OVERHEATING MITIGATION STRATEGY

MILTON KEYNES EAST

MARCH 2021

HODKINSON

Overheating Mitigation Framework

St James Group Limited

Milton Keynes East

Final

Chiara Fratter
BArch, MSc (Hons), CEng MCIBSE
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ABOUT HODKINSON CONSULTANCY

Our team of technical specialists offer advanced levels of expertise and experience to our clients. We have a wide experience of the construction and development industry and tailor teams to suit each individual project.

We are able to advise at all stages of projects from planning applications to handover.

Our emphasis is to provide innovative and cost-effective solutions that respond to increasing demands for quality and construction efficiency.

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Executive Summary

This overheating mitigation strategy report sets out potential mitigation measures that would enable compliance with current and future overheating planning requirements and minimise the risk of overheating in homes. This document is prepared in support of the Outline Application of the Milton Keynes East development by St James in the Borough of Milton Keynes, Buckinghamshire.

The Hybrid Planning Application for the proposed development comprises the following elements:

> **Outline Component**: Outline permission for a large-scale mixed use urban extension comprising residential (up to 4,600 homes), employment including business, general industry and storage/distribution, three primary schools and a secondary school, community hub, a new linear park, open space, access roads and associated highways improvements and associated infrastructure works.

> **Detailed Component**: Strategic highway and transport infrastructure and associated utilities, lighting, earthworks and drainage works.

This document outlines some key measures that will require some attention during the next design stages of the development to ensure that the risk of overheating is controlled looking at the future energy standards (Part L 2021, Future Home Standards 2025 and UKGBC Net Zero Building 2030) as well as considering warmer climate scenarios with hotter summers.

Dynamic thermal modelling has been carried out using example dwelling types in order determine the key design parameters that should taken into account at future design stage to address overheating.

The following actions and design principles are proposed:

> Use the early-stage Good Home Alliance (GHA) overheating risk tool to identify any key risks factors and site constraints that can restrict the use of natural ventilation as primary means of ventilation before fixing the massing of the development;

> Carry out interim dynamic thermal modelling exercise adopting the appropriate standard (currently CIBSE TM59:2017) to guide the design process and tackle overheating; and

> Control glazing ratio below recommend values (<35% of façade area or <25% of internal floor area), maximise window openability and allow for fully openable windows (provide at least 3 times more free areas beyond minimum Part F purge ventilation requirements (especially for bedrooms), avoid full-height windows where they are not necessary and make effective use of external shadings based on the orientation.

> Considering potential noise and air quality issues, quantify their magnitude and use a holistic approach to ensure that the overheating strategy takes into account these aspects when appropriate.

Contents

1. INTRODUCTION

Site and Context

1.1 This overheating mitigation strategy report has been completed by Hodkinson Consultancy, a specialist energy and environmental consultancy for planning and development, in support of the Outline Application at Milton Keynes East by St. James Group Limited in the Borough of Milton Keynes.

1.2 The proposed development site at Milton Keynes East is located to the north east of Milton Keynes town centre, as shown in Figure 1 below.

Figure 1: Site Location (Source: Map data © 2021 Google)

Proposed Development

1.3 The Proposed Development is described as follows:

"Hybrid planning application encompassing: (i) outline element (with all matters reserved) for a large-scale mixed-use urban extension (creating a new community) comprising: residential development;

employment including business, general industry and storage/distribution uses; a secondary school and primary schools; a community hub containing a range of commercial and community uses; a new linear park along the River Ouzel corridor; open space and linked amenities; new redways, access roads and associated highways improvements; associated infrastructure works; and (ii) detailed element for strategic highway and multi-modal transport infrastructure, including: new road and redway extensions; a new bridge over the M1 motorway; a new bridge over the River Ouzel; works to the Tongwell Street corridor between Tongwell roundabout and Pineham roundabout including new bridge over the River Ouzel; alignment alterations to A509 and Newport Road; and associated utilities, lighting, earthworks and drainage works."

1.4 The submitted parameter plans and Design and Access Statement show the proposed site layout.

Overheating and Thermal Comfort

1.5 This document acknowledges the importance that overheating in homes has become a major concern and will become even more relevant in the immediate future, given the current climate emergency.

1.6 Due to the size and long delivery timescale of the development it would be inappropriate to set a precise overheating strategy for all dwellings to follow. A standards based approach is therefore adopted. This document aims to provide designers of future phases the ability to adopt different mitigation strategies at the early stage of the design to ensure the standards are achieved.

1.7 The proposed approach looks at the overheating mitigation measures using dynamic thermal modelling to outline some key design parameters to help the design team during detailed stages in considering effective passive design features to future proof homes and reduce risk of overheating.

2. OVERHEATING POLICY AND BEST PRACTICE GUIDANCE

Current Planning Policies

2.1 The development will compliance with the following current national and local planning policies.

National Policy: National Planning Policy Framework – NPPF (2019)

2.2 The revised National Planning Policy Framework (NPPF) was published on the 19th February 2019 and sets out the Government's planning policies for England.

2.3 The NPPF provides a framework for achieving sustainable development, which has been summarised as "*meeting the needs of the present without compromising the ability of future generations to meet their own needs*" (Resolution 42/187 of the United National General Assembly). At the heart of the framework is a **presumption in favour of sustainable development**.

2.4 The NPPF leaves the opportunity to local authorities to identify the appropriate to define policies on how to mitigate the risk of overheating in their local context.

