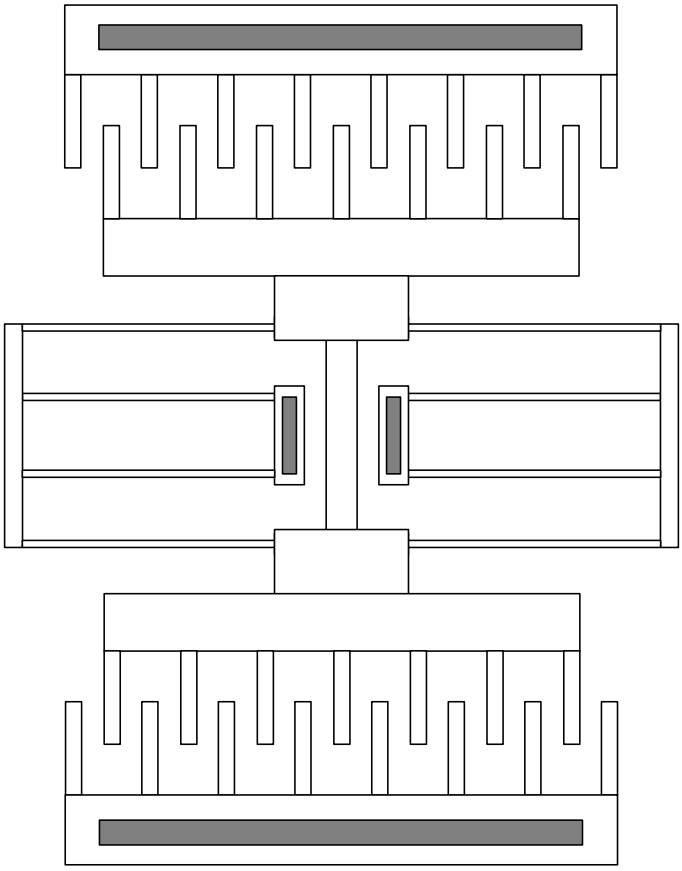
Problem 1: Comb-Drive Array

Below is a typical comb-drive resonator. Design, using your CAD tool of choice, an array of comb-drive resonators using layer poly1 in the MCNC/MUMPS process.



- Design a design-rule-correct bonding bad with a metal square 100 microns on a side.
- Create a folded spring suspension and turn it into a pcell parameterized by the length of the beams.
- Create a comb drive unit cell that can be tiled as an array of instances.
- Create a 3x3 array of resonators, varying the beam length from 100 to 300 microns, and varying the number of comb teeth from 10 to 30.
- Make sure that all electrical connections to the array are made from bonding pads on the perimeter. Share pads when it makes sense.
- Remember to include grounding planes under moving, biased objects

a) Calculate the spring constant of the biggest and the smallest resonator support of your array assuming that the end beams are perfectly stiff *(hint: HW#3 problem 4)*.
b) Calculate the mass of the whole structure for the biggest and the smallest resonator using the dimensions you chose in your design.
c) Calculate the effective mass using Rayleigh's method for the biggest and the smallest resonator assuming that the end beams are perfectly stiff.
d) Calculate the expected static deflection, resonant frequency, and resonant amplitude of the biggest and the smallest resonators of your array. Assume a 45V DC bias and a 5V AC excitation.
e) Use SUGAR to estimate the resonant frequency and amplitude of the biggest and the smallest resonators of your array. (turn in Bode plot of freq. response)

Problem 2: Design Practice

Design an electrostatically actuated POLY1 structure in the MUMPS process that has a deflection of at least 20 microns. You may apply up to 15Volts to your actuators. Try to minimize the size of the smallest circumscribed square that will contain your layout. What's the size of your design? Please print out your design here.