

Overheating Risk Assessment

138-144 Friar Street

For National Pub Portfolio Limited

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ecolytik

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1 Executive Summary

This Overheating Report has been prepared by Ecolytik for the proposed development at 138-144 Friar Street, located within the jurisdiction of Reading Borough Council.

The methodology adopted is in line with CIBSE Technical Memorandum 52 (2013) and CIBSE Guide A for the shared basement and ground floor areas of the scheme and in line with the current Approved Document Part O of Building Regulations (2021) and the associated CIBSE TM59 (2017) for the co-living units.

To carry out the assessment, a 3D computer model of the proposed development was generated in line with the guidelines. London Gatwick Design Summer Year (DSY) weather files (with their DSY1/DSY2/DSY3 variations) were used in the assessments for the 2020's period (high emissions, 50th percentile scenarios), in line with CIBSE TM49 guidance.

An initial review using Good Homes Alliance Overheating checklist was carried out and identified that the co-living units could be at risk of overheating. The checklist is included in Appendix D of this report.

Subsequently, dynamic thermal modelling showed that the proposed development can comply with Part O (2021), provided the measures proposed and included in this report are fully incorporated and retained to construction.

Assessments were carried out with windows being open (to determine whether passive measures have been maximised) and with windows closed due to noise constraints.

All co-living units, 11no. communal corridors, and the basement and ground floor communal spaces such as multimedia room, resident lounge, gym, dining areas and café were included in the analyses. Co-living units and communal corridors were assessed against CIBSE TM59 and Part O while the ground floor communal spaces were evaluated against CIBSE TM52 and CIBSE Guide A.

1.1 Co-living units

1.1.1 Without useability constraints

When assuming that there are no noise or security constraints to limit the opening of windows during night-time, the proposed scheme was found to meet the overheating risk criteria for all habitable rooms (as per requirement O1(1) of Part O (2021)). This demonstrates that passive measures such as solar control glazing and window openable areas (via provision of fully openable windows with Juliet balconies) have been maximised and the respective Building Regulations requirement O1(1) has been met (iteration 1, Table 1 on the following page).

1.1.2 With useability constraints

Noise consultants Quantum Acoustics have confirmed that co-living unit windows on all elevations cannot be relied upon for night-time ventilation due to noise levels being above the limits stipulated within Part O for all facades. Quantum Acoustics expressed concern that noise levels during daytime may also inhibit the use of windows for ventilation during daytime on the façade fronting Friar Street.

Ground floor units at Fife Court and Courtyard Elevations of the scheme would also not be able to open windows fully at night-time due to security constraints, as per Part O guidance.

Given the above constraints, and while windows are not proposed to be fixed shut, analyses were carried out to determine a suitable backup strategy with windows closed for the scheme.

MVHR systems alone were not found to be sufficient to enable compliance with Part O when windows are closed. Therefore, air tempering coils are proposed for the MVHR systems. Air tempering coils are not full cooling systems per se offering full temperature control. The MVHR systems with air tempering coils connected to them should be capable of providing at least 60 l/s per co-living unit.

With this approach, co-living units can comply with requirement O1(2) of Part O 2021 (iteration 2, Table 1 on the following page).

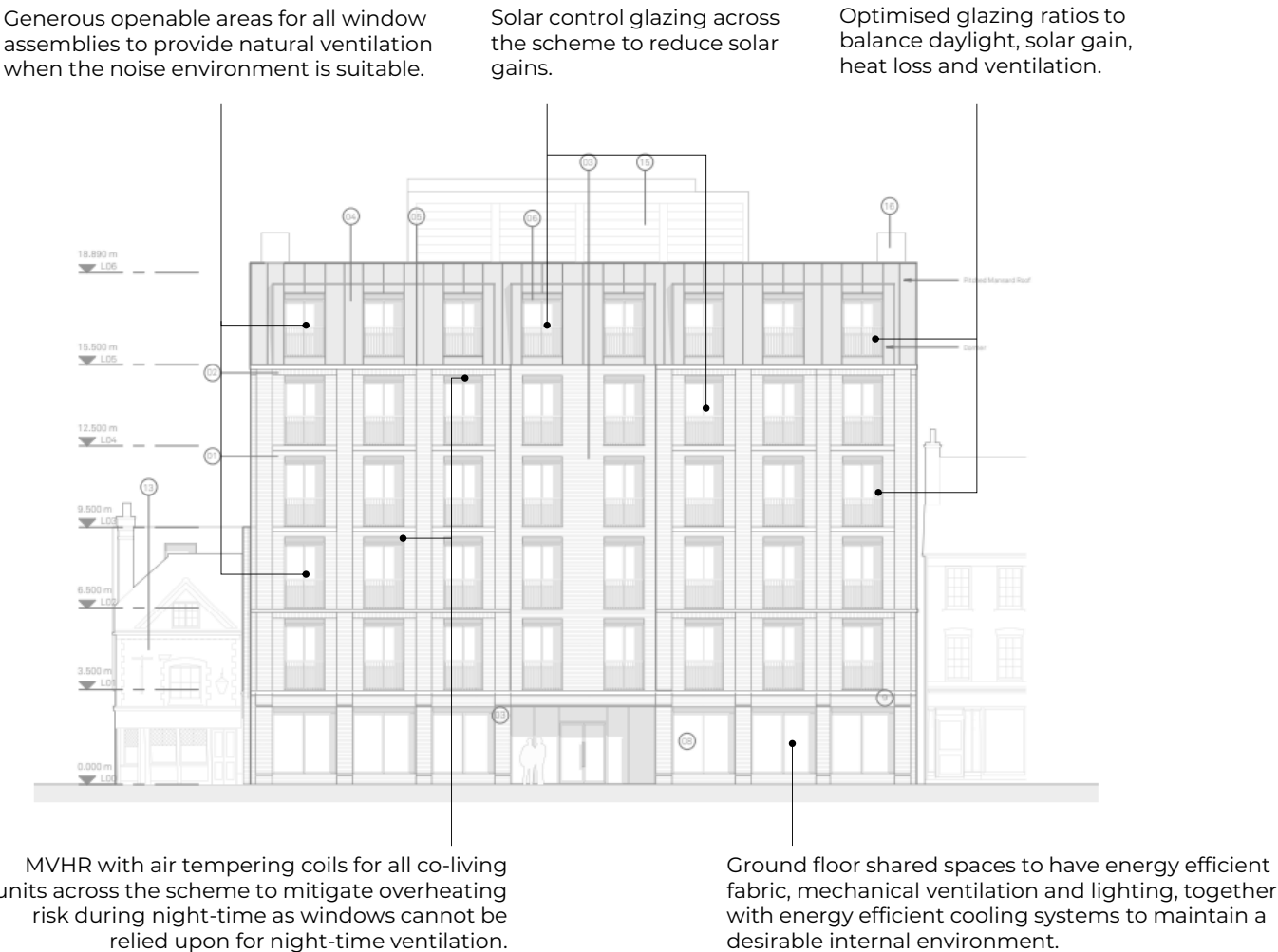


Figure 1. Summary of measures to reduce overheating risks (North / Friar Street elevation).

