A 3 m high and 5 m wide wall consists of long **32 cm 22 cm** cross section horizontal bricks (k =0.72 W/m · ° C) separated by 3 cm thick plaster layers (k =0.22 W/m · °C).
There are also 2 cm thick plaster layers on each side of the brick and a 3-cm-thick rigid foam (k 0.026 W/m · °C) on the inner side of the wall The indoor and the outdoor temperatures are 20°C and -10°C, and the convection heat transfer coefficients on the inner and the outer sides are h1=10 W/m2 · °C and h2 =40 W/m2 · °C, respectively.Assuming one-dimensional heat transfer and disregarding radiation, determine the rate of heat transfer through the wall.

$$R_i = \frac{1}{10 \times 0.25} = 0.4 C/W$$
$$R_f = \frac{0.03}{0.026 * 0.25} = 4.62 \frac{C}{W}$$

$$R_{p_{up}} = R_{p_{down}} = \frac{L_{p_{c_1}}}{k_p \times A_{p_{c_1}}} = \frac{0.32}{0.22 * 0.015} = 96.97\,° \frac{C}{W}$$

$$R_b = \frac{L_b}{k_b \times A_b} = \frac{0.32}{0.72 * 0.22} = 2.02\,° \frac{C}{W}$$

$$\frac{1}{R_{tot_{parallel}}} = \frac{1}{R_b} + \frac{1}{R_{p_{up}}} + \frac{1}{R_{p_{down}}} = \frac{1}{2.02} + 2 * \left(\frac{1}{96.97}\right) = 0.52\,°C/W$$
$$\rightarrow \frac{1}{R_{tot_{parallel}}} = 0.52\,W/°C \longrightarrow R_{tot_{parallel}} = \frac{1}{0.52} = 1.92°C/W$$

$$R_{P_1} = R_{P_2} = \frac{L_{p_1}}{k_p \times A_{p_1}} = \frac{0.02}{(0.22 * 0.25)} = 0.363\,°C/W$$

$$R_{\downarrow o} = \frac{1}{h_0 \times A} = \frac{1}{40 * 0.25} = 0.1\,°C/W$$

$$R_{total} = R_i + R_o + 2 * R_{P_1} + R_{tot_{parallel}} + R_{foam}$$

$$R_{total} = 7.78\,°C/W$$

$$\mathrm{Q} = T/\mathrm{R_{total}} = \frac{\mathbf{30}}{\mathbf{7.78}} = \mathbf{3,86W}$$

Finilize the composite wall question by finding the heat transfer rate

$$R_{total} = 6.81\,^{\circ}\frac{C}{W}$$

$$\mathrm{Q} = T/\mathrm{R_{total}} = \frac{\mathbf{30}}{\mathbf{6.81}} = \mathbf{4,405W}$$

Brick Thickness And Thermal Resistance does not increase equally proportianol

- Determine the overall unit thermal resistance (the *R*-value) and the overall heat transfer coefficient (the *U*-factor) of 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 Urithane rigid insulation. The inside is finished with 13-mm gypsum wallboard and the outside with 13 mm plywood 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.
- Find twoRunit values.

	Wood	Insulation
Outside Air	0.03	0.03
Wood bevel l.	0.14	0.14
plywood(13mm)	0.11	0.11
Urithane Rigid foam Ins.	No	0.98*90/25=3.53
Wood studs	0.63	No
Gypsum board	0.079	0.079
Inside surface	0.12	0.12

$$R'_{withWood} = 0.03 + 0.14 + 0.11 + 0.63 + 0.079 + 0.12 = 1.109\,m^2.^{\circ}\frac{C}{W}$$

$$R'_{withIns} = 0.03 + 0.14 + 0.11 + 3.53 + 0.079 + 0.12 = 4.007\,m^2.^{\circ}C/W$$