Local policy: Plan:MK Local Plan 2016-2030 (2019)

2.5 The Milton Keynes Plan 2016-2030 adopted in March 2019 sets requirements for mitigating overheating risk. Policy SC1 *Sustainable Construction* under *Energy and Climate* section states that:

'Development proposals for 11 or more dwellings and non-residential development with a floor space of 1000 sq.m or more will be required to submit an Energy and Climate Statement that demonstrates how the proposal will achieve the applicable requirements below:

- *[..] Calculate Indoor Air Quality and **Overheating Risk performance** for proposed new dwellings.*
- *Implement a recognised quality regime that ensures the 'as built' performance (energy use, carbon emissions, indoor air quality, and overheating risk) matches the calculated design performance of dwellings in 4) above.*
- *Put in place a recognised monitoring regime to allow the assessment of energy use, indoor air quality, and overheating risk for 10% of the proposed dwellings for the first five years of their occupancy, and ensure that the information recovered is provided to the applicable occupiers and the planning authority.'*

Best Practice and future requirements

CIBSE TM59: Design Methodology for the Assessment of Overheating Risk in Homes

2.6 The current criteria for the assessment of overheating risk have been specified by the Chartered Institute of Building Services Engineers (CIBSE) in the CIBSE TM59: *Design methodology for the assessment of overheating risk in homes* (2017). CIBSE TM59 provides a standardised approach to predicting overheating risk for both naturally and mechanically ventilated residential buildings.

2.7 The following criteria must be met in order to demonstrate compliance:

> **For living rooms, kitchens and bedrooms:** The indoor operative temperature should not exceed the threshold comfort temperature by 1 ºC or more for more than 3 % of occupied hours.

> **For bedrooms only:** To guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10 pm to 7 am should not exceed 26 °C for more than 1% of annual hours.

2.8 Should CIBSE TM59 be updated or superseded in the future, the prevailing standard most applicable to the development should be followed.

Modelling Weather Files

2.9 CIBSE TM59 also recommends carrying out overheating modelling, using Design Summer Year (DSY) weather files from the CIBSE TM49 (*Design Summer Years for London*) and CIBSE's *Probabilistic Climate Profiles* (ProCliPs) for the most appropriate available location.

2.10 Currently the CIBSE TM59 requires that the building meets the TM59 criteria under DSY1 *moderately warm summer* for the year 2020, high emission, 50% percentile scenario. However other weather files including more extreme summer conditions DSY2 and DSY3 and future scenarios (e.i. 2050s and 2080s) can also be used to further test the design if there are any concerns.

2.11 Due to the evidence that the climate is warming, use of the mandatory weather file for the year 2020 may soon become obsolete. For the purpose of this study the dynamic modelling has been carried out using the future weather file for the year 2050s under DSY1 *moderately warm summer* conditions which is considered a more appropriate future timeframe to provide a sustainable and future proof design. Updated weather files may become available in the future as the changing climate evolves.

2.12 Importance should also be given to the weather file location used for the assessment. CIBSE TM49 currently provides DSYs weather files for 13 locations. Milton Keynes is not covered in this set of data. The London Gatwick weather file location has been selected as representative for rural and peri-urban areas around the edge of London which will most closely reflect the Milton Keynes East development.

UKGBC – The New Homes Policy Playbook (2021)

2.13 The UKGBC has recently published a document to help local authorities in driving sustainability in new homes within their policies (*The New Homes Policy Playbook*) as part of its support to Advancing Net Zero Programme.

2.14 The document contains a section on how to mitigate the overheating risk in homes which summarises the current national policies (NPPF), best-practice standard (CIBSE TM59, Passivhaus Planning Package (PHPP), Home quality Mark etc.), and future direction of travelling with regards to the Government Future Home Standard 2025. It also refers to exemplary local overheating policies such as the GLA New London Plan (2021), Cornwall County Council Local Plan (2016) as well as the Milton Keynes Local Plan (2019).

Good Home Alliance (GHA) Overheating Risk Tool

2.15 The GLA Energy Assessment Guidance (April 2020) introduces the GHA Overheating Risk Tool which aims to encourage sufficient consideration to estimate the risk of overheating in new homes since the outset of the design. This tool uses a holistic consideration of overheating which looks at the link between site constraints and design features. For instance, a very noisy site can limit reliance on window openings and therefore on the use of natural ventilation to control overheating.

2.16 The tool is based on the Cooling Hierarchy approach and seeks to prioritize passive features and reduce the need for active cooling in line with the more challenging policy on overheating. The use of the GHA overheating tool is flexible and it can be applied at the overall scheme level as well as to specific building or dwelling types based on level of detail available.

2.17 The result of the GHA checklist provides a score which categorises the level of overheating risk (low, medium or high). In case of low-risk levels the team should commit to maintain the proposed design features throughout design development to ensure that risk of overheating is mitigated. For Medium and High-risk levels, the tool may help the team to identify opportunities to reduce risk factors and improve mitigation factors that can be investigated through more detailed tools such as dynamic thermal modelling.

2.18 A copy of the GHA overheating risk checklist is provided in Appendix A.

Future Homes Standard: Approved Document [x] - Overheating

2.19 The recently released consultation of the changes to Part L and Part F of the Building Regulations (issued on the 27/01/2021) introduces a separate Approved Document which deals with overheating. The document provides two methods to assess the risk of overheating in homes, the simplified method and the use of dynamic thermal analysis method which is based on the CIBSE TM59 methodology. The latter is currently used for major developments (with more than 150 units) located in London, while it is rarely required outside London except for some progressive councils such as Oxford, Cambridge, Brighton and Milton Keynes which have a detailed overheating policy in place.