1.1.3 Proposed strategy

The proposed scheme will include the following measures to mitigate overheating risks:

- High specification building fabric to limit unintended heat ingress through conduction or infiltration.
- Balanced and reasonable glazing ratios.
- Solar control glazing with g-value of 0.4.
- Glazing areas which are fully openable with provision of Juliet balconies with railings (please refer to Appendix E for early stage guidance provided to the design team and the submitted elevations).
- MVHR with connected air tempering coils for all co-living units.

The above measures are illustrated in Figure 1 on the previous page and enable all co-living units to comply with Part O (2021), as shown in Table 1.

1.2 Communal corridors

Due to the proposed implementation of communal heating network for the scheme, the overheating risk within communal corridors was assessed. The strategies to reduce this risk include:

- All distribution pipework will be well insulated and in accordance with latest practice and standards at the time of construction.
- Occupancy sensors should be used to regulate the use of communal lighting.

There are two options to provide ventilation to communal corridors:

- Natural ventilation through the AOV shafts for all corridors. Modelling was carried out with a 3m² grille for each corridor shaft, 1.5m² opening at the top of each smoke shaft; all ventilation openings are proposed to achieve 60% free area. The results showed that there is significant risk of overheating in corridors with natural ventilation due to achievable ventilation naturally relative to the potential heat gains within corridors from distribution pipework. Further review is recommended during detailed design.
- Alternatively, fans could be installed within the AOV shafts for the corridors providing at least 2.5 litres/ second / m² of ventilation for

each corridor. This flow rate can potentially reduce during detailed design when the exact pipework sizes, insulation and heat gains can be determined more accurately. With mechanical ventilation, the communal corridors were found to meet the overheating criteria.

1.3 Basement and ground floor spaces

For the basement and ground floor shared use spaces of the scheme, the simulations indicated that there is a risk of overheating if no cooling system is provided.

Consequently, a series of iterations were carried out to reduce the cooling demand as far as possible. In summary, this part of the scheme will include the following measures:

- High specification building fabric to prevent unintended heat ingress through conduction or infiltration.
- Balanced and reasonable glazing ratios.
- Solar control glazing with g-value of 0.4.
- MVHR for all spaces.
- Energy efficient lighting to reduce internal heat gains, heat recovery ventilation and cooling are proposed.

With the above measures, these spaces can provide a desirable internal environment. When cooling is factored in the modelling, compliance can be achieved against relevant CIBSE recommendations and criteria.

Through iterative analysis, the cooling demand was reduced by 14% compared to the baseline design, using dynamic thermal modelling and DSY1 2020's weather file.

1.4 DSY2/DSY3 weather files

Modelling was also carried out in line with more onerous weather files DSY2 and DSY3. Compliance with these datasets is not a policy or regulatory requirement. Minor deviations from performance metrics were identified with these weather data sets for the co-living units while the predicted cooling loads for the ground floor spaces were expected to increase.

Table 1. Part O (2021) modelling results summary for all co-living units of the scheme.

Iteration (Weather file)	Ventilation strategy	Applicable criteria*	Applicable number of sample rooms	Sample rooms meeting criteria	% of rooms complying
1(DSY1)	Open windows 24/7 (no MVHR)	Test A	145	145	100%
		Test B	145	145	100%
2 (DSY1)	Closed windows; MVHR*	Test C	145	145	100%
2 (DSY2)**	Closed windows; MVHR*	Test C	145	142	98%
2 (DSY3)**	Closed windows; MVHR*	Test C	145	145	100%

*Naturally ventilated co-living units

Test A: May-September: % of occupied hours ΔT>1°K (<3%), for all co-living units.

Test B: Annual night hours T_{op}>26°C (<33 hours), for all co-living units.

Mechanically ventilated co-living units

Test C: T_{op}>26°C (<3% of annual hours), for all co-living units.

** Flow rate ≥ 60 l/s per co-living unit with air tempering coil connected. Please refer to section 6.3 for further details on the air tempering coil.

*** Compliance with these weather files is not a regulatory or policy requirement.

2 Introduction

2.1 Site

The site is situated in the heart of Reading Town Centre, adjacent to the key junction of Friar Street and Queen Victoria Street (QVS), approximately a 3-minute walk (circa 250m) from Reading Railway Station.

The site is located adjacent to Queen Victoria Street – Phase 1 (QVS1), which has consent for hotel and leisure use and is currently under refurbishment. These proposals relate to Queen Victoria Street – Phase 2 and are linked to the expansion of the QVS1 application, aiming to further the shared vision of Reading Borough Council and local stakeholders.

A previous application for hotel use on this site was approved (planning ref: PL/22/1235); however, following review the hotel proposal was not considered viable.

The current application is for the phased redevelopment of the site involving the demolition of Nos. 138–141 and 142–143 Friar Street, partial demolition of No. 144 Friar Street, and erection of a basement and 6-storey building to provide co-living residential accommodation (purpose-built shared living accommodation – Sui Generis use class), together with the partial retention of the former Bugle Public House as a standalone Class E commercial unit.

The site location is presented in Figure 2.



Figure 2. Approximate site location of the proposed development at 138-144 Friar Street (Source: Google Maps, accessed: June 2026).

2.2 Application of guidance

2.2.1 Approved Document Part O

The currently adopted Approved Document Part O (published in 2021, hereafter referred to as ADO or Part O) sets out rigorous performance standards in relation to overheating risks for residential developments and applies additional considerations to CIBSE TM59 (2017) guidance.

The overheating risk is evaluated for habitable spaces during occupied hours. These are determined from CIBSE TM59 guidance. Studios are assumed occupied on 24/7 basis.

The criteria relate to the frequency of overheating during occupied hours and between May to September, when overheating is most likely to cause discomfort.

There is an additional criterion for studios where the frequency of overheating is assessed during night-time only, on an annual basis.

The above metrics are applicable for dwellings which are predominantly naturally ventilated. For predominantly mechanically ventilated dwellings (e.g. where windows have to be fixed or restricted due to noise, safety or security constraints), the applicable criterion for assessing overheating risk is a different frequency test, measuring the percentage of hours a certain temperature threshold is exceeded on an annual basis.

The proposed studios/ co-living units of 138-144 Friar Street were evaluated against all applicable criteria (Table 2). Due to known noise constraints at the application site and security constraints for ground floor windows, the co-living units were evaluated with windows closed whilst relying on the proposed MVHR systems (see accompanying Energy and Sustainability Statement for the planning application). In this modelling scenario, the applicable criteria for predominantly mechanically ventilated dwellings from TM59 were used (Table 2).

Whilst there are no criteria for the potential severity of overheating on any given day within Part O and TM59, the standards are challenging to meet and require robust mitigation strategies incorporated into the design from the earliest stages of projects.

CIBSE TM59 also includes a test to evaluate overheating risks within communal corridors where communal heating pipework is installed. This is also a frequency test and is evaluated across the entire year.

Communal corridors of 138-144 Friar Street with potential distribution pipework in their ceiling voids and adjacent risers were evaluated in detail.

2.2.2 CIBSE TM52 and CIBSE Guide A

The basement and ground floor communal spaces of 138-144 Friar Street comprising Multimedia room, Gym, Café and shared lounge and dining rooms are more likely to resemble the profiles of non-residential spaces. Therefore, these spaces were evaluated against the CIBSE TM52 (2013) guidance.

CIBSE TM52 sets out performance criteria for regularly occupied areas of non-residential uses. These include the frequency test (hours of exceedance H_e), a severity test on any given day (daily weighted exceedance W_e) and a max temperature test (upper limit temperature). CIBSE TM52 guidance notes that only two of the above three criteria need to be met to demonstrate compliance and is applicable to naturally ventilated spaces.

