Heat transfer in buildings

Video n°6

Ventilation

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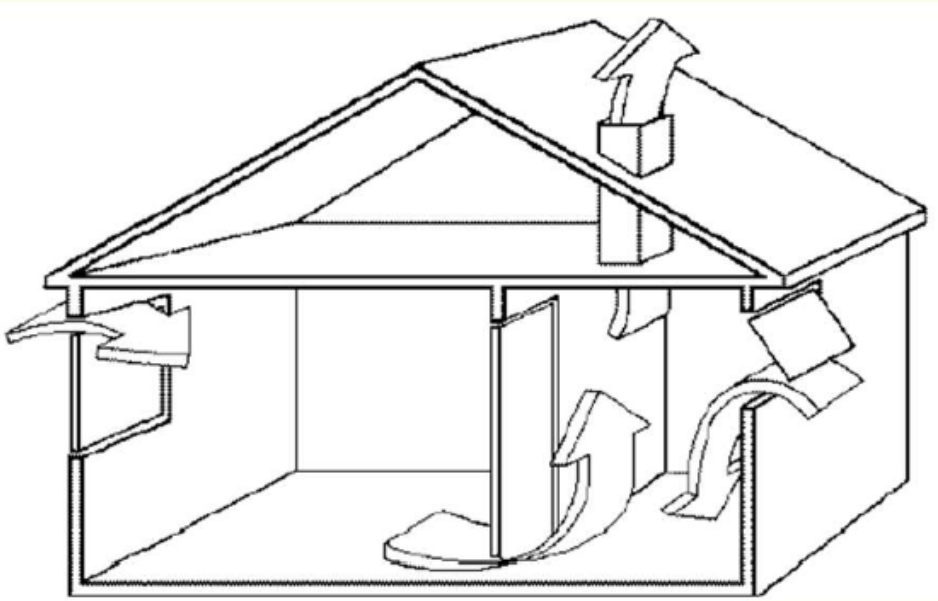
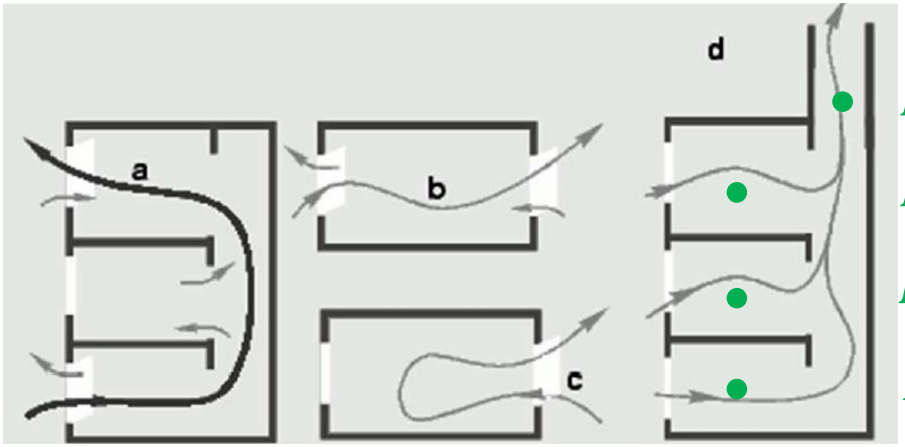
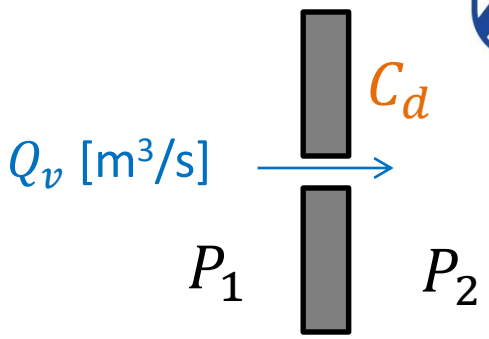


Q_v [m³/s]
$\dot{m}$ [kg/s]



