

Module 2

Heat and Cold Energy Demands of Buildings

Part of the SHaKE Educational Package on District Heating and Cooling Systems

Question Bank

Reusable assessment and classroom discussion resource

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<https://www.shakeproject-dhc.eu/>



Part 1: Space Heating Demands

1. What is the main objective of a DHC network?
 - a) Generate electricity
 - b) Provide heating and cooling to buildings
 - c) Reduce water consumption
 - d) Increase outdoor temperature
2. What does the coefficient K represent in the formula $\dot{Q} = K (T_{in} - T_{out})$?
 - a) Thermal capacity of air
 - b) Global heat transfer coefficient of the building
 - c) Radiator nominal power
 - d) Mass flow rate
3. Numerical application: A building has $K = 350 \text{ W/K}$, $T_{in} = 20^\circ\text{C}$ and $T_{out} = 0^\circ\text{C}$. Calculate the required heating power.
4. What does HDD (Heating Degree Days) represent?
 - a) Difference between indoor and outdoor average temperature
 - b) Number of heating days per year
 - c) Indoor setpoint temperature
 - d) Thermal transmission coefficient

Part 2: Space Cooling Demand

1. Which parameter is most critical for calculating cooling demand?
 - a) Transmission losses
 - b) Solar gains
 - c) Air infiltration
 - d) Domestic hot water temperature
2. What is the typical temperature regime for FCU cooling?
 - a) $80/60^\circ\text{C}$
 - b) $55/45^\circ\text{C}$
 - c) $7/12^\circ\text{C}$
 - d) $35/30^\circ\text{C}$
3. Why should condensation on cooling ceilings be avoided?
 - a) To prevent corrosion
 - b) To avoid thermal losses
 - c) To prevent water drops and discomfort
 - d) To reduce electricity consumption
4. Numerical application: Calculate ventilation heat gain: $\dot{Q}_v$. Data: $q_v = 500 \text{ m}^3/\text{h}$, $T_{in} = 26^\circ\text{C}$, $T_{out} = 32^\circ\text{C}$.
5. Which factor most influences the equivalent temperature (T_{eq}) of a wall in summer?
 - a) Wall thickness
 - b) Solar absorption



- c) Indoor temperature
- d) Mechanical ventilation

Part 3: Domestic Hot Water (DHW) Demands

1. What is the minimum temperature to prevent Legionella growth?
 - a) 40°C
 - b) 50°C
 - c) 55°C
 - d) 65°C
2. What percentage of daily DHW consumption corresponds to the peak period in residential buildings?
 - a) 15%
 - b) 36%
 - c) 65%
 - d) 78%
3. Numerical application: Calculate energy to heat 500 L of water from 10°C to 55°C.
4. What is the main health risk associated with DHW?
 - a) Condensation
 - b) Legionella
 - c) Overpressure
 - d) Corrosion
5. Which DHW production type requires the highest instantaneous power?
 - a) Instantaneous
 - b) Semi-instantaneous
 - c) Accumulation
 - d) Semi-accumulation

Part 4: Buildings Side Hydronic Systems

1. Which emitter provides the most uniform heat distribution?
 - a) Radiator
 - b) Underfloor heating
 - c) FCU
 - d) Fan coil unit
2. What is the typical temperature regime for underfloor heating?
 - a) 80/60°C
 - b) 55/45°C
 - c) 35/30°C
 - d) 7/12°C
3. Numerical application: Calculate mass flow rate for a radiator. Data: $\dot{Q} = 5 \text{ kW}$, $C_p = 4.18 \text{ kJ/kg}\cdot\text{K}$, $\Delta T = 20^\circ\text{C}$.



4. What percentage of heat transfer in a radiator occurs by radiation?

- a) 10%
- b) 30%
- c) 50%
- d) 70%

5. Why are low-temperature radiators larger?

- a) To reduce convection
- b) To increase heat exchange surface
- c) To lower pressure
- d) To prevent corrosion

Part 5: Substation and Control

1. What is the main role of a substation?

- a) Generate heat
- b) Hydraulically separate primary and secondary circuits
- c) Store hot water
- d) Reduce outdoor temperature

2. What does "pinch" mean in a heat exchanger?

- a) Difference between primary inlet and secondary outlet temperature
- b) Difference between primary outlet and secondary inlet temperature
- c) Setpoint temperature
- d) Minimum flow rate

3. Numerical application: Calculate exchanged power. Data: $\dot{m} = 1 \text{ kg/s}$, $C_p = 4.18 \text{ kJ/kg}\cdot\text{K}$, $\Delta T = 10^\circ\text{C}$.

4. Which valve type is most used for regulation?

- a) Butterfly valve
- b) 2-way valve
- c) 3-way valve
- d) Ball valve

5. Why is primary flow regulation important?

- a) To prevent condensation
- b) To reduce return temperature
- c) To increase pressure
- d) To improve corrosion

Part 6: Primary Network

1. What is the main objective of the primary network?

- a) Distribute heat between buildings
- b) Generate electricity
- c) Ventilate rooms
- d) Reduce indoor temperature



2. Numerical application: Calculate minimum pipe diameter to limit velocity to 1 m/s with flow rate of 0.5 kg/s.
3. What is the typical temperature regime of a primary network?
 - a) 80/60°C
 - b) 55/45°C
 - c) 35/30°C
 - d) 7/12°C
4. Why is pipe insulation important?
 - a) To reduce heat losses
 - b) To increase velocity
 - c) To prevent corrosion
 - d) To improve regulation
5. Which parameter is used to size the pump?
 - a) Outdoor temperature
 - b) Differential pressure
 - c) Pipe color
 - d) Valve type