Intro to Mechanics
GEEN 1400-040
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Fall 2001

Consider a bar clamped to the edge of a table, so the tip can move. The deformation can be described by

$x = \frac{FL^3}{3EI}$, thus $F = \frac{3EI}{L^3}x$

where

x	Movement at tip; displacement
F	Applied force
L	Length of bar
E	Young's modulus, a material property that describes springiness
I	Rectangular moment of inertia; $I = \frac{bh^3}{12}$
b	Base; width of bar
h	Height; thickness of bar

Young's Modulus E: Approximate values, and density

Steel	30×10^6 psi	7.86 g/cc
Aluminum	10×10^6 psi	2.7 g/cc
Brass	15×10^6 psi	8.5 g/cc
Copper	17×10^6 psi	8.96 g/cc
Wood	1×10^6 psi	0.6 g/cc
Glassy plastic	250×10^3 psi	1.4 g/cc

For a bar with simple supports on the ends, and an applied force F in the center

$x = \frac{Fl^3}{48EI}$, where x is the maximum displacement at the center.

For a tube with inner and outer diameters d_i, and d_o, moment of interia

$I = \frac{\pi}{64}(d_o^4 - d_i^4)$

For a box section, compute I for a solid box, then subtract I for the empty internal space.