Good Homes Alliance

OVERHEATING IN NEW HOMES

Tool and guidance for identifying and mitigating early stage overheating risks in new homes

July 2019

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1. INTRODUCTION

This tool is intended for use at the early design stages of new residential development in order to identify key factors contributing to overheating risk, and possible mitigation measures.

The tool (see page 7) consists of a scoresheet containing 14 questions with accompanying guidance notes (see pages 8-38) for each question: how it identifies an overheating risk or mitigation factor, how to estimate the score, and related references for further reading.

It is not meant to provide a detailed assessment, but instead to sit between existing high-level guidance, often aimed at policy makers, and detailed calculation and modelling tools, often aimed at architects and engineers. Ideally, it should be used collaboratively to prompt dialogue between project teams and local authorities, with disciplines including architecture, building services engineering, acoustics, and environmental health, among others.

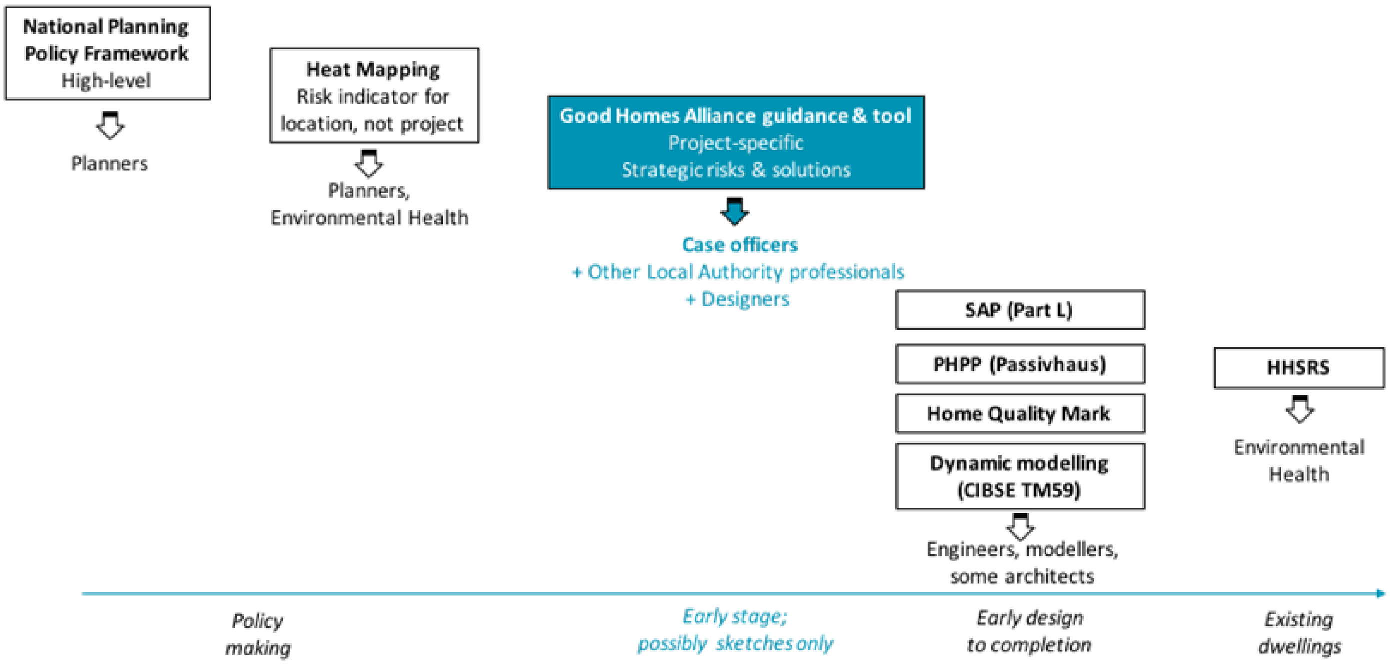
The tool is informed by existing guidance, current research and feedback from occupied schemes. It covers early design decisions as well as site-related issues which can impact on overheating risk in practice and are often not covered in existing overheating tools and guidance documents, such as noise levels, blue/green infrastructure or other site characteristics.

Context

There is growing evidence that homes are at risk of overheating, and that this will increase with climate change.

This is currently only partially addressed in current tools and approaches, which typically focus on the detailed design stage and do not encourage sufficient consideration of early stage decisions such as site and dwelling layout, nor holistic consideration of overheating risk together with linked design issues such as ventilation and noise. Tools are also often limited in how they can take account of local design features, such as neighbouring green space.

This guidance intends to start an evolution towards more comprehensive approaches by providing guidance for early design stages. It is aimed at generalist stakeholders, including local authorities, as well as more technical designers.



The intended audience for this tool and guidance includes planners, designers, engineers and more.

Providing cooling should not be the preferred solution to addressing overheating risk, for a number of reasons:

- Resilience: Homes that rely on mechanical cooling solutions are more vulnerable to power failure or equipment breakdown
- Affordability: Mechanical cooling solutions can be costly to run, and some occupants may not have the means to run them
- Negative impact on surrounding properties: The heat rejected from mechanical cooling plant will increase the air temperature in the immediate surroundings, which could impact on neighbouring properties (pollutant heat); heat rejection plant can also be noisy, which may deter neighbouring properties from opening windows, further increasing their overheating risk.

This guidance therefore seeks to remove, or significantly reduce the need for cooling; it should be used regardless of whether cooling may be installed in the future.

Approach to scoring

The tool may be used in different ways depending on the context e.g.:

- Applied to an overall scheme, with questions answered for the majority of the units. This would be more suitable at the very early stages, when key strategic design decisions are being made such as location and shape of a building, broad floor layouts (e.g. dual-aspect layouts vs corridors and single-aspect units).
- Applied to an overall scheme, but used to identify units or house types that may show higher risk characteristics; this would typically be at a slightly more detailed level of design, when the broad design principles may already be agreed and acceptable, but some flexibility is still available e.g. reducing glazing proportions or incorporating shading to more

exposed areas. Particular attention should be paid to corner rooms and top floors, where heat gains may be higher than the average across the scheme.

- Applied to individual dwellings.

What if your answer is not shown in the tool?

- For simplicity, the tool only includes responses which are attributed a risk or mitigation point. If the scheme's characteristics do not show, it means they should simply be given a score of zero. For example, in answer to #7, a score of zero should be allocated if the glazing ratio is 35% or below. The only exception is #1, where the "Northern England, Scotland and Northern Ireland" option is shown on the tool even if it is attributed a score of zero, in order to make it clear the tool does apply in these areas of the UK.

- Inevitably, this tool cannot account for all configurations; some innovative features may be proposed by the team, such as acoustically attenuated natural ventilation openings, which are not included as options here. In this case, the team should exercise cautious judgement on the closest representative scoring option and/or explore this through a more detailed assessment.

See also Worked Examples.

DISCLAIMER

This tool is provided as general guidance only. The information is intended to support decision-making and facilitate dialogue. Use of the tool does not guarantee that a new building will not overheat, nor does it constitute legal advice or attempt to provide a legal interpretation of the relevant legislation.

ACKNOWLEDGEMENTS

The main authors of this guidance are Susie Diamond from Inkling LLP and Julie Godefroy from Julie Godefroy Sustainability, with the support of Nicola O'Connor from Mandarin Research.

Thanks are due to the GHA project leads (Lynne Sullivan and Julian Brooks), project steering group (Michael Swainson, BRE; Anastasia Mylona, CIBSE; Victoria Tink, MHCLG; Chris Twinn, Twinn Sustainability Innovation; Guy Thompson, The Concrete Centre; Joe Baker, Haringey Council; Tom Dollard, Pollard Thomas Edwards), to Tessa Hurstwyn for her review of the tool and guidance, to Ben Abel, Hilson Moran; Marguerita Chorafa, AECOM; Louise Clarke, Berkeley Group; Ed Cremin, Etude; Jack Harvie-Clark, Apex Acoustics; Tom McNeil, Max Fordham; Clare Murray, Levitt Bernstein; Giorgos Petrou, UCL; Becci Taylor, ARUP; James Woodall, Allies and Morrison and to the many people who helped by responding to surveys, providing comments and case studies, and testing the early tool proposals.

We would especially like to thank the research project partners:

Berkeley Group

Centre for Window and Cladding Technology

The Concrete Centre

Construction Products Association

NHBC Foundation

Velux

EARLY STAGE OVERHEATING RISK TOOL

Version 1.0, July 2019

Good Homes Alliance

This tool provides guidance on how to assess overheating risk in residential schemes at the early stages of design. It is specifically a pre-detail design assessment intended to help identify factors that could contribute to or mitigate the likelihood of overheating.

The questions can be answered for an overall scheme or for individual units. Score zero wherever the question does not apply. Additional information is provided in the accompanying guidance, with examples of scoring and advice on next steps.

Find out more information and download accompanying guidance at goodhomes.org.uk/overheating-in-new-homes.

KEY FACTORS INCREASING THE LIKELIHOOD OF OVERHEATING | **KEY FACTORS REDUCING THE LIKELIHOOD OF OVERHEATING**

Geographical and local context

#1 Where is the scheme in the UK? See guidance for map	South east	4	
	Northern England, Scotland & NI	0	
	Rest of England and Wales	2	

#2 Is the site likely to see an Urban Heat Island effect? See guidance for details	Central London (see guidance)	3	
	Grtr London, Manchester, B'ham	2	
	Other cities, towns & dense sub-urban areas	1	

#8 Do the site surroundings feature significant blue/green infrastructure? Proximity to green spaces and large water bodies has beneficial effects on local temperatures; as guidance, this would require at least 50% of surroundings within a 100m radius to be blue/green, or a rural context	1	

Site characteristics

#3 Does the site have barriers to windows opening? - Noise/Acoustic risks - Poor air quality/smells e.g. near factory or car park or very busy road - Security risks/crime - Adjacent to heat rejection plant	**Day** - reasons to keep all windows closed	8	
	Day - barriers some of the time, or for some windows e.g. on quiet side	4	
	Night - reasons to keep all windows closed	8	
	Night - bedroom windows OK to open, but other windows are likely to stay closed	4	

#9 Are immediate surrounding surfaces in majority pale in colour, or blue/green? Lighter surfaces reflect more heat and absorb less so their temperatures remain lower; consider horizontal and vertical surfaces within 10m of the scheme	1	
#10 Does the site have existing tall trees or buildings that will shade solar-exposed glazed areas? Shading onto east, south and west facing areas can reduce solar gains, but may also reduce daylight levels	1	

Scheme characteristics and dwelling design

#4 Are the dwellings flats? Flats often combine a number of factors contributing to overheating risk e.g. dwelling size, heat gains from surrounding areas; other dense and enclosed dwellings may be similarly affected - see guidance for examples	3	
#5 Does the scheme have community heating? i.e. with hot pipework operating during summer, especially in internal areas, leading to heat gains and higher temperatures	3	

#11 Do dwellings have high exposed thermal mass AND a means for secure and quiet night ventilation? Thermal mass can help slow down temperature rises, but it can also cause properties to be slower to cool, so needs to be used with care - see guidance	1	

#12 Do floor-to-ceiling heights allow ceiling fans, now or in the future? Higher ceilings increase stratification and air movement, and offer the potential for ceiling fans	>2.8m and fan installed	2	
	> 2.8m	1	

Solar heat gains and ventilation

#6 What is the estimated average glazing ratio for the dwellings? (as a proportion of the facade on solar-exposed areas i.e. orientations facing east, south, west, and anything in between). Higher proportions of glazing allow higher heat gains into the space	>65%	12	
	>50%	7	
	>35%	4	

#7 Are the dwellings single aspect? Single aspect dwellings have all openings on the same facade. This reduces the potential for ventilation	Single-aspect	3	
	Dual aspect	0	

#13 Is there useful external shading?
Shading should apply to solar exposed (E/S/W) glazing. It may include shading devices, balconies above, facade articulation etc. See guidance on "full" and "part". Scoring depends on glazing proportions as per **#6**

	Full	Part	
>65%	6	3	
>50%	4	2	
>35%	2	1	

#14 Do windows & openings support effective ventilation?
Larger, effective and secure openings will help dissipate heat - see guidance

	Openings compared to Part F purge rates			
	= Part F	+50%	+100%	
Single-aspect	minimum required	3	4	
Dual aspect		2	3	

TOTAL SCORE ☐ = Sum of contributing factors: ☐ *minus* Sum of mitigating factors: ☐

High 12 **Medium** 8 **Low**

score >12: Incorporate design changes to reduce risk factors and increase mitigation factors AND Carry out a detailed assessment (e.g. dynamic modelling against CIBSE TM59)	**score between 8 and 12:** Seek design changes to reduce risk factors and/or increase mitigation factors AND Carry out a detailed assessment (e.g. dynamic modelling against CIBSE TM59)	**score <8:** Ensure the mitigating measures are retained, and that risk factors do not increase (e.g. in planning conditions)

3. ACCOMPANYING GUIDANCE

3.1 Key factors increasing the likelihood of overheating

#1 Where is the scheme in the UK?

Why?

Geographical location influences external temperature and solar radiation. Schemes in the South are typically more at risk of overheating.

Scoring this question

- 0 points for Northern England, the Borders, Scotland and Northern Ireland
- 4 points for the Thames area, Southeast England and southern England
- 2 points for everywhere else

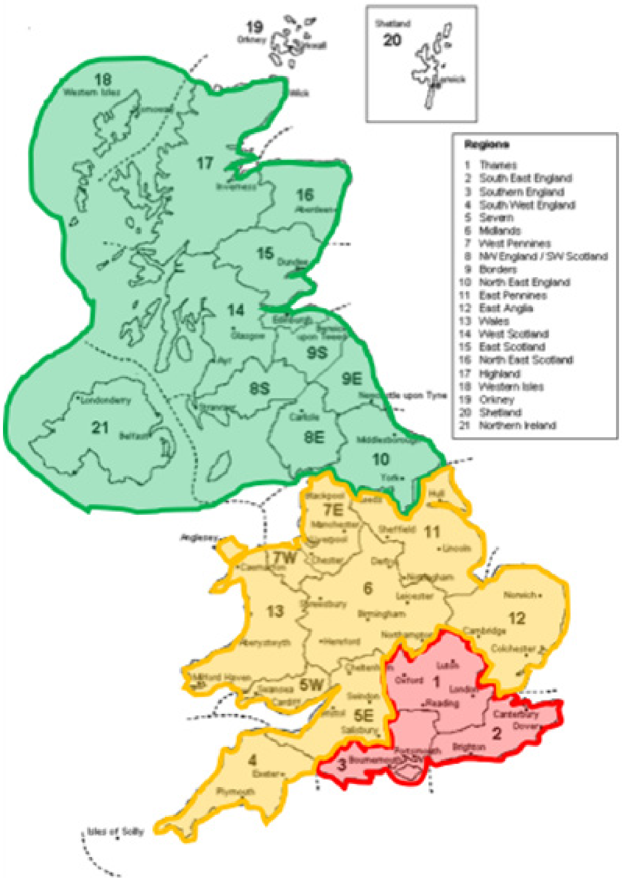


Figure #1-1: Risk zoning from geographical location, based on average external temperature and average solar radiation between May and September (data and zones from SAP 2012 version 9.92, October 2013; These are unchanged in draft SAP 10, 2018).

Note this is based on current climate data; overheating risk is expected to increase with climate change; current projections indicate that future temperature increases may be more pronounced in the South.

#2 Is the site likely to see an urban heat island effect?

Why?

In cities and built-up areas the preponderance of hard surfaces increases average air temperatures as these surfaces absorb solar heat during the day and release it at night. This is exacerbated by factors including heat rejection from vehicles and air conditioning equipment. This is known as the Urban Heat Island (UHI) effect.

The UHI effect occurs throughout the day but is stronger at night, with night-time temperatures sometimes significantly higher than in surrounding rural locations. Higher night-time temperatures can impact on sleep and the ability to cool building fabric.

