Elmsbrook Local Centre

A2Dominion

Sustainability Statement

AES Sustainability Consultants Ltd

April 2021

	Author	Date	E-mail address
Produced By:	Andrew McManus	28.08.20	Andrew.McManus@aessc.co.uk
Reviewed By:	Silvio Junges	01.09.20	Silvio.Junges@aessc.co.uk

Revision	Author	Date	Comment
Draft issue	Andrew McManus	01.09.20	Initial issue for comment
Rev 1	Andrew McManus / Crystal Miller	28.04.21	Inclusion of condition 11
Rev 2	Andrew McManus	22.06.21	Removal of reference to Condition 10 (now to be submitted separately)

This statement has been commissioned by A2Dominion to detail the proposed approach to addressing a range of the sustainability related planning requirements for the Local Centre building at Elmsbrook. It should be noted that the details presented, including the proposed specifications, are subject to change as the detailed design of the buildings progresses, whilst ensuring that the overall commitments will be achieved.

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1. Introduction

Preface

1.1. This Sustainability Statement has been prepared on behalf of A2Dominion in support of the application for the development of the Local Centre building at Elmsbrook.

Development Description

1.2. A hybrid application under ref 19/01036/HYBRID has been submitted for the development of the Local Centre, incorporating residential apartments over community floorspace:

Full permission is sought for Local Centre Community Floorspace (Use Class D1 with ancillary A1/A3), with a total GIA of 541 sqm, and 16 residential units (Use Class C3) with associated access, servicing, landscaping and parking. Outline consent is sought for Local Centre Retail, Community or Commercial Floorspace (flexible Use Class A1/A2/A3/A4/A5/B1/D1).

Purpose and Scope of the Statement

1.3. Previously submitted statements prepared by Hoare Lea detailed the proposed approach to the energy strategy for the development.

1.4. This statement has been amended as Revision 2 to address Conditions 7, 9 and 11 - embodied carbon, overheating and water usage respectively - with a report detailing the approach to achieving zero carbon in accordance with Condition 10 to be submitted separately.

Figure 1. Elmsbrook Local Centre - view from road

2. Planning Policy and Conditions

Cherwell Local Plan 2011-2031

2.1. The Cherwell Local Plan 2011-2031 was adopted in July 2015. Section B.3 contains a number of policies aimed at ensuring sustainable development, with ESD2- ESD6 as extracted being of principle relevant to this statement:

> Policy ESD 2: Energy Hierarchy and Allowable Solutions
>
> In seeking to achieve carbon emissions reductions, we will promote an 'energy hierarchy' as follows:
>
> - Reducing energy use, in particular by the use of sustainable design and construction measures
> - Supplying energy efficiently and giving priority to decentralised energy supply
> - Making use of renewable energy
> - Making use of allowable solutions.

Allowable Solutions

2.2. The text supporting ESD2 notes:

Carbon emissions reductions can be achieved through a range of "allowable solutions"; measures which secure carbon savings off site. These have yet to be defined by the government but could potentially include investment in off-site low and zero carbon technologies. The concept is relatively new and is seen as a way to enable developments to become carbon neutral where it is not possible to deal with all carbon emissions through on site measures.

It will not always be cost effective or technically feasible to meet the zero carbon standard through on site measures and the government is therefore proposing that the zero carbon standard could be achieved by mitigating the remaining emissions off-site through the use of allowable solutions. The Council will support the implementation of the national approach to allowable solutions once defined

> Policy ESD 3: Sustainable Construction
>
> All new residential development will be expected to incorporate sustainable design and construction technology to achieve zero carbon development through a combination of fabric energy efficiency, carbon compliance and allowable solutions in line with Government policy.
>
> Cherwell District is in an area of water stress and as such the Council will seek a higher level of water efficiency than required in the Building Regulations, with developments achieving a limit of 110 litres/person/day.
>
> All new non-residential development will be expected to meet at least BREEAM 'Very Good' with immediate effect, subject to review over the plan period to ensure the target remains relevant. The demonstration of the achievement of this standard should be set out in the Energy Statement.
>
> The strategic site allocations identified in this Local Plan are expected to provide contributions to carbon emissions reductions and to wider sustainability
>
> All development proposals will be encouraged to reflect high quality design and high environmental standards, demonstrating sustainable construction methods including but not limited to:
>
> - Minimising both energy demands and energy loss
> - Maximising passive solar lighting and natural ventilation
> - Maximising resource efficiency
> - Incorporating the use of recycled and energy efficient materials Incorporating the use of locally sourced building materials
> - Reducing waste and pollution and making adequate provision for the recycling of waste
> - Making use of sustainable drainage methods
> - Reducing the impact on the external environment and maximising opportunities for cooling and shading (by the provision of open space and water, planting, and green roofs, for example); and
> - Making use of the embodied energy within buildings wherever possible and re-using materials where proposals involve demolition or redevelopment.

Policy ESD 4: Decentralised Energy Systems

The use of decentralised energy systems, providing either heating (District Heating (DH)) or heating and power (Combined Heat and Power (CHP)) will be encouraged in all new developments.

A feasibility assessment for DH/CHP, including consideration of biomass fuelled CHP, will be required for:

- All residential developments for 100 dwellings or more
- All residential developments in off-gas areas for 50 dwellings or more
- All applications for non-domestic developments above 1000m2 floorspace.

The feasibility assessment should be informed by the renewable energy map at Appendix 5 'Maps' and the national mapping of heat demand densities undertaken by the Department for Energy and Climate Change (DECC) (see Appendix 3: Evidence Base).

Where feasibility assessments demonstrate that decentralised energy systems are deliverable and viable, such systems will be required as part of the development unless an alternative solution would deliver the same or increased benefit.

Policy ESD 5: Renewable Energy

The Council supports renewable and low carbon energy provision wherever any adverse impacts can be addressed satisfactorily. The potential local environmental, economic and community benefits of renewable energy schemes will be a material consideration in determining planning applications.

Planning applications involving renewable energy development will be encouraged provided that there is no unacceptable adverse impact, including cumulative impact, on the following issues, which are considered to be of particular local significance in Cherwell:

- Landscape and biodiversity including designations, protected habitats and species, and Conservation Target Areas
- Visual impacts on local landscapes
- The historic environment including designated and non-designated assets and their settings
- The Green Belt, particularly visual impacts on openness
- Aviation activities
- Highways and access issues, and
- Residential amenity.

A feasibility assessment of the potential for significant on site renewable energy provision (above any provision required to meet national building standards) will be required for:

- All residential developments for 100 dwellings or more
- All residential developments in off-gas areas for 50 dwellings or more
- All applications for non-domestic developments above 1000m2 floorspace.

Where feasibility assessments demonstrate that on site renewable energy provision is deliverable and viable, this will be required as part of the development unless an alternative solution would deliver the same or increased benefit. This may include consideration of 'allowable solutions' as Government Policy evolves.

2.3. The development as a whole is additionally subject to Policy Bicester 1, a large part of which relates to the wider masterplanning and provision of facilities, access and movement. The aspects of the policy relevant to the reserved matters applications considered within this statement are extracted below and mirror the standards required by Condition.

> Policy Bicester 1: North West Bicester Eco-Town (condensed)
>
> Development Description: A new zero carbon(i) mixed use development including 6,000 homes will be developed on land identified at North West Bicester. Planning permission will only be granted for development at North West Bicester in accordance with a comprehensive masterplan for the whole area to be approved by the Council as part of a North West Bicester Supplementary Planning Document. The Council will expect the Masterplan and applications for planning permission to meet the following requirements:
>
> .....
>
> Key site specific design and place shaping principles
>
> - High quality exemplary development and design standards including zero carbon development, Code Level 5 for dwellings at a minimum and the use of low embodied carbon in construction materials, as well as promoting the use of locally sourced materials.
> - All new buildings designed to incorporate best practice on tackling overheating, taking account of the latest UKCIP climate predictions.
> - Proposals should enable residents to easily reduce their carbon footprint to a low level and live low carbon lifestyles.
> - Demonstration of climate change mitigation and adaptation measures including exemplary demonstration of compliance with the requirements of policies ESD 1 – 5
>
> ...

Planning Policy Statement: EcoTowns

2.4. The PPS1 EcoTowns supplement contains the following policy relating to zero carbon standards in eco-towns:

> ET 7.1 The definition of zero carbon in eco-towns is that over a year the net carbon dioxide emissions from all energy use within the buildings on the eco-town development as a whole are zero or below. The initial planning application and all subsequent planning applications for the development of the eco-town should demonstrate how this will be achieved.
>
> ET 7.2 The health and social care needs of residents, and the resulting energy demand, should be taken into account when demonstrating how this standard will be met.
>
> ET 7.3 This standard will take effect in accordance with a phased programme to be submitted with the planning application. It excludes embodied carbon7 and emissions from transport but includes all buildings – not just houses but also commercial and public sector buildings which are built as part of the eco-town development. The calculation of net emissions will take account of:
>
> (a) emissions associated with the use of locally produced energy
>
> (b) emissions associated with production of energy imported from centralised energy networks, taking account of the carbon intensity of those imports as set out in the Government's Standard Assessment Procedure, and
>
> (c) emissions displaced by exports of locally produced energy to centralised energy networks where that energy is produced from a plant (1) whose primary purpose is to support the needs of the eco town and (2) has a production capacity reasonably related to the overall energy requirement of the eco town.
>
> ET 7.4 This standard attempts to ensure that energy emissions related to the built environment in eco-towns are zero or below. Standards applicable to individual homes are set out in policy ET 9.

2.5. In March 2015 the EcoTowns PPS was withdrawn for all areas previously covered by the policy with the exception of North West Bicester. The relevant policies were brought into the North West Bicester Supplementary Planning Document.

North West Bicester SPD

2.6. The North West Bicester SPD was adopted in February 2016, to expand on Policy Bicester 1 of the Local Plan and set the minimum standards to be achieved by the proposed development. It includes the following 'Development Requirements' (condensed) relevant to this strategy:

> Development Principle 2 – "True" zero carbon development
>
> 4.23 In accordance with the Local Plan the definition of true zero carbon is that over a year the net carbon dioxide emissions from all energy use within buildings on the eco-town development as a whole are zero or below. It excludes embodied carbon and emissions from transport but includes all buildings – not just houses but also commercial and public sector buildings.
>
> 4.24 Development at North West Bicester must achieve zero carbon emissions as defined in this SPD.
>
> 4.5 Each full and outline application will need to be supported by an energy strategy and comply with the definition of true zero carbon development.
>
> 4.26 Energy strategies should identify how the proposed development will achieve the zero carbon targets and set out the phasing.
>
> 4.28 Applicants will be encouraged to maximise the fabric energy efficiency of buildings
>
> Development Requirement 3 - Climate Change Adaptation
>
> 4.41 Planning applications will be required to incorporate best practice on tackling overheating.
>
> 4.44 Planning applications should:
>
> - Provide evidence to show consideration of climate change adaptation

