Abbey Road Phase 3

Approved Document Part O: Overheating assessment
Building Physics

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Quality information

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Table of Contents

Figures

Tables

1. Executive Summary

An overheating analysis was undertaken for the Abbey Road Phase 3 development following the CIBSE TM59 and Approved Document Part O: Overheating methods. The analysis covered a total of 27 sample units selected equating to around 20% of the site, which formed a good representation of the site. The overheating analysis was also undertaken on a number of sample corridors following the CIBSE TM59 methodology.

The Approved Document Part O 2021 provides guidance on how to comply with Part O of the Building Regulations. New requirement O1 (overheating mitigation) can be demonstrated by using either the simplified method or the dynamic thermal modelling method.

The simplified method is not appropriate for buildings with more than one residential unit with a communal heating or hot water system, or with high noise levels at night therefore, the dynamic thermal modelling method is applicable to the Abbey Road Phase 3 development. To demonstrate compliance using the dynamic thermal modelling method, a few additional criteria need to be followed including defined window opening operation and compliance with acceptable strategies, these are detailed in Section 3.

Approved Document Part O referred to the CIBSE's TM59 methodology for predicting overheating risk. CIBSE TM59 laid out the following criteria:

- For apartments that are predominantly naturally ventilated, compliance is based on passing both of the following two criteria:
  a) For living rooms, kitchens and bedrooms the number of hours during which the difference between the operative temperature and the dynamic threshold comfort temperature exceeds 1°K or more during the period May to September inclusion shall not be more than 3 per cent of occupied hours.
  b) For bedrooms only, to guarantee comfort during the sleeping hours, the operative temperature in the bedroom from 10 pm to 7 am shall not exceed 26°C for more than 1% of annual hours. 1% of the annual hours between 22:00 and 07:00 is 32 hours, so 33 or more hours above 26°C will be recorded as a fail.
- The criteria for apartments that are predominantly mechanically ventilated should follow the CIBSE TM59 fixed temperature test, i.e. all occupied rooms should not exceed an operative temperature of 26 ˚C for more than 3% of the annual occupied annual hours.

For the communal corridors, CIBSE TM59 requires that the operative temperature should not exceed 28°C for more than 3% of the total annual hours or they are considered a significant overheating risk.

Based on the acoustics assessment, the units adjacent to the road and some of the units facing the rear of the site exceed the noise limits set by Approved Document Part O. Also, the ground floor sample units may also be subject to the security limitations in Approved Document Part O. Therefore, windows in these areas were modelled closed during the night-time period.

The building fabric was optimised to meet the Part L1A 2013 SAP requirements (also with view of complying with the 2021 updates), the energy strategy and the overheating study.

The base run was analysed for the relevant weather data (DSY 1) and was found to significantly overheat resulting in 100% of the sample units failing the assessment as the windows were unable to open at night due to the site constraints (i.e. noise and security). Similarly, if window restrictors were in use there was insufficient ventilation to mitigate overheating and again 100% of the units failed.

If the site had no noise or security constraints (i.e. manageable levels of noise and sufficient security measures implemented to the ground floor) and the windows were able to open fully during the day and at night-time periods, the majority of the sample units would achieve compliance. This is shown in option 2, resulting in approximately 85% of the sample units achieving a pass. The suggested improvements for option 3 (i.e. double casement with double openings in bedrooms and opening of balcony doors during peak periods in living rooms) were implemented on the relevant rooms. This resulted in approximately 96% of the sample units achieving a pass. If the living room and kitchen are combined into one room then this results in a 100% pass.

Given the acoustic constraints identified by the acoustic survey, which affected approximately 86% of the site, active solutions needed to be considered.

A mechanical ventilation solution was initially considered, however this indicated that excessively high flow rates would be required to achieve a pass under TM59. These flow rates cannot be practically achieved by standard MVHR units and would require a dedicated system. Such a system may have a significant impact on the external envelope, GA space allocation, room heights and energy usage, therefore an alternative MVHR temperature lopping solution was also considered.

The temperature lopping solution can achieve full compliance with CIBSE TM59 and Approved Document Part O. For several of the apartments with higher occupancy, reduced floor area and a greater solar exposure, the minimum unit cooling capacity had to be increased to achieve compliance. With the installation of internal blinds, it was possible to reduce a number of the cooling capacities. Please see Section 8.2 for detailed results.

Based on the analysis undertaken, with the site acoustic constraints, a temperature lopping solution with internal blinds appeared to be a reasonable solution to mitigate the overheating. This option was also tested and showed compliance under the more extreme weather tapes and therefore considered as the proposed design solution.

The corridor overheating assessment showed that with an increased mechanical ventilation operational run time, all corridors passed the TM59 analysis for the current and extreme weather tapes.

It should be noted that the estimated cooling capacities and ventilation rates are not explicitly for sizing purposes, only to demonstrate that mitigation of overheating can be achieved with a limited amount of cooling to the unit and ventilation to the corridors. Detailed sizing calculations on a room, apartment, and corridor basis should be undertaken at the next stage of design by the relevant parties.

The study also has followed the six-level hierarchy of cooling from the London Plan, as set out below, with the following design features incorporated in order to achieve the hierarchy measures:

- Minimise internal heat generation through energy efficient design
  - Heating pipework distribution runs have been minimised to recedes losses
  - All of the heat distribution and DHW distribution infrastructure will be insulated to minimise unwanted heat gains
  - Low energy lights have been included in all rooms
- Reduce the amount of heat entering a building in summer through orientation, shading, fenestration, insulation and green roofs and walls
  - The orientation is fixed, however the nature of the multiple blocks results in shading to other apartments
  - Glazing areas were reduced
  - A window g-value of 0.4
  - Window reveal depth of ~0.2m
  - Where applicable the balconies are also used as external shading devices to the below apartment
  - Well insulated walls and roof will be used to reduce conduction gains through the building fabric (wall U-value 0.15 W/m²K and roof U-value 0.10 W/m²K)
- Manage the heat within the building through exposed internal thermal mass and high ceilings
  - Some areas used a green roof system to take advantage of the additional thermal mass and thermal lag to help lower and off set internal peak temperatures
  - Limited exposed mass opportunities due to required level of finishes, but the ceiling height was maximised where reasonably possible

- Passive ventilation
  - Where feasible, the option of the opening windows and doors promotes the use of cross ventilation
  - Residents have the ability to override the 100mm restrictor on windows and open them fully when required for ventilation in an overheating situation
- Mechanical ventilation
  - MVHRs are provided in all areas
- Active cooling systems
  - Full mechanical ventilation and temperature lopping were considered
  - Given the location and constraints on this site, some temperature lopping integrated into the MVHR units is the most practical and reasonable solution

In keeping with CIBSE TM59 the design was developed to demonstrate that all units could potentially achieve a pass for a passive design approach via natural ventilation. However, the Approved Document Part O and the site acoustic constraints prevent windows opening on approximately 86% of the units. Implementing active temperature lopping for all units on the site was shown to be a reasonable solution to mitigate the overheating for the current and extreme weather tapes. This study should provide sufficient information to comply with the current GLA requirements.

It is important to take note that any design changes from the inputs laid out in this document may invalidate the results presented in this report and further studies may be required.

2. Introduction

This document details the inputs used in the CIBSE TM59 and Approved Document O overheating assessment for Abbey Road Phase 3 development. Previous overheating modelling was carried out on the site that included 6 initial sample units (4 units from Block A and 2 units from Block B) which helped to inform the early design. The sample unit selection was then expanded by 21 additional units.

The expanded sample overheating assessment was carried out on a total of 27 sample units, equating to approximately 20% of the site. The expanded sample units were selected to reasonably represent the site, taking account of unit type, location, orientation, and acoustic constraints. The selection concentrated on ground, lower/mid floor and top floor units. The units selected are shown in Appendix B.

An overheating assessment for the communal corridors were also undertaken following CIBSE TM59. The sample communal corridors cover one lower, and one upper floor for each block. The sample corridors are shown in Appendix C.

3. Design methodology

3.1 Software

AECOM uses IES software to undertake dynamic thermal modelling. In this instance, version 2021.3.1.0 has been used. This uses the SunCast module to model sun paths and account for solar shading. The Macroflo bulk airflow module within IES allows the user to set the openable area and window or opening type. The software calculates the natural ventilation based on standard wind pressure coefficients and using wind data from the selected weather tapes.

3.2 Approved Document Part O: Overheating

The 2021 Approved Document Part O provides guidance on how to comply with Building Regulations. Demonstration of compliance with the new requirement O1 (Overheating mitigation) is done by using one of the following methods:

1. Simplified method: gives elemental guidance on glazing area and g-value depending on location overheating risk and whether the dwelling has cross-ventilation. The simplified method is not appropriate for buildings with more than one residential unit with a communal heating or hot water system, or with high noise levels at night.
2. Dynamic thermal modelling method: for dwellings that don't meet the simplified method requirements. Multi residential blocks with a communal heating or hot water system, or areas with high noise levels at night must use dynamic thermal modelling. This provides a standardised approach to predict overheating risk for residential buildings.

The Abbey Road Phase 3 development does not meet the requirements for the simplified method therefore, the dynamic thermal modelling method has been implemented. To demonstrate compliance using the dynamic thermal modelling method, all of the following guidance should be followed:

A. CIBSE's TM59 methodology for predicting overheating risk

B. The limits on the use of CIBSE's TM59 methodology:

   a. Windows openings in a ramp function in daytime

   b. Set parameters for night-time openings

   c. Secured openings on ground floor units and easily accessible rooms

C. The acceptable strategies for reducing overheating risk are:

   a. Limiting solar gains through fixed external shading device (shutters, external blinds, overhangs and awnings) and appropriate glazing design considering size, orientation, g-value and depth of window reveal

b. Removing excess heat through opening windows, ventilation louvres in external walls, mechanical ventilation systems or mechanical cooling system.

The building should be constructed to meet requirement O1 using passive means as far as reasonably practicable. It should be demonstrated to the building control body that all practicable passive means of limiting unwanted solar gains and removing excess heat have been used first before adopting mechanical cooling. Any mechanical cooling (air-conditioning) is expected to be used only where requirement O1 cannot be met using passive means.

3.3 Approved Document Part O site constraints

3.3.1 Noise

Approved Document Part O stated that in locations where external noise may be an issue (for example, where the local planning authority considered external noise to be an issue at the planning stage), the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11 pm to 7 am). Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits:

a. 40dB $L_{Aeq,T}$, averaged over 8 hours (between 11 pm and 7 am).

b. 55dB L_{AFmax}, more than 10 times a night (between 11 pm and 7 am).

According to the acoustics assessment, the units adjacent to the road and some of the units facing the rear of the site exceed the noise limits set by Approved Document Part O, therefore windows should be considered closed during sleeping hours.

3.3.2 Security

When determining the free area available for ventilation during sleeping hours, only the proportion of openings that can be opened securely should be considered to provide useful ventilation. This particularly applies in the following locations, where openings may be vulnerable to intrusion by a casual or opportunistic burglar.

a. Ground floor bedrooms

b. Easily accessible bedrooms

Open windows or doors can be made secure by using any of the following.

a. Fixed or lockable louvred shutters

b. Fixed or lockable window grilles or railings

The ground floor sample unit have been modelled with windows closed at night due to security limitations.

3.4 CIBSE TM59

The thermal comfort criteria for assessments within the apartments that are predominantly naturally ventilated are defined in CIBSE TM59. Compliance is based on passing both of the following two criteria:

a) For living rooms, kitchens and bedrooms the number of hours during which the difference between the operative temperature and the dynamic threshold comfort temperature exceeds 1°K or more during the period May to September inclusion shall not be more than 3 per cent of occupied hours

b) For bedrooms only, to guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10 pm to 7 am shall not exceed 26°C for more than 1% of annual hours. 1% of the annual hours between 22:00 and 07:00 is 32 hours, so 33 or more hours above 26°C will be recorded as a fail

The criteria for apartments that are predominantly mechanically ventilated should follow the CIBSE TM59 fixed temperature test, i.e. all occupied rooms should not exceed an operative temperature of 26 ˚C for more than 3% of the annual occupied annual hours.

The thermal comfort criterion for the assessments within the communal corridors is also defined in CIBSE TM59 where the corridor's operative temperature should not exceed 28°C for more than 3% of the total annual hours. (Note: 3% of the annual hours is 262 hours, so 263 or more hours above 28°C will be recorded as a fail).

Each scenario was simulated using the London Heathrow DSY1 weather data for the 2020's high emissions, 50% percentile scenario, as specified in CIBSE TM59.

All units have been assessed as Category II buildings where there is a normal level of expectation of comfort. The base run, options 1, 2 and 3 were assessed under the criteria for apartments that are predominantly naturally ventilated while options 4, 5 and 6 were assessed under the criteria for predominantly mechanically ventilated dwellings.

3.5 Cooling hierarchy

All major development proposals should reduce the potential overheating risk and the reliance on air conditioning systems. The London Plan sets out a six-level hierarchy of cooling, which is designed to maximise passive measures to minimise the need for active cooling. The hierarchy is set out below:

1. Minimise internal heat generation through energy efficient design
2. Reduce the amount of heat entering a building in summer through orientation, shading, fenestration, insulation and green roofs and walls
3. Manage the heat within the building through exposed internal thermal mass and high ceilings
4. Passive ventilation
5. Mechanical ventilation
6. Active cooling systems

4. Geometry

The site model was built using the draft issue drawings provided by Pollard Thomas Edwards architects dated 2022/03/04. However, the architects have issued the final planning drawings on 2022/04/27. The two drawing sets were compared, and only minor differences were found. The differences include minimal layout changes to the GAs and elevations, an orientation change of less than 1° for block B and C, reduction to window areas by less than 1% and the proposed double casement with double openings in failing bedrooms. Therefore, the modelling results and selected sample units are considered to be valid. The final planning drawings are summarised in the table below and the drawing set used for the overheating assessment were summarised in Appendix F.