For air-conditioned spaces, CIBSE Guide A (2015) sets the expected internal environment of different building types. These internal conditions are expected to be met with appropriately sized systems by the M&E consultant during detailed design and fit-out stages.

The specific numerical and technical standards set out within CIBSE TM59, TM52 and Part O are presented in more detail in Appendix C of this report. Table 2 summarises the spaces assessed against the relevant guidance and criteria.



Table 2. Summary of guidance used for different spaces at 138-144 Friar Street.

Space	Guidance document	Criteria*
Studios / co-living units	Part O and CIBSE TM59	<u>When predominantly naturally ventilated</u> A. May-September: % of occupied hours $\Delta T > 1^\circ\text{K}$ (<3%), for all co-living units B. Annual night hours $T_{op} > 26^\circ\text{C}$ (<33 hours), for all co-living units. <u>When predominantly mechanically ventilated</u> C. $T_{op} > 26^\circ\text{C}$ (<3% of annual hours), for all habitable rooms.
Communal corridors	Part O and CIBSE TM59	– % Annual hours $> 28^\circ\text{C}$ ($\leq 3\%$)
Basement and Ground floor: Multimedia room, Gym, resident lounge, dining rooms, co-working, café.	CIBSE TM52	– Hours of exceedance (H_e): $H_e < 3\%$ of occupied hours – Daily weighted exceedance (W_e): $W_e < 6$ – Upper limit temperature (T_{upp}): $T_{op} - T_{max} < 4^\circ\text{C}$

*Please refer to Appendix C of the report for definitions and further details on the assessment criteria.

2.2.3 Reading Draft Local Plan (2025)

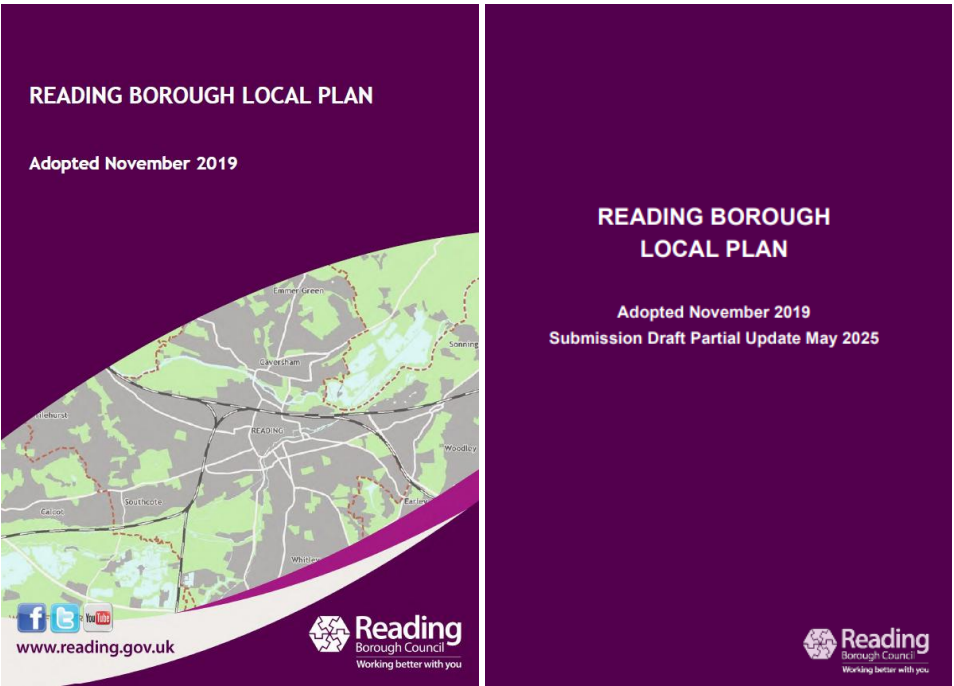
Policy CC3 of the Local Plan outlines that developments should be designed to adapt to climate change mitigate the risks of overheating, by considering the following measures:

- Solar shading
- Thermal mass
- Appropriate heating and ventilation for the building
- Appropriately coloured materials in areas exposed to direct sunlight
- Green and brown roofs
- Green walls

The policy states that all development must address the risks of overheating through passive cooling and energy efficiency measures in the first instance, by using the Good Homes Alliance (GHA) early-stage overheating risk tool.

The preliminary assessment using GHA's tool is presented in Appendix D of this report. Following the findings of this initial review, detailed overheating assessments using CIBSE and Part O methodologies was carried out.

The report first discusses how an appropriate hierarchy of measures has informed the design of the proposed development at 138-144 Friar Street considering Policy CC3 and subsequently presents the technical analysis and results in line with CIBSE TM59, Part O, and CIBSE TM52 methodologies.



3 Design Hierarchy

The design of the proposed scheme at 138-144 Friar Street has considered Policy CC3 of the Draft Local Plan by RBC, as well as the following principles and hierarchy of measures set out below.

1. Solar shading

- Glazing areas have been balanced between heat loss, daylight access and solar gains.
- The main façade is north facing, while other facades facing east and west would experience an element of solar protection from surrounding buildings.
- Solar control measures will include high specification glazing with an appropriate g-value.
- External shading or adjustments to glazing areas are not proposed currently due to the impact they would have on daylight levels within the co-living units.

2. Thermal mass

- Exposed internal thermal mass is more effective for non-domestic buildings when it is possible to significantly pre-cool spaces during night-time when they are unoccupied.
- The inclusion of exposed internal thermal mass will result in higher space heating demand for residential type spaces such as co-living studios.
- Exposed internal thermal mass (at ceiling level) also requires exposed building services and is not deemed suitable for this scheme.

3. Appropriate heating and ventilation design

- Low carbon heating systems are proposed (Air Source Heat Pumps).
- Ventilation strategy includes maximisation of passive measures as far as possible, together with mechanical ventilation with heat

recovery (MVHR) throughout the scheme.

- All heat sources such as heat distribution pipework will be well insulated to reduce heat loss. Lateral heat distribution pipework will be minimised as far as feasible. All light fixtures will be low energy and will not result in notable internal lighting heat gains.

4. Appropriate coloured materials

- The roof and facades of the building will utilise light and reflective colours as far as possible to reduce conductive heat gains.
- Conductive heat gains through the building fabric will be primarily controlled through insulation.

5. Green and brown roofs

- A portion of the roof not utilised for plant is proposed to be green roof, which will further reduce conductive heat gains to the spaces below.

6. Green walls

- Green walls require significant maintenance and are unlikely to provide notable benefits in reducing overheating risks for this scheme.

4 Design Development

Architects Falconer Chester Hall, Noise Consultants Quantum Acoustics, M&E Consultants Innovo, Daylight Consultants DPR, Ecolytik and the Client collaborated to support design development for overheating risk mitigation and coordination between disciplines.

Various solutions to maximise the potential for passive ventilation and reduce M&E infrastructure within the development were explored, in line with the requirements of Part O and the principles of emerging policy CC2 of RBC's Draft Partial Update to the Local Plan.

As the proposed development is located along Friar Street, noise poses a notable constraint, especially to the opening of windows during night-time.

