Overheating homes. Why?

Only by understanding heat can we develop ways to reject it.

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Overheating – understanding why?

- The causes of overheating:
  - Heat balance
  - Heat gains
    - Internal
    - External
  - Heat losses
    - Heat storage
    - Heat rejection

- Why do we have a problem in modern buildings?
Overheating – understanding why?

- The heat balance is simple:
  - Heat in = heat out
  - Heat gains = heat losses
  - Heat gains = heat losses + heat rejected

- Heat balance in a building
  - Short term – hourly, daily
  - Long term – weekly or longer

- Thermal mass (storage of heat) modifies changes in temperature over short term.
Overheating - understanding why?

- The heat balance is simple:

  Heat gains = heat losses + heat rejected

UK dwellings – not been a problem ..... well, maybe loft conversions ...
Overheating - understanding why?

- The heat balance is simple:

  \[
  \text{Heat gains} = \text{heat losses} + \text{heat rejected}
  \]

Non domestic – a different story – very low heat losses has for a long time required heat rejection to be considered.
Overheating – understanding why?

- Heat gains in a dwelling

- Solar gains conducted through fabric. Re-radiated and convected internally
- Ventilation and infiltration of outside air
- Internal gains from services; DHW system, lights, etc.
- Internal gains from occupants, occupant activities and white/electrical goods
- Direct solar gains through glazing

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Overheating – understanding why?

- Heat gains in a block of flats – communal heating

Rooms at 20°C

Void at 40~50°C

Rooms at 20°C

Water at 80°C
Overheating – understanding why?

- Outside air
  - Local
    - Urban heat island effect

- Micro climate
  - 100 m
  - 10 m
  - 100 mm ??
Overheating – understanding why?

- Outside air
  - Micro climate
Overheating – understanding why?

- Fabric insulation – well insulated and getting better
- Airtightness – good and getting better
- Glazing and shading – balance of daylight and gains
- Internal gains / usage patterns – defined by building user and overall little changed
- Thermal mass – move towards lower mass with timber frame, plasterboard lining on walls and partitions, etc.
Overheating – understanding why?

- Thermal mass as a modifier
Overheating – understanding why?

– The heat balance is simple:

Heat gains = heat losses + heat rejected

But how do we reject heat from dwellings and most UK buildings?

Ventilation – natural or mechanically driven

Ventilation of buildings is for the provision of fresh air and removal of pollutants; moisture, odours, etc.

AD-F 2010 states: Purge ventilation is intermittent, i.e. required only when such occasional activities occur. Purge ventilation provisions may also be used to improve thermal comfort, although this is not controlled under the Building Regulations.
Overheating – understanding why?

- Ventilation as a means of heat rejection
  - Type of windows
  - Ability to achieve purge ventilation overnight
Overheating – understanding why?

HOME IS WHERE THE HEAT IS

We’ve forgotten how to design for natural ventilation in dwellings – we’ve lost the art
Michael Swainson

CIBSE Journal August 2014

Is this really good design?
Overheating – A review of solutions / prevention

- Solutions which limit heat gains
  - Urban heat island
    - Green spaces
    - Albedo – urban level
  - Local micro climate modification
    - Blue / green spaces – e.g. green roofs
    - Albedo - roof, etc.
  - Building micro climate modification
    - Green walls, trees
    - Albedo – walls, etc.
  - Solar shading and glazing
    - Existing glazing types
    - Near market glazing types
  - Internal gains
Overheating – A review of solutions / prevention

- Solutions which enhance heat rejection
  - Natural ventilation
  - Mechanical ventilation

- Thermal mass
  - Attenuates rather than rejects heat
Overheating – A review of solutions / prevention

- Solutions which use cooling
  - Evaporative cooling
  - Ground loops
    - Ventilation air – earth tubes, etc.
    - Brine loops
  - District cooling
  - Linked thermal mass or building structures and mechanical systems
- Mechanical cooling
Overheating – A review of solutions / prevention

- The levels of heat gains in single dwellings have changed little. In some residential blocks of flats, communal systems do result in the structure of the building becoming warm.

- The natural heat loss routes; building fabric, and infiltration, have been significantly reduced – the fabric first approach is working...

- Preventing, or providing solutions for overheating requires an understanding of the local and micro climates, and how these can be modified, and the massive potential opportunities to reject heat.

- There is no single action to prevent overheating in an energy efficient manner, designs must be reviewed and case studies of solutions established. The problem is here, now.
Overheating homes. Why?
It’s a balancing act; limit gains, reject imbalance

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