$$\underline{\nabla}\cdot(\varepsilon\underline{\nabla}\phi) = -q\rho$$

$\varepsilon = \varepsilon_r \varepsilon_0$

$\varepsilon_{r_{Si}} \simeq 11.8$

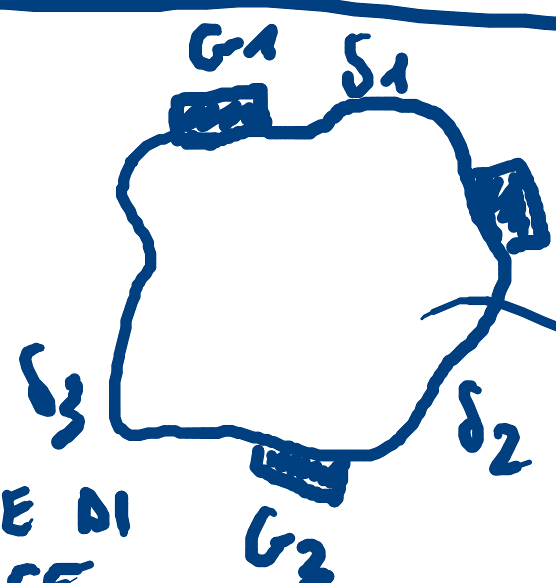
$\varepsilon_{r_{SiO_2}} \simeq 3{,}9$

$\varepsilon_{r_{HfO_2}} \simeq 20$

$\underline{E} = -\underline{\nabla}\phi$

$\underline{D} = \varepsilon\,\underline{E}$ Displacement Field

Condizioni al contorno



DIRICHLET

In G_i : $\phi_i = V_{G_i}$

S NEUMANN

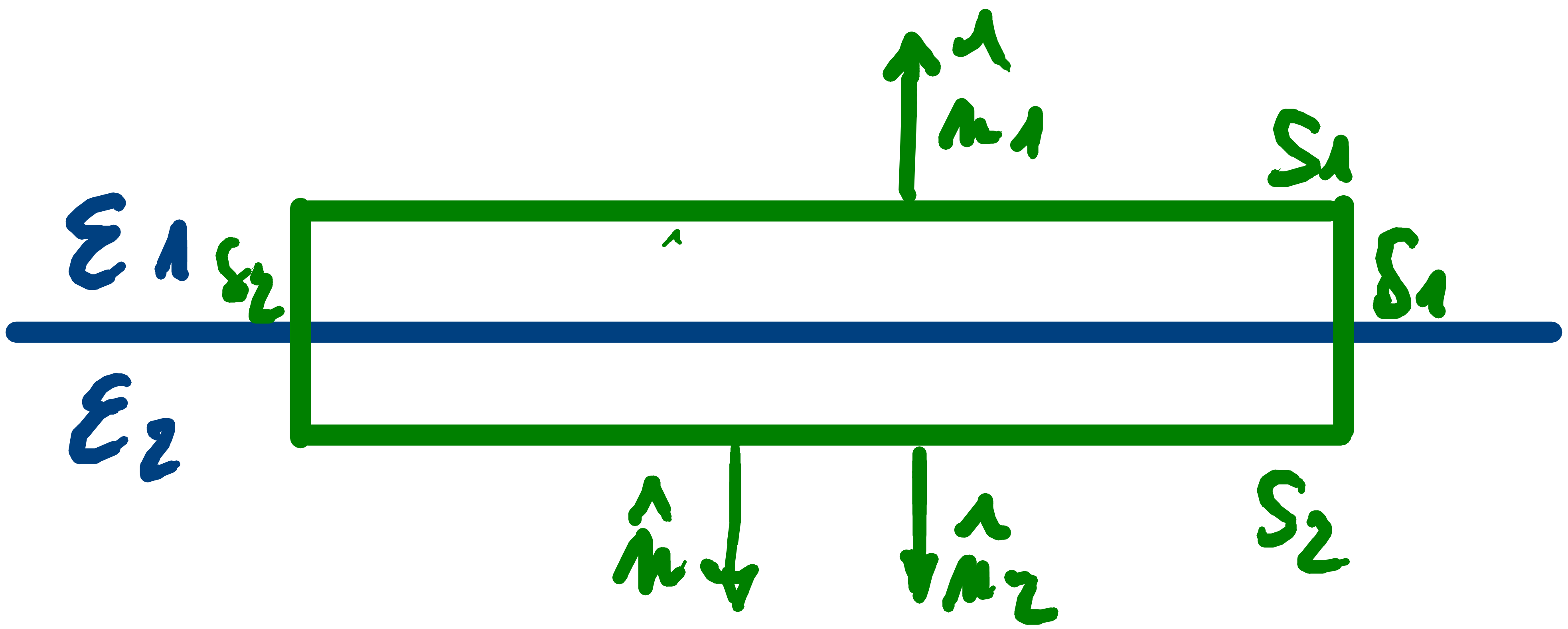
In δ_i : $-\underline{\nabla}\phi\big|_{\delta_i} = E_{\delta_i}$

EQUAZIONE DI LAPLACE

$$\underline{\nabla}\cdot(\varepsilon\underline{\nabla}\phi) = 0 \qquad \rho = 0 \quad \text{ovunque}$$

