Auditorieøving 6, Fluidmekanikk

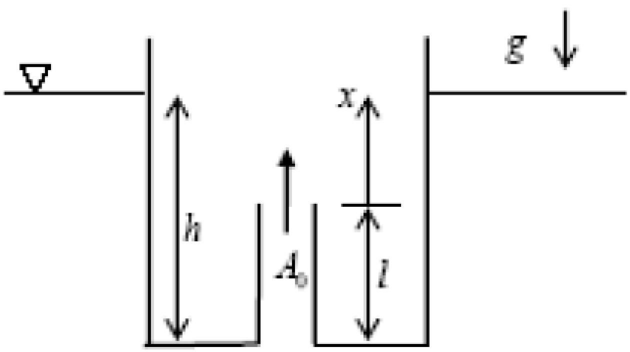
Utført av:

Oppgave 1:

A container is open at one end and has a hole in the bottom, fitted to an inward facing tube of length *l* and circular cross section with area A_0 . The container, which is originally empty, is lowered into the water to a depth *h*> *l* as shown in the figure, and kept in this position.

Assume that the flow arising from hole and in the tube is friction free and steady. Consider the situation only before the liquid level inside the container reaches the tube top.

Determine the velocity *v* through the tube and find the pressure in the tube as a function of height *z* above the container bottom.



Oppgave 2:

Two vertical plates with height *L* are at an arbitrary time a separated by a distance *2h.* The plates move towards each other with constant velocity v_0 on a smooth horizontal table. The space between the plates is filled with an incompressible fluid, which in addition is assumed to be inviscid. Because of the plates movement, the distance *h* decreases with time and fluid is expelled from the gap.

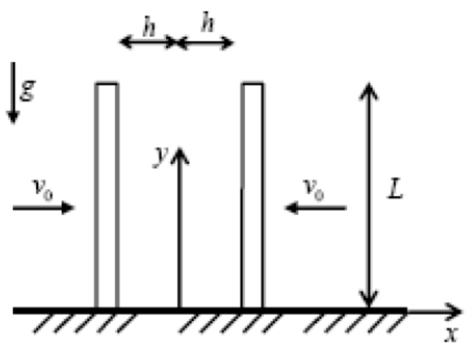
This results in a non-stationary flow, which is assumed to be two-dimensional.

Find the force needed to push the plates together as you assume that the x-component of the fluid velocity is expressible as

$$u = u(x,t) = -\frac{v_0 x}{h(t)},$$

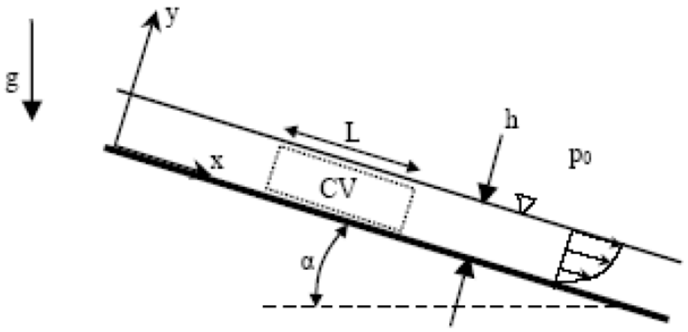
v_0 being the constant plate speed.

(See the coordinate system of the below figure.)



Oppgave 3:

A liquid of density ρ and viscosity μ flows as a laminar and stationary film along a straight plate with slope α. See the figure shows below.



The liquid film has a constant thickness *h*. Friction forces at the surface can be neglected.

We are given the following solutions for the flow

$$p(y) = p_0 + \rho g (h - y) \cos(\alpha)$$

$$u(y) = \frac{\rho g \sin(\alpha)}{\mu}(yh - \frac{1}{2}y^2)$$

a) Verify that the solution fulfills the boundary conditions of the problem.

b) Consider the control volume CV shown in the figure. Find all the forces acting on the fluid in the control volume (both in *x*- and *y*-direction).

Oppgave 4:

Derive the kinematic boundary conditions for waves through a geometrical consideration. See the figure below. A fluid element placed in *A* at the time t will move along with the wave interface to point *B* during the time *dt.* The distance travelled is in this case ***V****dt,* where ***V****=[u,w].*

Hint*:* Find an expression for the vertical fluid element movement $\Delta z = AD + DE$ in terms of ***V*** and derivatives of η