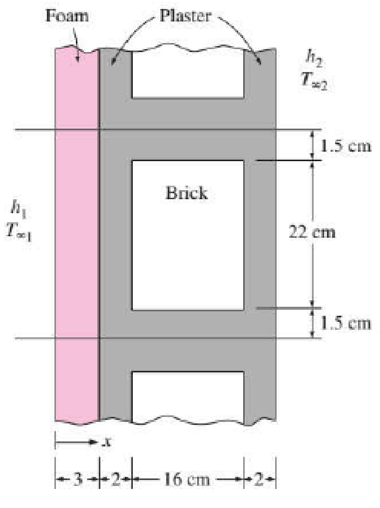
First dfinlize the composite wall question by finding the heat transfer rate, and then solve the same question while the thickness of the brick is increased to 32 cm and comment on the results, ☐

3m 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 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=10W/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.



$R_{conv,1}$=1/h_1A=1/10 W/m^2°C*0.25m^2=0.4°C/W
R_f= L/KA =0.03/0.026 W/m^2°C*0.25m^2≈4.615°C/W

R_{PC1}= R_{PC2}= L/KA =0.32/0.22W/m^2°C*0.015m^2≈96.97°C/W
R_{BRICK}= L/KA =0.32/0.72W/m^2°C*0.22m^2≈2.02°C/W
1/R_{TOT}=1/ R_{PC1}+ 1/R_{PC2}+ 1/R_{BRICK} =1.94°C/W

R_{P1}=R_{P2}=L/KA=0.02m/ 0.22 W/m°C*0.25m^2≈0.36°C/W
$R_{conv,2}$=1/h_2A=1/40 W/m^2°C*0.25m^2≈0. 1°C/W

$R_{TOT'}$= $R_{conv,1}$+ $R_{conv,2}$+ R_{TOT} + R_{P1}*2+R_F=7.78°C/W

The heat transfer rate is:

Q=^{detT}/$R_{TOT'}$=30/7.78=3.856W

While the thickness of the wall is 16cm,we calculate the heat transfer rate is 30/6.81≈4.41W>3.856W, SO the doble thicker the brick,the thermal resistente will get a littele increase,and the heat transfer rate will get a little decrease.

Determine the overall unit thermal resistance (the R-value) and the overall heat transfer coefficient (the U-factor) of 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 urethane rigif foam. The inside is finished with 13-mm gypsum wallboard and the outside with 13-mm plywood and 13-mm 200-mm wood bevel lapped siding. The insulated cavity constitutes 75 percent 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. Also, determine the rate of heat loss through the walls of a house whose perimeter is 50 m and wall height is 2.5 m in Las Vegas, Nevada, whose winter design temperature is -2 C. Take the indoor design temperature to be 22 C and assume 20 percent of the wall area is occupied by glazing

The unit thermal resistance of a plane layer of thickness L and thermal conductivity k can be determined from R = L/k.

Unit thermal resistance (the *R*-value) of common components used in buildings

Component	*R*-Value $m^2 \cdot °C/W$	*R*-Value $ft^2 \cdot h \cdot °F/Btu$
Outside surface (winter)	0.030	0.17
Outside surface (summer)	0.044	0.25
Inside surface, still air	0.12	0.68
Plane air space, vertical, ordinary surfaces (ε_{eff} = 0.82):		
13 mm (1/2 in)	0.16	0.90
20 mm (3/4 in)	0.17	0.94
40 mm (1.5 in)	0.16	0.90
90 mm (3.5 in)	0.16	0.91
Insulation, 25 mm (1 in)		
Glass fiber	0.70	4.00
Mineral fiber batt	0.66	3.73
Urethane rigid foam	0.98	5.56
Stucco, 25 mm (1 in)	0.037	0.21
Face brick, 100 mm (4 in)	0.075	0.43
Common brick, 100 mm (4 in)	0.12	0.79
Steel siding	0.00	0.00
Slag, 13 mm (1/2 in)	0.067	0.38
Wood, 25 mm (1 in)	0.22	1.25
Wood stud, nominal 2 in × 4 in (3.5 in or 90 mm wide)	0.63	3.58
Wood stud, nominal 2 in × 6 in (5.5 in or 140 mm wide)	0.98	5.56
Clay tile, 100 mm (4 in)	0.18	1.01
Acoustic tile	0.32	1.79
Asphalt shingle roofing	0.077	0.44
Building paper	0.011	0.06
Concrete block, 100 mm (4 in):		
Lightweight	0.27	1.51
Heavyweight	0.13	0.71
Plaster or gypsum board, 13 mm (1/2 in)	0.079	0.45
Wood fiberboard, 13 mm (1/2 in)	0.23	1.31
Plywood, 13 mm (1/2 in)	0.11	0.62
Concrete, 200 mm (8 in)		
Lightweight	1.17	6.67
Heavyweight	0.12	0.67
Cement mortar, 13 mm (1/2 in)	0.018	0.10
Wood bevel lapped siding, 13 mm × 200 mm (1/2 in × 8 in)	0.14	0.81

FROM OUTSIDE TO INSIDE	A/WOOD	B/INSULATION
Outside air	0.03	0.03
Wood bevel 13mm	0.14	0.14
13-mm plywood	0.11	0.11
urethane rigif foam	/	0.98*90/25=3.528
Wood studs	0.63	/
13-mm gypsum wallboard	0.079	0.079
Inside surface	0.12	0.12

R_{wood}= 1.109°C/W
$R_{insulation}$=4.007°C/W