Other surrounding buildings have not been included in the modelling.

Table 1. Drawing reference

Drawing number	Description
ARR-PTE-VA-ZZ-DR-A-10141	Proposed Block A Plans - Ground & First to Fifth floor
ARR-PTE-VA-ZZ-DR-A-10142	Proposed Block A Plans - Sixth to Eight floor & Roof
ARR-PTE-VA-ZZ-DR-A-10247	Proposed Block A Section
ARR-PTE-VB-ZZ-DR-A-10143	Proposed Block B Plans - Ground & First to Sixth floor
ARR-PTE-VB-ZZ-DR-A-10144	Proposed Block B Plans - Seventh to Tenth floor & Roof
ARR-PTE-VB-ZZ-DR-A-10248	Proposed Block B Section
ARR-PTE-VC-ZZ-DR-A-10145	Proposed Block C Plans - Ground & First to Third floor
ARR-PTE-VC-ZZ-DR-A-10146	Proposed Block C Plans - Fourth to Fifth floor & Roof
ARR-PTE-VC-ZZ-DR-A-10249	Proposed Block C Section
ARR-PTE-ZZ-ZZ-DR-A-10359	Proposed Belsize Road Elevation

Drawing number	Description
ARR-PTE-ZZ-ZZ-DR-A-10360	Proposed Abbey Road Elevation
ARR-PTE-ZZ-ZZ-DR-A-10361	Proposed Courtyard 1 Elevation
ARR-PTE-ZZ-ZZ-DR-A-10362	Proposed Courtyard 2 Elevation

Modelled units are shown in blue in the images below, the surrounding areas are shown in pink and local shading in green.

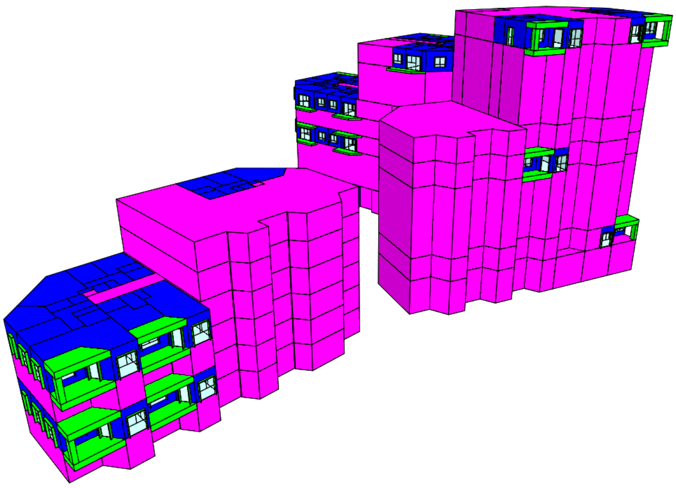

Figure 1. Model view from the South

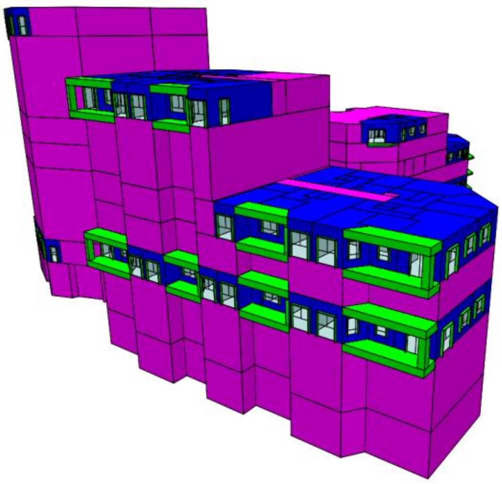

Figure 2. Model view from the North

5. Key modelling inputs

This section outlines the key inputs and assumptions applied to the thermal model.

5.1 Building fabric specifications

The building fabric U-values and typical build-ups were based on the input used in the Part L 1A SAP assessment used to produce the energy strategy assessment. These are summarised in the table below.

A green roof is applied to Block B lower roof and Block C lower and upper roof while the paving/ballast roof is applied to Block A lower and upper roof and Block B upper roof. Roof mark-ups provided by the architects are located in Appendix D.

For the glazing, the SAP assessment considered a range of 0.9W/m²K to 1.2W/m²K. The overheating assessment considered a more conservative case of 0.87 W/m²K. Sensitivity tests with the higher values indicated minor changes to hours of overheating in the order of approximately 10%, which is considered minimal. The g-value of the glazing was also optimised to meet the Part L1A SAP requirements and energy strategy.

The final building fabric specification is shown in Table 2 and Table 3 below.

Table 2. Opaque building fabric

Building fabric	U-value (W/m²K)
Ground floor	0.10
Exposed floor soffit	0.10
Green roof	0.10
Paving/ballast roof	0.10
External wall	0.15
Party wall*	0.16
Wall to core/communal corridor	0.25

*Note: *The party wall U-value was generated based on the details provided in the AECOM SAP input. The SAP input may detail this U-value as zero, as this is the descriptive definition for regulatory assessment purposes. For thermal modelling the wall requires a physical U-value in order to calculate the heat losses and gains through the wall.*

Table 3. Glazed fabric

Glazed fabric	U-value including frame (W/m²K)	g-value (EN 410)	Light transmittance	Frame factor
External glazing	0.87	0.4	0.705	20%
External glazed doors	0.87	0.4	0.705	20%

5.2 Internal shading device

Under CIBSE TM59, internal shading devices can be used if they do not impact/restrict airflow. Approved Document Part O: Overheating states that although internal blinds and curtains provide some reduction in solar gains, they should not be taken into account when considering whether requirement O1 has been met.

For the passive (natural ventilation assessments), blinds were not taken into account, however for the active runs (temperature lopping), we have considered the use of internal blinds in peak conditions as windows are assumed closed and therefore they do not impact on any air flow.

5.3 Infiltration rates

The air permeability of 3m³/h/m²@50Pa was taken from the current SAP modelling specification. This equates to approximate average infiltration rates of 0.056ach^{-1} and was applied in the model.

5.4 Mechanical ventilation

The mechanical ventilation rate of the MVHR unit was 0.3l/s/m² and applied to all occupied rooms (based on the minimum ventilation covered in Approved Document Part F). The standard mechanical ventilation is assumed to be on continuously.

5.5 Temperature lopping

A temperature lopping solution was tested. This introduced a small amount of limited cooling to the spaces via a MVHR unit and was only considered to be active when room environment exceeded the upper threshold of 25°C. At this stage of the design the temperature lopping was modelled by applying a limited amount of cooling based on the unit size and pro-rated based on the floor areas of the occupied spaces within the sample units. As the design is progressed, more detailed sizing checks should be undertaken at the next stage of design by the relevant parties.

5.6 Heat Interface Unit

Heat Interface Unit losses are taken as 42W based on previous project experience and applied in the utility cupboards. This input should be reviewed and if necessary, update at the next stage of design by the relevant parties.

5.7 Openings

The model was run using the Macroflo bulk airflow module within IES which allows the user to set the openable area and window type for the windows. The software then calculates the natural ventilation based on standard wind pressure coefficients and using wind data from the weather data.

We have been advised at this stage to assume that the residents will be able to override the 100mm restrictor on the windows, for the purpose of providing adequate ventilation in peak periods to mitigate overheating.

The opening profile of all external openable windows was based on the limitations set by Approved Document O on CIBSE TM59 window and door openings and as summarised below.

a. When a room is occupied during the day (8 am to 11 pm), openings should be modelled to do all of the following:

   I. Start to open when the internal temperature exceeds 22°C

   II. Be fully open when the internal temperature exceeds 26°C

   III. Start to close when the internal temperature falls below 26°C

   IV. Be fully closed when the internal temperature falls below 22°C

b. At night (11 pm to 8 am), openings should be modelled as fully open if both of the following apply

   I. The openings are on the first floor or above and not easily accessible

   II. The internal temperature exceeds 23°C at 11 pm

c. When a ground floor or easily accessible room is unoccupied, both of the following apply

   I. In the day, windows, patio doors and balcony doors should be modelled as open, if this can be done securely. Openable windows or doors can be made secure by using fixed or lockable louvred shutters, window grilles or railings

   II. At night, windows, patio doors and balcony doors should be modelled as closed.

d. An entrance door should be included, which should be shut all the time.

Details of the openings are shown below.

Table 4. Details of Macroflo openings

Opening category	Openable area	Maximum angle openable (°)
Tilt and turn bedroom/living room windows	90%	90
Tilt and turn living room to balcony windows	90%	90
Balcony glazed doors (when openable)	90%	90
Sealed windows (remaining openings)	N/A	N/A

5.8 Weather data

Weather data for three locations in and around London were provided to accompany TM49 (Design summer years for London): London Weather Centre (LWC), London Heathrow airport (LHR) and Gatwick Airport (GTW). LWC provides the best currently available weather station to represent central London, e.g. as defined by the Mayor's Central Activity Zone (CAZ), LHR can be considered representative of urban areas outside the CAZ and GTW can be considered representative of rural areas around London.

Weather data was used relating to the design summer year 1 (DSY1) 2020s high emissions 50% percentile scenario, as required by TM59. The London Heathrow weather file was taken as the most suitable for the site location.

Whilst the London Heathrow DSY1 2020 High emissions 50% percentile weather data is all that is required for confirmation of overheating compliance, TM59 also recommends consideration to weather data DSY2 and DSY3. These weather data files are designed to consider more intense and longer summer periods:

- DSY2 has a summer with a short intense warm spell
- DSY3 has a summer with a long but less intense warm spell

These additional weather tapes have been assessed for the final option to provide an indication of how the units and corridors are likely to perform under more intense conditions.

6. Overheating improvement options

A base run was first established and the results from the base run have been used to inform potential improvement runs to reduce and mitigate the risk of overheating within the sample units. These options and variations are detailed below.

6.1 Base run

A base run was established following the methodology laid out in Approved Document O and using the drawings provided with the key inputs listed in the previous sections. The base run was also assessed under the Approved document O site constraints, i.e. noise and security.

6.2 Option 1

Option 1 was per the base run with daytime window restriction of 100mm.

6.3 Option 2

Option 2 was the base run without any site constraints, i.e. with no noise or security limitations, in order to demonstrate that the design performs well with the passive measures that have been implemented.

6.4 Option 3

Option 3 was as option 2 with further improvements to the failing bedrooms and living room. The double casement with double openings (similar to the other bedroom window arrangements) were applied to the bedrooms, and the living rooms considered the balcony door was open during peak conditions.

6.5 Option 4

Option 4 was as the base run, with all windows closed and with mechanical ventilation flow rates adjusted to achieve a pass on CIBSE TM59. The rates normally required to mitigate overheating far exceed what standard MVHR are able to supply, and so additional dedicated ventilation system would be required.

6.6 Option 5

Option 5 was as the base but with all windows closed and temperature lopping applied to the MVHR. Multiple runs were undertaken within this option to provide a preliminary indication of the cooling capacities required for each of the sample units.

6.7 Option 6

Option 6 was as Option 5 but with internal blinds included, to try and minimise the amount of cooling required. The blinds were based on a standard, light-coloured, fabric roller blind with the below specification:

- Shading coefficient: 0.439
- Short wave radiant fraction: 0.228

7. Corridor overheating

Communal corridor spaces have also been checked for overheating, in order to assess the impacts of the heating pipework. If the operative temperature exceeds 28°C for more than 3% of the total annual hours, then this should be identified as a significant risk. The risk of overheating in communal corridors is largely due to internal gains from community heating distribution pipework.

For the initial corridor overheating assessment, the heat loss from pipework was initially assumed based on the typical outside pipe diameter thickness of 35 mm with 11 W/m losses and a lighting gain of 2 W/m² with no PIR sensors on the corridor lighting per CIBSE TM59 guidance.

Additional runs were undertaken with refined typical corridor inputs provided by the Norman Bromley MEP team. For a typical corridor, a total heat loss of 270 W from the pipework was advised and there was confirmation that PIR sensors would be present in the communal corridors. A ventilation flow rate of 300 l/s was advised for each floor with the operational hours of 6 am to 8 pm. A thermostat will be located on the top floor which will activate the systems as necessary. It was assumed that the ventilation was set to operate when the corridor air temperature exceeded 25°C.

A further improved run was also undertaken which extended the operation hours of the mechanical ventilation system to 24 hours.

The results for the communal corridor overheating assessment are shown in the results Section 8.3 below.

8. Results summary

Full results for each of the options can be found in Appendix A.

8.1 Passive results

The base run and options 1, 2 and 3 were assessed under the CIBSE TM59 and Approved Document Part O: Overheating criteria for natural ventilation. i.e. considered as passive runs.

The table below shows the results summary of passive runs undertaken. See Appendix A.1 for the full passive results and Appendix B for the unit ID mark-up.

