Politecnico di Milano University
M.Arch Sustainable Architecture and Landscape Design
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WEEKLY SUBMISSION - TASK 03

01. Finalize the Example D : Heat Loss Through a Composite Wall by finding the heat transfer rate. (Considering the changes did in class to h2 = 40 and outside temperature = -10 °C)
02. Solve the same question while the thickness of the brick is increased to 32 cm and comment on the results.
03. 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.

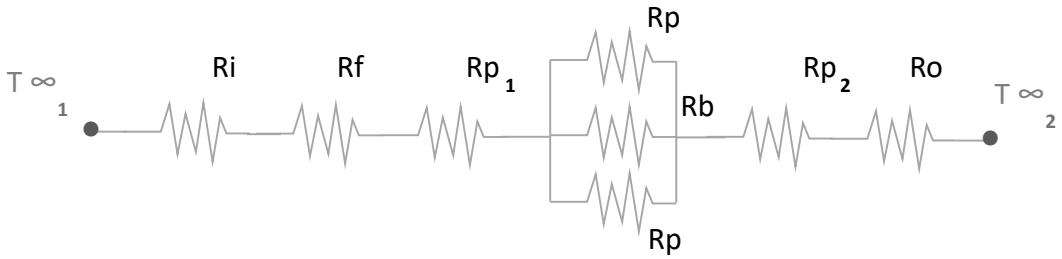
ANSWERS:

01.

R total = 6,81 °C/W

$$\dot{Q} = \frac{T_{\infty 1} - T_{\infty 2}}{R_{total}} = \frac{20 - (-10)}{6,81} = 4,40W$$

02.



$$Ri = Rconv. = \frac{1}{hA} = \frac{1}{10 \times 0,25} = 0,4\ °C/W$$

$$Rf = Rcond. = \frac{L}{KA} = \frac{0,03}{0,026 \times 0,25} = 4,6\ °C/W$$

$$Rp_1 = Rcond. = \frac{L}{KA} = \frac{0,02}{0,22 \times 0,25} = 0,36\ °C/W$$

Rparallel

Rp + Rb + Rp →

$$Rp = Rcond. = \frac{L}{KA} = \frac{0,32}{0,22 \times 0,015} = 96,96\ °C/W$$

$$Rb = Rcond. = \frac{L}{KA} = \frac{0,32}{0,72 \times 0,22} = 2,02\ °C/W$$

$$Rp = Rcond. = \frac{L}{KA} = \frac{0,32}{0,22 \times 0,015} = 96,96\ °C/W$$

$$R_{parallel\ total} \rightarrow \frac{1}{R_{total}} = \frac{1}{R_p} + \frac{1}{R_b} + \frac{1}{R_p}$$

$$\frac{1}{R_{total}} = \frac{1}{96,96} + \frac{1}{2,02} + \frac{1}{96,96}$$

$$\frac{1}{R_{total}} = 0,51$$

$R_{parallel\ total} = 1,96\ °C/W$

$$Rp_2 = R_{cond.} = \frac{L}{KA} = \frac{0,02}{0,22x\ 0,25} = 0,36\ °C/W$$

$$R_o = R_{conv.} = \frac{1}{h\ A} = \frac{1}{40 \times 0,25} = 0,10\ °C/W$$

R total = 7,78 °C/W

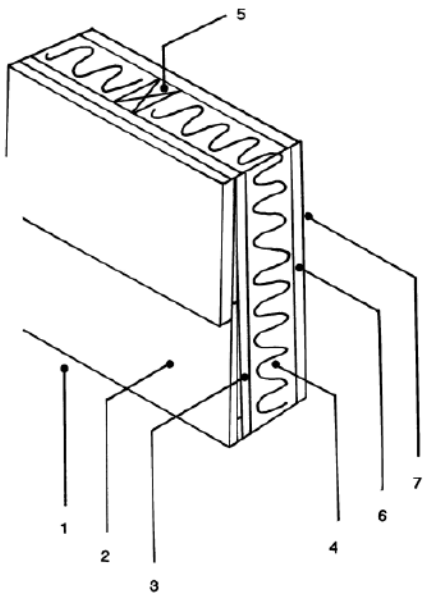
Commenting the result:
Even doubling the thickness of the brick layer (from 16cm to 32cm) the heat transfer resistance had a slight improvement, from 6.81°C/W to 7.84°C/W.
Which leads us to conclude that the brick thickness has only structural relevance, since the foam layer is the main responsible for generating the greatest resistance to heat transfer.

$$\dot{Q} = \frac{T_{\infty 1} - T_{\infty 2}}{R_{total}} = \frac{20 - (-10)}{7,78} = 3,85\ W$$

03.

Simplified Wall Calculation – Example 01 (Heat Transfer Through Wall)

	Wood (A Section)	Insulation (B Section)
Outside	0.03	0.03
Wood Bevel	0.14	0.14
Plywood	0.144	0.11
Urethane Rigid Foam	no	0.98 x (90/25) = 3.53
Wood Studs	0.63	no
Gypsum Board	0.079	0.079
Inside Surface	0.12	0.12



R in Wood Stud = 0.03 + 0.14 + 0.11 + 0.63 + 0.079 + 0.12 = 1.11 $M^2°C/W$

R in Insulation = 0.03 + 0.14 + 0.11 + 3.53 + 0.079 + 0.12 = 4.00 $M^2°C/W$