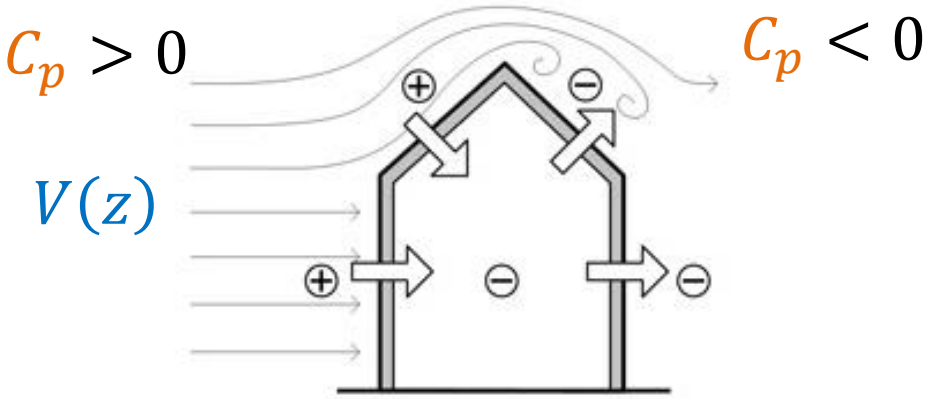
- Air flow though an opening

$$P_1 - P_2 = \frac{\rho Q_v^2}{2\,S^2 C_d^2}$$



- Wind

$$P = P_{atm} + C_p \cdot \frac{1}{2}\rho\, V^2$$

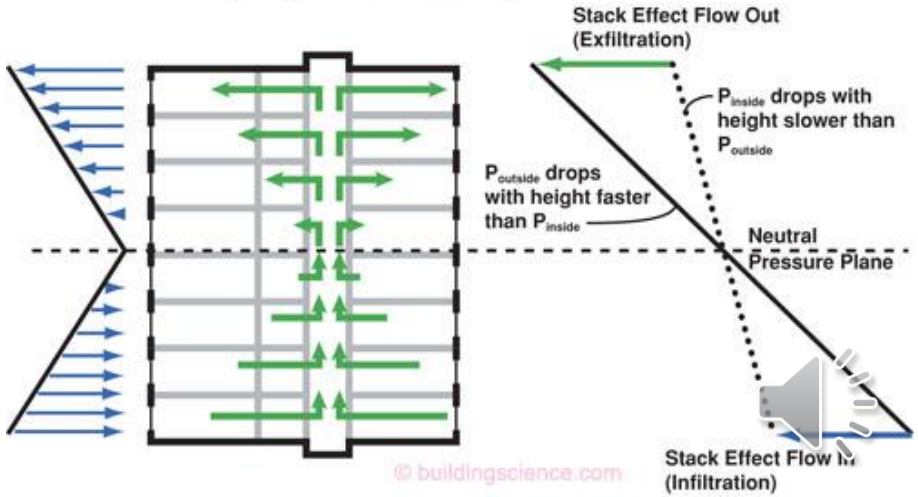


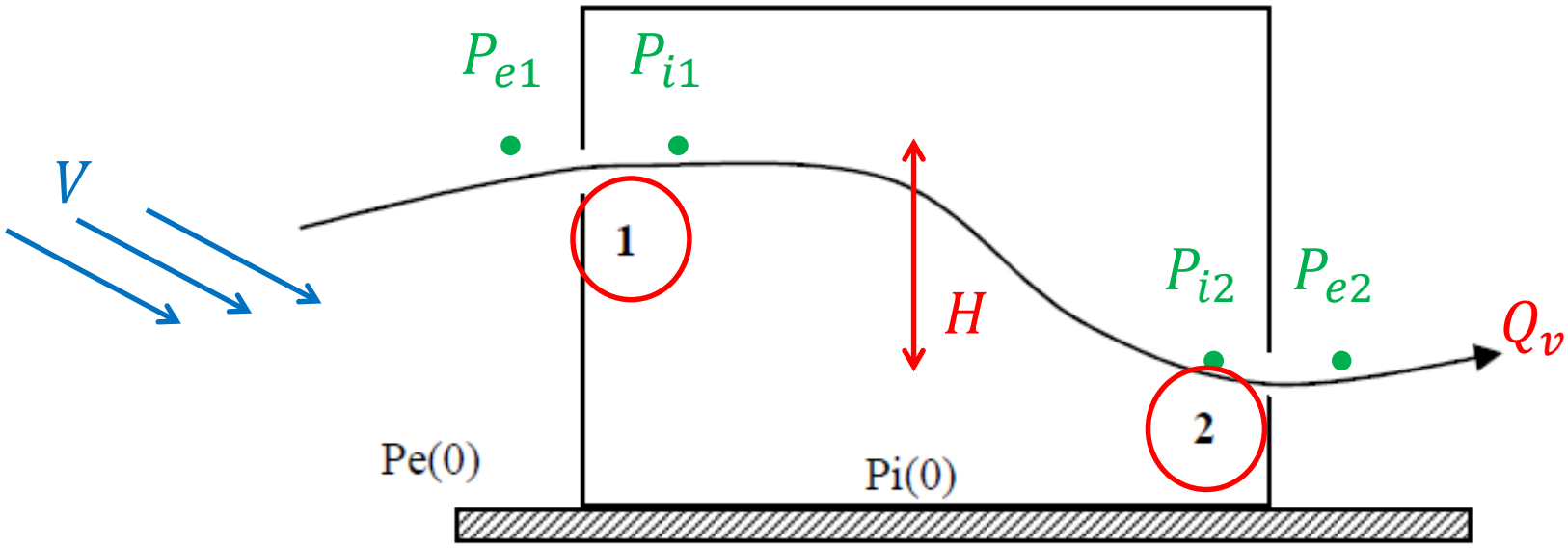
- Stack effect

$$P(z) = P(0) - \rho\, g\, z$$

$$z_n = \frac{P_e(0) - P_i(0)}{g\,(\rho_i - \rho_e)}$$

$$\Delta P(z) = g\,(\rho_e - \rho_i)\,(z_n - z)$$





(1) $$\left(P_{e1} + C_{p1}.\frac{1}{2}\rho_e V^2\right) - P_{i1} = \frac{\rho_e Q_v^2}{2\, S_1^2\, C_{d1}^2}$$