Table 5. Passive runs results

Unit ID	Base run	Option 1	Option 2	Option 3
A L00_01	Fail	Fail	Fail	Pass
A L03_01	Fail	Fail	Pass	Pass
A L03_02	Fail	Fail	Pass	Pass
A L03_03	Fail	Fail	Pass	Pass
A L03_04	Fail	Fail	Fail	Pass
A L03_05	Fail	Fail	Pass	Pass
A L03_06	Fail	Fail	Pass	Pass
A L03_07	Fail	Fail	Fail	Pass
A L05_01	Fail	Fail	Pass	Pass
A L05_02	Fail	Fail	Pass	Pass
A L05_03	Fail	Fail	Pass	Pass
A L05_04	Fail	Fail	Pass	Pass
A L08_01	Fail	Fail	Pass	Pass
A L08_02	Fail	Fail	Pass	Pass
A L08_03	Fail	Fail	Fail	Fail
B L01_02	Fail	Fail	Pass	Pass
B L05_01	Fail	Fail	Pass	Pass
B L10_01	Fail	Fail	Pass	Pass
B L10_02	Fail	Fail	Pass	Pass
C L01_01	Fail	Fail	Pass	Pass
C L01_02	Fail	Fail	Pass	Pass
C L01_03	Fail	Fail	Pass	Pass
C L01_04	Fail	Fail	Pass	Pass
C L03_01	Fail	Fail	Pass	Pass
C L03_02	Fail	Fail	Pass	Pass
C L03_03	Fail	Fail	Pass	Pass
C L05_01	Fail	Fail	Pass	Pass
Number of sample units passing	**0**	**0**	**23**	**26**
Total number of sample units	**27**	**27**	**27**	**27**
Sample unit pass rate	**0**	**0**	**85%**	**96%**

As expected, all sample units failed the base run, as the windows were unable to open at night due to the site constraints (i.e. noise and security). Similarly, for option 1 with 100mm restrictors applied to all the window openings, all the units failed. With closed or restricted openings there was insufficient natural ventilation to the spaces.

Option 2 assumed that no noise constraints were present on the site and sufficient security measures were implemented in the ground floor units. This is to demonstrate the passive design measures included within the overall design are capable of mitigating overheating via natural ventilation before restrictions are applied. The results showed a significant improvement over the base run and option 1 and resulted in 23 out of the 27 sample units achieving a pass which translated to an approximately sample unit pass rate of 85%. This is due to the ability of the windows to open fully during the day and at night. Only 4 sample units failed, as set out below (see Appendix E for mark-ups of sample units that failed):

- Ground floor bedroom - this has different window unit design (i.e. a single casement with opening) which limits the amount of ventilation to the space. It is estimated that with the double casement with double openings (similar to the other bedroom window arrangements), the room may pass.
- Mid floor bedrooms - similar to the ground floor they have a single casement window design which limits the amount of ventilation. Again, with double casement and openings it is estimated that these rooms may pass.
- The mid floor living room has a reduced internal floor area which results in more condensed internal and solar gains. Additional ventilation is required to remove the gains, this could be achieved by considering the balcony door to be open during peak periods.
- The top floor bedroom is similar to the ground and mid floor bedrooms and has a single casement with opening, which again limits the amount of ventilation. The top floor also has greater solar exposure. It is estimated that with double casement and openings the room may pass.
- The top floor living room failed due to the same reason as the mid floor living room, but also suffers from greater solar exposure. Consideration of a balcony door open with the addition of either some solar shading and/or denser roof medium (i.e. green roof) may achieve a solution. Another potential solution would be to combine the living room and kitchen which would help distribute the internal gains over a larger internal floor area and may also help improve daylight.

Option 3 implemented the suggested improvements in the failing rooms of option 2. This resulted in 26 out of the 27 sample units achieving a pass, which translated to an approximate sample unit pass rate of 96%. The measures suggested in option 2 were sufficient to mitigate the overheating in the failing bedrooms and mid floor living room. However, the top floor living room still failed the TM59 assessment due to greater solar exposure. If a pass is required, we would recommend considering the above suggested improvements.

In summary, the passive runs showed that without any noise or security constraints in the site, the majority of the sample units can achieve compliance with CIBSE TM59 (option 3). The current layout and façade design with suggested improvements indicated a 96% sample unit pass rate. However, when both the acoustic and security constraints are taken into account or if window openings are restricted, overheating compliance cannot be achieved via natural ventilation. Therefore, active runs were considered i.e. full mechanical ventilation and temperature lopping.

8.2 Active results

Options 4, 5 and 6 were assessed under the CIBSE TM59 and Approved Document Part O: Overheating criteria for apartments with restricted window openings and were considered as active runs.

Given the acoustic constraints identified on the site which affect approximately 86% of dwellings and considering potential security issues for the ground floor units, active solutions were investigated.

Option 4 considered a mechanical ventilation solution. Flow rates from 4 ach^{-1} to 12 ach^{-1} were tested. The mechanical ventilation solution indicated that excessively high flow rates would be required to achieve a pass under TM59. Results for option 4 are contained in Appendix A.2.1. These flow rates cannot be achieved by standard MVHR units and would require a more dedicated system. Such a system may have a significant impact on the external envelope, GA space allocation, room heights and energy usage, therefore an alternative temperature lopping solution was considered for options 5 and 6.

The table below shows the summary of estimated cooling capacities of each unit to comply with TM59. See Appendix B for the unit ID mark-up.

Table 6. Option 5 and 6 estimated cooling capacity to comply with TM59

Unit ID	Flat type	Estimated cooling capacity required to pass (kW)	
		Without blinds (Option 5)	With blinds (Option 6)
A L00_01	1B2P	1.5	1.5
A L03_01	2B3P	1.5	1.5
A L03_02	2B3P	1.5	1.5
A L03_03	2B4P	2	1.5
A L03_04	2B4P	1.5	1.5
A L03_05	1B2P	1.5	1.5
A L03_06	3B5P	2.5	2
A L03_07	3B5P	2.5	2
A L05_01	2B3P	1.5	1.5
A L05_02	2B3P	1.5	1.5
A L05_03	2B4P	2	1.5
A L05_04	2B4P	1.5	1.5
A L08_01	1B2P	1.5	1.5
A L08_02	3B5P	2.5	2
A L08_03	3B5P	3.5	2.5
B L01_02	2B4P	1.5	1.5
B L05_01	1B2P	1.5	1.5
B L10_01	1B2P	1.5	1.5
B L10_02	2B4P	1.5	1.5
C L01_01	2B4P	2	1.5
C L01_02	2B4P	2	1.5
C L01_03	1B2P	1.5	1.5
C L01_04	2B4P	1.5	1.5
C L03_01	2B4P	2	1.5
C L03_02	2B4P	2	1.5
C L03_03	1B2P	1.5	1.5
C L05_01	2B4P	1.5	1.5

The majority of the units passed with a minimal cooling capacity. However, for some apartments with higher occupancy, smaller rooms and a greater solar exposure, the cooling capacity had to be increased in order to achieve compliance with TM59. See Appendix A.2.2 for the full results. The increase in capacity required may have an impact on the space allocation of the utilities/services cupboards.

Option 6 was also a temperature lopping solution incorporating internal blinds. This run showed the estimated cooling capacities required to comply with TM59 and with the internal blinds led to the reduction of solar gains and therefore more sample units comply with the minimal cooling capacities. See Appendix A.2.3 for the full results. Based on the analysis undertaken a temperature lopping solution with internal blinds appears to be a reasonable solution, therefore this option was considered as the proposed design solution, for which the more extreme weather tapes were also tested.

The DSY 2 and 3 assessment for option 6 i.e. temperature lopping with internal blinds, showed that the results are similar to DSY 1 as in all units achieve a pass. This indicated that the initial limited cooling capacities of the units may well mitigate extreme weather conditions and potentially help reduce the impact of future climate change. See Appendix A.3.1 for the full results.

It should be noted that the estimated cooling capacities are not explicitly for sizing purposes, only to demonstrate that mitigation of overheating can be achieved with a limited amount of cooling. Detailed sizing calculations on a room and apartment basis should be undertaken at the next stage of design by the relevant parties.

8.3 Communal corridor results

If the operative temperature of 28 ºC is exceeded for more than 3% of the total annual hours, then this should be identified as a significant risk.

The table below summarises the results for the communal corridor overheating assessments undertaken. The text highlighted in red shows failure while green shows compliance with TM59 communal corridor criteria.

Table 7. Summary of communal corridor overheating assessment

Location	Operative temperature (°C) - % annual hours above 28°C		
	Initial overheating run (high gains)	Revise run based on supplied MEP data	Increased run hours
A L04 Communal corridor	97.4	48	0.6
A L04 Stair/Lift lobby	82.8	26.9	0.4
A L07 Communal corridor	60.2	59.3	1.4
A L07 Stair/Lift lobby	38.3	36.7	0.8
B L04 Communal corridor	97	39.9	0.6
B L04 Stair/Lift lobby	70.4	8	0.3
B L09 Communal corridor	80.8	54.4	1.2
B L09 Stair/Lift lobby	45.2	34.6	0.9
C L02 Communal corridor	97	42.6	0.6
C L02 Stair/Lift lobby	72.5	17.4	0.3
C L04 Communal corridor	85.8	57.6	1.1
C L04 Stair/Lift lobby	47	36.5	0.9

The initial corridor overheating assessment indicated failures in all corridors modelled and this was linked to high internal gains and the ventilation system running only between the hours of 6 am to 8 pm.

A revised corridor overheating assessment was undertaken with inputs based on the supplied MEP data. This indicated that although the internal gains were reduced, the ventilation operation time was not sufficient to mitigate the overheating risk therefore, an option with an increased operation run time was also considered.

An increased operation time to 24 hours was tested. This indicated that the modelled ventilation in all corridors was sufficient to mitigate overheating. The number of operational hours could be further refined during the next stage of design, however for the purposes of the overheating assessment this is a reasonable solution. This solution was also tested for the more extreme weather tapes

The DSY 2 and 3 assessment for the increased run hours indicated increased temperatures over DSY 1. However, the results still showed that overheating in all sample communal corridors were mitigated. See Appendix A.3.2 for the full results.

As only a single sample corridor gain and flow rate was provided, we would recommend further investigations and refinement for all the corridors during the next stage of design

Appendix A Results

A.1 Passive full results

Both criterion A and criterion B must be passed in order to pass TM59 criteria overall and all rooms in a dwelling must pass for the dwelling itself to meet the criteria. The pass threshold for criterion A is not more that 3% of occupied hours more than 1°C above the threshold temperature, and the pass threshold for criterion B is not more than 32 night time hours in bedrooms to be above 26°C. Areas of failure are highlighted in red, and areas of a pass are highlighted in green in the results table below.

Unit ID	Base case - with Approved document O site constraints, i.e. noise and security			Option 1 - per the base run with daytime window restriction of 100mm			Option 2 - per the base run without any site constraints, i.e. noise and security			Option 3 - per option 2 with proposed improvements in failing rooms		
	Criterion (a) result (%)	Criterion (b) result (hrs)	Overall TM59 result	Criterion (a) result (%)	Criterion (b) result (hrs)	Overall TM59 result	Criterion (a) result (%)	Criterion (b) result (hrs)	Overall TM59 result	Criterion (a) result (%)	Criterion (b) result (hrs)	Overall TM59 result
A L00_01 Bed (double)	1.5	323	Fail	24.1	995	Fail	0.2	42	Fail	0.4	31	Pass
A L00_01 Liv/Kitch 2B4P	3.1	NA	Fail	34.1	NA	Fail	0.8	NA	Pass	0.8	NA	Pass
A L03_01 Bed (double)	2.5	343	Fail	27.6	1012	Fail	0.7	26	Pass	0.7	26	Pass
A L03_01 Bed (single)	3.1	294	Fail	27.8	968	Fail	1.3	26	Pass	1.3	26	Pass
A L03_01 Liv/Kitch 2B3P	4.2	NA	Fail	42.2	NA	Fail	1	NA	Pass	1	NA	Pass
A L03_02 Bed (double)	1.7	265	Fail	18.7	777	Fail	0.5	25	Pass	0.5	25	Pass
A L03_02 Bed (single)	2.3	265	Fail	19.8	777	Fail	0.7	24	Pass	0.7	24	Pass
A L03_02 Liv/Kitch 2B3P	4.4	NA	Fail	37	NA	Fail	1.2	NA	Pass	1.2	NA	Pass
A L03_03 Bed (double) 01	2.6	248	Fail	8.9	607	Fail	1.3	25	Pass	1.3	25	Pass
A L03_03 Bed (double) 02	2.3	249	Fail	9	621	Fail	1.1	26	Pass	1.1	26	Pass
A L03_03 Liv/Kitch 2B4P	3.9	NA	Fail	15.4	NA	Fail	2.5	NA	Pass	2.5	NA	Pass
A L03_04 Bed (double) 01	2.2	213	Fail	4.9	521	Fail	1.1	23	Pass	1.1	23	Pass
A L03_04 Bed (double) 02	2.4	280	Fail	6.9	613	Fail	1.1	33	Fail	1.1	26	Pass
A L03_04 Liv/Kitch 2B4P	3.8	NA	Fail	10.9	NA	Fail	2.2	NA	Pass	2.2	NA	Pass
A L03_05 Bed (double)	2.2	337	Fail	21.8	871	Fail	0.6	26	Pass	0.6	26	Pass

