Task 1: you should complete the modified example of simplified wall calculations that you went through in the assignment of week 3 and find the total heat transfer through wall

Question :

A wood frame wall that is built around 38-mm 90-mm wood studs with a center-to-center distance of 400 mm. The 90-mm-wide cavity between the studs is filled with urethane rigid foam insulation. The inside is finished with 13-mm gypsum wallboard and the outside with 13 mm poly wood and 13-mm 200-mm wood bevel lapped siding. The insulated cavity constitutes 75 percent of the heat transmission area while the studs, plates, and sills constitute 21 percent. The headers constitute 4 percent of the area, and they can be treated as studs (this means 75% of area is insulation and 25% can be considered wood).

Find the two R values, determine the overall unit thermal resistance (the R-value) and the overall heat transfer coefficient (the U-factor)

Also, determine the rate of heat loss through the walls of a house whose perimeter is 50 m and wall height is 2.5 m in Las Vegas, Nevada, whose winter design temperature is -2 C. Take the indoor design temperature to be 22 C and assume 20 percent of the wall area is occupied by glazing.

Answer：

	Wood	Insulation
Outside air	0.03	0.03
Wood bevel(13mm-200mm)	0.14	0.14
Plywood(13mm)	0.11	0.11
Urethane rigif foam insulation(90mm)	×	$\frac{0.98}{25} \times 90 = 3.528$
Wood studs(90mm)	0.63	×
Gypsum board(13mm)	0.079	0.079
Inside surface	0.12	0.12

R wood = 0.03+0.14+0.11+0.63+0.079+0.12 = 1.109 ㎡℃/W

R insulation = 0.03 + 0.14 + 0.11 + 3.528 + 0.079 + 0.12 = 4.007 ㎡°C/W

U wood = 1/ R wood = 1/1.109 = 0.9017 ㎡℃/W

U insulation = 1/ R insulation = 1/4.007 = 0.2496 ㎡℃/W

U total =25% U wood +75% U insulation = 0.902*0.25 + 0.25*0.75 = 0.4126 W/㎡°C

Q = U total*As*ΔT = 0.4126*125*0.8*24 = 990.24W

Task 2 : In 2 pages you should write a summary of what you have learnt in this lecture about radiation and radiation heat transfer

Thermal radiation is electromagnetic radiation generated by the thermal motion of particles in matter. All matter with a temperature greater than absolute zero emits thermal radiation. Particle motion results in charge-acceleration or dipole oscillation which produces electromagnetic radiation.

The infrared radiation emitted by animals that is detectable with an infrared camera, and the cosmic microwave background radiation, are all examples of thermal radiation.

If a radiation-emitting object meets the physical characteristics of a black body in thermodynamic equilibrium, the radiation is called blackbody radiation.[1] Planck's law describes the spectrum of blackbody radiation, which depends solely on the object's temperature. Wien's displacement law determines the most likely frequency of the emitted radiation, and the Stefan – Boltzmann law gives the radiant intensity.

Thermal radiation is also one of the fundamental mechanisms of heat transfer.

Electromagnetic waves are characterized by their frequency (v) or wavelength (c). These two properties in a medium are related by the speed of propagation of a wave in that medium (λ). $\lambda = c/v$

Electromagnetic radiation is the propagation of elementary particle called photons. The energy of a photon is inversely proportional to its wavelength.

RADIATION HEAT TRANSFER

Heat transfer through radiation takes place in form of electromagnetic waves mainly in the infrared region. Radiation emitted by a body is a consequence of thermal agitation of its composing molecules. Radiation heat transfer can be described by reference to the 'black body'.

BLACK BODY RADIATION

The black body is defined as a body that absorbs all radiation that falls on its surface. Actual black bodies don't exist in nature - though its characteristics are approximated by a hole in a box filled with highly absorptive material. The emission spectrum of such a black body was first fully described by Max Planck.

A black body is a hypothetical body that completely absorbs all wavelengths of thermal radiation incident on it. Such bodies do not reflect light, and therefore appear black if their temperatures are low enough so as not to be self-luminous. All black bodies heated to a given temperature emit thermal radiation.

The radiation energy per unit time from a black body is proportional to the fourth power of the absolute temperature and can be expressed with Stefan-Boltzmann Law as

$q = \sigma$ T4 A (1)

where

q = heat transfer per unit time (W)

σ = 5.6703 10-8 (W/m2K4) - The Stefan-Boltzmann Constant

T = absolute temperature in kelvins (K)

A = area of the emitting body (m2)