Submission 3

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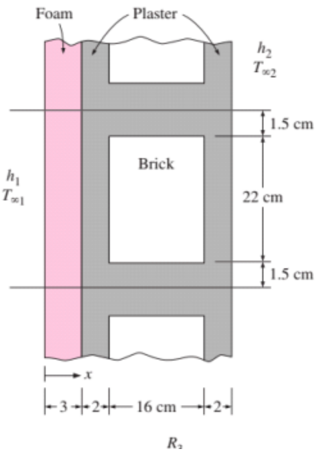
QUESTION 1:



Heat Loss through a composit wall
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 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 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 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. wall.

$R_{1,conv} = 1/h_1 * A_{1-dim} = 1/10 * (0{,}015 + 0{,}22 + 0{,}015) * 1 = 0{,}4\ °C/W$
$R_{foam} = L_{foam}/K_{brick} * A_{1-dim} = 0{,}03/0{,}026 * (0{,}015 + 0{,}22 + 0{,}015) * 1 = 4{,}615\ °C/W$
$R_{plaster1} = L_{p1}/K_p * A_{p1(1-\mathrm{dim})} = 0{,}32/0{,}22 * 0{,}015 * 1 = 96{,}97\ °C/W$
$R_{plaster2} = L_{p2}/K_p * A_{p2(1-\mathrm{dim})} = 0{,}32/0{,}22 * 0{,}015 * 1 = 96{,}97\ °C/W$
$R_{bric} = L_{brick}/K_{brick} * A_{brick(1-\mathrm{dim})} = 0{,}32/0{,}72 * 0{,}22 * 1 = 2{,}02\ °C/W$
$1/R_{total-parallel} = 1/R_{plaster1} + 1/R_{brick} + 1/R_{plaster2} = 1/96{,}97 + 1/2{,}02 + 1/96{,}97 = 0{,}516\ W/°C$
i.e, $R_{total\text{-}parallel} = 1/R_{total-parallel} = 1/0{,}516 = 1{,}94\ °C/W$
$R_{plaster\ left} = R_{plaster\ right} = L_p/k_p * A_{p(1-\mathrm{dim})} = 0{,}02/0{,}022 * (0{,}015 + 0{,}22 + 0{,}015) * 1 = 0{,}363\ °C/W$
$R_{2,conv} = 1/h_2 * A_{1-dim} = 1/40 * (0{,}015 + 0{,}22 + 0{,}015) * 1 = 0{,}1\ °C/W$
$R_{wall\ total(1\text{-}dim)} = R_{1,conv} + R_{foam} + R_{plaster\ left} + R_{total\ parallel} + R_{plaster\ right} + R_{2,conv}$ = 0,4 + 4,615 + 0,363 + 1,94 + 0,363 + 0,1 = 7,781 °C/W
$Q = T_1 - T_\infty / R_{wall\ total} = 20 - (-10)/7{,}781 = 3{,}86\ W$
We have already calculated the $R_{wall\ total}$ with the thickness of the wall like a 16 mm
$R_{wall\ total}$ = 6,81 °C/W
$Q = T_1 - T_\infty / R_{wall\ total} = 20 - (-10)/6{,}81 = 4{,}41\ W$

Comment
We notice that the two results that there isn't so much difference, in fact there isn't a significantly increase of the thermal resistance of the whole wall between the 16 cm thickness of brick and 32 thickness of brick, so the rate of heat transfer doesn't have a significantly decrease in the wall with a thickness of 32 cm.

Question 2 – *Find the two R_{unit} values*
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 glass fiber insulation. The inside is finished with 13-mm gypsum wallboard and the outside with 13-mm wood fiberboard and 13-mm 200-mm wood bevel lapped siding. The insulated cavity constitutes constitutes 75 % 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.

	Wood	Insulation
Outside air	0,03	0,03
Wood bevel (13*200mm)	0,14	0,14
Plywood (13mm)	0,11	0,11
Urethane Rigif Foam (90mm)	X	0,98*90/25=3,528
Wood Studs (90mm)	0,63	X
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°C/W
$R_{with\ insulation}$ = (0,03+0,14+0,11+3,528+0,079+0,12)= 4,007 m^2°C/W