TACKLING OVERHEATING IN HOUSING

Susie Diamond – Inkling
Adapting Buildings for Resilient Cities
25th Feb 2016 - Brunel
About Inkling

- Building Physics Consultancy
  - Susie Diamond
  - Claire Das Bhaumik

- Services
  - Design stage overheating risk assessments
  - Part L2A/CO2 emissions calculations
  - Massing and orientation advice
  - Daylight, sunlight and overshadowing reports
  - EPC predictions
  - Thermal performance and TM54 analyses
  - CFD modelling
Domestic overheating

HOME IS WHERE THE HEAT IS

As global temperatures rise, overheating is becoming an urgent problem for the residential sector. With no government-enforced sanctions on maximum temperatures and little incentive for developers, Liza Young finds out what can be done to keep cool.

The consequences of climate change are not a problem for future generations — they are an immediate threat. Already, there is growing evidence of overheating in homes. According to the Committee on Climate Change (CCC), one fifth of domestic properties could be overheating, even during a cool summer.

By the 2040s, half of all summers are expected to be as hot, if not hotter, than in 2003, when temperatures of up to 38°C led to more than 2,000 excess deaths in the UK. A recent CCC adaptation sub-committee report predicts that annual deaths caused by high UK temperatures will triple to 7,000 on average by the 2050s.

Yet at the same time, we are designing and building for winter energy efficiency.
Assessing Overheating risk

- Zero Carbon Hub publication
- Co-authored by Inkling and Anastasia Mylona (ARCC and CIBSE)
- Part of report series and ongoing research
What is overheating?

- No one definition fits all
- Comfort is subjective
- Depends on both environmental and human factors
- Duration/timing of high temperatures is important
- Very high temperatures (>35°C) lead to Heat stress
- High bedrooms temperatures (>26°C) can impair sleep

Image from ZCH Overheating in homes - Where to Start - An introduction for planners, designers and property owners, 2013
Key overheating risk factors

- Single aspect
- Large areas of glazing
- Limited ventilation
  - Restricted openings
- City centre locations
  - Noise and/or air pollution limiting natural ventilation
  - UHI effects
- Community heating
Higher overheating risk in city centres

Image from ZCH publication: *Overheating in homes - Where to Start - An introduction for planners, designers and property owners, 2013*
Existing Methodologies

- SAP (Appendix P)
  - Single calculation for June, July and August using monthly averages for weather data
  - Single zone model
  - Easy to fudge
- CIBSE Guide A 2015
  - Follows TM52 – adaptive thermal comfort
  - Based on commercial buildings - advice for dwellings is limited
- PHPP
  - Passive House Planning Package
  - Spreadsheet based
  - Uses bespoke internal gains but similar calc to SAP
- Dynamic Thermal Simulation
  - Powerful software, but inconsistent application as no defined methodology
Evidence?
What do we need?

- A stakeholder agreed methodology to follow:
  - Reliable
  - Cost-effective
  - Flexible
  - Understandable
- Not as easy as it first appears, but do-able
CIBSE TM52

• Developed for commercial buildings
• Provides a definition of overheating and pass/fail criteria
• Based on BS EN Standard 15251:2007
• Sets three criteria against which designs should be assessed:
  • Criterion 1: Hours of Exceedance
  • Criterion 2: Daily Weighted Exceedance
  • Criterion 3: Upper Limit Temperature
1. The first criterion sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature (upper limit of the range of comfort temperature) by 1 K or more during the occupied hours of a typical non-heating season (1 May to 30 September). 3%

2. The second criterion deals with the severity of overheating within any one day, which can be as important as its frequency, the level of which is a function of both temperature rise and its duration. This criterion sets a daily limit for acceptability. Weighted exceedance ≤6

3. The third criterion sets an absolute maximum daily temperature for a room, beyond which the level of overheating is unacceptable. It requires the internal operative temperature not to exceed the external running mean by more than 4 degrees. ΔT≤4K
**TM52 – variable threshold**

- TAS results – Threshold temperature graph

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<tr>
<th>Zone Name</th>
<th>Result</th>
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Simulation Results File (.tsd): stebornprimary_overheating_ph_DSY.tsd

Building Designer File (.tbd): stebornprimary_overheating_ph_DSY.tbd

Date: Tuesday, September 17, 2013

Adaptive Overheating Report (CIBSE TM52)

Adaptive Summer Temperatures for London DSY

- (T<sub>ed</sub>) External Dry Bulb
- (T<sub>rm</sub>) External Running Mean
- (T<sub>max</sub>) Comfort Range Max.
- (T<sub>upp</sub>) Absolute Upper Limit
## TM52 – results presentation

- **TAS results – zones results for each criteria**

### Results

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<tr>
<th>Zone Name</th>
<th>Occupied Summer Hours</th>
<th>Max. Exceedable Hours (3%)</th>
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<th>Peak Daily Weighted Exceedance</th>
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TM52 – future proofing

- TM52 threshold temperature graphs for different weather years

- Current DSY
- 2050’s
- 2080’s
Adapting TM52 for homes

- Occupancy profiles are required (not easy)
  - Domestic occupancy very variable
  - To test design need ‘worst case’ scenario, but too ‘worst case’ is excessive and might force mechanical cooling
  - Profiles should reference standard behaviour patterns
  - Include scenarios where people are present and windows open during the day, and also were they are out and non-secure openings are closed
- Thresholds – are these also suitable for homes?
Domestic profiles

- Inkling working with Arup and Aecom to compile profiles based on suggestions from range of sources
- Lighting and equipment gains linked back to annual electrical consumption for homes

This image shows the collated profile for living room occupancy gains. There is significant correlation, but also variation.
Limitations

• Cannot guarantee that people will always be comfortable, regardless of how they act
• Will need adaptation for different sizes of unit
• Will need to advise on modelling of opening windows
Start somewhere

“IF YOU DON’T START SOMEWHERE, YOU’RE GONNA GO NOWHERE.” - BOB MARLEY
The End

Thank you for listening!

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