13.3 Laboratory Procedure / Summary Sheet

Group: ____ Names: ___________________________ ________________________________

___________________________ ________________________________

The experimental setup is illustrated in Figure 13.4. We wish to determine the bending moment M (theoretical value = mgb), the torque T (theoretical value = mga), and the mass m by utilizing the strain gage measurements given.

Properties and geometry of the aluminum tube, strain gage rosette, and hanging mass:

E = 70 GPa, ν = 0.334
L = 0.395 m, a = 0.16 m, b = 0.182 m
d_o = 1.00 in, t = 0.085 in
F = 2.05
m = 1.492 kg

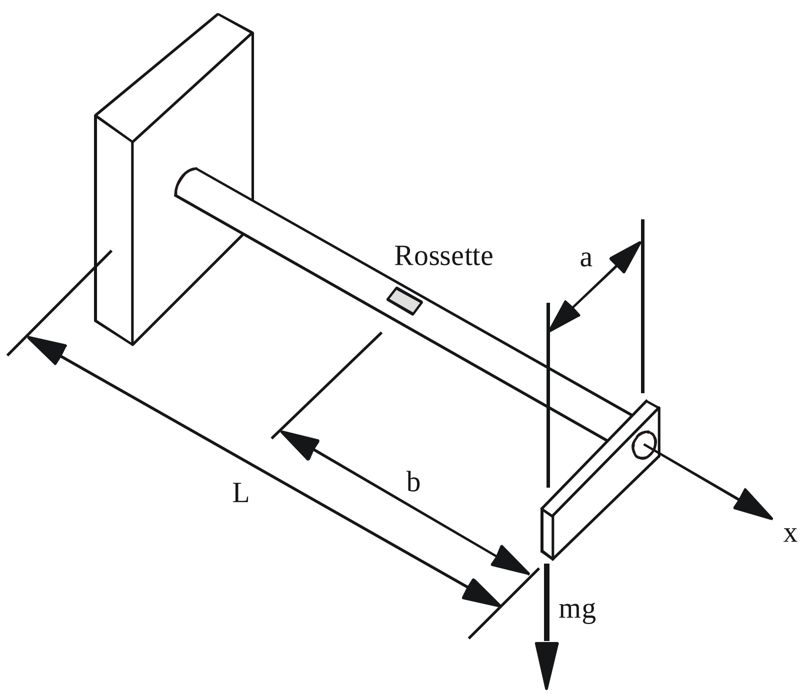

Figure 13.4 Experimental Setup

(1) It can be shown (see "Experimental Stress Analysis" by Dally and Riley, McGraw-Hill, 1991) that an active gage (with gage factor F) produces approximately F/4 output microvolts per microstrain and per volt excitation. NOTE - this is a unitless quantity: $\frac{\mu V}{\mu\varepsilon V}$.
Thus the equation relating strain to measured voltage is:

$$\varepsilon = \frac{V_{meas}/GAIN}{\left(\frac{F}{4}\right)V_{ex}} \tag{13.16}$$

For an excitation potential of 5 volts, we wish to find the gain of the amplifier required to produce a 2 volt output at 500$\mu\varepsilon$. Calculate the required gain assuming a gage factor of 2, realizing that the gage factors for the gages being used might be different.

Gain = ______________

(2) The strain gage rosette is connected to channels 1, 2 and 3 on the 2120A. Make sure that the gain multiplier control is set to x200. Now set the gain control dial based on the value calculated in part 1; i.e. set the gain control to gain/200 for channels 1 – 3.

(3) Make sure that there is no external load applied to the cantilever. Now adjust the bridge balance for each channel (1 – 3); First turn the EXCIT toggle ON and rotate the BALANCE control until both output lamps are extinguished. If the (-) lamp is illuminated turn the BALANCE control clockwise. Conversely, if the (+) lamp is illuminated turn the BALANCE control counterclockwise. If you are having difficulty distinguishing whether or not the lamps are illuminated, you may use a voltmeter attached to the DAC interface card to zero the bridge potential. Under no load conditions each channel should read zero volts; adjust the BALANCE control accordingly.

(4) Hang the mass from the center of the tube and record the gage voltages. Comment on these results.

(5) Hang the mass at the end of the lever arm. Using a voltmeter, read the voltages corresponding to gages 1, 2 and 3, and record them below. Also, be sure to measure the actual excitation voltage on each bridge using the selector knob and ports on the right side of the bridge unit.

V_1 = ______________ V_{1ext} = ______________

V_2 = ______________ V_{2ext} = ______________

V_3 = ______________ V_{3ext} = ______________

(6) Now calculate the strains in each of the three gages of the rosette; utilize the relationship from part 1.

ε_1 = ______________

ε_2 = ______________

ε_3 = ______________

(7) Knowing these strains determine the following:

a) The bending moment in the beam associated with the applied load.

b) The torque produced by the lever arm and the applied load.

c) The mass applied at the end of the lever arm.

(8) Submit your full analysis used to determine the value of the hung mass from the strain gage voltage measurements. Compare the calculated result to the actual value of the mass. Submit your work to your TA at the following week's Lab meeting. Comment on various possible sources for error in the measurements and analyses.