University of Biskra 2024-2025

Building Physics

LEVEL: **1 YEAR BACHELOR**

SPECIALTY: **COP**

COURS 02

HEAT TRANSFER

University of Biskra

2024-2025

Building Physics

Understanding the principles of building physics is key. It helps optimise energy efficiency and indoor comfort. This ensures sustainability and well-being.

Thermal Comfort

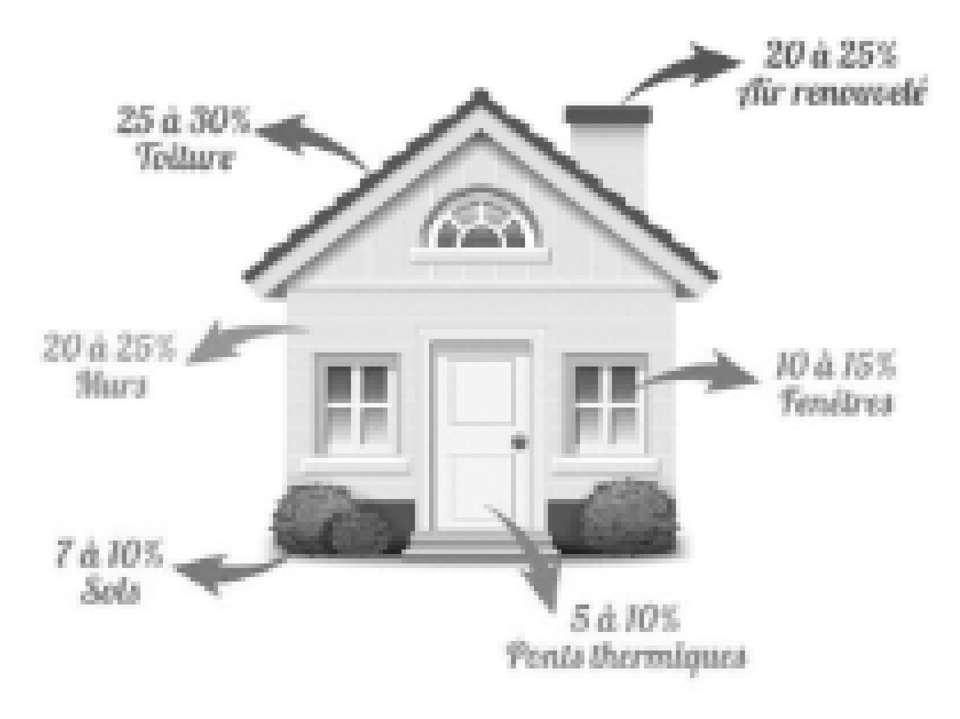
Maintaining optimal temperature and humidity levels indoors.

Energy Efficiency

Reducing energy consumption for heating and cooling.

Indoor Air Quality

Ensuring a healthy and comfortable indoor environment.



Understanding Heat Transfer: Conduction, Convection, and Radiation

Heat transfer is fundamental to many aspects of engineering, physics, and our everyday lives. This presentation explores the three primary modes of heat transfer: conduction, convection, and radiation. Understanding these principles is crucial for designing efficient heating systems, optimizing aerospace engineering, and more. We'll journey through each mode, examining their mechanisms, governing laws, and real-world applications.

Understanding Heat Transfer

Exploring conduction, convection, and radiation. These methods govern heat movement in buildings.