Draft Planning Conditions - 19/01036/HYBRID

2.7. The relevant draft planning conditions attached to application ref 19/01036/HYBRID are extracted below:

> 7. Carbon Emissions Report
>
> No development shall take place until a report outlining how carbon emissions from the construction process and embodied carbon have been minimised has been submitted to and approved in writing by the Local Planning Authority. The development shall thereafter be carried out in accordance with the recommendations contained in the approved report.
>
> Reason - To ensure that the development achieves a reduced carbon footprint in accordance with Planning Policy Statement 1: Eco Towns. This information is required prior to the commencement of any development as it is fundamental to the acceptability of the scheme.
>
> 9. Overheating Report
>
> No development shall take place until an updated Overheating Report to consider a predicted 2050 climate scenario has been submitted to and approved in writing by the Local Planning Authority. The report shall consider whether there is a need for additional mitigation required to ensure the development does not overheat in the 2050 climate scenario and full details of that mitigation shall be provided. The development shall be implemented in accordance with the approved details.
>
> Reason: To deliver a development that can be mitigated to deal with predicted future climate scenarios in accordance with Policy Bicester 1 of the Cherwell Local Plan Part 1 and Planning Policy Statement 1: Eco Towns. This information is required prior to the commencement of any development as it is fundamental to the acceptability of the scheme.
>
> 11. Minimising water use
>
> No development shall take place until full details of measures to minimise water use, in line with the Masterplan Water Cycle Study have been submitted to and approved in writing by the Local Planning Authority. The development shall be carried out in accordance with the approved details.
>
> Reason: To support reduction in water use and to achieve the requirements of Planning Policy Statement 1: Eco Town. This information is required prior to the commencement

Committee Report

2.8. A committee report dated 18th December 2019 includes a range of comments relating to energy and sustainability related matters in the previously submitted statements, via Tyrens, an external consultant appointed by Cherwell District Council:

- The proposal does not meet the true zero carbon energy requirements as the proposals around reduction of energy demand, being energy efficient and the installation of renewable energy technologies, including connection to the energy centre is to meet regulated energy demand only (there is no mention of the unregulated demand). Further detail on this should be sought.
- There is also a lack of detail around the materials to be used (in terms of the low and embodied carbon credentials of them), the use of locally sourced materials, the use of real time energy monitoring systems, the water consumption targets and the percentage of green space to be provided.
- The proposals include provision of solar PV (and the roof design has optimised the space for PV deployment), air source heat pumps and connection to the CHP powered energy centre for heating and hot water. There are some questions over how the figures have been arrived at due to the specification of various proposals not having been provided.

2.9. Further comments were then received relating to updated statements submitted:

- An amended Sustainability and Energy Statement is provided. This considers unregulated energy but no further information is presented to address compliance with policy requirements.
- There continues to be no mention of water consumption requirements.
- It is unclear what role air source heat pumps will play in the overall energy strategy and what contribution they make to the carbon balance of the proposed development.
- Target values in terms of compliance with Building Regulations for building fabric are set as well as minimum performance criteria being specified.
- In order to achieve true zero carbon, offsite measures will be necessary, and no detail is provided of this as to how this will meet the renewable energy generation requirements.
- Further detail is sought to demonstrate how the detailed calculations have been arrived at.

2.10. These comments will be addressed through the information provided in this strategy document.

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3. Condition 7 – Carbon Emissions Report

3.1. Condition 7 states:

> No development shall take place until a report outlining how carbon emissions from the construction process and embodied carbon have been minimised has been submitted to and approved in writing by the Local Planning Authority. The development shall thereafter be carried out in accordance with the recommendations contained in the approved report.

3.2. The construction strategy for the building seeks to balance the competing demands of a range of issues:

- Overheating – typically materials with higher thermal mass assist in smoothing internal temperature profiles and reducing the risk of summer overheating
- Noise – requirements relating to the management of noise have also mandated some related construction materials choices, including the wall types and glazing specification
- Embodied energy and carbon

3.3. After review of a range of construction options, these considerations dictated that the main construction materials would need to be relatively heavyweight to take advantage of sound damping and thermal mass attributes, and a lightweight timber structure would not be able to effectively meet the requirements.

3.4. A life cycle assessment has been undertaken, identifying a range of measures to ensure that the construction method selected still seeks to maximise opportunities for a reduction in embodied energy and carbon emissions. This is presented in Appendix A.

3.5. The specific materials utilised to undertake the assessment are considered representative of the final products to be selected. Where deviation from the design stage assumptions is necessary, these products will be reviewed to ensure that embodied emissions are not increased as a whole.

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4. Condition 9 – Overheating Assessment

4.1. Condition 9 states:

> No development shall take place until an updated Overheating Report to consider a predicted 2050 climate scenario has been submitted to and approved in writing by the Local Planning Authority. The report shall consider whether there is a need for additional mitigation required to ensure the development does not overheat in the 2050 climate scenario and full details of that mitigation shall be provided. The development shall be implemented in accordance with the approved details.

4.2. Overheating assessments have previously been undertaken using current weather files. An updated assessment to take account of the updated building designed and extend the analysis to cover the year 2050 has been undertaken and is included in this statement as Appendix B.

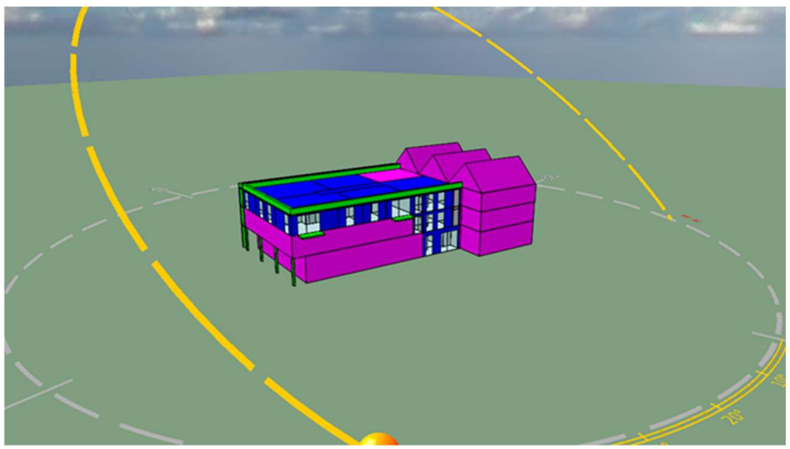

Figure 2. 3D Overheating Model (IES VE)

4.3. The results demonstrate that due to the overall construction strategy incorporating relatively high thermal mass, a glazing specification to control gain and natural ventilation, no additional mitigation measures are required in order to maintain acceptable internal temperatures in accordance with CIBSE TM59 guidance.

Results - Natural Ventilation - (Base Case)

4.4. Table 1 shows the detailed results for the modelled residential units against CIBSE TM59:2017 criteria when using a glazing g-value of 0.50 to all elevations.

Table 1. Results – Natural Ventilation (Base Case)

Apartment	Room Name	Criteria 1	Criteria 2	Pass / Fail
Flat 14	Living / Kitchen	1.3	N/A	Pass
	Bedroom 01	0.1	17	Pass
	Bedroom 02	0.2	7	Pass
Flat 15	Living / Kitchen	0.2	N/A	Pass
	Bedroom 01	0.0	21	Pass

4.5. The results show there is no significant risk of overheating within the living/kitchen and bedrooms when compared with CIBSE TM59. The maximum hours of exceedance are not above the 3% threshold. The results show that the predicted hours over and above 26°C in Bedrooms between 10pm and 7am are less than 32 hours in total and therefore the second design criteria is met.

4.6. Table 2 illustrates the results for the communal areas modelled. The results demonstrate that the suggested ventilation strategy will be compliant with CIBSE TM59 criteria, i.e. T>28 ˚C for less than 3% of the annual hours.

Table 2. Results of communal corridors overheating analysis

Location	Operative temperature (°C) - % hours in range >28.00
GF Communal Stairs	1.0
1F Communal Stairs	0.2
1F Communal Corridor	0.0
2F Communal Stairs	0.4
2F Communal Corridor	0.0
Total hours (% of sum)	0.3

5. Condition 11 – Minimising water use

5.1. Condition 11 states:

> No development shall commence until full details of measures to minimise water use which could include the use of rainwater harvesting or incorporating such other agreed measures, in line with the Masterplan Water Cycle Study have been submitted to and approved in writing by the Local Planning Authority. The development shall be carried out in accordance with the approved details.

5.2. Water will be managed effectively to reduce the water consumption associated with the proposed development.

5.3. Water efficiency measures will be utilised, in line with the Masterplan Water Cycle Study, with the aim to limit the use of water during the operation of the development. This includes the use of efficient dual flush WCs, low flow showers and taps and appropriately sized baths.

Residential performance – water reduction

5.4. The Masterplan Water Cycle Study recommends for residential properties that the following sanitaryware adhere to the below flowrates:

- 2.6/4.0l dual flush toilet
- 9 l/minute shower
- 150 l bath
- 6 l/minute taps
- Conventional dishwasher and washing machine, assumed to use 4.5 and 17.16 l/p/d respectively; and
- Any water used external (approximated at 5 l/p/d) is excluded from the total potable water demand.

Non-Residential water reduction

5.5. The Masterplan Water Cycle Study identifies water performance targets that represent performance levels that represent BREEAM Excellent. This continues that "whole building potable water usage is reduced by at least 55% from the baseline condition". The performance requirements for sanitaryware are therefore as follows:

- 2.6/4.0l dual flush toilets
- Dry urinal systems
- Kitchen and bathroom taps limited to 5 l/minute and 3 l/minute respectively; and
- 3.5 l/minute showers

5.6. Appendix D evidences the approach to reducing water consumption. Sanitaryware will be installed with the following performance, each at BREEAM performance level 5, equating to 55% improvement over the baseline condition:

- 2.6/4.0l dual flush toilets
- 3l – Doc M Pack WC system
- 3l/minute wash hand basin taps
- 5l/minute kitchen taps

5.7. The above performance levels achieve 80% of the available Wat 01 credits. Equating this performance to a BREEAM Excellent threshold for the overall assessment (70%), this performance exceeds what would typically be targeted within a BREEAM Excellent assessment.

5.8. Additional ways in which water consumption will be reduced through the BREEAM assessment are detailed below:

- Wat 02 – Water monitoring: A water meter which has a pulsed or other open protocol communication output to enable connection to a building management system will be included on the mains water supply to ensure water consumption can be monitored and managed.
- Wat 03 – Flow control devices: PIRs and solenoid valves will be placed on WC areas/facilities to regulate the supply of water thereby minimising water leaks and wastage from sanitary fittings.
- Wat 04 – Water efficient equipment: the design team has identified all unregulated water demands that could be realistically mitigated or reduced throughout the design process e.g. landscaping will rely solely on precipitation and not irrigation.

Rainwater Harvesting

5.9. It is understood that the wider development of individual domestic units makes use of rainwater harvesting to further reduce water consumption. The nature of this build (multiple function, occupancy and story) presents challenges in the implementation of RWH or GWH systems, as recognized by the Masterplan Water Cycle Study.

5.10. A centralised system would be required due to the multiple occupancy of the building. Ownership arrangements therefore present issues with billing for the main water backup.

5.11. Roof space is limited and therefore the ratio of roof space to users is not favourable to providing a sufficient rainwater supply to each user. The supply would revert to the mains water backup the majority of time.

5.12. The is no district treatment and distribution network, of either rain or greywater, available to the site.

5.13. In summary neither, property nor neighborhood RWH or GWH are appropriate or practical for this development.

6. Conclusions

6.1. This Sustainability Statement has been prepared on behalf of A2Dominion in support of the application for the development of the Local Centre building at Elmsbrook.

6.2. In response to Condition 7, this statement provides a life cycle assessment of embodied energy and carbon emissions. Appropriate materials choices have been made to respond to the key criteria of the building relating to thermal and acoustic performance. Wherever possible, subsequent materials have been selected based on reduced embodied energy and CO_2 emissions.

6.3. In response to Condition 9 and in order to ensure that the development is constructed to improve resilience to future climate change and deliver a comfortable living environment for future residents, an updated overheating assessment has been undertaken in accordance with CIBSE TM59 criteria. This demonstrates that the materials and glazing specification reduces the risk of internal overheating below the guidelines set out for climate projections in the year 2050.

