

Lab 1 report guidelines

Calculations

- Evaluate the slopes of various lines on the X-Y plots. Use these slopes to calculate E, ν , G.
- Do an error analysis to estimate the error in your reporting values.
- Attach all the Excel spreadsheets with your report.

Report

- Briefly describe the stress strain equations used in both the experiments.
- Give a physical meaning of E, ν , G, use stress-strain/shear stress -shear strain plots to make your point clear.
- What is a strain gauge and how it works?
- What is a Wheatstone bridge? Why do we need it here?
- Briefly describe the experimental procedure and observations.
- Report measured values of E, ν , and G, and compare these to literature values for Aluminum.
- Report $\epsilon = 2G(1 + \nu) / E$ for three different materials. Are ϵ values close to unity? Estimate the experimental “measurement” error on ϵ value. Discuss possible error sources other than the experimental “measurement” error.

Notes

- The strain is related to voltage as follows:

$$\epsilon = \frac{-4V_r}{GF(1 + 2V_r)} (1 + R_l / R_g) \approx \frac{-4V_r}{GF(1 + 2V_r)} \quad ; \quad \text{Since } R_g \gg R_l$$

Here $V_r = (V_{out}/V_{in})_{strained} - (V_{out}/V_{in})_{unstrained}$

(Unstrained voltage is voltage at time $t=0$, when the strain gage is not under any load. Therefore the initial voltage is actually the unstrained voltage).

V_{out} = Voltage recorded

V_{in} = Voltage input (Excitation voltage) = 5 V

ϵ = Strain

GF = Gage factor = 2.055

R_g = Gage resistance

R_l = Line resistance

- Load is related to voltage as

$$F = V * P_s \quad F: \text{Load (kN)}, V = [V_{\text{Strained}} - V_{\text{unstrained}}] \text{ (V)},$$

$$P_s (\text{Load cell sensitivity}) = 10 \text{ kN/Volt}$$

- To calculate stress divide load by cross sectional area.
- Torque is related to voltage as

$$T = V * Q_s \quad T: \text{Torque (kN*cm)}, V = [V_{\text{Strained}} - V_{\text{unstrained}}] \text{ (V)},$$

$$Q_s : \text{Torque sensor sensitivity} = 0.1 \text{ kN*cm/Volt}$$

- You have to do a detailed error analysis for calculation of each parameter. See the online notes on EN 31 webpage to learn more about it. Take the error in load cell sensitivity and torque sensor sensitivity to be zero.