

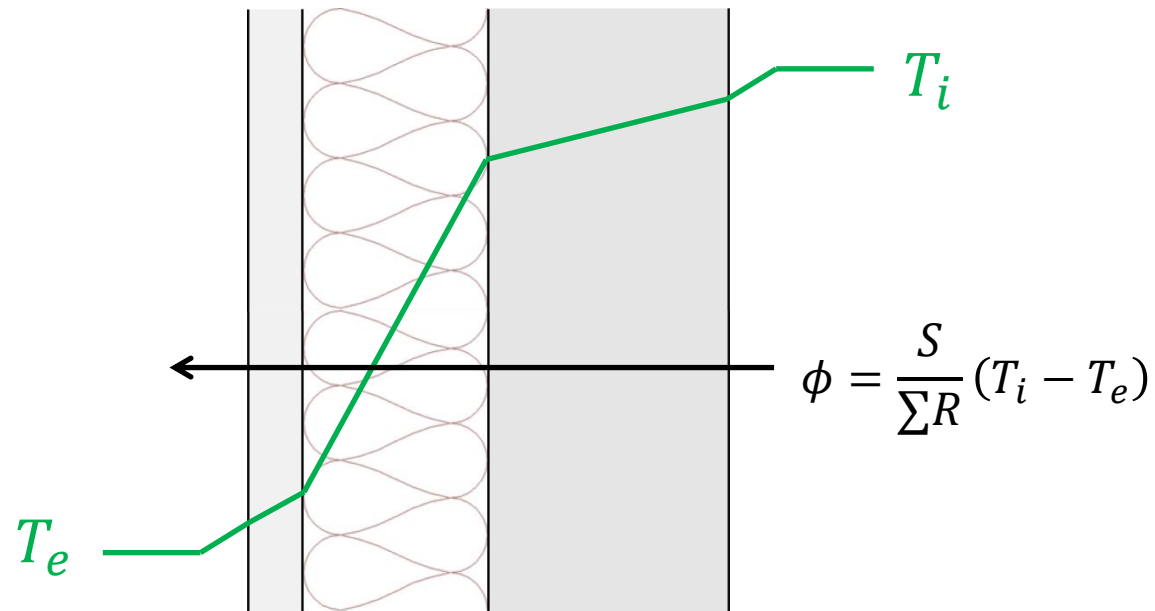
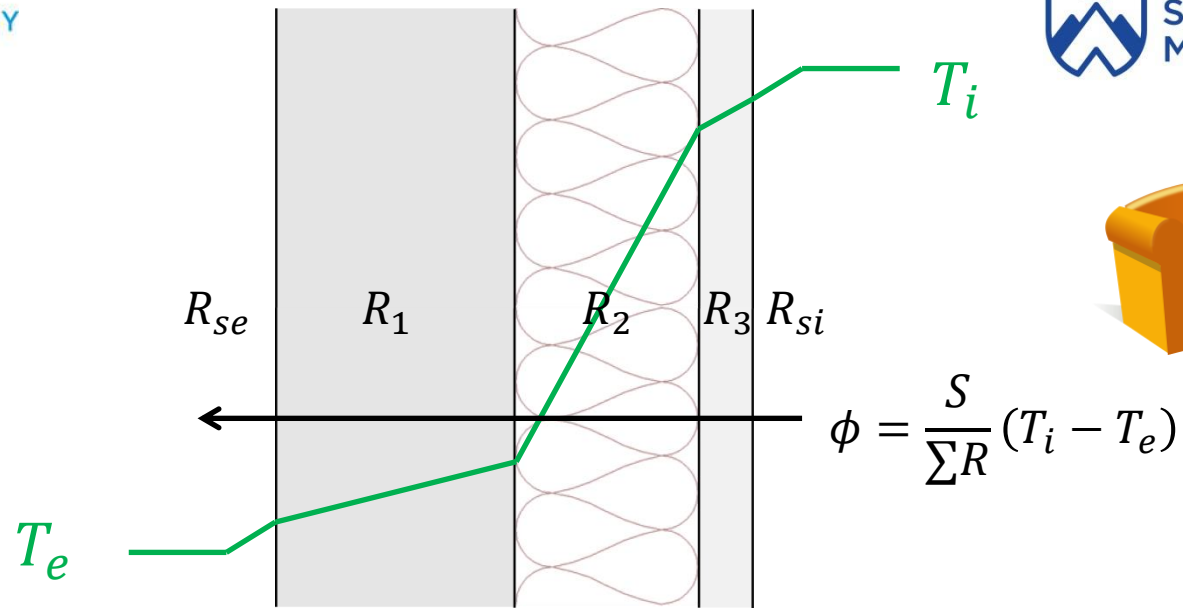
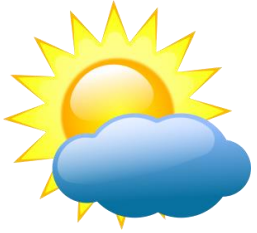
Cours de Thermique du bâtiment

