# MEMS cantilever beam deflection and restoration using electrostatic force.

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The cantilever under consideration is shown in FIGURE 1.0 below.

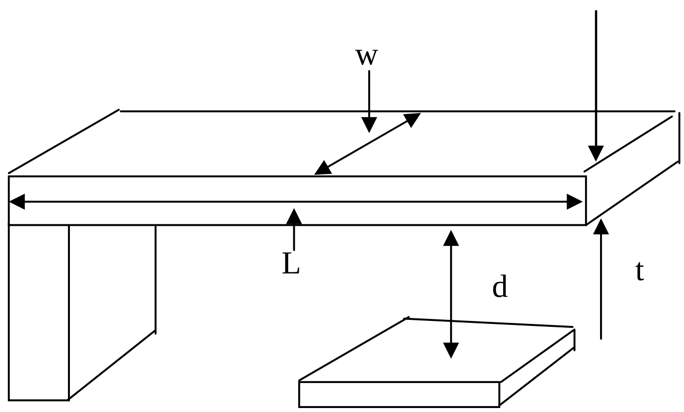


Figure 1.0

If an electric field is applied between the cantilever and the baseplate, B an electrostatic force is created. This force will bend the cantilever towards the baseplate. As the field is increased the deflection will increase. When the deflection reaches approximately 2/3 of the total deflection the process will speed up and the cantilever will touch the baseplate. The voltage at which this happens is the pull-in voltage.

The electrostatic force generated is given by:

$$F = \frac{1}{2} eAV^2 \frac{1}{g^2} \qquad (1)$$

Here,

e = permittivity of the medium between the plates
g = distance between the plates

V = applied voltage between the plates
A = effective area of the plate

The restoring force that moves the cantilever back to its original position upon removal of the electrostatic force is the spring force of the cantilever. (*Note that these considerations are only valid within the elastic limits of the cantilever*.)

The restoring force is given by:

Fres = K*deflection.

where K, the spring constant is given by:

$$K = E*w*t^3 /(4*L^3) \text{ ( N/m)} \qquad (2)$$

Here,

E = Young’s modulus of the cantilever material ( Gpa)
w = width of the cantilever ( meter)
t = thickness of the cantilever ( meter)
L = length of the cantilever( meter)

The pull-in voltage is given by:

$$Vpi = \sqrt{\frac{8Kg^3}{27eA}} \qquad (3)$$