An Active Learning Approach To Teaching Mechanics of Materials

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The Course

- 200-level course taken in the sophomore or junior year (ME 223)
- Often called “Mechanics of Materials” or “Strength of Materials”
- Problem solving course
- Difficult subject matter
- Homework-intensive
The Difficulty

• Visualization of small movements – how much does a large steel beam deflect?
• Visualization of internal stresses – stress cannot be measured directly, yet we expect students to understand it.
The Difficulty

- Students in ME 223 need to develop critical thinking and problem solving skills.
- The course introduces many new and complex equations.
• A sample homework problem – determine the maximum deflection, $\delta_{\text{max}}$
An Active Learning Approach

- To help students visualize the small movements in materials that don’t move much...
An Active Learning Approach

use materials that do.
An Active Learning Approach

• Objectives
  - Teach the material more effectively
  - Replace lecture time wisely
  - Encourage in-class problem solving in groups
Teaching the Material

- Students can visualize the concepts when experimenting on a material that responds perceptibly to forces.
Torsion Box

- Torsion box shows twist when a torque is applied
Torsion Box
Beam Bending

- No measurable bending with in-class demonstration of steel or concrete beams
- Measurable bending with stiff foam material
• Measurable “Squish to Squash” (Poisson’s) ratio with stress-ball material
Effective Replacement of Lecture Time

• Normal class is about 30 minutes lecture, and the remainder working example problems
• With active learning method – lecture is still about 25 minutes and example problems and in-class experiments take up the remainder
Effective Replacement of Lecture Time

• Most class periods are unchanged
• Often a visualization “prop” is used to help students visualize the more difficult topics
In-Class Group Problem Solving

• Students separated into groups of 3 or 4
• One group comes forward (on a volunteer basis) and conducts the short experiment
• The other groups record the data and measurements, and calculate the material response or property
Assessment

• Students’ learning
  - Students quizzed on material the class period after conducting the experiment
  - Measurable improvement

• Instructor’s teaching
  - Informal evaluations
  - Students enjoy a break in the lecture and the use of visual aids
Conclusion

• The use of visual aids and group learning has helped students understand the concepts presented in this difficult course.

• I will continue to develop similar visual aids to further improve my teaching and the students’ learning and interest in the course topics.