

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

Find the 2 *RUnit* values.

	WOOD	INSULATION
OUTSIDE AIR	0.03	0.03
WOOD BEVEL (13*20mm)	0.14	0.14
PLYWOOD (13mm)	0.11	0.11
URETHANE RIDGID FOAM INSULATION (90mm)	-	$0.98 \times 90 / 25 = 3.5$
WOOD STUDS (90mm)	0.63	-
GYPSUM BOARD (13mm)	0.079	0.079
INSIDE SURFACE	0.12	0.12
TOTAL m2.C/W	1.11	3.98

Start by calculating the area of the wall: $A = 50 \times 2.5 \times 0.8 = 100 \text{ m}^2$

Temperature variation: $\Delta T = 22 - (-2) = 24^\circ\text{C}$

$$U_{\text{total}} = U_{\text{wood}} \times \frac{A_{\text{wood}}}{A_{\text{total}}} + U_{\text{insulation}} \times \frac{A_{\text{insulation}}}{A_{\text{total}}} = 0.25 \times U_{\text{wood}} + 0.75 \times U_{\text{insulation}}$$

$$U_{\text{wood}} = \frac{1}{R'_{\text{Wood}}} = 1/1.11 = 0.901 \text{ m}^2\text{.C/W}$$

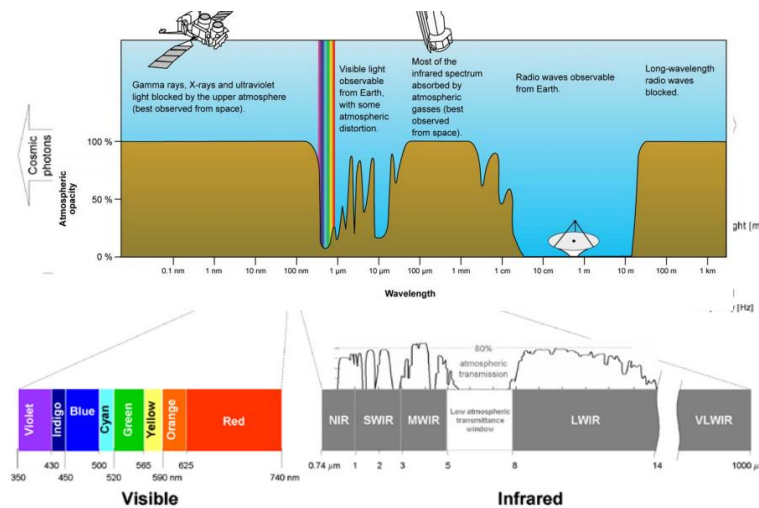
$$U_{\text{insulation}} = \frac{1}{R'_{\text{insulation}}} = 1/3.98 = 0.251 \text{ m}^2\text{.C/W}$$

$$U_{\text{total}} = 0.25 \times 0.901 + 0.75 \times 0.251 = 0.4135 \text{ m}^2\text{.C/W}$$

$$\text{The rate of heat loss through wall: } \dot{Q}_{\text{total}} = U_{\text{total}} \times A \times \Delta T = 0.4135 \times 100 \times 24 = 992.4 \text{ W}$$

2) The world is built around heat transfer, whether you're heating your food made last night or cooling your home in the summer times. We have previously learned about convection and conduction but there is a third mechanism which is called thermal radiation. Unlike convection and conduction needing material to transfer heat, radiation can happen without any contact between the heat source and the object. That is why heat energy from the sun is able to reach the earth.

Radiation heat transfer occurs in solids, liquids and even gases. This mechanism travels as infrared radiation and in form of electromagnetic waves or radiation. Heat comes to us from the sun in which there are no particles in space, this is called a vacuum. An electromagnetic spectrum can be presented in order to understand the different phases that are present in the known world. The spectrum is numbered from 10^{-9} to 10^{10} where all hot objects are emitted in heat radiation should be above 0 Kelvin. However, it will also be absorbing heat radiation only if a hotter object is placed in the surrounding.



Visible high frequency waves within the infrared and visible are generated by molecular excitation followed by decay. The emitted frequency is precisely associated with the energy distinction between the 2 energy of the molecules.

Radio generated by periodic currents of electrical charges in wires.