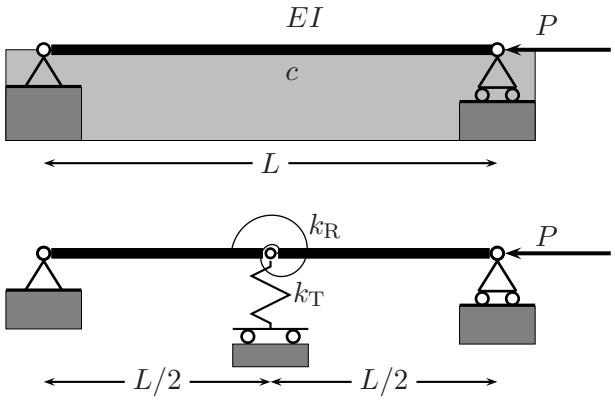
RAK-33030 Stability of structures

1. exercise – equilibrium paths of simple structural models

1. Consider a beam on an elastic foundation. Idealize the beam as a discrete system of two equal length rigid bars connected by a linear rotational spring characterizing the bending rigidity of the beam. The foundation can be idealized with a linear translational spring. Determine all equilibrium paths and the critical load P_{cr}. The foundation coefficient is $c = \beta\pi^2 EI/L^4$, where β is a dimensionless constant. The spring constants are thus $k_{\mathrm{T}} = \frac{1}{2}cL$ and $k_{\mathrm{R}} = \frac{1}{4}\pi^2 EI/L$. Are the equilibrium paths near the critical point stable or unstable?



2. Determine all equilibrium paths of the simple rigid bar-spring system. Investigate stability of these paths. Determine also the possible critical points and the corresponding load values P_{cr}. The constitutive relation of the spring is

$$M = k_1\phi + k_2\phi^3, \qquad k_1 > 0.$$

Investigate the effect of the nonlinear term k_2, i.e. use different values of the ratio $\alpha = k_2/k_1$.