Task1

	Wood	Insulation
Outside Air	0.03	0.03
Wood Bevel l.	0.14	0.14
Plywood(13mm)	0.11	0.11
Urethane Rigid Foam	No	0.98*(90/25)=3.528
Wood Stud	0.63	No
Gypsum Board	0.079	0.079
Inside Surface	0.12	0.12

$$R'_{with.wood} = 0.03 + 0.14 + 0.11 + 0.63 + 0.079 + 0.12 = 1.109 m^2 * ℃/\mathrm{W}$$

$$R'_{with.\mathrm{insulation}} = 0.03 + 0.14 + 0.11 + 3.528 + 0.079 + 0.12 = 4.007 m^2 * ℃/\mathrm{W}$$

$$U_{\mathrm{wood}} = \frac{1}{R'_{with.wood}} = \frac{1}{1.109} = 0.9017 W / ㎡℃$$

$$U_{\mathrm{insulation}} = \frac{1}{R'_{with.\mathrm{ins}}} = \frac{1}{4.007} = 0.2496 W / ㎡℃$$

$$U_{\mathrm{total}} = U_{\mathrm{wood}} * \frac{A_{wood}}{A_{total}} + U_{\mathrm{ins}} * \frac{A_{ins}}{A_{total}} = (21+4)\% * 0.9017 + 75\% * 0.2496 = 0.4126 \mathrm{W}/㎡℃$$

$$R_{\mathrm{value}} = \frac{1}{U_{\mathrm{total}}} = \frac{1}{0.4126} = 2.4237 ㎡℃/W$$

$$\dot{Q}_{\mathrm{total}} = U_{\mathrm{total}} * A_{\mathrm{total}} * \Delta \mathrm{T} = 0.4126 * 50 * 2.5 * (1 - 20\%) * 22 + 2 = 990.24 W$$

Task2

Summary about radiation and radiative 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.

Thermal radiation is a basic form of heat transfer. Radiation is a phenomenon that transmits energy in electromagnetic waves. Objects emit radiant energy for a variety of reasons. The process of emitting radiant energy due to heat is called thermal radiation. It is transmitted in the form of electromagnetic wave and propagates in space. When encountering another object, it is partially or completely absorbed and converted into heat energy again. Different from heat conduction and

convection, radiation is not only the transfer of energy but also the transformation of energy forms. Moreover, radiant energy can travel in a vacuum without any material as a medium. The most important thermal radiation in industry is the mutual radiation between solids, and only at high temperatures can radiation become the main mode of heat transfer. Liquids and gases can also transmit heat by radiating, but only a tiny fraction of the total heat transfer.

The process of heat transfer between hot and cold objects by electromagnetic radiation is a kind of non-contact heat transfer, which can also be carried out in vacuum. The electromagnetic wave emitted by the object is theoretically distributed in the whole spectrum, but in the temperature range encountered in industry, what is of practical significance is the thermal radiation with wavelength between 0.38 ~ 1000um, and most of it is located in the range of 0.76 ~ 20um in the infrared range. Infrared heating is the use of this region of thermal radiation.