TM59 - A NEW METHODOLOGY FOR PREDICTING OVERHEATING RISK IN HOMES

Susie Diamond – Inkling
CIBSE Webinar
22nd May 2017
About Inkling

- Building Physics Consultancy
  - Susie Diamond
  - Claire Das Bhaumik

- Services
  - Design stage overheating risk assessments for all building types
  - Thermal performance and TM54 analyses
  - Modelling in support of BREEAM, WELL, LEED
  - Advanced HVAC modelling
  - Part L2A compliance modelling and advice
  - EPC assessments
  - Research
Assessing Overheating risk

• Overheating identified as issue
• Multiple studies calling for methodology

Article by Liza Young
CIBSE Journal August 2014

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.

By the 2040s, half of all summers are expected to be as hot, if not hotter than in 2003, when two people of up to 65°C led to more than 2,000 excess deaths in the UK. A recent CCC adaptation subcommittee report predicts that annual deaths caused by high UK temperatures will triple to 2,000 per year by the 2030s.

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

We've forgotten how to design for natural ventilation in dwellings, says the art Michael Swindells.
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 in homes

- 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
- Locations in the South-East
What do we need?

• A design stage modelling methodology to follow that is:
  • Reliable
  • Cost-effective
  • Flexible
  • Understandable
• Not as easy as it first appears, but do-able
Introducing CIBSE TM59!

Design methodology for the assessment of overheating risk in homes

TM59: 2017
CIBSE TM59

- Focuses on naturally ventilated (free running) homes

- Criteria for predominantly *mechanically ventilated* homes (where opening windows cannot be used for cooling):
  - Operative temps should not exceed 26°C for more than 3% of occupied hours
  - Refer to CIBSE Guide A (2015a)
CIBSE TM59 – pass/fail criteria

• Where predominantly Naturally Ventilated
• Draws from TM52 AND CIBSE Guide A
  • **Criterion 1**: For living rooms, kitchens and bedrooms: the number of hours during which DT is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3% of occupied hours. *(CIBSE TM52 Hours of exceedance)*
  • **Criterion 2**: For bedrooms only: the operative temperature from 10 pm to 7 am shall not exceed 26°C for more than 1% of annual hours (33 hours)
• Bedrooms must pass both requirements
CIBSE TM59 – gain profiles

- Gain profiles for occupancy, lights and equipment
- 24/7 occupancy of bedrooms (worst case)
- Daytime (10am-10pm) occupancy of living rooms and kitchens

<table>
<thead>
<tr>
<th>Peak / No of People</th>
<th>Hour</th>
<th>Time period</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0-1</td>
</tr>
<tr>
<td>Single Bedroom Occupancy</td>
<td>75</td>
<td>0.7</td>
</tr>
<tr>
<td>Double Bedroom Occupancy</td>
<td>150</td>
<td>110</td>
</tr>
<tr>
<td>Studio Occupancy</td>
<td>150</td>
<td>110</td>
</tr>
<tr>
<td>Single Bedroom Occupancy</td>
<td>75</td>
<td>55</td>
</tr>
<tr>
<td>1 Bed Living/Kitchen Occupancy</td>
<td>75</td>
<td>55</td>
</tr>
<tr>
<td>1 Bed Living Occupancy</td>
<td>75</td>
<td>55</td>
</tr>
<tr>
<td>1 Bed Kitchen Occupancy</td>
<td>75</td>
<td>55</td>
</tr>
<tr>
<td>2 Bed Living/Kitchen Occupancy</td>
<td>150</td>
<td>110</td>
</tr>
<tr>
<td>2 Bed Living Occupancy</td>
<td>150</td>
<td>110</td>
</tr>
<tr>
<td>2 Bed Kitchen Occupancy</td>
<td>150</td>
<td>110</td>
</tr>
<tr>
<td>3 Bed Living/Kitchen Occupancy</td>
<td>215</td>
<td>165</td>
</tr>
<tr>
<td>3 Bed Living Occupancy</td>
<td>215</td>
<td>165</td>
</tr>
<tr>
<td>3 Bed Kitchen Occupancy</td>
<td>215</td>
<td>165</td>
</tr>
<tr>
<td>Single Bedroom Equipment</td>
<td>80</td>
<td>0.13</td>
</tr>
<tr>
<td>Double Bedroom Equipment</td>
<td>80</td>
<td>0.13</td>
</tr>
<tr>
<td>Studio Equipment</td>
<td>450</td>
<td>0.19</td>
</tr>
<tr>
<td>Living/Kitchen Equipment</td>
<td>450</td>
<td>0.19</td>
</tr>
<tr>
<td>Living Equipment</td>
<td>150</td>
<td>0.23</td>
</tr>
<tr>
<td>Kitchen Equipment</td>
<td>300</td>
<td>0.17</td>
</tr>
</tbody>
</table>

