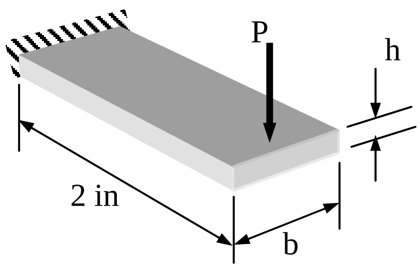
Lecture 2 - Homework

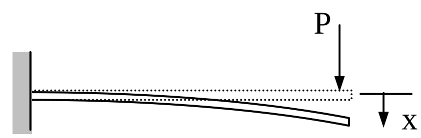
Problem 2.1

Select the thickness h and width b (all dimensions are in inches) of a cantilevered beam spring such that the equivalent stiffness is $k_{eq} = 10.0 \pm 0.1$ lbf/in and the maximum stress σ at the base does not exceed 40,000 psi for a load of P = 1 lbf. The beam is stainless steel with modulus $E = 30 \times 10^6$ psi, and for a load of 1 lbf, assume that the maximum stress at the base is given by

$$\sigma = \frac{12}{bh^2}$$

Once you have designed the cantilevered beam spring, use your values of h and b to compute k_{eq} and σ. Show that your design meets the specifications.

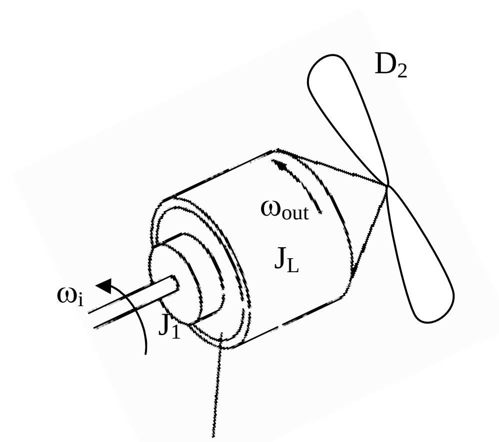




Side view, deflection

Problem 2.2

A fluid transmission can be represented by a damper, D_1, as shown in the figure to the right. A viscous fluid occupies the space in the annulus. Assuming the gap between the inner and outer cylinder is 2 mm, the diameter of the inner cylinder is 0.1 m, the distance the inner cylinder extends inside the outer cylinder is 0.2 m, $\mu = 0.24$ N-s/m^2, and $\rho = 850$ kg/m^3, find the torsional damping constant D_1.



Fluid in annulus,
Damping = D_1

Problem 2.3

Assuming the damping D_1 and D_2 and the mass moments of inertias J_1 and J_L are known in Problem 2.2 determine the differential equation relating the input angular velocity ω_i to the output angular velocity ω_{out}.