The density of the surrounding context could limit daylight access to the proposed co-living units. It was initially established that full height glazing areas should be maintained in order to provide an enjoyable internal environment for future residents from a daylight perspective. The application of shading devices or alterations to the glazing areas was found to impact on daylight levels and was avoided.

Considering the above and in order to maximise the passive ventilation potential of the scheme, the architects evolved the design to incorporate Juliet balconies with railings. This design response enables the entire glazed area of each window assembly to the co-living units to be openable for ventilation, when the noise environment is deemed suitable by future residents.

Examples of the evolution of the elevations at RIBA Stage 2 are illustrated in Figure 3. This principle applies to all facades across the scheme.

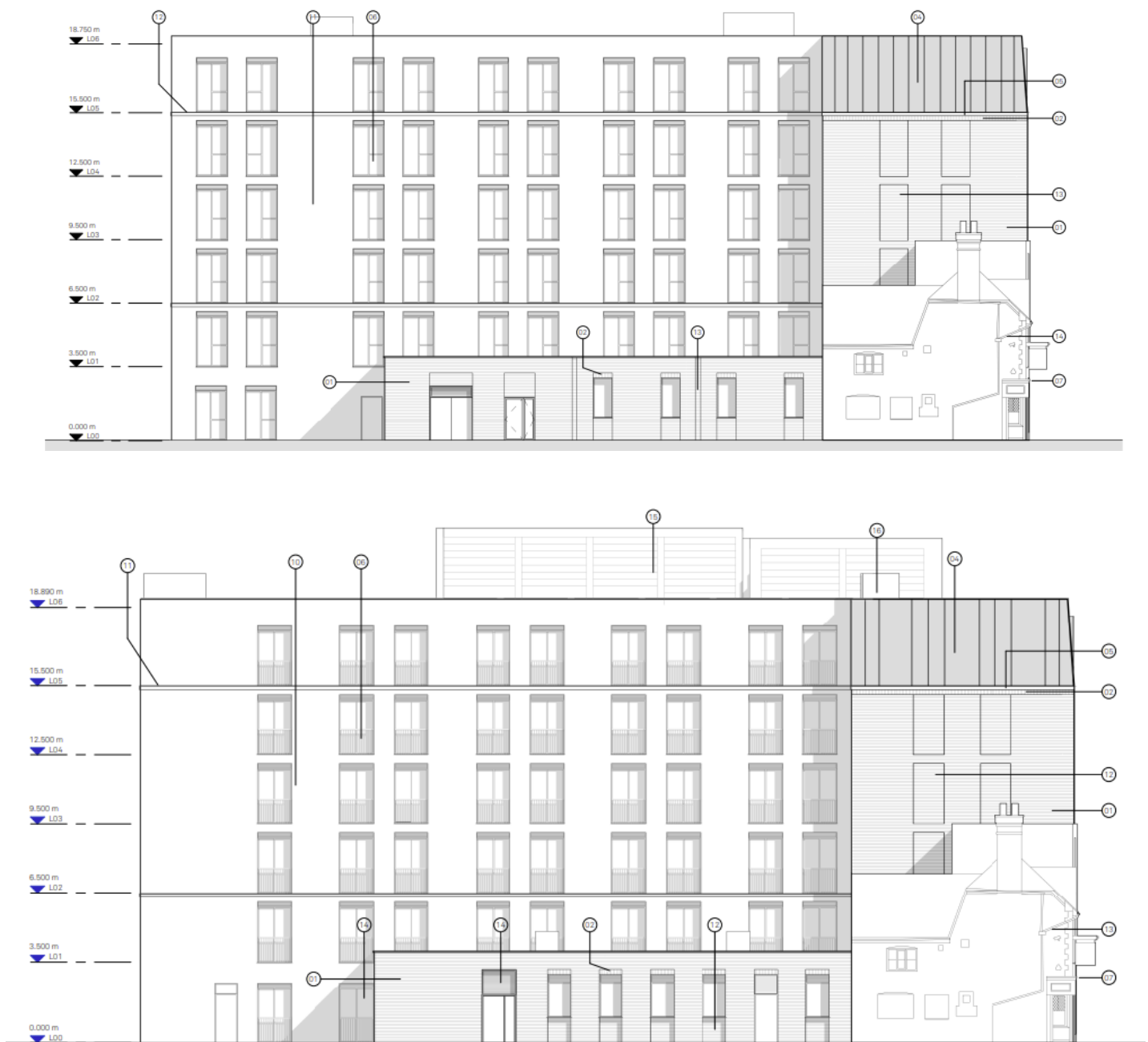


Figure 3. Top: Initial design of east elevation with limited openable areas, bottom: updated design of east elevation with Juliet balconies and larger openable windows.

5 Technical model

5.1 Sources of information

Architectural drawings have been used to create a 3D computer model of the proposed development. The full list of sources of information used in this assessment is as follows.

Drawings by Falconer Chester Hall (FCH) Architects:

- P21109-FCH-BA-B1-DR-A-0300-Proposed Basement Plan
- P21109-FCH-XX-00-DR-A-1300-1306 (Floor plans)
- P21109-FCH-XX-XX-DR-A-1400-Proposed Friar Street Elevation
- P21109-FCH-XX-XX-DR-A-1401-Proposed Fife Court Elevation
- P21109-FCH-XX-XX-DR-A-1402-Proposed Courtyard Elevation
- P21109-FCH-XX-XX-DR-A-1403-Proposed Rear Elevation.

5.2 Scope of assessment

Figure 4 shows the technical 3D model developed for the analysis. Surrounding buildings were modelled in a simplified way and as a worst-case approach.

All co-living units, 11no. communal corridors, and the basement and ground floor spaces such as multimedia room, residential lounges, gym, shared dining areas and café were included in the analyses.

The thermal model includes the following key inputs summarised below.

- Building fabric as shown in Appendix B.
- The degree of window opening for the co-living units was determined from the architects' planning submission drawings. Appendix E illustrates early stage guidance provided to inform elevation design.

It should be noted that air quality, noise and security constraints can limit the extent of window opening which could lead to greater overheating risks.

It has been assumed that Air Quality will not pose a constraint to the opening of windows at this stage.

Safety is also a key consideration for upper floor windows across the scheme. The railings of the Juliet balconies will be designed to comply with Part O guidance.

Quantum Acoustics have advised that all windows cannot be relied upon for night-time ventilation for this scheme as noise levels would exceed the limits set out within Part O. The levels of noise on Friar Street may also limit the use of opening windows during daytime.

Security is generally an issue for ground floor or easily accessible units. This affects the ground floor shared spaces, as well as the ground floor co-living units on Fife Court and Courtyard Elevations.

Given the above constraints, and while windows are not proposed to be fixed shut, two key assessments were carried out for the co-living units. One assumed no noise or security constraints to evaluate whether all passive measures have been maximised, in line with requirement O1(1) of Part O, while an assessment was also carried out with windows closed to identify a backup overheating mitigation strategy for the scheme (as per requirement O1(2) of Part O).

For the ground floor shared spaces, due to the site's constraints, windows facing Friar Street were modelled as closed throughout the day. Due to security constraints, no windows of ground floor spaces were modelled as open during night-time.

The overheating risk assessment was carried out at planning stage and presents an overall strategy on how overheating risks could be reduced and how compliance with relevant regulations and standards could be achieved. It is recommended this assessment is updated as the design progresses to confirm compliance with overheating regulations at detailed design and construction stages.

