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Conduction in Plane Wall Formulas

Calculators! Examples! Conversions!

List of 22 Conduction in Plane Wall Formulas

Conduction in Plane Wall

1) Area of Plane Wall Required for Given Temperature Difference

Open Calculator

$$A_{wall} = \frac{Q \cdot L}{k \cdot (T_i - T_o)}$$

ex $$50m^2 = \frac{125W \cdot 3m}{10W/(m^*K) \cdot (400.75K - 400K)}$$

2) Inner Surface Temperature of Plane Wall

Open Calculator

$$T_i = T_o + \frac{Q \cdot L}{k \cdot A_{wall}}$$

ex $$400.75K = 400K + \frac{125W \cdot 3m}{10W/(m^*K) \cdot 50m^2}$$

3) Outer Surface Temperature of Wall in Conduction through Wall

Open Calculator

$$T_o = T_i - \frac{Q \cdot L}{k \cdot A_{wall}}$$

ex $$400K = 400.75K - \frac{125W \cdot 3m}{10W/(m^*K) \cdot 50m^2}$$

4) Temperature at Distance x from Inner Surface in Wall

Open Calculator

$$T = T_i - \frac{x}{L} \cdot (T_i - T_o)$$

ex $$400.375K = 400.75K - \frac{1.5m}{3m} \cdot (400.75K - 400K)$$

5) Thermal Conductivity of Material Required to Maintain Given Temperature Difference

Open Calculator

$$k = \frac{Q \cdot L}{(T_i - T_o) \cdot A_{wall}}$$

ex $$10W/(m^*K) = \frac{125W \cdot 3m}{(400.75K - 400K) \cdot 50m^2}$$

6) Thermal Resistance of Wall

Open Calculator

fx $$R_{th} = \frac{L}{k \cdot A}$$

ex $$0.023077\text{K/W} = \frac{3\text{m}}{10\text{W/(m*K)} \cdot 13\text{m}^2}$$

7) Thickness of Plane Wall for Conduction through Wall

Open Calculator

fx $$L = \frac{(T_i - T_o) \cdot k \cdot A_{wall}}{Q}$$

ex $$3\text{m} = \frac{(400.75\text{K} - 400\text{K}) \cdot 10\text{W/(m*K)} \cdot 50\text{m}^2}{125\text{W}}$$

8) Total Thermal Resistance of Plane Wall with Convection on Both Sides

Open Calculator

fx $$r_{th} = \frac{1}{h_i \cdot A_{wall}} + \frac{L}{k \cdot A_{wall}} + \frac{1}{h_o \cdot A_{wall}}$$

ex $$0.022856\text{K/W} = \frac{1}{1.35\text{W/m}^2\text{*K} \cdot 50\text{m}^2} + \frac{3\text{m}}{10\text{W/(m*K)} \cdot 50\text{m}^2} + \frac{1}{9.8\text{W/m}^2\text{*K} \cdot 50\text{m}^2}$$

2 Layers

9) Area of Composite Wall of 2 Layers

Open Calculator

fx $$A_{2wall} = \frac{Q_{2layer}}{T_{i2} - T_{o2}} \cdot \left(\frac{L_1}{k_1} + \frac{L_2}{k_2}\right)$$

ex $$866.6667\text{m}^2 = \frac{120\text{W}}{420.75\text{K} - 420\text{K}} \cdot \left(\frac{2\text{m}}{1.6\text{W/(m*K)}} + \frac{5\text{m}}{1.2\text{W/(m*K)}}\right)$$

10) Heat Flow Rate through Composite Wall of 2 Layers in Series

Open Calculator

fx $$Q_{2layer} = \frac{T_{i2} - T_{o2}}{\frac{L_1}{k_1 \cdot A_{2wall}} + \frac{L_2}{k_2 \cdot A_{2wall}}}$$

ex $$120\text{W} = \frac{420.75\text{K} - 420\text{K}}{\frac{2\text{m}}{1.6\text{W/(m*K)} \cdot 866.6667\text{m}^2} + \frac{5\text{m}}{1.2\text{W/(m*K)} \cdot 866.6667\text{m}^2}}$$

11) Inner Surface Temperature of Composite Wall for 2 Layers in Series

Open Calculator

fx $$T_{i2} = T_{o2} + Q_{2layer} \cdot \left(\frac{L_1}{k_1 \cdot A_{2wall}} + \frac{L_2}{k_2 \cdot A_{2wall}} \right)$$

ex $$420.75\text{K} = 420\text{K} + 120\text{W} \cdot \left(\frac{2\text{m}}{1.6\text{W}/(\text{m*K}) \cdot 866.6667\text{m}^2} + \frac{5\text{m}}{1.2\text{W}/(\text{m*K}) \cdot 866.6667\text{m}^2} \right)$$

12) Interface Temperature of Composite Wall of 2 Layers given Inner Surface Temperature

