GATE 2024

प्रचण्ड Batch

HMT

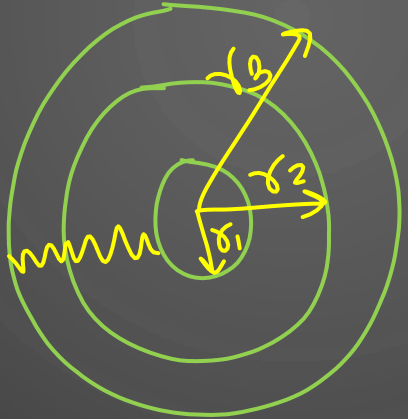
MODES OF HEAT TRANSFER

TIME- 4:30PM

YOGESH SIR

Overall H T Coefficient :→ (U)

$$UA = \frac{1}{R_{th}}$$



$$Q = \frac{4\pi k r_1 r_2 (T_1 - T_2)}{r_2 - r_1}$$

$$\frac{1}{h_1 A_1} \quad \frac{r_2 - r_1}{4\pi k r_1 r_2} \quad \frac{r_3 - r_1}{4\pi k r_1 r_2} \quad \frac{1}{h_o A_o}$$

$$\frac{1}{U_1 A_1} = \frac{1}{h_1 A_1} + \frac{r_2 - r_1}{4\pi k r_1 r_2} + \frac{r_3 - r_2}{4\pi k r_1 r_2} + \frac{1}{h_o A_o}$$

$$\frac{1}{U_1} = \frac{1}{h_1} + \frac{4\pi r_1^2 (r_2 - r_1)}{4\pi k r_1 r_2} + \frac{4\pi r_1^2 (r_3 - r_2)}{4\pi k r_2 r_3} + \frac{4\pi r_1^2}{h_o 4\pi r_3^2}$$

$$\frac{1}{U_1} = \frac{1}{h_1} + \frac{r_1}{r_2}(r_2 - r_1) + \frac{r_1^2}{r_2 r_3}(r_3 - r_2) + \left(\frac{r_1}{r_3}\right)^2 \frac{1}{h_o}$$

$$\frac{1}{U_0} = \left(\frac{r_3}{r_1}\right)^2 \frac{1}{h_1} + \frac{r_3}{r_1 r_2}(r_2 - r_1) + \frac{r_3}{r_2}(r_3 - r_2) + \frac{1}{h_o}$$

$$K = k_0(1 \pm \alpha T)$$

$$Q = \frac{-KA(T_2 - T_1)}{L}$$

$$Q = \frac{KA(T_1 - T_2)}{L}$$

($K \rightarrow K_{avg}$)

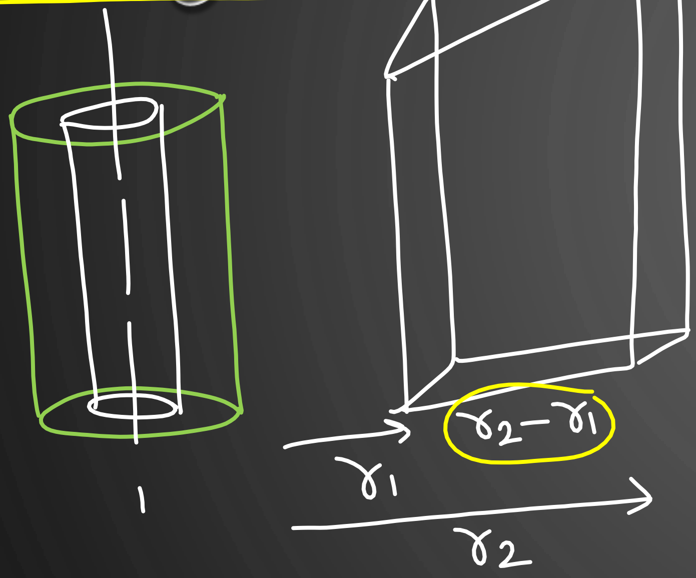
$$Q = \frac{k_0(1 \pm \alpha T)A(T_1 - T_2)}{L}$$

$k_0 \rightarrow$ Conductivity at 0°C

$T \rightarrow$ °C

K = C	R_{th}	Temp Profile
Wall	$\frac{L}{KA}$	Linear
Cylinder	$\frac{\ln r_2/r_1}{2\pi KL}$	Logarithmic
Sphere	$\frac{r_2 - r_1}{4\pi K r_1 r_2}$	Hyperbolic
	$\frac{1}{r_1} - \frac{1}{r_2}$	

Log Mean Area:



$$Q_{cyl} = \frac{\Delta T}{R_{th}} = \frac{T_1 - T_2}{R_{thcyl}}$$

$$Q_{wall} = \frac{\Delta T}{R_{th}} = \frac{T_1 - T_2}{R_{thwall}}$$

$$Q_{cyl} = Q_{wall}$$

$$R_{thwall} = R_{thcyl}$$

$$\downarrow$$

$$\frac{L}{KA} = \frac{\ln r_2/r_1}{2\pi K l}$$

$$\frac{r_2 - r_1}{\cancel{K} A_m} = \frac{\ln r_2/r_1}{2\pi \cancel{K} l}$$

$$A_m = \frac{2\pi r_2 L - 2\pi r_1 L}{\ln r_2/r_1 \; 2\pi l}$$

$$A_m = \frac{A_2 - A_1}{\ln \frac{A_2}{A_1}} \checkmark$$

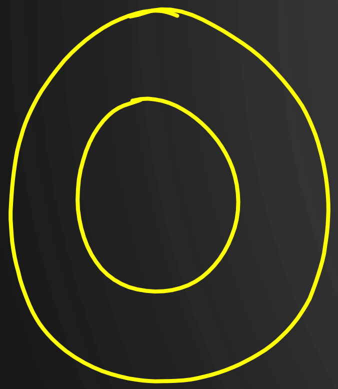
$$A_m = \frac{A_2 - A_1}{\ln \frac{A_2}{A_1}}$$

→ Log Mean Area

$$r_m = \frac{r_2 - r_1}{\ln \frac{r_2}{r}}$$

→ Log Mean Radius ✓

Geometric Mean Area :→



$$R_{th\,sphere} = R_{th\,wall}$$

$$\frac{r_2 - r_1}{4\pi k r_1 r_2} = \frac{L}{k A_m} = \frac{r_2 - r_1}{k A_m}$$

$$A_m = 4\pi r_1 r_2$$

$$A_m = \sqrt{4\pi r_1^2 \times 4\pi r_2^2}$$

$$\boxed{A_m = \sqrt{A_1 A_2}}$$ ✓

$$4\pi r_m^2 = 4\pi r_1 r_2$$

$$\boxed{r_m = \sqrt{r_1 r_2}}$$ ✓