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Ministry of Higher Education and Scientific Research
وزارة التعليم العالي و البحث العلمي

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Module: Heat transfer

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كلية التكنولوجيا
قسم :الهندسة الكهربائية

Tutorial 02

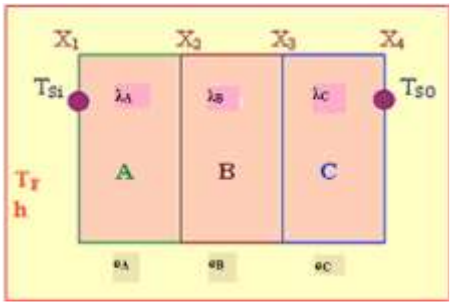
Exercise 1

We consider a concrete wall with dimensions **3 m** in height, **5 m** in length, and **0.20 m** in thickness. The inner surface of the wall is at a temperature of **20°C**, while the outer surface is at **5°C**.

1. Calculate the heat flow that passes through this wall at a perpendicular angle, in steady state.
2. We now insulate this wall by adding a layer of glass wool **8 cm** thick and a plasterboard **2 cm** thick.
   - Calculate the new value of heat flow through the insulated wall.
   - Thermal conductivity of concrete: **0.92 W/ (m°C)**
   - Thermal conductivity of the plaster: **0.50 W/ (m. °C)**
   - Thermal conductivity of glass: **0.04 W/ (m°C)**

Exercise 2

A furnace wall is composed of three materials. **Material A** has a known thermal conductivity of λ_A=20W/mK and a thickness of e_A=0.3m. **Material C** has a known thermal conductivity of λ_C=50W/mK and a thickness of e_C=0.15m. **Material B**, which is located between materials A and C, has a thickness of e_B=0.15m, but its thermal conductivity λ_B is unknown. Under steady-state operating conditions, the measured temperatures are an external surface temperature of T_{S0}=20°C, an internal surface temperature of T_{Si}=600°C, and a surrounding temperature of T_∞=800°C. The internal convection heat transfer coefficient is h=25W/m²·K.



Determine the value of λ_B?

Given Data: $\lambda_A = 20$ W/m·K, $\lambda_C = 50$ W/m·K, $\lambda_B = ?$, $e_A = 0.3$ m, $e_B = 0.15$ m, $e_C = 0.15$ m, $T_F = 800°C$, $T_{Si} = 600°C$, $T_{So} = 20°C$, $h = 25$ W/m²·K.

Exercise 3

A furnace wall with a surface area of **1m²** is composed of two layers:

- **First layer:** Refractory brick with a thickness of **L_1 = 0.20 m** and thermal conductivity **λ_1 = 1.38 W/(m·°C)**
- **Second layer:** Insulating brick with a thickness of **L_2 = 0.10 m** and thermal conductivity **λ_2 = 0.17 W/(m·°C)**

Calculate:

1. The thermal resistance of each layer
2. The total thermal resistance of the wall
3. The inner wall temperature, given that the outer temperature is **30°C** and the heat loss is **1000 W**