Should construction take place following the publication of an updated version of Part O, the team should ensure the suitable version of the regulations will be complied with.

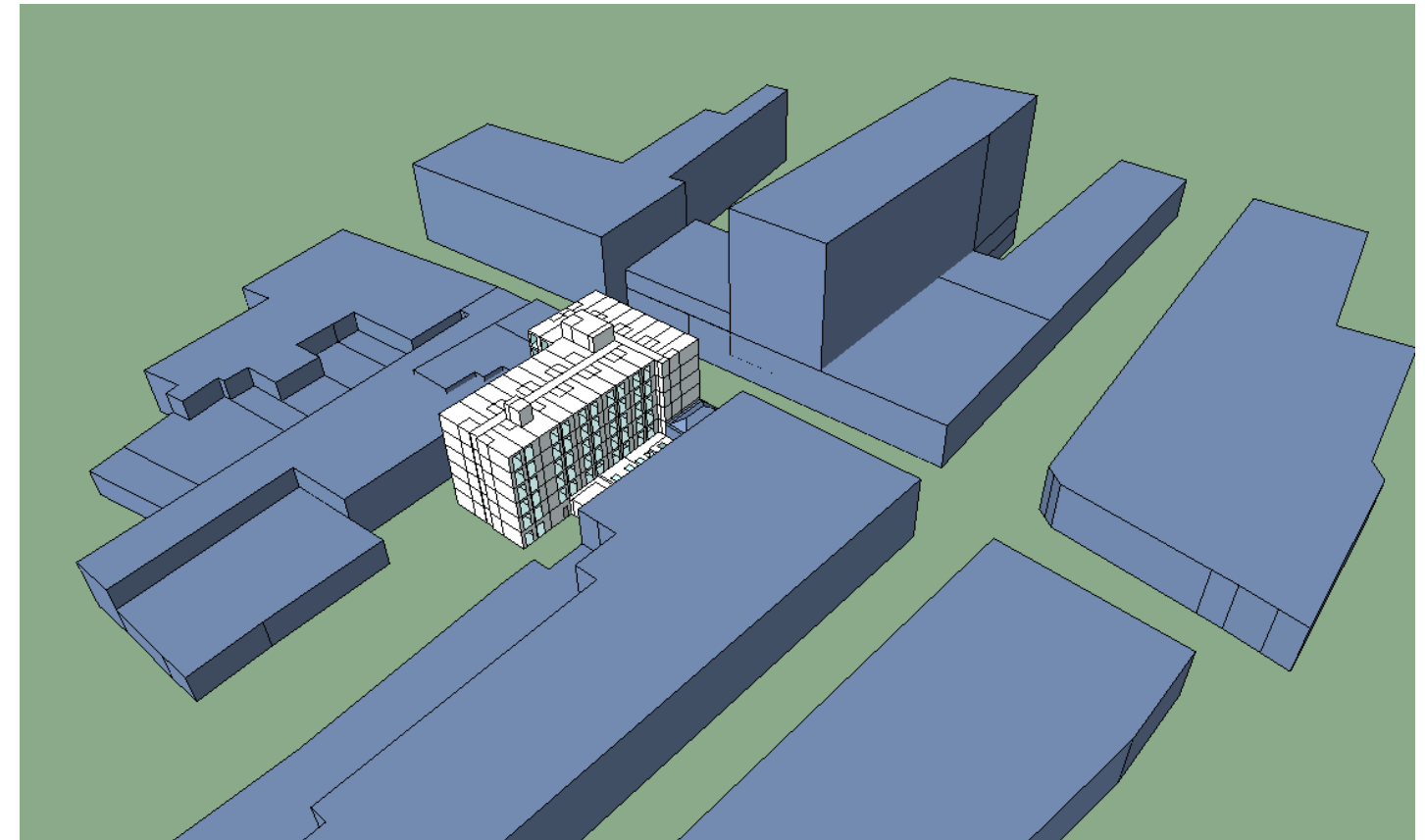


Figure 4. View from southeast of 3D simulation model.

6 Co-living units assessment

6.1 Initial review

The updated designs developed by FCH Architects for the planning application already include features that help reduce overheating risks. Openable areas of glazing have been maximised. All window assemblies to Co-living units have been designed to have two inward opening panes to 90-degree angle which enables good natural ventilation potential.

An initial review using Good Homes Alliance Overheating checklist was carried out and identified that the co-living units could be at risk of overheating. The checklist is included in Appendix D of this report.

Following this, dynamic thermal modelling was carried out. In principle, key overheating remediation techniques include reducing solar gains and increasing the ventilating capacity of windows. These were explored via dynamic thermal modelling and are discussed in more detail in the next section (6.3) of the report. Prior to presenting the results of the analysis, some background is provided on solar control techniques in subsection 6.2 below.

6.2 Solar control

It is not considered appropriate to incorporate external shading measures as this would interfere notably with architecture and would reduce internal daylight levels to the co-living units.

The specification of glazing, in particular the use of lower g-value glazing, was deemed to be the main remaining method of further reducing solar gains.

There is often a balance to be made between admitting useful heat gain in winter and daylight against limiting solar gains through the specification of glazing.

Ideally, glazing is transparent to short-wave radiation and reflective to long wave radiation, allowing daylight to enter while resisting radiative heat transfer. The two properties of glazing that affect solar control are the g-value and the light transmission factor; low-e coatings can be applied to glass to achieve certain specifications.

Figure 5 illustrates the transmission of different, generic glazing types across the spectrum. Thermally efficient glazing is designed to transmit less of the far infrared radiation (>1.5 μ m.) which is emitted by objects within rooms, thereby keeping the heat within buildings. Solar control glazing is designed to screen out the near infrared radiation which is emitted by the sun (0.7-1.5 μ m.), thereby keeping the solar energy out of buildings. However, this entails a reduction in the transmission of the visible light of the spectrum.

It is therefore key to not reduce significantly the g-value of glazing in residential uses as it would affect the ingress of useful solar gain in winter and the level of daylight (among potential aesthetic implications on the appearance of glazing).

From past project experience, it is often not possible to achieve Part O compliance without solar control glazing. Therefore, the assessment included glazing with a g-value of 0.4.