TEOREMA DIVERGENZA

$$\int_V \underline{\nabla}\cdot\underline{E}\,dV = \int_S \underline{E}\cdot d\underline{S}$$



$$\underline{\nabla}\cdot \varepsilon \underline{\nabla}\phi = 0$$

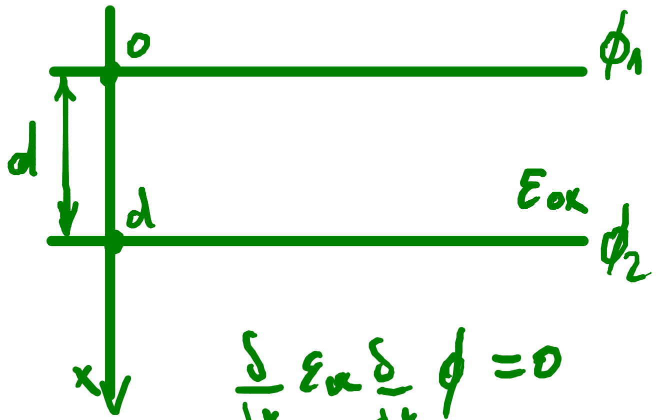
$$\underline{\nabla}\cdot\underline{D} = 0 \qquad \int_V \underline{\nabla}\cdot\underline{D}\,dV = 0 = \int_S \underline{D}\cdot d\underline{S} =$$

$$= S\left(\underline{D_1}\cdot\hat{n}_1 + \underline{D_2}\cdot\hat{n}_2\right) = 0$$

$$\hat{n}_2 = \hat{n} = -\hat{n}_1$$

$$\hat{n}\cdot\left(\underline{D_1} - \underline{D_2}\right) = 0 \qquad \underline{D_1} = \underline{D_2}$$

$$\varepsilon_1 E_1 = \varepsilon_2 E_2$$



$$\frac{\delta}{\delta x}\varepsilon_{\alpha}\frac{\delta}{\delta x}\phi = 0$$

$$\varepsilon_\alpha \frac{\delta}{\delta x}\phi = A \Rightarrow \frac{\delta\phi}{\delta x} = \frac{A}{\varepsilon_\alpha} \Rightarrow \phi = \frac{A}{\varepsilon_\alpha}x + B$$

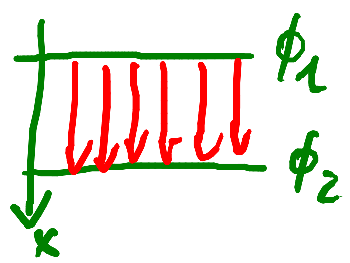
$$\phi(x=0)=\phi_1 \qquad \phi(x=d)=\phi_2$$

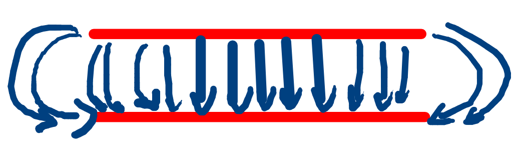
$$A = (\phi_2-\phi_1)\underbrace{\frac{\varepsilon_\alpha}{d}}_{C_\alpha} = C_\alpha(\phi_2-\phi_1)$$

$$B=\phi_1$$

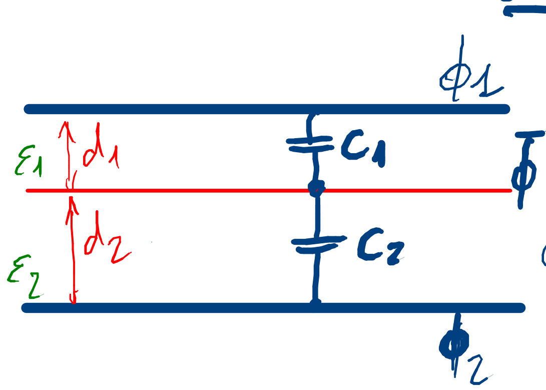
$$\phi(x,y,z) = \frac{C_\alpha}{\varepsilon_\alpha}(\phi_2-\phi_1)x + \phi_1$$

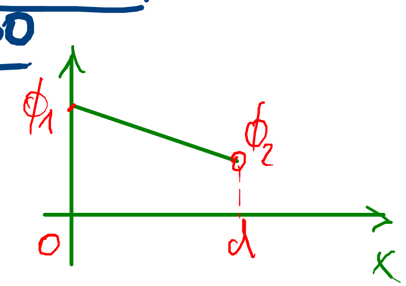
$$E(x) = -\frac{\delta}{\delta x}\phi = (\phi_1-\phi_2)\frac{C_\alpha}{\varepsilon_\alpha}$$

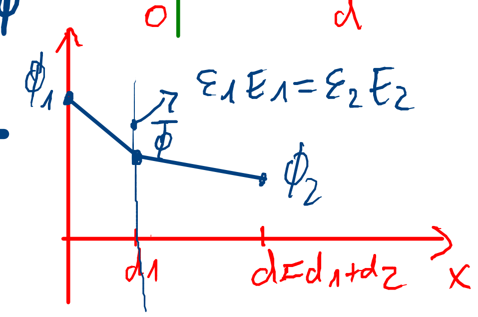




EFFETTI DI BORDO







$$\varepsilon_1\frac{(\phi_1-\bar\phi)}{d_1} = \varepsilon_2\frac{\bar\phi-\phi_2}{d}$$

$$\varepsilon_1\frac{\phi_1}{d_1}+\varepsilon_2\frac{\phi_2}{d_2} = \left(\frac{\varepsilon_1}{d_1}+\frac{\varepsilon_2}{d_2}\right)\bar\phi \qquad \frac{\varepsilon_1}{d_1}=C_1 \quad \frac{\varepsilon_2}{d_2}=C_2$$

$$\bar\phi = \frac{C_1\phi_1}{C_1+C_2} + \frac{C_2\phi_2}{C_1+C_2}$$

$$\Updownarrow$$

$$\bar\phi = \frac{C_1}{C_1+C_2}\phi_1 + \frac{C_2\phi_2}{C_1+C_2}$$