2.20 The use of dynamic modelling allows the design to be more flexible compared with the simplified method that imposes specific design features to include maximum glazing areas, minimum openable area, use of external shutters etc. The dynamic thermal modelling carried out following CIBSE TM59 methodology also provides a robust evidence that the design is capable to maintained acceptable indoor temperatures during the summertime.

3. OVERHEATING MITIGATION STRATEGY

3.1 This section outlines the modelling approach as well as potential design principles to ensure that the risk of overheating is mitigated, accounting for future 2050s predicted climate scenario. This also set out key design elements that could be incorporated into detailed design stage for the proposed Milton Keynes East development to reduce the risk of overheating.

Modelling approach

3.2 In order to undertake dynamic thermal modelling a defined design of the dwellings is required, however as this piece of information hasn’t been developed at this stage, two dwelling types (one house and one flat) from another project have been used to define the baseline. The internal layouts of the tested homes are presented in Appendix B.

3.3 Two dwelling types have been modelled in the worst-case location from an overheating point of view within the proposed context as part of the Parameter Plan that is submitted as part of the application. A south-west solar exposed orientation has been chosen for the house and a western top floor for the apartment assuming the higher parameter height.

3.4 The building fabric parameters used in the modelling are in line with the predicted minimum building fabric specifications contained within the Energy Statement (Milton Keynes East, Energy Statement, Hodkinson Consultancy, February 2021) to meet future regulations and standards (e.i. Future Home Standards 2025, UKGBC Net Zero Building 2030, etc.). Those specifications are also summarised in Appendix C.

3.5 Dynamic thermal modelling has been carried out using a specialist software (Design Builder Software v.6). Figure 2 shows a view of the model used for the assessment.

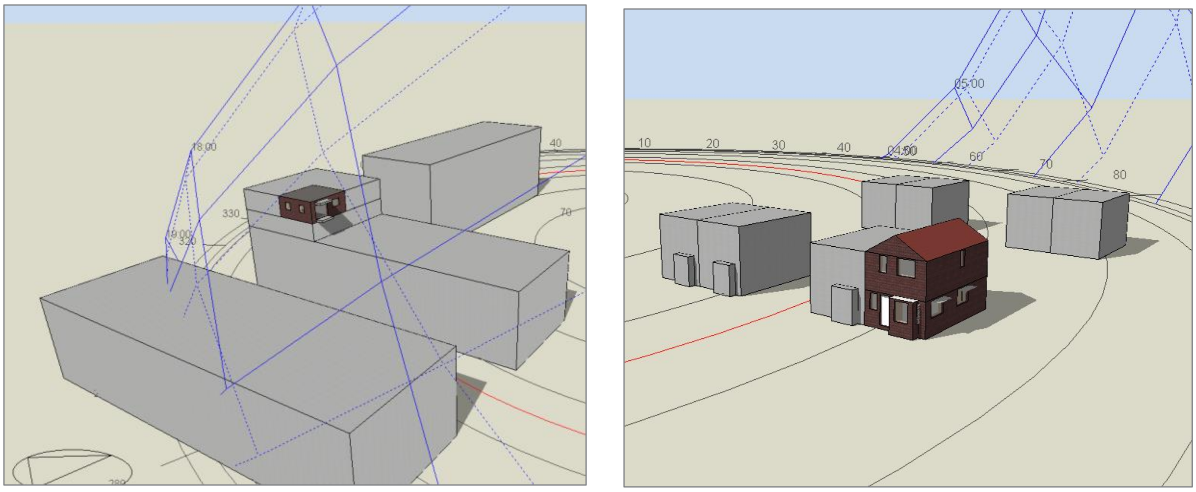


Figure 2. View of the model used for the assessment. House type on the right and apartment type on the left. (Design builder simulation model, sun path shown for 21st June 12:00 noon BST)

3.6 The performance of the units has been assessed under the CIBSE TM59 guidance and the adaptive thermal comfort model for a primarily natural ventilated scenario under DSY 1 high emissions, 50% percentile scenario for the 2050s year. External constraints such as noise and air quality issues have not been accounted for this stage of the assessment.

Modelling Results and Design principles

3.7 The results of the TM59 overheating assessment of the two tested units using the future-proofed fabric specifications and future climate weather file DSY1 for the 2050 year indicate that the following design features are paramount in order to mitigate the risk of overheating:

> Controlling glazing ratio, that is the amount of glazed area per total façade area, avoiding the use of full-height windows if they are not provided with external shadings;

> Allow for the highest proportion of fully openable panes (ideally 100% of the glazed area should be openable) going beyond minimum Part F purge ventilation requirements to accelerate the dissipation of internal heat;

> Ensure that window can safely open at their maximum allowance. The modelling indicates that side hung 90-degree openable windows are the more effective solution;

> Use of external shadings in the forms of overhangs or fixed elements (for the windows that cannot open) such as louvres should be employed on south, south-east, south-west and west elevations which are more exposed to the higher amount of solar radiation during the summer.

3.8 Appendix D summarise in detail some key design parameters to include glazing ratio, percentage/areas of openable panes and external shadings characteristics that have been edited to ensure that the baseline design is robust enough under future climate change weather scenario.

