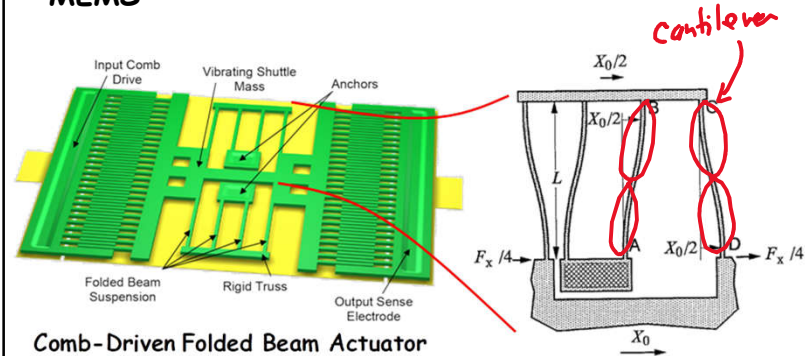


Lecture 12: Mechanics of Materials II

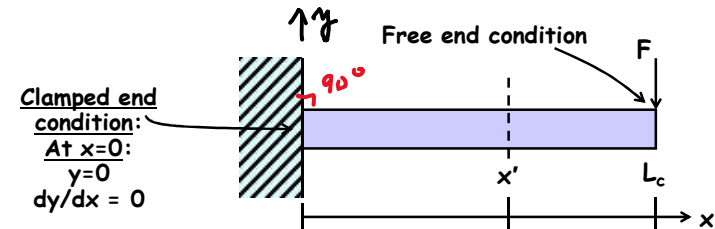
- **Announcements:**
- HW#3 due Tuesday, 3/5, at 9 a.m.
- Module 8 on "Microstructural Elements" online
- -----
- Reading: Senturia, Chpt. 8
- Lecture Topics:
 - ↳ Stress, strain, etc., for isotropic materials
 - ↳ Thin films: thermal stress, residual stress, and stress gradients
 - ↳ Internal dissipation
 - ↳ MEMS material properties and performance metrics
- -----
- Reading: Senturia, Chpt. 9
- Lecture Topics:
 - ↳ Bending of beams
 - ↳ Cantilever beam under small deflections
 - ↳ Combining cantilevers in series and parallel
 - ↳ Folded suspensions
 - ↳ Design implications of residual stress and stress gradients
- -----
- Last Time:
- Going thru Module 7 on "Mechanics of Materials"
- Now, continue with this ...

- Springs and suspensions very common in MEMS
- Coils are popular in the macro-world; but not easy to make in the micro-world
- Beams: simpler to fabricate and analyze; become "stronger" on the micro-scale → use beams for MEMS



Comb-Driven Folded Beam Actuator

Problem: Bending a Cantilever Beam



- **Objective:** Find relation between tip deflection $y(x=L_c)$ and applied load F
- **Assumptions:**
 1. Tip deflection is small compared with beam length
 2. Plane sections (normal to beam's axis) remain plane and normal during bending, i.e., "pure bending"
 3. Shear stresses are negligible

