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Question: In a coal-fired power plant, a furnace wall consists of a 125-mm-...

In a coal-fired power plant, a furnace wall consists of a 125-mm-thick refractory brick and a 125-mm-thick insulating firebrick separated by an air gap as shown in the figure. The outside wall is covered with a 12 mm thickness of plaster. The inner surface of the wall is at 1100°C, and the room temperature is 25°C. The heat-transfer coefficient from the inside-wall surface to the air in the room is 17 W/m²·K, and the resistance to heat flow of the air gap is 0.16 K/W. The thermal conductivities of the refractory brick, the insulating firebrick, and the plaster are 1.6, 0.3, and 0.14 W/m·K, respectively. Calculate the rate of heat loss per unit area of wall surface. (28 pts)



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Expert Answer

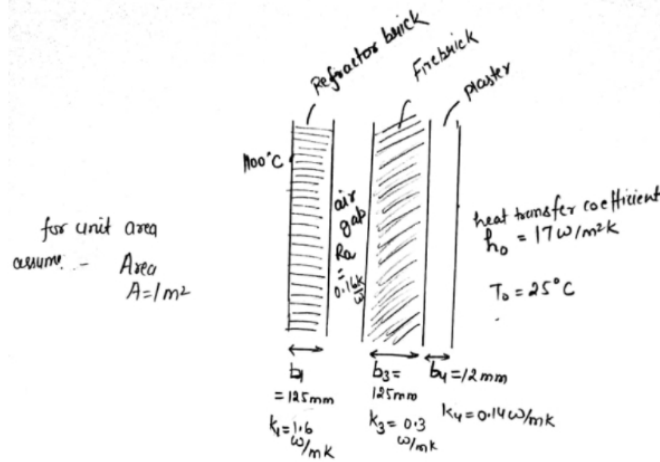


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for unit area
assume: Area = 1 m²

Thermal Resistance due to Refractory brick

$$R_1 = \frac{b_1}{k_1 A} = \frac{125 \times 10^{-3}}{1.6 \times 1}$$

Thermal Resistance due to air gap
 $R_a = 0.16 \text{ K/W}$

Thermal Resistance due to fire brick
 $R_3 = \frac{b_3}{k_3 A} = \frac{125 \times 10^{-3}}{0.3 \times 1}$

Thermal Resistance due to Plaster
 $R_4 = \frac{b_4}{k_4 A} = \frac{12 \times 10^{-3}}{0.14 \times 1}$

Thermal Resistance due to Out side heat transfer coefficient
 $R_0 = \frac{1}{h_0 A} = \frac{1}{17 \times 1}$

total Net thermal Resistance

$$\begin{aligned}
 R &= R_1 + R_a + R_3 + R_4 + R_0 \\
 &= \frac{0.125}{1.6} + 0.16 + \frac{0.125}{0.3} + \frac{0.012}{0.14} + \frac{1}{17} \\
 &= 0.799329 \text{ K/W}
 \end{aligned}$$

Overall rate of heat loss per unit area of the wall surface

$$q = \frac{T_w - T_o}{R} = \frac{1100 - 25}{0.799329}$$

$$q = 1344.8772 \text{ W} \quad \text{Answer}$$

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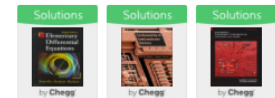
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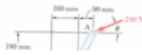
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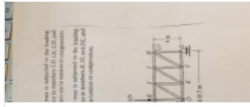
Arm ABC is connected by pins to a collar at B and to crank CD at C. Neglecting the effect of friction, determine...

Arm ABC is connected by pins to a collar at B and to crank CD at C. Neglecting the effect of friction, determine the couple M required to hold the system in equilibrium when $\theta = 0$.



[See answer](#)

The Pratt bridge truss is subjected to the loading shown. Determine the force in members LD, LK, CD, an...



[See answer](#)

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Q: 3. In a coal-fired power plant, a furnace wall consists of a 125-mm-wide refractory brick and a 125-mm-wide insulating firebrick separated by an airgap as shown in the figure. The outside wall is covered with a 12 mm thickness of plaster. The inner surface of the wall is at 1100°C, and the room temperature is 25°C. The heat-transfer coefficient from the outside wall surface to the...

A: [See answer](#)

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