Assignment 3
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Question 1

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

Every 25 cm of distance in vertical direction, a brick is in place. Therefore, every meter is 0.25m in height. **A= 0.25 m^2**

$R_i = R_{conv1} = \frac{1}{h1*A} = \frac{1}{10*0.25}$= **0.4 ℃/W**

R_1 (foam)= $\frac{L(foam)}{k(foam)*A} = \frac{0.03}{0.026*0.25}$ = **4.6 ℃/W**

R_2=R_6 (side plaster) = $\frac{L(sideplaster)}{k(sideplaster)*A} = \frac{0.02}{0.22*0.25}$= **0.36℃/W**

R3=R5 (center plaster) =$\frac{L(centerplaster)}{k(centerplaster)*A} = \frac{0.32}{0.22*0.015}$= **96.97 ℃/W**

R4 (brick)= $\frac{L(brick)}{k(brick)*A(brick)} = \frac{0.32}{0.72*0.22}$= **2.02 ℃/W**

$R_0 = R_{conv2} = \frac{1}{h2*A} = \frac{1}{25*0.25}$ = 0.16 ℃/W

$\frac{1}{R\ (parallel)} = \frac{1}{R3} + \frac{1}{R5} + \frac{1}{R4} = \frac{1}{96.97} + \frac{1}{96.97} + \frac{1}{2.02}$ = **0.516 ℃/W**

Therefore**,** $R_{parallel} = \frac{1}{0.516}$ = **1.94 ℃/W**

$R_{total} = R_i + R_1$ (foam) + R_2 + R_6 (side plaster) + $R_{parallel}$ + R_0

R_{total} = 0.4+4.6+0.36+0.36+1.94+0.16= **7.82 ℃/W**

Heat transfer through wall: $\dot{Q} = \frac{T(inf1)-T(inf2)}{R\ total} = \frac{20-(-10)}{7.82}$ = **3.84 W**

Question 2

A wood frame wall that is built around 38mm x 90mm wood studs with a center-to-center distance of 400mm.The 90mm-wide cavity between the studs is filled with urethane rigid foam insulation. The inside is finish with 13-mm gypsum wallboard and the outside with 13-mm plywood and 13-mm x 200-mm wood bevel lapped siding. The insulated cavity constitutes 75% of the heat transmission area while the studs, plates, and sills constitute 21%. The headers constitute 4 % of the area, and they can be treated as studs.

Find the 2 $RUnit$ values.

	WOOD	**INSULATION**
OUTSIDE AIR	0.03	0.03
WOOD BEVEL (13*20mm)	0.14	0.14
PLYWOOD (13mm)	0.11	0.11
URETHANE RIDGID FOAM INSULATION (90mm)	-	0.98*90/25= **3.5**
WOOD STUDS (90mm)	0.63	-
GYPSUM BOARD (13mm)	0.079	0.079
INSIDE SURFACE	0.12	0.12
TOTAL m^2.C/W	**1.11**	**3.98**