Scoring this question

The scoring seeks to take account of temperature differences overall, not just night-time.

- 3 points: the term "central London" is used in the tool for simplicity, but the Boroughs recommended in this category are: City, Westminster, Camden, Islington, Hackney, Tower Hamlets, Newham. See map below and references for background data.
- 2 points for Greater London, Birmingham and Manchester
- 1 point for other cities, large towns and dense sub-urban areas
- 0 points for rural locations, smaller towns and less dense sub-urban areas

An element of judgement has to be applied on the suitable categorisation of the site. For example, on the London map below, while Camden is attributed a high UHI score overall for simplicity, it could be argued that the north of the Borough (near Hampstead) should have a lower one. This may be judged on a case by case basis, but with caution not to overstate the effects of local greenery against overall trends at the local authority /large neighbourhood level. The much more local effects of green infrastructure on temperatures are accounted for in #8 and #9.

Other local authorities may be developing datasets as part of exercises such as heat risk mapping. Please contact the Good Homes Alliance if you would like your Local Authority data to be added to the reference list.

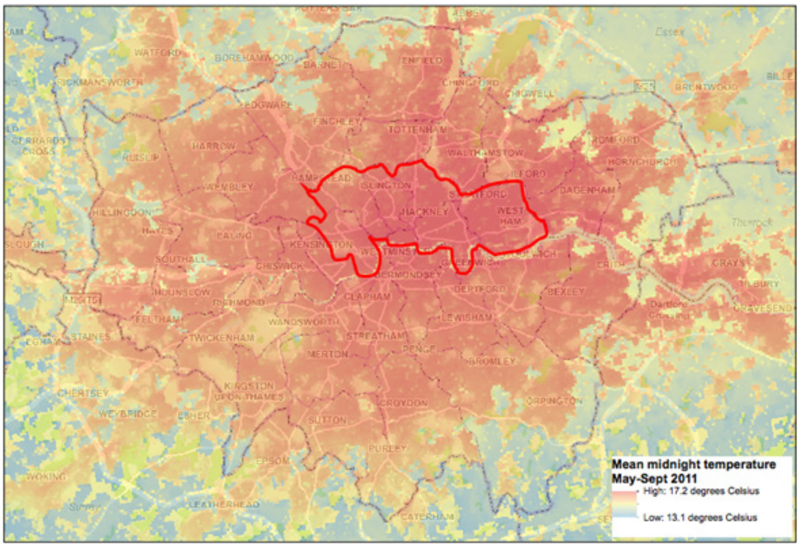


Figure #2-1: Zoning for scoring of sites in London, informed by data from Greater London Authority map - https://data.london.gov.uk/dataset/london-s-urban-heat-island---average-summer.

Mitigation

Incorporating blue/green areas can help reduce the UHI effect - see #8 and #9.

References

Met Office, What are urban heat islands? - https://www.metoffice.gov.uk/binaries/content/assets/mohippo/pdf/8/m/mo_pup_insert_health.web.pdf

NHBC Foundation and Zero Carbon Hub, NF44 Understanding overheating - Where to start?, 2012 - http://www.zerocarbonhub.org/sites/default/files/resources/reports/Understanding_Overheating-Where_to_Start_NF44.pdf, p9 Urban Heat Island Effect

Zero Carbon Hub, Overheating Evidence Review, 2016, pp 13-14 'Local climate (city level) – Urban Heat Island (UHI)' - http://www.zerocarbonhub.org/sites/default/files/resources/reports/ZCH-OverheatingEvidenceReview.pdf

London data: Greater London Authority, London's Urban Heat Island - Average Summer - https://data.london.gov.uk/dataset/london-s-urban-heat-island---average-summer. Note this is mean midnight temperature, May - September 2011.

Manchester data - http://www.instesre.net/GCCE/ManchesterHeatIsland.pdf

Birmingham data - https://rmets.onlinelibrary.wiley.com/doi/full/10.1002/wea.1998

#3 Does the site have barriers to windows opening?

Why?

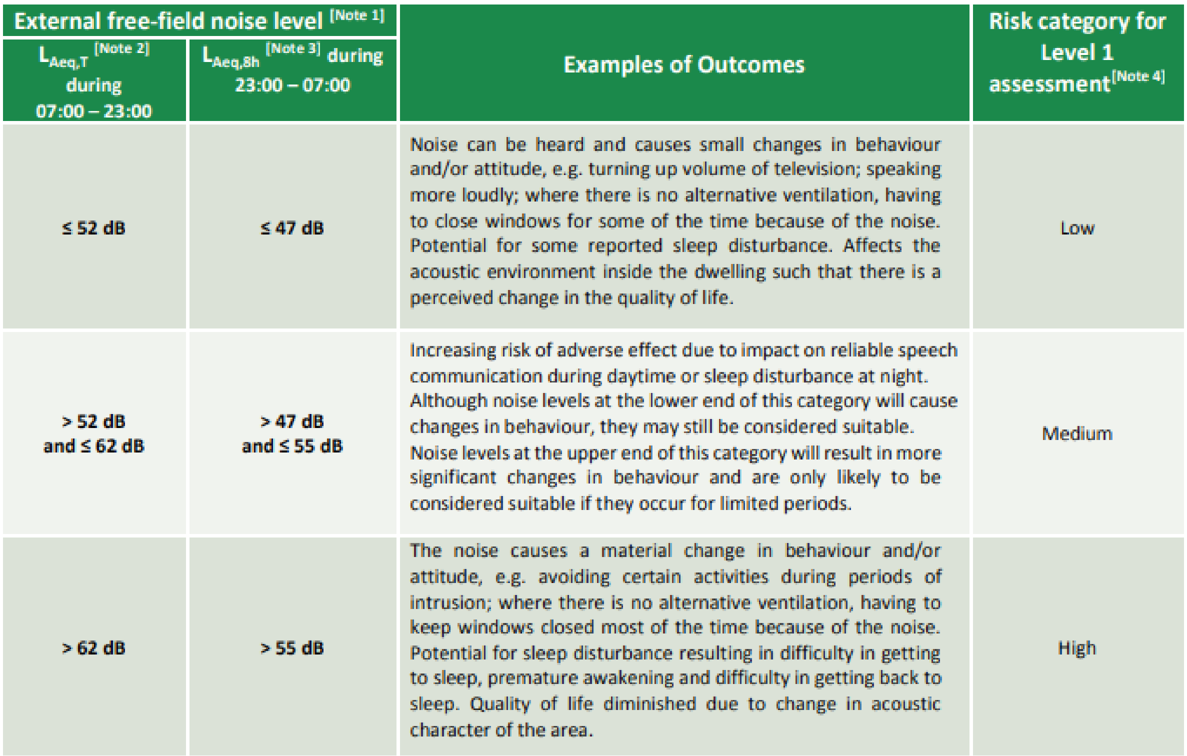
Ventilation is one of the key measures to mitigate overheating risk by dissipating heat from solar and internal gains, and ideally by creating a breeze.

Ventilation is sometimes limited by the design of the window or opening - see #14. However, even if occupants can physically open windows or other openings, they are often deterred from doing so by other reasons, the main ones being:

- **Noise levels**: this is known to be a significant barrier to window opening, particularly in urban areas and near transport routes. The risks and possible mitigation measures should be evaluated as part of the planning application process, with advice from the project team's acoustic consultant (if available) and the local authority's environmental health department on site conditions and how best to balance the needs for ventilation, temperature management and acoustics. See references for further guidance, including the emerging guidance from the Association of Noise Consultants on this issue; see also Figure #3-2.
- **Poor air quality/smells**: this should be evaluated as part of the planning application process, with advice from the project team's air quality consultant (if available) and the local authority's environmental health department. While poor air quality as such may not necessarily change people's behaviour to window opening, smells from neighbouring uses such as busy roads, car park areas, factories, or commercial kitchens, could.
- **Security risks/crime**: this should be assessed as part of the planning application process, with advice from the local security officer or police force where there are concerns. Lower floors are likely to be more susceptible. Thought should be given to whether occupants would feel safe leaving their windows open, particularly at night when sleeping, or day-time when they are not in that room.
- **Health and safety**: concerns by residents which might restrict how they use openings in practice should be considered e.g. risk of falling from higher floors; strong winds in high-rise buildings making it difficult to open windows safely; fear of small children escaping from openings on ground floors or through patio doors to balconies (especially in non-master bedrooms, which may be used for children and therefore not left open at night).
- **Directly adjacent heat rejection plant**: in cases where heat rejection plant is located near window openings, this may prevent residents from opening their windows due to noise issues and/or resulting increases in local air temperatures. The presence of heat rejection plant should also be taken into account in the location of mechanical air inlets - see #14 and Next Steps - Detailed Design.

These considerations are often different during the day and at night, hence the approach to scoring for this question.

Figure #3-1: The busy road and bus stop in front of this apartment block are likely to make it uncomfortable for occupants to regularly open their windows for long periods of time, due to noise as well as exhaust fume smells.



External free-field noise level [Note 1]		Examples of Outcomes	Risk category for Level 1 assessment[Note 4]
$L_{Aeq,T}$ [Note 2] during 07:00 – 23:00	$L_{Aeq,8h}$ [Note 3] during 23:00 – 07:00		
≤ 52 dB	≤ 47 dB	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic environment inside the dwelling such that there is a perceived change in the quality of life.	Low
> 52 dB and ≤ 62 dB	> 47 dB and ≤ 55 dB	Increasing risk of adverse effect due to impact on reliable speech communication during daytime or sleep disturbance at night. Although noise levels at the lower end of this category will cause changes in behaviour, they may still be considered suitable. Noise levels at the upper end of this category will result in more significant changes in behaviour and are only likely to be considered suitable if they occur for limited periods.	Medium
> 62 dB	> 55 dB	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	High

Figure #3-2: Guidance for Level 1 assessment of noise from transport noise sources relating to overheating condition. *(Draft AVOG (Acoustics, Ventilation and Overheating Residential Design Guide published by the Association of Noise Consultants), table 3-2)*

Scoring this question

Points are awarded on a sliding scale and separately for daytime AND night-time issues from:

- 0 points - no significant external barriers to window opening on any facade
- 4 points - day-time: barriers to window opening some of the time or only for some windows; night-time: barriers to window opening elsewhere, but bedroom windows can be assumed to be open
- 8 points - significant barriers requiring most windows to be closed most of the time.

In the case of noise, an acoustician and/or environmental health officer should be involved to advise on how to score this question. For example, in reference to the AVOG (Acoustics, Ventilation and Overheating Residential Design Guide published by the Association of Noise Consultants) guidance illustrated in Figure #3-2, they should advise which Level 1 assessment risk category the scheme falls under, and therefore the appropriate score for day-time and for night-time e.g. 8 points for the "high" and for the high end of the "medium" risk categories (as defined by AVOG), 4 points for the lower part of "medium" and 0 points where acoustic risk is defined as "low".

Mitigation

A number of mitigation measures are possible - see references for detail. Some relate to site and building layout decisions at the early design stages e.g. creating buffers to noise through site features and landscaping, locating sensitive uses away from the main sources of noise, and incorporating dual-aspect apartments to allow openings on a quieter side (see also #7).

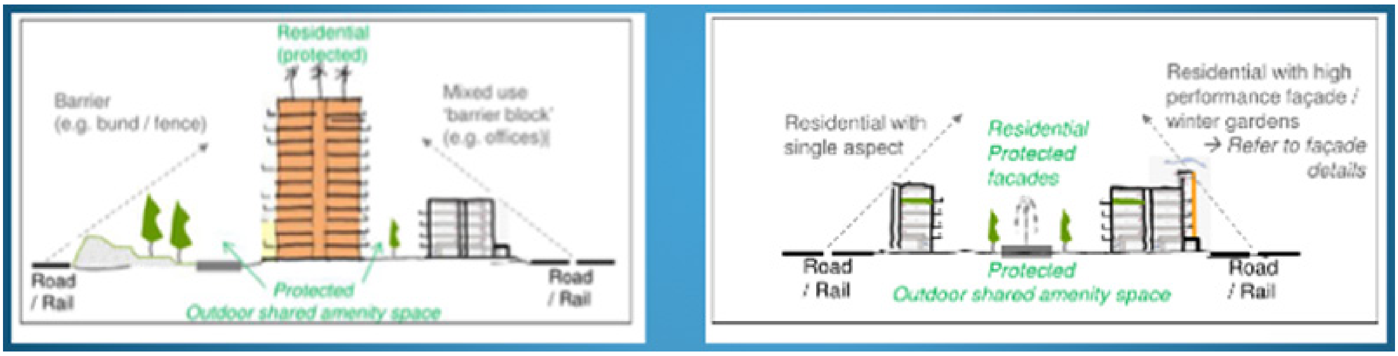


Figure #3-3: Examples of site layout mitigation measures.

Other measures relate to more detailed design but can affect the facade's aesthetics and therefore also need to be considered early on as part of the planning application e.g. security features on windows and openings, acoustic louvres, facades with double-skin or similar arrangements offering a "buffer" zone.

Figure #3-4: Examples of secure window openings.

Figure #3-5: Example of opening in high-rise building, addressing safety concerns: Parallel opening windows provide a relatively high overall opening area when opening is limited to 100 mm on safety grounds, are secure against strong gusts and allow stack driven ventilation within each room served. This combination of effects makes this type of window very effective for providing ventilation in tall buildings.
(Wicona Wicline 215, Hybrid window with double skin technology - https://www.wicona.com/en/uk/Range-of-systems/Windows/Profile-depth-215-mm*)*

References

NHBC Foundation and Zero Carbon Hub, NF44 Understanding overheating - Where to start? - http://www.zerocarbonhub.org/sites/default/files/resources/reports/Understanding_Overheating-Where_to_Start_NF44.pdf, p6 'Is the ventilation strategy appropriate?'; p8 site context

Noise: site assessments and design guidance

- Association of Noise Consultants (ANC), currently in draft: Acoustics, Ventilation and Overheating Guide (AVOG) - Residential Design Guide - http://www.association-of-noise-consultants.co.uk/wp-content/uploads/2018/02/AVO-Guide-draft-for-consultation.pdf
- Institute of Acoustics (IOA), ANC and Chartered Institute of Environmental Health (CIEH): ProPG: Planning & Noise – New Residential Development - https://www.ioa.org.uk/publications/propg

#4 Are the dwellings flats?

Why?

Flats are typically more prone to overheating. This is due to a number of reasons including their (typically) smaller size, denser occupation, fewer opportunities for cross ventilation, and surrounding dwellings and communal areas preventing heat dissipation or even adding to heat gains. Flats in upper floors of high-rise buildings are even more at risk, as heat rises, and they tend to be more solar exposed.

While these factors are exacerbated in flats, they may be similar in small enclosed dwellings, and this should be taken into account on a case by case basis when using the scoring tool.

Scoring this question

The scheme should be awarded 3 risk points if it includes flats (single storey dwellings within the larger building).

References

Office of the Deputy Prime Minister (ODPM). Housing Health and Safety Rating System (HHSRS): Operating guidance. London, ODPM, 2006: "Smaller, more compact dwellings, and particularly attic flats, are more prone to overheating than are large dwellings."

Modern English homes at higher risk of overheating, quoting - https://www.arcc-network.org.uk/modern-english-homes-at-higher-risk-of-overheating.

Beizaee, A., Lomas, K.J. & Firth, S.K., 2013. National survey of summertime temperatures and overheating risk in English homes. Building and Environment, 65, July 2013: 1–17.

NHBC Foundation and Zero Carbon Hub, NF46 Overheating in new homes, A review of evidence, 2012 - http://www.zerocarbonhub.org/sites/default/files/resources/reports/Overheating_in_New_Homes-A_review_of_the_evidence_NF46.pdf

#5 Does the scheme have community heating?

Why?

