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Sharing Knowledge on Energy Communities

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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

Developing institution: Mines Paris – PSL
Erasmus+ KA220-HED Cooperation Partnerships in Higher Education
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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. Which method is suitable for quickly estimating heating needs of an existing building?
 a) Degree-day method
 b) Thermal signature method
 c) Dynamic simulation
 d) Fast archetype method

3. 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

4. Numerical application: A building has K = 350 W/K, T_{in} = 20°C and T_{out}= 0°C. Calculate the required heating power.

5. 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°C
 b) 55/45°C
 c) 7/12°C
 d) 35/30°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 m³/h, T_{in}= 26°C, T_{out}= 32°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 kW, Cp = 4.18 kJ/kg·K, ΔT = 20°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 kg/s, Cp = 4.18 kJ/kg·K, ΔT = 10°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