Figures 1 and 2 show this process through the facade evolution developed using dynamic thermal modelling tool to enable the assessed dwellings to meet compliance with TM59 overheating criteria under moderately warm summer (DSY1) for the 2050 year.

3.9 Detailed results of all rooms tested against the TM59 overheating criteria are presented in Appendix E.

Table 1. Flat type design evolution to adapt to climate change scenario 2050

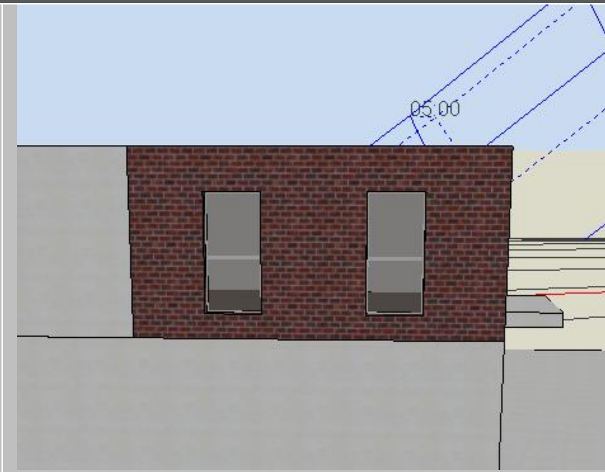
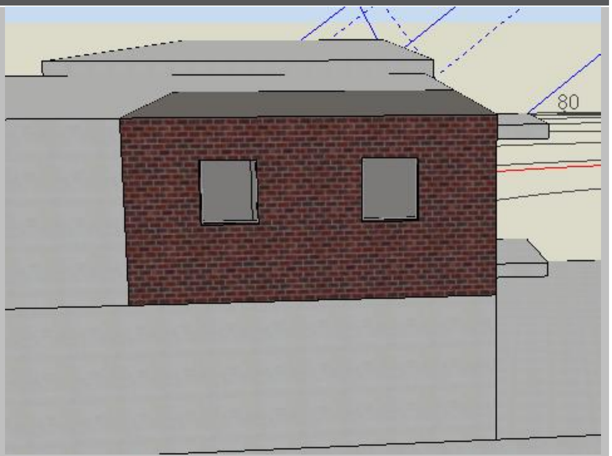
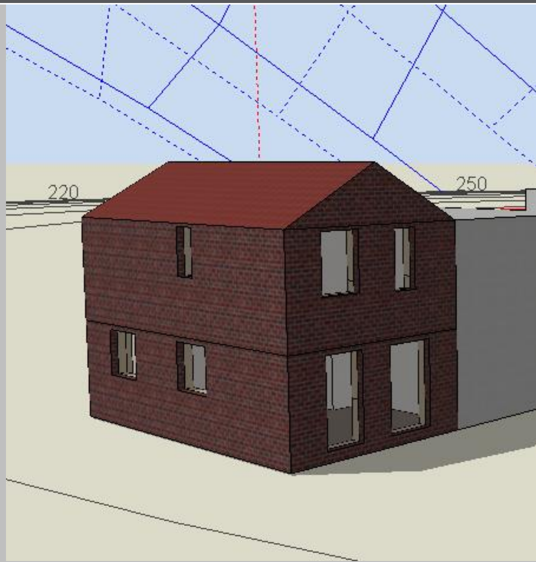
BASELINE	
	
South elevation Kitchen/living room two openable windows and a balcony door and bedroom with full-height window with upper pane fully openable and bottom pane fixed.	**West elevation** Kitchen/Living Room two full height windows with upper pane fully openable, bottom pane fixed.
FUTURE-PROOFED DESIGN	
	
South Elevation Kitchen/living room two openable windows and a balcony door and bedroom with two openable panes. Additional overhang to protect the large glazed to the south.	**West elevation** Kitchen/living room two fully openable windows.

Table 2. House type design evolution to adapt to climate change scenario 2050

BASELINE	
	
South-west and south elevation Fully openable windows and full-height window with upper pane openable (bottom pane fixed) on the ground floor kicthen.	**South and North-East elevation** Fully openable windows and full-height window with upper pane openable (bottom pane fixed) on north-east elevations.
FUTURE-PROOFED DESIGN	
	
South-west elevation. Fully openable windows (side hung 90-degree) with fixed external louvres (fixed panes) and overhangs for south windows on the ground (kitchen/Living room).	**South and north-east elevations.** Fully openable windows with overhangs (at least 0.6m) on wider windows on the south façade. Fully openable windows (side hung 90-degree) and glazed doors.

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Additional considerations

3.10 The results of this overheating modelling exercise also suggest that a high-insulated fabric envelope contributes to attenuate the external heat for longer period. This is demonstrated by the fact that certain rooms oriented north and east, which are less exposed to intense solar radiation, are able to maintain acceptable indoor thermal conditions during the summertime in the baseline openings design. Table F1 (Appendix F) indicates the window free areas for both baseline and future proofed design scenarios compared with the minimum ventilation requirements from current B.R. Part F.

3.11 It is evident that to mitigate the risk of overheating in homes the design team have to carefully balance the proportion of fixed and glazed areas based on the facade orientation, room function and presence of external shading devices. For instance, where full height windows and large glazed areas are required, these should be protected from the summer afternoon solar radiation and the proportion of fixed lights should be minimised to enhance internal ventilation. This is a critical design feature, especially for bedrooms that can rarely benefit from external shadings and they tend to build up heat during the daytime when the spaces are less frequently used. Unshaded full height windows increase the risk of overheating because the fixed panes at the bottom creates additional heat that cannot be fully dissipated during the evening when widows are utilised if the window free area is not well calibrated. In the proposed improved design scenario windows in bedrooms are sized to provide up to 3 times more airflow than the minimum Part F (refer to Table F1 in Appendix F).

