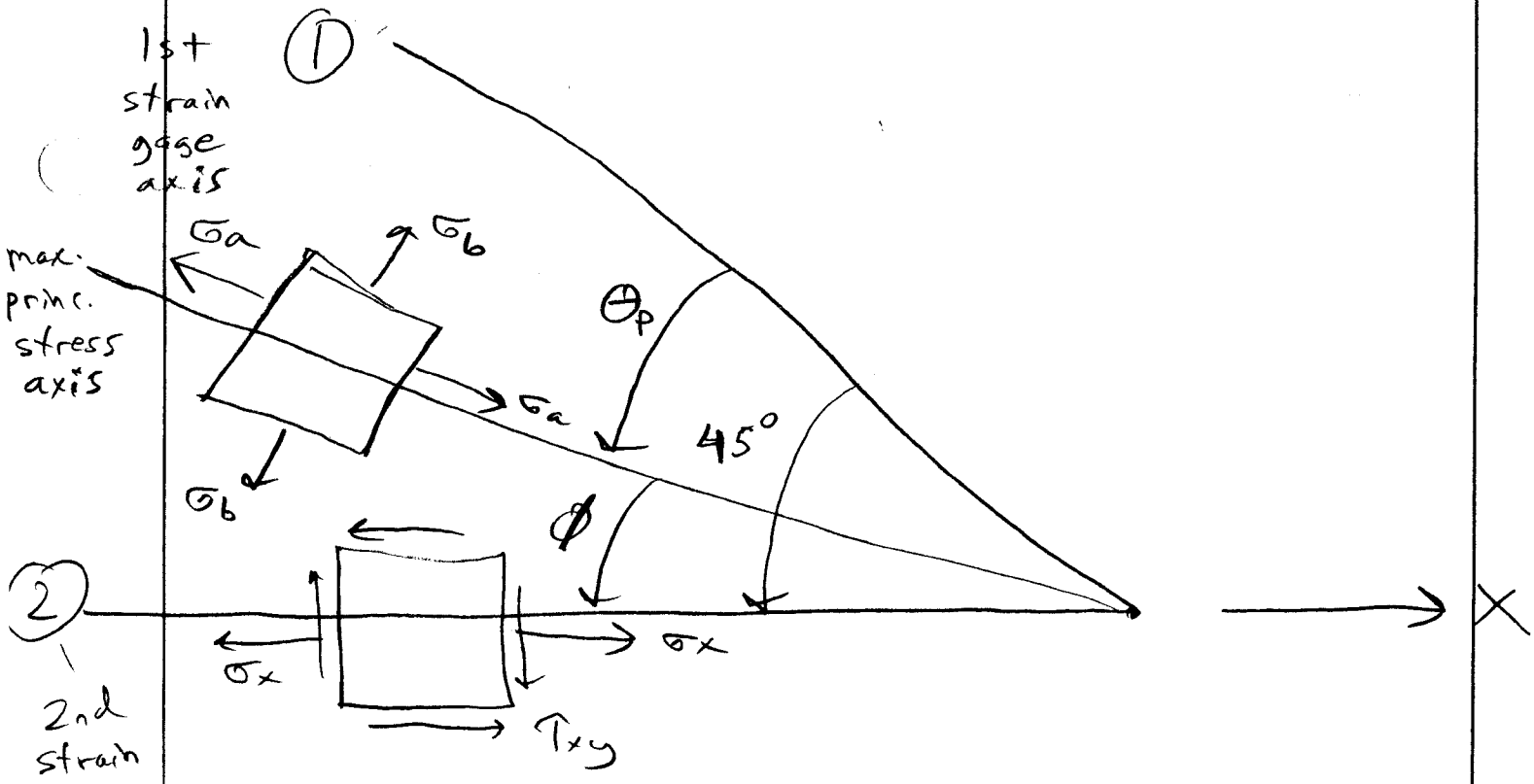
COMBINED EFFECTS

W/ BENDING DOMINANT,

$$\varepsilon_2 > \varepsilon_1 > \varepsilon_3$$

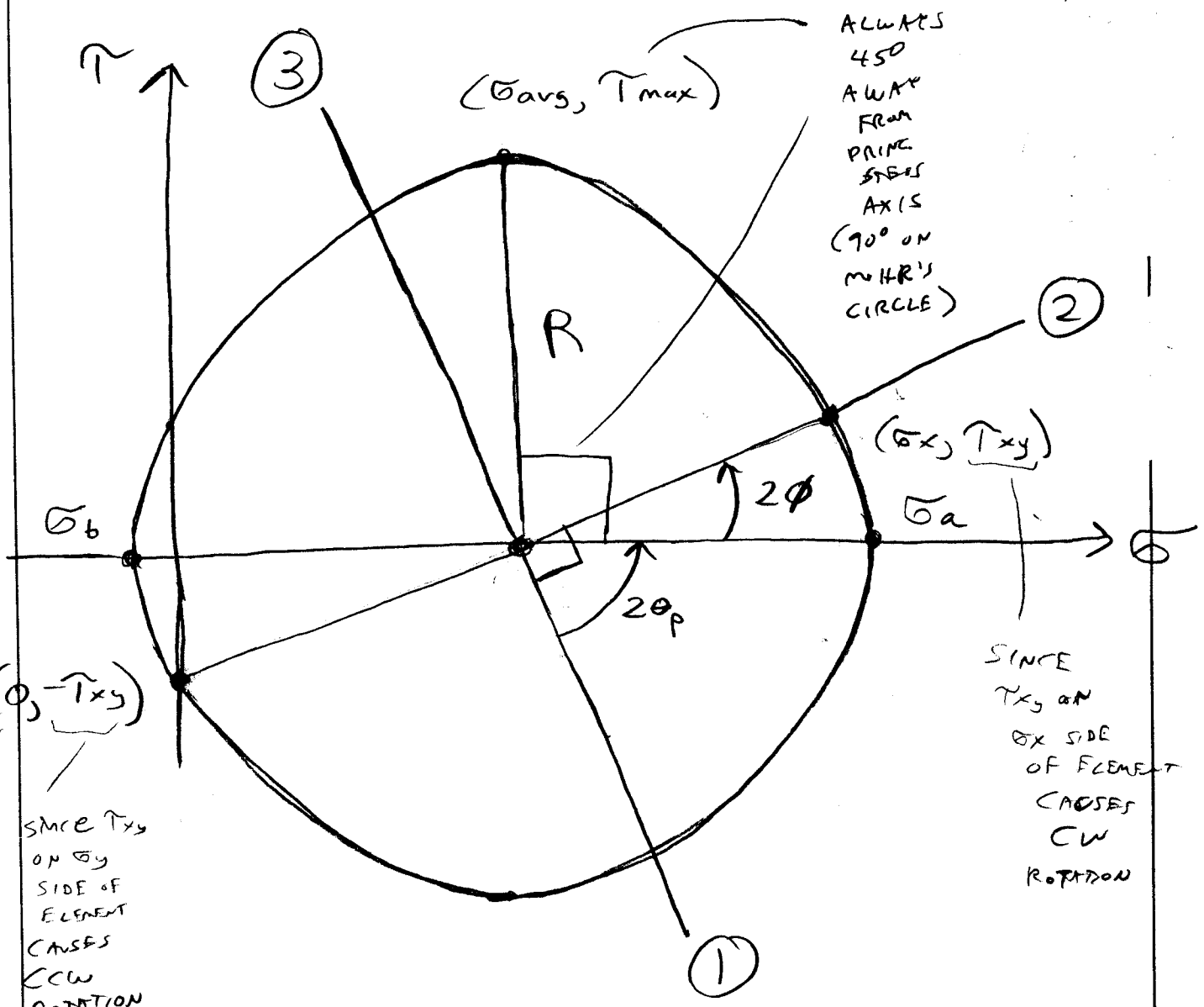
PRINCIPAL STRESS DIRECTION





$$\phi = 45^\circ - \theta_p$$

MOHR'S CIRCLE



$$\sigma_{avg} = \frac{(\sigma_a + \sigma_b)}{2}$$

$$R = \tau_{max} = \frac{(\sigma_a - \sigma_b)}{2}$$

$$\sigma_x = \sigma_{avg} + R\cos 2\phi$$

$$\tau_{xy} = R \sin 2\phi$$