Centralised heating systems (e.g. per block or scheme) can contribute to overheating risk through a range of issues including lack of individual controls, and heat gains from distribution pipework and Heat Interface Units (HIUs). This heat is often released 24/7 and, when this happens in internal spaces which are not well ventilated (such as internal corridors), it accumulates and can significantly contribute to overheating of these and neighbouring occupied spaces.

Scoring this question

3 risk points should be awarded if the scheme is heated by a system that covers multiple units, thus requiring pipework to distribute hot water for space heating and domestic hot water all year.

For simplicity and because this tool is used at the early design stages, an overall risk factor of 3 is attributed; however, risks will vary depending on the configuration of the heating distribution and building; in particular, they will be higher if distribution pipework runs in internal spaces (e.g. corridors). There are a number of measures available to reduce this risk.

Mitigation

A number of mitigation measures are available including:

- Insulation to pipework, HIUs and storage vessels
- Lower flow temperatures, following current best practice or moving towards systems circulating water at even lower temperatures, such as “ambient loops”.
- More efficient control strategies
- Minimising pipe runs, particularly in enclosed areas such as hallways and corridors
- Ventilating any enclosed areas where heat is likely to accumulate (e.g. with actuated louvres or mechanical extract) to avoid the gradual build-up of heat. This would include corridors and risers with pipework, and potentially areas where the HIU and associated storage (if any) are located.

To a very large extent, these measures will also align with energy efficiency considerations i.e. reducing unwanted heat losses through distribution and storage - see references for guidance on good practice.

References

Evidence of risk:

http://www.zerocarbonhub.org/sites/default/files/resources/reports/ZCH-OverheatingEvidenceReview.pdf, p51 ‘Central distribution systems’

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/7604/2185850.pdf, DCLG Investigation into Overheating in Homes Literature Review 2012 (Aecom): “The strongest single message is that overheating is occurring as a result of community/district heating systems in apartment buildings, where unintended heat losses due to a lack of insulation is resulting in problems in some parts of some buildings, especially corridors.“

Minimum requirements and design guidance:

Domestic Building Services Compliance Guide, 2013 Edition – including minimum requirements for communal system internal pipework insulation (Table 29)

Mayor of London, London Heat Network Manual, 2014 - https://www.london.gov.uk/sites/default/files/london_heat_map_manual_2014.pdf

CIBSE & Association for Decentralised Energy (ADE), CP1, Heat Networks: Code of Practice for the UK, July 2015 - currently being updated, revision expected in 2019 - https://www.cibse.org/knowledge/knowledge-items/detail?id=a0q20000009OMYHAA2

#6 What is the estimated average glazing ratio for the dwellings? (as a proportion of the façade)

Why?

Higher proportions of glazing allow greater levels of solar heat gains to enter spaces (the original greenhouse effect). Windows are a vital feature for daylight access, views and ventilation, but excess glazing can have severe consequences in aggravating overheating risk.

This question tries to identify schemes where high glazing proportions on West, South and East facing elevations (and those in between) may contribute to overheating.

Scoring this question

This is scored according to the estimated proportion of glazing across the facades. All, solar-exposed elevations i.e. those facing East, West and South (and everything in between) should be included, even if shaded - the effects of shading features is taken into account in #13. Illustrations below provide examples of what different glazing proportions might look like in practice.

Percentage glazing	Points to allocate
Less than 35%	0
35-50%	4
50-65%	7
Over 65%	12

Estimating percentages of glazing:

- Strictly speaking the solar gains will only occur through glazed areas, not the frame. However, this can be difficult to evaluate at the early design stages, so the score can be based on the “total glazed area” including frame, which then provides a small error on the “safe” side.
- Where possible, the score should be evaluated on the proportion of facade as seen from the occupied areas i.e. from the inside without the slab. Again, this can be difficult to evaluate; as an estimate, the glazing proportion seen from the inside is usually approximately 10% higher than when seen from the outside (in proportion, not in percentage points). For example, if the total facade from the outside is approximately 50% glazed, this is approximately equivalent to a glazing percentage of 55% as seen from the inside (50% PLUS 10% of 50%, or 1.1*50%).
- Attention should be paid to corner rooms with windows on adjacent facades, as these spaces could be exposed to high solar gains even if each facade glazing ratio is still modest.

Figure #6-1: Examples of glazing proportion below 35% of facade area

Figure #6-2: Example of glazing proportion between 35% and 50% of facade area

Figure #6-3: Examples of glazing proportion between 50 and 65% of facade area; (left) on upper end, un-mitigated; (right) Colby Lodge, with shading through balconies and articulation (Pollard Thomas Edwards)

Figure #6-4: Examples of glazing proportion over 65% of facade area; (top) with partial shading through balconies and recesses; (bottom - Happy Facades) unmitigated. Note the left and middle examples show substantial use of internal blinds, likely to be for privacy and control of solar gains

Mitigation

- Reducing glazing areas: In order to maintain good daylight levels with lower proportions of glazing, it is useful to note that glazing areas located below 700mm and in corners do not contribute usefully to daylight levels in a room, but still contribute to winter heat losses and summer overheating risk. Raising sill heights is particularly relevant in bedrooms, where this may help address concerns about the security of openings for children (see #14), and where offering views from low-level glazing may be less important
- Incorporating external shading - see #13.
- Use of solar control glass (lower g-value).

References

http://www.zerocarbonhub.org/sites/default/files/resources/reports/ZCH-OverheatingEvidenceReview.pdf, p29 'Glazing area and orientation' and p37 'Glazing types – existing technologies'

#7 Are the dwellings single aspect?

Why?

Single aspect dwellings are where all rooms, and therefore windows, are on the same facade. Units like this are more likely to overheat as natural ventilation is less effective (lower flow rate) when there is no cross-ventilation (i.e. potential for air to pass through the unit from one facade to another), and this limits the amount of heat that can be purged. In addition, in single aspect dwellings, all solar gains occur at the same time, increasing the total peak solar gains.

Note that bay windows or small articulations in the facade do not mitigate for this. Corner units offer some benefit compared to single-aspect ones, but less than dwellings with windows or openings on opposite sides.

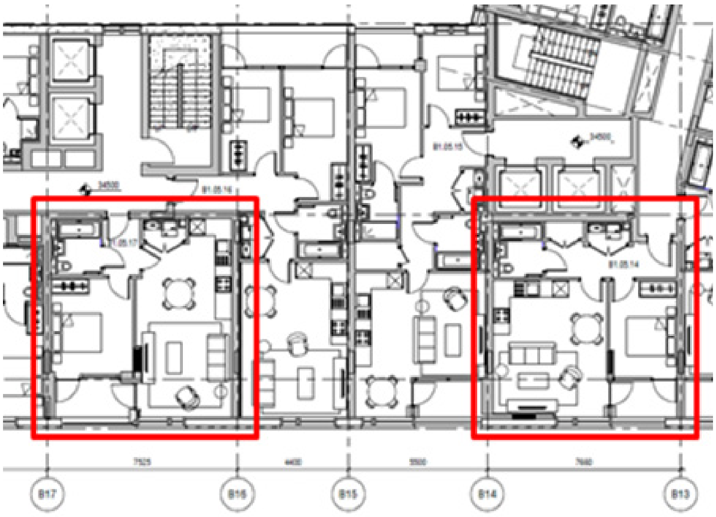


Figure #7-1: Examples of single-aspect flats

Scoring this question

3 risk points should be allocated if units have all windows on the same facade.

Mitigation

Building layouts should be reviewed at the early design stages to avoid configurations such as long corridors with single aspect units on each side. It is possible to design efficient floor layouts with a majority of dual aspect units - see examples below.

In addition to solar gains and ventilation potential, dual-aspect units often offer other opportunities that will help mitigate overheating risk, such as openings on a quieter facade away from the main elevation on the road (see #3).

Figure #7-2: Examples of schemes maximising dual aspect dwellings: (top) Colby Lodge, designed by Pollard Thomas Edwards; (bottom): Sutherland Road, Waltham Forest, designed by Levitt Bernstein (Image credit - Tim Crocker).

Other design measures that can be used to increase ventilation potential include openings with good free area (see [#14](#14)); generous floor-to-ceiling heights and ceiling fans can also help, though to a smaller extent (see [#12](#12)).

References

Zero Carbon Hub, Overheating Evidence Review - Drivers of Change, 2016, http://www.zerocarbonhub.org/sites/default/files/resources/reports/ZCH-OverheatingInHomes-DriversOfChange.pdf, p6

BRE, Guidance Document, Overheating in Dwellings, v3 - https://www.bre.co.uk/filelibrary/Briefing%20papers/116885-Overheating-Guidance-v3.pdf, p8 & 14

Zero Carbon Hub, Overheating Evidence Review, 2016, http://www.zerocarbonhub.org/sites/default/files/resources/reports/ZCH-OverheatingEvidenceReview.pdf, p73 solutions

Example of encouragement to dual-aspect dwellings through local planning policy: Greater London Authority, Housing Supplementary Planning Guidance, Implementation Framework, 2016: https://www.london.gov.uk/sites/default/files/housing_spg_final.pdf

#8 - Do the site surroundings feature significant blue/green infrastructure?

Why?

At the local level, the presence of blue/green infrastructure such as parks, generous landscaped grounds, rivers, or large water features helps reduce external air temperature.

Small blue and green infrastructure elements aggregate and contribute to local effects, so there is a continuum of effects rather than a clear threshold. For the purpose of this tool, the level of blue/green infrastructure considered to have a beneficial effect is at least 50% cover, within a 100m radius from the site (note - this is in line with the approach to this issue in the BRE's Home Quality Mark temperature tool).

This question can be evaluated from local site information, satellite views (e.g. Google maps), or other mapping resources if available. Examples are included in the references; other local authorities may be developing datasets as part of exercises such as green infrastructure or heat risk mapping; do feel free to contact the GHA if you would like your local authority data to be added to the reference list.

Local authorities who do not currently have green infrastructure maps may find it useful to develop one, as this can help with a number of objectives beyond addressing overheating risk, such as flood risk mitigation, biodiversity, air quality, and general health and wellbeing.

Figure #8-1: Examples of local blue / green infrastructure: (left) Local park in Poplar, London; (right) University campus route lined with trees and water features, Birmingham

Scoring this question

One mitigation point should be allocated if at least 50% of the surroundings within a 100m radius of the buildings are to be blue/green.

Areas of green roofs or living walls could be used to contribute to the 50% target here.

This point can more easily be awarded in a rural context and for low-density developments, although as this considers the very local neighbourhood context, it may not always be met in developments with large hard-surfaced areas and little planting.

Figure #8-2: Examples of using satellite view (Google Earth) to help score this question: these two sites in East London have similar built typologies with mostly low-rise housing and some isolated high-rise blocks, and would score the same for overall urban heat island effect (#2) because of their location in Tower Hamlets and Hackney. However, at the local scale (100m radius) they have very different characteristics in terms of green infrastructure, with the left-hand side site likely to experience higher local temperatures.

Mitigation

Seek to incorporate blue and green infrastructure to increase the proportion in the neighbourhood; more locally this may have added benefits to the scheme itself by offering local shading and cooling effects as well as other biodiversity, health and wellbeing benefits.

References

Evidence and background information: http://www.zerocarbonhub.org/sites/default/files/resources/reports/ZCH-OverheatingEvidenceReview.pdf, p14 onwards 'Addressing the Urban Heat Island – Trees and green space'

Blue/green infrastructure mapping of Greater London: https://maps.london.gov.uk/green-infrastructure/; in the future this may be linked to quantified data, for example by reference to the Urban Green Factor proposed in the draft London Plan (policy G5 - https://www.london.gov.uk/what-we-do/planning/london-plan/new-london-plan/draft-new-london-plan/chapter-8-green-infrastructure-and-natural-environment/policy-g5)

Blue/green infrastructure mapping of Birmingham: Birmingham Green Living Spaces Plan - https://www.birmingham.gov.uk/download/downloads/id/832/green_living_spaces_plan.pdf, see Green & Blue Infrastructure map on Plan 7

Blue/green infrastructure mapping of Liverpool: The Value of Mapping Green Infrastructure, RICS, 2011 - https://www.merseyforest.org.uk/files/The_Value_of_Mapping_Green_Infrastructure_pdf.pdf

#9 - Are immediate surrounding surfaces in majority light in colour or blue/ green?

Why?

Light coloured surfaces are more reflective and lead to lower surface temperatures and lower heat absorption; these are sometimes described as surfaces of high albedo. Similarly, surfaces covered in plants or water absorb less heat and maintain lower surface temperatures. By comparison, surfaces such as dark brick or tarmac absorb heat and can show much higher surface temperatures, which then leads to higher air temperatures in the immediate surroundings; this is described as surfaces of low albedo.

This is particularly important around mechanical air intakes or small window openings (e.g. restricted top-hung windows) as darker, hotter surfaces can significantly increase the temperature of incoming air, meaning ventilation potentially exacerbates the risk of overheating rather than mitigating.

Figure 9-1: A study carried out by the BRE showed that surface temperatures contributed to overheating risk, with south-facing exposed brick facades and tarmac areas nearby contributing to high temperatures near air inlets.

Scoring this question

Award 1 point where hard surfaces and/or cladding within 10m of the building(s), and particularly around ventilation inlets and opening windows, are designed to be of a pale colour or blue/green (water or planting).

Figure 9-1: Examples of light-coloured (high albedo) facades, likely to be of lower temperatures than surfaces such as brick.

Figure 9-2: Example of light-coloured (high albedo) facades and external hard surfaces (left) and tarmac (right). Ground surface temperatures are likely to be lower in the left-hand example than the right with a consequent impact on local air temperatures in hot weather, for a given similar location

Figure 9-2: Living wall, London

References

http://www.zerocarbonhub.org/sites/default/files/resources/reports/ZCH-OverheatingEvidenceReview.pdf, p18 onwards 'Addressing the Urban Heat Island – Albedo' and p22 'Local micro climate – albedo'

University of Kent, Urban Albedo calculator: https://research.kent.ac.uk/urbanalbedo

#10 - Does the site have existing tall trees or buildings that will shade solar exposed glazing areas?

Why?

Shading from surrounding trees and other buildings can reduce solar gains from glazed areas, and reduce the heat absorbed by the building fabric. The extent will vary depending on the height of trees and buildings, where they are located in relation to the building and sunpath, and the type of trees (deciduous or not, shape and density of foliage).

The impact of buildings may be assessed using a solar shading analysis produced as part of the planning application, if this has been carried out.

When assessing the impact of trees, only existing mature and healthy trees being retained should be accounted for, and only if they are tall enough and located close enough to the glazed areas to have a useful shading effect.

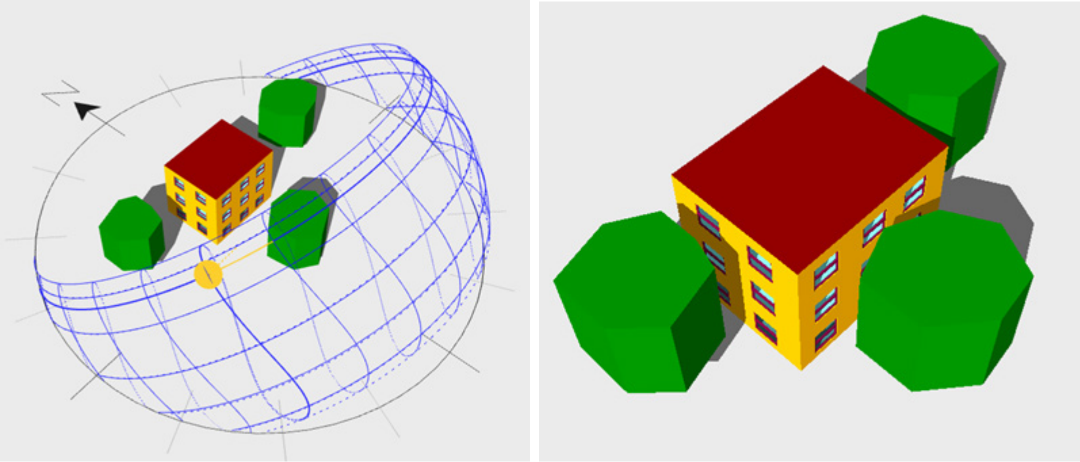


Figure #11-1 - This simple model (left hand image) illustrates a 10m high building surrounded by trees at an approximate 10m distance, and each 10m high. The shading they provide is modest: the snapshot shows the situation at 3pm in May. At this time of year the shadows from the most southerly tree never reach the lower windows as the solar angles are too high. The trees to the east and west do provide shade but only in the early morning and late afternoon, The image on the right shows the increased shading provided when trees are located 5m from the building.