Note: The table shows the peak and no of people for different occupancies and equipment. The time period covers from 0-24 hours of a day.
CIBSE TM59 – weather file

- Requires
  - Local to site
  - 2020s
  - High emissions, 50th %ile
  - DSY1

- Recommendation to run for DSY2/3 or 2050/2080s data but not required to pass
Including Blinds

- If blinds form part of the mitigation strategy then these must be included in the base build
- Results without blinds must be included in the report
- Blinds should not interfere with the free area of opening windows, or if they do this reduction should be taken into account
Ventilation

Window opening

- Open (free) areas should include any restrictors, and take into account any security, noise or air quality issues which reduce opening area
- Windows should only be modelled as open when rooms are scheduled to be occupied, unless secure openings are provided
- Internal doors can be included and open as modelled as open during waking hours to improve cross-ventilation
Key points

Vulnerable residents

- Care homes and accommodation for vulnerable occupants should assume Type I occupancy (see CIBSE TM52 for description)

Community heating

- Heat losses from pipework, HIUs and heat maintenance tape should be included for community heating systems, and/or where heat maintenance tape is used
Reporting Requirements

Suggestions include:

• Site location and orientation.
• Images of the model and internal layouts
• Construction types including U- and g- values and thermal mass
• Ventilation strategy - including details of window openings, infiltration rates and any mechanical flow rates
• The weather file(s) used
• The results of the analysis
## Presenting results

### Example results

<table>
<thead>
<tr>
<th>Zone Name</th>
<th>Room Use</th>
<th>Occupied Summer Hours</th>
<th>Max. Exceedable Hours</th>
<th>Criterion 1: #Hours Exceeding Comfort Range</th>
<th>Annual Night Occupied Hours for Bedroom</th>
<th>Max Exceedable Night Hours</th>
<th>Criterion 2: Number of Night Hours Exceeding 26 °C for Bedrooms</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1_Bed1</td>
<td>Bedroom</td>
<td>3672</td>
<td>110</td>
<td>27</td>
<td>3285</td>
<td>32</td>
<td>84</td>
<td>Fail</td>
</tr>
<tr>
<td>1_Bed2</td>
<td>Bedroom</td>
<td>3672</td>
<td>110</td>
<td>68</td>
<td>3285</td>
<td>32</td>
<td>94</td>
<td>Fail</td>
</tr>
<tr>
<td>1_Bed3</td>
<td>Bedroom</td>
<td>3672</td>
<td>110</td>
<td>39</td>
<td>3285</td>
<td>32</td>
<td>76</td>
<td>Fail</td>
</tr>
<tr>
<td>1_Bed4(single)</td>
<td>Bedroom</td>
<td>3672</td>
<td>110</td>
<td>52</td>
<td>3285</td>
<td>32</td>
<td>96</td>
<td>Fail</td>
</tr>
<tr>
<td>G_KitchenDining</td>
<td>Living Room</td>
<td>1989</td>
<td>59</td>
<td>273</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Fail</td>
</tr>
<tr>
<td>G_Lounge</td>
<td>Living Room</td>
<td>1989</td>
<td>59</td>
<td>41</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Pass</td>
</tr>
<tr>
<td>G_Study</td>
<td>Living Room</td>
<td>1989</td>
<td>59</td>
<td>34</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Pass</td>
</tr>
</tbody>
</table>
Testing

• Tested on multiple DTM tools
• Focused on flats
• Applied to other unit types including houses, care homes, and student residences
• Further testing by wider modelling community
• Peer reviewed
Limitations

• Cannot guarantee that people will always be comfortable, regardless of how they act
• Modellers will need to use common sense and professionalism
• Continued testing and feedback from monitoring will feed into future updates
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The End

Thank you for listening!

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