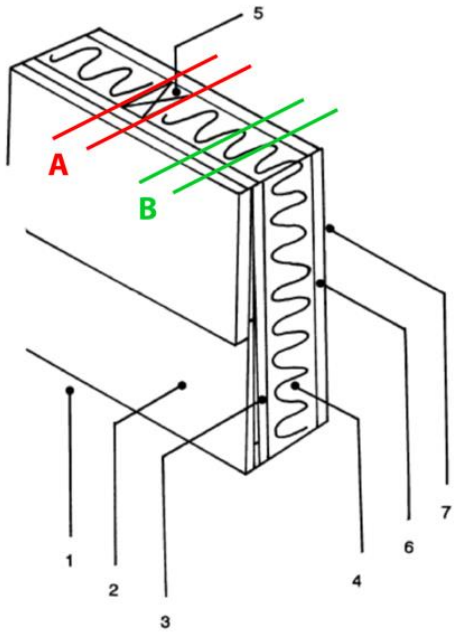
Week4

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 glass fiber insulation. The inside is finished with 13-mm gypsum wallboard and the outside with 13-mm wood fiberboard and 13-mm 200-mm wood bevel lapped siding. The insulated cavity constitutes 75 % 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. Find the two Runit values and determine the overall unit thermal resistance and the overall heat transfer coefficient (U).



Also determine the rate of heat loss through the walls of a house whose perimeter is 50 meter and the 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 % of the wall area is occupied by glazing

	Wood	Insulation
Outside Air	0.03	0.03
Wood Bevel l.	0.14	0.14
Plywood(13mm)	0.11	0.11
Urethane Rigid Foam	/	0.98*(90/25)=3.528
Wood Stud	0.63	/
Gypsum Board	0.079	0.079
Inside Surface	0.12	0.12

Answer:

$R_{with\ wood}$ = (0,03+0,14+0,11+0,63+0,079+0.12)= 1,109m²°C/W

$R_{with\ insulation}$ = (0,03+0,14+0,11+3,528+0,079+0,12)= 4,007m²°C/W

U_{wood} = $1/R'_{with\ wood}$ = 1/1,109=0,9017 $W/\mathrm{m}^{2\circ}/C$

$U_{insulation}$ = $1/R'_{with\ insulation}$ = 1/4,007=0,2496 $W/\mathrm{m}^{2\circ}C$

U_{total} = $U_{wood} * A_{wood}/A_{total} + U_{insulation} * A_{insulation}/A_{total}$ =25% * 0,9017+75% * 0,2496=0,4126 $W/\mathrm{m}^{2\circ}C$

R_{value} = $1/U_{total}$= 1/0,4126=2,4237 $\mathrm{m}^{2\circ}C/W$

Q_{total}= $U_{total}* U_{total}*\Delta T$=0,4126*50*25*(1−20%)*22−(−2)=990,24 W

Task 2 In 2 pages you shoudl write a summary (in your own word! in your own words !!) of what you have learnt in this session about radiation and radiative heat transfer

Answer：

In the course I learned that Thermal radiation is the phenomenon of electromagnetic waves radiated by an object due to its temperature. One of the three ways that heat is transferred. Radiation transfer occurs in solid as well as liquid and gases. Because electromagnetic waves travel without any medium, thermal radiation is the only way to transfer heat in a vacuum.

A significant difference between thermal radiation and other mechanisms of heat transfer is, thermal radiation does not need the presence of a material medium to take place. So thermal radiation can occur in vacuum."

According to Maxwell theory, energy transfer takes place via electromagnetic waves in radiation. Electromagnetic waves transport energy like other waves and travel at the speed of light. Electromagnetic waves are characterized by their frequency ν (Hz) and wavelength λ (μm), where: λ = c / ν, where c is the speed of light in that medium; in a vacuum c0 = 2.99 x 108 m / s. Radiation heat transfer is very important in buildings, application on that: heat exchange between the lighting fixture and interior surfaces;
solar heat absorption on exterior surfaces;
solar heat absorption and reflection by interior building surface;
heat emission by the exterior surfaces to the sky;

heat exchange among interior surfaces;
heat exchange between interior surfaces and occupants;

A blackbody is an object that absorbs at any temperature any wavelength of energy that radiates to its surface. Blackbody is a kind of idealized object with the strongest absorption ability to thermal radiation. However, it is possible to design various absolute black bodies in theoretical research.

In blackbody radiation, the color of light changes with temperature,there are shades of orange and blue and white. The color of the light is the same as the color of the light.

Radiation heat transfer is a basic way of heat transfer. While emitting radiant energy outward, an object will continuously absorb the radiant energy emitted by other objects around it and convert it into heat energy again. The heat transfer process between such objects is called radiant heat transfer. If the radiation heat transfer is carried out between two objects with different temperatures, the result of the heat transfer is that the high temperature object transfers heat to the low temperature object. If the two objects have the same temperature, the radiation heat transfer between the objects is equal to zero, but the process of radiation and absorption between the objects is still going on.