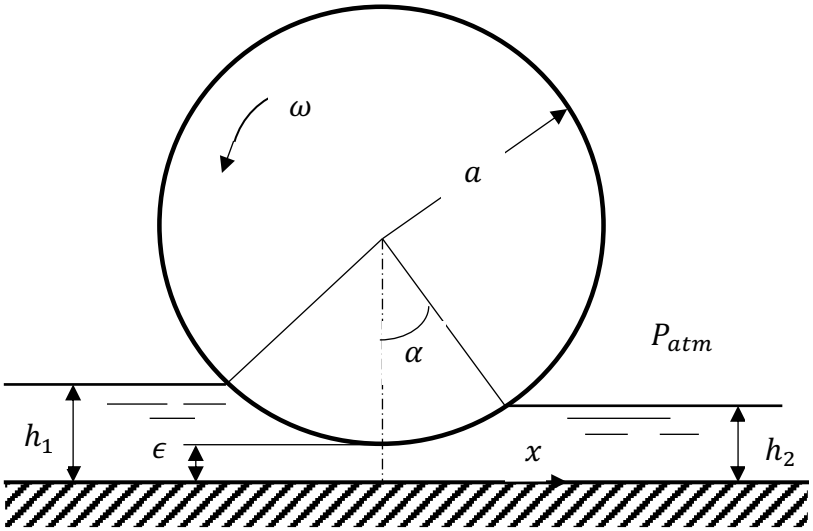
ME 55600/I0200
HW: Lubrication Project

Consider an extrusion process where a fluid of high viscosity is squeezed between a flat solid surface and a roller of radius a as shown in the figure. The roller is rotating at an angular velocity ω, reducing the thickness of the fluid layer from h_1 to h_2 with a minimum gap of ϵ between the roller and the flat boundary.



Assume a profile for the liquid layer between the roller and the flat surface in the form:

$$h(x) = \epsilon + a(1 - \cos\alpha)$$

and assume α is small.

(a) Use the lubrication approximation to determine the pressure distribution in the liquid film and show it graphically.
(b) Determine the maximum angular velocity which can be used to avoid cavitation.
(c) Calculate the lubrication thickness and the maximum angular velocity for the following conditions*:

$$a = 1m,\ h_1 = 20\ mm,\ h_1 = 2\ mm,\ \epsilon = 1\ mm,\ \mu = 10^4 \times \mu_{water}$$

*Numbers have been selected to simplify mathematical analysis