Scoring this question

An element of judgement has to be applied to scoring this question, as it will be quite context-dependent. In most cases this would only apply to the scoring of small schemes or individual dwellings, as there will usually be too much variation on larger schemes to apply an overall mitigation point.

One mitigation point should be allocated if there are trees or buildings at least the same height (h) as the glazed areas of the dwellings being assessed, and within a radius of h from the exterior walls in either East or West direction, and also South in the case of large buildings. In most cases, trees located South of the glazed areas should not be awarded points as the sun will typically be too high for them to be effective, unless they really are very close to and much higher than the glazed areas. Note there are good reasons not to plant some tree species too close to building foundations which should be considered.

In some dense high-rise areas, apartments at the lower levels may be shaded for a significant proportion of the time by neighbouring buildings. In these cases, when considering overheating risk the project team may decide to award points in **#13**, as if for external shading features. Teams should however also be mindful of any units that may receive little or no shading (e.g. upper floors), and the benefits of being shaded should be balanced against access to direct sunlight as this is a significant contributor to health and wellbeing.

#11 - Do dwellings have high exposed thermal mass and a means for secure and quiet night ventilation?

Why?

The thermal mass present in medium and heavyweight construction materials can offer an effective means of reducing overheating, particularly during the hottest part of the day and if it is exposed to occupied rooms.

To be effective, thermal mass must be used in combination with night-time ventilation to remove heat that has built up in the dwelling, otherwise heat is gradually released again into the occupied areas, which can be problematic particularly in bedrooms at night. The importance of night purge ventilation should also be explained in the occupants guide (see Next steps).

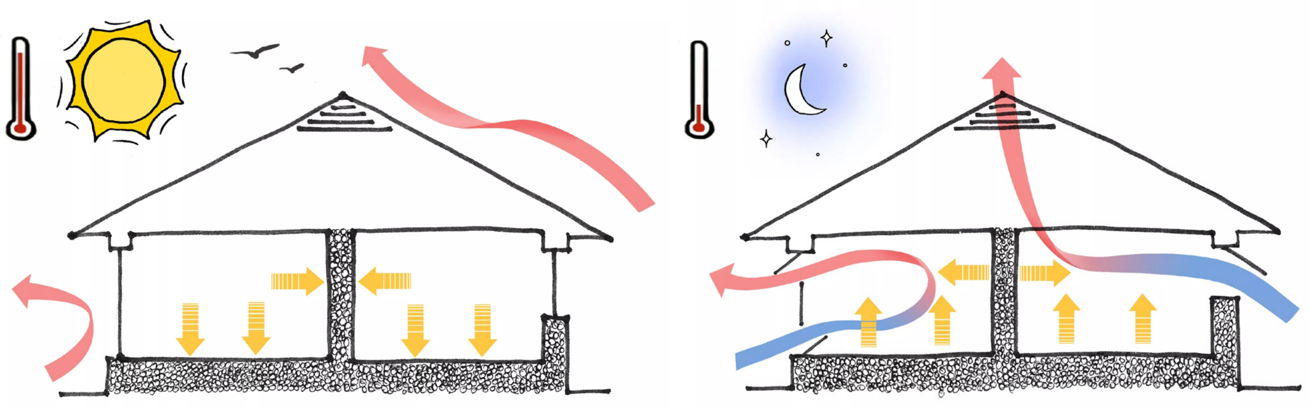


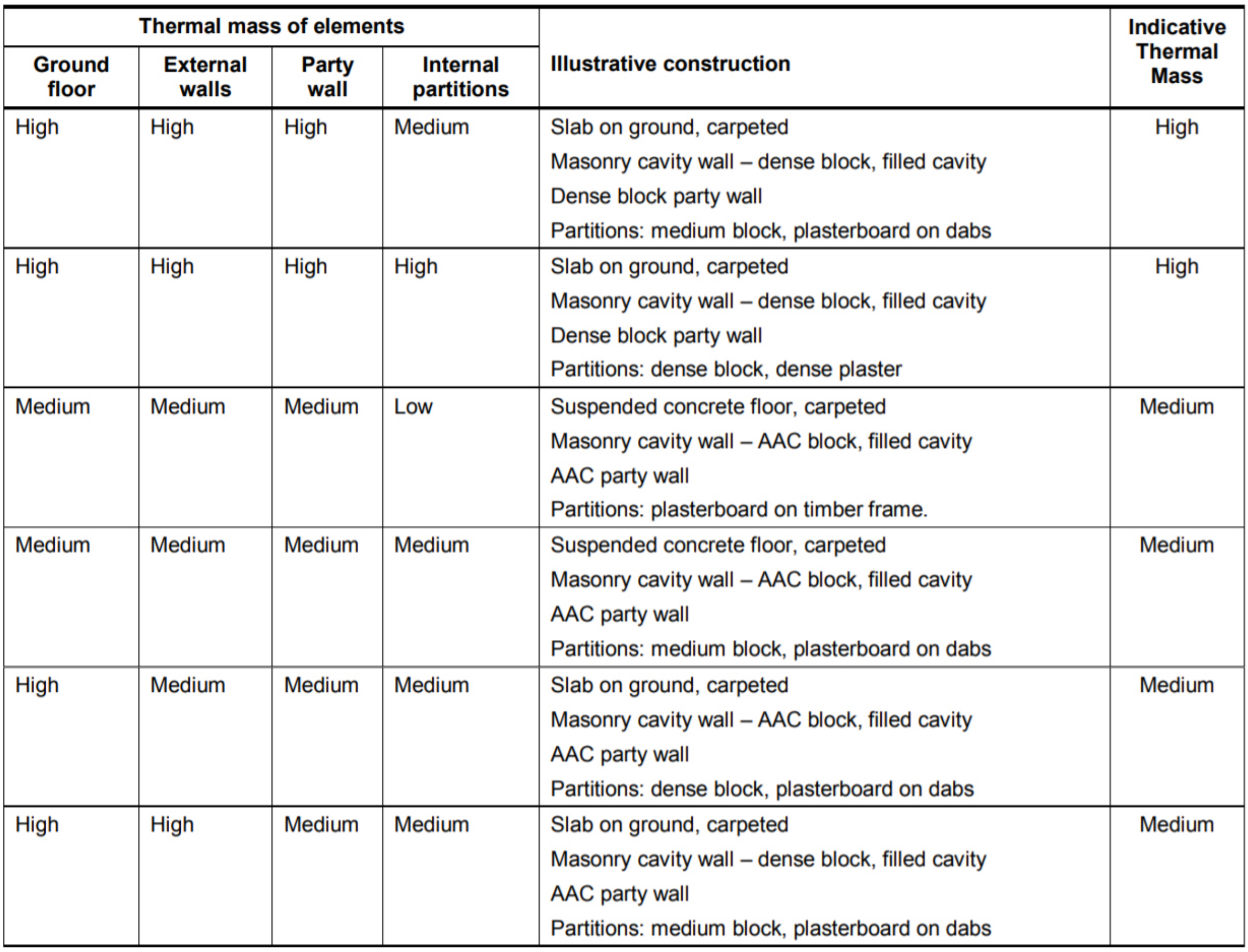
Figure #11-1: Illustration of thermal mass and night-time ventilation: Heat is absorbed during the day into high thermal mass elements; at night, the heat is released into the rooms and ventilation helps dissipate it to the outside.

Conversely, very lightweight construction types can make homes quicker to respond to temperature fluctuations and therefore increase susceptibility to overheating.

Scoring this question

One mitigation point can be allocated where the construction includes high exposed thermal mass (e.g. exposed stone or concrete floors; walls or ceilings with wet plaster finish) and there is a realistic strategy for secure and quiet night ventilation.

It may be helpful to refer to the thermal mass categories within SAP - anything qualifying as high or medium 'Indicative thermal mass' from the table below would qualify - provided it also meets the night ventilation requirement.



Thermal mass of elements				Illustrative construction	Indicative Thermal Mass
Ground floor	**External walls**	**Party wall**	**Internal partitions**		
High	High	High	Medium	Slab on ground, carpeted Masonry cavity wall – dense block, filled cavity Dense block party wall Partitions: medium block, plasterboard on dabs	High
High	High	High	High	Slab on ground, carpeted Masonry cavity wall – dense block, filled cavity Dense block party wall Partitions: dense block, dense plaster	High
Medium	Medium	Medium	Low	Suspended concrete floor, carpeted Masonry cavity wall – AAC block, filled cavity AAC party wall Partitions: plasterboard on timber frame.	Medium
Medium	Medium	Medium	Medium	Suspended concrete floor, carpeted Masonry cavity wall – AAC block, filled cavity AAC party wall Partitions: medium block, plasterboard on dabs	Medium
High	Medium	Medium	Medium	Slab on ground, carpeted Masonry cavity wall – AAC block, filled cavity AAC party wall Partitions: dense block, plasterboard on dabs	Medium
High	High	Medium	Medium	Slab on ground, carpeted Masonry cavity wall – dense block, filled cavity AAC party wall Partitions: medium block, plasterboard on dabs	Medium

Figure #11-2: Indicative thermal mass for different construction types demonstrating high or medium thermal mass.
(SAP 2012 conventions, p33 - https://www.bre.co.uk/filelibrary/SAP/2012/SAP-Conventions-v7.01.pdf)

References

Zero Carbon Hub, Solutions to Overheating in Homes: Evidence review, 2016 - http://www.zerocarbonhub.org/sites/default/files/resources/reports/ZCH-OverheatingEvidenceReview.pdf, p33 'Thermal mass'

The Concrete Centre, Overheating, an extract from Resilient Homes, 2018 - https://www.concretecentre.com/Publications-Software/Publications/Overheating-An-extract-from-Resilient-Homes.aspx

#12 - Do floor-to-ceiling heights allow ceiling fans, now or in the future?

Why?

Higher ceilings increase stratification and air movement, and also allow for the possibility of installing ceiling fans.

Ceiling fans provide useful air movement and can reduce the temperature experienced by occupants as the breeze generated increases the evaporation of moisture from skin, increasing adiabatic cooling.

Ceiling fans may be a good option when ventilation is otherwise limited - note they cannot replace actual ventilation, as heat does need to be dissipated, but they can help supplement the main ventilation which is provided by openings. For example, if the external environment is noisy and ventilation is provided by acoustic vents to baffle the noise, this will reduce air movement and ceiling fans can help provide a breeze effect which will improve occupant comfort.

Ceiling fans usually need a clear 500mm of ceiling height if they are to operate effectively without danger to tall occupants.

Scoring this question

Award 1 mitigation point if the floor-to-ceiling height within occupied rooms is designed to be 2.8m or more.

Award an extra 1 mitigation point if ceiling fans are included in the design and will be installed by the developer.

#12-1 Example of a ceiling fan (Image credit: Haiku Fans)

#13 - Is there useful external shading?

Why?

External shading devices can significantly reduce the solar gains admitted into a space. This can be in the form of features such as shutters, overhangs and awnings. The architecture might also provide shading, such as from balconies above or the articulation of the facade.

South-facing glazing will benefit most from horizontal shading e.g. louvres, balconies above. East and West facing glazing will benefit most from vertical shading e.g. deep recesses, vertical fins.

Typically, movable shading devices are preferred as this allows a level of adaptation by occupants; in some cases, the design of devices such as shutters means they can be closed while windows are left open and still allow a level of secure ventilation e.g. at night, or when people are not in the room. If devices are movable, a simple explanation on their use should be provided to occupants in the user handbook - see Next steps.

Scoring this question

The scoring takes account of the glazing ratio as estimated for #6 since the greater the area of glazing the more important shading features become. Once this is evaluated, the level of external shading provided needs to be categorised as Full or Partial:

- **Full** implies that all glazing receives half of the sunshine it would without the shading - e.g. shaded for at least half the day, or half the pane at all times.
- **Partial** implies some shading e.g. some windows receive adequate shading, but not all, or the shading will only have impact for some sun angles

Percentage glazing	Full effective shading applied - effective shading on all solar-exposed areas	Partial shading achieved - some shading on some solar-exposed areas
Less than 35%	0	0
35-50%	2	1
50-65%	4	2
Over 65%	6	3

Figure #13-1: Examples of movable shading devices. They are used differently across the facade, showing user adaptation.

Figure #13-2: Examples of shading from balconies. On the right-hand side example, proportions of glazing are lower and shading more comprehensive. On the left hand-side, the building is highly glazed (around 65%, and a fully glazed circulation area), shading is only partial as a number glazed areas have none. In both cases, the top floor apartments have no balconies above and are therefore more exposed to solar gains.

See also some examples in #6.

References

http://www.zerocarbonhub.org/sites/default/files/resources/reports/ZCH-OverheatingEvidenceReview.pdf, p29 'Glazing area and orientation' and p43 'Solar shading – Windows'

http://www.zerocarbonhub.org/sites/default/files/resources/reports/Understanding_Overheating-Where_to_Start_NF44.pdf, p23-24 'Solar shading'

CIBSE': TM37: Design for Improved Solar Shading Control - https://www.cibse.org/knowledge/knowledge-items/detail?id=a0q20000008I7elAAC

BRE, Solar shading of buildings - https://www.brebookshop.com/details.jsp?id=327972

#14 - Do windows and openings support effective ventilation?

Why?

Ventilation is one of the key measures for mitigating overheating risk. Large and widely openable windows or other openings help create good air flow and a pleasant breeze in hot weather. The design of the windows or the application of restrictors can limit the gap created (or 'free area') through which air can flow, and therefore limit the capacity for a dwelling to dissipate heat.

The opening type (top hung, side hung, sash, patio door etc) makes a key difference to how wide a window will open and how well air can flow. Common installations that limit the air flow include:

- Restrictors installed that cannot be overridden, or which would lead to unsafe openings
- Few small panes openable in larger glazing areas
- Deep reveals limiting the gap obtained when windows open
- Patio doors that don't offer a range of open positions and are therefore unlikely to be left open at night or in unoccupied rooms.

Windows in high rise buildings often have more limited openings due to concerns over high wind speeds or health and safety: well designed windows can enable good ventilation whilst managing these risks.

Sliding windows or doors, and sash windows can usually achieve large openings in relation to the pane area (up to 50%). Side hung windows can often create wider areas for air flow (potentially the full pane area, if not restricted) than top or bottom hung windows. Some types of folding patio doors allow very large free areas.

Figure #14-1: Examples of restricted window openings; (left): Only one of six panes was openable, and only to a limited extent - the flats overheated (GHA Preventing overheating report, 2014); right: only the top ⅔ part of windows opens, and the opening is restricted to only a very small gap.

Scoring this question

A core assumption here is that all dwellings should have openings, whether or not they have mechanical ventilation. Schemes where this is not the case should be treated with extreme caution and are NOT recommended.

The scoring for this question is done by reference to the minimum requirements for purge ventilation in Building Regulations Approved Document F:

As a minimum, the team should satisfy themselves that all dwellings can meet the minimum purge ventilation requirements of Approved Document F i.e. each room can achieve 4 air changes per hour (ach) when windows are open. Approved Document F (Appendices B and C) provides guidance on how that could typically be satisfied:

- Wide openings, e.g. hinged or pivot windows with angle over 30 degrees: total opening provision per room of at least 1/20th of the floor area
- Narrow openings, e.g. hinged or pivot windows with angle of 15-30 degrees: total opening provision per room of at least 1/10th of the floor area.

