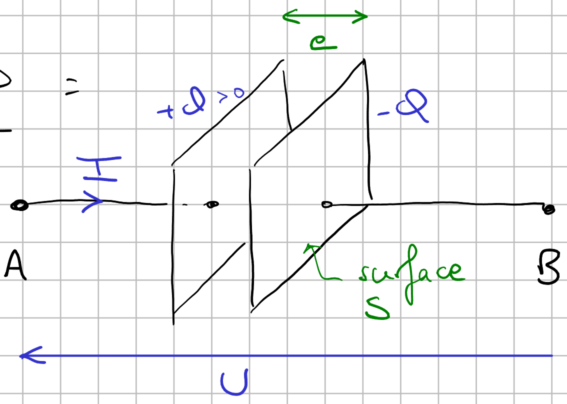
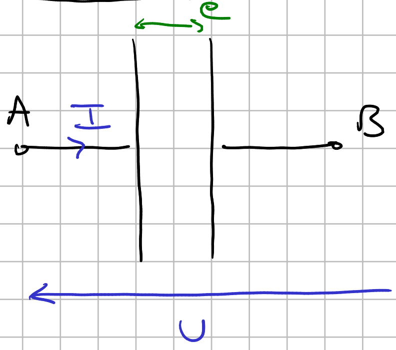
Condensateur plan

1.1.

Vue 3D :

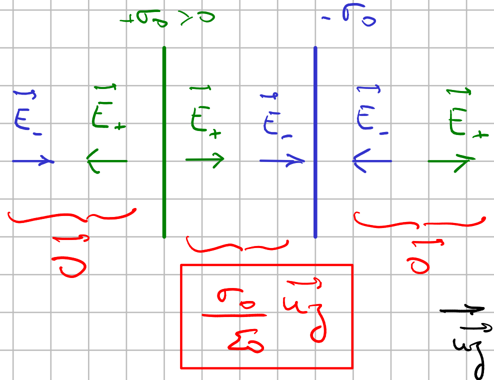


Vue profil :



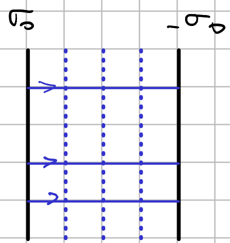
* Armatures chargées uniformément $\sigma_0 = \frac{Q}{S} > 0$
* Si besoin, parce que $S \gg e^2$, on pourra considérer armatures ∞.

1.2. Rappel : $\|\vec{E}\| = \frac{|\sigma_0|}{2\varepsilon_0}$ pour plan ∞



→

→ ldchp + équipot :



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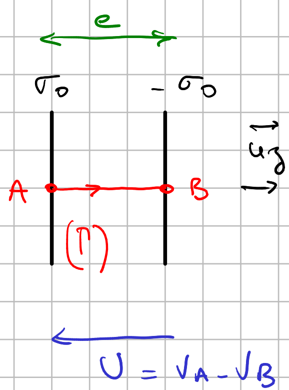

$$\int_{A\,(\Gamma)}^{B} \underbrace{\vec{E}}_{\frac{\sigma_0}{\varepsilon_0}\vec{u_z}} \cdot \underbrace{\vec{dl}}_{dl\,\vec{u_z}} = V_A - V_B \Rightarrow \boxed{U = \frac{\sigma_0}{\varepsilon_0} e}$$

$\|\vec{E}\| = \frac{U}{e}$

ou $\vec{E} = -\overrightarrow{\text{grad}}\, V \Rightarrow \begin{vmatrix} 0 \\ 0 \\ \frac{\sigma_0}{\varepsilon_0} \end{vmatrix} = - \begin{vmatrix} \frac{\partial V}{\partial x} \\ \frac{\partial V}{\partial y} \\ \frac{\partial V}{\partial z} \end{vmatrix} \Rightarrow \frac{dV}{dz} = -\frac{\sigma_0}{\varepsilon_0}$

$\Rightarrow \left| V(z) = -\frac{\sigma_0}{\varepsilon_0} z + C^{te} \right.$

CL limites : $\begin{vmatrix} V(z=0) = V_A \\ V(z=e) = V_B \end{vmatrix} \Rightarrow \left| V_A - V_B = \frac{\sigma_0}{\varepsilon_0} e \right.$.

(⊕ long !)

1.3. Déf$^\circ$ C : $Q \overset{\text{déf}}{=} C\,U$

Ici $U = \dfrac{\sigma_0}{\varepsilon_0} e$ or $\sigma_0 = \dfrac{Q}{S}$ $\Rightarrow$ $U = \dfrac{Q}{S\,\varepsilon_0} e$

$$\boxed{Q = \frac{\varepsilon_0 S}{e} U}$$

$$\boxed{C = \underbrace{\varepsilon_0}_{\mathrm{F\,m^{-1}}} \frac{S}{e}}$$

C : F

1.4. Si milieu DLHI à la place du vide interarmature, ou air

alors $\varepsilon_0 \longrightarrow \varepsilon$. $\varepsilon_{eau} \sim 80\,\varepsilon_0$!

NB : attent$^\circ$ au chp disruptif. air : $3\,\mathrm{MV.m^{-1}}$

1.5. Energie EM$^{\text{que}}$ stockée dans $\vec{E}$ interarmature :

$$E_{stock} = \iiint_{\text{tout l'espace où } \exists \text{ chp élec.}} \varepsilon_0 \frac{\|\vec{E}\|^2}{2} d\tau = \frac{\varepsilon_0}{2} \frac{U^2}{e^2} (S \times e) = \frac{1}{2} \left(\frac{\varepsilon_0 S}{e} \right) U^2$$

$$= \frac{1}{2} C U^2 \; !$$