MER 214 Strength of Materials

Lab 3 Poisson's Ratio

(some material from Dr. Ron Bucinell)

BACKGROUND

We will examine the strain transverse to the loading direction in this lab using an electro-mechanical screw-driven load frame, a biaxial extensometer and biaxial strain gages and conducted in the elastic range of the materials tested.

PRELAB

Find values for the Young's modulus *E*, the Poisson's ratio ν and the shear modulus *G* for aluminum, brass and steel. Be prepared to calculate the Young's modulus and Poisson's ratio using strains from extensometers and strain gages.

EXPERIMENTAL PROCEDURE

1. Acquire a tensile specimen from the Instructor.
2. Measure and record specimen dimensions appropriate to reducing and reporting derived properties. The data recorded by the computer will be time, load and crosshead and extensometer displacements and strains from gages. Stress and extensometer strains and derived properties must be calculated.
3. Secure the specimen in the 10 kip electro-mechanical screw-driven load frame.
4. Attach the biaxial extensometer.
5. Connect strain gages to scanner. Attach lead wires from the strain gages attached to the specimen to the strain cards as shown (single wire to P+, and common wires to S- and D). Connect the strain cards into strain channels 1 and 2 on the back of the Vishay Model 5100 Scanner as shown. Note that on channels 15 and 16 two additional connectors are present. These connectors are load and cross-head displacement inputs coming from the load frame. After the strain card is attached, zero the two strain channels, the load channel and the crosshead displacement channel. Calibrate the strain channels prior to starting the test. Do not calibrate the other channels: they are calibrated prior to the lab.
6. Manually apply approximately a 10 N pre-load.
7. Start the test program to apply a quasi-static load to the specimen. Stop the test at the following load levels: 13 kN for aluminum, 15 kN for brass and 17 kN for steel.
8. Download the data text files from all groups from:

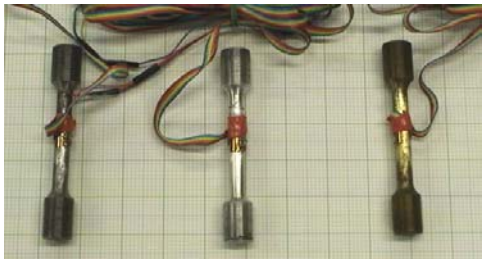
engineering.union.edu/~rapoffa/MER214/laboratories/lab3data

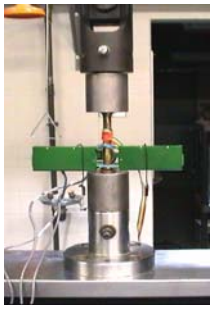
DATA ANALYSIS

1. Determine Poisson's ratio and Young's modulus and Poisson's ratio from the strain gages and biaxial extensometer.
2. Compute the shear modulus from

$$G = \frac{E}{2(1+\nu)}$$

3. Compare these properties to their published values.





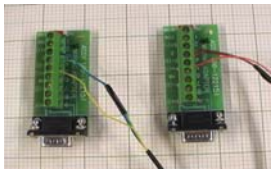


Table 1. Specimen dimensions as measured by groups with digital calipers.

Dimension (mm)	**Material**					
	Steel 1	**Steel 1**	**Aluminum 1**	**Aluminum 2**	**Brass 1**	**Brass 2**
Original diameter, d_0	9.51	9.52	9.58	9.53	9.73	9.67
Original axial 1 gage length, $L_{1\,0}$	27.00	28.12	27.45	27.30	27.79	27.84
Original axial 2 gage length, $L_{2\,0}$	27.00	27.72	26.72	27.57	27.74	27.72