6.4. In response to Condition 11 and in order to ensure that the sanitaryware installed meets the recommendations proposed within the NW Bicester Masterplan Water Cycle Study this statement provides confirmation of the water efficiency standards that will be met.

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Appendix A: Condition 7 - Life Cycle Assessment

Elmsbrook Local Centre

A2Dominion

Embodied Carbon

AES Sustainability Consultants Ltd

November 2020

	Author	Date	E-mail address
Produced By:	Claire Stone	09.11.2020	Claire.Stone@aessc.co.uk
Reviewed By:	Andrew McManus	09.11.2020	Andrew.McManus@aessc.co.uk

Revision	Author	Date	Comment
-	Claire Stone	09.11.2020	Initial issue

Contents

List of figures & tables

1. Introduction

1.1. AES Sustainability Consultants Ltd. has been appointed to undertake an embodied carbon assessment of the proposed Elmsbrook Local Centre which is being developed as part of the Bicester Eco Town. This report has been written to summarise the process and results of the analysis.

Development Description

1.2. A hybrid application under ref 19/01036/HYBRID has been submitted for the development of the Local Centre, incorporating 16 residential apartments over community floorspace and a cafe:

Full permission is sought for Local Centre Community Floorspace (Use Class D1 with ancillary A1/A3), with a total GIA of 552 sqm, and 16 residential units (Use Class C3) with associated access, servicing, landscaping and parking. Outline consent is sought for Local Centre Retail, Community or Commercial Floorspace (flexible Use Class A1/A2/A3/A4/A5/B1/D1).

1.3. Condition 7 requires the completion of a report demonstrating the approach to reducing embodied carbon emissions, as extracted below:

> 7. Carbon Emissions Report
>
> No development shall take place until a report outlining how carbon emissions from the construction process and embodied carbon have been minimised has been submitted to and approved in writing by the Local Planning Authority. The development shall thereafter be carried out in accordance with the recommendations contained in the approved report.
>
> Reason - To ensure that the development achieves a reduced carbon footprint in accordance with Planning Policy Statement 1: Eco Towns. This information is required prior to the commencement of any development as it is fundamental to the acceptability of the scheme.

1.4. This document demonstrates that the required analysis has been undertaken and reports life cycle greenhouse gas emissions (kgCO_2eq.) for each element based on a 60-year building life.

Figure 1. Elmsbrook Local Centre - View from Road

2. Life Cycle Assessment

2.1. The life cycle assessment of buildings seeks to expand the boundaries of construction sustainability. Rather than simply examining operational energy demand and associated emissions, this methodology allows a sustainability appraisal to incorporate the energy and emissions associated with the extraction of raw materials, the manufacturing process, transport, application, and the energy used in recycling or replacement of the material at end of life.

2.2. Increasingly it is being demonstrated that as operational energy demand of buildings is being reduced through the energy efficiency provisions of the Building Regulations, in-use energy demand is accounting for a decreasing proportion of the overall Whole Life Cycle (WLC) energy and CO_2 emissions[1]. As such, the necessity for consideration of the embodied carbon of construction is becoming more apparent in order to continue to reduce the climate impacts of the built environment.

2.3. The calculation and reduction of whole-life CO_2e emissions has the potential to;

- Ensure that a significant source of emissions from the built environment are accounted for which is necessary in achieving a net zero-carbon development.
- Achieve resource efficiency and cost savings by encouraging the re-use of existing materials instead of new materials and the retrofit and retention of existing structures and fabric over new construction.
- Identify the carbon benefits of using recycled material and the benefits of designing for future reuse and recycling to reduce waste and support the circular economy.
- Encourage a 'fabric first' approach to building design thereby minimising mechanical plant and services in favour of natural ventilation.
- Identify the impact of maintenance, repair and replacement over a building's life-cycle which improves life-time resource efficiency and reduces life-cycle costs, contributing to the future proofing of asset value.
- Encourage durable construction and flexible design, both of which contribute to greater longevity, reduced obsolescence of buildings and avoiding carbon emissions associated with demolition and new construction.

2.4. Embodied carbon is regularly described as the total impact of all the greenhouse gases emitted by the construction and materials of our built environment. It includes the impacts of sourcing raw materials, manufacturing, transport, and wastage in the process2.

2.5. Carbon emissions associated with energy consumption (embodied energy) during the manufacture, transportation, assembly, replacements and deconstruction of construction materials or products. Embodied carbon is typically measured from cradle-to-gate, which is reflected by life cycles A1-A3 the product stage as detailed in this report.

Modelling Methodology

2.6. The calculations were performed with the One Click LCA calculation tool, which is able to assess life cycle impacts compliant with the requirements of BREEAM, LEED and numerous other sustainable construction certification schemes. The assessment methods conform with BS 15978:2011 Sustainability of construction works – Assessment of environmental performance of buildings

2.7. The LCA analysis includes the following elements:

- Substructure
- Superstructure
  - Frame
  - Upper floors incl. balconies
  - Roof
  - Stairs and ramps
  - External Walls
  - Windows and External Doors
  - Internal Walls and Partitions
  - Internal Doors

[1] Sansom, M. and Pope, R., 2012. A comparative embodied carbon assessment of commercial buildings. The Structural Engineer,.

[2] The Embodied Carbon Review, 2018, Bionova Ltd, www.embodiedcarbonreview.com

2.8. The following items are excluded; balconies, stair finishes, fixtures and fittings (e.g. handrails, cubicles etc.), all furniture and equipment, including building and external services are excluded from the LCA.

2.9. Building life cycle stages are the different periods of a building's lifetime. For instance: raw material harvesting, manufacturing of products, use phase of the building, end of life. In the European markets, the building life cycle stages are defined by EN 15978 and EN 15804 standards, which can be included in LCAs.

2.10. The following table lists all life cycle stages according to EN standards:

Product Stage			Construction Process Stage		Use Stage							End-of-Life Stage				Benefits and loads beyond the system boundary		
Raw material supply	Transport	Manufacturing	Transport to building site	Installation into building	Use/application	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction/demolition	Transport	Waste processing	Disposal	Reuse	Recovery	Recycling
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D	D	D

Figure 2. Life-cycle stages according to the EN standard

2.11. The following life-cycle stages have been included within the analysis:

- A1: raw material extraction and processing, processing of secondary material input (e.g. recycling processes)
- A2: transport to the manufacturer
- A3: manufacturing

2.12. Module A1, A2 and A3 may be declared as one aggregated module A1-3. All stages include the provision of all materials, products, and energy, as well as waste processing up to the end-of-waste state or disposal of final residues during the product stage. The assessment takes only the building and its parts into account, but not furniture or appliances, for example.

2.13. Raw material supply (A1) includes emissions generated when raw materials are taken from nature, transported to industrial units for processing and processed. Loss of raw material and energy are also taken into account.

2.14. Transport impacts (A2) include exhaust emissions resulting from the transport of all raw materials from suppliers to the manufacturer's production plant as well as impacts of production of fuels.

2.15. Production impacts (A3) cover the manufacturing of the production materials and fuels used by machines, as well as handling of waste formed in the production processes at the manufacturer's production plants until end-of-waste state.

- A4: transport to the building site

2.16. A4 includes exhaust emissions resulting from the transport of building products from manufacturer's production plant to building site as well as the environmental impacts of production of the used fuel.

- B4: replacement

2.17. The environmental impacts of maintenance and material replacements (B1-B5) include environmental impacts from replacing building products after they reach the end of their service life. The emissions cover impacts from raw material supply, transportation and production of the replacing new material as well as the impacts from manufacturing the replacing material as well as handling of waste until the end-of-waste state.

- C1: de-construction, demolition
- C2: transport to waste processing
- C3: waste processing for reuse, recovery and/or recycling
- C4: disposal

2.18. All C stages include provision and transport, provision of all materials, products and related energy and water use.

2.19. The impacts of deconstruction include impacts for processing recyclable construction waste flows for recycling (C3) until the end-of-waste stage or the impacts of pre-processing and landfilling for waste streams that cannot be recycled (C4) based on type of material. Additionally, deconstruction impacts include emissions caused by waste energy recovery.

2.20. However, it should be noted that A4, B4 and C1-C4 should be ignored for the purposes of an embodied carbon assessment. In line with BS EN 15978 A1-A3 – the product stage (cradle to gate), are the pertinent figures required to show embodied carbon.

Project Data Sources and Assumptions

Material Quantities (A1-A3)

2.21. A 3D model of the building has been built using the dynamic thermal software developed by Integrated Environmental Solutions (IES). The building geometry has been modelled using drawn information produced by Mark Bell Architects Ltd.

2.22. Fabric elements have been entered as per the External Fabric Materials Spec provided by A2Dominion.

2.23. Data for all materials in the analysis has been collated from the One-Click database, including manufacturer specific data (where available), as well as generic data which represents the industry average for the selected material.

Building Material Transport Distances (A4)

2.24. The case specific transport distances were used when available. Other transport distances were estimated based on typical average transport distances based on material type provided by calculation tool.

Material Service Life (B1-B5)

2.25. The service life information for each material was checked and project specific values were used when available. Otherwise default values from One Click LCA database were used.

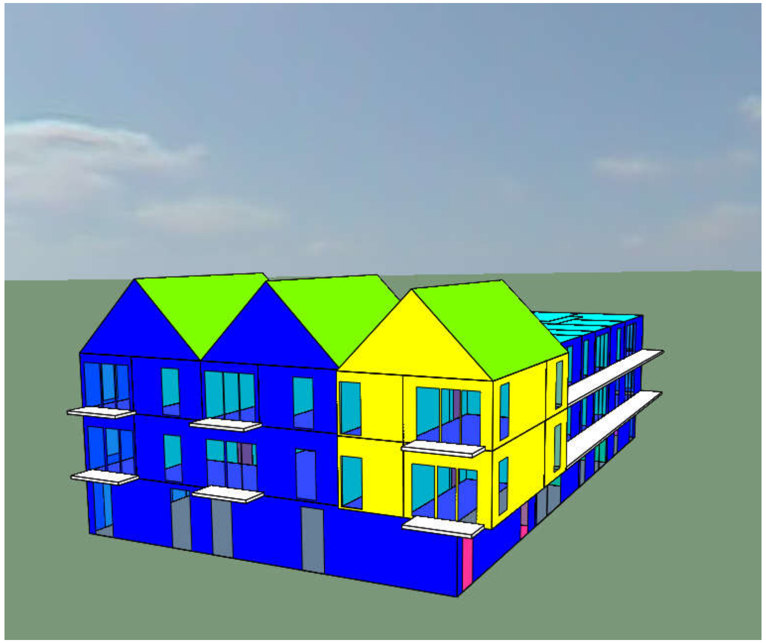

Figure 3. IES Model

Assessed Impact Categories

2.26. Global warming potential is a relative measure of how much heat a greenhouse gas traps in the atmosphere. The global warming potential is calculated in carbon dioxide equivalents meaning that the greenhouse potential of emission is given in relation to CO_2.

2.27. The global warming potential for each material specified is reported in a measure of $kgCO_2e$ per kilogram of material used. This is an aggregate measure, which incorporates the greenhouse gases listed below, and converts these to an equivalent quantity of carbon dioxide, in order to facilitate easier comparison between materials with varying impacts[3].

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous Oxides (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulphur hexafluoride (SF_6)

[3] Moncaster, A. and Symons, K., 2013. A method and tool for 'cradle to grave' embodied carbon and energy impacts of UK buildings in compliance with the new TC350 standards. Energy and Buildings, 66, pp.514-523.

4. Results

4.1. The life cycle assessment was assessed using One Click LCA. The results are summarised in the following table. The results represent the total life cycle impact during a 60 year service life.

