

Quiz 2

Problem 2 [50 points] (a) [20 pts] , (b) [10 pts], (c) [10 pts], (d) [10 pts]

A schematic of *stepped bearing* is shown in the figure below. The moving part consists of a plate moving a speed V with respect to the unmoving part, which is called the bearing shoe. The moving plate drags oil, which is present between the two walls, through the clearance. The flow is *incompressible, steady, and two-dimensional*. You may also assume the oil flow to be *fully developed* in both sections (the section from $x = -L$ to $x = 0$ and the section from $x = 0$ to $x = L$) below the bearing shoe. The pressure distribution in each section is linear, rising from p_a to p_m along the left section and dropping from p_m to p_a along the right section (see sketch below schematic).

- (a) Find the volume flow rate q , per unit depth, through the left section in terms of p_m , p_a , L , h_1 , V and density ρ and viscosity μ of oil.
- (b) Find the volume flow rate q , per unit depth, through the right section in terms of p_m , p_a , L , h_2 , V and density ρ and viscosity μ of oil.
- (c) Using parts (a) and (b), find the pressure p_m in terms of p_a , L , V , h_1 , h_2 , ρ and μ .
- (d) Find the (vertical) load the bearing can carry per unit width.

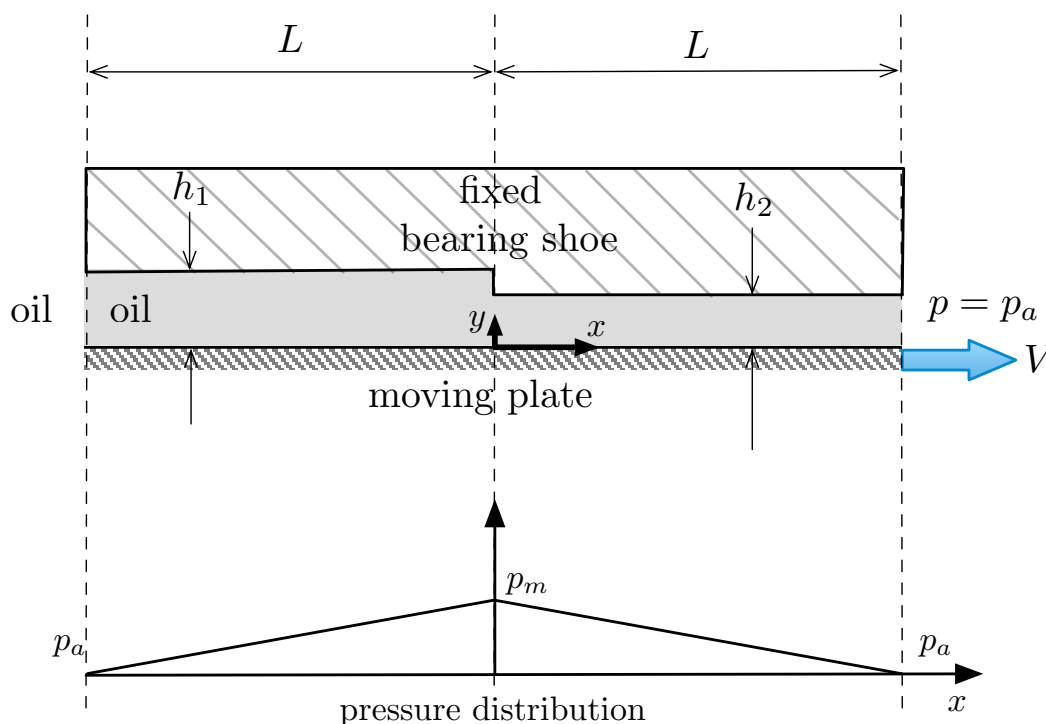


Figure 1: Schematic for problem 2.