QUESTION1:

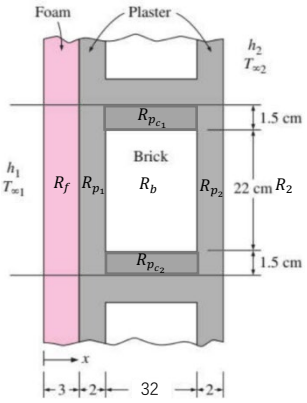
- A 3m high and 5m wide wall consists of long 32cm 22cm cross section horizontal bricks(k=0.72W/m·℃) separated by 3 cm thick plaster layers(k=0.22W/ m·℃)
- There are also 2 cm thick plaster layers on each side of the brick and a 3-cm-thick rigid foam(k=0.026 W/m·℃) on the inner sider of the wall.
- The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

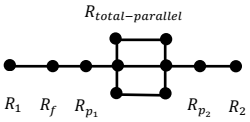
$$R_1 = \frac{1}{h_1 A} = \frac{1}{\frac{10W}{m^2 \cdot ℃} \cdot 0.25m \cdot 1m} = 0.4\,℃/W$$

$$R_f = \frac{L_f}{k_f A} = \frac{0.03m}{\frac{0.026W}{m \cdot ℃} \cdot 0.25m \cdot 1m} = 4.615\,℃/W$$

$$R_{p_{c_1}} = R_{p_{c_2}} = \frac{L_{p_{c_1}}}{k_p A} = \frac{0.32m}{\frac{0.22W}{m \cdot ℃} \cdot 0.015m \cdot 1m}$$

$$= 96.97\,℃/W$$





$$R_f = \frac{L_f}{k_f A} = \frac{0.03m}{\frac{0.026W}{m \cdot ℃} \cdot 0.25m \cdot 1m} = 4.615\,℃/W$$

$$R_b = \frac{L_b}{k_b A} = \frac{0.32m}{\frac{0.72W}{m \cdot ℃} \cdot 0.22m \cdot 1m} = 2.02\,℃/W$$

$$\because \frac{1}{R_{total-parallel}} = \frac{1}{R_b} + \frac{1}{R_{p_{c_1}}} + \frac{1}{R_{p_{c_2}}}$$

$$\therefore R_{total-parallel} = 0.66\,℃/W$$

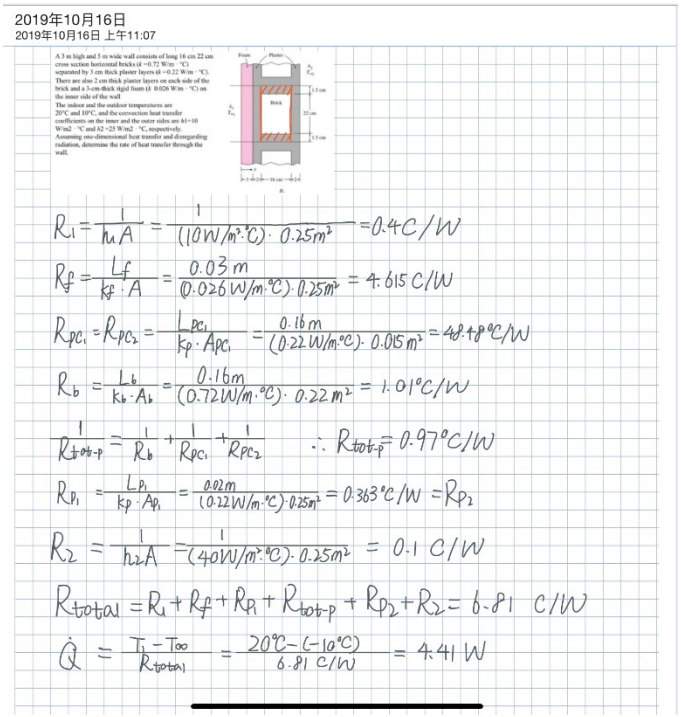
$$R_{p_1} = R_{p_2} = \frac{L_{p_1}}{k_p A} = \frac{0.02m}{\frac{0.22W}{m \cdot ℃} \cdot 0.25m \cdot 1m} = 0.363\ ℃/W$$

$$R_2 = \frac{1}{h_2 A} = \frac{1}{\frac{40W}{m^2 \cdot ℃} \cdot 0.25m \cdot 1m} = 0.1\,℃/W$$

$$\therefore R_{total} = R_1 + R_f + R_{p_1} + R_{total-parallel} + R_{p_2} + R_2 = 7.781\,℃/W$$

$$\dot{Q} = \frac{T_1 - T_\infty}{R_{total}} = \frac{20℃ - (-10℃)}{7.781℃/W} = 3.86W$$

Comparing with those in class with the thickness of brick long 16m



We can find that in this situation with the composite wall, simply adding the thickness of the wall doesn't help to increase the thermal resistance of the whole wall.

QUESTION2:

	Wood	Insulation
Outside Air	0.03	0.03
Wood Bevel (13mm*200mm)	0.14	0.14
Polywood(13mm)	0.11	0.11
Urethane Rigif Foam Ins. (90mm)	No	3.528
Wood Studs(90mm)	0.63	No
Gypsum Borad(13mm)	0.079	0.079
Inside Surface	0.12	0.12

$$R_{withwood} = 0.03 + 0.14 + 0.11 + 0.63 + 0.079 + 0.12 = 1.109\frac{m^2\,℃}{W}$$

$$R_{withinsulation} == 0.03 + 0.14 + 0.11 + 3.528 + 0.079 + 0.12 = 4.007\frac{m^2\,℃}{W}$$