Open Calculator

fx $$T_2 = T_1 - \frac{Q_{2layer} \cdot L_1}{k_1 \cdot A_{2wall}}$$

ex $$420.5769\text{K} = 420.74997\text{K} - \frac{120\text{W} \cdot 2\text{m}}{1.6\text{W}/(\text{m*K}) \cdot 866.6667\text{m}^2}$$

13) Interface Temperature of Composite Wall of 2 Layers given Outer Surface Temperature

Open Calculator

fx $$T_2 = T_{o2} + \frac{Q_{2layer} \cdot L_2}{k_2 \cdot A_{2wall}}$$

ex $$420.5769\text{K} = 420\text{K} + \frac{120\text{W} \cdot 5\text{m}}{1.2\text{W}/(\text{m*K}) \cdot 866.6667\text{m}^2}$$

14) Length of 2nd Layer of Composite Wall in Conduction through Walls

Open Calculator

fx $$L_2 = k_2 \cdot A_{2wall} \cdot \left(\frac{T_{i2} - T_{o2}}{Q_{2layer}} - \frac{L_1}{k_1 \cdot A_{2wall}} \right)$$

ex $$5\text{m} = 1.2\text{W}/(\text{m*K}) \cdot 866.6667\text{m}^2 \cdot \left(\frac{420.75\text{K} - 420\text{K}}{120\text{W}} - \frac{2\text{m}}{1.6\text{W}/(\text{m*K}) \cdot 866.6667\text{m}^2} \right)$$

15) Outer Surface Temperature of Composite Wall of 2 Layers for Conduction

Open Calculator

fx $$T_{o2} = T_{i2} - Q_{2layer} \cdot \left(\frac{L_1}{k_1 \cdot A_{2wall}} + \frac{L_2}{k_2 \cdot A_{2wall}} \right)$$

ex $$420\text{K} = 420.75\text{K} - 120\text{W} \cdot \left(\frac{2\text{m}}{1.6\text{W}/(\text{m*K}) \cdot 866.6667\text{m}^2} + \frac{5\text{m}}{1.2\text{W}/(\text{m*K}) \cdot 866.6667\text{m}^2} \right)$$

16) Thermal Resistance of Composite Wall with 2 Layers in Series

Open Calculator

fx $$R_{th2} = \frac{L_1}{k_1 \cdot A_{2wall}} + \frac{L_2}{k_2 \cdot A_{2wall}}$$

ex $$0.00625\text{K/W} = \frac{2\text{m}}{1.6\text{W}/(\text{m*K}) \cdot 866.6667\text{m}^2} + \frac{5\text{m}}{1.2\text{W}/(\text{m*K}) \cdot 866.6667\text{m}^2}$$

3 Layers

17) Area of Composite Wall of 3 Layers

Open Calculator

fx $$A_{3wall} = \frac{Q_{3layer}}{T_{i3} - T_{o3}} \cdot \left(\frac{L_1}{k_1} + \frac{L_2}{k_2} + \frac{L_3}{k_3} \right)$$

ex $$1383.333m^2 = \frac{150W}{300.75K - 300K} \cdot \left(\frac{2m}{1.6W/(m*K)} + \frac{5m}{1.2W/(m*K)} + \frac{6m}{4W/(m*K)} \right)$$

18) Heat Flow Rate through Composite Wall of 3 Layers in Series

Open Calculator

fx $$Q_{3layer} = \frac{T_{i3} - T_{o3}}{\frac{L_1}{k_1 \cdot A_{3wall}} + \frac{L_2}{k_2 \cdot A_{3wall}} + \frac{L_3}{k_3 \cdot A_{3wall}}}$$

ex $$150W = \frac{300.75K - 300K}{\frac{2m}{1.6W/(m*K) \cdot 1383.33333m^2} + \frac{5m}{1.2W/(m*K) \cdot 1383.33333m^2} + \frac{6m}{4W/(m*K) \cdot 1383.33333m^2}}$$

19) Inner Surface Temperature of Composite Wall of 3 Layers in Series

Open Calculator

fx $$T_{i3} = T_{o3} + Q_{3layer} \cdot \left(\frac{L_1}{k_1 \cdot A_{3wall}} + \frac{L_2}{k_2 \cdot A_{3wall}} + \frac{L_3}{k_3 \cdot A_{3wall}} \right)$$

ex $$300.75K = 300K + 150W \cdot \left(\frac{2m}{1.6W/(m*K) \cdot 1383.33333m^2} + \frac{5m}{1.2W/(m*K) \cdot 1383.33333m^2} + \frac{6}{4W/(m*K) \cdot} \right.$$

20) Length of 3rd Layer of Composite Wall in Conduction through Walls

Open Calculator

fx $$L_3 = k_3 \cdot A_{3wall} \cdot \left(\frac{T_{i3} - T_{o3}}{Q_{3layer}} - \frac{L_1}{k_1 \cdot A_{3wall}} - \frac{L_2}{k_2 \cdot A_{3wall}} \right)$$

ex $$6m = 4W/(m*K) \cdot 1383.33333m^2 \cdot \left(\frac{300.75K - 300K}{150W} - \frac{2m}{1.6W/(m*K) \cdot 1383.33333m^2} - \frac{5m}{1.2W/(m*K) \cdot 13} \right.$$