Examples are provided in Approved Document F, and teams may need more detailed calculations depending on the types of openings.

Mitigation points can be awarded if the size and design of openings offer ventilation provision going beyond these minimum requirements of Building Regulations Approved Document F (referred to as Part F here for simplicity), as follows:

Openings provision	Meets Part F purge requirements	50% over Part F minimum requirements	100% over Part F minimum requirements
Single aspect dwellings	0	3	4
Dual aspect dwellings	0	2	3

The design team may not be able to provide calculations at the very early stages of design, when little detail is available on the size and design of the openings, however the strategic design options should be discussed and agreed upon e.g. broad types of openings, how to provide secure openings, approach to restrictors (if any). By the time of the planning application, it is recommended that initial calculations based on the design proposals should be available: these are anyway recommended to be produced as early assessments of compliance with Approved Document F, and can therefore also be used when assessing the score for this question.

These points are awarded even if the site is considered to have barriers to window openings (as assessed under #3), because these site characteristics may change in the future, or not affect all occupants in the same way (e.g. some people are more/less sensitive to noise), and because it helps build resilience in the design.

What to look out for when assessing ventilation provision

Note that the Approved Document F purge requirements are aimed at situations where high ventilation rates are needed to deal quickly with temporary situations, such as fresh paint or burnt toast. While they may in some cases be used for thermal comfort, this is not what they are intended to address and they may therefore rely on solutions which are not appropriate for a longer and more regular use, to prevent overheating. It is therefore imperative that proposals for opening sizes and types are discussed with the project team to ensure Approved Document F purge requirements (or higher) have been considered and can be met alongside other requirements, such as safety and security.

For example, restrictors are often installed on windows for safety or security reasons, and strategies for meeting Approved Document F purge requirements tend to assume that restrictors can be overridden for short periods. For the purpose of overheating risk mitigation, overriding restrictors should only be assumed if this can be done while still meeting best practice recommendations on safety and security (e.g. those of the Royal Society for the Protection of Accidents and Environmental Health officers, including sill heights). In addition:

- Where restrictors are installed with an override option, they should automatically re-latch once the window is closed
- There should be clear explanations to occupants about the presence of restrictors, how they can be overridden (if applicable), and how they can be relatched (this should be included in the User guide).

Another example where purge requirements may differ from overheating mitigation strategies is where some rooms may be fitted with mechanical systems to boost ventilation/extract briefly in response to certain activities (e.g. cooking in kitchens and showering in bathrooms). These systems are typically too noisy for occupants to run for long periods e.g. overnight, and not sufficient for purging overheating in larger rooms (bedrooms or living rooms). Proposals for overheating mitigation ventilation to be met purely through mechanical systems (without opening windows) should be treated with much caution - see also Detailed design.

Project teams should also be aware of any heat rejection plant from Air Conditioning units operating nearby as these could significantly increase air temperature in the immediate locality. Openings and air inlets should, as much as possible, be located away from these heat sources, to avoid drawing hot air inside, thereby increasing rather than mitigating the risk of overheating.

Figure #14-2: Examples of openings providing just under 50% free area: window with bottom half opening; patio door

Figure #14-3: Examples of openings providing up to 90% free area: patio door; side-hung window

See also #3 for examples of openings where security concerns have been addressed.

References

http://www.zerocarbonhub.org/sites/default/files/resources/reports/Understanding_Overheating-Where_to_Start_NF44.pdf, page p18 'Restricted ventilation', p21 'Window design' and p22 'Secure ventilation'

http://www.zerocarbonhub.org/sites/default/files/resources/reports/ZCH-OverheatingEvidenceReview.pdf, p53 'Natural ventilation'

Natural ventilation in non-domestic buildings, CIBSE Applications Manual AM10:2005

http://www.zerocarbonhub.org/sites/default/files/resources/reports/Understanding_Overheating-Where_to_Start_NF44.pdf, p28 'Case study 3'

4. NEXT STEPS

Once a scheme has been assessed using this tool, a number of options are available depending on the level of overheating risk estimated:

- **Low risk**: the team should commit that the key overheating mitigation characteristics of the scheme will be maintained throughout design development to ensure a balance between heat gains and heat dissipation opportunities. This may be secured by planning condition.
- **Medium risk**: the balance of characteristics of the scheme means that a more detailed assessment is required; the scoring may help the team identify opportunities to reduce risk factors and improve mitigation factors, or this may be assessed through more detailed tools (e.g. dynamic model).
- **High risk**: the team should carry out a detailed assessment of overheating risk, for example using dynamic thermal modelling against CIBSE TM59. However, the total score means there are likely to be a number of easily identifiable risk factors and/or a lack of mitigation factors, which should enable the project team to incorporate design changes to improve heat balance, before a more detailed assessment and detailed design work is carried out. This should save time and resources in modelling for where it adds most value.

In all cases, there will be measures that can be looked into at the detailed design stage - see detailed design guidance below.

In general it is strongly recommended that overheating risk is mitigated **prior to** planning submission and approval, as some schemes may find it difficult to incorporate design changes afterwards (e.g. changing glazing areas or incorporating external shading). This is certainly the case if a "high" level of risk has been identified. Once the project team and local authority are satisfied that the risk of overheating has been mitigated, either through the use of this tool or through an additional assessment, the characteristics of the scheme should be secured through planning condition and checked at completion.

If the team are satisfied that overheating risk can be addressed through design changes that will not affect planning permission, it is recommended to condition the production of a detailed overheating risk assessment with satisfactory results - see guidance below.

Detailed design

There are a number of measures that contribute to or mitigate overheating risk, which are not explored in this tool due to its simplicity and its intent to focus on strategic early stage decisions. These include:

- Glazing characteristics, including capacity to retain heat (U-value) and solar control factor (g-value)
- Internal blinds: while these are recommended for glare control and privacy issues, and may help in some cases to reduce internal solar gains, occupants may choose not to use them or they may hinder air flow when windows are open.

- Characteristics of the district heating scheme: see guidance references in #5
- Mechanical ventilation: if heat recovery is provided, this should include a summer bypass . If mechanical ventilation is provided, this will usually provide background ventilation only, and will be insufficient for the purpose of overheating risk mitigation (by an order of magnitude). In some cases, the team may put forward an increased mechanical ventilation rate. This should be examined with caution to ensure the proposed ventilation rates can indeed be delivered, and that there are no adverse effects, especially mechanical noise which may deter occupants from using the system, particularly at night. This type of solution should only be relied upon if subject to a detailed overheating assessment, including the advice from an acoustic specialist.
- Mechanical cooling: as explained in the broader context for this guidance, it is imperative that overheating risk is reduced as much as possible via passive means before mechanical cooling solutions are considered. If such solutions are installed, they should be highly efficient to minimise energy use, and the location of heat rejection plant should be carefully considered to avoid creating noise and heat rejection issues for neighbouring areas.

If planning consent relies on a detailed overheating risk assessment which takes account of such detailed design measures, this should be conditioned and checked at completion.

Detailed overheating risk assessments

If an overheating risk assessment using more detailed tools and methodologies is carried out, such as dynamic modelling against CIBSE TM59, or PHPP (used in Passivhaus) , it is recommended that this is informed by an initial GHA tool assessment, in particular with regards to site characteristics. For example, if it has been established that there are likely barriers to occupants opening windows (#3), this should be reflected in the model set-up. Note this is not possible for all parameters as, although softwares typically take account of weather files, and of Urban Heat Island effects in London, they rarely include more local effects such as blue/ green infrastructure (#9) or surface characteristics (#10) which are considered in this tool.

CIBSE TM59 is currently the most established methodology and it is therefore covered in more detail here. When an assessment against CIBSE TM59 is carried out, the following information should be included in the report:

- Site location and orientation; weather files used should be reasonably local to the site location and be CIBSE 2020 DSY1 files
- Images of the model indicating the sample units selected and the basis for selection
- Images showing the internal layouts for the sample units
- Occupancy levels; profiles should follow the TM59 24/7 levels and not be bespoke
- Information on the construction type with layers of construction (used to determine U-values and g-values) for all external and internal building elements, plus any additional shading features (including any blinds, and demonstrating that the blinds do not clash with opening windows if blinds are used to contribute to a pass). If blinds are assumed these must be installed by the developer and not left for occupants.

- Thermal mass, with an explanation of where the thermal mass is incorporated in the construction, and confirmation that it is exposed (i.e. not covered in plasterboard)
- The ventilation strategy modelled, including details of window opening assumptions and how they relate to the site assessment (including noise levels), free areas calculated, infiltration rates assumed and any mechanical supply/extract flow rates;
- The thermal comfort category assumed based on CIBSE TM52 (2013); this should be Cat. II by default, but Cat. I for vulnerable residents (see section 4.4); Cat. III for existing buildings should not be used for the purposes of this methodology
- The results of the analysis:
  - Reports should be clearly reported based on criteria (a) and (b) in section 4.2
  - Corridors should be included where there is communal heating pipework
  - The report may include the results for several iterations explored, to demonstrate the route to compliance
  - If blinds were part of the strategy used to gain a pass, then results without blinds must also be included for information
  - The report should state clearly whether the project passes or fails the assessment and, where a pass is indicated, it should make clear on what design features this depends (e.g. the inclusion of glazing with g-value below x, reduced window sizes, etc). A unit is only shown to comply if all occupied spaces meet relevant overheating criteria.

User guide

It is good practice to produce a user guide that explains to occupants the key features of the scheme; this should be a short and visual document in simple language. It should cover measures they can take to prevent overheating in their home and include the following information as a minimum:

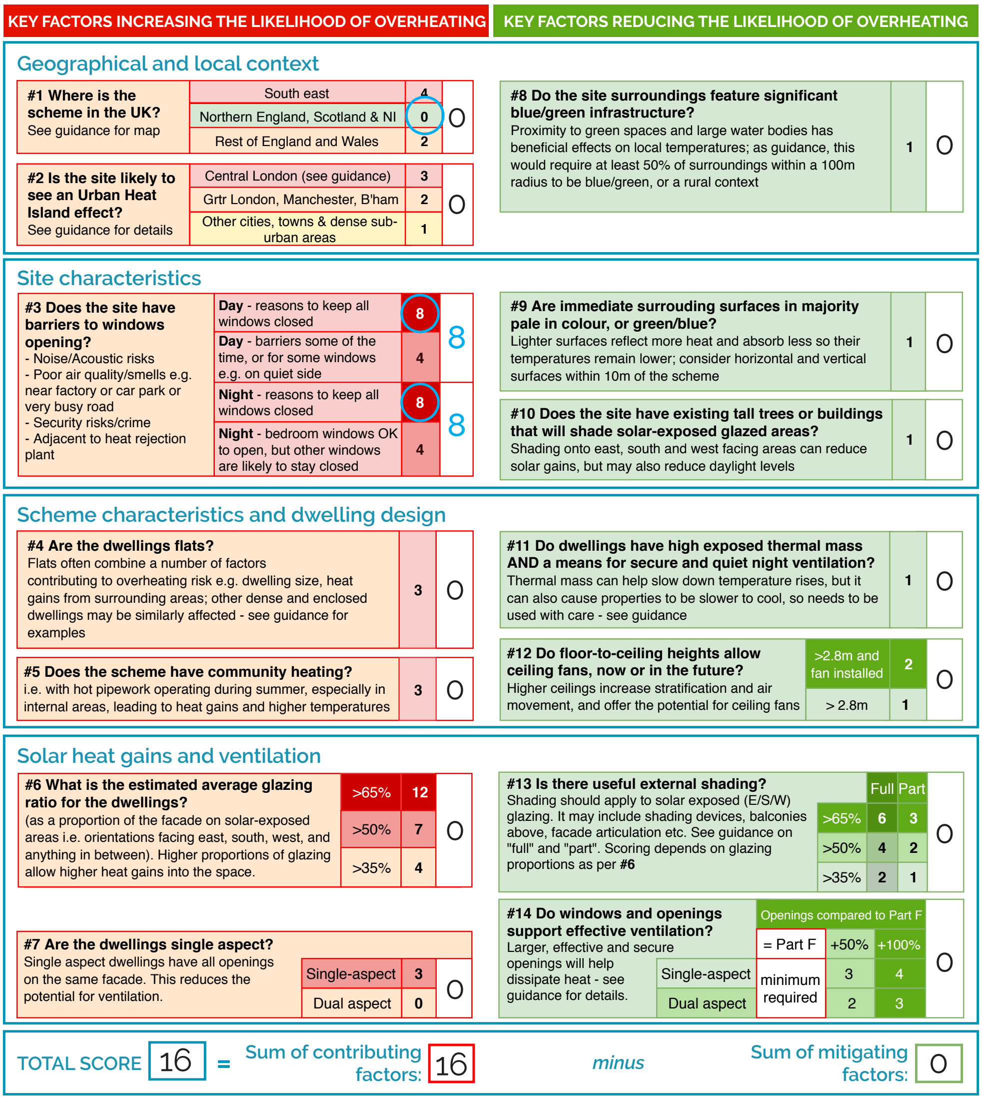
- Simple concepts and tips, such as the benefits of cross-ventilation (if present) and of ventilation at high levels (e.g. windows on upper floors in houses)
- Presence and operation of secure openings that can help ventilation at night or when occupants are not in the room e.g. side panels, window locks
- Presence and operation of movable shading devices
- The importance of changing filters and maintaining mechanical ventilation systems: While mechanical ventilation systems are typically not an overheating mitigation measure on their own as the ventilation rates will be low, poorly maintained systems or systems that are switched off, can contribute to even lower ventilation rates and higher temperatures.

5. WORKED EXAMPLES

The following provide examples of how illustrative schemes would score under the tool, including the impact of mitigation options.

EXAMPLE 1: NOISE OR OTHER FACTORS PREVENTING HEAT DISSIPATION

Example 1-1: Dwelling in rural northern areas, where windows are assumed to be closed most of the time because of restrictions such as noise levels, lack of secure openings, or midges without nets; there is otherwise no other significant risk factor:



KEY FACTORS INCREASING THE LIKELIHOOD OF OVERHEATING

KEY FACTORS REDUCING THE LIKELIHOOD OF OVERHEATING

Geographical and local context

#1 Where is the scheme in the UK?
See guidance for map

South east	4	0
Northern England, Scotland & NI	0	
Rest of England and Wales	2	

#2 Is the site likely to see an Urban Heat Island effect?
See guidance for details

Central London (see guidance)	3	0
Grtr London, Manchester, B'ham	2	
Other cities, towns & dense sub-urban areas	1	

#8 Do the site surroundings feature significant blue/green infrastructure?
Proximity to green spaces and large water bodies has beneficial effects on local temperatures; as guidance, this would require at least 50% of surroundings within a 100m radius to be blue/green, or a rural context — 1 — 0

Site characteristics

#3 Does the site have barriers to windows opening?
- Noise/Acoustic risks
- Poor air quality/smells e.g. near factory or car park or very busy road
- Security risks/crime
- Adjacent to heat rejection plant

Day - reasons to keep all windows closed	8	8
Day - barriers some of the time, or for some windows e.g. on quiet side	4	
Night - reasons to keep all windows closed	8	8
Night - bedroom windows OK to open, but other windows are likely to stay closed	4	

#9 Are immediate surrouding surfaces in majority pale in colour, or green/blue?
Lighter surfaces reflect more heat and absorb less so their temperatures remain lower; consider horizontal and vertical surfaces within 10m of the scheme — 1 — 0

#10 Does the site have existing tall trees or buildings that will shade solar-exposed glazed areas?
Shading onto east, south and west facing areas can reduce solar gains, but may also reduce daylight levels — 1 — 0

Scheme characteristics and dwelling design

#4 Are the dwellings flats?
Flats often combine a number of factors contributing to overheating risk e.g. dwelling size, heat gains from surrounding areas; other dense and enclosed dwellings may be similarly affected - see guidance for examples — 3 — 0

#5 Does the scheme have community heating?
i.e. with hot pipework operating during summer, especially in internal areas, leading to heat gains and higher temperatures — 3 — 0

#11 Do dwellings have high exposed thermal mass AND a means for secure and quiet night ventilation?
Thermal mass can help slow down temperature rises, but it can also cause properties to be slower to cool, so needs to be used with care - see guidance — 1 — 0

#12 Do floor-to-ceiling heights allow ceiling fans, now or in the future?
Higher ceilings increase stratification and air movement, and offer the potential for ceiling fans

>2.8m and fan installed	2	0
> 2.8m	1	

Solar heat gains and ventilation

#6 What is the estimated average glazing ratio for the dwellings?
(as a proportion of the facade on solar-exposed areas i.e. orientations facing east, south, west, and anything in between). Higher proportions of glazing allow higher heat gains into the space.

