Week3_KKAZAN

22 Ekim 2019 Salı
23:08

QUESTION 1:

A 3 m high and 5 m wide wall consists of long 16 cm 22 cm cross section horizontal bricks (k =0.72 W/m · °C) separated by 3 cm 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 the wall The indoor and the outdoor temperatures are 20°C and -10°C, and the convection heat transfer coefficients on the inner 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.

SOLUTION :

$R_i = 1/ (h_1 * A_1) = 1/ (10*0.25) = 0.4$ °C/W

$R_f = L_f / (k_f * A_1) = 0.03/ (0.026*0.25) = 4.615$ °C/W

$R_{plaster\ upper} = L_{Pc1} / (k_p * A_{Pc1}) = 0.32 / (0.22 * 0.015) = 96.97$ °C/W

$R_{plaster\ down} = L_{Pc1} / (k_p * A_{Pc1}) = 0.32 / (0.22 * 0.015) = 96.97$ °C/W

$R_{brick} = L_b / (k_b * A_b) = 0.32 / (0.72 * 0.22) = 2.02$ °C/W

$1 / R_{TOTALparallel} = 1 / R_{brick} + 1/ R_{plaster\ upper} + 1/R_{plaster\ down} = 1/2.02 + 2 *(1/ 96.97) = 0.516$ W/°C

$= 0.516$ W/ °C $R_{TOTALparallel} = 1/0.516 = 0.97$ °C/W

$R_{p1} = L_{p1} / (k_p * A_{p1}) = 0.02 / (0.22 * 0.25) = 0.363$ °C/W

$R_{p2} = L_{p2} / (k_p * A_{p2}) = 0.02 / (0.22 * 0.25) = 0.363$ °C/W

$R_o = 1 / (h_0 * A) = 1/ (40 * 0.25) = 0.1$ °C/W

$R_{total} = R_i + R_o + R_{p1} + R_{p2} + R_{TOTALparallel} + R_{foam}$

$R_{total} = 7.781$ °C/W

$Q = \Delta T / R_{total} = 30/7.781 = 3,855$W

Condition :
the thickness of brick in this wall is 16mm bricks

$R_{total} = 6.81$ °C/W

the heat transfer rate is:

$Q = \Delta T / R_{total} = 30/6.81$W

Result:
According to these calculations, the change in wall thickness has little effect on the ratio of heat transfer.

QUESTION 2:

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Determine the overall unit thermal resistance (the R-value) and the overall heat transfer coeffcient (the U- factor) of a wood frame wall that is around 38 mm 90mm wood studs a center - to distance of 400 mm . The 90 mm wide cavity between the studs is filled with urenhade rigid insulation. The inside is finished with 13mm gypsum wallboard and the outside with 13 mm plywood 13mm 2mm wood bevel lapped siding . The insulated cavity constitutes 75 percent of the heat transmission area while the studs , plates ,and sills consitute 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 mm*200mm)	0.14	0.14
Plywood (13mm)	0.11	0.11
Urethane Rigid Foam Insulation (90 mm)	-	0.98*90/25=3.528
Wood Studs(90 mm)	0.63	-
Gypsum Board (13mm)	0.079	0.079
Inside Surface	0.12	0.12

$R_{withwood} = 0.03 + 0.14 + 0.11 + 0.63 + 0.079 + 0.12 = 1.109$ m2 * °C/W

$R_{withins} = 0.03 + 0.14 + 0.11 + 3.528 + 0.079 + 0.12 = 4.007$ m2 * °C/W