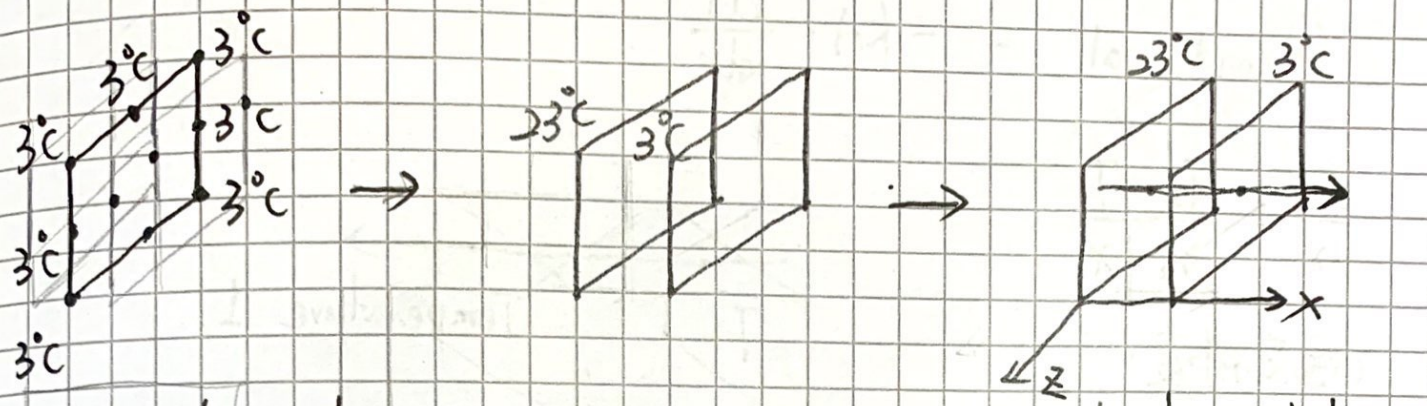
• Fourier's law of heat conduction



isothermal surface　　two different isothermal surfaces　　steady state heat conduction in plane wall

1) law / defination:

The rate of heat conduction through a plane wall:
is proportional to the average thermal conductivity, the wall are
and temperature difference

but is inversely proportional to the wall thickness.

2) property:

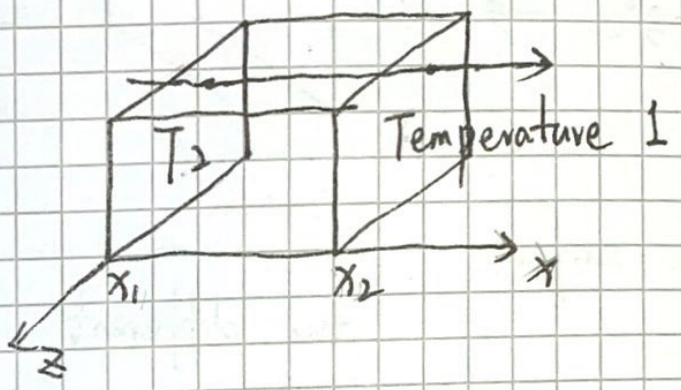
steady, one-dimensional (from higher to lower) and constant (for steady operation)

• Formula:

$$Q_{cond,\,wall} = -kA \cdot \frac{dT}{dx}$$

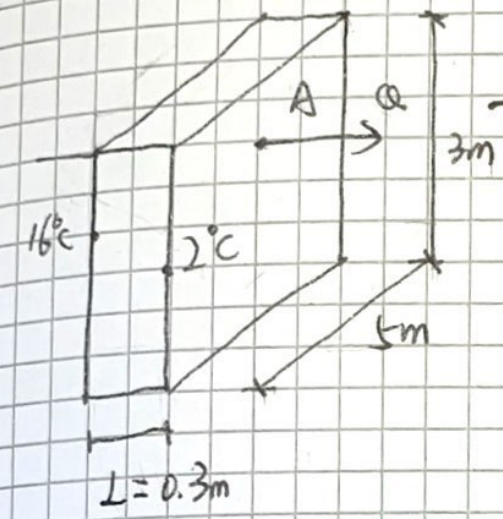
$$\frac{dT}{dx} = \frac{T_2 - T_1}{x_2 - x_1}$$

(温度梯度)
temperature gradient



	English name	Chinese	unit
$\frac{dT}{dx}$	temperature gradient	温度梯度	$°C \cdot m^{-1}$
k	average thermal conductivity	导热系数(λ)	$W \cdot m^{-1} \cdot K$
A	area	面积	m^2
$Q_{cond,wall}$	X	功率	W

- Formula Application:



$k = 0.9\ W \cdot m^{-1} \cdot C$

By using simple method:

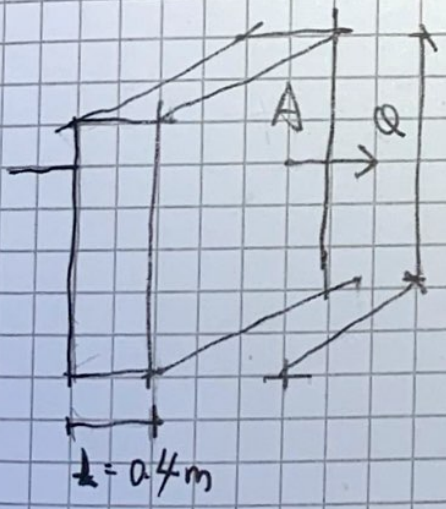
$$\dot{Q} = -kA \cdot \frac{dT}{dx}$$

$$= 0.9 * (3*5) * \frac{(16-2)}{0.3} = 630\ W$$

By using resistance concept:

$$R_{wall} = \frac{L}{kA} = \frac{0.3}{0.9*(3*5)} \approx 0.0222\ °C/W$$

$$\dot{Q} = \frac{\Delta T}{R_{wall}} = \frac{(16-2)}{0.0222} \approx 630.6\ W$$



$K = 0.78\ W \cdot m^{-1} \cdot k$

$A = 20m^2$, $\Delta T = 25k$

By using simple method:

$$\dot{Q} = -kA \frac{dT}{dx}$$

$$= 0.78 * 20 * \frac{25}{0.4} = 975\ W$$

By using resistance concept:

$$R_{wall} = \frac{L}{kA} = \frac{0.4}{0.78*20} \approx 0.0256\ °C/W$$

$$\dot{Q} = -\cancel{kA}\frac{dT}{dx} \quad \frac{\Delta T}{R_{wall}} = \frac{25}{0.0256} \approx 976.5\ W$$