>65%	12	0
>50%	7	
>35%	4	

#7 Are the dwellings single aspect?
Single aspect dwellings have all openings on the same facade. This reduces the potential for ventilation.

Single-aspect	3	0
Dual aspect	0	

#13 Is there useful external shading?
Shading should apply to solar exposed (E/S/W) glazing. It may include shading devices, balconies above, facade articulation etc. See guidance on "full" and "part". Scoring depends on glazing proportions as per **#6**

	Full	Part	
>65%	6	3	0
>50%	4	2	
>35%	2	1	

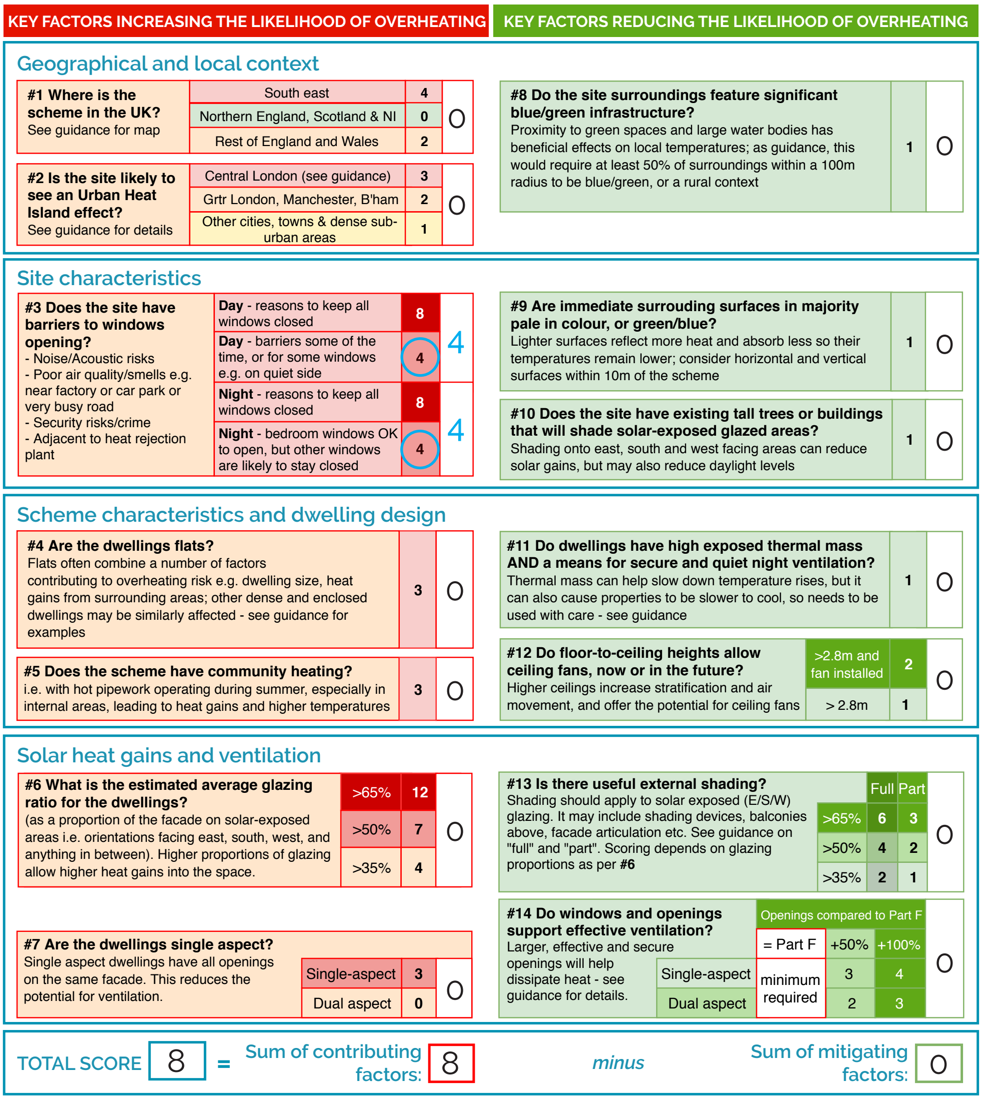
#14 Do windows and openings support effective ventilation?
Larger, effective and secure openings will help dissipate heat - see guidance for details.

	Openings compared to Part F			
	= Part F	+50%	+100%	
Single-aspect	minimum required	3	4	0
Dual aspect		2	3	

TOTAL SCORE 16 = Sum of contributing factors: 16 *minus* Sum of mitigating factors: 0

Total score of 16, high risk: The lack of options for heat dissipation, both day and night, represent a high risk of overheating for the dwelling as even without significant solar gains nor high external temperatures, there is a high risk that internal heat gains will accumulate and result in high temperatures.

Example 1-2: Same dwelling as in 1-1, but with modifications such as secure openings in some rooms, or a modified layout so that bedrooms (but not all rooms) are on a quieter side, allowing some level of day and night time ventilation:



KEY FACTORS INCREASING THE LIKELIHOOD OF OVERHEATING

KEY FACTORS REDUCING THE LIKELIHOOD OF OVERHEATING

Geographical and local context

#1 Where is the scheme in the UK? See guidance for map	South east	4	0
	Northern England, Scotland & NI	0	
	Rest of England and Wales	2	

#2 Is the site likely to see an Urban Heat Island effect? See guidance for details	Central London (see guidance)	3	0
	Grtr London, Manchester, B'ham	2	
	Other cities, towns & dense sub-urban areas	1	

#8 Do the site surroundings feature significant blue/green infrastructure? Proximity to green spaces and large water bodies has beneficial effects on local temperatures; as guidance, this would require at least 50% of surroundings within a 100m radius to be blue/green, or a rural context	1	0

Site characteristics

#3 Does the site have barriers to windows opening? - Noise/Acoustic risks - Poor air quality/smells e.g. near factory or car park or very busy road - Security risks/crime - Adjacent to heat rejection plant	**Day** - reasons to keep all windows closed	8	4
	Day - barriers some of the time, or for some windows e.g. on quiet side	4	
	Night - reasons to keep all windows closed	8	4
	Night - bedroom windows OK to open, but other windows are likely to stay closed	4	

#9 Are immediate surrouding surfaces in majority pale in colour, or green/blue? Lighter surfaces reflect more heat and absorb less so their temperatures remain lower; consider horizontal and vertical surfaces within 10m of the scheme	1	0
#10 Does the site have existing tall trees or buildings that will shade solar-exposed glazed areas? Shading onto east, south and west facing areas can reduce solar gains, but may also reduce daylight levels	1	0

Scheme characteristics and dwelling design

#4 Are the dwellings flats? Flats often combine a number of factors contributing to overheating risk e.g. dwelling size, heat gains from surrounding areas; other dense and enclosed dwellings may be similarly affected - see guidance for examples	3	0
#5 Does the scheme have community heating? i.e. with hot pipework operating during summer, especially in internal areas, leading to heat gains and higher temperatures	3	0

#11 Do dwellings have high exposed thermal mass AND a means for secure and quiet night ventilation? Thermal mass can help slow down temperature rises, but it can also cause properties to be slower to cool, so needs to be used with care - see guidance		1	0
#12 Do floor-to-ceiling heights allow ceiling fans, now or in the future? Higher ceilings increase stratification and air movement, and offer the potential for ceiling fans	>2.8m and fan installed	2	0
	> 2.8m	1	

Solar heat gains and ventilation

#6 What is the estimated average glazing ratio for the dwellings? (as a proportion of the facade on solar-exposed areas i.e. orientations facing east, south, west, and anything in between). Higher proportions of glazing allow higher heat gains into the space.	>65%	12	0
	>50%	7	
	>35%	4	

#7 Are the dwellings single aspect? Single aspect dwellings have all openings on the same facade. This reduces the potential for ventilation.	Single-aspect	3	0
	Dual aspect	0	

#13 Is there useful external shading? Shading should apply to solar exposed (E/S/W) glazing. It may include shading devices, balconies above, facade articulation etc. See guidance on "full" and "part". Scoring depends on glazing proportions as per **#6**		Full	Part	0
	>65%	6	3	
	>50%	4	2	
	>35%	2	1	

#14 Do windows and openings support effective ventilation? Larger, effective and secure openings will help dissipate heat - see guidance for details.		Openings compared to Part F			0
		= Part F	+50%	+100%	
	Single-aspect	minimum required	3	4	
	Dual aspect		2	3	

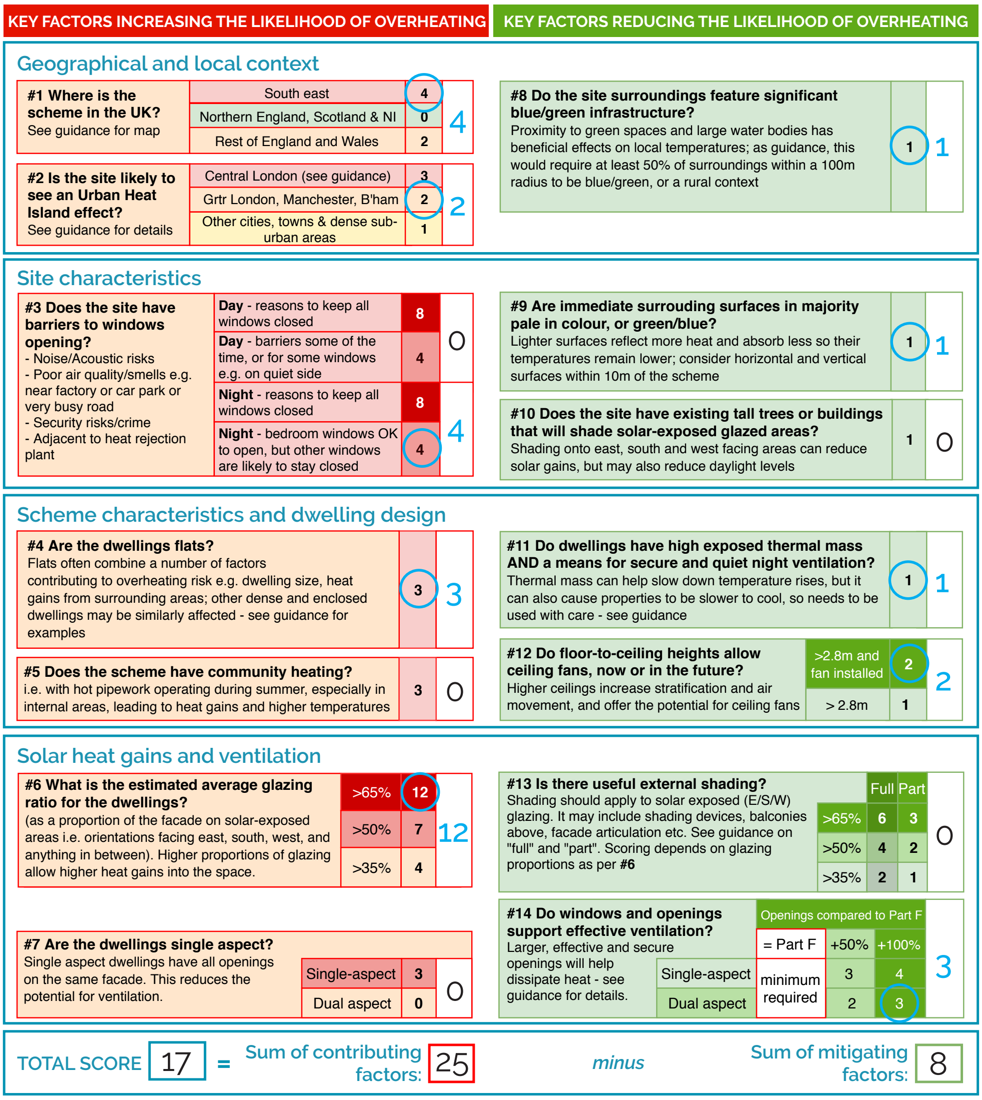
TOTAL SCORE	8	=	Sum of contributing factors: 8	*minus*	Sum of mitigating factors:	0

Total score of 8, medium risk: May be fine but warrants further investigation, including modelling, to ensure that ventilation is sufficient to dissipate the expected heat gains.

EXAMPLE 2: FLAT WITH HIGH PROPORTIONS OF GLAZING

Dual-aspect flat on a relatively green and quiet site with daytime window opening possible in all rooms, and night-time window opening possible in bedrooms (but not in all rooms); the design does not include external shading but includes generous openings and a range of other mitigation measures and no significant other risk factor than glazing proportions.

Example 2-1: Flat located in outer London:



KEY FACTORS INCREASING THE LIKELIHOOD OF OVERHEATING

KEY FACTORS REDUCING THE LIKELIHOOD OF OVERHEATING

Geographical and local context

#1 Where is the scheme in the UK?
See guidance for map

South east	[✓ 4]	4
Northern England, Scotland & NI	0	
Rest of England and Wales	2	

#2 Is the site likely to see an Urban Heat Island effect?
See guidance for details

Central London (see guidance)	3	
Grtr London, Manchester, B'ham	[✓ 2]	2
Other cities, towns & dense sub-urban areas	1	

#8 Do the site surroundings feature significant blue/green infrastructure?
Proximity to green spaces and large water bodies has beneficial effects on local temperatures; as guidance, this would require at least 50% of surroundings within a 100m radius to be blue/green, or a rural context

[✓ 1]	1

Site characteristics

#3 Does the site have barriers to windows opening?
- Noise/Acoustic risks
- Poor air quality/smells e.g. near factory or car park or very busy road
- Security risks/crime
- Adjacent to heat rejection plant

Day - reasons to keep all windows closed	8	0
Day - barriers some of the time, or for some windows e.g. on quiet side	4	
Night - reasons to keep all windows closed	8	4
Night - bedroom windows OK to open, but other windows are likely to stay closed	[✓ 4]	

#9 Are immediate surrouding surfaces in majority pale in colour, or green/blue?
Lighter surfaces reflect more heat and absorb less so their temperatures remain lower; consider horizontal and vertical surfaces within 10m of the scheme

[✓ 1]	1

#10 Does the site have existing tall trees or buildings that will shade solar-exposed glazed areas?
Shading onto east, south and west facing areas can reduce solar gains, but may also reduce daylight levels

1	0

Scheme characteristics and dwelling design

#4 Are the dwellings flats?
Flats often combine a number of factors contributing to overheating risk e.g. dwelling size, heat gains from surrounding areas; other dense and enclosed dwellings may be similarly affected - see guidance for examples

[✓ 3]	3

#5 Does the scheme have community heating?
i.e. with hot pipework operating during summer, especially in internal areas, leading to heat gains and higher temperatures

3	0

#11 Do dwellings have high exposed thermal mass AND a means for secure and quiet night ventilation?
Thermal mass can help slow down temperature rises, but it can also cause properties to be slower to cool, so needs to be used with care - see guidance

[✓ 1]	1

#12 Do floor-to-ceiling heights allow ceiling fans, now or in the future?
Higher ceilings increase stratification and air movement, and offer the potential for ceiling fans

>2.8m and fan installed	[✓ 2]	2
> 2.8m	1	

Solar heat gains and ventilation

#6 What is the estimated average glazing ratio for the dwellings?
(as a proportion of the facade on solar-exposed areas i.e. orientations facing east, south, west, and anything in between). Higher proportions of glazing allow higher heat gains into the space.