21) Outer Surface Temperature of Composite Wall of 3 Layers for Conduction

Open Calculator

fx $$T_{o3} = T_{i3} - Q_{3layer} \cdot \left(\frac{L_1}{k_1 \cdot A_{3wall}} + \frac{L_2}{k_2 \cdot A_{3wall}} + \frac{L_3}{k_3 \cdot A_{3wall}} \right)$$

ex $$300K = 300.75K - 150W \cdot \left(\frac{2m}{1.6W/(m*K) \cdot 1383.33333m^2} + \frac{5m}{1.2W/(m*K) \cdot 1383.33333m^2} + \frac{6}{4W/(m*K) \cdot} \right.$$

22) Thermal Resistance of Composite Wall with 3 Layers in Series

Open Calculator

fx $$R_{th3} = \frac{L_1}{k_1 \cdot A_{3wall}} + \frac{L_2}{k_2 \cdot A_{3wall}} + \frac{L_3}{k_3 \cdot A_{3wall}}$$

ex $$0.005\text{K/W} = \frac{2\text{m}}{1.6\text{W/(m*K)} \cdot 1383.33333\text{m}^2} + \frac{5\text{m}}{1.2\text{W/(m*K)} \cdot 1383.33333\text{m}^2} + \frac{6\text{m}}{4\text{W/(m*K)} \cdot 1383.33333\text{m}^2}$$

Variables Used

- **A** Cross-Sectional Area *(Square Meter)*
- A_{2wall} Area of 2 Layer Wall *(Square Meter)*
- A_{3wall} Area of 3 Layer Wall *(Square Meter)*
- A_{wall} Area of Wall *(Square Meter)*
- h_i Inside Convection *(Watt per Square Meter per Kelvin)*
- h_o External Convection *(Watt per Square Meter per Kelvin)*
- **k** Thermal Conductivity *(Watt per Meter per K)*
- k_1 Thermal Conductivity 1 *(Watt per Meter per K)*
- k_2 Thermal Conductivity 2 *(Watt per Meter per K)*
- k_3 Thermal Conductivity 3 *(Watt per Meter per K)*
- **L** Length *(Meter)*
- L_1 Length 1 *(Meter)*
- L_2 Length 2 *(Meter)*
- L_3 Length 3 *(Meter)*
- **Q** Heat Flow Rate *(Watt)*
- Q_{2layer} Heat Flow Rate 2 Layer *(Watt)*
- Q_{3layer} Heat Flow Rate 3 Layer *(Watt)*
- r_{th} Thermal Resistance with Convection *(Kelvin per Watt)*
- R_{th} Thermal Resistance *(Kelvin per Watt)*
- R_{th2} Thermal Resistance of 2 Layer *(Kelvin per Watt)*
- R_{th3} Thermal Resistance of 3 Layer *(Kelvin per Watt)*
- **T** Temperature *(Kelvin)*
- T_1 Temperature of Surface 1 *(Kelvin)*
- T_2 Temperature of Surface 2 *(Kelvin)*
- T_i Inner Surface Temperature *(Kelvin)*
- T_{i2} Inner Surface Temperature 2 layer wall *(Kelvin)*
- T_{i3} Inner Surface Temperature 3 Layer Wall *(Kelvin)*
- T_o Outer Surface Temperature *(Kelvin)*
- T_{o2} Outer Surface Temperature of 2 Layer *(Kelvin)*
- T_{o3} Outer Surface Temperature 3 Layer *(Kelvin)*
- **x** Distance from Inner Surface *(Meter)*

Constants, Functions, Measurements used

- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Temperature** in Kelvin (K)
  Temperature Unit Conversion
- Measurement: **Area** in Square Meter (m²)
  Area Unit Conversion
- Measurement: **Power** in Watt (W)
  Power Unit Conversion
- Measurement: **Thermal Resistance** in Kelvin per Watt (K/W)
  Thermal Resistance Unit Conversion
- Measurement: **Thermal Conductivity** in Watt per Meter per K (W/(m*K))
  Thermal Conductivity Unit Conversion
- Measurement: **Heat Transfer Coefficient** in Watt per Square Meter per Kelvin (W/m²*K)
  Heat Transfer Coefficient Unit Conversion

Check other formula lists

- **Conduction in Cylinder Formulas**
- **Conduction in Plane Wall Formulas**
- **Conduction in Sphere Formulas**
- **Conduction Shape Factors for Different Configurations Formulas**
- **Other shapes Formulas**
- **Steady State Heat Conduction with Heat Generation Formulas**
- **Transient Heat Conduction Formulas**

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