Unit ID	Base case - with Approved document O site constraints, i.e. noise and security			Option 1 - per the base run with daytime window restriction of 100mm			Option 2 - per the base run without any site constraints, i.e. noise and security			Option 3 - per option 2 with proposed improvements in failing rooms		
	Criterion (a) result (%)	Criterion (b) result (hrs)	Overall TM59 result	Criterion (a) result (%)	Criterion (b) result (hrs)	Overall TM59 result	Criterion (a) result (%)	Criterion (b) result (hrs)	Overall TM59 result	Criterion (a) result (%)	Criterion (b) result (hrs)	Overall TM59 result
A L03_05 Liv/Kitch 1B2P	4.2	NA	Fail	33.2	NA	Fail	1.1	NA	Pass	1.1	NA	Pass
A L03_06 Bed (double) 01	2.6	235	Fail	7.9	593	Fail	1.3	20	Pass	1.3	20	Pass
A L03_06 Bed (double) 02	2.3	235	Fail	8.4	607	Fail	0.9	26	Pass	0.9	26	Pass
A L03_06 Bed (single)	2.4	234	Fail	9.2	626	Fail	1.2	26	Pass	1.2	26	Pass
A L03_06 Kitchen 3B5P	3.3	NA	Fail	12.1	NA	Fail	2	NA	Pass	2	NA	Pass
A L03_06 Living 3B5P	4.2	NA	Fail	17.7	NA	Fail	2.2	NA	Pass	2.2	NA	Pass
A L03_07 Bed (double) 01	1.7	232	Fail	6.2	690	Fail	0.9	34	Fail	1	24	Pass
A L03_07 Bed (double) 02	2	237	Fail	6.9	586	Fail	0.7	24	Pass	0.7	24	Pass
A L03_07 Bed (single)	2	204	Fail	7.4	645	Fail	1	25	Pass	1.1	25	Pass
A L03_07 Kitchen 3B5P	3	NA	Pass	8.8	NA	Fail	1.7	NA	Pass	1.8	NA	Pass
A L03_07 Living 3B5P	4.4	NA	Fail	15.2	NA	Fail	3.1	NA	Fail	2.9	NA	Pass
A L05_01 Bed (double)	2	291	Fail	20.3	938	Fail	0.6	26	Pass	0.6	26	Pass
A L05_01 Bed (single)	2.4	269	Fail	22.1	904	Fail	1.1	22	Pass	1.1	22	Pass
A L05_01 Liv/Kitch 2B3P	4.1	NA	Fail	40.1	NA	Fail	1.1	NA	Pass	1.1	NA	Pass
A L05_02 Bed (double)	0.9	193	Fail	9.2	687	Fail	0.4	20	Pass	0.4	20	Pass
A L05_02 Bed (single)	1.5	217	Fail	12.3	707	Fail	0.6	19	Pass	0.6	19	Pass
A L05_02 Liv/Kitch 2B3P	3.1	NA	Fail	26.7	NA	Fail	0.7	NA	Pass	0.7	NA	Pass
A L05_03 Bed (double) 01	2	a	Fail	6.8	566	Fail	1.2	22	Pass	1.2	22	Pass
A L05_03 Bed (double) 02	1.9	212	Fail	6.2	601	Fail	1	26	Pass	1	26	Pass
A L05_03 Liv/Kitch 2B4P	3.9	NA	Fail	14.9	NA	Fail	2.6	NA	Pass	2.6	NA	Pass
A L05_04 Bed (double) 01	1.7	176	Fail	3.2	493	Fail	1	17	Pass	1	17	Pass
A L05_04 Bed (double) 02	1.7	247	Fail	4.2	605	Fail	1	26	Pass	1.1	23	Pass
A L05_04 Liv/Kitch 2B4P	3.6	NA	Fail	7.4	NA	Fail	2	NA	Pass	2.1	NA	Pass

Unit ID	Base case - with Approved document O site constraints, i.e. noise and security			Option 1 - per the base run with daytime window restriction of 100mm			Option 2 - per the base run without any site constraints, i.e. noise and security			Option 3 - per option 2 with proposed improvements in failing rooms		
	Criterion (a) result (%)	Criterion (b) result (hrs)	Overall TM59 result	Criterion (a) result (%)	Criterion (b) result (hrs)	Overall TM59 result	Criterion (a) result (%)	Criterion (b) result (hrs)	Overall TM59 result	Criterion (a) result (%)	Criterion (b) result (hrs)	Overall TM59 result
A L08_01 Bed (double)	1.5	246	Fail	4.2	628	Fail	0.6	22	Pass	0.7	23	Pass
A L08_01 Liv/Kitch 1B2P	2.9	NA	Pass	6.2	NA	Fail	1.4	NA	Pass	1.4	NA	Pass
A L08_02 Bed (double) 01	2.2	209	Fail	6.1	571	Fail	1.2	16	Pass	1.2	16	Pass
A L08_02 Bed (double) 02	1.8	209	Fail	6.1	577	Fail	0.8	24	Pass	0.8	24	Pass
A L08_02 Bed (single)	1.9	199	Fail	7.3	602	Fail	1.1	26	Pass	1.1	26	Pass
A L08_02 Kitchen 3B5P	3.1	NA	Fail	11.7	NA	Fail	2	NA	Pass	2	NA	Pass
A L08_02 Living 3B5P	4	NA	Fail	16.9	NA	Fail	2.2	NA	Pass	2.2	NA	Pass
A L08_03 Bed (double) 01	1.4	200	Fail	6.1	703	Fail	0.9	33	Fail	1	23	Pass
A L08_03 Bed (double) 02	1.9	240	Fail	7.8	620	Fail	0.8	24	Pass	0.8	24	Pass
A L08_03 Bed (single)	1.8	195	Fail	7.8	653	Fail	1.1	24	Pass	1.1	23	Pass
A L08_03 Kitchen 3B5P	3.3	NA	Fail	9.7	NA	Fail	1.9	NA	Pass	1.8	NA	Pass
A L08_03 Living 3B5P	5.5	NA	Fail	19.4	NA	Fail	3.8	NA	Fail	3.5	NA	Fail
B L01_02 Bed (double) 01	2.3	254	Fail	10.1	641	Fail	0.9	22	Pass	0.9	22	Pass
B L01_02 Bed (double) 02	2.9	288	Fail	12.4	660	Fail	1.4	27	Pass	1.4	27	Pass
B L01_02 Liv/Kitch 2B4P	4	NA	Fail	13	NA	Fail	2.1	NA	Pass	2.1	NA	Pass
B L05_01 Bed (double)	2.1	291	Fail	20	938	Fail	0.5	26	Pass	0.5	26	Pass
B L05_01 Liv/Kitch 1B2P	4.2	NA	Fail	35.6	NA	Fail	1.2	NA	Pass	1.2	NA	Pass
B L10_01 Bed (double)	1.9	195	Fail	4.8	557	Fail	1	16	Pass	1	16	Pass
B L10_01 Liv/Kitch 1B2P	3.2	NA	Fail	15.9	NA	Fail	1.6	NA	Pass	1.6	NA	Pass
B L10_02 Bed (double) 01	1.7	204	Fail	4	533	Fail	1	18	Pass	1	18	Pass
B L10_02 Bed (double) 02	2.4	240	Fail	5.9	560	Fail	1.4	22	Pass	1.4	22	Pass
B L10_02 Liv/Kitch 2B4P	3.3	NA	Fail	6.1	NA	Fail	2.1	NA	Pass	2.1	NA	Pass

Unit ID	Base case - with Approved document O site constraints, i.e. noise and security			Option 1 - per the base run with daytime window restriction of 100mm			Option 2 - per the base run without any site constraints, i.e. noise and security			Option 3 - per option 2 with proposed improvements in failing rooms		
	Criterion (a) result (%)	Criterion (b) result (hrs)	Overall TM59 result	Criterion (a) result (%)	Criterion (b) result (hrs)	Overall TM59 result	Criterion (a) result (%)	Criterion (b) result (hrs)	Overall TM59 result	Criterion (a) result (%)	Criterion (b) result (hrs)	Overall TM59 result
C L01_01 Bed (double) 01	2.6	288	Fail	16	744	Fail	1.3	27	Pass	1.3	27	Pass
C L01_01 Bed (double) 02	1.9	267	Fail	12.9	738	Fail	0.6	25	Pass	0.6	25	Pass
C L01_01 Liv/Kitch 2B4P	4.4	NA	Fail	18.1	NA	Fail	2.3	NA	Pass	2.3	NA	Pass
C L01_02 Bed (double) 01	2.8	263	Fail	11	607	Fail	1.4	25	Pass	1.4	25	Pass
C L01_02 Bed (double) 02	3.4	287	Fail	13.2	622	Fail	1.9	28	Pass	1.9	28	Pass
C L01_02 Liv/Kitch 2B4P	4	NA	Fail	12.3	NA	Fail	2.4	NA	Pass	2.4	NA	Pass
C L01_03 Bed (double)	2	290	Fail	22.4	940	Fail	0.5	26	Pass	0.5	26	Pass
C L01_03 Liv/Kitch 1B2P	4.1	NA	Fail	41	NA	Fail	1	NA	Pass	1	NA	Pass
C L01_04 Bed (double) 01	2.5	274	Fail	10.4	712	Fail	1.1	26	Pass	1.1	26	Pass
C L01_04 Bed (double) 02	1.8	251	Fail	8.4	717	Fail	0.6	24	Pass	0.6	24	Pass
C L01_04 Liv/Kitch 2B4P	3.3	NA	Fail	11.3	NA	Fail	1.6	NA	Pass	1.6	NA	Pass
C L03_01 Bed (double) 01	2.3	251	Fail	10.5	696	Fail	1.3	25	Pass	1.3	25	Pass
C L03_01 Bed (double) 02	1.4	219	Fail	7.8	691	Fail	0.5	20	Pass	0.5	20	Pass
C L03_01 Liv/Kitch 2B4P	4.1	NA	Fail	14.5	NA	Fail	2.3	NA	Pass	2.3	NA	Pass
C L03_02 Bed (double) 01	2.2	232	Fail	7.4	565	Fail	1.3	22	Pass	1.3	22	Pass
C L03_02 Bed (double) 02	2.9	258	Fail	9	590	Fail	1.8	24	Pass	1.8	24	Pass
C L03_02 Liv/Kitch 2B4P	3.5	NA	Fail	8.4	NA	Fail	2.2	NA	Pass	2.2	NA	Pass
C L03_03 Bed (double)	1.2	241	Fail	12.9	834	Fail	0.4	24	Pass	0.4	24	Pass
C L03_03 Liv/Kitch 1B2P	3	NA	Pass	31	NA	Fail	0.8	NA	Pass	0.8	NA	Pass
C L05_01 Bed (double) 01	2	237	Fail	6.5	656	Fail	1.1	25	Pass	1.1	25	Pass
C L05_01 Bed (double) 02	1.3	218	Fail	4.6	668	Fail	0.6	22	Pass	0.6	22	Pass
C L05_01 Liv/Kitch 2B4P	2.9	NA	Pass	7.4	NA	Fail	1.4	NA	Pass	1.4	NA	Pass

Unit ID	Base case - with Approved document O site constraints, i.e. noise and security			Option 1 - per the base run with daytime window restriction of 100mm			Option 2 - per the base run without any site constraints, i.e. noise and security			Option 3 - per option 2 with proposed improvements in failing rooms		
	Criterion (a) result (%)	Criterion (b) result (hrs)	Overall TM59 result	Criterion (a) result (%)	Criterion (b) result (hrs)	Overall TM59 result	Criterion (a) result (%)	Criterion (b) result (hrs)	Overall TM59 result	Criterion (a) result (%)	Criterion (b) result (hrs)	Overall TM59 result
Number of sample units passing	**0**			**0**			**23**			**26**		
Total number of sample units	**27**			**27**			**27**			**27**		
Sample unit pass rate	**0%**			**0%**			**85%**			**96%**		

A.2 Active full results

All occupied rooms should not exceed an operative temperature of 26 ˚C for more than 3% of the annual occupied annual hours following the guidance from CIBSE TM59. Areas of failure are highlighted in red, and areas of a pass are highlighted in green in the results table below.

A.2.1 Option 4 full results

Option 4 summary

- Option 4-1 was per the base but with all windows closed and 4 ach^{-1} of mechanical ventilation applied in all occupied areas
- Option 4-2 was per option 4-1 with 6 ach^{-1} of mechanical ventilation applied in all occupied areas
- Option 4-3 was per option 4-2 with 8 ach^{-1} of mechanical ventilation applied in all occupied areas
- Option 4-4 was per option 4-3 with 12 ach^{-1} of mechanical ventilation applied in all occupied areas

Unit ID	Operative temperature - % annual occupied hours above 26°C			
	Option 4-1	Option 4-2	Option 4-3	Option 4-4
A L00_01 Bed (double)	1.5	1.4	1.4	1.6
A L00_01 Liv/Kitch 2B4P	3.8	3.2	3.2	3.2
A L03_01 Bed (double)	5.1	3.3	2.8	2.5
A L03_01 Bed (single)	5.9	4	3.4	3
A L03_01 Liv/Kitch 2B3P	6.5	4.5	3.8	3.6
A L03_02 Bed (double)	3.2	2.3	1.9	1.9
A L03_02 Bed (single)	4	3	2.6	2.3
A L03_02 Liv/Kitch 2B3P	6	4.7	4.3	3.9
A L03_03 Bed (double) 01	5.1	3.5	3	2.6
A L03_03 Bed (double) 02	4.7	3.3	2.8	2.5
A L03_03 Liv/Kitch 2B4P	8.8	6.4	5.8	5.1
A L03_04 Bed (double) 01	4.5	3.1	2.7	2.3
A L03_04 Bed (double) 02	4.7	3.2	2.8	2.4
A L03_04 Liv/Kitch 2B4P	8.3	6.3	5.6	5
A L03_05 Bed (double)	4	2.7	2.3	2.1
A L03_05 Liv/Kitch 1B2P	5.5	4.5	4	3.8
A L03_06 Bed (double) 01	5.7	3.6	3.1	2.8
A L03_06 Bed (double) 02	4.8	3.3	2.8	2.4
A L03_06 Bed (single)	5.7	3.7	3.1	2.7
A L03_06 Kitchen 3B5P	7.5	5.2	4.7	4.1
A L03_06 Living 3B5P	10.3	6.9	5.9	5.1
A L03_07 Bed (double) 01	3.2	2.2	1.8	1.9
A L03_07 Bed (double) 02	4.3	2.8	2.4	2
A L03_07 Bed (single)	4.1	2.9	2.4	2.2
A L03_07 Kitchen 3B5P	6.1	4.5	3.9	3.7
A L03_07 Living 3B5P	9.6	7.2	6.4	6
A L05_01 Bed (double)	4.6	3	2.4	2.2
A L05_01 Bed (single)	5.4	3.7	3.1	2.8

