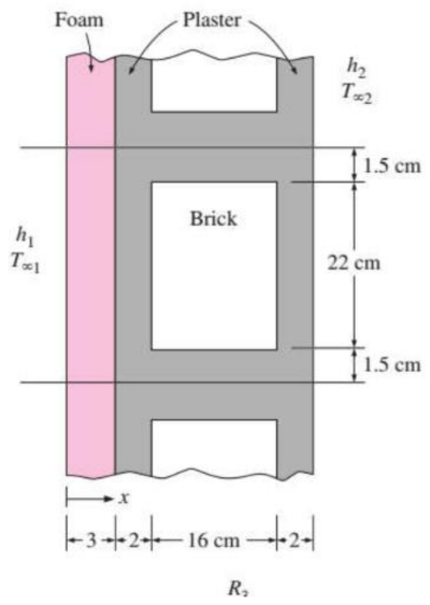
3th *WEEK'S* SUBMISSION

1. FINALIZING CLASS EXERCISE

A 3 M HIGHT AND 5 M WIDE WALL CONSIST OF LONG 16CM 22CM CROSS SECTION HORIZONTAL BRICKS (K= 0,72 W/m°C) SEPARATED BY A 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 3 CM THICK RIGID FOAM (K=0,026 W/m°C) ON INNER SIDE OF THE WALL

THE INDOOR AND OUTDOOR TEMPERATURE ARE 20° AND -10° AND THE CONVECTION HEAT TRANSFER COEFFICIENT ON THE INNER AND OUTSIDE ARE h_1= 10 W/m^2°C AND h_2= 40 W/ m^2°C.

ASSUMING ONE DIMENSIONAL HEAT TRANSFER AND DISREGARDING RADIATION, DETERMINE THE RATE OF HEAT TRANSFER THROUGH THE WALL.



During the lesson we have calculate the R of the total wall, so now we have to finish the problem by calculating the total heat transfer by the wall.

$$R\ total = Ri + R\ f + R\ p1 + \frac{1}{Rplaster} + \frac{1}{Rbrick} + \frac{1}{Rplaster} + Rp2 + Ro$$

$$R\ total = 0.4 + 4.615 + 0.36 + 0.0206 + 0.990 + 0.0206 + 0.36 + 0.1$$

$$R\ total = 6.81\ °C/W$$

Now we can calculate the total heat transfer:

$$\dot{Q} = \frac{Ts - T\infty}{Rtotal}$$

$$\dot{Q} = \frac{20°C - (-10°C)}{6.81°\frac{C}{W}} = 4.405\ W$$

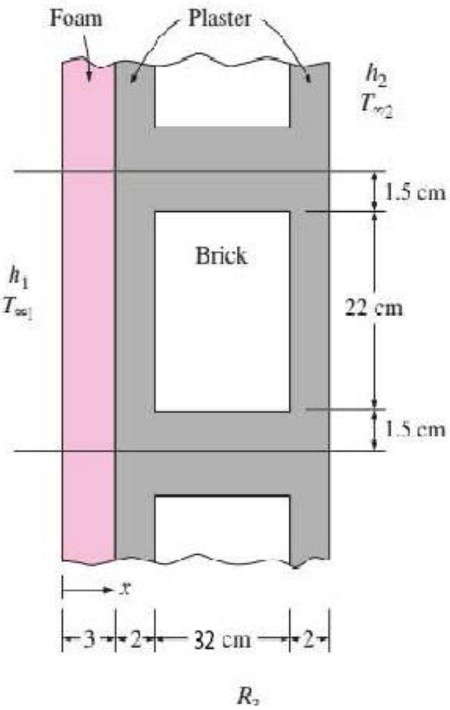
2. EXERCISE

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 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:
h_1 = 10 W/m^2°C
h_2 = 25 W/m^2°C

ASSUMING ONE-DIMENSIONAL HEAT TRANSFER AND DISREGARDING RADIATION, DETERMINE THE RATE OF HEAT TRANSFER THROUGH THE WALL.