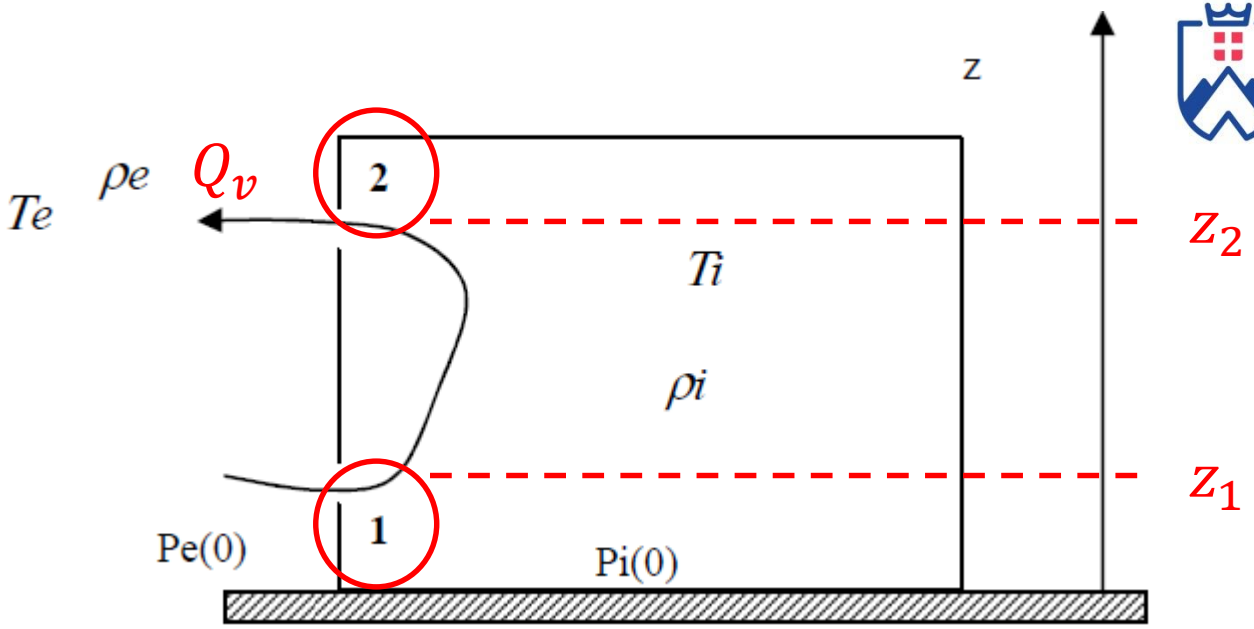
(2) $$P_{i2} - \left(P_{e2} + C_{p2}.\frac{1}{2}\rho_e V^2\right) = \frac{\rho_i Q_v^2}{2\, S_2^2\, C_{d2}^2}$$

$$P_{i1} - P_{i2} = -\rho_i\, g\, H$$

$$P_{e2} - P_{e1} = -\rho_e\, g\, H$$

$$\rho_e = \rho_i \qquad S_1 = S_2 \qquad C_{d1} = C_{d2}$$

$$Q_v = S\, C_d\, V \sqrt{\frac{C_{p1} - C_{p2}}{2}}$$



(1) z_1 $$P_e(z_1) - P_i(z_1) = \frac{\rho_e Q_{v1}^2}{2\, S_1^2\, C_{d1}^2}$$

$$(P_e(0) - \rho_e\, g\, z_1) - (P_i(0) - \rho_i\, g\, z_1) = \frac{\rho_e Q_{v1}^2}{2\, S_1^2\, C_{d1}^2}$$

(2) z_2 $$(P_i(0) - \rho_i\, g\, z_2) - (P_e(0) - \rho_e\, g\, z_2) = \frac{\rho_i Q_{v2}^2}{2\, S_2^2\, C_{d2}^2}$$

(1) + (2) $$\dot{m} = C_d \sqrt{\frac{2\, g\, H\, (\rho_e - \rho_i)}{\frac{1}{\rho_e S_1^2} - \frac{1}{\rho_i S_2^2}}}$$

$$\rho \approx \frac{353}{T}$$

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