Fourth lesson (23rd of October, 2019).
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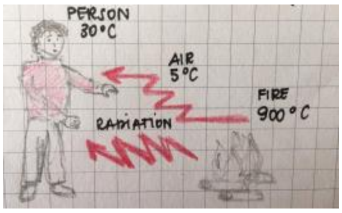
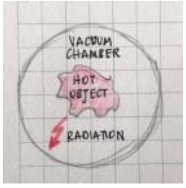
Summary of what I understood about radiation and radiative heat tranfer

While conduction and convection require matter to transfer heat, radiation can heat transfer without any contact between the heat source and the heated object.
Practical examples: we feel heat from the sun, even though we are not touching it.
We feel warm in front of a fire, even tought we are not touching it. →→→→→→→→→→→→→→→→→→→→→→

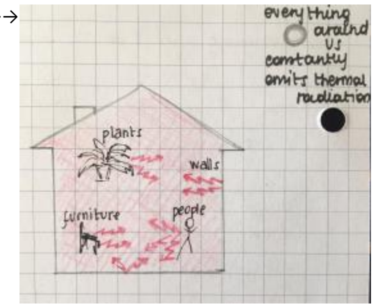


Heat can be transmitted though empty space by thermal radiation, the type of electromagnetic radiation that is pertinent to heat transfer.
All objects absorb and emit radiation and radiation transfer of heat occurs in solid as well as liquids and gases.



The hot object in vacuum chambers will eventually cool down and reach thermal equilibrium with its sorrounding by a heat transfer mechanism: radiation

Temperature is a measure of strenght of these activities and the rate of thermal radiation emissions increases with increasing temperature.
When the absorption of energy balances the emission of energy, the temperature of an object stays constant.
When the absorption of energy is greater than the emission of energy, the temperature of an object rises.
When the absorption of energy is less than the emission of energy, the temperature of an object falls.
Thermal radiation is continuously emitted by all matter whose temperature is above zero. →→→→→→→→→→



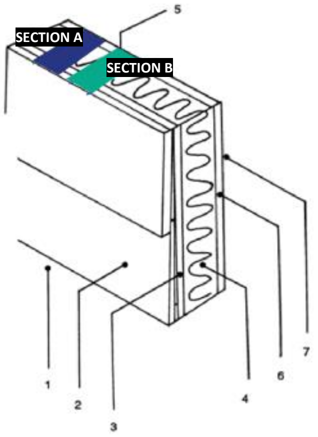
The net radiative heat transfer from one surface to another is the radiation leaving the first surface for (*) the other minus (-) that arriving from the second surface.
So it's possible to say that different bodies may emit different amounts of radiation per unit surface area.

So, let's introduce now a specific body: the blackbody.
Blackbody is an idealized body, a standard body with wich the radiative properties of real surfaces can be compared.
Blackbody is a perfect emitter and absorber of radiation, it emits the maximum amount of radiation by a surface at a given temperature and it absorbs all incident radiation, regardless of waveless and direction.

Complete the modified example of simplified wall calculations that you went through in the assignmentof week 3 and find the total heat transfer through wall.

3) Determine the overhall unit thermal resistance (R value) and the overall heat transfer coefficient (the U value) of a wood frame wall that is built around 38mm 90mm wood studs with the center-to-center distance of 400mm. The 90mm wide cavity between the studs is filled with urethane rigid foam insulation. The inside is finished with 13mm gypsum wallboard and the outside with 13mm playwood and 13mm 200mm wood bevel lapped siding.
   The insuled cavity constitutes 75% of the heat transmission area, while the studs, plates and sills constitutes 21%.
   The headers constitute 4% of the area and they can be treated as studs (=> 75% of the area = insulation / 25% = 25% wood).
   Determine also the rate of heat loss through the walls of a house, whose perimeter is 50m and wall hight is 2.5m, in Las Vegas, Nevada, whose winter design temperature is -2°C.
   Take the indoor design temperature to be 22°C and assume 20% of the wall area is occupied by glazing.

	SectionA with wood	SectionB with insulation
1. outside Air	0.03	0.03
2. wood bevel lapped siding (13mm * 200mm)	0.14	0.14
3. playwood (13mm)	0.11	0.11
1. urethane rigid foam (90mm)	-	0.98*90/25
5. wood studs	0.63	-
6. gypsum wallboard	0.079	0.079
7. inside surface	0.12	0.12



$A_{wall} = 50 * 0.8 = 100\ m^2$

ΔT = 22 - (-2) = 24 24°C

R' withIns = 0.03 + 0.14 + 0.11 + 0.63 + 0.079 + 0.12 = 1.109 m^2 . °C/W

R' withWood = 0.03 + 0.14 + 0.11 + (0.98*90/25) + 0.079 + 0.12 = 4.007 m^2 . °C/W

Overall heat transfer coefficient:

$$U_{tot} = U_{wood} * \frac{A_{wood}}{A_{tot}} + U_{insulation} * \frac{A_{insulation}}{A_{tot}} = U_{wood} * 0.25 + U_{insulation} * 0.75$$

$$U_{wood} = \frac{1}{R'_{wood}} = \frac{1}{1.109} = 0.9017\ \frac{W}{m^2\ °C}$$

$$U_{ins} = \frac{1}{R'_{ins}} = \frac{1}{4.007} = 0.2496\frac{W}{m^2\ °C}$$

$$U_{tot} = 0.9017 * 0.25 + 0.2496 * 0.75 = 0.226 + 0.188 = 0.4126\frac{W}{m^2\ °C}$$

The rate of heat loss through the wall:

$\dot{Q}_{total}$ = $U_{tot} * A_{tot} *$ ΔT = 0.4126 * 100 * 24 = 2.400 990.24 W