# Submission 3 - Technical Environmental Systems

1. **Complete the composite wall question by finding the heat transfer rate. Solve the same question while the thickness of the brick is increased to 32 cm and comment on the results.**

$R_{total} = 6.8119 \circ \frac{C}{W}$

Therefore, Heat transfer rate, $\dot{Q} = (T_{\infty_1} - T_{\infty_2})/R_{total} = (20 - (-10))/6.8119 = \quad 4.404\, W$

**If the brick thickness is increased to 32cm :**

$R_i = 0.4$ ; $R_f = 4.615$ ; $R_{plaster} = 0.3636$ ; $R_{parallel} = 1.9393\ (increased\ to\ 2\ times)$ ; $R_o = 0.1$

$R_{total} = 0.4 + 4.615 + 0.3636 + 1.9393 + 0.3636 + 0.1 = 7.7815$

Therefore, Heat transfer rate, $\dot{Q} = (T_{\infty_1} - T_{\infty_2})/R_{total} = (20 - (-10))/7.7815 = \quad 3.8553\, W$

*Increasing the thickness of the parallel configuration will not bring a significant change to the overall resistance of the wall. The thermal resistance of the wall is therefore not greatly affected by a parallel configuration when compared to a series configuration.*

2. **Solve again, the simplified wall calculation procedure replacing the glass fiber one with urethane rigid foam and while replacing the fiberboard with plywood and find the two R_unit values**

$R_{unit}$ Values:

| | Wood | Insulation |
|---|---|---|
| Outside Air | 0.03 | 0.03 |
| Wood Bevel (13*200mm) | 0.14 | 0.14 |
| Plywood (13mm) | 0.11 | 0.11 |
| Urethane rigid foam (90mm) | - | 0.98*90 / 25 = 3.528 |
| Wood Studs (90mm) | 0.63 | - |
| Gypsum board (13mm) | 0.079 | 0.079 |
| Inside surface | 0.12 | 0.12 |

$R_{with\ wood} = (0.03 + 0.14 + 0.11 + 0.63 + 0.079 + 0.12) = 1.109\ m^2 \circ \frac{C}{W}$

$R_{with\ insulation} = (0.03 + 0.14 + 0.11 + 3.528 + 0.079 + 0.12) = 4.007\ m^2 \circ \frac{C}{W}$