Results for Global Warming Potential (GWP), $kgCO_2$ eq

4.2. The results show that based on the life cycle stages, stage A1-A3 Materials constitutes the highest contribution, at over three quarters of the total. This is the stage that is taken into account for embodied carbon.

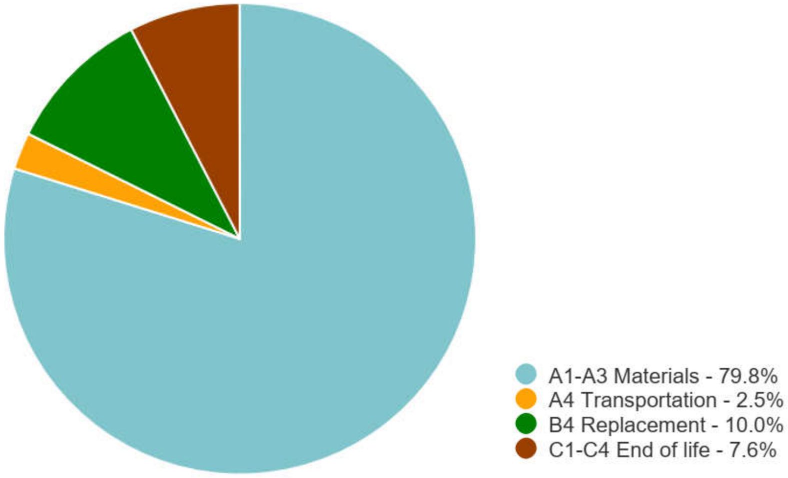

Figure 4. Total $kgCO_2e$ by life-cycle stage

4.3. The analysis concluded that the currently specified materials have a total embodied carbon impact of 410,735 $kgCO_2$ eq.

Table 1. Total embodied carbon - A1-A3 Materials

Impact category	Unit	Results
Global warming potential (greenhouse gases)	$kgCO_2$ eq	410,735

4.4. This figure has been achieved through the specification of low impact products and manufacturers.

4.5. This figure can be further disseminated to show the major resource contributors. Results show that concrete contributes to over 50% of the buildings total kgCO2e for the building.

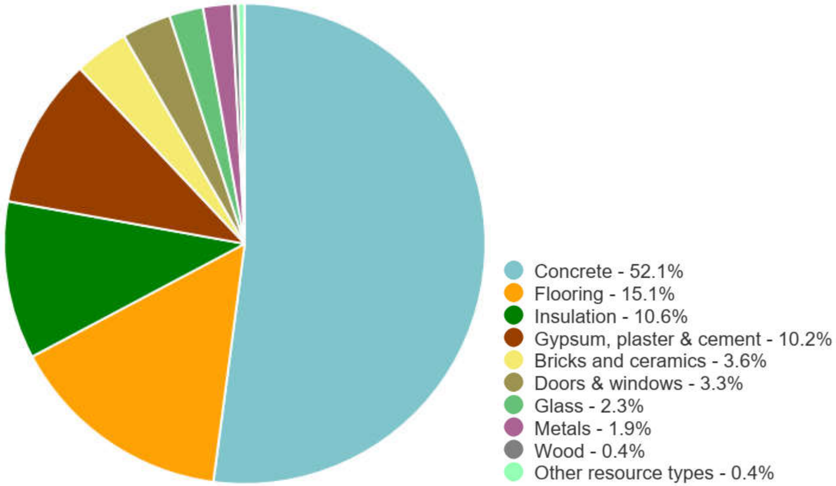

Figure 5. Total $kgCO_2e$ by resource type

4.6. Figure 6 shows clearly that the materials with the highest impact on the embodied carbon are the concrete items (shown in orange), which are prevalent within our building.

4.7. Concrete is one of the main contributors to the embodied carbon footprint of most buildings and infrastructure assets. It can also offer a number of possible routes to embodied carbon reduction. The specification of greener concrete mixtures has great potential to reduce the carbon footprint of construction.

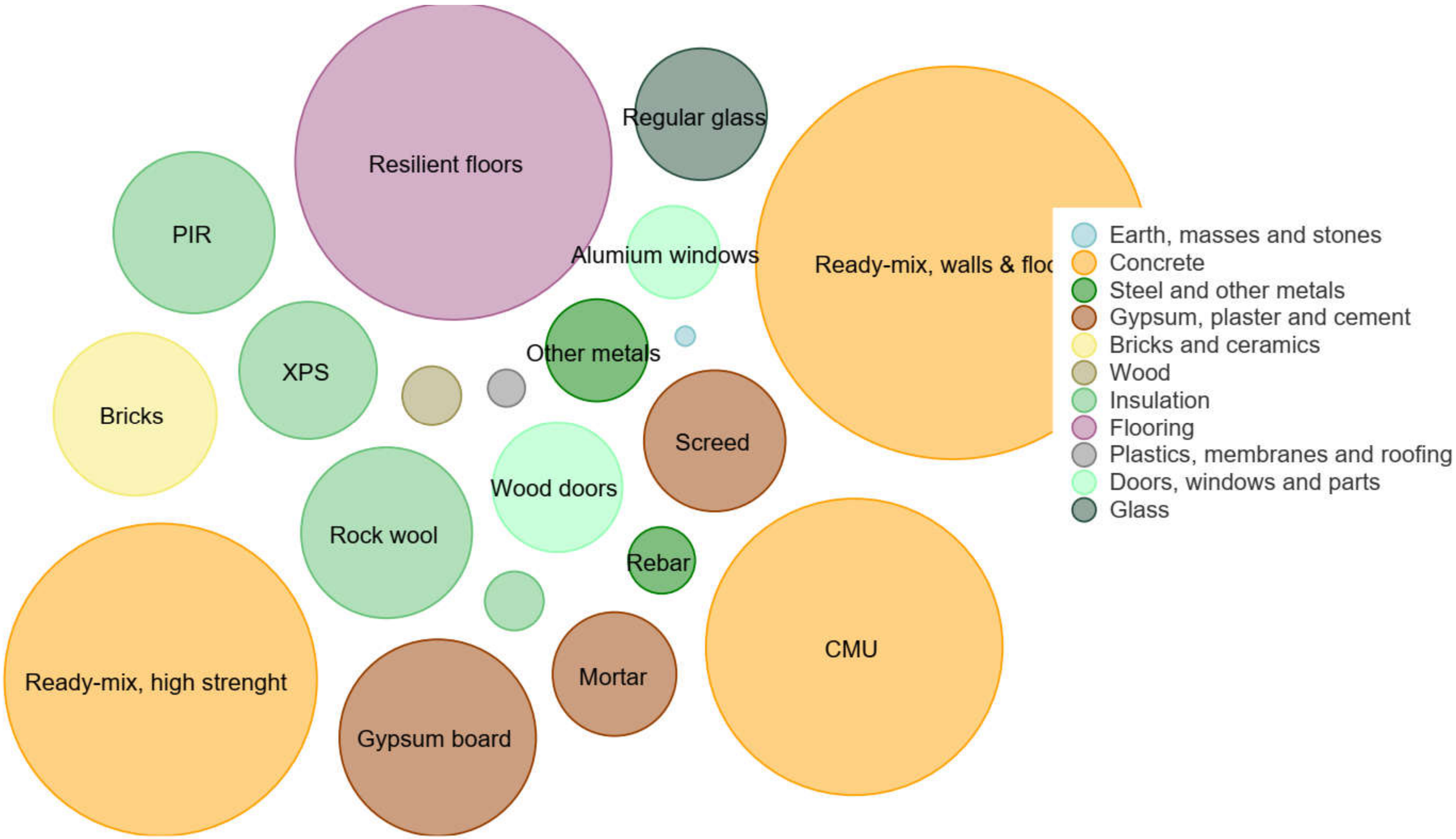

Figure 6. Total life cycle impact by resource type and subtype - $kgCO_2e$

5. Conclusion

5.1. AES Sustainability Consultants Ltd. have been appointed to undertake an embodied carbon assessment of the proposed Elmsbrook Local Centre as required by Planning Condition 7.

5.2. By using IES VE and OneClick LCA software, the analysis has found that following the specification of low embodied carbon materials where possible, the residual embodied carbon of the proposed materials is 410,735 $kgCO_2$, with concrete being the major contributing material, accounting for just over half the embodied emissions of the materials.

5.3. Embodied carbon will continue to be monitored throughout the design and procurement stages of the project in order to further inform any selection of materials, products and suppliers to further influence the impact and potential reduction of embodied carbon.

Appendix B: Condition 9 - Overheating Assessment

Elmsbrook Local Centre, NW Bicester

A2Dominion

Residential Summer Overheating Analysis
CIBSE TM59:2017

AES Sustainability Consultants Ltd

June 2020

AES Sustainability Consultants

	Author	Date	E-mail address
Produced By:	Silvio Junges	29.06.2020	Silvio.Junges@aessc.co.uk
Reviewed By:	Mitchell Bennellick	30.06.2020	Mitchell.Bennellick@aessc.co.uk

Revision	Author	Date	Comment
Rev0	Silvio Junges	30.06.2020	First Issue

a2dominion group

This report has been commissioned by A2Dominion to assess the potential risk of overheating to a number of plots at Elmsbrook Local Centre, NW Bicester. It should be noted that the details presented, including the proposed specifications, are subject to change as the detailed design of the dwellings progresses, whilst ensuring that the overall commitments will be achieved.

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Contents

List of figures & tables

1. Executive Summary

Purpose and scope of the statement

1.1. AES Sustainability Consultants Ltd has undertaken calculations to identify whether Flats 14 & 15 and communal corridors within Elmsbrook Local Centre, NW Bicester will be at significant risk of overheating. The samples have been selected as their orientation and glazing areas represent a worst case for the proposed development.

1.2. This report uses room profiles assessed against CIBSE benchmarks outlined in CIBSE TM52:2013 and TM59:2017 for the analysis of the risk of overheating by using CIBSE weather files.

1.3. CIBSE TM59 provides a methodology to assess the risk of overheating in homes and has been used to carry out this analysis.

1.4. Compliance is based on passing BOTH of the following 2 criteria:

1) TM52 Criterion 1 must pass (Operative temperature cannot exceed the upper comfort limit for more than 3% of the occupied summer hours).

2) TM59 Bedrooms only - An additional requirement must be checked for the bedrooms to guarantee comfort during the sleeping hours. The resultant temperature in the bedroom from 10pm to 7am cannot exceed 26°C for more than 1% of annual hours (1% of hours between 22:00-07:00 for bedrooms is 32 hours).

1.5. The modelling has been conducted using design weather data taken from the file Swindow Weather Centre - Design Summer Year 1 (Swindon DSY 1 - 2050s, high emissions, 50% scenario). The weather files have been chosen as most appropriate following guidance from TM59:2017 and the CL2.1 SBEM Weather location lookup.

1.6. The modelling has been carried out to coply with planning condition 9 (:19/01036/HYBRID):

No development shall take place until an updated Overheating Report to consider a predicted 2050 climate scenario has been submitted to and approved in writing by the Local Planning Authority. The report shall consider whether there is a need for additional mitigation required to ensure the development does not overheat in the 2050 climate scenario and full details of that mitigation shall be provided. The development shall be implemented in accordance with the approved details.

