TM59 - A NEW METHODOLOGY FOR PREDICTING OVERHEATING RISK IN HOMES

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CIBSE Webinar

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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

HOUSING 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. Flats, which make up 40% of new dwellings, are especially vulnerable.[1]

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.[2]

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 – we've lost the art"
Michael Swainson

Zero Carbon Hub report published 2015

ASSESSING OVERHEATING RISK

EVIDENCE REVIEW

ZERO CARBON HUB

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

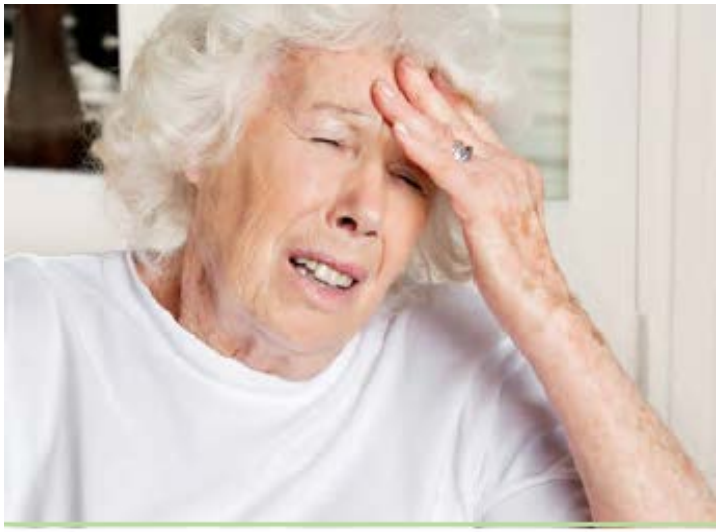


Image from ZCH *Overheating in homes - Where to Start - An introduction for planners, designers and property owners,* 2013