3.12 It should also be noted that the modelling exercise presented in this document considers a limited range of measures. In fact, following the current best-practice ‘cooling hierarchy’ approach, there are additional design options that can be used to mitigate the risk of overheating. The most relevant are summarises in Table 3 below.

Table 3. Additional design options following the cooling hierarchy approach.

Cooling hierarchy	Design element		Discussion
Reduce the heat entering the building	External shadings	External shutters	*Select the appropriate external shade device considering the size of the window and its orientation.* *West and East facades are affected by diagonal solar rays therefore vertical shadings are more effective. Horizontal shadings are effective for south facades.*
		External blinds (automatically controlled based on indoor temperatures or solar radiation)	
		Awnings	
	Window size		*When sizing the windows, it should be considered their solar exposure (south more the required airflow based on the requirements of the room function*
	External reveals		*Deep external reveals will help to reduce solar radiation. This element, when well incorporated into the façade, it characterises the building.*

Table 3. Additional design options following the cooling hierarchy approach.

Cooling hierarchy	Design element		Discussion
Managing internal heat	Ceiling height		*Higher internal floor-to-ceiling heights (>2.8m) will help to increase stratification of air movement.*
	Exposed thermal mass		*Exposed thermal mass material used in some elements such as internal walls, floor, or ceilings can help slow down temperature rises but need to be well ventilated during the night-time.*
Provide Natural Ventilation	Fully openable windows		*Window sill height should be design to ensure window can safely open (B.R Part K Guarding heights)*
Provide Natural Ventilation and Noise Mitigation	Passive measures	Plenum windows	*Plenum windows allow to utilise openable windows, while reducing external noise. They can provide a reduction up to 11dB (AVO Guide v1.1 2020).*
		Acoustically treated ventilated louvres	Traditional acoustic louvres coupled with a fan can enhanced airflow into the spaces while mitigating external noise. *They can provide a reduction up to 11dB (AVO Guide v1.1 2020).*
Provide Mechanical Ventilation	Tempered fresh air MVHR units (peak looping)		*These MVHR units (Zehnder) can provide some amount of fresh air at lower temperature (free cooling) during the summer months to assist natural ventilation to mitigate the risk of overheating.*
Provide Active cooling	Active cooling		*Active cooling it should be used only as last resort when all passive measures from the 'cooling hierarchy' have been explored.*

4. CONCLUSION

4.1 This overheating mitigation strategy report sets out potential mitigation measures that would enable compliance with current and future overheating planning requirements and minimise the risk of overheating in homes. This document is prepared in support of the Outline Application of the Milton Keynes East development by St James in the Borough of Milton Keynes, Buckinghamshire.

4.2 The Hybrid Planning Application for the proposed development comprises the following elements:

4.3 **Outline Component**: Outline permission for a large-scale mixed use urban extension comprising residential (up to 4,600 homes), employment including business, general industry and storage/distribution, a three primary schools and a secondary school, community hub, a new linear park, open space, access roads and associated highways improvements and associated infrastructure works.

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4.7 The following actions and design principles are proposed:

> Use the early-stage Good Home Alliance (GHA) overheating risk tool to identify any key risks factors and site constraints that can restrict the use of natural ventilation as primary means of ventilation before fixing the massing of the development;

> Carry out interim dynamic thermal modelling exercise adopting the appropriate standard (currently CIBSE TM59:2017) to guide the design process and tackle overheating; and

> Control glazing ratio below recommend values (<35% of façade area or <25% of internal floor area), maximise window openability and allow for fully openable windows (provide at least 3 times more free areas beyond minimum Part F purge ventilation requirements (especially for bedrooms), avoid full-height windows where they are not necessary and make effective use of external shadings based on the orientation.

> Considering potential noise and air quality issues, quantify their magnitude and use a holistic approach to ensure that the overheating strategy takes into account these aspects when appropriate.

APPENDICES

Appendix A
GHA Overheating Risk Tool scoresheet

Appendix B
Dwellings Internal Layouts

Appendix C
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Appendix D
Modelling Design Parameters

Appendix E
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Appendix F
Modelling Windows Ventilation Provision

Appendix A
GHA Overheating Risk Tool scoresheet

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	

		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	
	>50%	4	2	
	>35%	2	1	

		Openings compared to Part F purge rates			
#14 Do windows & openings support effective ventilation? Larger, effective and secure openings will help dissipate heat - see guidance		= 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)

