Third lesson (16th of October, 2019).
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1) Finish the question on the composite wall (example C) finding the heat transfer rate.

Already calculated resistance:

$$R_{tot} = 6{,}81\ \frac{°C}{W}$$

Indoor temperature: $T1 = 20°C$

Outoor temperature: $T2 = -10°C$

Heat transfer rate:

$$\dot{Q} = \frac{T1 - T2}{R_{tot}} = \frac{20 - (-10)}{6{,}81} = 4{,}40\ W$$

2) A 3 m high and 5 m wide wall consists of long 16 cm 32 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.

$$R_i = \frac{1}{h_1 * A} = \frac{1}{10 * 0{,}25} = 0{,}4\ °C/W$$

$$R_f = \frac{L_f}{K_f * A} = \frac{0{,}03}{(0{,}026 * 0{,}25)} = 4{,}615\ °C/W$$

$$R_{P1} = R_{P2} = \frac{L_{p1}}{K_p * A_{p1}} = \frac{0{,}02}{(0{,}22 * 0{,}25)} = 0{,}363\ °C/W$$

$$R_{p_{c_1}} = R_{p_{c_2}} = \frac{L_{p_{c_1}}}{k_p \times A_{p_{c_1}}} = \frac{0.32}{0.22 * 0.015} = 96.97\ °\frac{C}{W}$$

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

$$\frac{1}{R_{tot_{parallel}}} = \frac{1}{R_b} + \frac{1}{R_{p_{c_1}}} + \frac{1}{R_{p_{c_2}}} = \frac{1}{2.02} + 2 * \left(\frac{1}{96.97}\right) = 0{,}51\ °C/W$$

$$\rightarrow = \frac{1}{0{,}516} = 1{,}938\ °\frac{C}{W}$$

$$R_o = \frac{1}{h_2 * A} = \frac{1}{40 * 0.25} = 0{,}1\ °\frac{C}{W}$$

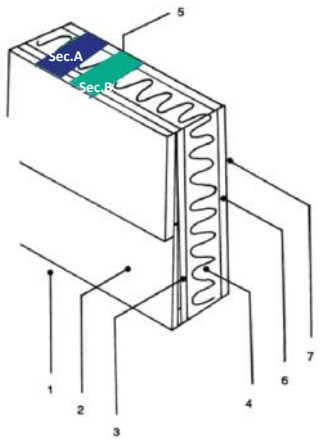
$$R_{total} = R_i + R_o + 2 * R_{P_1} + R_{tot_{parallel}} + R_{foam}$$

$$R_{total} = 0{,}4 + 0{,}1 + 2 * 0{,}363 + 1{,}938 + 4{,}615 = 7{,}76°\frac{C}{W}$$

$$\dot{Q} = \frac{T1 - T2}{R_{tot}} = \frac{20 - (-10)}{7{,}76} = 3{,}86\ W$$

3) Determine the overhall unit thermal resistance (R value) of a wood frame composed as reported under:

	SectionA with wood	SectionB with insulation
1. outside Air	0.03	0.03
2. wood bevel lapped siding (13mm * 200mm)	0.14	0.14
3. playwood (13mm)	0.11	0.11
1. urethane rigid foam (90mm)	-	0.98*90/25
5. wood studs	0.63	-
6. gypsum wallboard	0.079	0.079
7. inside surface	0.12	0.12



R' withIns = 0.03 + 0.14 + 0.11 + 0.63 + 0.079 + 0.12 = 1.109 m^2 . °C/W

R' withWood = 0.03 + 0.14 + 0.11 + (0.98*90/25) + 0.079 + 0.12 = 4.007 m^2 . °C/W