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 $\beta$ is a dimensionless constant. The spring constants are thus $k_T = \frac{1}{2}cL$ and $k_R = \frac{1}{4}\pi^2 EI/L$. Are the equilibrium paths near the critical point stable or unstable?

![Beam on Elastic Foundation](image)

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

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

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

![Rigid Bar-Spring System](image)