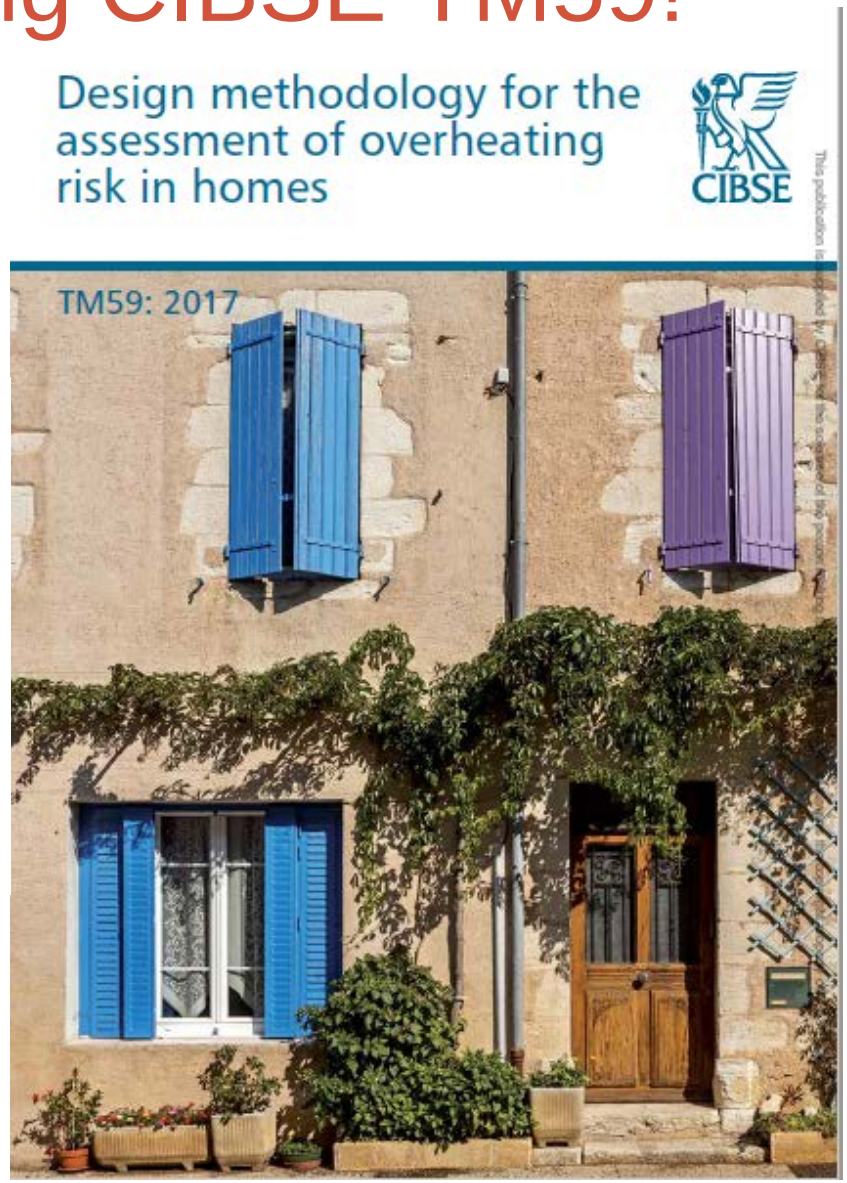
Key overheating risk factors in homes

- 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!



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

		Peak Load		Time period																							
				0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
Peak / No of People	Hour	Sensible (W)	Latent (W)	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00
1	Single Bedroom Occupancy	75	55	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.7
2	Double Bedroom Occupancy	150	110	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	0.7
2	Studio Occupancy	150	110	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1 Bed Living/Kitchen Occupancy	75	55	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
1	1 Bed Living Occupancy	75	55	0	0	0	0	0	0	0	0	0	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0	0
1	1 Bed Kitchen Occupancy	75	55	0	0	0	0	0	0	0	0	0	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0	0
2	2 Bed Living/Kitchen Occupancy	150	110	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
2	2 Bed Living Occupancy	150	110	0	0	0	0	0	0	0	0	0	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0	0
2	2 Bed Kitchen Occupancy	150	110	0	0	0	0	0	0	0	0	0	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0	0
3	3 Bed Living/Kitchen Occupancy	225	165	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
3	3 Bed Living Occupancy	225	165	0	0	0	0	0	0	0	0	0	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0	0
3	3 Bed Kitchen Occupancy	225	165	0	0	0	0	0	0	0	0	0	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0	0
	Single Bedroom Equipment	80		0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.13
	Double Bedroom Equipment	80		0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.13
	Studio Equipment	450		0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	1	1	0.44	0.44	0.24	0.24
	Living/Kitchen Equipment	450		0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	1	1	0.44	0.44	0.24	0.24
	Living Equipment	150		0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	1	1	1	1	0.4	0.4
	Kitchen Equipment	300		0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	1	1	0.17	0.17	0.17	0.17

CIBSE TM59 – weather file

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

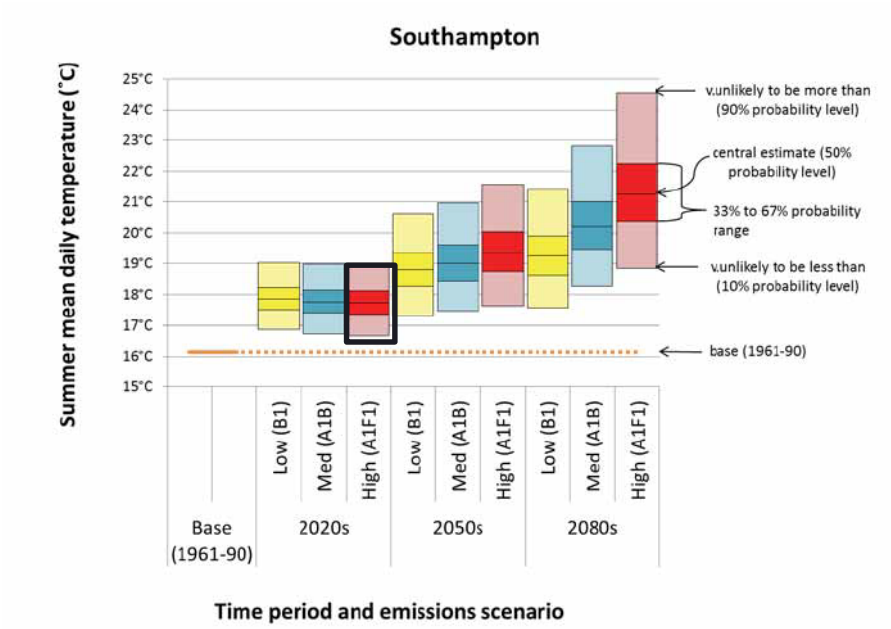


Figure: Probabilistic climate profile (ProCliP) graph from UKCP09 data - Southampton summer mean daily temperature (°C)

- 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 of 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

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

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

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