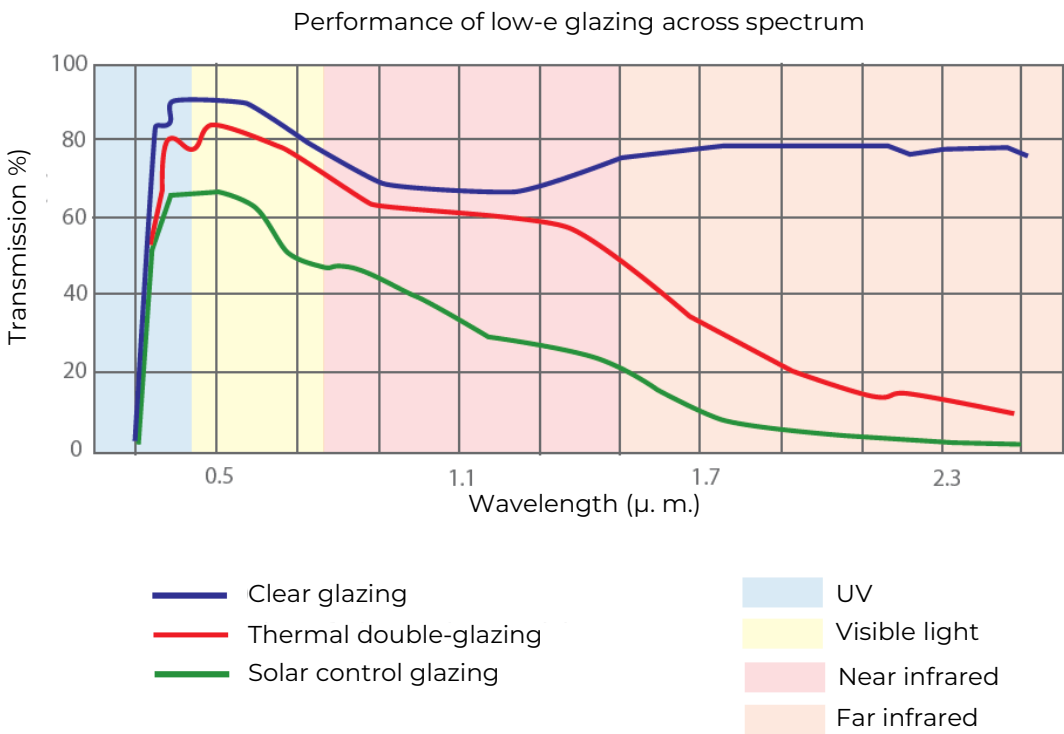


Figure 5. Indicative transmission of different glazing types across the spectrum.

6.3 Modelling iterations

6.3.1 Without useability constraints

If noise and security constraints were to be disregarded, all co-living units modelled were found to have adequate levels of passive ventilation via openable windows and reduced solar gains, demonstrating compliance with requirement O1(1) of Part O. This is reflected in Iteration 1, shown in Table 3 and Table 4.

Detailed numerical results for all rooms modelled are presented in Appendix A.

Overall, the proposed design demonstrates that passive overheating risk mitigation measures can be deemed to have been maximised at the scheme.

6.3.2 With useability constraints

Subsequently, the potential impact of noise and security was introduced to the analysis to evaluate overheating risks. The co-living units were modelled with windows closed.

From past experience, as well as analysis results not included in this report, the use of MVHR in bypass mode during the summer and without air tempering coils was not found to suffice to enable compliance with the performance criteria (this can be inferred from Appendix A, where certain co-living units marginally comply with Test B, when windows are fully openable 24/7 and MVHR supplies 60 l/s as per iteration 1; each window typically delivers circa 400 l/s per co-living unit, therefore removing this level of flow during night-time by the windows does not enable compliance).

Air tempering coils are considered the least energy intensive method of reducing overheating risks and their application has become common and best practice for flatted developments with constraints to opening windows. The proposed solution is not a full cooling system providing complete temperature control within the spaces but is only capable of providing an element of trim cooling.

The results showed that all co-living units are predicted to comply with Part O criteria in this

assessment scenario (Iteration 2, Table 4). Therefore, the use of air tempering coils integrated to the MVHR systems is recommended to all co-living units within the scheme to enable compliance with requirement O1(2).

Table 3. Iterations carried out to identify how Part O compliance can be achieved for co-living units modelled.

Iteration	Description	Window openable area	MVHR flow rate
1	Initial simulation, no window useability constraints.	Openable panes of windows assumed to ventilate co-living units on 24/7 basis. See Appendix E for details.	60 l/s in bypass mode.
2	Noise and security constraints factored into the assessment.	Windows closed to assess adequacy of MVHR and air tempering coil as a back-up strategy.	For each co-living unit ≥ 60 l/s Air tempering coil connected to MVHR*

** The Supply Air Temperature (SAT) of the MVHR considered the potential variable contribution from the air tempering coil, dependent on the external (T_{ext}) and internal (T_{int}) temperature. This was approximated as follows in the modelling:*
- If $T_{int} \geq 22^{\circ}\text{C}$ and $T_{ext} < 30^{\circ}\text{C}$, $SAT = 16^{\circ}\text{C}$
- If $T_{int} \geq 22^{\circ}\text{C}$ and $T_{ext} \geq 30^{\circ}\text{C}$, $SAT = T_{ext} - 14^{\circ}\text{C}$
- If $18^{\circ}\text{C} \leq T_{int} < 22^{\circ}\text{C}$ and $T_{ext} \geq 12^{\circ}\text{C}$ and $T_{int} > T_{ext}$, $SAT = T_{ext}$ (bypass)
- In all other instances, $SAT = 0.8 \times T_{int} + 0.2 \times T_{ext}$ (heat recovery)

The air tempering coils may have fairly limited cooling capacity (typically lower than 2kW at peak flow and temperatures) and do not provide full temperature control but only an element of trim cooling.

Table 4. Part O modelling results summary for all co-living units of the scheme.

Iteration (Weather file)	Part O requirement	Applicable criteria	Applicable number of sample rooms	Sample rooms meeting relevant criteria	% of rooms complying
1 (DSY1)	O1(1)	Test A	145	145	100%
	O1(1)	Test B	145	145	100%
2 (DSY1)	O1(2)	Test C	145	145	100%

Naturally ventilated co-living units

Test A: May-September: % of occupied hours $\Delta T > 1^{\circ}\text{K}$ (<3%), for all co-living units.

Test B: Annual night hours $T_{op} > 26^{\circ}\text{C}$ (<33 hours), for all co-living units.

Mechanically ventilated co-living units

Test C: $T_{op} > 26^{\circ}\text{C}$ (<3% of annual hours), for all co-living units.

6.3.3 Impact of DSY2/DSY3 weather files

Simulations were also carried out against more onerous weather data sets (DSY2 and DSY3) as required by guidance.

Full compliance with the overheating tests for DSY2 and DSY3 weather files is not an adopted policy or regulatory requirement. The analysis was carried out for the proposed strategy (iteration 2, Table 3 on the previous page), which entails the use of MVHR with air tempering coils and windows being closed as the most likely operation profile of the scheme.

Minor deviations from the overheating risk performance criteria were identified, as shown in Table 5.

Reducing the g-value of glazing to below 0.4 is not recommended as it would increase heating demand, and energy/carbon emissions. It would also notably reduce the visible light transmittance of glazing (see section 6.2 for further details) which would compromise daylight levels and compliance with associated design policies.

No further improvements to the passive design strategies are deemed possible and the application of cooling systems to enable compliance with DSY2/DSY3 weather files is not proposed.

Table 5 summarises the findings while detailed results are shown in Appendix A of the report. Compliance with DSY2 and DSY3 weather files is not a regulatory or policy requirement.

It should also be noted that at the time of construction, the proposed development may have to comply with the upcoming version of TM59 and Part O, which would likely follow a different set of modelling rules not currently known or published.

Table 5. Results summary with DSY2 and DSY3 weather files (compliance not required).

Iteration	Applicable criteria	Applicable number of sample rooms	Sample rooms meeting relevant criteria	% of rooms meeting criteria
2 (DSY2)	Test C	145	142	98%
2 (DSY3)	Test C	145	145	100%

Mechanically ventilated co-living units

Test C: T_{op}>26°C (<3% of annual hours), for all co-living units.

7 Communal corridors assessment

The heat gains from pipework within risers and ceiling voids have been estimated using CIBSE TM59 guidelines.

