

Exercice 3 Double couette

1 Conditions aux limites. La vitesse tangentielle du fluide est égale à la vitesse de la paroi.

zone 1 • $y=0$ $v_x = 0 = A_1$

• $y=y_0$ $v_x = v_0 = A_1 y_0 \Rightarrow A_1 = v_0 / y_0$

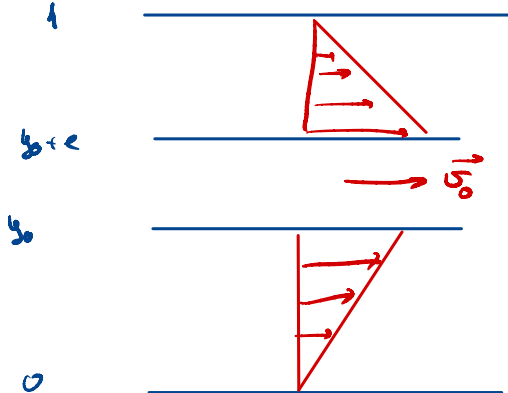
zone 2 • $y=h$ $v_x = 0 = A_2 h + B_2 \Rightarrow B_2 = -A_2 h$

• $y=y_0+e$ $v_x = v_0 = A_2(y_0+e) + B_2 = A_2(y_0+e-h)$

$$A_2 = \frac{v_0}{y_0+e-h} \quad \text{et} \quad B_2 = \frac{-v_0 h}{y_0+e-h}$$

$$\vec{v}_1 = \frac{v_0}{y_0} x \vec{e}_x \quad \text{et} \quad \vec{v}_2 = \frac{v_0}{y_0+e-h} (y-h) \vec{e}_x$$

2



3
$$d\vec{f} = \pm \rho \left| \frac{\partial \sigma_x}{\partial y} \right|_{y=y_{\text{paroi}}} ds \vec{e}_x$$

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 exercé par le fluide sur la paroi

4 Ici il y a 2 parois

$$d\vec{f}_1 = -\rho \left| \frac{\partial \sigma_x}{\partial y} \right|_{y=y_0} ds \vec{e}_x$$

le fluide freine la paroi

$$d\vec{f}_2 = -\rho \left| \frac{\partial \sigma_x}{\partial y} \right|_{y=y_0+e} ds \vec{e}_x$$

$$\vec{f}_1 = \int_S d\vec{f}_1 = -\rho \frac{v_0}{y_0} S \vec{e}_x$$

$$\vec{f}_2 = \int_S d\vec{f}_2 = -\rho \frac{v_0}{y_0+e-h} S \vec{e}_x$$

$$\text{d'ici } \vec{f} = \vec{f}_1 + \vec{f}_2 = -\rho v_0 S \left(\frac{1}{y_0} + \frac{1}{y_0+e-h} \right) \vec{e}_x$$

$$\text{et } \vec{F}_0 = -\vec{f} = \rho v_0 S \left(\frac{1}{y_0} + \frac{1}{y_0+e-h} \right) \vec{e}_x$$