>65%	[✓ 12]	12
>50%	7	
>35%	4	

#7 Are the dwellings single aspect?
Single aspect dwellings have all openings on the same facade. This reduces the potential for ventilation.

Single-aspect	3	0
Dual aspect	0	

#13 Is there useful external shading?
Shading should apply to solar exposed (E/S/W) glazing. It may include shading devices, balconies above, facade articulation etc. See guidance on "full" and "part". Scoring depends on glazing proportions as per **#6**

	Full	Part	
>65%	6	3	0
>50%	4	2	
>35%	2	1	

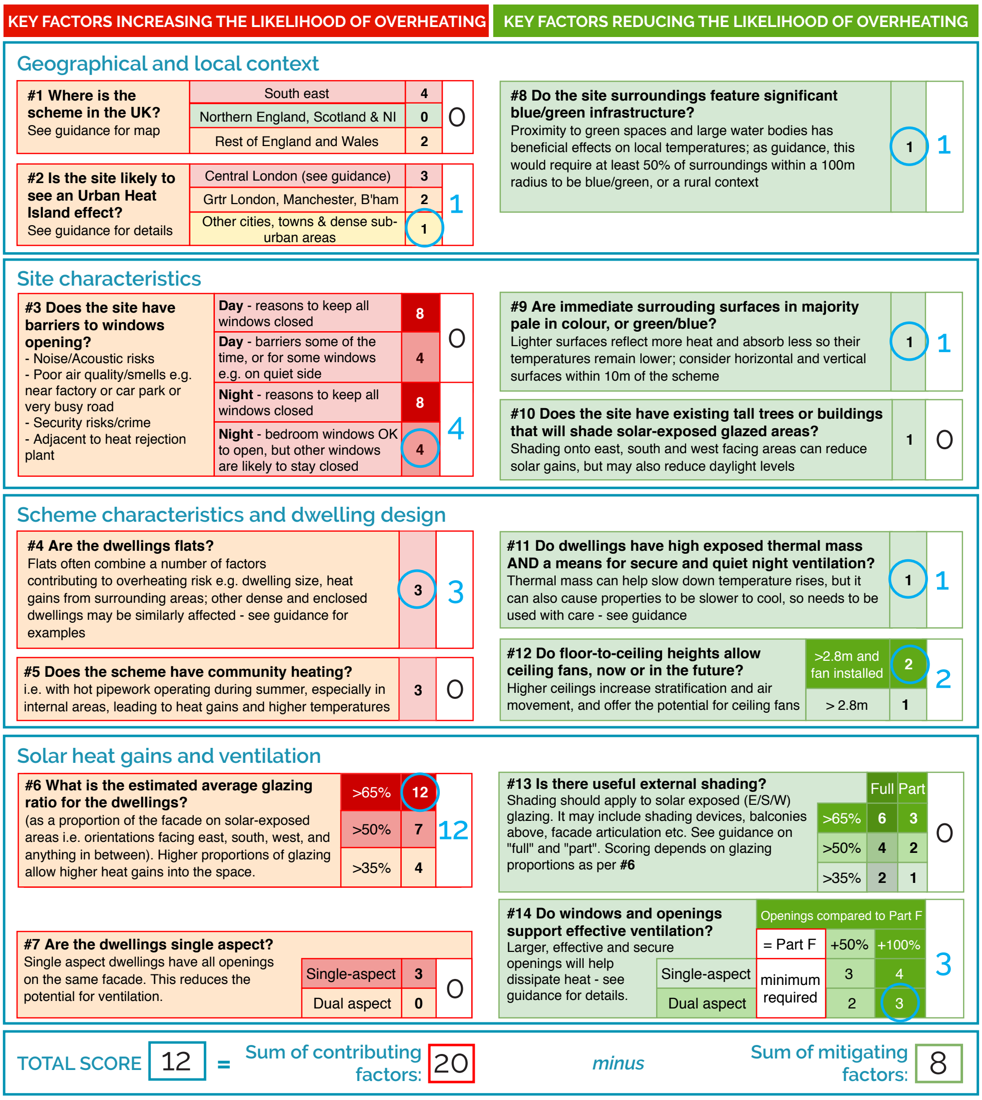
#14 Do windows and openings support effective ventilation?
Larger, effective and secure openings will help dissipate heat - see guidance for details.

	Openings compared to Part F			
	= Part F	+50%	+100%	
Single-aspect	minimum required	3	4	3
Dual aspect		2	[✓ 3]	

TOTAL SCORE 17 = Sum of contributing factors: 25 *minus* Sum of mitigating factors: 8

Total score of 17, high risk: The site location in London and its high proportions of unshaded glazing combine to represent significant risk factors

Example 2-2: Same flat and site characteristics, but in urban Scotland:



KEY FACTORS INCREASING THE LIKELIHOOD OF OVERHEATING	KEY FACTORS REDUCING THE LIKELIHOOD OF OVERHEATING

Geographical and local context

#1 Where is the scheme in the UK? See guidance for map			
	South east	4	0
	Northern England, Scotland & NI	0	
	Rest of England and Wales	2	

#2 Is the site likely to see an Urban Heat Island effect? See guidance for details			
	Central London (see guidance)	3	1
	Grtr London, Manchester, B'ham	2	
	Other cities, towns & dense sub-urban areas	[✓ 1]	

#8 Do the site surroundings feature significant blue/green infrastructure? Proximity to green spaces and large water bodies has beneficial effects on local temperatures; as guidance, this would require at least 50% of surroundings within a 100m radius to be blue/green, or a rural context	[✓ 1]	1

Site characteristics

#3 Does the site have barriers to windows opening? - Noise/Acoustic risks - Poor air quality/smells e.g. near factory or car park or very busy road - Security risks/crime - Adjacent to heat rejection plant			
	Day - reasons to keep all windows closed	8	0
	Day - barriers some of the time, or for some windows e.g. on quiet side	4	
	Night - reasons to keep all windows closed	8	4
	Night - bedroom windows OK to open, but other windows are likely to stay closed	[✓ 4]	

#9 Are immediate surrounding surfaces in majority pale in colour, or green/blue? Lighter surfaces reflect more heat and absorb less so their temperatures remain lower; consider horizontal and vertical surfaces within 10m of the scheme	[✓ 1]	1
#10 Does the site have existing tall trees or buildings that will shade solar-exposed glazed areas? Shading onto east, south and west facing areas can reduce solar gains, but may also reduce daylight levels	1	0

Scheme characteristics and dwelling design

#4 Are the dwellings flats? Flats often combine a number of factors contributing to overheating risk e.g. dwelling size, heat gains from surrounding areas; other dense and enclosed dwellings may be similarly affected - see guidance for examples	[✓ 3]	3
#5 Does the scheme have community heating? i.e. with hot pipework operating during summer, especially in internal areas, leading to heat gains and higher temperatures	3	0

#11 Do dwellings have high exposed thermal mass AND a means for secure and quiet night ventilation? Thermal mass can help slow down temperature rises, but it can also cause properties to be slower to cool, so needs to be used with care - see guidance	[✓ 1]	1

#12 Do floor-to-ceiling heights allow ceiling fans, now or in the future? Higher ceilings increase stratification and air movement, and offer the potential for ceiling fans			
	>2.8m and fan installed	[✓ 2]	2
	> 2.8m	1	

Solar heat gains and ventilation

#6 What is the estimated average glazing ratio for the dwellings? (as a proportion of the facade on solar-exposed areas i.e. orientations facing east, south, west, and anything in between). Higher proportions of glazing allow higher heat gains into the space.			
	>65%	[✓ 12]	12
	>50%	7	
	>35%	4	

#7 Are the dwellings single aspect? Single aspect dwellings have all openings on the same facade. This reduces the potential for ventilation.			
	Single-aspect	3	0
	Dual aspect	0	

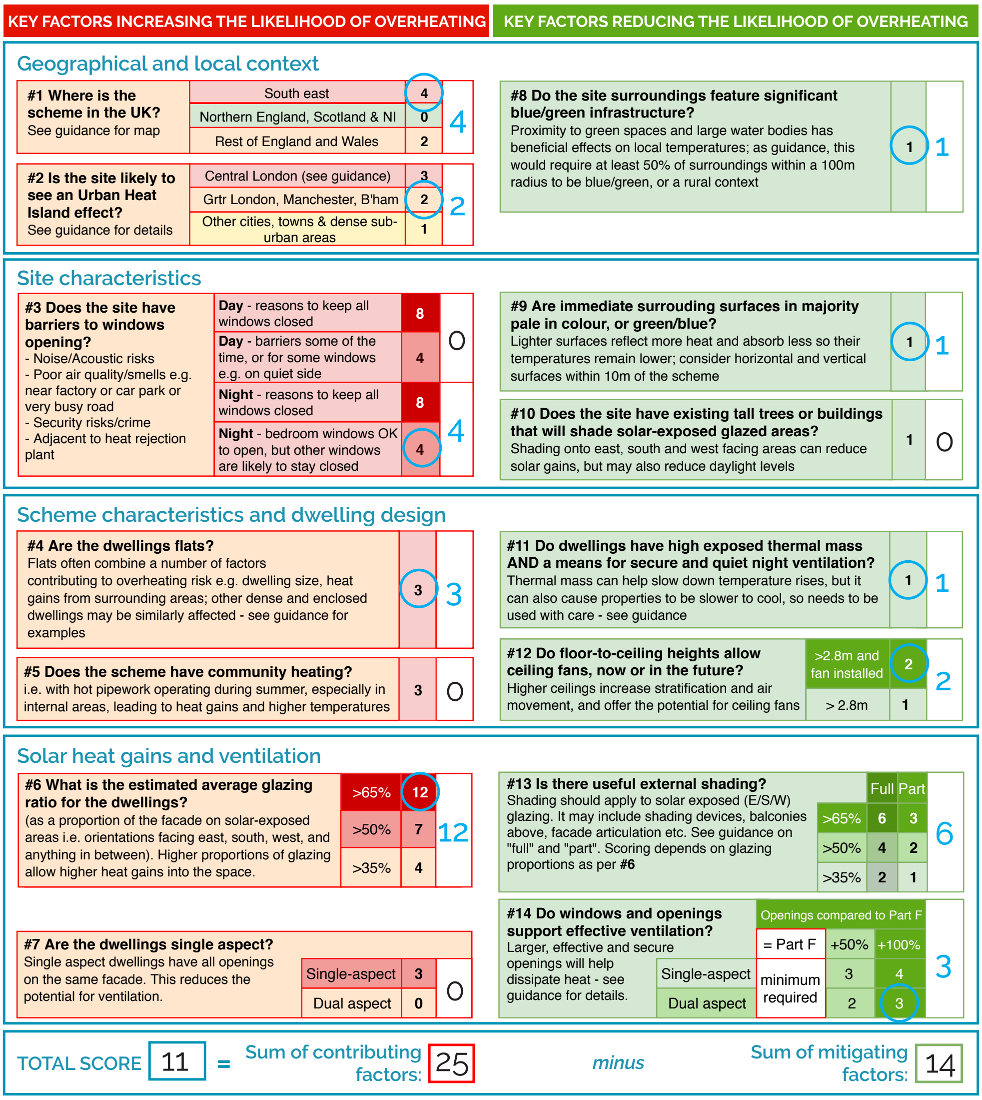
#13 Is there useful external shading? Shading should apply to solar exposed (E/S/W) glazing. It may include shading devices, balconies above, facade articulation etc. See guidance on "full" and "part". Scoring depends on glazing proportions as per **#6**				
		Full	Part	0
	>65%	6	3	
	>50%	4	2	
	>35%	2	1	

#14 Do windows and openings support effective ventilation? Larger, effective and secure openings will help dissipate heat - see guidance for details.		Openings compared to Part F			
		= Part F	+50%	+100%	3
	Single-aspect	minimum required	3	4	
	Dual aspect		2	[✓ 3]	

TOTAL SCORE	12	=	Sum of contributing factors:	20	*minus*	Sum of mitigating factors:	8

Total score of 12, medium risk: This may be fine but does need attention to detail and/or modelling, because of the high proportions of glazing and absence of external shading.

Example 2-3: Same outer London flat as in 2-1, but with <u>full</u> external shading on <u>all</u> glazed areas:



KEY FACTORS INCREASING THE LIKELIHOOD OF OVERHEATING	KEY FACTORS REDUCING THE LIKELIHOOD OF OVERHEATING

Geographical and local context

#1 Where is the scheme in the UK? See guidance for map	South east	[✓ 4]	4
	Northern England, Scotland & NI	0	
	Rest of England and Wales	2	

#2 Is the site likely to see an Urban Heat Island effect? See guidance for details	Central London (see guidance)	3	2
	Grtr London, Manchester, B'ham	[✓ 2]	
	Other cities, towns & dense sub-urban areas	1	

#8 Do the site surroundings feature significant blue/green infrastructure? Proximity to green spaces and large water bodies has beneficial effects on local temperatures; as guidance, this would require at least 50% of surroundings within a 100m radius to be blue/green, or a rural context	[✓ 1]	1

Site characteristics

#3 Does the site have barriers to windows opening? - Noise/Acoustic risks - Poor air quality/smells e.g. near factory or car park or very busy road - Security risks/crime - Adjacent to heat rejection plant	**Day** - reasons to keep all windows closed	8	0
	Day - barriers some of the time, or for some windows e.g. on quiet side	4	
	Night - reasons to keep all windows closed	8	4
	Night - bedroom windows OK to open, but other windows are likely to stay closed	[✓ 4]	

#9 Are immediate surrounding surfaces in majority pale in colour, or green/blue? Lighter surfaces reflect more heat and absorb less so their temperatures remain lower; consider horizontal and vertical surfaces within 10m of the scheme	[✓ 1]	1

#10 Does the site have existing tall trees or buildings that will shade solar-exposed glazed areas? Shading onto east, south and west facing areas can reduce solar gains, but may also reduce daylight levels	1	0

Scheme characteristics and dwelling design

#4 Are the dwellings flats? Flats often combine a number of factors contributing to overheating risk e.g. dwelling size, heat gains from surrounding areas; other dense and enclosed dwellings may be similarly affected - see guidance for examples	[✓ 3]	3

#5 Does the scheme have community heating? i.e. with hot pipework operating during summer, especially in internal areas, leading to heat gains and higher temperatures	3	0

#11 Do dwellings have high exposed thermal mass AND a means for secure and quiet night ventilation? Thermal mass can help slow down temperature rises, but it can also cause properties to be slower to cool, so needs to be used with care - see guidance	[✓ 1]	1

#12 Do floor-to-ceiling heights allow ceiling fans, now or in the future? Higher ceilings increase stratification and air movement, and offer the potential for ceiling fans	>2.8m and fan installed	[✓ 2]	2
	> 2.8m	1	

Solar heat gains and ventilation

#6 What is the estimated average glazing ratio for the dwellings? (as a proportion of the facade on solar-exposed areas i.e. orientations facing east, south, west, and anything in between). Higher proportions of glazing allow higher heat gains into the space.	>65%	[✓ 12]	12
	>50%	7	
	>35%	4	

#7 Are the dwellings single aspect? Single aspect dwellings have all openings on the same facade. This reduces the potential for ventilation.	Single-aspect	3	0
	Dual aspect	0	

