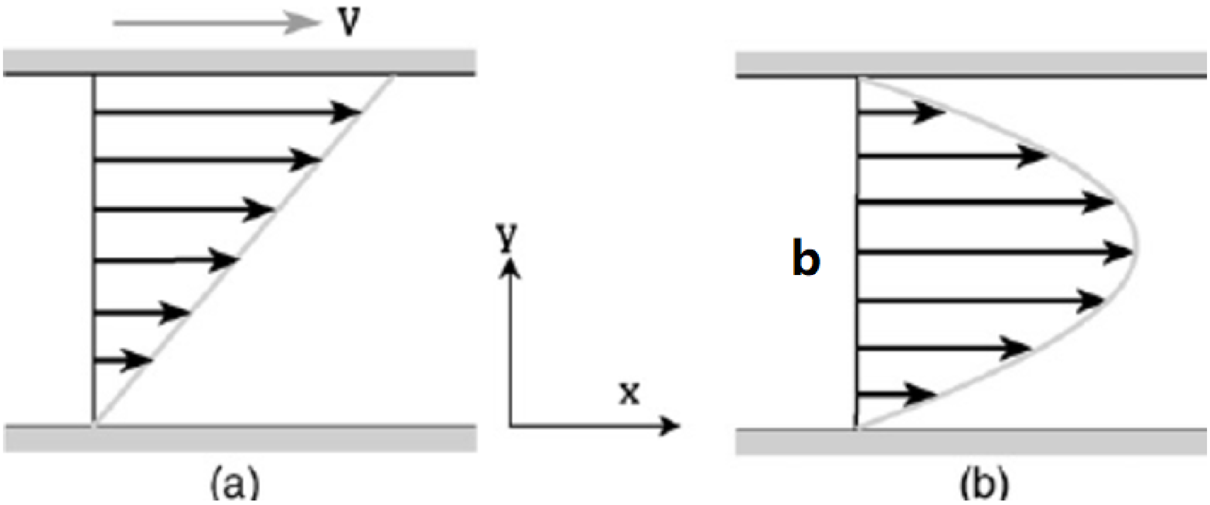
I Coutte Flow



The general formula should be

$$u = \frac{1}{2\mu}(\frac{\partial P}{\partial x})y^2 + C_1 y + C_2 \tag{1}$$

where C_1 and C_2 are constants.

Consider the boundary conditions:

- $u = 0$ at $y = 0$; u=U at $y = b$:

$$u = U\frac{y}{b} + \frac{1}{2\mu}(\frac{\partial P}{\partial x})(y^2 - by)$$

- $u = U$ at both $y = 0$ and $y = b$:

$$u = U + \frac{1}{2\mu}(\frac{\partial P}{\partial x})(y^2 - by)$$

Since the shear force is calculated through $\tau = \mu\frac{\mathrm{d}u}{\mathrm{d}y}$, then the shear stresses can be calculated as follows (**boundary conditions:** $u = u_1$ **at** $y = 0$**;** $u = u_2$ **at** $y = b$):

$$\tau(y) = (\frac{\partial P}{\partial x})(y - \frac{b}{2}) + \mu\frac{u_2 - u_1}{b}$$

Special cases:

- $u = 0$ at $y = 0$; u=U at $y = b$:

$$\tau = \mu\frac{U}{b} + \frac{1}{2}(\frac{\partial P}{\partial x})b$$

- $u = U$ at both $y = 0$ and $y = b$:

$$\tau = \frac{1}{2}(\frac{\partial P}{\partial x})b$$