Unit ID	Operative temperature - % annual occupied hours above 26°C			
	Option 4-1	Option 4-2	Option 4-3	Option 4-4
A L05_01 Liv/Kitch 2B3P	7	4.8	4	3.8
A L05_02 Bed (double)	2.4	1.8	1.6	1.6
A L05_02 Bed (single)	3.3	2.5	2.2	2.1
A L05_02 Liv/Kitch 2B3P	5	3.9	3.6	3.5
A L05_03 Bed (double) 01	4.8	3.4	2.8	2.5
A L05_03 Bed (double) 02	4.4	3.1	2.5	2.3
A L05_03 Liv/Kitch 2B4P	9.4	6.8	5.9	5.3
A L05_04 Bed (double) 01	3.8	2.7	2.3	2.1
A L05_04 Bed (double) 02	4.1	2.9	2.4	2.2
A L05_04 Liv/Kitch 2B4P	7.6	5.7	5.1	4.7
A L08_01 Bed (double)	3.8	2.6	2.1	1.9
A L08_01 Liv/Kitch 1B2P	5.8	4.3	3.8	3.4
A L08_02 Bed (double) 01	5.6	3.6	3	2.7
A L08_02 Bed (double) 02	4.7	3.1	2.5	2.2
A L08_02 Bed (single)	5.6	3.5	3	2.6
A L08_02 Kitchen 3B5P	8.5	5.5	4.7	4.2
A L08_02 Living 3B5P	11.6	7.2	6	5.2
A L08_03 Bed (double) 01	3.7	2.4	2	1.8
A L08_03 Bed (double) 02	5.4	3.5	2.7	2.4
A L08_03 Bed (single)	5.1	3.2	2.7	2.3
A L08_03 Kitchen 3B5P	7.5	5.4	4.5	4
A L08_03 Living 3B5P	11.6	8.9	7.9	7
B L01_02 Bed (double) 01	6.7	3.8	3.1	2.6
B L01_02 Bed (double) 02	7.9	4.6	3.6	3.1
B L01_02 Liv/Kitch 2B4P	11.4	7.4	6.1	5.2
B L05_01 Bed (double)	3.5	2.5	2.1	2
B L05_01 Liv/Kitch 1B2P	6.2	4.7	4.2	4
B L10_01 Bed (double)	5.5	3.5	2.8	2.5
B L10_01 Liv/Kitch 1B2P	6.9	4.9	4.2	3.9
B L10_02 Bed (double) 01	6	3.4	2.7	2.4
B L10_02 Bed (double) 02	7.4	4.2	3.3	2.9
B L10_02 Liv/Kitch 2B4P	10.8	6.8	5.7	5.1
C L01_01 Bed (double) 01	5.5	3.7	3.2	2.8
C L01_01 Bed (double) 02	4.2	2.6	2.1	1.9
C L01_01 Liv/Kitch 2B4P	8.9	6.6	5.9	5.3
C L01_02 Bed (double) 01	7.5	4.9	3.9	3.2
C L01_02 Bed (double) 02	8.3	5.7	4.7	3.9
C L01_02 Liv/Kitch 2B4P	11.4	8.1	6.7	5.8
C L01_03 Bed (double)	3.4	2.4	2	1.9
C L01_03 Liv/Kitch 1B2P	5.8	4.5	4	3.9
C L01_04 Bed (double) 01	4.6	3.3	2.9	2.6
C L01_04 Bed (double) 02	3.7	2.4	1.9	1.7

Unit ID	Operative temperature - % annual occupied hours above 26°C			
	Option 4-1	Option 4-2	Option 4-3	Option 4-4
C L01_04 Liv/Kitch 2B4P	6.2	5	4.4	4.1
C L03_01 Bed (double) 01	5	3.4	2.9	2.6
C L03_01 Bed (double) 02	3.9	2.3	1.9	1.6
C L03_01 Liv/Kitch 2B4P	9	6.6	5.9	5.4
C L03_02 Bed (double) 01	7.1	4.4	3.6	3
C L03_02 Bed (double) 02	7.9	5.3	4.5	3.7
C L03_02 Liv/Kitch 2B4P	11	7.5	6.1	5.4
C L03_03 Bed (double)	2.9	2	1.8	1.7
C L03_03 Liv/Kitch 1B2P	5.1	4	3.6	3.4
C L05_01 Bed (double) 01	4.2	3.1	2.5	2.4
C L05_01 Bed (double) 02	3.2	2.1	1.8	1.6
C L05_01 Liv/Kitch 2B4P	6	4.5	4	3.8
Number of sample units passing	**0**	**0**	**0**	**0**
Total number of sample units	**27**	**27**	**27**	**27**
Sample unit pass rate	**0%**	**0%**	**0%**	**0%**

A.2.2 Option 5 full results

Option 5 summary

- Option 5-1 was per the base with but with all windows closed and temperature lopping. The limited cooling capacity was set to 1.5 kW.
- Option 5-2 was per option 5-1 but with an increased limited cooling capacity of 2 kW on units that failed CIBSE TM59 in option 5-1.
- Option 5-3 was per option 5-2 but with an increased limited cooling capacity of 2.5 kW on units that failed CIBSE TM59 in option 5-2.
- Option 5-4 was per option 5-3 but with an increased limited cooling capacity of 3.5 kW on a unit that failed CIBSE TM59 in option 5-3.

Unit ID	Operative temperature - % annual occupied hours above 26°C			
	Opt 5-1	Opt 5-2	Opt 5-3	Opt 5-4
A L00_01 Bed (double)	0	0	0	0
A L00_01 Liv/Kitch 2B4P	0.1	0.1	0.1	0.1
A L03_01 Bed (double)	0.2	0.2	0.2	0.2
A L03_01 Bed (single)	2.7	2.7	2.7	2.7
A L03_01 Liv/Kitch 2B3P	0.5	0.5	0.5	0.5
A L03_02 Bed (double)	0	0	0	0
A L03_02 Bed (single)	0	0	0	0
A L03_02 Liv/Kitch 2B3P	0	0	0	0
A L03_03 Bed (double) 01	0.7	0	0	0
A L03_03 Bed (double) 02	0.1	0	0	0
A L03_03 Liv/Kitch 2B4P	4.1	0.6	0.6	0.6

Unit ID	Operative temperature - % annual occupied hours above 26°C			
	Opt 5-1	Opt 5-2	Opt 5-3	Opt 5-4
A L03_04 Bed (double) 01	0	0	0	0
A L03_04 Bed (double) 02	0	0	0	0
A L03_04 Liv/Kitch 2B4P	2	2	2	2
A L03_05 Bed (double)	0	0	0	0
A L03_05 Liv/Kitch 1B2P	0	0	0	0
A L03_06 Bed (double) 01	1.7	0.2	0	0
A L03_06 Bed (double) 02	0.3	0	0	0
A L03_06 Bed (single)	0.8	0	0	0
A L03_06 Kitchen 3B5P	2.3	0.1	0	0
A L03_06 Living 3B5P	12.4	3.2	0.9	0.9
A L03_07 Bed (double) 01	0	0	0	0
A L03_07 Bed (double) 02	0.9	0.1	0	0
A L03_07 Bed (single)	0.1	0	0	0
A L03_07 Kitchen 3B5P	1.1	0	0	0
A L03_07 Living 3B5P	10.1	4.6	1.8	1.8
A L05_01 Bed (double)	0.1	0.1	0.1	0.1
A L05_01 Bed (single)	2.1	2.1	2.1	2.1
A L05_01 Liv/Kitch 2B3P	1.1	1.1	1.1	1.1
A L05_02 Bed (double)	0	0	0	0
A L05_02 Bed (single)	0	0	0	0
A L05_02 Liv/Kitch 2B3P	0	0	0	0
A L05_03 Bed (double) 01	0.8	0	0	0
A L05_03 Bed (double) 02	0.2	0	0	0
A L05_03 Liv/Kitch 2B4P	6.2	1.4	1.4	1.4
A L05_04 Bed (double) 01	0	0	0	0
A L05_04 Bed (double) 02	0	0	0	0
A L05_04 Liv/Kitch 2B4P	1.7	1.7	1.7	1.7
A L08_01 Bed (double)	0	0	0	0
A L08_01 Liv/Kitch 1B2P	0	0	0	0
A L08_02 Bed (double) 01	3.2	0.3	0	0
A L08_02 Bed (double) 02	0.7	0	0	0
A L08_02 Bed (single)	2.1	0	0	0
A L08_02 Kitchen 3B5P	7.5	1.7	0.1	0.1
A L08_02 Living 3B5P	16.2	6	2.3	2.3
A L08_03 Bed (double) 01	1.8	0	0	0
A L08_03 Bed (double) 02	4.5	0.8	0	0
A L08_03 Bed (single)	3	0	0	0
A L08_03 Kitchen 3B5P	5	0.2	0	0
A L08_03 Living 3B5P	17.9	10.6	6.5	1.4
B L01_02 Bed (double) 01	0.2	0.2	0.2	0.2

Unit ID	Operative temperature - % annual occupied hours above 26°C			
	Opt 5-1	**Opt 5-2**	**Opt 5-3**	**Opt 5-4**
B L01_02 Bed (double) 02	2.6	2.6	2.6	2.6
B L01_02 Liv/Kitch 2B4P	2.9	2.9	2.9	2.9
B L05_01 Bed (double)	0	0	0	0
B L05_01 Liv/Kitch 1B2P	0	0	0	0
B L10_01 Bed (double)	0	0	0	0
B L10_01 Liv/Kitch 1B2P	0	0	0	0
B L10_02 Bed (double) 01	0.2	0.2	0.2	0.2
B L10_02 Bed (double) 02	2.5	2.5	2.5	2.5
B L10_02 Liv/Kitch 2B4P	2.5	2.5	2.5	2.5
C L01_01 Bed (double) 01	0.5	0	0	0
C L01_01 Bed (double) 02	0	0	0	0
C L01_01 Liv/Kitch 2B4P	3.5	1.2	1.2	1.2
C L01_02 Bed (double) 01	3.9	1	1	1
C L01_02 Bed (double) 02	6.5	2.9	2.9	2.9
C L01_02 Liv/Kitch 2B4P	5.1	0	0	0
C L01_03 Bed (double)	0	0	0	0
C L01_03 Liv/Kitch 1B2P	0	0	0	0
C L01_04 Bed (double) 01	0.1	0.1	0.1	0.1
C L01_04 Bed (double) 02	0	0	0	0
C L01_04 Liv/Kitch 2B4P	0	0	0	0
C L03_01 Bed (double) 01	0.5	0	0	0
C L03_01 Bed (double) 02	0.1	0	0	0
C L03_01 Liv/Kitch 2B4P	4.1	1.5	1.5	1.5
C L03_02 Bed (double) 01	3.5	0.8	0.8	0.8
C L03_02 Bed (double) 02	5.9	2.5	2.5	2.5
C L03_02 Liv/Kitch 2B4P	4.4	0	0	0
C L03_03 Bed (double)	0	0	0	0
C L03_03 Liv/Kitch 1B2P	0	0	0	0
C L05_01 Bed (double) 01	0	0	0	0
C L05_01 Bed (double) 02	0	0	0	0
C L05_01 Liv/Kitch 2B4P	0	0	0	0
Number of sample units passing	**17**	**23**	**26**	**27**
Total number of sample units	**27**	**27**	**27**	**27**
Sample unit pass rate	**63%**	**85%**	**96%**	**100%**

A.2.3 Option 6 full results

Option 5 summary:

- Option 6-1 was per option 5-1 with internal blinds and limited cooling capacity set to 1.5 kW.
- Option 6-2 was per option 6-1 but with an increased limited cooling capacity of 2 kW on units that failed CIBSE TM59 in option 6-1.
- Option 6-3 was per option 6-2 but with an increased limited cooling capacity of 2.5kW on a unit that failed CIBSE TM59 in option 6-2.

