## WEEK ASSIGNMENT 4

**Task 1**: Complete the modified example of simplified wall calculations from the assignment of week 3 and find the total heat transfer through wall.

**Solution:**

| | **Wood** | **Insulation** |
|---|---|---|
| **Outside air** | 0.03 | 0.03 |
| **Wood bevel** | 0.14 | 0.14 |
| **Urethane rigid foam** | / | (0.98/25)x90 = 3.53 |
| **Plywood** | 0.11 | 0.11 |
| **Gypsum board** | 0.079 | 0.079 |
| **Inside surface** | 0.12 | 0.12 |
| **Wood studs** | 0.63 | / |

R'$_{wood}$ =0.03+0.14+0.11 + 0.079 + 0.12 + 0.63 =1.11 $\frac{\mathrm{m2 \cdot °C}}{W}$

R'$_{insulation}$ = 0.03+0.14+3.53+0.11+0.079+0.12=4.01 $\frac{\mathrm{m2 \cdot °C}}{W}$

$$U_{tot} = U_{ins} * \frac{A_{ins}}{A_{tot}} + U_{wood} * \frac{A_{wood}}{A_{tot}}$$

$$U_{tot} = U_{ins} * 0.75 + U_{wood} * 0.25$$

$$U_{ins} = \frac{1}{R'_{ins}} = \frac{1}{4.01} = 0.2494 \ \frac{W}{m^2 °\mathrm{C}}$$

$$U_{wood} = \frac{1}{R'_{wood}} = \frac{1}{1.11} = 0.9009 \ \frac{W}{m^2 °\mathrm{C}}$$

$$U_{tot} = 0.2494 * 0.75 + 0.9009 * 0.25 = 0.18705 + 0.225225 = 0.412275 \ \frac{W}{m^2 °\mathrm{C}}$$

$$A_{tot} = 50 * 2.5 * 0.8 = 100 m^2$$

$$\Delta T = 22 - (-2) = 24 °\mathrm{C}$$

$$Q_{tot} = U_{tot} * A_{tot} * \Delta T = 989.46 \ W$$

**Task 2**: In 2 pages write a summary of what you have learnt about radiation and radiative heat transfer.

**Radiation**

Radiation is method of heat transfer just like conduction and convection, but radiation does not require the presence of material medium to take place. Radiation transfer is occurred in solid, liquid and gases.

In general radiation is emission of energy in form of waves through space. Electromagnetic waves travel at the speed of light. Electromagnetic waves transport energy just like other waves and they are characterized by their frequency *v* or wavelength $\lambda$. These two properties in a medium are related by:

$$\lambda = \frac{C}{V}$$

**Light**

Light is presented as visible portion of electromagnetic spectrum that lies between 0.40 and 0.76 μm.

Light source is name for current body that is emitting radiation in visible eange.

**TABLE 12–1**

The wavelength ranges of different colors

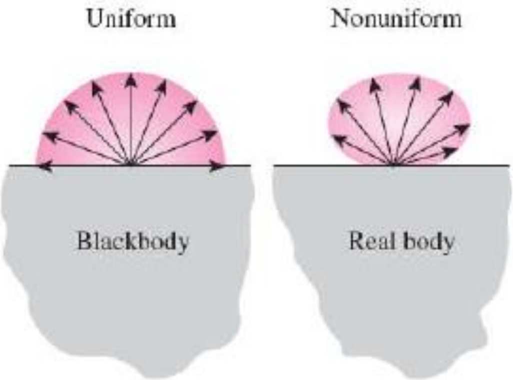
| Color | Wavelength band |
|---|---|
| Violet | 0.40–0.44 μm |
| Blue | 0.44–0.49 μm |
| Green | 0.49–0.54 μm |
| Yellow | 0.54–0.60 μm |
| Orange | 0.60–0.67 μm |
| Red | 0.63–0.76 μm |

**Black body radiation**

Black body is perfect emitter and absorber of radiation. A blackbody is able to emit the maximum amount of radiation by a surface at a given temperature. In nature bodies emit different amounts of radiation per unit surface area.

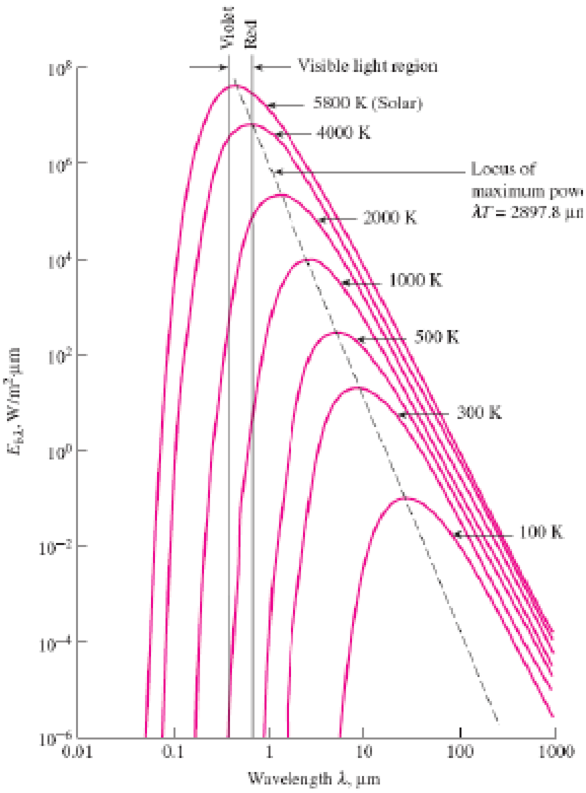
The radiation energy emitted by black body is expressed by:

$$E_b(T) = \sigma T^4 \qquad (\text{W/m}^2)$$



**Planck's law:**

$$E_{b\lambda}(\lambda, T) = \frac{C_1}{\lambda^5[\exp(C_2/\lambda T) - 1]} \qquad (\mathrm{W/m^2 \cdot \mu m})$$




*The variation of the blackbody emissive power with wavelength for several temperatures.*

**Radiation intensity** is quantity which shows us magnitude of radiation emitted (or incident) in a specified direction in space. It is denoted by the symbol ***I***.

**Irradiation** is radiation flux incident on a surface from all directions. It is denoted by symbol $\boldsymbol{G}$.

$$G = \int_{\text{hemisphere}} dG = \int_{\phi=0}^{2\pi}\int_{\theta=0}^{\pi/2} I_i(\theta, \phi)\cos\theta \sin\theta d\theta d\phi \qquad (\mathrm{W/m^2})$$

**Radiosity** is quantity that represents the rate at which radiation energy leaves a unit area of a surface in all directions. It is denoted by symbol ***J***.

$$J = \int_{\phi=0}^{2\pi}\int_{\theta=0}^{\pi/2} I_{e+r}(\theta, \phi)\cos\theta \sin\theta d\theta d\phi \qquad (\mathrm{W/m^2})$$