ME 305 Fall 2014

Lab 2: Torsion

Grading Rubric

**Introduction (10 points)**

* What are the objectives of this lab?
  + Review Coulomb torsion theory and observe twisting of uniform shafts (4 points)
  + Test validity of Coulomb torsion theory
    - Test prediction of linearity (2 points)
    - Validate Coulomb torsion by measuring shear modulus and comparing it to accepted values (2 points)
* Why is this important? How is it relevant for engineer/scientists? (2 points)

**Theory (15 points)**

* (2 points)
* (2 points)
* (2 points)
* (2 points)
* (1 points)
* No rotation at one end (boundary condition)/assumptions for equations (3 points)
* Uniform cross section, one material (3 points)
* All variables must be defined; equations explained

**Measurements (15 points)**

* *Equipment (4 points)*
  + Megazord apparatus
  + Samples – 3 materials
  + Ruler/micrometer
  + Weights
  + Level
  + DLAG
* *Procedure (11 points)*
  + Level Megazord (1 point)
  + Measure lengths and diameters of samples (1 point)
  + Load sample, fit hexagons into slots, clamp one end (2 point)
  + Add 10 g mass to end of wire (1 point)
  + Zero DLAG and record initial angle measurement (2 points)
  + Add weight in 20 g increments until total of 130 grams, record angle after each added weight (2 points)
  + Loosen clamp before removing weights and sample (1 point)
  + Repeat for remaining samples (1 point)

**Results and Analysis (25 points)**

* Table with all measurements of the samples and apparatus (4 points)
* Angle of twist data with error (2 points)
* Torque values (2 points)
* J values (1 point)
* Torque vs. angle of twist plot for each material (3 points each)
  + Fit line to get slope (k)
* Plot for all materials with error bars for ϕ; could be either ϕ vs. T or T vs. ϕ (2 points)
* Table with experimental shear modulus (G) values with errors, accepted G values for each material, and difference between experimental and accepted (5 points)

**Discussion and Conclusion**

* *Discussion (20 points)*
  + Question 1 (6 points)
  + Question 2 (9 points – 6 points for steel and why, remaining 3 points for discussion of other 2 materials)
  + Sources of error (3 points)
    - Deformations in samples
    - Measurements of dimensions
    - Only 1 sample tested for each material
    - Friction between load wire and torque wheel
    - Calibration error due to taking off and adding weight
    - Too few data points
    - Error due to poor level
  + How can the lab be improved? (2 points)
* *Conclusion (5 points)*
  + Did the lab achieve its purpose? What was accomplished?
  + What did you learn?
  + Key results of the lab? Conclusions made based on results?
  + Why is this experiment useful?