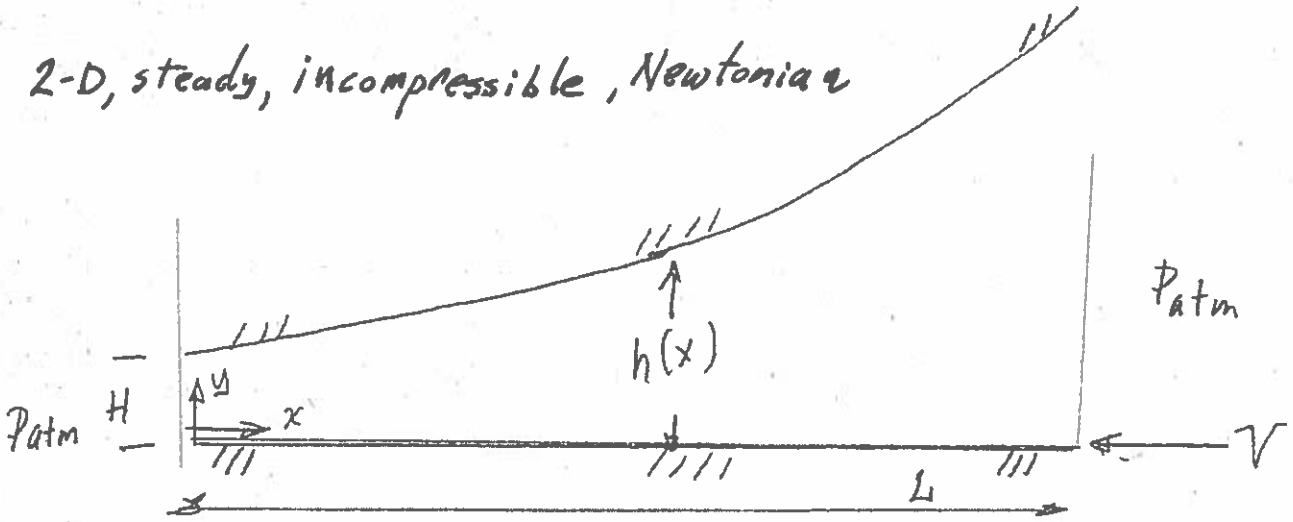
MANE 6520 - Fluid Mechanics

Homework #5 - Thurs 27 October 2022, due Thurs 3 November



Consider an exponential slider bearing, $h = H\exp\left(m\frac{x}{L}\right)$. In this case the sliding of the lower surface is in the negative x-derection. Pressure is atmospheric at both ends $x = 0, L$.

The parameters are $H, L, W, V, \rho, g, \mu, p_{atm}$.

a) Find an expression for the pressure p, in terms of x and the above parameters.
b) Find an expression for the velocity profile v_x in terms of x, y, and the above parameters.
c) Find an expression for the location x_m, where the viscosity gradient is zero, in terms of the above parameters.
d) Find an expression for the force on the lower surface, in terms of the above parameters.

Now, use the following parameter values:

$H = 1$ mm, $L = 100$ mm, $W = 1$ m, $V = -1$ m/s, $\rho = 850$ kg/m^3, g = 9.81 m/s^2,
$\mu = 0.020$ Pa-s, $p_{atm} = 0.1$ MPa.

Plot h/H, $0 \le x/L \le 1$ for $m = 0.5$ and $m = 1.5$. Two curves on the same plot.
Plot $p(x)$, $0 \le x \le L$ for $m = 0.5$ and $m = 1.5$. Two curves on the same plot.
Plot $v_x(x, y)$, $0 \le y \le h$ for $m = 1.5$ and $x = 0$ and $x = L$. Two plots, each with one curve.