Appendix B

Dwellings Internal Layouts

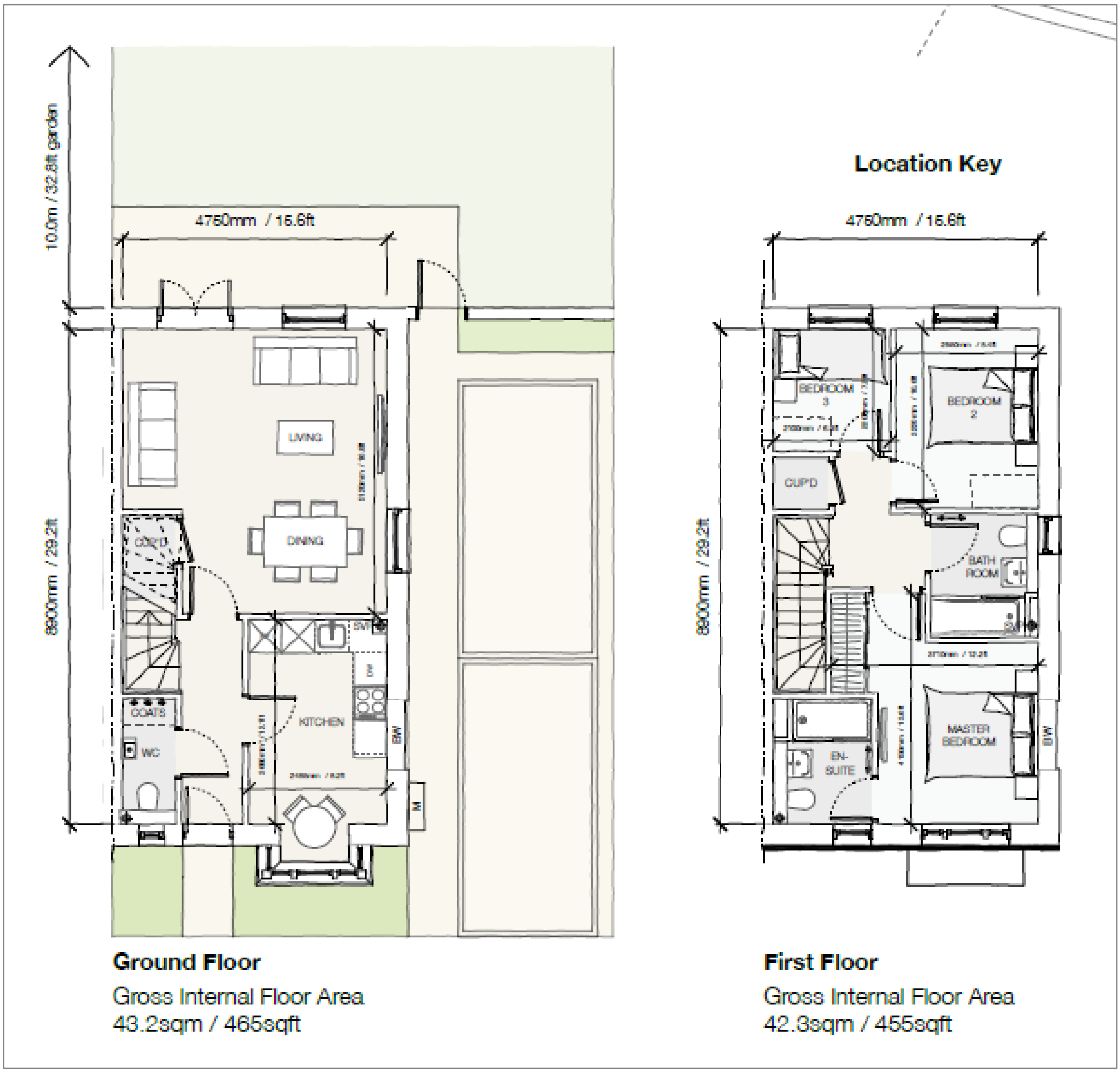

Figure B1. House type, 3bed dwelling used for the assessment – Floor Plans.