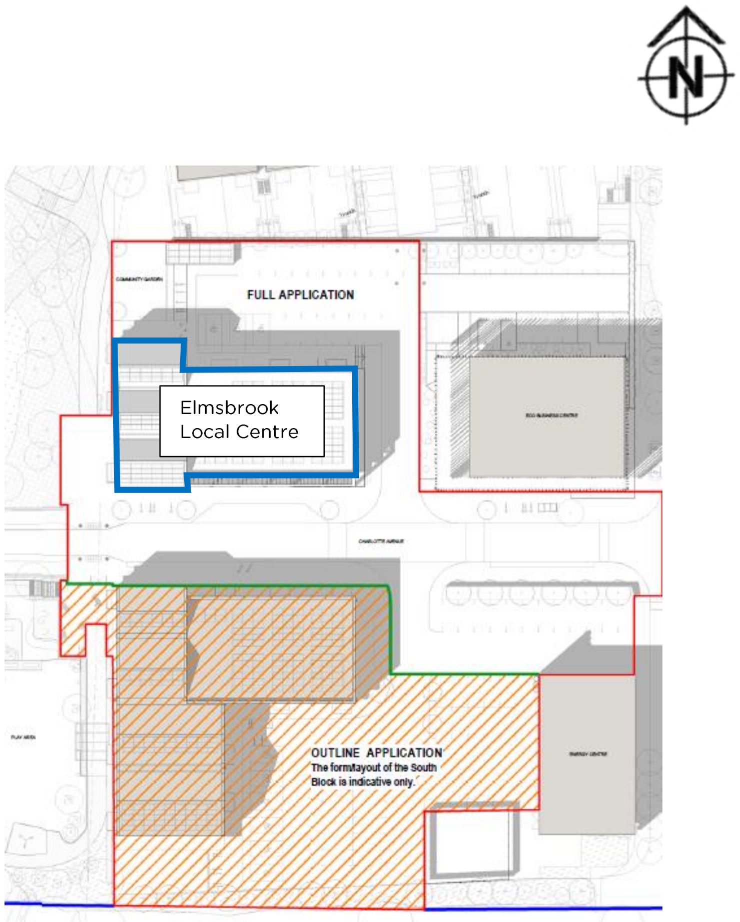

Figure 1. Proposed Site Layout

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Swindon DSY 1 - 2050s, high emissions, 50% scenario

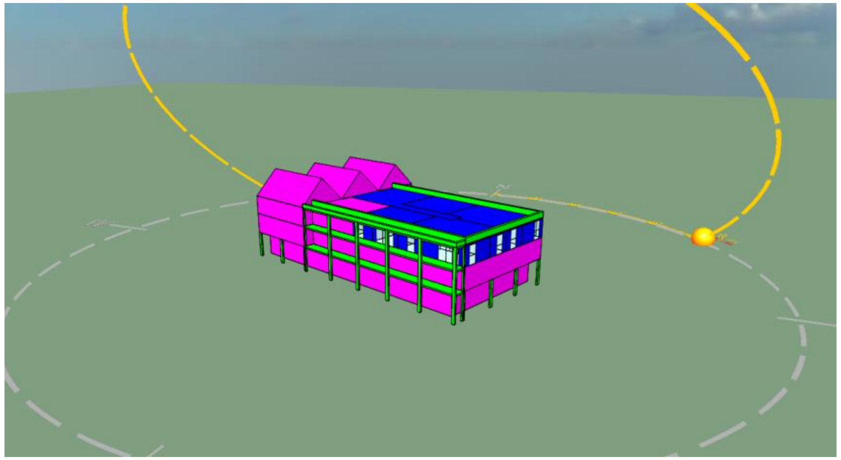
1.7. Initial results indicate that there is no risk of overheating using the base specification with a Windows U value of 1.29 / g-value of 0.50.

Table 1: Thermal modelling results (Swindon DSY 1 - 2050, high emissions, 50% scenario)

	Results apartments 14 / 15 and communal corridors
Base case	No high risk of overheating to apartments 14 & 15 (criterion a) and b) of CIBSE TM59 met). Communal Corridors are within the limits of operational temperature no greater than 28°C for more than 3% of the year.
Mitigation Measure 1	N/A

1.8. The modelled base case is shown to be effective for all rooms (Living/ Kitchen/ Bedrooms) on dwellings.

1.9. Based on these results, we would recommend that the windows specification for all apartments incorporates a g- value of 0.50g in order to mitigate the high risk of overheating.



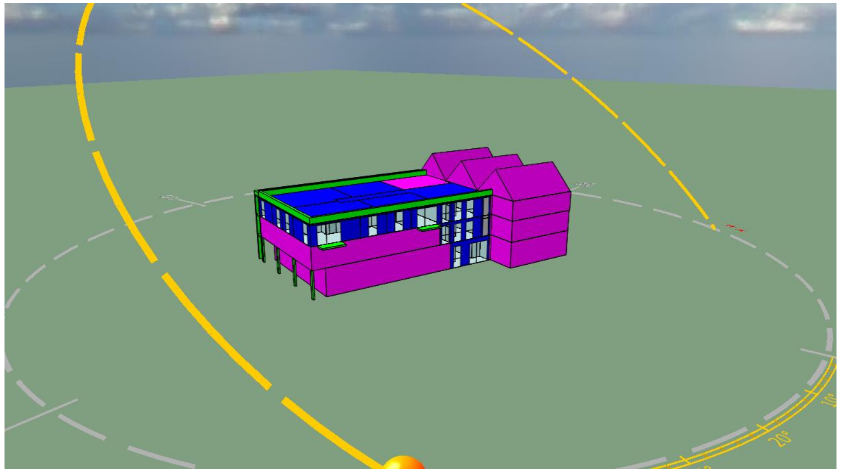


Figure 2 & 3. 3D Model (IES VE)

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2. Scope and Limitations

2.1. Part L1A – Building Regulations 2013 Criterion 3 – Limiting the effects of solar gains during the summer states that reasonable provision should be made to limit solar gains. This can be achieved by an appropriate combination of window size and orientation, solar protection through shading and other solar control measures, ventilation (day and night) and high thermal capacity.

2.2. This is assessed within SAP in terms of regulatory compliance, however, this is a not a particularly sensitive analysis. Assessing the risk in accordance with CIBSE guidance provides a more in-depth analysis.

2.3. Living areas and bedrooms are the rooms that should be considered most closely as it is envisaged that these will be the rooms occupied for significant periods of time. Bedroom temperatures are likely to be most critical as people find sleeping difficult in the heat. Rooms such as bathrooms, circulations spaces, store rooms and kitchens do not have overheating criteria or a suggested maximum temperature as it is envisaged that no one will occupy these rooms for a significant period of time.

2.4. The purpose of this report is to ascertain whether internal temperatures are likely to exceed the criterion recommended in CIBSE TM59:2017 – Design methodology for the assessment of overheating risk in homes.

2.5. This methodology provides a baseline for all domestic overheating risk assessments. and will:

1) Allow different designs to be compared with a common approach based on reasonable assumptions.
2) Support design decisions that improve comfort without cooling.
3) Provide consistency across the industry as all consultants will be using the same methodology for overheating risk prediction.

2.6. This methodology will not:

1) Guarantee that people will always be comfortable, however they act.
2) Take into account unusual use.

2.7. Compliance is based on passing BOTH of the following 2 criteria:

a) TM52 Criterion 1 must pass (Operative temperature cannot exceed the upper comfort limit for more than 3% of the occupied summer hours)
b) TM59 Bedrooms only - An additional requirement must be checked for the bedrooms to guarantee comfort during the sleeping hours. The resultant temperature in the bedroom from 10pm to 7am cannot exceed 26°C for more than 1% of annual hours (1% of hours between 2200-0700 for bedrooms is 32 hours).

2.8. If a dwelling fails above criteria, measures should be investigated to reduce internal temperatures and therefore reduce the likelihood of overheating.

2.9. To ensure that the CIBSE standards are met it is necessary to use appropriate simulation software in the design process and introduce adequate measures to ensure it is maintained within the completed dwellings. In order to assess the overheating risk IES Virtual Environment has been used. IES Virtual Environment is a state-of-the-art dynamic modelling software tool for assessing building energy, carbon, lighting and thermal comfort.

2.10. IES version 2019 'Apache Sim' has been used to carry out dynamic simulation to analyse the thermal comfort likely to be experienced within the apartments. The full dynamic simulation in accordance with CIBSE TM59:2017 combines the effects of:

- Annual Design Summer Year (DSY) weather data as produced by CIBSE;
- Casual, lighting and people heat gains;
- Thermal mass of the building;
- Solar heat gain.

2.11. All results and strategies are directly affected by the inputs listed in this document. Any deviations from these will affect the results. It is important to note that with any modelling exercise there are assumptions and approximations that have to be made. Details of all assumptions made and approximations used are supplied as part of the report.

2.12. The results give an indication of the predicted environmental conditions based on weather data and the anticipated operation strategy of the building.

2.13. The predicted simulated internal temperatures generated by the software may not match the actual internal air temperatures due to several reasons, for example, change in space function, use of equipment, natural wear and tear of building elements, global climate change and metrological changes, change in operation management of apertures etc.

3. Introduction to Overheating in Modern Dwellings

3.1. The project team should consider the risk of overheating in their building designs very early in the design process as it has the potential to not only cause discomfort for building occupants, but also cause potentially harmful medical conditions such as dehydration or heat exhaustion.

3.2. People may feel hot, uncomfortable and show lower productivity when temperatures reach between 25-28°C. Indoor operative temperatures that stay at or over 28°C for long periods of the day will result in dissatisfaction for many occupants. This can be expressed as the occupant experiencing thermal discomfort and in some cases thermal stress. Thermal discomfort is where occupants feel uncomfortable as they are too hot (or cold). Thermal stress is where the thermal environment will cause potentially harmful medical conditions such as dehydration or heat exhaustion. Vulnerable people, such as the elderly are particularly susceptible to health problems due to overheating.

3.3. Homes in the UK have not historically been associated with overheating. This is most likely due to a combination of the heavyweight materials from which they were constructed, a low level of thermal insulation and high levels of uncontrolled ventilation through minor gaps in the fabric.

3.4. The use of heavyweight materials provides high thermal mass within the building envelope. This ensures that external daily temperature variations are not reproduced as quickly inside the building because the fabric will absorb heat during the day and release it slowly when temperatures drop at night. In this way, the impact of maximum heat levels reached during the day is delayed by the thermal mass of the building and can be counter-balanced by strategies that make use of the cool of the night.

3.5. Modern homes are usually constructed from lightweight materials, are highly insulated, have been built to high standards of air tightness and have double-glazed windows that have coatings specifically designed to trap the sun's heat. This results in more heat being retained within the homes which is not able to be absorbed by the lightweight fabric.

3.6. Rooms with large glazing areas to their South and West facades are likely to be those at highest risk of overheating. South facades receive the highest amount of direct sunlight when the sun is highest, whilst West facades experience unwanted solar gains from low-level sun in the evenings. Proposed mitigation measures need to take account of the difference in the position of the sun during the day as some measures will work on certain facades but not on others. For example, overhangs can block out the sun when it is high in the sky but will have little effect if installed on West facing elevations when the sun is low in the sky.

3.7. Overheating in apartments is a greater risk where apartments are designed with a single-aspect and where community heating pipework is routed through corridors and common spaces. In these situations, high internal temperatures are often caused by a combination of inadequate ventilation and excessive heat discharged by heating pipework.