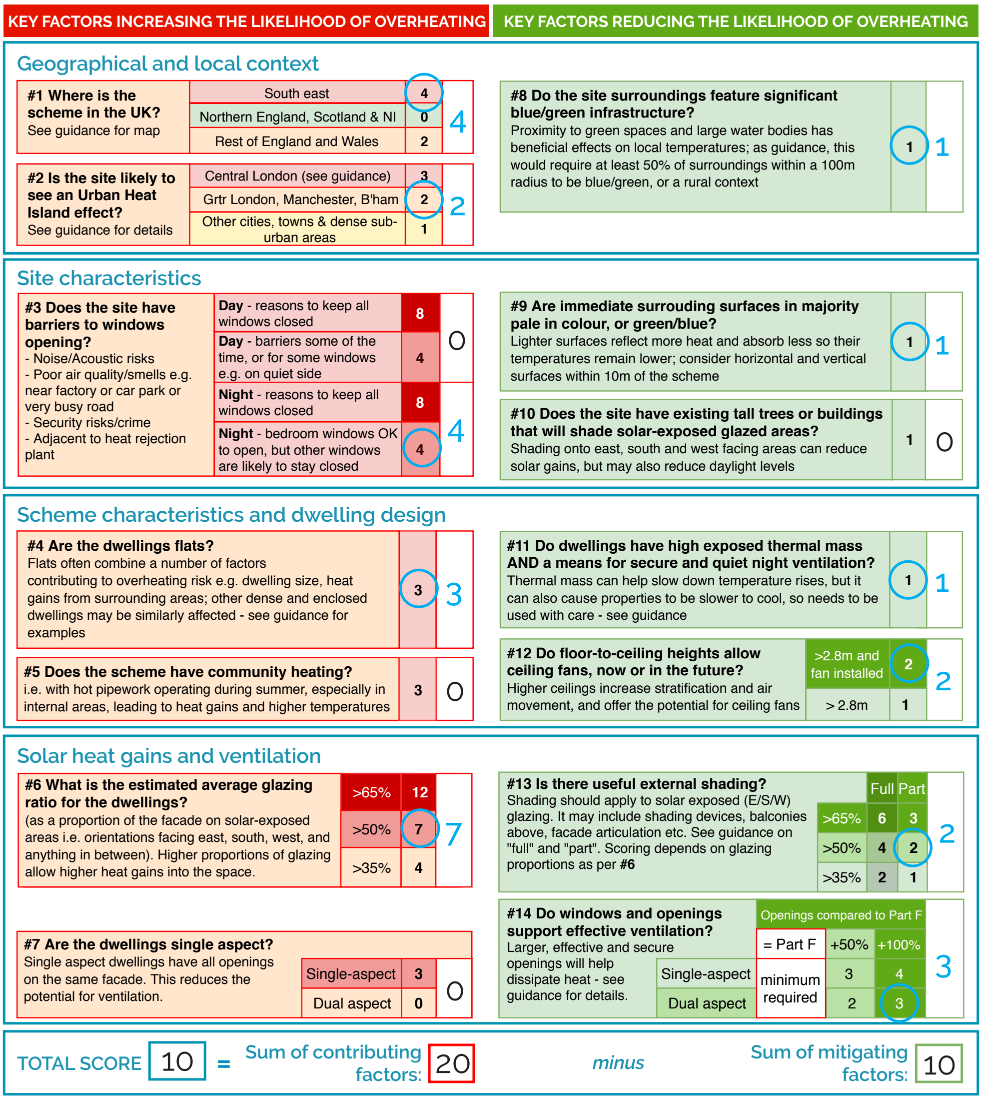
		Full	Part	
#13 Is there useful external shading? Shading should apply to solar exposed (E/S/W) glazing. It may include shading devices, balconies above, facade articulation etc. See guidance on "full" and "part". Scoring depends on glazing proportions as per **#6**	>65%	6	3	6
	>50%	4	2	
	>35%	2	1	

		Openings compared to Part F			
#14 Do windows and openings support effective ventilation? Larger, effective and secure openings will help dissipate heat - see guidance for details.		= Part F	+50%	+100%	3
	Single-aspect	minimum required	3	4	
	Dual aspect		2	[✓ 3]	

TOTAL SCORE	11	=	Sum of contributing factors:	25	*minus* Sum of mitigating factors:	14

Total score of 11, medium risk: This may be fine but does need attention to detail and/or modelling because of the London location and high proportions of glazing.

Example 2-4: Same outer London flat as in 2-1, but with partial external shading AND proportions of glazing reduced to 50-65%:



KEY FACTORS INCREASING THE LIKELIHOOD OF OVERHEATING | **KEY FACTORS REDUCING THE LIKELIHOOD OF OVERHEATING**

Geographical and local context

#1 Where is the scheme in the UK? See guidance for map	South east	[✓ 4]	4
	Northern England, Scotland & NI	0	
	Rest of England and Wales	2	

#2 Is the site likely to see an Urban Heat Island effect? See guidance for details	Central London (see guidance)	3	2
	Grtr London, Manchester, B'ham	[✓ 2]	
	Other cities, towns & dense sub-urban areas	1	

#8 Do the site surroundings feature significant blue/green infrastructure? Proximity to green spaces and large water bodies has beneficial effects on local temperatures; as guidance, this would require at least 50% of surroundings within a 100m radius to be blue/green, or a rural context	[✓ 1]	1

Site characteristics

#3 Does the site have barriers to windows opening? - Noise/Acoustic risks - Poor air quality/smells e.g. near factory or car park or very busy road - Security risks/crime - Adjacent to heat rejection plant	**Day** - reasons to keep all windows closed	8	0
	Day - barriers some of the time, or for some windows e.g. on quiet side	4	
	Night - reasons to keep all windows closed	8	4
	Night - bedroom windows OK to open, but other windows are likely to stay closed	[✓ 4]	

#9 Are immediate surrouding surfaces in majority pale in colour, or green/blue? Lighter surfaces reflect more heat and absorb less so their temperatures remain lower; consider horizontal and vertical surfaces within 10m of the scheme	[✓ 1]	1
#10 Does the site have existing tall trees or buildings that will shade solar-exposed glazed areas? Shading onto east, south and west facing areas can reduce solar gains, but may also reduce daylight levels	1	0

Scheme characteristics and dwelling design

#4 Are the dwellings flats? Flats often combine a number of factors contributing to overheating risk e.g. dwelling size, heat gains from surrounding areas; other dense and enclosed dwellings may be similarly affected - see guidance for examples	[✓ 3]	3
#5 Does the scheme have community heating? i.e. with hot pipework operating during summer, especially in internal areas, leading to heat gains and higher temperatures	3	0

#11 Do dwellings have high exposed thermal mass AND a means for secure and quiet night ventilation? Thermal mass can help slow down temperature rises, but it can also cause properties to be slower to cool, so needs to be used with care - see guidance	[✓ 1]	1

#12 Do floor-to-ceiling heights allow ceiling fans, now or in the future? Higher ceilings increase stratification and air movement, and offer the potential for ceiling fans	>2.8m and fan installed	[✓ 2]	2
	> 2.8m	1	

Solar heat gains and ventilation

#6 What is the estimated average glazing ratio for the dwellings? (as a proportion of the facade on solar-exposed areas i.e. orientations facing east, south, west, and anything in between). Higher proportions of glazing allow higher heat gains into the space.	>65%	12	7
	>50%	[✓ 7]	
	>35%	4	

#7 Are the dwellings single aspect? Single aspect dwellings have all openings on the same facade. This reduces the potential for ventilation.	Single-aspect	3	0
	Dual aspect	0	

#13 Is there useful external shading? Shading should apply to solar exposed (E/S/W) glazing. It may include shading devices, balconies above, facade articulation etc. See guidance on "full" and "part". Scoring depends on glazing proportions as per **#6**		Full	Part	
	>65%	6	3	2
	>50%	4	[✓ 2]	
	>35%	2	1	

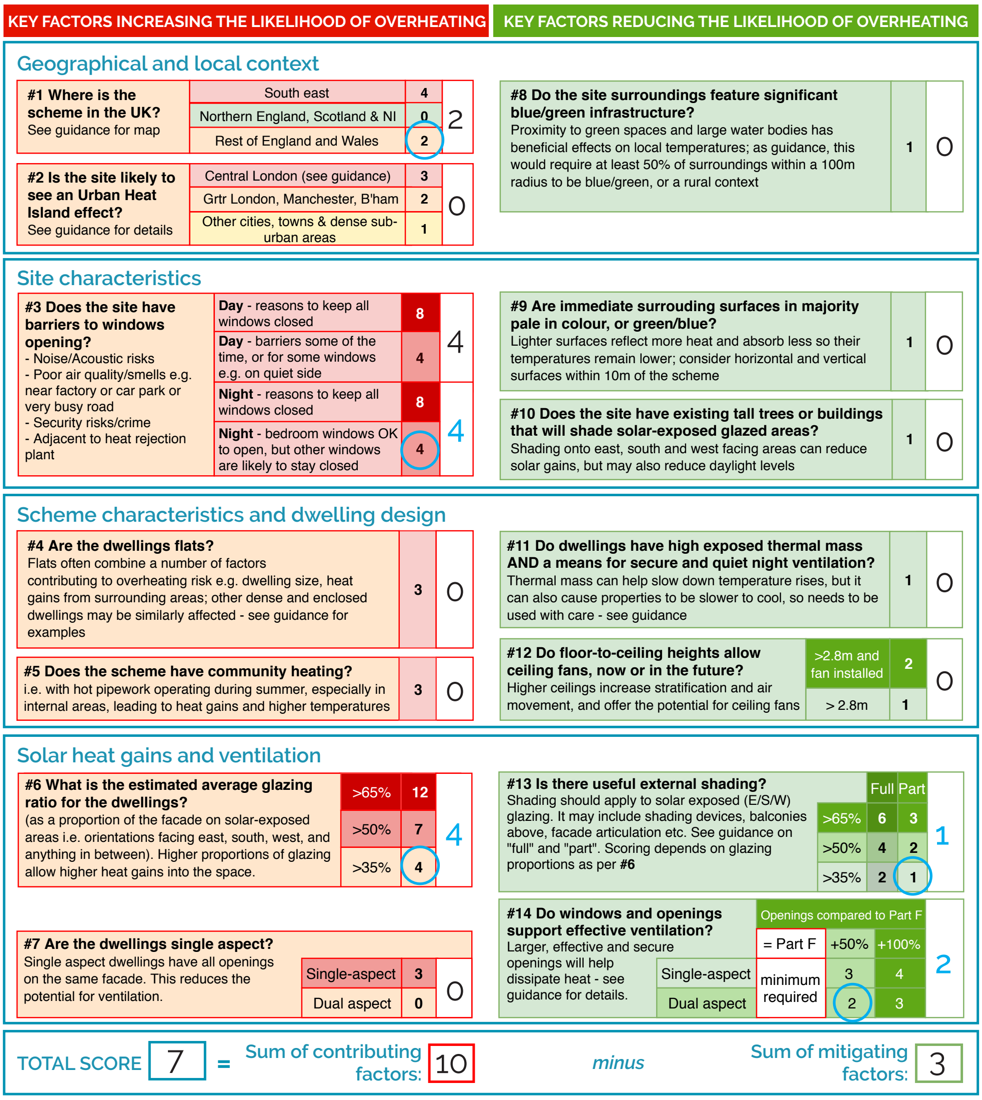
#14 Do windows and openings support effective ventilation? Larger, effective and secure openings will help dissipate heat - see guidance for details.	Openings compared to Part F	= Part F	+50%	+100%	
	Single-aspect	minimum required	3	4	3
	Dual aspect		2	[✓ 3]	

TOTAL SCORE 10 = Sum of contributing factors: 20 *minus* Sum of mitigating factors: 10

Total score of 10, medium risk: This may be fine but does need attention to detail and/or modelling because of the London location and still relatively high proportions of glazing, including unshaded areas.

EXAMPLE 3: HOUSE IN CENTRAL ENGLAND

House with reasonable proportions of glazing (35-50%) with some shading, on a relatively quiet site allowing secure daytime window opening and nighttime bedroom window opening; windows in other rooms are assumed closed at night; openings offer 50% beyond minimum Part F provision; the site may be sub-urban or on the edge of a town, but not in a dense sub-urban area.



KEY FACTORS INCREASING THE LIKELIHOOD OF OVERHEATING | **KEY FACTORS REDUCING THE LIKELIHOOD OF OVERHEATING**

Geographical and local context

#1 Where is the scheme in the UK? See guidance for map	South east	4	2
	Northern England, Scotland & NI	0	
	Rest of England and Wales	[✓ 2]	
#2 Is the site likely to see an Urban Heat Island effect? See guidance for details	Central London (see guidance)	3	0
	Grtr London, Manchester, B'ham	2	
	Other cities, towns & dense sub-urban areas	1	

#8 Do the site surroundings feature significant blue/green infrastructure? Proximity to green spaces and large water bodies has beneficial effects on local temperatures; as guidance, this would require at least 50% of surroundings within a 100m radius to be blue/green, or a rural context	1	0

Site characteristics

#3 Does the site have barriers to windows opening? - Noise/Acoustic risks - Poor air quality/smells e.g. near factory or car park or very busy road - Security risks/crime - Adjacent to heat rejection plant	**Day** - reasons to keep all windows closed	8	4
	Day - barriers some of the time, or for some windows e.g. on quiet side	4	
	Night - reasons to keep all windows closed	8	4
	Night - bedroom windows OK to open, but other windows are likely to stay closed	[✓ 4]	

#9 Are immediate surrounding surfaces in majority pale in colour, or green/blue? Lighter surfaces reflect more heat and absorb less so their temperatures remain lower; consider horizontal and vertical surfaces within 10m of the scheme	1	0
#10 Does the site have existing tall trees or buildings that will shade solar-exposed glazed areas? Shading onto east, south and west facing areas can reduce solar gains, but may also reduce daylight levels	1	0

Scheme characteristics and dwelling design

#4 Are the dwellings flats? Flats often combine a number of factors contributing to overheating risk e.g. dwelling size, heat gains from surrounding areas; other dense and enclosed dwellings may be similarly affected - see guidance for examples	3	0
#5 Does the scheme have community heating? i.e. with hot pipework operating during summer, especially in internal areas, leading to heat gains and higher temperatures	3	0

#11 Do dwellings have high exposed thermal mass AND a means for secure and quiet night ventilation? Thermal mass can help slow down temperature rises, but it can also cause properties to be slower to cool, so needs to be used with care - see guidance		1	0
#12 Do floor-to-ceiling heights allow ceiling fans, now or in the future? Higher ceilings increase stratification and air movement, and offer the potential for ceiling fans	>2.8m and fan installed	2	0
	> 2.8m	1	

Solar heat gains and ventilation

#6 What is the estimated average glazing ratio for the dwellings? (as a proportion of the facade on solar-exposed areas i.e. orientations facing east, south, west, and anything in between). Higher proportions of glazing allow higher heat gains into the space.	>65%	12	4
	>50%	7	
	>35%	[✓ 4]	
#7 Are the dwellings single aspect? Single aspect dwellings have all openings on the same facade. This reduces the potential for ventilation.	Single-aspect	3	0
	Dual aspect	0	

		Full	Part	
#13 Is there useful external shading? Shading should apply to solar exposed (E/S/W) glazing. It may include shading devices, balconies above, facade articulation etc. See guidance on "full" and "part". Scoring depends on glazing proportions as per **#6**	>65%	6	3	1
	>50%	4	2	
	>35%	2	[✓ 1]	

		Openings compared to Part F			
#14 Do windows and openings support effective ventilation? Larger, effective and secure openings will help dissipate heat - see guidance for details.		= Part F	+50%	+100%	2
	Single-aspect	minimum required	3	4	
	Dual aspect		[✓ 2]	3	

TOTAL SCORE 7 = Sum of contributing factors: 10 *minus* Sum of mitigating factors: 3

Total score of 7, low risk.

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