1. **Conduction**

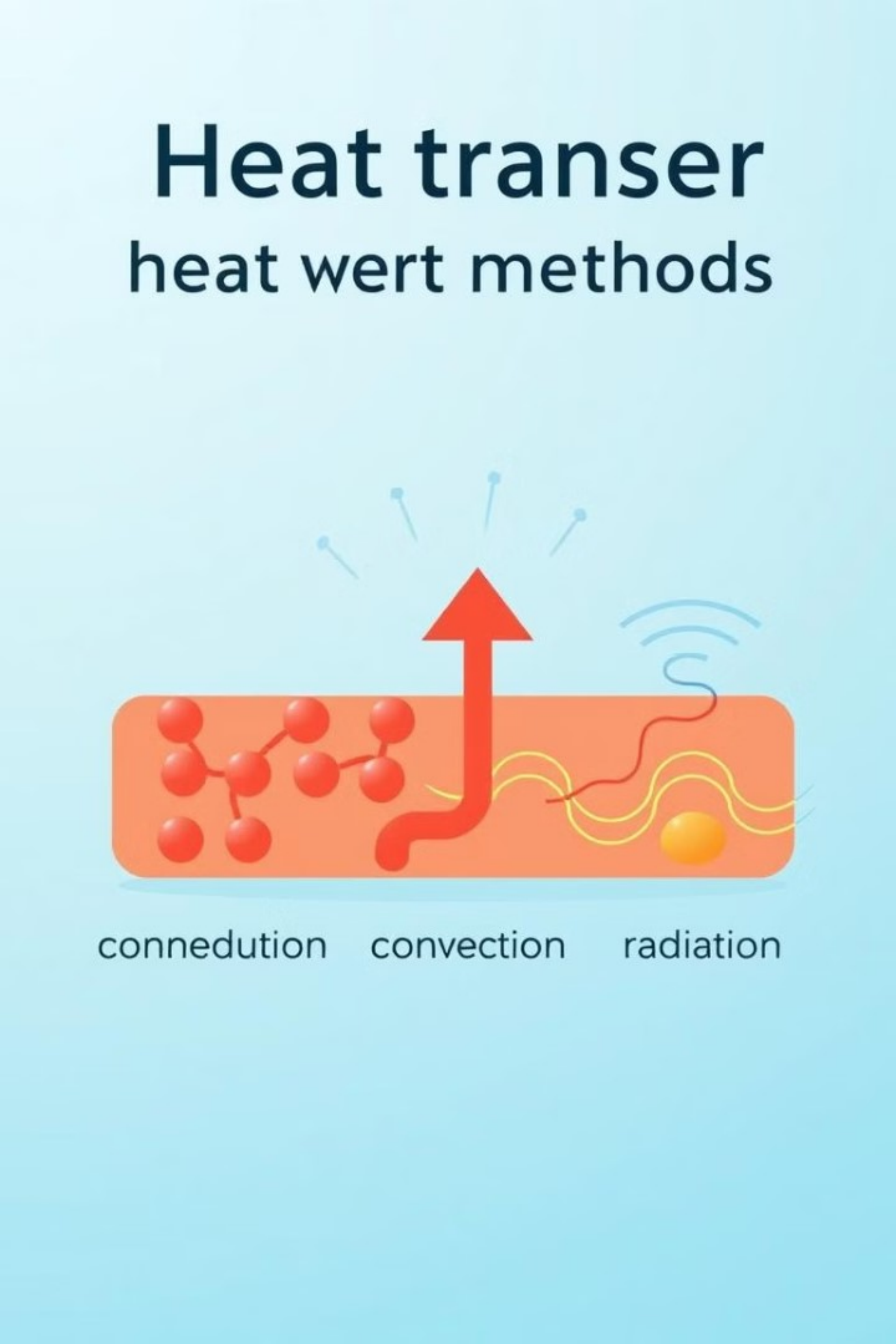
   Heat transfer through solids by molecular vibration.

2. **Convection**

   Heat transfer through fluids via circulation.

3. **Radiation**

   Heat transfer via electromagnetic waves.



Conduction: Heat Transfer Through Solids

Definition

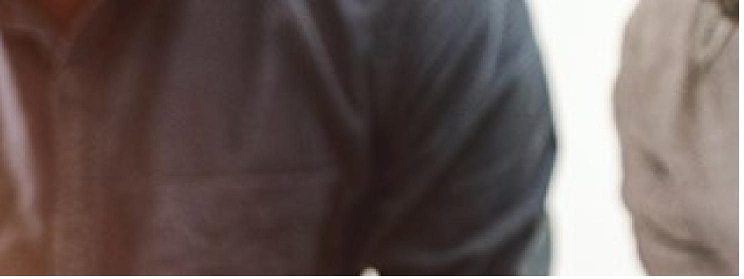
Conduction is heat transfer through a material without any bulk motion of the material itself. It occurs via the transfer of kinetic energy from more energetic particles to less energetic ones through molecular vibrations and collisions.