Unit ID	Operative temperature - % annual occupied hours above 26°C		
	Opt 6-1	Opt 6-2	Opt 6-3
A L00_01 Bed (double)	0	0	0
A L00_01 Liv/Kitch 2B4P	0	0	0
A L03_01 Bed (double)	0	0	0
A L03_01 Bed (single)	0.1	0.1	0.1
A L03_01 Liv/Kitch 2B3P	0	0	0
A L03_02 Bed (double)	0	0	0
A L03_02 Bed (single)	0	0	0
A L03_02 Liv/Kitch 2B3P	0	0	0
A L03_03 Bed (double) 01	0	0	0
A L03_03 Bed (double) 02	0	0	0
A L03_03 Liv/Kitch 2B4P	0.5	0.5	0.5
A L03_04 Bed (double) 01	0	0	0
A L03_04 Bed (double) 02	0	0	0
A L03_04 Liv/Kitch 2B4P	0.7	0.7	0.7
A L03_05 Bed (double)	0	0	0
A L03_05 Liv/Kitch 1B2P	0	0	0
A L03_06 Bed (double) 01	0	0	0
A L03_06 Bed (double) 02	0	0	0
A L03_06 Bed (single)	0	0	0
A L03_06 Kitchen 3B5P	0.1	0	0
A L03_06 Living 3B5P	3.3	0.1	0.1
A L03_07 Bed (double) 01	0	0	0
A L03_07 Bed (double) 02	0	0	0
A L03_07 Bed (single)	0	0	0
A L03_07 Kitchen 3B5P	0.2	0	0
A L03_07 Living 3B5P	3.9	0.8	0.8
A L05_01 Bed (double)	0	0	0
A L05_01 Bed (single)	0	0	0
A L05_01 Liv/Kitch 2B3P	0	0	0
A L05_02 Bed (double)	0	0	0
A L05_02 Bed (single)	0	0	0
A L05_02 Liv/Kitch 2B3P	0	0	0
A L05_03 Bed (double) 01	0	0	0

Unit ID	Operative temperature - % annual occupied hours above 26°C		
	Opt 6-1	Opt 6-2	Opt 6-3
A L05_03 Bed (double) 02	0	0	0
A L05_03 Liv/Kitch 2B4P	0.9	0.9	0.9
A L05_04 Bed (double) 01	0	0	0
A L05_04 Bed (double) 02	0	0	0
A L05_04 Liv/Kitch 2B4P	0.7	0.7	0.7
A L08_01 Bed (double)	0	0	0
A L08_01 Liv/Kitch 1B2P	0	0	0
A L08_02 Bed (double) 01	0	0	0
A L08_02 Bed (double) 02	0	0	0
A L08_02 Bed (single)	0.1	0	0
A L08_02 Kitchen 3B5P	0.4	0	0
A L08_02 Living 3B5P	5.2	0.3	0.3
A L08_03 Bed (double) 01	0	0	0
A L08_03 Bed (double) 02	0.5	0	0
A L08_03 Bed (single)	0.2	0	0
A L08_03 Kitchen 3B5P	0.5	0	0
A L08_03 Living 3B5P	8.8	3.3	0.7
B L01_02 Bed (double) 01	0	0	0
B L01_02 Bed (double) 02	0.1	0.1	0.1
B L01_02 Liv/Kitch 2B4P	0	0	0
B L05_01 Bed (double)	0	0	0
B L05_01 Liv/Kitch 1B2P	0	0	0
B L10_01 Bed (double)	0	0	0
B L10_01 Liv/Kitch 1B2P	0	0	0
B L10_02 Bed (double) 01	0	0	0
B L10_02 Bed (double) 02	0.1	0.1	0.1
B L10_02 Liv/Kitch 2B4P	0	0	0
C L01_01 Bed (double) 01	0	0	0
C L01_01 Bed (double) 02	0	0	0
C L01_01 Liv/Kitch 2B4P	1.1	1.1	1.1
C L01_02 Bed (double) 01	0.5	0.5	0.5
C L01_02 Bed (double) 02	1.6	1.6	1.6
C L01_02 Liv/Kitch 2B4P	0.2	0.2	0.2
C L01_03 Bed (double)	0	0	0
C L01_03 Liv/Kitch 1B2P	0	0	0
C L01_04 Bed (double) 01	0	0	0
C L01_04 Bed (double) 02	0	0	0
C L01_04 Liv/Kitch 2B4P	0	0	0
C L03_01 Bed (double) 01	0	0	0
C L03_01 Bed (double) 02	0	0	0
C L03_01 Liv/Kitch 2B4P	1.1	1.1	1.1

Unit ID	Operative temperature - % annual occupied hours above 26°C		
	Opt 6-1	**Opt 6-2**	**Opt 6-3**
C L03_02 Bed (double) 01	0.4	0.4	0.4
C L03_02 Bed (double) 02	1.4	1.4	1.4
C L03_02 Liv/Kitch 2B4P	0.2	0.2	0.2
C L03_03 Bed (double)	0	0	0
C L03_03 Liv/Kitch 1B2P	0	0	0
C L05_01 Bed (double) 01	0	0	0
C L05_01 Bed (double) 02	0	0	0
C L05_01 Liv/Kitch 2B4P	0	0	0
Number of sample units passing	**23**	**26**	**27**
Total number of sample units	**27**	**27**	**27**
Sample unit pass rate	**85%**	**96%**	**100%**

A.3 Future weather tape full results

A.3.1 The DSY 2 and 3 results for proposed design solution

All occupied rooms should not exceed an operative temperature of 26 ˚C for more than 3% of the annual occupied annual hours following the guidance from CIBSE TM59. Areas of failure are highlighted in red, and areas of a pass are highlighted in green in the results table below.

Unit ID	Operative temperature - % annual occupied hours above 26°C	
	Opt 6-3 DSY2	Opt 6-3 DSY3
A L00_01 Bed (double)	0	0
A L00_01 Liv/Kitch 2B4P	0	0
A L03_01 Bed (double)	0	0
A L03_01 Bed (single)	0.2	0.1
A L03_01 Liv/Kitch 2B3P	0	0
A L03_02 Bed (double)	0	0
A L03_02 Bed (single)	0	0
A L03_02 Liv/Kitch 2B3P	0	0
A L03_03 Bed (double) 01	0	0
A L03_03 Bed (double) 02	0	0
A L03_03 Liv/Kitch 2B4P	0.5	0.7
A L03_04 Bed (double) 01	0	0
A L03_04 Bed (double) 02	0	0
A L03_04 Liv/Kitch 2B4P	0.5	1.1
A L03_05 Bed (double)	0	0
A L03_05 Liv/Kitch 1B2P	0	0
A L03_06 Bed (double) 01	0	0
A L03_06 Bed (double) 02	0	0
A L03_06 Bed (single)	0	0
A L03_06 Kitchen 3B5P	0	0
A L03_06 Living 3B5P	0.3	0.5
A L03_07 Bed (double) 01	0	0
A L03_07 Bed (double) 02	0	0
A L03_07 Bed (single)	0	0
A L03_07 Kitchen 3B5P	0	0
A L03_07 Living 3B5P	1.4	0.6
A L05_01 Bed (double)	0	0
A L05_01 Bed (single)	0.1	0.1
A L05_01 Liv/Kitch 2B3P	0	0
A L05_02 Bed (double)	0	0
A L05_02 Bed (single)	0	0
A L05_02 Liv/Kitch 2B3P	0	0
A L05_03 Bed (double) 01	0	0
A L05_03 Bed (double) 02	0	0

Unit ID	Operative temperature - % annual occupied hours above 26°C	
	Opt 6-3 DSY2	Opt 6-3 DSY3
A L05_03 Liv/Kitch 2B4P	0.8	1.4
A L05_04 Bed (double) 01	0	0
A L05_04 Bed (double) 02	0	0
A L05_04 Liv/Kitch 2B4P	0.4	1
A L08_01 Bed (double)	0	0
A L08_01 Liv/Kitch 1B2P	0	0
A L08_02 Bed (double) 01	0	0
A L08_02 Bed (double) 02	0	0
A L08_02 Bed (single)	0	0
A L08_02 Kitchen 3B5P	0	0
A L08_02 Living 3B5P	1.1	1.3
A L08_03 Bed (double) 01	0	0
A L08_03 Bed (double) 02	0	0
A L08_03 Bed (single)	0	0
A L08_03 Kitchen 3B5P	0	0
A L08_03 Living 3B5P	1	0.7
B L01_02 Bed (double) 01	0	0
B L01_02 Bed (double) 02	0.1	0.2
B L01_02 Liv/Kitch 2B4P	0.2	0.1
B L05_01 Bed (double)	0	0
B L05_01 Liv/Kitch 1B2P	0	0
B L10_01 Bed (double)	0	0
B L10_01 Liv/Kitch 1B2P	0	0
B L10_02 Bed (double) 01	0	0
B L10_02 Bed (double) 02	0.1	0.3
B L10_02 Liv/Kitch 2B4P	0.2	0.1
C L01_01 Bed (double) 01	0	0
C L01_01 Bed (double) 02	0	0
C L01_01 Liv/Kitch 2B4P	0.8	1.5
C L01_02 Bed (double) 01	0.7	0.8
C L01_02 Bed (double) 02	1.9	1.9
C L01_02 Liv/Kitch 2B4P	0.8	0.9
C L01_03 Bed (double)	0	0
C L01_03 Liv/Kitch 1B2P	0	0
C L01_04 Bed (double) 01	0	0
C L01_04 Bed (double) 02	0	0
C L01_04 Liv/Kitch 2B4P	0	0
C L03_01 Bed (double) 01	0	0.1
C L03_01 Bed (double) 02	0	0
C L03_01 Liv/Kitch 2B4P	0.9	1.7
C L03_02 Bed (double) 01	0.6	0.9

Unit ID	Operative temperature - % annual occupied hours above 26°C	
	Opt 6-3 DSY2	Opt 6-3 DSY3
C L03_02 Bed (double) 02	1.6	1.7
C L03_02 Liv/Kitch 2B4P	0.8	1.1
C L03_03 Bed (double)	0	0
C L03_03 Liv/Kitch 1B2P	0	0
C L05_01 Bed (double) 01	0	0
C L05_01 Bed (double) 02	0	0
C L05_01 Liv/Kitch 2B4P	0	0.1
Number of sample units passing	**27**	**27**
Total number of sample units	**27**	**27**
Sample unit pass rate	**100%**	**100%**

A.3.2 The DSY 2 and 3 results for increased run hours (corridors)

If the operative temperature of 28 ºC is exceeded for more than 3% of the total annual hours, then this should be identified as a significant risk following the guidance from CIBSE TM59. Areas of failure are highlighted in red, and areas of a pass are highlighted in green in the results table below.

Location	Operative temperature (°C) - % annual hours above 28°C	
	Increased run hours option - with DSY 2	Increased run hours option - with DSY 2
A L04 Communal corridor	1.2	2
A L04 Stair/Lift lobby	1	1.6
A L07 Communal corridor	1.8	2.8
A L07 Stair/Lift lobby	1.3	2.3
B L04 Communal corridor	1.2	2
B L04 Stair/Lift lobby	0.8	1.4
B L09 Communal corridor	1.7	2.7
B L09 Stair/Lift lobby	1.4	2.3
C L02 Communal corridor	1.3	2.1
C L02 Stair/Lift lobby	0.9	1.5
C L04 Communal corridor	1.7	2.7
C L04 Stair/Lift lobby	1.4	2.4
Number of sample corridor passing	**12**	**12**
Total number of sample units	**12**	**12**
Sample corridor pass rate	**100%**	**100%**

Appendix B Sample unit selection

Table 8. Tabular summary of sample unit selection

Model unit reference	Block	Level	Flat type	Aspect	Location
A L00_01	A	Level 0	1B2P WCH	Single	Ground floor unit
A L03_01	A	Level 3	2B3P WCH	Single	Mid floor unit
A L03_02	A	Level 3	2B3P WCH	Single	Mid floor unit
A L03_03	A	Level 3	2B4P	Triple	Mid floor unit
A L03_04	A	Level 3	2B4P	Dual	Mid floor unit
A L03_05	A	Level 3	1B2P	Single	Mid floor unit
A L03_06	A	Level 3	3B5P	Dual	Mid floor unit
A L03_07	A	Level 3	3B5P	Triple	Mid floor unit
A L05_01	A	Level 5	2B3P WCH	Single	Top floor unit
A L05_02	A	Level 5	2B3P WCH	Single	Top floor unit
A L05_03	A	Level 5	2B4P	Triple	Top floor unit
A L05_04	A	Level 5	2B4P	Dual	Top floor unit
A L08_01	A	Level 8	1B2P	Dual	Top floor unit
A L08_02	A	Level 8	3B5P	Dual	Top floor unit
A L08_03	A	Level 8	3B5P	Triple	Top floor unit
B L01_02	B	Level 1	2B4P	Triple	Lower midfloor unit
B L05_01	B	Level 5	1B2P	Single	Mid floor unit
B L10_01	B	Level 10	1B2P	Dual	Top floor unit
B L10_02	B	Level 10	2B4P	Triple	Top floor unit
C L01_01	C	Level 1	2B4P	Dual	Lower midfloor unit
C L01_02	C	Level 1	2B4P	Triple	Lower midfloor unit
C L01_03	C	Level 1	1B2P	Single	Lower midfloor unit
C L01_04	C	Level 1	2B4P	Dual	Lower midfloor unit
C L03_01	C	Level 3	2B4P	Dual	Top floor unit
C L03_02	C	Level 3	2B4P	Triple	Top floor unit
C L03_03	C	Level 3	1B2P	Single	Top floor unit
C L05_01	C	Level 5	2B4P	Dual	Top floor unit