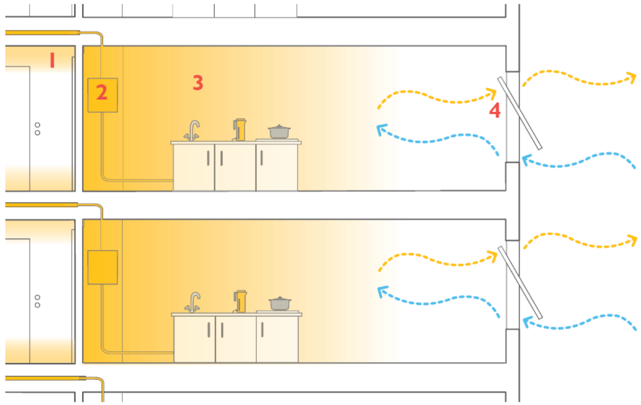

Figure 4. Service design in apartments, cumulative effects of individual heat gains

3.8. Mechanical services installed in apartments cause heat gains in the same way as in houses; however with limited scope for ventilation their impact becomes more significant. Consequently, a different strategy is required to ensure that unwanted heat is removed. In blocks where space and water heating is provided by a community heating system, the CIU is permanently charged with hot water all year round to meet the hot water demand. This unit, particularly if not well insulated, may effectively emit heat like a radiator in the dwelling. It is often positioned in an unventilated cupboard or kitchen so heat transfers directly to the living spaces.

3.9. In addition, the distribution pipework for the community heating system often runs through the corridors and common spaces. Since this pipework is constantly emitting heat, it can cause high temperatures in these spaces, especially when there is insufficient ventilation. Even well-insulated heating systems will emit heat, albeit at a slower rate. Unless there is a strategy to remove this heat it will be transferred from common areas into the adjacent apartments.

4. Methodology and Key Assumptions

Methodology

4.1. CIBSE has undertaken considerable consultation and research on the impact of climate change on the indoor environment and weather data. TM52:2013, TM59:2017, CIBSE Guide A 2015, AD Part L1A 2013, AD Part F 2013 and SAP 2012 provide data on maximum average temperatures, ventilation rates and overheating criteria for areas of dwellings as illustrated below. We have used this data as the basis for our analysis and the recommendations presented in this report.

4.2. Building Regulations Part F 2013 states that for dwellings the whole dwelling ventilation rate for the supply of air to the habitable rooms should be no less than the rates detailed in the Table 2 below.

Table 2: Part F minimum standards for new dwellings

	Number of bedrooms in dwelling				
	1	2	3	4	5
Whole dwelling ventilation rate [a, b] (l/s)	13	17	21	25	29

Notes:

a. In addition, the minimum ventilation rate should be not less than 0.3 l/s per m² of internal floor area. (This includes all floors, e.g. for a two-storey building add the ground and first floor areas.)

b. This is based on two occupants in the main bedroom and a single occupant in all other bedrooms. This should be used as the default value. If a greater level of occupancy is expected add 4 l/s per occupant.

4.3. The proposed ventilation for all of the apartments in this development is continuously running fans. These units individually extract air from wet rooms, such as bathrooms and kitchens.

4.4. The proposed mechanical ventilation for all of the apartments in this development is centralised Mechanical Ventilation (cMEV). This system is a whole house ventilation system that extracts air from wet rooms, such as bathrooms and kitchens.

4.5. Fans are continuously running and have been taken into account within this assessment with the assumption that minimum rates stated in Part F (0.30l/s per m² of floor area) will be achieved in all rooms.

Weather Data

4.6. Our analysis has been carried out using average weather data appropriate to the location of the proposed development. The weather files that have been used are Swindon Weather Centre:

- Swindon DSY 1 - 2050s, high emissions, 50% percentile scenario

4.7. Figure 5 below shows a typical metrological year for Swindon using DSY 1 2050 weather data. Dry bulb temperature excees 31.6°C in August and the maximum adaptive temperature is exceeded 46 hours over the course of a year.

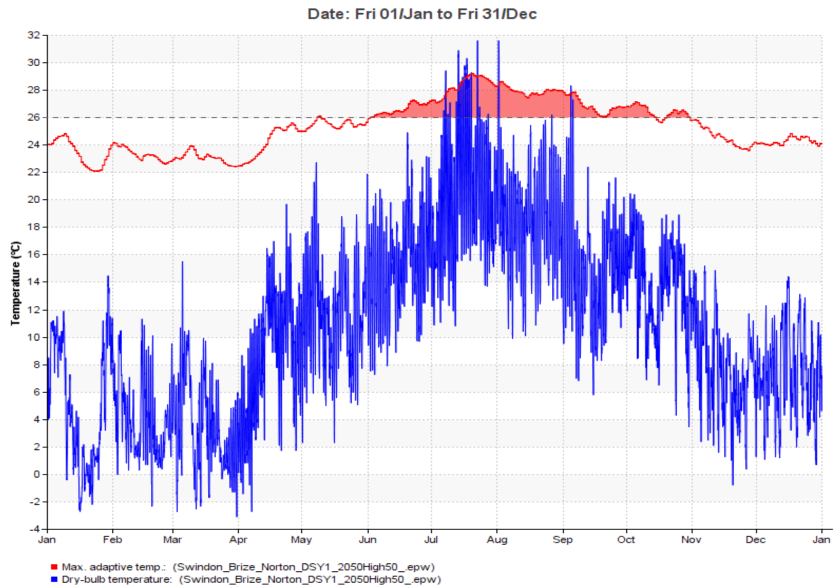

Figure 5: Temperature profile Swindon DSY 01 2050, high emissions, 50% percentile scenario [Screenshot – IES VE 2019]

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Development Design

4.8. The modelling has been based upon the architectural plans: issue dated 08.04.2020 – Revision P1 provided by Mark Bell Architects, on 24.04.2020. For more detailed apartment designs, please see Appendix B of this report.

4.9. The following design criteria have been used in the modelling software to perform the calculations and modelling to assess the risk of summertime overheating.

Building Fabric

4.10. The building elements were modelled according to the construction specification detailed in the table below, with derivation of an overall U-value calculated using the BRE U-value calculator, or by the software used for the overheating analysis.

Table 3: Baseline Building Fabric

Construction Elements	U-value in [W/m2K]	Kappa in (kJ/m²K)
Ground Floor	0.20	76
External Wall	0.18	61
Wall to Corridor	0.23	61
Main Roofs	0.12	140
Int. Ceiling & Floor	N/A	140
Party Wall	N/A	61
Internal Partitions	N/A	9
Windows	U=1.29	g=0.50
Infiltration	CIBSE A 2015 - Table 4.24	0.35 ACH

*Kappa values stated for structural element only. DSM model accounts for low thermal mass including the plasterboard of the suspended ceiling.

Lighting Gains

4.11. The following table summarises the assumed lighting gains used in the base model. Light energy is assumed to be proportional to the floor area. Only summer months are assessed from 6pm to 11 pm.

Table 4: Lighting Gains

Area	Lighting Gains in (W/m2)	Notes
All rooms	2.0	TM59

Natural Ventilation

4.12. One of the most effective ways of addressing the risk of overheating in homes is to have a well thought out strategy for purge ventilation (supply of large amounts of fresh air in a short period of time).

4.13. This can be achieved by providing means for cross-ventilation, circulating large amounts of air through the home. Where mechanical ventilation is used, occupants should still be able to open windows adequately and in a secure manner, even if only for a short period of time.

Table 5: Ventilation & Shading Strategy

	Notes
Ventilation Strategy	Calculated natural ventilation (MacroFlo). Windows / doors are allowed to be open when internal temperatures are higher than ambient temperatures and internal dry-bulb temperature exceeds 22°C.
Shading Strategy	Shade from external balconies included in model.

4.14. Natural ventilation via openable windows has been allowed during times when the room being assessed is occupied. For a more detailed schedule of ventilation assumptions, please see Appendix D of this report.

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Occupancy Gains

4.15. Maximum Sensible Gain assumptions are based on CIBSE Guide A 2015 at 75 W/person and Maximum Latent Gain of 55 W/person. See Appendix C for full occupancy profiles.

Equipment Gains

4.16. It is assumed that apartments with the same number of occupants and bedrooms are usually provided with the same appliances, therefore any gains resulting from them is assumed to be independent of floor area.

4.17. The following equipment gains have been assumed for the rooms being assessed. Equipment gains for the living room are based on CIBSE TM59. Variation profiles are shown in Appendix C.

Table 6: Equipment gains

Room	Equipment gains (W)	
Living/Kitchen	450	ICT (information and communications technologies), Audio-visual and Kitchen appliances and others
Bedroom	80	Laptop or TV

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5. Results – Summertime Overheating Modelling

5.1. The following table illustrate the results using the design specification, mechanical and natural ventilation. The results are compared with the recommendations from TM59:2017 as stated earlier in this report.

Items within the table:

- Items in Red DO NOT comply with the CIBSE recommendations
- Items in Green DO comply with the CIBSE recommendations

5.2. Natural ventilation via openable windows has been allowed once the internal air temperature exceeds a comfortable temperature, which is modelled as 22°C.

5.3. Compliance is based on passing BOTH of the following 2 criteria:

1) TM52 Criterion 1 must pass (Operative temperature cannot exceed the upper comfort limit for more than 3% of the occupied summer hours)

2) TM59 Bedrooms only - An additional requirement must be checked for the bedrooms to guarantee comfort during the sleeping hours. The resultant temperature in the bedroom from 10pm to 7am cannot exceed 26°C for more than 1% of annual hours. (1% of hours between 22:00-07:00 for bedrooms is 32).

Results - Natural Ventilation - (Base Case)

5.4. The below table shows the detailed results against CIBSE TM59:2017 criteria when using a glazing g-value of 0.50 to all elevations.

Table 7. Results – Natural Ventilation (Base Case)

Apartment	Room Name	Criteria 1	Criteria 2	Pass / Fail
Flat 14	Living / Kitchen	1.3	N/A	Pass
	Bedroom 01	0.1	17	Pass
	Bedroom 02	0.2	7	Pass
Flat 15	Living / Kitchen	0.2	N/A	Pass
	Bedroom 01	0.0	21	Pass

5.5. The results show there is no significant risk of overheating within the living/kitchen and bedrooms when compared with CIBSE TM59. The maximum hours of exceedance are not above the 3% threshold.

5.6. The results show that the predicted hours over and above 26°C in Bedrooms between 10pm and 7am are less than 32 hours in total and therefore the second design criteria is met.

6. Overheating risk to communal corridors

6.1. The communal corridors within the development have been included within the analysis. Whilst there is no mandatory target to meet, in line with CIBSE TM59 guidance, if an operative temperature of 28 °C is exceeded for more than 3% of the total annual hours, then this should be identified as a risk.

6.2. The communal corridors, whereby access can be gained from the apartments, have been assessed.

6.3. The overheating test for corridors should be based on the percentage number of annual hours for which an operative temperature of 28 °C is exceeded.

Development Design

6.4. The modelling has been based upon the architectural plans: issue dated 08.04.2020 – Revision P1 provided by Mark Bell Architects, on 24.04.2020.

6.5. The following design criteria have been used in the modelling software to perform the calculations and modelling to assess the risk of summertime overheating.

Building Fabric

6.6. The building elements were modelled according to the construction specification used for the residential apartments, with derivation of an overall U-value calculated using the BRE U-value calculator, or by the software used for the overheating analysis.

Lighting Gains

6.7. No gains from lighting have been assumed for the corridors, as per TM59 for corridors with passive infrared (PIR) sensors.

Natural Ventilation

6.8. The model includes all windows and doors, which are assumed to be openable, as well as windows being used for AOV being openable in the event of internal dry bulb temperatures exceeding 22°C.

Table 8: Ventilation & Shading Strategy

	Notes
Ventilation Strategy	Calculated natural ventilation (MacroFlo). Windows are allowed to be open when: - internal temperatures are higher than ambient temperatures, - internal dry-bulb temperature exceeds 22°C
Shading Strategy	Shade from external balconies included in model.

Infiltration

6.9. An infiltration rate of 0.35 air changes per hour has been utilised for the model derived by CIBSE Guide A, Table 4.24.