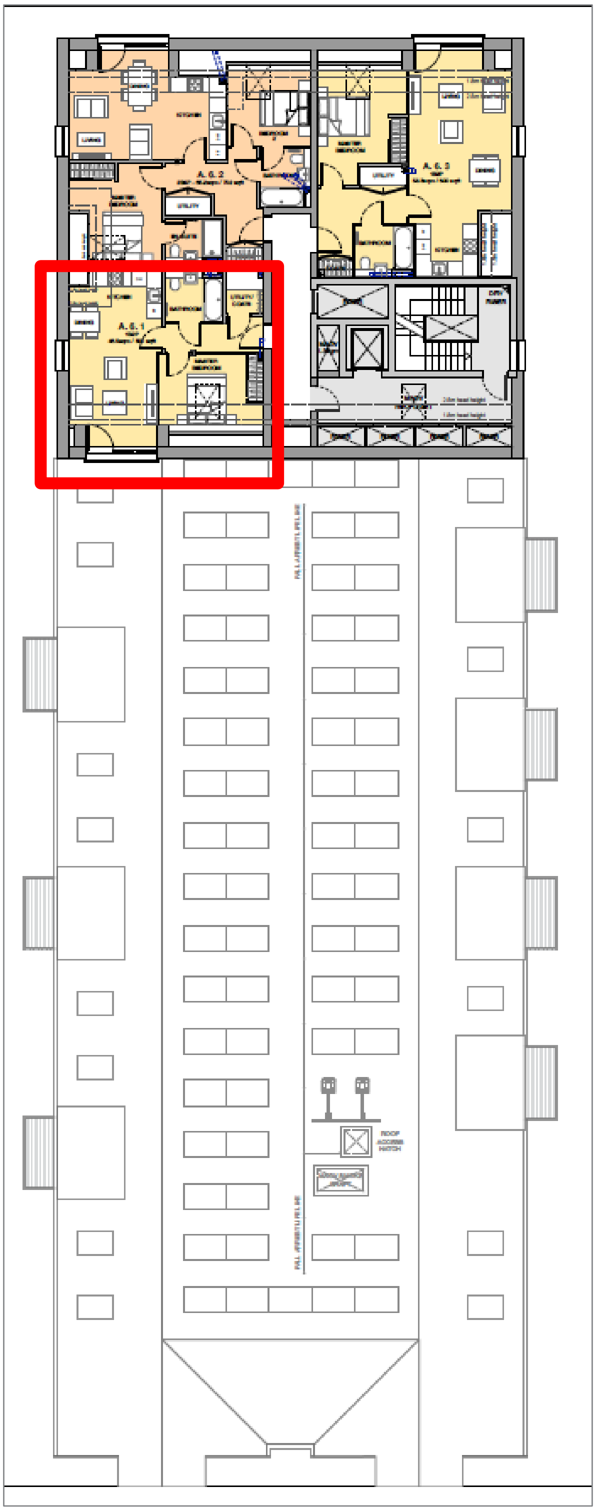

Figure B2. Block of flats type, 1bed top floor dwelling used for the assessment – Floor Plan.

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Appendix C
Modelling inputs

Table C1: Dynamic thermal modelling design assumptions			
Data Input			**Discussion**
Weather data	**Location**	CIBSE London Gatwick Design Summer Years (DSYs) for 2050s, high emissions, 50% percentile scenario	*Geographically closest and most representative industry-standard CIBSE weather data file*
Building Fabric Construction details	**External walls**	Flats:0.15 W/m²K Houses: 0.10 W/m²K	*As per the Energy Statement 2030-2050 fabric specifications (Hodkinson Consultancy)*
	Roofs	Main Roof: 0.10 W/m²K	*As per the Energy Statement 2030-2050 fabric specifications (Hodkinson Consultancy)*
	Ground floor	0.10 W/m²K	*As per the Energy Statement 2030-2050 fabric specifications (Hodkinson Consultancy)*
	Ceilings/floors	Assumed to be adiabatic between adjacent floors	*Concrete frame (flats) and beam and blocks (houses) slabs have been assumed. When dwelling units above / below heat loss is assumed to be zero.*
	Party walls between units and houses	Assumed to be adiabatic between adjacent dwellings	*Walls adjacent to other units are assumed to be lightweight partitions. Adjacent units have been included in the dynamic simulation calculations*
	Partitions within units	Steel-stud partitions	*Assumed thicknesses of 100mm*
	Internal doors	0.90 m width	*Assumed*
Windows	**Windows and Glazed Doors**	U value 1.2 W/m²K g-value of 0.50	*As per the Energy Statement 2030-2050 fabric specifications (Hodkinson Consultancy)*
	Reveal depth	External reveal: 200 mm	*Assumed*
Infiltration	**Air Tightness**	1.5 $m^3/hr\text{-}m^2$ @50 pascals	*Assumed to accommodate future standards requirements such as UKGBC (Target of Net Zero Carbon)*

Table C1: Dynamic thermal modelling design assumptions			
Data Input			**Discussion**
Natural ventilation	**Window openings**	Fully openable windows (side-hung) 90-degree maximum angle with 1100mm guarding. Kitchen / Living rooms: 09:00-22:00 Bedrooms: 24/7	*BASELINE -Windows are simulated to be open when internal temperature exceeds 22°C and when external temperature is lower than the internal temperature:* $T_{indoor} > 22°C$, $T_{outdoor} < T_{indoor}$ *IMPROVED DESIGN - Windows are simulated to be open when internal temperature exceeds 23°C and when external temperature is lower than the internal temperature:* $T_{indoor} > 23°C$, $T_{outdoor} < T_{indoor}$
Mechanical Ventilation	**Mechanical ventilation**	Mechanical ventilation system to achieve Min Part F requirements for all dwellings.	*Minimum requirement*

Table C2: Occupancy and equipment gains for dwellings (CIBSE TM59)		
Unit/room type	**Occupancy**	**Equipment Load**
1-bedroom apartment: living room/kitchen	1 person from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
2-bedroom apartment: living room/kitchen	2 people from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
3-bedroom apartment: living room/kitchen	3 people from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
Double bedroom	2 people at 70% gains from 11 pm to 8 am, 2 people at full gains from 8 am to 9 am and from 10 pm to 11 pm, 1 person at full gain in the bedroom from 9 am to 10 pm	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during the sleeping hours

Table C2: Occupancy and equipment gains for dwellings (CIBSE TM59)		
Unit/room type	**Occupancy**	**Equipment Load**
Single bedroom	1 person at 70% gains from 11 pm to 8 am, 1 person at full gains from 8 am to 11 pm	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during sleeping hours
Utility cupboard (flats only)	N/A	10 W on 24/7

Appendix D
Modelling Design Parameters

Table D1. Key design characteristics and parameters - baseline

BASELINE DESIGN								
			GLAZING RATIO		WINDOWS OPENABILITY		EXTERNAL SHADINGS	
Dwelling	Room type	Window	% of external facades (best practice <35%)	% of internal floor area (best practice <25%)	% of openable area	% of fixed glazed area	Orientation	Type of shade
Flat type 1Bed	LDK	window 1	29%	41%	100%	0%	West	None
		window 2			100%	0%	West	None
		balcony door			100%	0%	South	Balcony
		balcony window			54%	46%	South	Balcony
	Bedroom	window 3	19%	17%	100%	0%	South	None
House type 3Bed	Kitchen	window 1 (side bow-window)	28%	42%	0%	100%	South-West	External Louvres
		window 2 (bow-window)			100%	0%	South-West	None
		window 3 (side bow-window)			0%	100%	South-West	External Louvres
		window 4			100%	0%	South	Overhang (0.6m)
	Toilet GF	window 5	23%	24%	100%	0%	South-West	None
	Living room	window 6	26%	30%	100%	0%	South	Overhang (0.6m)
		window 7			54%	46%	North-East	None
		window 8			100%	0%	North-East	None
	Bedroom 1	window 9	11%	16%	100%	0%	South-West	None
	Bathroom 1	window 10	14%	15%	100%	0%	South-West	None
	Bathroom 2	window 11	13%	16%	100%	0%	South	None
	Bedroom 2	window 12	10%	16%	81%	19%	North-east	None
	Bedroom 3 (single bed)	window 13	12%	19%	72%	28%	North-east	None