Total sample units 27

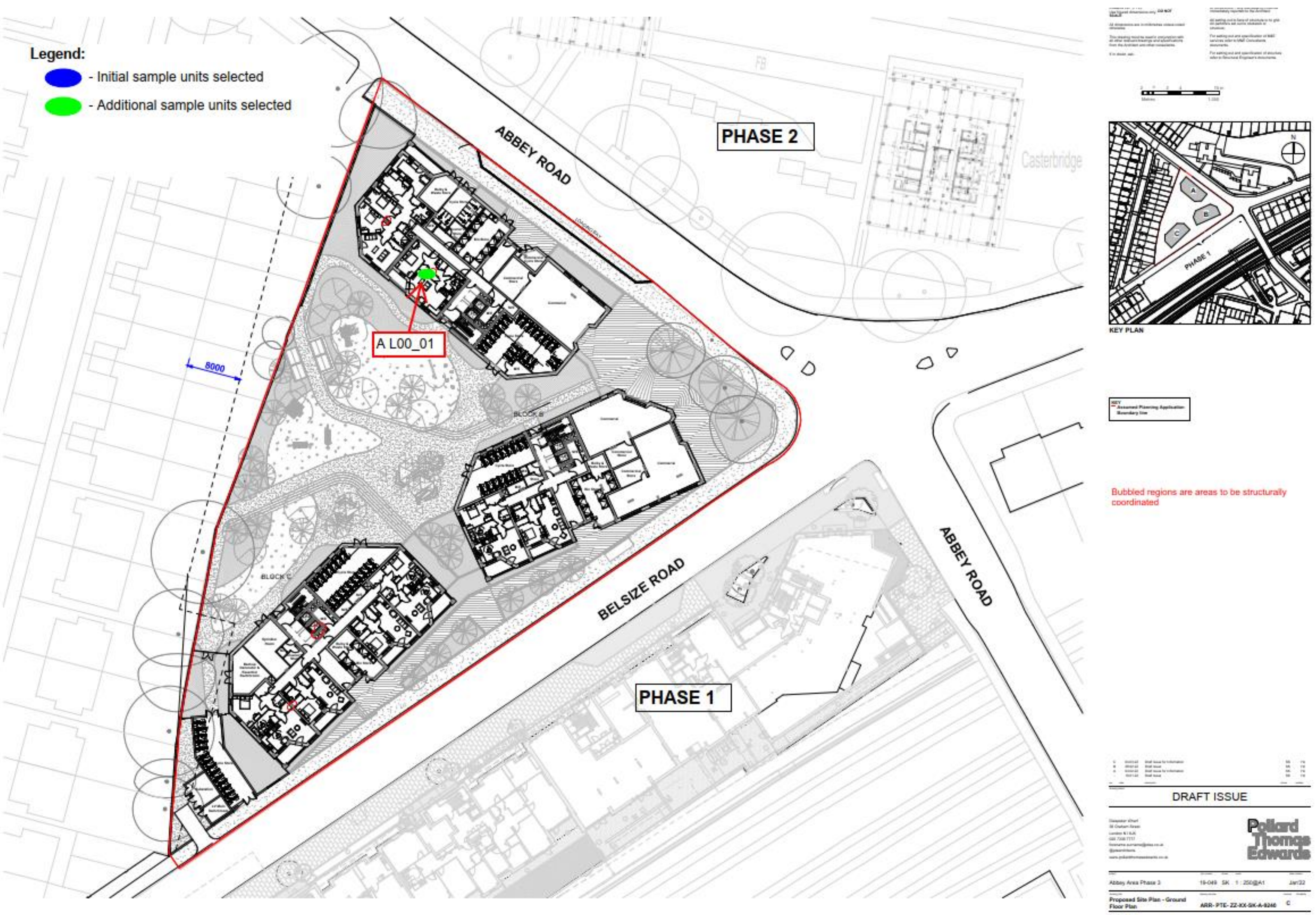

Figure 3. Ground floor sample unit selections

Figure 4. First floor sample unit selections

Figure 5. Third floor sample unit selections

Figure 6. Fifth floor sample unit selections

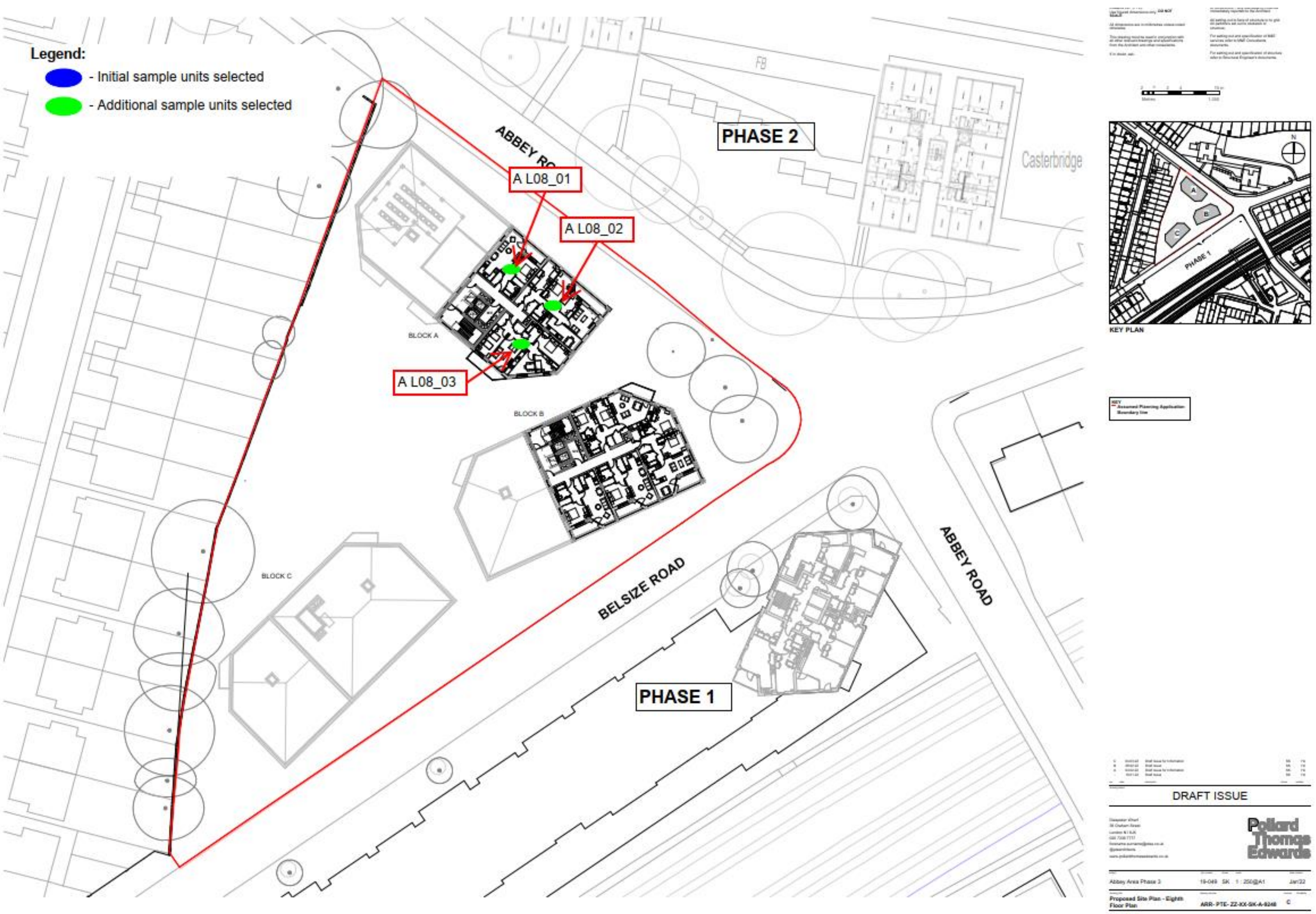

Figure 7. Eighth floor sample unit selections

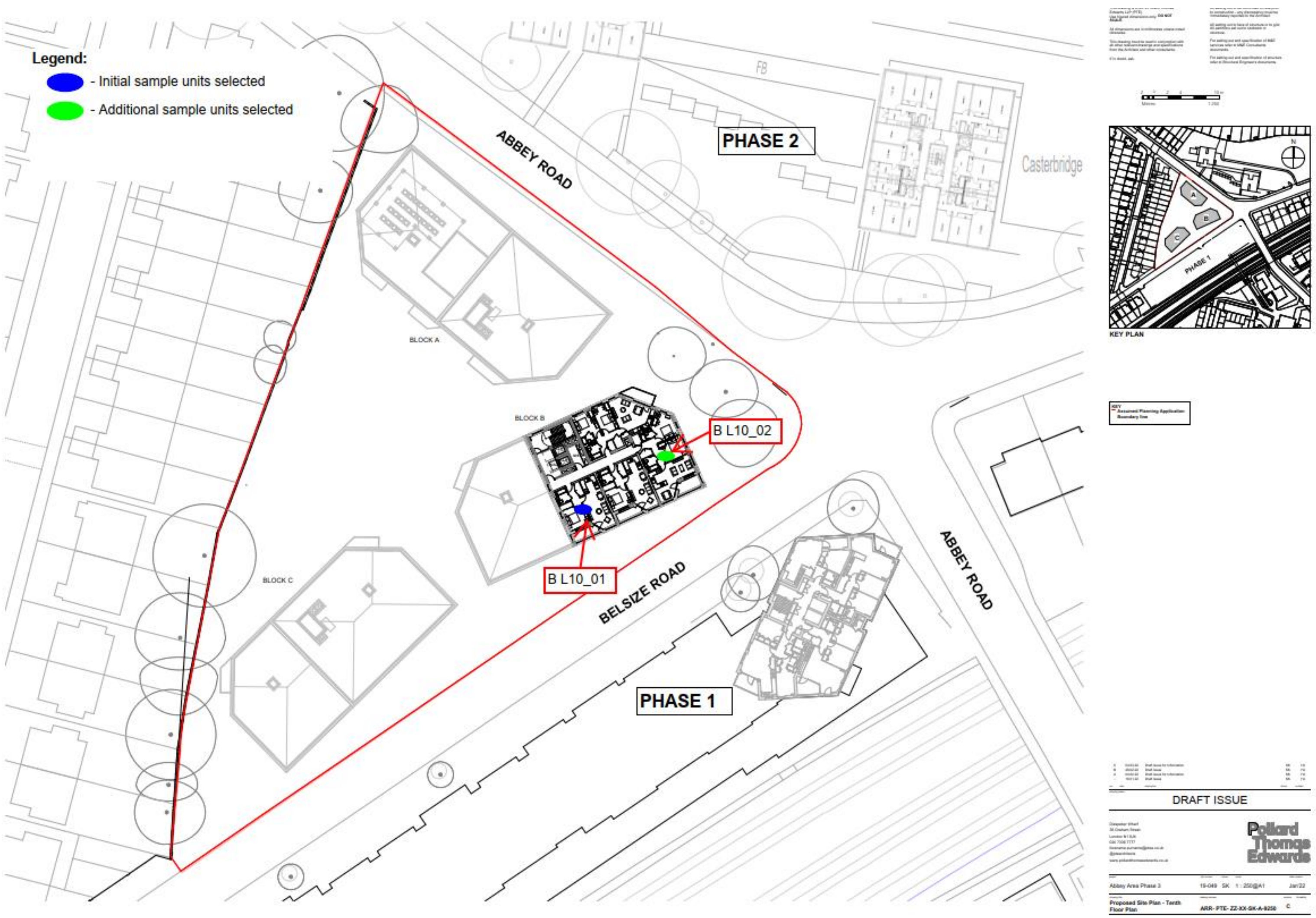

Figure 8. Tenth floor sample unit selections

Appendix C Sample communal corridor mark ups

Figure 9. Second floor sample communal corridor selections

Figure 10. Fourth floor sample communal corridor selections

Figure 11. Seventh floor sample communal corridor selections

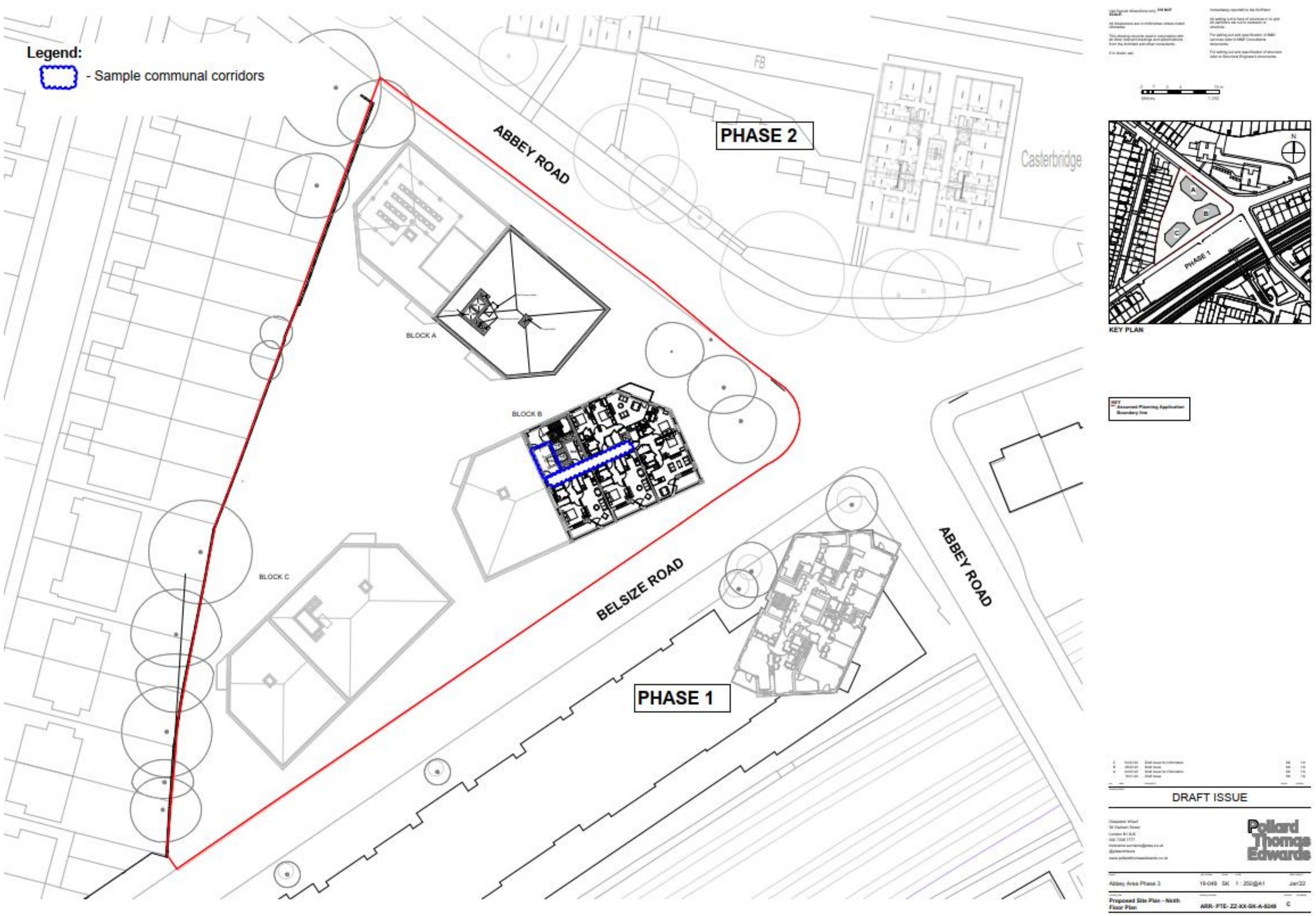

Figure 12. Ninth floor sample communal corridor selections

Appendix D Roof mark up

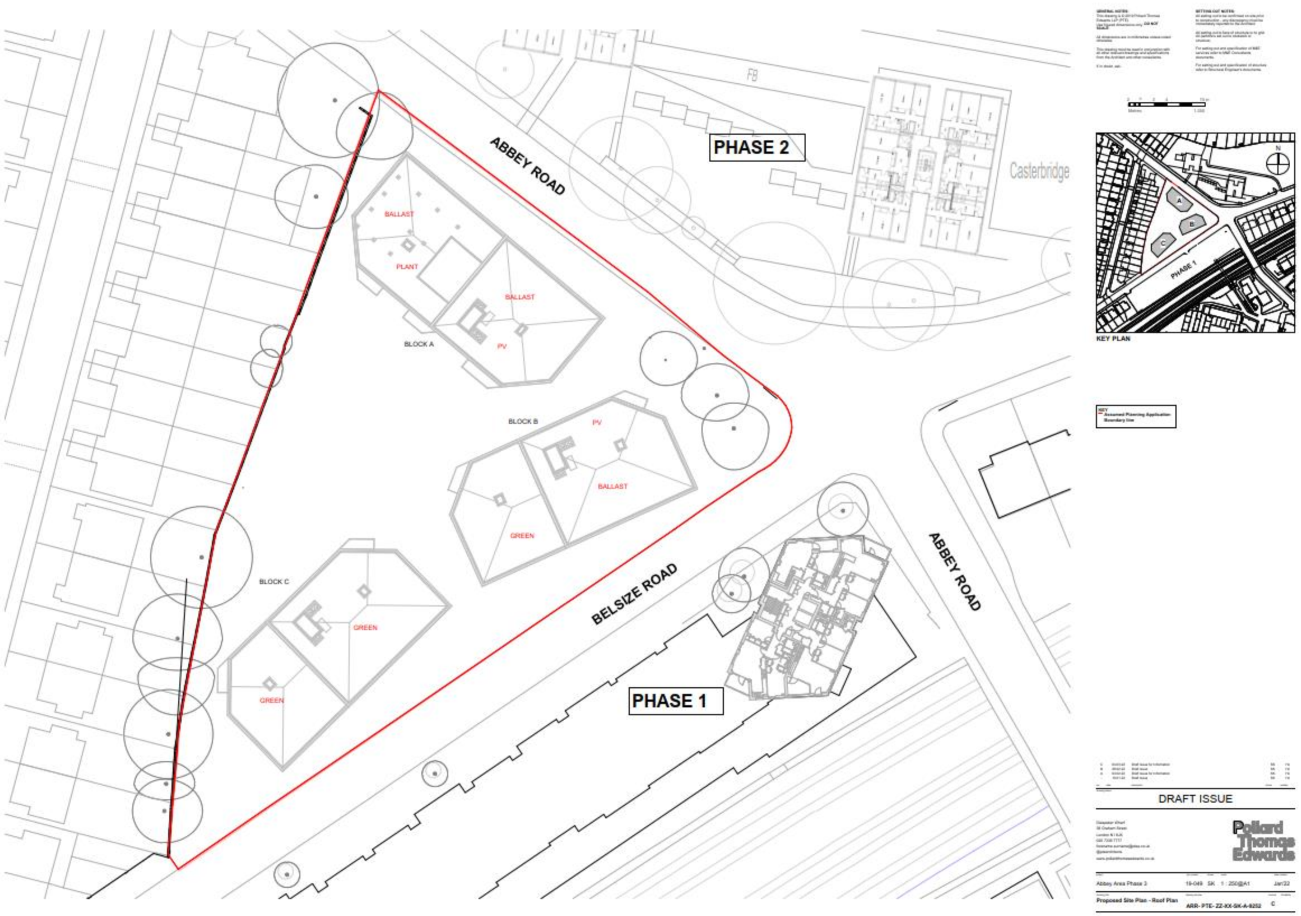

Figure 13. Roof type locations

Appendix E Run 1 room failures mark-up

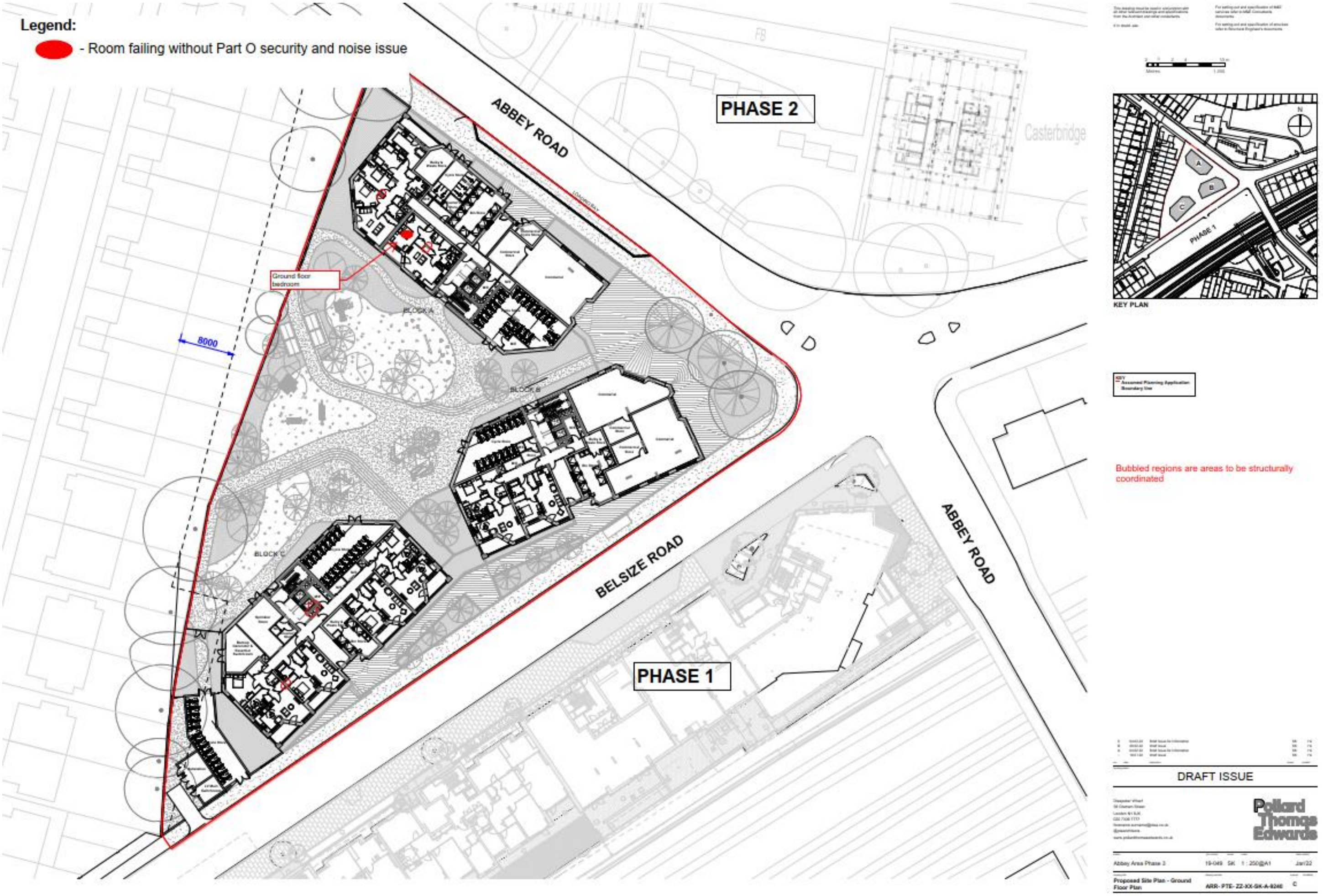

Figure 14. Ground floor bedroom location

Figure 15. Mid floor bedrooms and living room location at level 3