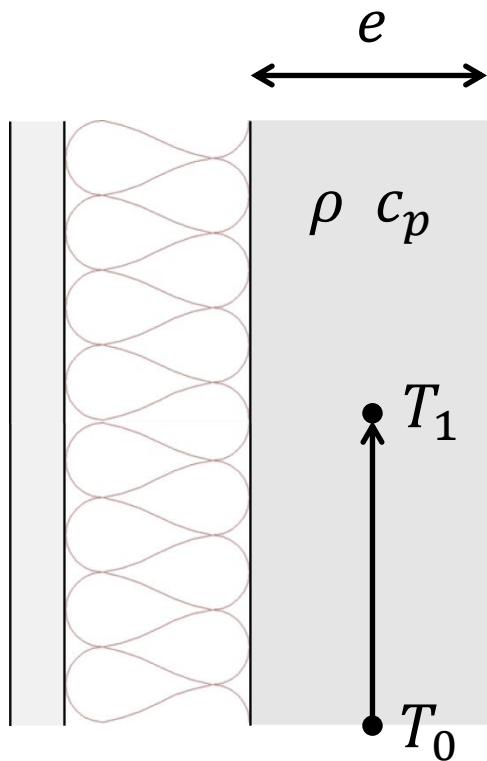
Vidéo n°3

# Inertie thermique et paroi en régime transitoire

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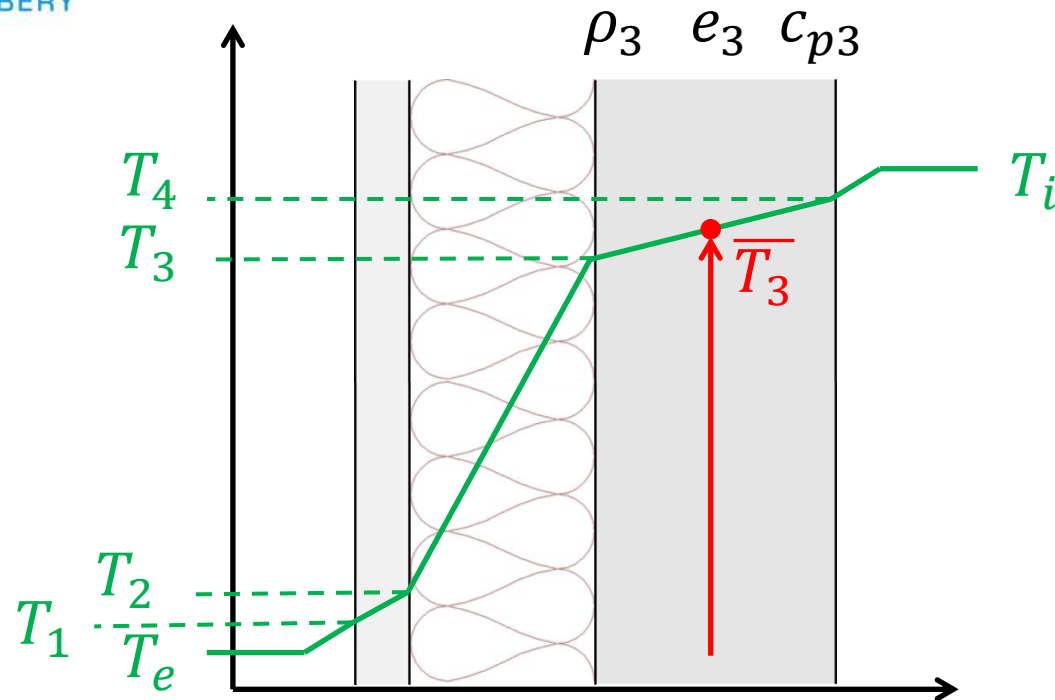
vidéo réalisée le 12/10/2015





$$Q_{vol} = \underbrace{\rho \cdot c_p}_{\text{Capacité volumique [J/m}^3\cdot\text{K]}} (T_1 - T_0) \quad [\text{J/m}^3]$$

$$Q = \rho \cdot e \cdot c_p (T_1 - T_0) \quad [\text{J/m}^2]$$



- Volant thermique d'une couche

$$Q_3 = \rho_3 \cdot e_3 \cdot c_{p3} (\bar{T}_3 - T_e) \quad \text{avec} \quad \bar{T}_3 = \frac{(T_3 + T_4)}{2}$$