LDK = Kitchen, Dining and Living room; All windows are provided with an external reveal of 200mm.

Table D2. Key design characteristics and parameters - baseline

FUTURE PROOFED DESING								
			GLAZING RATIO		WINDOWS OPENABILITY		EXTERNAL SHADINGS	
Dwelling	Room type	Window	% of external facades (best practice <35%)	% of internal floor area (best practice <25%)	% of openable area	% of fixed glazed area	Orientation	Type of shade
Flat type 1Bed	LDK	window 1	23%	33%	**100%**	**0%**	**West**	**None**
		window 2			100%	0%	West	None
		balcony door			100%	0%	South	Balcony
		balcony window			54%	46%	South	Balcony
	Bedroom	window 3	15%	13%	100%	0%	South	None
House type 3Bed	Kitchen	window 1 (side bow-window)	23%	37%	0%	100%	South-West	External Louvres
		window 2 (bow-window)			100%	0%	South-West	None
		window 3 (side bow-window)			0%	100%	South-West	External Louvres
		window 4			100%	0%	South	Overhang (0.6m)
	Toilet GF	window 5	23%	24%	100%	0%	South-West	None
	Living room	window 6	26%	30%	100%	0%	South	Overhang (0.6m)
		window 7			54%	46%	North-East	None
		window 8			100%	0%	North-East	None
	Bedroom 1	window 9	11%	16%	100%	0%	South-West	None
	Bathroom 1	window 10	14%	15%	100%	0%	South-West	None
	Bathroom 2	window 11	13%	16%	100%	0%	South	None
	Bedroom 2	window 12	10%	16%	81%	19%	North-east	None
	Bedroom 3 (single bed)	window 13	20%	23%	81%	19%	North-east	None

LDK = Kitchen, Dining and Living room; All windows are provided with an external reveal of 200mm.

Appendix E

TM59 Overheating Modelling Results

Table E1: TM59 Overheating Results for DSY1 2050s - BASELINE				
Unit	**Room**	**TM59 Criterion A: Hours of exceedance (pass ≤ 3%)**	**TM59 Criterion B: Bedroom temperature hours >26°C (pass ≤ 32)**	**Overall compliance with TM59**
		% Hours of overheating	**Hours of overheating**	
Flat 6F 1BedSW	Bedroom	0.59	40.67	Fail
	LDK	6.98	N/A	Fail
House 3Bed GF	Kitchen	5.11	N/A	Fail
	Living Room	2.01	N/A	Pass
House 3Bed 1F	Bedroom 1	0.05	21.00	Pass
	Bedroom 2	0.00	23.67	Pass
	Bedroom 3 (Single Occupancy)	0.00	27.17	Pass

Table E2: TM59 Overheating Results for DSY1 2050s – FUTURE PROOFED DESIGN				
Unit	**Room**	**TM59 Criterion A: Hours of exceedance (pass ≤ 3%)**	**TM59 Criterion B: Bedroom temperature hours >26°C (pass ≤ 32)**	**Overall compliance with TM59**
		% Hours of overheating	**Hours of overheating**	
Flat 6F 1BedSW	Bedroom	0.10	24.50	Pass
	LDK	2.68	N/A	Pass
House 3Bed GF	Kitchen	2.99	N/A	Pass
	Living Room	1.75	N/A	Pass
House 3Bed 1F	Bedroom 1	0.06	21.17	Pass
	Bedroom 2	0.00	25.17	Pass
	Bedroom 3 (Single Occupancy)	0.00	21.67	Pass

Appendix F
Windows ventilation provision

Table F1. Windows ventilation provision.

Dwelling	Room type	Orientation	Floor area (m^2)	Min Part F opening areas (1/20 floor area m^2)	BASELINE		FUTURE PROOFED	
					Provided openable window areas (m^2)	Fixed glazed areas (m^2)	Provided openable window areas (m^2)	Fixed glazed areas (m^2)
Flat type 1Bed	LDK	West	29.76	1.49	2.94	2.50	8.82	0.00
		South			4.50	0.99	4.50	0.99
	Bedroom	South	15.80	0.79	1.47	1.25	2.12	0.00
House type 3Bed	Kitchen	South	13.42	0.67	1.78	0.00	1.88	0.00
		South-west			2.02	2.30	2.34	0.82
	Living room	South	27.90	1.40	1.78	0.00	2.34	0.00
		North-east			4.72	1.25	4.74	1.25
	Bedroom 1	South-west	13.38	0.67	2.08	0.00	2.08	0.00
	Bedroom 2	North-east	10.91	0.55	1.48	0.34	1.48	0.34
	Bedroom 3	North-east	6.59	0.33	0.89	0.34	1.48	0.34

LDK = Kitchen, Dining and Living room;