E- Course on Heat Transfer 3151909

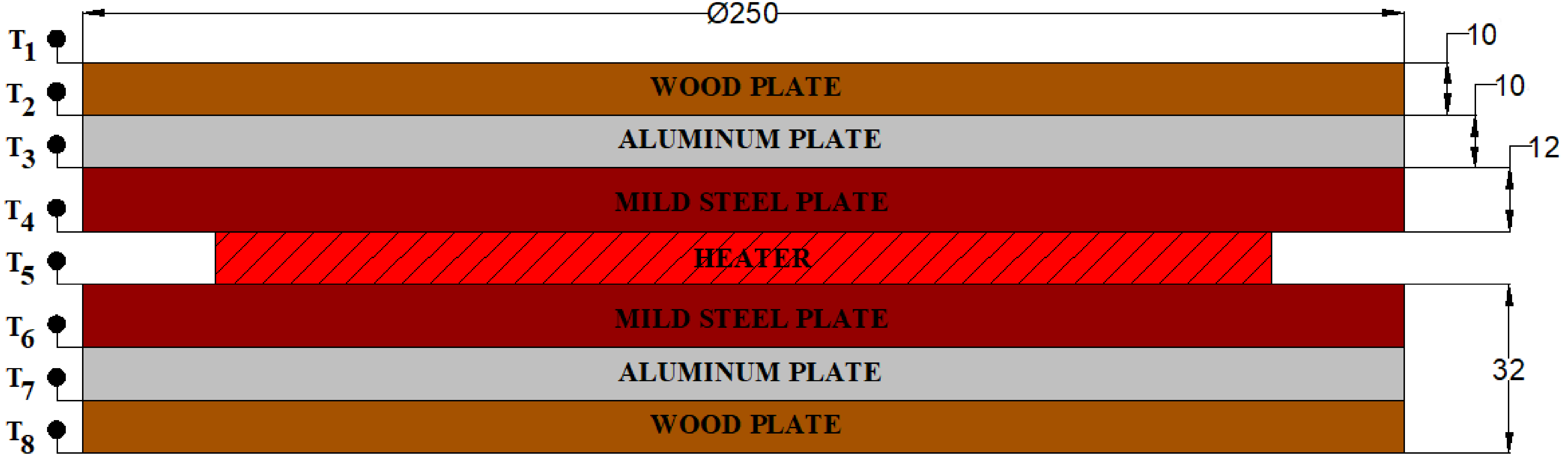
Practical Session EXPERIMRNT No. 2

AIM

To Determine

1. The overall thermal resistance(R) for a composite wall and to compare with theoretical value.
2. Temperature distribution across the width of the composite wall.
3. Find thermal conductivity of different material.

Thermal Conductivity of Composite Wall Apparatus



- Composite Wall Plates
- M.S :- 25 cm x 12mm thick
- wood : - 25 cm x 10 mm thick
- Aluminum :- 25 cm x 10mm thick

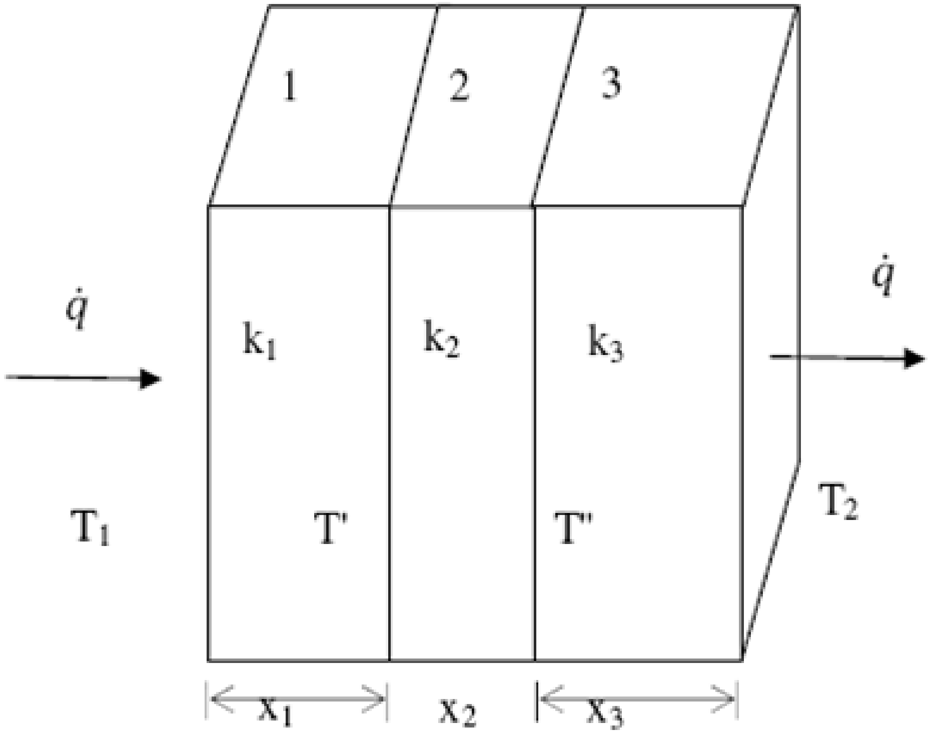
T1	Wood plate outer temperature
T2	Aluminum plate outer temperature
T3	MS plate outer Temperature
T4	Heater Surface Temperature
T5	Heater Surface Temperature
T6	MS plate outer Temperature
T7	Aluminum plate outer temperature
T8	Wood plate outer temperature

