Today’s Webinar

CIBSE AM17

Introduction to AM17 – Purpose and contents
Application and design considerations for different building types
Case studies
Q&A
AM17 Heat pump installations for large non-domestic buildings

The PDF version of this publication is free to all - simply use the voucher code ‘AM17’ at checkout.
Purpose of AM17

Heat pumps key to decarbonisation
Delivery at scale
Support delivery of high quality installations
Principally aimed at building services engineers
Scope of AM17

Large installations >45kW
Assumes heat pump is chosen technology
Non-domestic buildings
Existing and new buildings
Other resources

- LETI Climate Energy Design Guide (2020)
- Best practice sustainable building accreditation schemes (BREEAM)

GSHP reading
- CIBSE TM51: Ground source heat pumps (2013)

WShP reading
- CIBSE CP2: Surface water source heat pumps: Code of Practice for the UK (2016)
- CIBSE CP3: Open-loop groundwater source heat pumps: Code of Practice for the UK (2016)

- BSRIA Heat pump installer manual (2010)
- BS EN 15450:2007: Design of heat pump heating systems
- BS EN 378:2020 for design requirements relating to refrigerant management
- CIBSE Commissioning Code R: Refrigerating systems
- Soft Landings, for handover


Using this Applications Manual

- Chapter 2 highlights the importance of reducing energy demand (particularly in existing buildings) to enable effective heat pump operation.
- The next step is to characterise the heating and cooling demand (temperature, capacity, requirements relating to resilience)
- Chapter 3 sets out the different types of heat pump on the market: ground source, air source, exhaust air source and water source
- Chapter 4 explains how to size a heat pump system — including when working with a bivalent system
- Chapter 7 provides high-level guidance on capital, energy and maintenance costs of heat pumps
- Chapter 5 covers the impact on architectural and building design, including concept space allowances for different types of building
- Chapter 6 is System performance optimisation, which focuses on closing the performance gap through efficient controls and effective metering
- Chapter 9 provides guidance on installation and workmanship, particularly for ground source systems
- Chapter 8 also gives guidance on metering and monitoring
- Chapter 10 outlines the subjects which should be included within user guidance for heat pump systems
- Chapter 11 covers whole life carbon and responsible decommissioning options
Define load types

What loads does the building need to satisfy?
Space heating / Space cooling / DHW / Process heating/cooling

Reduce demand

What energy efficiency or passive measures can be used to minimise these loads?

Define building requirements

Calculate peak loads (point of use)
- What is the peak load for each load type seen at the point of use? [kW]

Calculate peak loads (diversified)
- What is the peak load for each load type considering diversity (at floor level, building level, whole development level)? [kW]

Calculate load profiles
- What is the daily and annual profile for each load?
- What is the typical range of part loads?
- When are heating and cooling loads coincident, and what is the magnitude of these coincident loads? [kW]
- What is the annual heating and cooling demand? [kWh]

Choose emitters
- FCU/AHU/Radiator/Chilled beam/ UFH etc.

Define temperatures
- What temperature is required at point of use for each load type? [°C]
- What level of resilience is required for each load type?
- Are there likely to be any changes to requirements during the lifetime of the heat pump system?

Define additional requirements

Use the answers to these questions to select the heat pump technology, and size the system
(Proceed to Sections 3 and 4)
Building requirements

<table>
<thead>
<tr>
<th>Building heating/cooling demand</th>
<th>Resilience requirement</th>
<th>Emitters</th>
<th>Temperatures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space heating</td>
<td>Central plant to be able to provide 60% peak load in the event of one heat pump failure</td>
<td>AHU/FCU/LTHW coil</td>
<td>50 °C/30 °C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>UFH</td>
<td></td>
</tr>
<tr>
<td>DHW</td>
<td>Storage of 30% of morning peak</td>
<td></td>
<td>70 °C flow</td>
</tr>
<tr>
<td>Space cooling</td>
<td>N + 1 for central plant</td>
<td>FCU/CHW coil</td>
<td>7 °C/13 °C</td>
</tr>
</tbody>
</table>

Figure 11 Heating and cooling characteristics for an example building
Figure 12  Sources and sinks of heating and cooling for heat pumps
**Figure 44** Typical ASHP equipment lengths (L), widths (W) and heights (H) for four manufacturers’ products, based on heat pump rated cooling capacity (kW)

**Figure 42** ASHP typical clearances: elevation (top) and plan (bottom)
Figure 14  Energy flows for a heat pump in heating and cooling mode

CoP: 
\[
(1) \quad \text{CoP} = \frac{Q_2}{E}
\]
\[
(2) \quad Q_1 + E = Q_2
\]

EER: 
\[
(1) \quad \text{EER} = \frac{Q_1}{E}
\]
\[
(2) \quad Q_1 + E = Q_2
\]
Figure 24  Example pipework and heat exchanger arrangement to facilitate passive cooling; in this arrangement the ground loop can exchange heat directly with the building CHW circuit without operation of the heat pump(s)
Measures of success

- A comfortable environment for building occupants
- Reliability of heating/cooling supply
- Ease of use and ease of maintenance
- Low energy use in operation
- Safe operation
- Future proofed and resilient
- As cost-effective as possible in terms of capital and life-cycle costs
Case studies included within AM17

AM17 includes 5 case studies:

- Case study 1 – Heat pump sizing based on annual building loads analysis - 350 Room hotel in Scotland
- Case study 2 – GSHP system operation varying from design – College building in Oxford
- Case study 3 – Sizing cascade systems – Chapel building retrofit in Gloucester
- Case study 4 – Buffer vessel as a thermal store to stabilise the system return temperature – University building in Edinburgh
- Case study 5 – ASHP sizing, system volume and minimum turndown – Public food hall in Cambridge
Case Study 5: ASHP sizing, system volume and minimum turndown

**Figure 39** Single large size heat pump scenario

**Figure 40** Multiple smaller size heat pumps scenario
Case Study 3: Cascade systems for higher temperatures

Figure 33: Temperatures, efficiencies and loads of the ASHP-WSHIP cascade system
Case study 2: GSHP System varying from design

Figure 17: Ground temperature change over an annual cycle
Questions