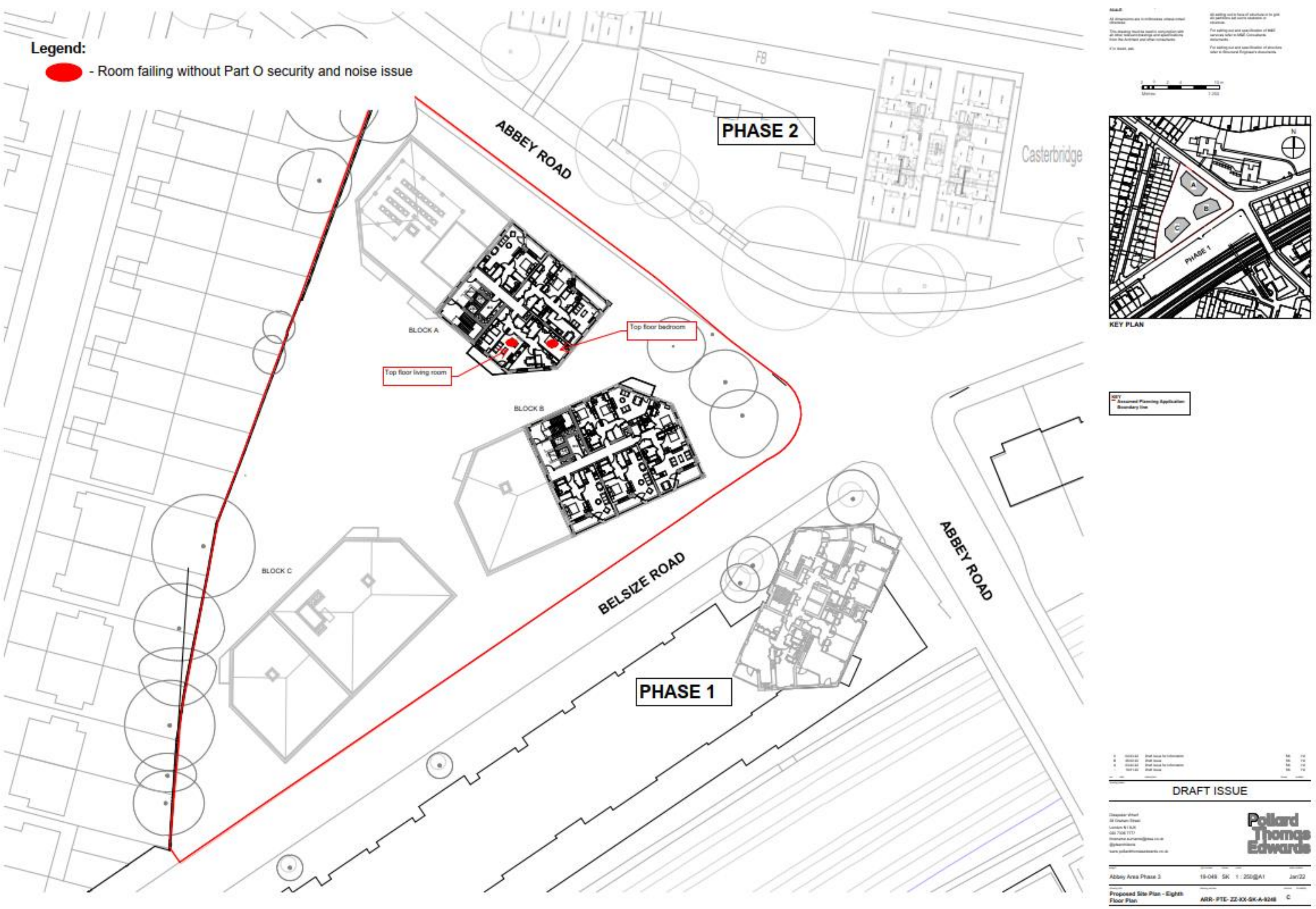

Figure 16. Top floor bedroom and living room location at level 8

Appendix F Drawings used for the overheating assessment

Table 9. Drawing set used for the overheating assessment

Drawing number	Description	Revision
ARR-PTE-ZZ-XX-SK-A-9240-C-Ground Floor Plan	Proposed site plan – Ground floor plan	C
ARR-PTE-ZZ-XX-SK-A-9241-C-First Floor Plan	Proposed site plan – First floor plan	C
ARR-PTE-ZZ-XX-SK-A-9243-C-Third Floor Plan	Proposed site plan – Third floor plan	C
ARR-PTE-ZZ-XX-SK-A-9245-C-Fifth Floor Plan	Proposed site plan – Fifth floor plan	C
ARR-PTE-ZZ-XX-SK-A-9248-C-Eighth Floor Plan	Proposed site plan – Eight floor plan	C
ARR-PTE-ZZ-XX-SK-A-9250-C-Tenth Floor Plan	Proposed site plan – Tenth floor plan	C
ARR-PTE-ZZ-XX-SK-A-9260-C-Elevations - Block A	Elevations – Block A	B
ARR-PTE-ZZ-XX-SK-A-9261-C-Elevations - Block B	Elevations – Block B	B
ARR-PTE-ZZ-XX-SK-A-9262-C-Elevations - Block C	Elevations – Block C	B

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