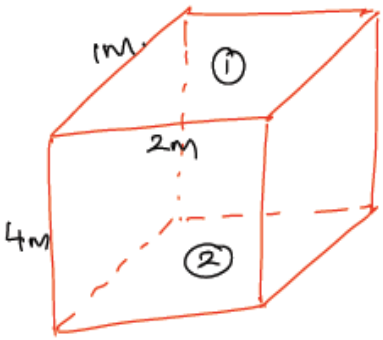
Obtain the shape factor and total emissive power for the rectangular box, whose top surface is maintained at 473 K and bottom surface is at 373 K, seperated by 4 m apart, while the surfaces surrounding these top and bottom doesn't participate in any radiation phenomena. (5)



$A_1 = A_2 = 1 \times 2 = 2m^2$.

$Q_{1-2} = F_{1-2} \cdot A_1 \sigma (T_1^4 - T_2^4)$

$= 0.04 \times 2 \times 5.67 \times 10^{-8} (473^4 - 373^4)$

$Q_{1-2} = 159.2$ W.

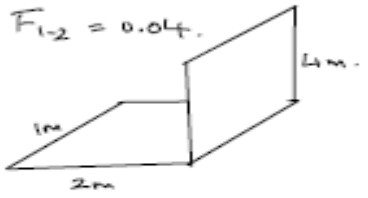
$L = 1m$; $R = 2m$; $D = 4m$.

$\frac{L}{D} = 0.25$; $\frac{R}{D} = 0.5$

$F_{1-2} = 0.04$

4.6. Sides of the rectangular box are participating in the radiation with its temp as 300 k.

Sol: $F_{1-2} = 0.04$.



$Z = \frac{L_3}{B} = \frac{4}{1} = 4.$; $Y = \frac{L_4}{B} = \frac{2}{1} = 2$;

$F_{2-3} = 0.17$.

$F_{2-3} A_2 = F_{3-2} A_3$. $\longrightarrow$ $F_{3-2} = 2 * 0.17 = 0.34$

$F_{2-3} = F_{2-5} = 0.17$.

$F_{2-4} = F_{2-6} = 0.3$:

$F_{1-3} = F_{1-5} = 0.17$

$F_{1-4} = F_{1-6} = 0.3$.

$Q_{net} = Q_{1-2} + Q_{1-3} + Q_{1-4} + Q_{1-5} + Q_{1-6}$.

(source) $= F_{1-2} A_1 (T_1^4 - T_2^4) + F_{1-3} A_1 (T_1^4 - T_3^4) +$

$F_{1-4} A_1 (T_1^4 - T_4^4) + F_{1-5} A (T_1^4 - T_5^4) + F_{16} A_1 (T_1^4 - T_6^4)$

$Q_{net} = 4.5$ kW.

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3. MIT open courseware – https://ocw.mit.edu/courses/mechanical-engineering

Other web sources