Andrea Foppiani / Week 4 assignment

1 SIMPLIFIED WALL CALCULATION : find Q_{TOT}

$$\left(R\_unit = \frac{L}{K} \quad \left[m^2 \cdot \frac{°C}{W} \right] \right)$$

- Total $R\_unit_{WOOD} = 1,109 \ m^2 \cdot \frac{°C}{W}$
- Total $R\_unit_{INSULATION} = 4,007 \ m^2 \cdot \frac{°C}{W}$

from past week's table

$$\rightarrow U_{WOOD} = \frac{1}{R\_unit_{WOOD}} = \frac{1}{1,109} = 0,9017 \frac{W}{m^2 \cdot °C}$$

$$\rightarrow U_{INS} = \frac{1}{R\_unit_{INS}} = \frac{1}{4,007} = 0,2496 \frac{W}{m^2 \cdot °C}$$

$$A_{WALL}^{TOT} = 50 \cdot 2,5 \cdot 0,8 = 100 m^2$$

$$\boxed{U_{TOT} = U_{WOOD} \cdot \frac{A_{WOOD}}{A_{WALL}^{TOT}} + U_{INS} \cdot \frac{A_{INS}}{A_{WALL}^{TOT}}}$$

$$\hookrightarrow U_{TOT} = 0,9017 \cdot 0,25 + 0,2495 \cdot 0,75 = 0,4125 \frac{W}{m^2 \cdot °C}$$

$$\Delta T = 22°C - (-2°C) = 24°C$$

$$\boxed{Q_{TOT} = U_{TOT} \cdot A_{TOT} \cdot \Delta T} \Rightarrow Q_{TOT} = 0,4125 \cdot 100 \cdot 24 = 990 W$$

2 SUMMARY : Radiation and radiative heat transfer

- RADIATION is → an emission or transmission of energy, with a propagation in all directions
  → happening in the form of waves
  → a propagation of a collection of discrete packets of energy called photons
  [ELECTROMAGNETIC RADIATION]

ELECTROMAGNETIC WAVES are characterized by → c = their speed of propagation in a medium

$$\lambda = \frac{c}{\nu}$$

→ ν = their frequency

→ λ = their wavelenght

WAVELENGHT λ is expressed in micrometers (10^{-6} m)

The energy of a photon can be calculated through it's frequency and a constant (h = PLANK'S CONSTANT)

$e = h \cdot \nu = h \cdot \frac{c}{\lambda}$ ⇒ the ENERGY is inversely proportional to the WAVELENGHT (directly proportional to the FREQUENCY)

THERMAL RADIATION
↳ is an electromagnetic radiation emitted by matter depending on its temperature

a BLACKBODY is → an ideal body (doesn't exist in nature)
→ a perfect emitter and absorber of thermal radiation (heat)

It emitts a UNIFORM RADIATION whose energy depends very much on its <u>temperature</u> (and on Boltzmann's constant σ)

$$E_b(T) = \sigma \cdot T^4 \quad \left[\frac{W}{m^2}\right]$$

(!) → A blackbody emits the MAXIMUM AMOUNT OF RADIATION BY A SURFACE AT A GIVEN TEMPERATURE

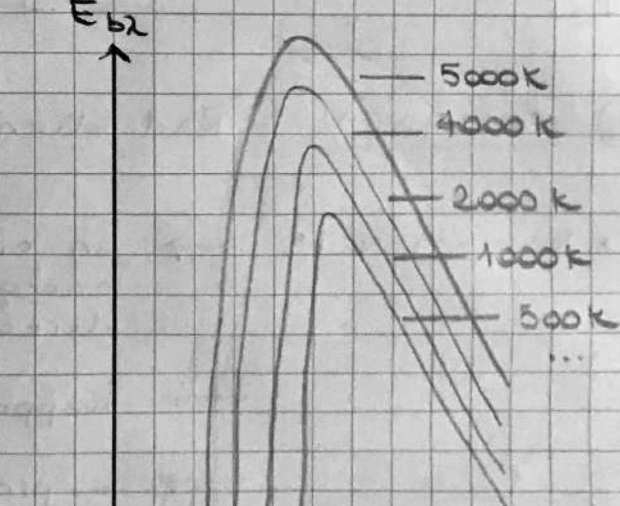
- The emitted thermal radiation is also a function of its WAVELENGHT

→ each temperature has a certain range of wavelenght emission, with a peak that characterizes it

→ not all temperatures have an emission at all wavelenghts

→ radiations with a wavelenght energy peak above 800 degrees Kelvin emit a VISIBLE <u>LIGHT</u> RADIATION

(other objects are only visible because they reflect light)



RADIATION INTENSITY (I)

= the power of emission (/reflection/transmission/...) of a body in a certain direction in space

→ this emission is usually different according to the direction, except for the BLACKBODY, where it's always the same (uniform)

- All surfaces EMIT AND RECEIVE radiation to/by other surfaces
  - ↳ INCIDENT RADIATION (G)
    energy being received by a surface
  - ↳ RADIOSITY (J)
    energy leaving an area