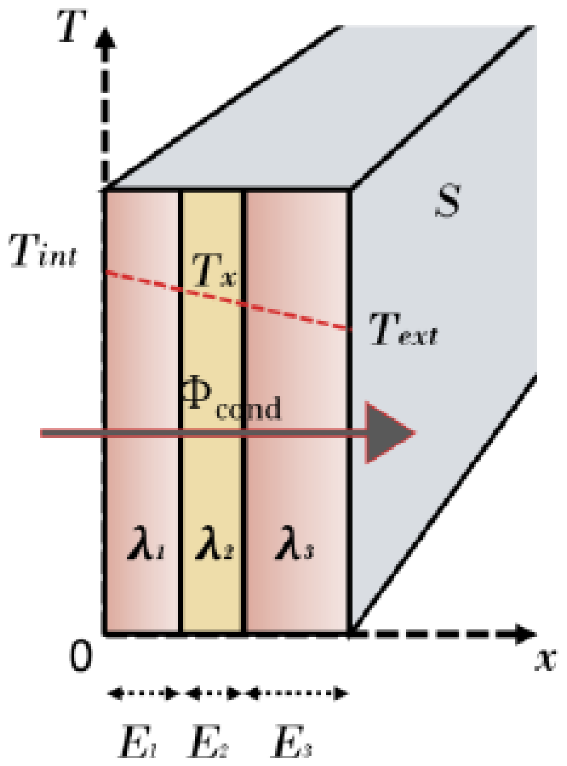
Fourier's Law

Fourier's Law of Conduction ($q = -kA(dT/dx)$) defines heat flux, where 'k' is thermal conductivity, 'A' is the area, and 'ΔT' is the temperature difference across a thickness 'L'.

Examples

Examples include heating a metal spoon in hot soup and heat transfer through walls. Factors affecting conduction are thermal conductivity, area, temperature difference, and thickness.

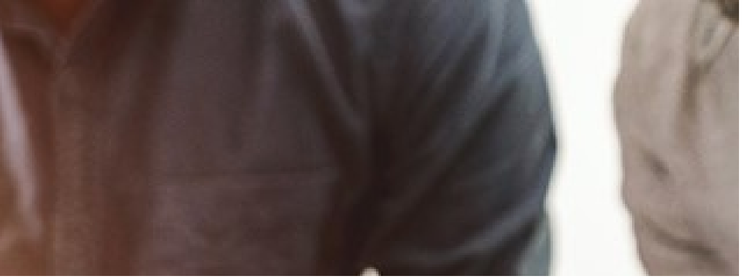




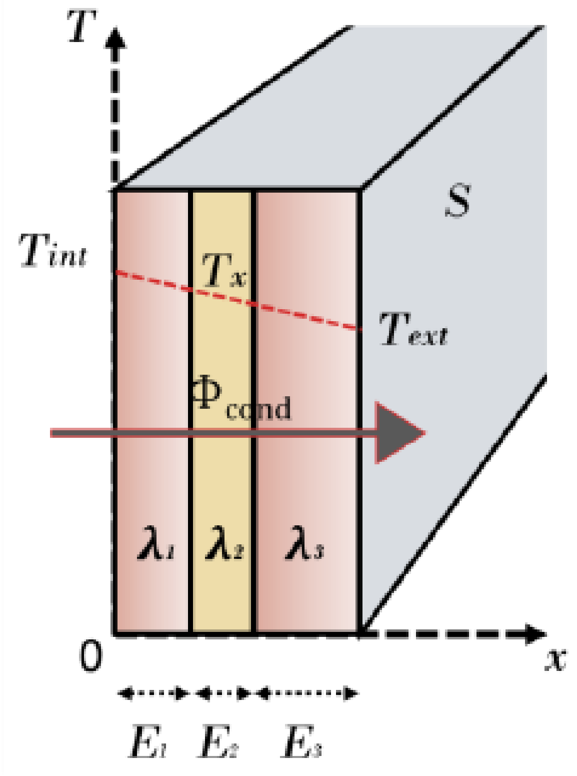
B. Case of a composite wall:

In order to give a detailed expression of the heat flux by conduction of a composite wall, we assume that we have a wall made of several layers of different thermal conductivity (λ1, λ2, λ3), and different thicknesses (E1, E2, E3)

$$\Phi_{Cond} = \left[\frac{1}{\frac{E_1}{\lambda_1} + \frac{E_2}{\lambda_2} + \frac{E_3}{\lambda_3}}\right] \cdot S \cdot (T_{int} - T_{ext})$$



B. Case of a composite wall:

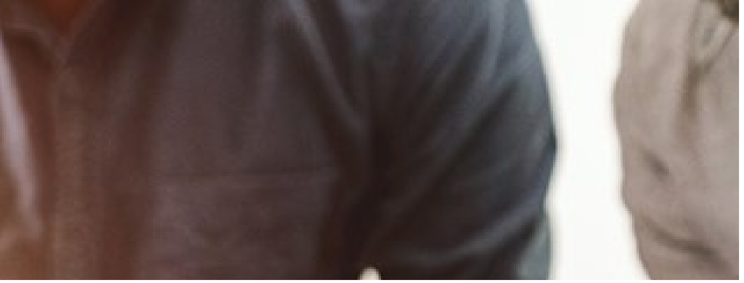


At this level, Jedidi and Benjeddou (2016) affirm that the calculation of the heat flow by conduction of this type of wall can be carried out by use of the expression

$$\varphi\ cond = \left[\frac{1}{\frac{E_1}{\lambda_1} + \frac{E_2}{\lambda_2} + \frac{E_3}{\lambda_3}}\right] \cdot S \cdot \Delta t$$

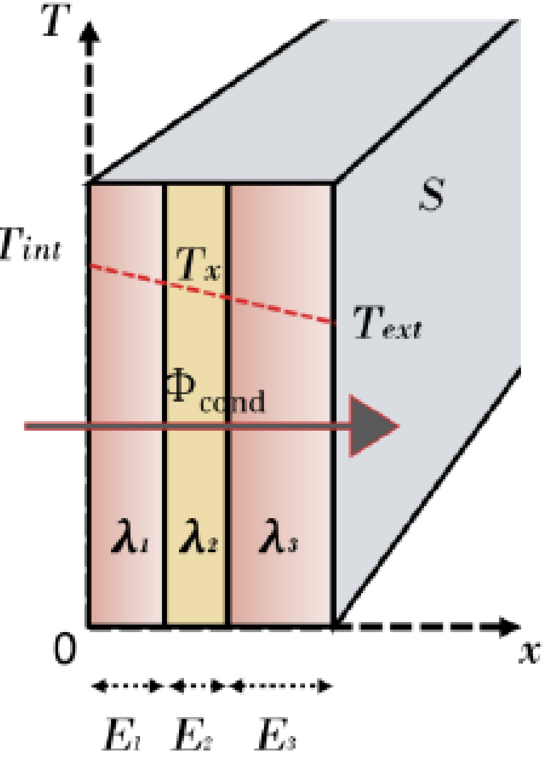
In this type, the calculation of the **heat flux by conduction** can be carried out using the following expression:

Qcond: Heat flux by conduction in W;
λ: Thermal conductivity of the material in W/m°C
S: Surface area of the element in m2;
E: Thickness of the material in m;
T1-T2: Surface temperature difference in (°C) or (K).



B. Case of a composite wall:

Thermal resistances :



Battaglia, Kusiak and Puiggali (2010) emphasize that conduction is a phenomenon very analogous to the conduction of electricity. In this case, the calculation of the resistance thermal can be represented by the sum of the thermal resistances of the different layers of this wall since the resistances are placed in series:

$$R_{Total} = \Sigma\, R_{Couches}$$

SO :

R Total = R1 + R2 + R3

R = E / λ S m2°C/W

R Total = (E1 / λ 1 * S) + (E2 / λ 2 * S) + (E3 / λ 3 * S)

Heat transmission by convection:

In fact, convection is a transfer which results of a movement overall of material supporting it (Battaglia, Kusiak and Puiggali, 2010). (the fluid movement is associated with the fact that, at any moment, a large number of molecules are moving together or in the form of aggregates (Bergman, Incropera, Lavine and DeWitt, 2011).

Noticed

An aggregate designates a set of distinct elements which form a whole and which d'adherent securely between them.

https://www.youtube.com/watch?v=v62iIJCaMFk

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Merci pour votre Attention

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