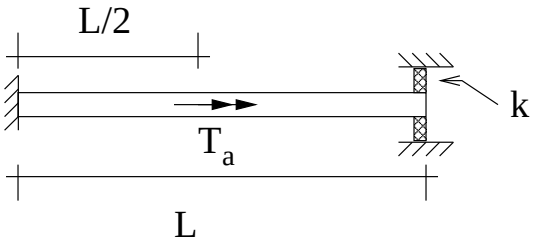
HW 1: Due Wednesday Feb. 10

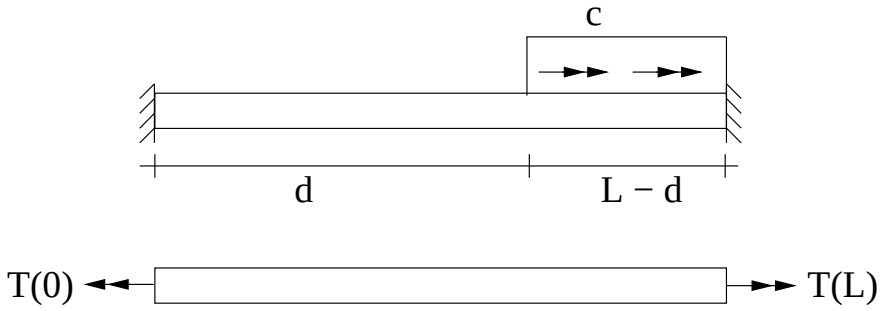
1. An elastic circular bar is fixed at one end and attached to a spring support at the other end. The torsional stiffness of the spring support is $k = 5 \times 10^5$ N m/rad. If a concentrated torque of magnitude $T_a = 500$ N m is applied in the center of the bar, what is the rotation at the end of the bar, $\phi(L)$, where $L = 300$ mm? Assume a shear modulus $G = 10$ kN/mm^2 and polar moment of inertia $J = 2000$ mm^4. **You should modify your MATLAB code from the lab to solve this problem.** You should double check your code by looking at the limits of zero and very high spring stiffness (as well as by hand, if you have the extra time).



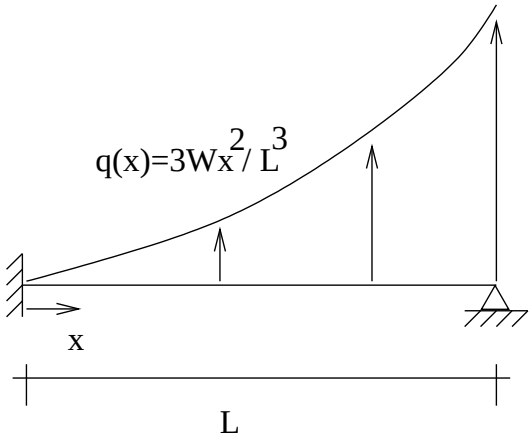
2. An elastic solid circular bar of length L with polar moment of inertia J and shear modulus G is built-in at both ends and subject to a system of distributed torques:

$$t(z) = \begin{cases} 0 & z < d \\ c & z \geq d \end{cases}$$

Determine the support torques $T(0)$ and $T(L)$ at the two ends of the bar. Solve this problem using the governing ODE.



3. In the statically indeterminate beam shown, find the reactions at the wall by integrating the differential equation for the deflection of the beam.



4. For the beam shown below, with imposed deflection Δ, find the deflection curve $v(x)$ and the location and magnitude of the maximum bending stress. Assume EI is constant and the maximum distance from the neutral axis to the outer fibers of the beam is c. Use the governing ODE to solve this problem.