- Volant thermique total

$$Q = \sum_{k=1}^3 Q_k$$

- Constante de temps de la paroi

$$\tau = \frac{Q}{U \cdot (T_i - T_e)}$$

$$\rho \cdot c_p \frac{\partial T}{\partial t} = \lambda \frac{\partial^2 T}{\partial x^2}$$

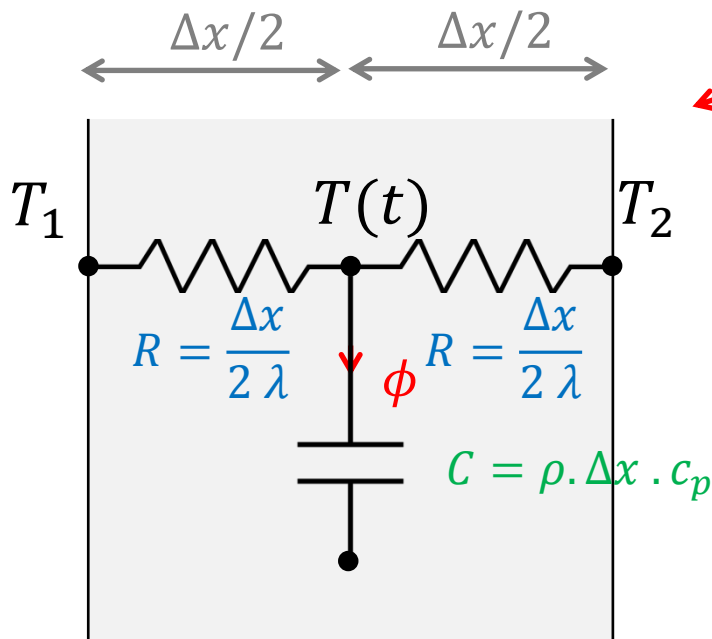
[W/m<sup>3</sup>.K]

discrétisation →

$$\rho \cdot c_p \frac{dT}{dt} = \frac{\lambda}{\Delta x^2/2} (T_1 - 2 \cdot T + T_2)$$

$$(\rho \cdot \Delta x \cdot c_p) \frac{dT}{dt} = \frac{T_1 - T}{\left(\frac{\Delta x}{2\lambda}\right)} + \frac{T_2 - T}{\left(\frac{\Delta x}{2\lambda}\right)}$$

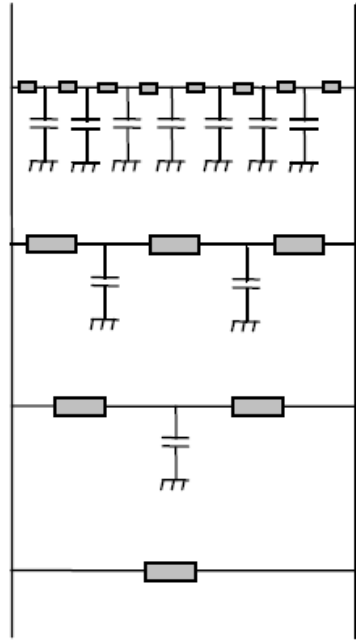
C                      R                      R



$$I = C \frac{dU}{dt}$$

$$\phi = C \frac{dT}{dt}$$

[J/m<sup>2</sup>.K]



Modélisation fine (LARET)

Modélisation simplifiée

Modélisation très simplifiée

Régime permanent

$$\frac{d\mathbf{T}}{dt} = \mathbf{A}\mathbf{T} + \mathbf{b}u(t)$$

$$\mathbf{T}(t) = [T_1(t) \ T_2(t) \ \dots \ T_N(t)]$$

$$\mathbf{A} = \frac{a}{\Delta x^2} \begin{bmatrix} -2 & 2 & 0 & \dots & 0 \\ 1 & -2 & 1 & & 0 \\ 0 & & & & \\ \dots & & & 1 & -2 & 1 \\ 0 & \dots & 0 & 2 & -2(1 + \text{Bi}) \end{bmatrix}$$

$$\mathbf{b} = \frac{2}{\rho c_p \Delta x} \begin{bmatrix} 1 \\ 0 \\ \dots \\ 0 \end{bmatrix}$$