$A_1 = 1 \times 0{,}015 = 0{,}015\ m^2$
$A_2 = 1 \times 0{,}22 = 0{,}22\ m^2$

$$R_{tot.parallel} = \frac{1}{\frac{1}{R\,pc1}+\frac{1}{R\,brick}+\frac{1}{R\,pc2}} = \frac{1}{\frac{1}{\frac{L}{k \times A1}}+\frac{1}{\frac{L}{k \times A2}}+\frac{1}{\frac{L}{k \times A1}}}$$



$$R_{pc1} = R_{pc2} = \frac{L}{k \times A1} = \frac{0{,}32}{0{,}22 \times 0{,}015} = 96{,}969\ \frac{°C}{W}$$

$$R_b = \frac{L}{k \times A1} = \frac{0{,}32}{0{,}72 \times 0{,}22} = 2{,}02\ \frac{°C}{W}$$

$$R_{tot.parallel} = \frac{1}{\frac{1}{96{,}969}+\frac{1}{2{,}02}+\frac{1}{96{,}969}} = \frac{1}{0{,}01+0{,}495+0{,}01} = 1{,}942\ \frac{°C}{W}$$

$$R_f = \frac{Lfoam}{kf \times Af} = \frac{0{,}03}{0{,}026\ \times 0{,}25} = 4{,}615\ \frac{°C}{W}$$

$$R_i = \frac{1}{h1 \times A} = \frac{1}{10\ \times 0{,}25} = 0{,}4\ \frac{°C}{W}$$

$$R_o = \frac{1}{h2 \times A} = \frac{1}{40\ \times 0{,}25} = 0{,}1\ \frac{°C}{W}$$

$$R_{p1} = R_{p2} = \frac{Lp}{kp \times Ap} = \frac{0{,}02}{0{,}22\ \times 0{,}25} = 0{,}363\ \frac{°C}{W}$$

$$R_{total} = R_f + R_i + R_o + R_{p1} + R_{p2} + R_{tot.parallel} = 4{,}615 + 0{,}4 + 0{,}1 + 0{,}363 + 0{,}363 + 1{,}942 = 7{,}783\ \frac{°C}{W}$$

$$\dot{Q} = \frac{Ts - T\infty}{Rtotal} = \frac{20-(-10)}{7{,}783} = 3{,}855\ W$$

From the exercise we did during the class, where the thickness of the brick was 16 cm, we knew that:

$R_{total} = 6{,}81\ \frac{°C}{W}$
$\dot{Q} = 4{,}405\ W$

We can see that there isn't a big discrepancy and that the wall's thermal resistance has not increased considerably. Consequently also the rate of heat transfer through the wall has not substantially decreased.

3. EXERCISE

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.

FIND THE TWO R_{unit} VALUES.

	Wood	Insulation
Outside air	0.03	0.03
Wood bevel (13x200mm)	0.14	0.14
Plywood (13mm)	0.11	0.11
Urethane rigif foam (90mm)	no	(0.98x90)/25 = 3.528
Wood studs (90mm)	0.63	no
Gypsum board (13mm)	0.079	0.079
Inside surface	0.12	0.12

$$R_{withwood} = 0.03\ m^2\,\frac{°C}{W} + 0.14\ m^2\,\frac{°C}{W} + 0.11\ m^2\,\frac{°C}{W} + 0.63\ m^2\,\frac{°C}{W} + 0.079\ m^2\,\frac{°C}{W} + 0.12\ m^2\,\frac{°C}{W} = 1.109\ m^2\,\frac{°C}{W}$$

$$R_{withinsulation} = 0.03\ m^2\,\frac{°C}{W} + 0.14\ m^2\,\frac{°C}{W} + 0.11\ m^2\,\frac{°C}{W} + 3.528\ m^2\,\frac{°C}{W} + 0.079 m^2\,\frac{°C}{W} + 0.12 m^2\,\frac{°C}{W} = 4.007\ m^2\,\frac{°C}{W}$$