



The Well-mixed Model

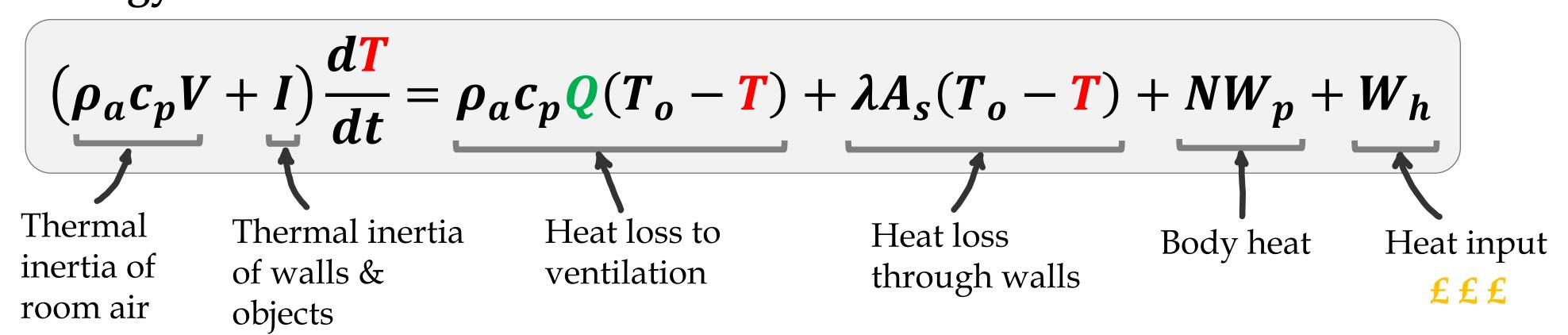
The well-mixed model assumes a uniform distribution of parameters in the room (e.g. Temperature & CO_2). This is often the starting point for thinking about ventilation.

Carbon dioxide conservation

$$V \frac{dC}{dt} = Q(C_o - C) + NG$$

Ventilation CO₂ from breath

Energy conservation



Ventilation

$$Q = \sum_{\mathbf{k}_{\mathbf{w}}} \mathbf{k}_{\mathbf{w}}(\boldsymbol{\theta}) \sqrt{|\mathbf{T} - \mathbf{T}_{o}|} + k_{l} A_{s} \sqrt{|\mathbf{T} - \mathbf{T}_{o}|}$$
Flow through windows Natural leak rate

C: CO₂ concentration

T: room temperature

Q: ventilation rate

 C_o : outdoor CO_2 concentration

 T_o : outside temperature

V: room volume

 A_s : room surface area

N: number of people (occupancy)

G: per person CO2 generation rate

 ρ_a : air density

 c_p : air specific heat capacity

I: thermal inertia of room objects

 λ : effective conductivity of walls

 W_p : per person heat output

 W_h : heating input

 k_w : window flow constant

 A_w : window area (function of opening angle)

 k_l : leak rate constant