A heat gain of 14 W/m of pipework was modelled for the risers due the larger pipework accommodated within and 12 W/m of pipework within ceiling voids. A storey's height was used to calculate the heat gains from riser pipework at each floor level.

Communal corridors were assessed as shown in Figure 6.

The length of the corridors has been used to derive the heat gains of ceiling void heating distribution and the floor-to-floor height to calculate the heat gain within risers. The following heat gains were modelled:

- Corridor A: 536 Watts (W) per ceiling void per floor
- Corridor B: 741W per ceiling void per floor
- Risers: 99W per floor

Lighting gains of 2 W/m² of corridor were included in the model as a worst-case approach and based on TM59 guidance.

All communal corridors assessed are fully internal and are proposed to be ventilated via the smoke shafts.

Two ventilation options were evaluated:

- Natural ventilation through the AOV shafts for all corridors. Modelling was carried out with 3m² grille for each corridor shaft, 1.5m² opening at the top of the smoke shaft; all ventilation openings are proposed to achieve 60% free area.
- Alternatively, mechanical ventilation with the use of fans through the AOV/smoke shafts at a rate of 2.5 litres/ second / m² of communal corridor.

CIBSE TM59 states that whilst there is no mandatory target for communal corridors, however if an operative temperature of 28°C is exceeded for more than 3% of annual hours, then

this should be identified as a significant risk within the TM59 overheating report.

The results indicate that with the above modelling parameters, overheating risks are unlikely in the communal corridors if mechanical ventilation is adopted and appropriately sized fans are installed.

With natural ventilation, the overheating risk in corridors was found to be significant. The detailed numerical results are presented in Table 6.

Further analysis and review is recommended during the detailed design stage of the project to determine the final strategy.

Overheating risks in communal corridors can be reduced by reducing distribution runs, insulating pipework and by aiming to achieve heat losses from pipework below the benchmark values of CIBSE TM59. Occupancy sensors should be used to regulate the use of lighting. Appropriate levels of ventilation should be provided accordingly to dissipate these heat gains as part of the design strategy.



Figure 6. Communal corridors assessed. Left: Ground floor, Right: Third floor (representative of first to fifth floors).

Table 6. Results for communal corridors.

Corridor name	Mechanical Ventilation % Annual hours > 28°C (≤3%)	Natural Ventilation % Annual hours > 28°C (≤3%)
0F Communal corridor A	0.6	43.6
1F Communal corridor A	0.9	23.3
1F Communal corridor B	0.7	69.3
2F Communal corridor A	1	24.1
2F Communal corridor B	1	76.3
3F Communal corridor A	1.1	22.2
3F Communal corridor B	1.1	55.4
4F Communal corridor A	1.2	18.3
4F Communal corridor B	1.2	43.8
5F Communal corridor A	1.4	19.5
5F Communal corridor B	1.5	24.8

8 Basement and ground floor spaces assessment

The use of natural ventilation is not considered suitable for the café and co-working space facing Friar Street. In addition, theses glazed areas are likely to be fixed due to noise and security constraints. Windows of shared spaces facing Fife Court and the Courtyard of the scheme were initially modelled as openable during occupied hours (Table 7).

The results showed that with the use of natural and mechanical ventilation alone, these ground floor spaces are predicted to deviate significantly from CIBSE TM52 criteria, as shown in Table 8, which indicates that the use of cooling is challenging to avoid for these spaces.

Therefore, the focus of subsequent simulations was to identify measures that would reduce the demand for cooling.

8.1.1 Solar and internal heat gain modulation

The first improvement measure tested included the use of more energy efficient lighting, in line with the principles of the design hierarchy set out in Policy CC3 (Iteration 1, Table 7). The results showed efficient lighting would reduce the cooling demand for the non-residential space. Compliance with CIBSE Guide A recommendations for air-conditioned spaces is achievable with the right sizing of the cooling system. Energy efficient lighting will provide a reduction in cooling energy demand and would also result in lower energy use from the lighting installation. Energy efficient lighting is therefore recommended for the basement and ground floors spaces.

8.1.2 Thermal mass

Introducing exposed thermal mass (via exposed concrete ceilings versus plasterboard false ceilings where services are concealed) was not found to provide a reduction in cooling demand (Iteration 2). Consequently, the ground floor spaces could adopt a design that exposes the building services or conceals them within a ceiling void without significantly compromising the performance of the cooling system.

8.1.3 Mechanical systems

A test was also carried out to quantify the improvement attainable with an increase in mechanical ventilation supply rate (Iteration 3). Notable cooling demand reductions were identified, although caution should be exercised before adopting this measure because the reduction in cooling demand is achieved through a threefold increase in fan energy. A cooling demand reduction of 37.3 kWh/m².year (difference between iterations 3 and 0 in Table 9), equates to 12,607 kWh/year. Assuming a system SEER of 4.4 for cooling results in cooling energy reduction of circa 2,900 kWh/year. However, the additional fan energy is estimated to be 9,230 kWh/year (assuming a specific fan power of 1.8 W/l.s provided by M&E consultants Innovo).

There may also be spatial implications with larger ventilation systems and ductwork to be incorporated for the basement and ground floor spaces.

The trade-off between increased mechanical ventilation for reducing cooling, versus providing minimum fresh air rates via the mechanical ventilation system while the cooling system controls internal temperatures, can be explored in more detail during the detailed design and construction stages.

Preliminary analysis at planning stage indicates the use of energy efficient cooling is the most appropriate solution for the basement and ground floor spaces, after the implementation of key design measures (efficient fabric, lighting, mechanical ventilation).

8.1.4 DSY2 and DSY3 weather data

The proposed strategy was also evaluated against more onerous weather files including DSY2 and DSY3 (Iterations 4 and 5). Weather files with elevated temperatures will result in increased cooling loads for the ground floor spaces to maintain the desirable temperatures.

Further measures are not deemed appropriate for the ground floor spaces at this stage. The glazing areas are sized reasonably, solar control glazing is included, and appropriately sized and efficient systems will be specified during the detailed design and fit-out stages post-planning.

Table 7. Thermal simulations carried out for the basement and ground floor shared spaces.

Iteration	Glazing g-value	Internal heat (lighting)	Thermal mass	Passive ventilation	Mechanical ventilation
0 (DSY1)	0.4	12 W/m ²	Low	North facing glazing of co-working area and café facing Friar Street assumed fixed. Windows to dining/lounge areas facing Fife Court or the Courtyard assumed openable.	10 l/s.p
1 (DSY1)	0.4	10 W/m ²	Low	N/A	10 l/s.p
2 (DSY1)	0.4	10 W/m ²	High	N/A	10 l/s.p
3 (DSY1)	0.4	10 W/m ²	Low	N/A	30 l/s.p
4 (DSY2)	0.4	10 W/m ²	Low	N/A	10 l/s.p
5 (DSY3)	0.4	10 W/m ²	Low	N/A	10 l/s.p

Table 8. TM52 results with the use of natural and mechanical ventilation for the basement and ground floor shared spaces (Iteration 0 from Table 7 above, DSY1 weather file).

Space	Frequency test (H _e <3%)	Severity test (W _e <6)	Max temperature test (<4°C)	TM52 result
Multimedia room	66%	77	8	No criteria met
Co-work cafe	23%	82	8	No criteria met
Gym	38%	75	8	No criteria met
Private dining	22%	85	8	No criteria met
Residential co-working	28%	61	8	No criteria met
Residential co-working 2	12%	41	7	No criteria met
Shared dining	23%	83	8	No criteria met
Shared lounge	30%	75	8	No criteria met

Table 9. Thermal modelling results for the basement and ground floor shared spaces.

