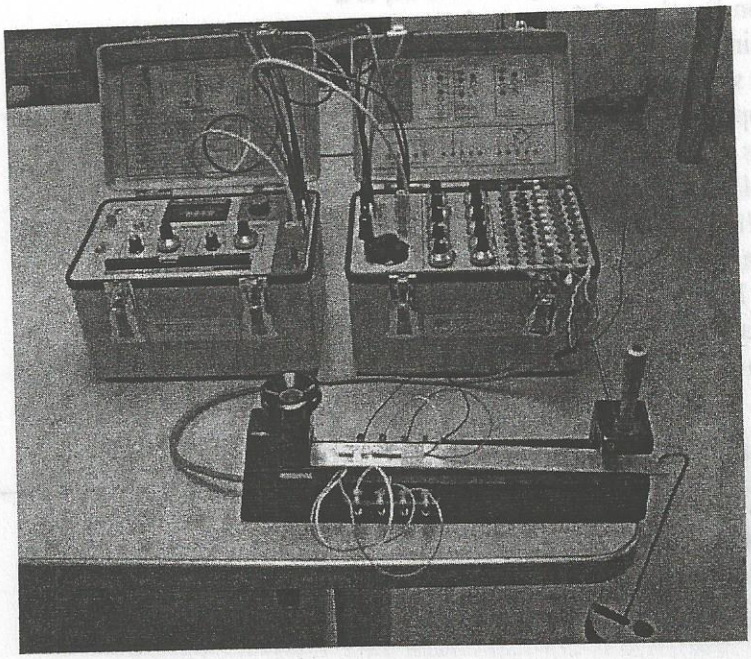
Experiment Five (5)
Principal of Stress and Strain

Introduction

Objective: To determine principal stresses and strains in a beam made of aluminum and loaded as a cantilever, and compare them with theoretical values.

Apparatus:

1. Cantilever beam, with Uniaxial, and Rosette Strain gauges
2. Wheatstone Bride and Strain Gauge Meter.



Materials and Equipment

1. Cantilever flexure frame
2. No. B101 (2024-T6 high-strength aluminum alloy beam); 1/8 x 1 x 12.5 in. (3x25x320 mm) or similar.
3. P-3500 strain indicator or equivalent (see Lab manual for details)
4. Micrometer
5. Calipers
6. Scale
7. Weights and hanger

(2) $\sigma = MC/I$

For cantilever beam $\sigma = (6PL_e)/(bt^2)$ (3)

Where b, and t are beam width and thickness and L_e is equivalent length of Beam, as shown above.

Preparation for the lab:

1. What is the maximum load that could be applied to an aluminum Beam with thickness of 5 mm and with of 24 mm and equivalent length of 20 cm? Use aluminum bars with average Yield Strength.
2. What will be the maximum deflection at the end tip?
3. Plot a graph, indicating Deflection and as function of load. Use this chart for application of Weights.
4. What is Hooke's Law?

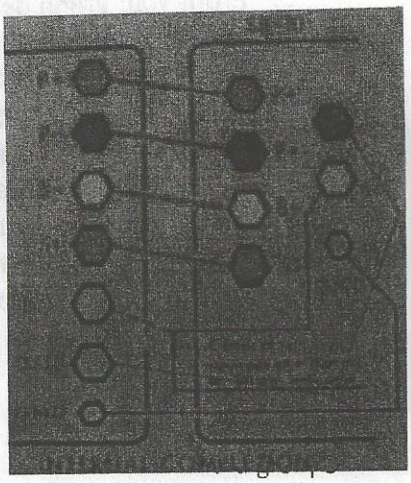
Procedure

The surface strain at the section of interest will be measured by a strain gage bonded at that point. The load will be applied in increments, and the corresponding strains recorded. The stresses and strains will be plotted to produce a stress-strain diagram rom which the modulus of elasticity is determined. Information should be entered on the attached work sheet. The steps to be followed are:

1. Measure and record the beam width (b), beam thickness (t), and effective length (L_e).
2. Record the gage factor, S_g, indicated on the beam.
3. Using Equation (3), determine the load, P, to be applied for a stress, σ, of 15,000 psi to result at the strain gage. This is the maximum load that can be safely applied to the beam without exceeding the yield stress, and is defined as P_{max} (a few pounds).

4. With the gaged end of the beam near the support, center the beam in the flexure frame and firmly clamp the beam in place.
5. Referring to Figure below (and Handout), connect the lead wires from the strain gage to the posts on the sides of the "flexor" frame. Referring to Figures connect the appropriate gage leads from the Flexor cable to the S-, P+, and D-120 binding posts of the P-3500 strain indicator. Note:

The strain gage employed in this experiment is used in a "Full-bridge" arrangement and Uniaxial Strains Only.



Connections:

1. The connections between strain indicator and balance unit are as the above photo

Possible Charts and Tables:

A. Observed measurements:

Load (Kg)	Experimental			Corrected Experimental		
	ε_1 (με)	ε_2 (με)	ε_3 (με)	ε_1' (με)	ε_2' (με)	ε_3' (με)
0.5						
1.0						
1.5						
2.0						

B. TABULATION OF LOADS, STRAINS, AND STRESSES:

LOAD (gm)	STRAIN (ε) μ/μ	STRESS (psi) (INCREASING LOAD)	STRAIN (με) (DECREASING LOAD)	STRESS (psi) (DECREASING LOAD)