Column Buckling

Euler load, effective length, slenderness.

Civil Engineering

A slender column buckles well below its squash load, and slenderness decides which failure comes first.

$$P_{cr} = \pi^2 EI / L_e^2 \cdot \lambda = L_e / r \cdot r = \sqrt{(I/A)}$$

Pinned both ends The base case.	$L_e = 1.0\ L$
Fixed both ends Theoretical value.	$L_e = 0.5\ L$
Fixed base, free top A flagpole.	$L_e = 2.0\ L$

THE COMMON MISTAKE

× Checking only the major axis

✓ Check every axis and take the worst

A column buckles about the axis with the smallest radius of gyration and the longest effective length, and those need not be the same axis.

Educational reference. Euler assumes an ideal elastic strut. Real columns use code curves for imperfection and yield.