Specifications

- Test Plate: Aluminum ,MS, wood material
- Heater Nichrome strip wound on mica sheet
- Dimmer stat Ammeter0 - 2 amp
- Voltmeter 0 – 230V
- Enclosure size 580mm x 300mm x 300mm approximately with one side of Perspex sheet.
- Thermocouples – Chromel Alumel – (8 No)
- Temperature indicator 0 – 300 ˚C.

Theory

Heat Conduction Through Composite Wall



Procedure

- Arrange the plates properly (symmetrically) on both side of heater plate.
- See that plate is symmetrically arranged on both sides of heater plate (arranged normally).
- Close the box by cover sheet to achieve the environmental conditions.
- Start the supply of heater, By varying the dimmer stat adjust the input power of heater.
- Take the readings of all thermocouples at an interval of 10 minutes until steady state is reached.
- Note down the steady state readings in the observation table

Observation Table

Sr.no.	Heat input(w)		Thermocouple readings ˚c							
	V	I	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
1										
2										
3										

Calculations

- Mean Temperature Reading:-

  $T_a = (T_4+T_5)/2$ °C

  $T_b = (T_3+T_6)/2$ °C

  $T_c = (T_2+T_7)/2$ °C

  $T_d = (T_1+T_8)/2$ °C

- Rate of heat supplied W=V x I Watts
- Now, Heat flux q = w / A watts/ m^2

Where, A= π/4 x d^2

(where d= dia of plates=0.250m)

- Total thermal resistance of composite slab
- $\mathbf{R_{total} = (T_a-T_d)/q}$ m^2k/w
- Thermal conductivity of composite slab
- $\mathbf{K_{composite} = qxb / (T_a-T_d)}$ w/m^2k
- Where b= total thickness of the composite slab=0.064m

Sample Calculation

Sr.no.	Heat input(w)		Thermocouple readings ˚c							
	V	I	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
1	111	1.05	51	57	60	70	71	62	59	53
2										
3										

Sample Calculation

Mean Temperature Reading:-

$T_a = (T_4+T_5)/2$ °C

$= (70+71)/2$ °C $= 70.5$°C

$T_b = (T_3+T_6)/2$ °C

$=(60+62)/2$ °C $=61$°C

$T_c = (T_2+T_7)/2$ °C

$=(57+59)/2$ °C $=58$°C

$T_d = (T_1+T_8)/2$ °C

$=(51+53)/2$ °C $=52$ °C

Rate of heat supplied

$W = V \times I$ Watts

$=111\times1.05$ Watts

$=116.55$ Watts

Now, Heat flux

$q = W/A$ watts/m^2

$= 116.55/0.0490$ watts/m^2

$= 2378.57$ watts/m^2

Where, $A=\pi/4 \times d^2$ m^2

(Where, d= diameter of plates=0.250m)

$A=3.14/4\times (0.250)^2 =0.0490$ m^2

Sample Calculation

Total thermal resistance of composite slab

$$R_{total} = (T_a - T_d)/q \quad m^2\text{k/w}$$

$$= (70.5\text{-}52)/\ 2378.57\ m^2\text{k/w}$$

$$= \underline{\mathbf{0.007777\ m^2k/w}}$$

Thermal conductivity of composite slab

$$K_{composite} = qxb\ /\ (T_a - T_d)\ \ \text{w/m}^2\text{ K}$$

$$= 2378.57 \times 0.064/(70.5\text{-}52)\ \ \text{w/m}^2\text{K}$$

$$= \underline{\mathbf{8.2285\ w/m^2K}}$$

Where b= total thickness of the composite slab=0.064m

Applications:

- Heat transfer has wide applications for the proper functioning of thermal devices and systems. This principle is used to solve many problems in thermal mechanics.

1. Heat exchangers.
2. Building construction works.
3. Thermal energy storage devices.
4. Heat transfer in human body.
5. Thermopile and infrared thermometer.
6. Thermal resistance in electronics like thermal diode or thermal rectifier.
7. Used in laser cooling, radiative cooling, magnetic cooling, etc.

Thank You