



# Hydraulic Engineering and Infrastructures

## Civil Engineering Department

### Fluid Mechanics Review

#### 1 Pressure of water flowing inside a pipe †

A U-tube piezometer is used to measure the pressure of water flowing inside a pipe. The fluid used in the piezometer is mercury, which has a specific weight  $\gamma_{Hg} = 133000 \text{ Nm}^{-3}$ . Two configurations are shown in Fig. 1, the first on the left and the second on the right.

Calculate:

- (a) the gauge pressure  $P_G$  of the water measured by the manometer.
- (b) the new heights  $h'_1$  and  $h'_2$  if the pressure inside the pipe is  $P'_G = P_G - 30 \text{ kPa}$ .

#### 2 Concomitant chambers †

A tank consists of two independent chambers connected by a square opening of side 0.4 m, which is kept closed by a gate of the same shape as the opening and hinged at the point  $O$ . The left chamber is sealed and contains pressurized gas, while the right chamber contains water up to a height  $y$  above the hinge. The left chamber is connected to a piezometer containing the gas with a column of water of height  $h = 1.2 \text{ m}$  above.

Calculate:

- (a) the pressure in the left chamber  $P_{GAS}$ .
- (b) the level  $y$  of water in the right tank for which the conditions shown in Fig. 2 give equilibrium for the gate.

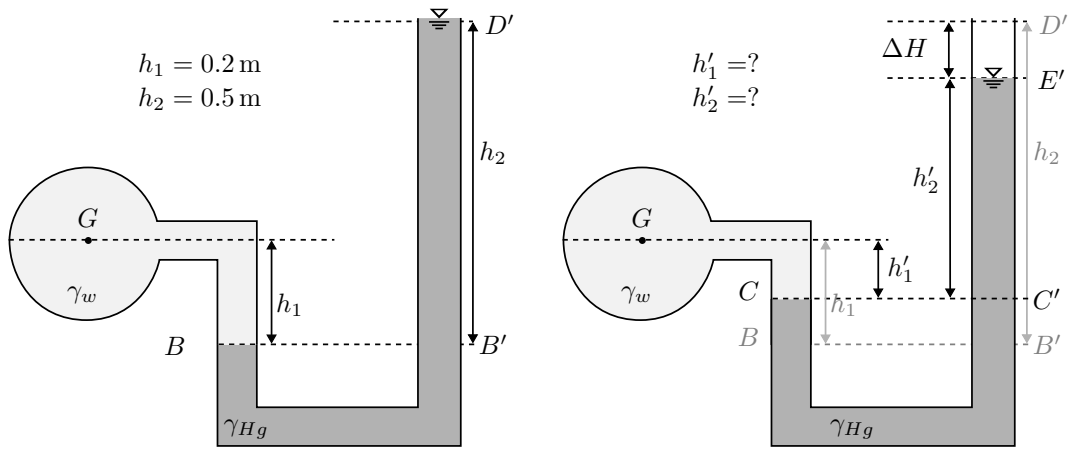


Figure 1: Two configurations of the U-tube piezometer.

(c) sketch all the forces acting on the gate, specifying magnitude, direction, and sense.

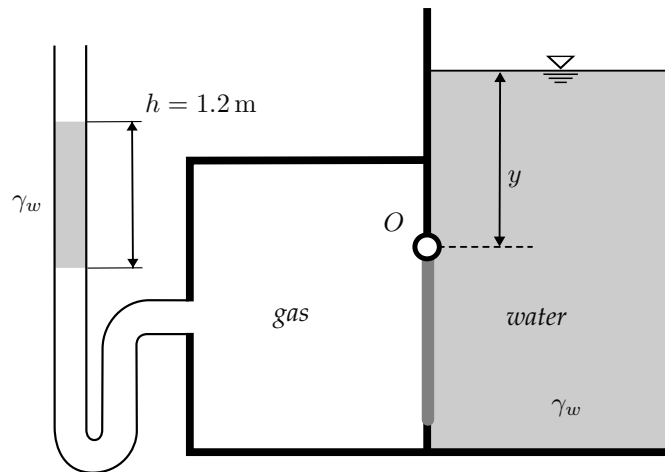


Figure 2: Problem configuration.

### 3 Force on a cylindrical aquarium † † †

A tank filled with a fluid ( $\gamma_f = \gamma_{\text{water}}/2 = 4900 \text{ N/m}^3$ ) and water ( $\gamma_{\text{water}} = 9800 \text{ N/m}^3$ ) has a cylindrical aquarium of width  $w = 10 \text{ m}$  and radius  $r = 3 \text{ m}$  placed right at the interface between the two fluids as shown in Figure 3. For a height  $h = 10 \text{ m}$ , compute the force applied on the aquarium and its application point on the aquarium's surface.

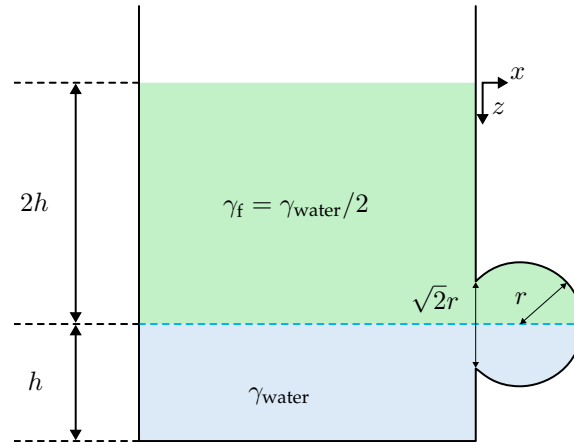


Figure 3: A cylindrical aquarium with its bottom half filled with water and the top half with a light fluid.