Occupancy Gains

6.10. Due to the transitory nature of the corridors, occupancy is assumed to be zero.

Heat Gains

6.11. Communal corridor heat gains should be modelled based on calculated losses from pipework (see CIBSE Guide C (2007) and/or the Domestic Heating Design Guide (DBSP, 2015)), or based on the simplifed method provided in Table 5 of the Domestic Building Services Compliance Guide (HMG, 2013).

6.12. For this overheating study, the NCM methodology internal gains were used for the corridors. In order to define the heat gains from the distribution pipework the default heat loss of 10.07 W/m from pipework Table 5 as per the CIBSE TM59 suggestion.

Results - Natural Ventilation – Communal Corridors (Base Case)

6.13. The following table illustrates the results using the design specification, mechanical and natural ventilation. The results are compared with the recommendations from TM59:2017 as stated earlier in this report.

Items within the table:

- Items in Red DO NOT comply with the CIBSE recommendations
- Items in Green DO comply with the CIBSE recommendations

6.14. Natural ventilation via openable windows has been allowed once the internal air temperature exceeds a comfortable temperature, which is modelled as 22°C.

6.15. The overheating test for corridors should be based on the number of annual hours for which an operative temperature of 28 °C is exceeded.

6.16. The results demonstrate that the suggested ventilation strategy will be compliant with CIBSE TM59 criteria, i.e. T>28 ˚C for less than 3% of the annual hours.

Table 9: Results of communal corridors overheating analysis

	Operative temperature (°C) - % hours in range >28.00
Location	> 28.00
GF Communal Stairs	1.0
1F Communal Stairs	0.2
1F Communla Corridor	0.0
2F Communal Stairs	0.4
2F Communla Corridor	0.0
Total hours (% of sum)	0.3

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References

CIBSE Guide A: Environmental Design. Chartered Institute of Building Services Engineers, London, 2015.

CIBSE TM36: Climate change and the indoor environment: Impacts and adaptation. (Principal authors Hacker J N, Holmes M J, Belcher S B, Davies G D). Chartered Institute of Building Services Engineers, London, 2005

CIBSE TM37: Design for improved solar shading control. (Principal author Paul Littlefair, BRE). Chartered Institute of Building Services Engineers, London, 2005

CIBSE TM52: The limits of thermal comfort: Avoiding overheating in European buildings. (Principal author Fergus Nicol, Oxford Brookes University). Chartered Institute of Building Services Engineers, London, 2013. ISBN 978-1-906846-34-4.

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The Building Regulations 2013: Conservation of Fuel and Power Part L1A. Conservation of fuel and power (New dwellings) (2013 edition).

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NHBC Foundation: Understanding overheating – where to start: An introduction for house builders and designers. NHBC Foundation by Richards Partington Architects. (July 2012), Milton Keynes. ISBN 978-1-84806-279-5

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Thermal simulation software: IES Virtual Environment – Version 2019

Weather file: CIBSE, in collaboration with UK Climate Impacts Programme (UKCIP). - http://www.cibse.org/index.cfm?go=page.view&item=1300

Appendix A – TM59 Risk factors

Risk Factors

A simple list of risk factors is provided below to assist in determining developments that have low risk of overheating and therefore do not require dynamic thermal modelling.

It is recommended that the risk factors are used for the assessment of all units and properties are identified as being at risk when they have answered 'yes' against any one of the risk factors below.

- ☐ Site location – South East England, Urban e.g. central London or in a high density urban area (UHI effect)
- ☐ Occupancy – Vulnerable people (elderly, disabled, young children), occupants likely to be at home during the day (e.g. students)
- ☒ Dwelling type – top floor, single aspect
- ☒ Fabric type – lightweight, dark colour facades, air tight constructions
- ☒ Orientation – South, south east/west
- ☒ Glazing – glazing ratio greater than 25%, roof lights
- ☐ Environmental factors that restrict the opening of windows – noise and air quality (e.g. near busy roads, railways, airports and flight paths, industrial activities, security (e.g. ground floor flats)

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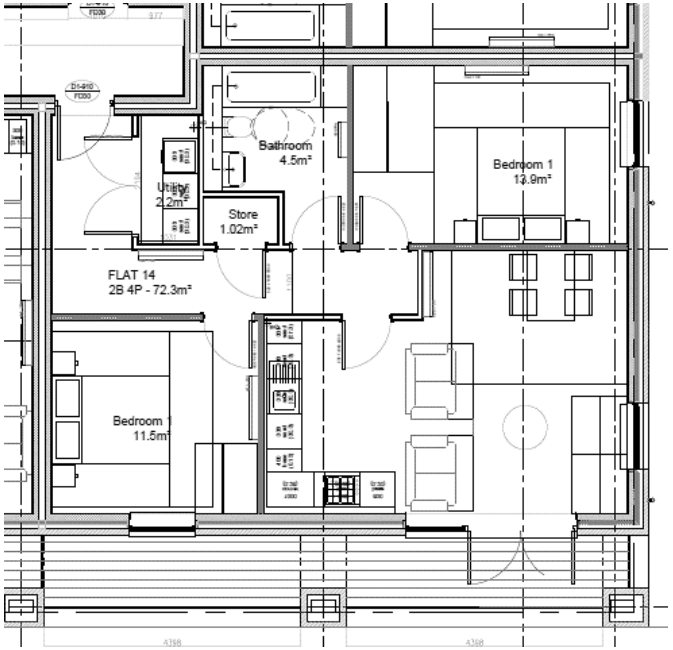
Appendix B – Dwelling designs

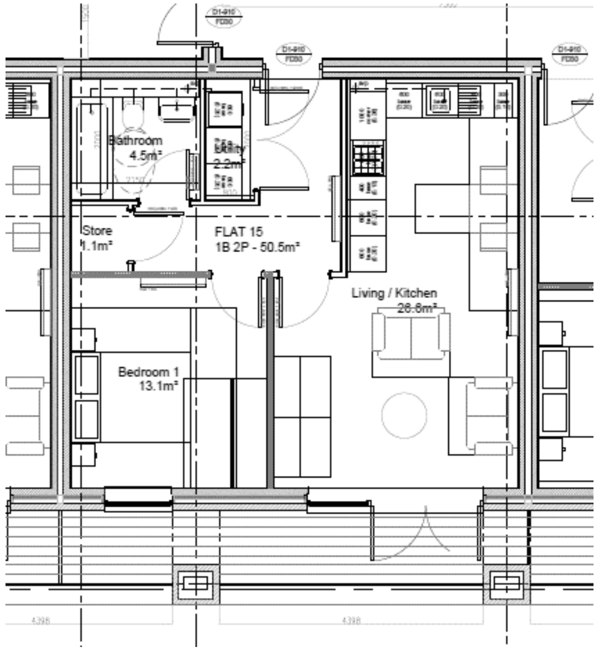
Development Design

The modelling has been based upon the architectural plans: issue dated 08.04.2020 – Revision P1 provided by Mark Bell Architects, on 24.04.2020

Floor Name:	Second Floor
Plot Number:	Flat 14



Floor Name:	Second Floor
Plot Number:	Flat 15



Appendix C – Modelling schedules

It is noted that the CIBSE TM59 method only assesses the overheating risk during occupied hours. The occupancy assumed is based on a typical lifestyle pattern for the occupants of each storey. The graphs illustrate the hours during which occupancy gains have been assumed.

The apartments have been modelled as occupied for 24 hours a day.

Kitchen / Living Rooms

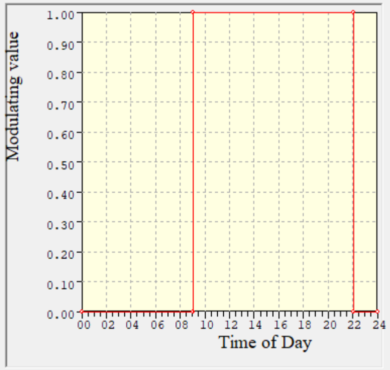
Kitchen/Living rooms will be unoccupied during the sleeping hours and occupied during the rest of the day. This is the worst case scenario since the room will be modelled as occupied during the hottest hours of the day.

No differences between weekdays and weekend are considered.

Living / Kitchen occupancy

Profile: Occupancy - 2Bed Living/ Kitchen
ID: DAY_0010
Modulating / Absolute
Categories: Occupancy

	Time	Value
1	00:00	0.000
2	09:00	0.000
3	09:00	1.000
4	22:00	1.000
5	22:00	0.000
6	24:00	0.000



1, 2 bed apartment kitchen/living

1 person from 9am to 10pm at 100% gains

Room is unoccupied for the rest of the day

Double bedrooms

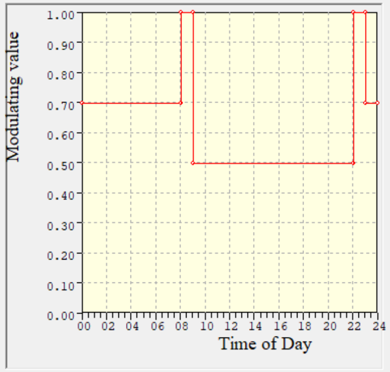
Bedrooms will be set with a 24h occupancy profile which means that 1 person is always considered inside the room during the daytime, and two people in each double bedroom at night.

For apartments with more than 1 bedroom, 1 person will be considered during the daytime in both the bedrooms in order to assess the worst case scenario. This means that one excess person to the real number of occupants will be considered in the dwelling during the day (a visitor).

Double Bedroom occupancy

Profile: Occupancy Double Bedroom TM59
ID: DAY_0007
Modulating / Absolute
Categories: Occupancy

	Time	Value
1	00:00	0.700
2	08:00	0.700
3	08:00	1.000
4	09:00	1.000
5	09:00	0.500
6	22:00	0.500
7	22:00	1.000
8	23:00	1.000
9	23:00	0.700
10	24:00	0.700



2 people are in the bedroom with 30% reduced gains from 11pm to 8am and with full gains from 8am to 9am and from 10pm to 11pm; 1 person at full gain is in the bedroom from 9am to 10pm

Single bedrooms

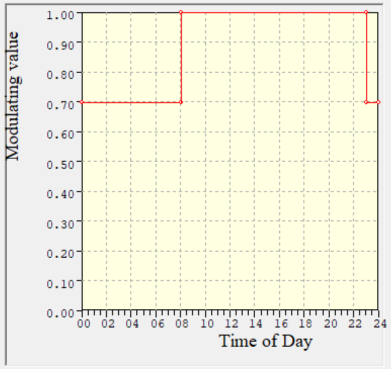
Bedrooms will be set with a 24h occupancy profile which means that 1 person is always considered inside the room during the daytime, and two people in each double bedroom at night.

For apartments with more than 1 bedroom, 1 person will be considered during the daytime in both the bedrooms in order to assess the worst case scenario. This means that one excess person to the real number of occupants will be considered in the dwelling during the day (a visitor).

Single Bedroom occupancy

Profile: Single Bedroom Occupancy
ID: DAY_0004
Modulating / Absolute
Categories:

	Time	Value
1	00:00	0.700
2	08:00	0.700
3	08:00	1.000
4	23:00	1.000
5	23:00	0.700
6	24:00	0.700



1 person is in the bedroom with 30% reduced gains from 11pm to 8am and with full gains from 8am to 11pm

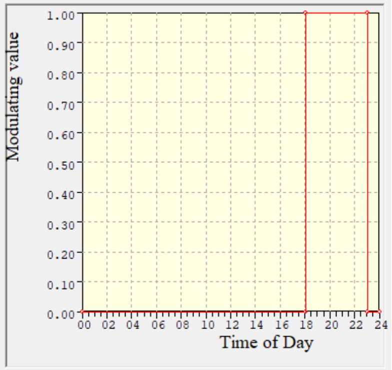
Lighting

Light energy is assumed to be proportional to floor area, so W/m² is used for lighting load. 2 W/m² from 6pm to 11pm is used as default to reflect an efficient new build.

