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CE 133/ME 180, Spring 2004      GSI: Roger Sauer

# Lab 2: 02/04/04
# **Convergence**

1. Consider the second problem from the first homework, that is a bar of length $L$ clamped at $x = 0$ and with an applied torque $\hat{T}$ at $x = L$. The shear modulus varies linearly across the bar, i.e $G(x) = G_1 + G_2 x$. Take $L = 100mm$, $\hat{T} = 1000Nmm$, $G_1 = 100MPa$, $G_2 = 100MPa/mm$ and $J = 200mm^4$. Run the problem on femlab. Pick 1,2,4,8,... equally spaced <u>linear</u> elements.

2. Once you are sure you get the right answer close and restart femlab. Now input the torsion problem again by executing all necessary commands only once. Solve once and save as *m-file*. Open the file and try to find where the number of elements are set.

3. Modify the number of elements in the *m-file* and run the file from matlab. Execute the commands given on the blackboard to extract the FE solution and compare it with the exact solution.

4. Download the driver file *driv.m* from the class folder and run it with your *m-file*. Does your FE solution converge?

5. Extra credit: Go back into femlab and rerun the torsion problem. Now instead of refining the mesh uniformly make local refinements only. See if you get a small error with much less elements as before.