

Spring 2021

控制系統
Control Systems

Unit 2G
Flow Models – Heat and Fluid

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- Heat flow

$$q = \frac{1}{R}(T_1 - T_2)$$

q = heat-energy flow, joules per second (J/sec)

R = thermal resistance, $^{\circ}C/J \cdot \text{sec}$

T = temperature, $^{\circ}C$

$$\dot{T} = \frac{1}{C}q, \quad (C : \text{thermal capacity})$$

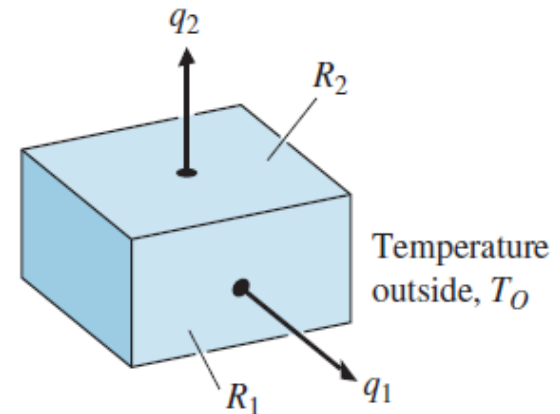
- Model (Equations for heat flow)

$$\dot{T}_I = \frac{1}{C_I} \left(\frac{1}{R_1} + \frac{1}{R_2} \right) (T_O - T_I)$$

C_I = thermal capacity of air in the room

T_I = temperature inside

R_2, R_1 = thermal resistance of room ceiling and wall, respectively



- Incompressible Fluid Flow

$$\dot{m} = w_{in} - w_{out}$$

m = fluid mass within a prescribed portion of the system

w_{in} = mass flow rate into the prescribed portion of the system

w_{out} = mass flow rate out of the prescribed portion of the system

- Model (Equations of Water tank height)

$$\dot{h} = \frac{1}{A\rho}(w_{in} - w_{out})$$

A = area of the tank

ρ = density of water

$h = \frac{m}{A\rho}$ = height of water

m = mass of water