Lighting

Profile: Lighting TM59
ID: DAY_0009
Modulating / Absolute
Categories: Lighting

	Time	Value
1	00:00	0.000
2	18:00	0.000
3	18:00	1.000
4	23:00	1.000
5	23:00	0.000
6	24:00	0.000



Equipment loads and profiles

It is assumed that apartments with the same number of occupants and bedrooms are usually provided with the same appliances, therefore the heat load from appliances is assumed to be independent of floor area for the purpose of overheating risk assessment. Heat loads from appliances are defined in Watts.

Single/ Double Bedrooms

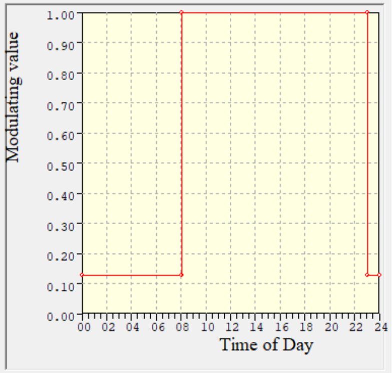
Profile: Equipment Double Bedroom TM59

ID: DAY_0008

Modulating / Absolute

Categories: Equipment

	Time	Value
1	00:00	0.130
2	08:00	0.130
3	08:00	1.000
4	23:00	1.000
5	23:00	0.130
6	24:00	0.130



Assumed equipment in the bedroom (e.g. laptop or TV) with a peak load of 80 W from 8am to 11pm and a base load of 10 W during the sleeping hours.

Living/Kitchen room – 1 Bedroom, 2 Bedroom Apartments

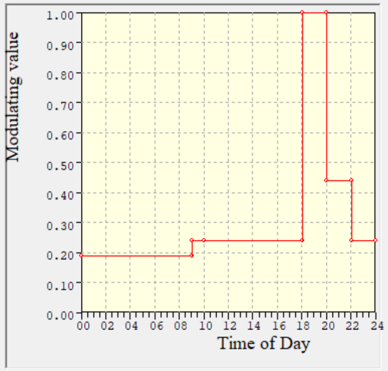
Profile: Equipment - 2Bed Living/ Kitchen

ID: DAY_0011

Modulating / Absolute

Categories: Equipment

	Time	Value
1	00:00	0.190
2	09:00	0.190
3	09:00	0.240
4	10:00	0.240
5	18:00	0.240
6	18:00	1.000
7	20:00	1.000
8	20:00	0.440
9	22:00	0.440
10	22:00	0.240
11	24:00	0.240



Peak load of 450 W from 6pm to 10pm. 200 W is assumed from 8pm to 10pm. 110 W is assumed from 9am to 6pm and from 10pm to 12pm. For the rest of the day a base load of 85 W is assumed.

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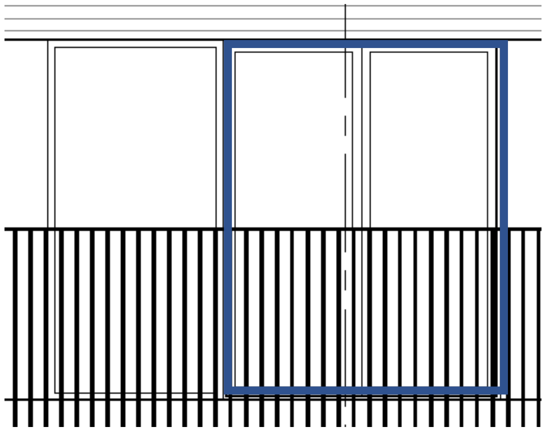
Appendix D - Assumptions for Natural Ventilation

In order to address the risk of security at ground floor level windows have been assumed closed when the rooms are not occupied.

In absence of a security risk above this level, all windows have been assumed openable 24/7 if the below conditions are met. The window schedule details below refer only to the openable parts of the windows. Glazing area which is not openable has been characterised as such in the software.

Flat 14 / Living Room French Door



Exposure Type:
Exposed wall

Category:
Window / Door – side hung

Openable Area:
70% (frame factor 70%)

Max Angle Open:
30°

Proportions:
Length/Height < 0.50

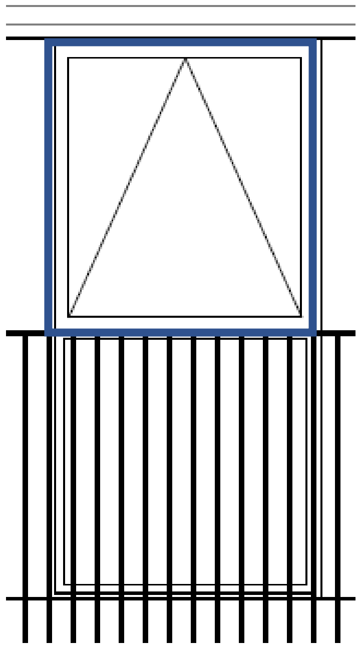
Equivalent area:
41%

Assumed openable::
09:00 – 22:00

Opening threshold 22°C, and internal temperature higher than ambient temperature

Notes:

Flat 14 / Living Room window



Exposure Type:
Exposed wall

Category:
Window – top hung

Openable Area:
70% (frame factor 70%)

Max Angle Open:
30°

Proportions:
0.50 < Length/Height < 1

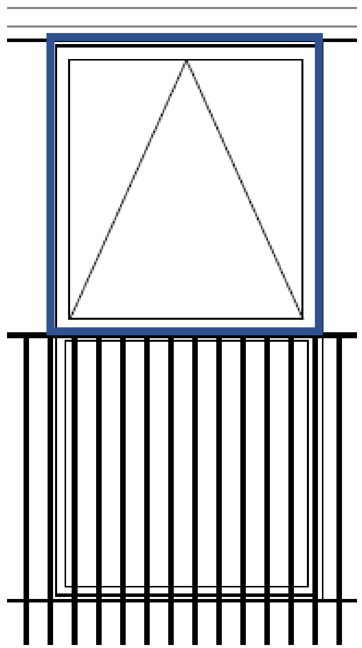
Equivalent area:
56%

Assumed openable::
09:00 – 22:00

Opening threshold 22°C, and internal temperature higher than ambient temperature

Notes:

Flat 14 / Bedroom 1 window



Exposure Type:
Exposed wall

Category:
Window – top hung

Openable Area:
70% (frame factor 70%)

Max Angle Open:
30°

Proportions:
0.50 < Length/Height < 1

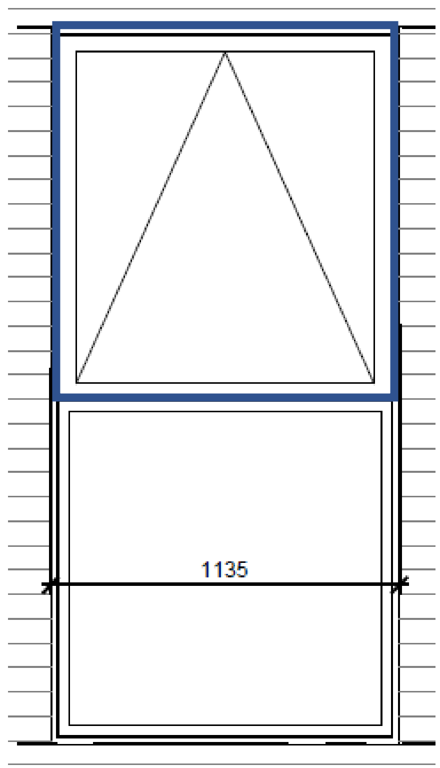
Equivalent area:
56%

Assumed openable::
24/7

Opening threshold 22°C, and internal temperature higher than ambient temperature

Notes:

Flat 14 / Bedroom 2 window



Exposure Type:
Exposed wall

Category:
Window – top hung

Openable Area:
70% (frame factor 70%)

Max Angle Open:
30°

Proportions:
0.50 < Length/Height < 1

Equivalent area:
56%

Assumed openable::
24/7

Opening threshold 22°C, and internal temperature higher than ambient temperature

Notes:

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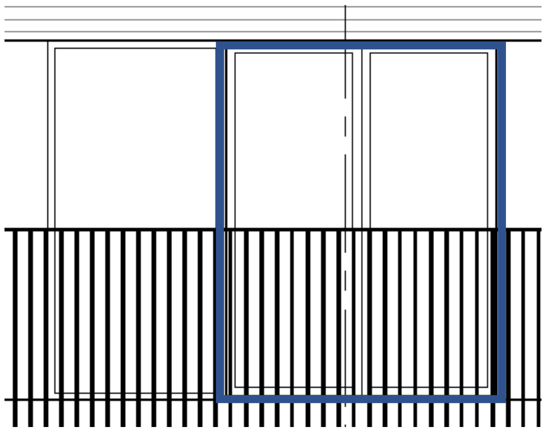
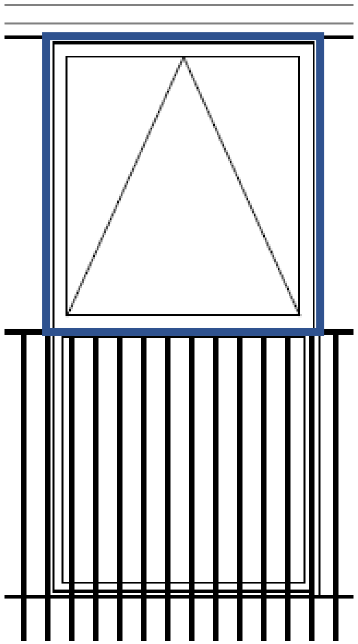
Flat 15 / Living Room French Door	
	Exposure Type: Exposed wall Category: Window / Door – side hung Openable Area: 70% (frame factor 70%) Max Angle Open: 30° Proportions: Length/Height < 0.50 Equivalent area: 41% Assumed openable:: 09:00 – 22:00 Opening threshold 22°C, and internal temperature higher than ambient temperature
Notes:	

Flat 15 / Bedroom 1 window	
	Exposure Type: Exposed wall Category: Window – top hung Openable Area: 70% (frame factor 70%) Max Angle Open: 30° Proportions: 0.50 < Length/Height < 1 Equivalent area: 56% Assumed openable:: 24/7 Opening threshold 22°C, and internal temperature higher than ambient temperature
Notes:	

Appendix C: Condition 11 – Water Minimisation

Water consumption - building microcomponents

		WC	Urinals	Wash hand basin taps	Showers	Baths	Kitchen taps (staff/residents kitchen)
Component assessed for building type (if specified)		Yes	Yes	Yes	Yes	No	Yes
Please confirm if this component type is specified in the building and will be installed		Specified	Not Specified	Specified	Not Specified		Specified
Please select the number of different types of specification that you wish to enter for this		2		1			1
Type 1	Please confirm the BREEAM water efficient component level achieved for this	5		5			5
	Please confirm the no. of type 1 components specified	6					
	Type 1 - aggregate component level	3.75		5.00			5.00
Type 2	Please confirm the BREEAM water efficient component level achieved for this	5					
	Please confirm the no. of type 1 components specified	2					
	Type 2 - aggregate component level	1.25					

Total number of fittings for component	8									
Level achieved for component type	5.00		5.00			5.00				
Component weighting factor for building type	49.77%		32.18%			18.05%				
Contribution to overall component level achieved	2.49		1.61			0.90				
Overall component level achieved	5.00	*Note: for the purpose of awarding credits this figure is rounded down to the nearest whole component level, e.g. if the total from the individual component*								