Iteration	TM52 compliance (without cooling)	CIBSE Guide A compliance (with cooling)	Annual cooling demand (kWh/m ² .year)	Cooling demand change
0 (DSY1)	No	0% of occ. hours > 23°C	92.3	-
1 (DSY1)	No	0% of occ. hours > 23°C	79.8	-14%
2 (DSY1)	No	0% of occ. hours > 23°C	80.6	-14%
3 (DSY1)	No	0% of occ. hours > 23°C	55	-40%
4 (DSY2)	No	0% of occ. hours > 23°C	85.6	-7%
5 (DSY3)	No	0% of occ. hours > 23°C	94.4	2%

9 Proposed design

9.1 Summary of measures

The overheating risk mitigation strategy includes several measures and follows the hierarchy set out in Policy CC3 of RBC's Draft Local Plan:

- High specification building fabric to prevent unintended heat ingress through conduction or infiltration.
- Generous openable areas for the co-living units as shown in the elevations for when noise and security allow. Figure 7 shows the proposed west elevation. Initial guidance on key elevations is presented in Appendix E.
- Solar control glazing with g-value of 0.4 for all glazing across the scheme.
- MVHR for all co-living units to provide 24-hour ventilation. The system will have boost and summer modes.
- MVHR systems to have integrated air tempering coils for all co-living units.
- The MVHR systems should provide at least 60 l/s per co-living unit.
- Communal corridors to have energy efficient lighting, well insulated pipework, occupancy sensors and mechanical ventilation through smoke/AOV shafts at a rate of 2.5 litres/second / m².
- Basement and ground floor shared use spaces will utilise energy efficient HVAC and lighting systems as part of the fit-out works to maintain a desirable internal environment.

The preliminary analysis at planning stage indicates that with the above measures in place, the proposed co-living units and communal corridors are predicted to comply with Part O (2021), while the ground floor shared spaces will minimise their reliance on cooling systems.

9.2 Guidance to future residents

Future residents should be made aware of how to mitigate overheating and improve thermal comfort during heat waves. Below is a summary of recommendations that can be included in a home user guide.

- Residents should be advised on how to best operate windows for ventilation, security and safety.
- Current ventilation guidance assumes windows would open when internal temperatures exceed 22°C but during heat waves windows should be opened more pre-emptively.
- On warm summer days and when the noise environment is suitable, the co-living units can be ventilated during night-time by leaving the windows open and taking advantage of the lower external temperatures. If the noise environment is not appropriate, the guidance should encourage the use of MVHR with its integrated air tempering coils to provide a more comfortable internal environment.
- Where blinds or internal curtains are installed, these should be light coloured to reflect solar radiation. Any internal shading devices should not notably interfere with the air flow through windows.
- Future residents should reduce the use of heat generating equipment as far as practicable during hot summer days.
- During heat waves, the use of fans could improve air circulation and thermal comfort.
- During hot summer days, residents should be encouraged to wear lighter, breathable and loose clothing and should be advised to hydrate regularly.

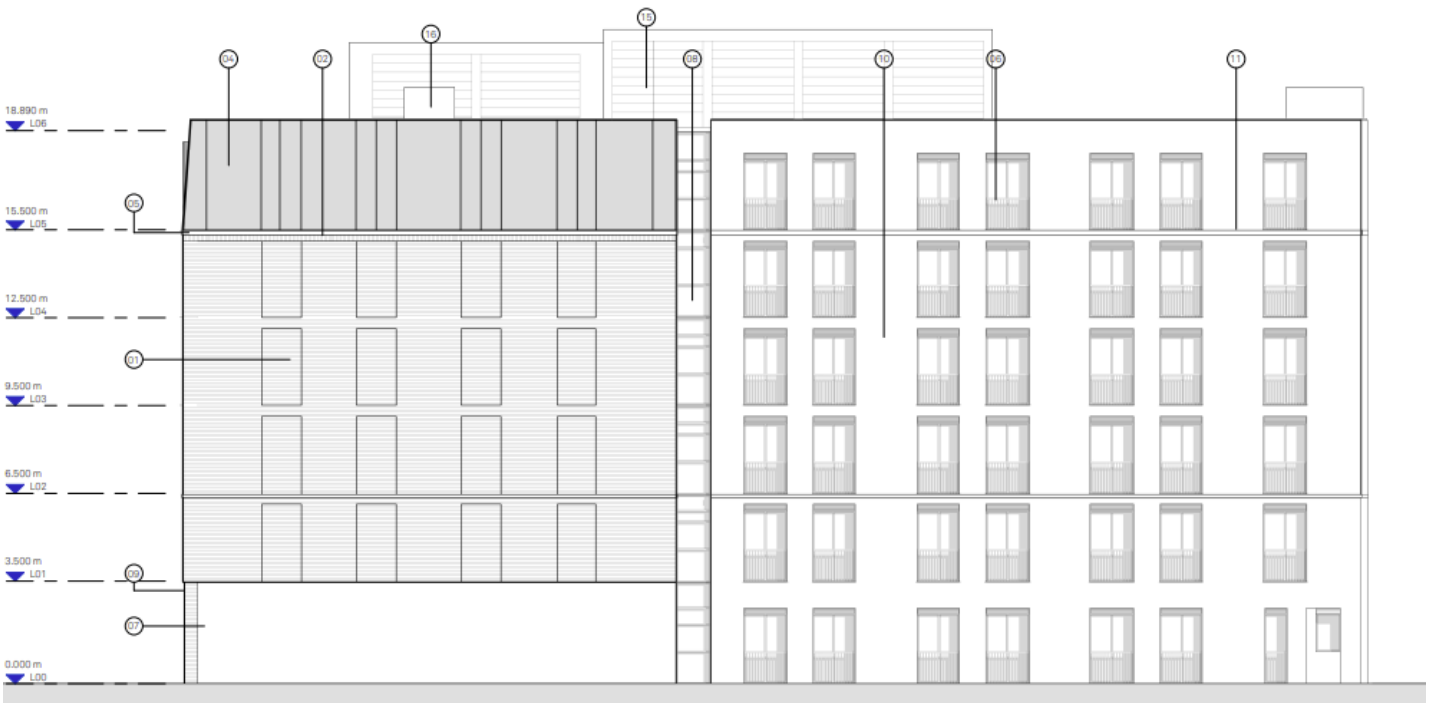


Figure 7. Proposed west elevation with Juliet balconies and large openable window areas.

10 Conclusions

The proposed overheating risk mitigation strategy for 138-144 Friar Street maximised passive measures as far as practicable and was developed following the principles of the emerging draft Policy CC3, CIBSE TM59 (2017) and Building Regulations Part O (2021).

The proposed scheme has been designed to enable thermal comfort for future residents of the co-living units and users of the basement and ground floor shared spaces.

The use of air tempering coils connected to the MVHR systems is proposed as a back-up strategy and for increased resilience. With the proposed measures retained to construction stage, the co-living units are anticipated to comply with Building Regulations Part O (2021).

The cooling demand for the basement and ground floor shared spaces was minimised through the application of passive design techniques within the constraints of the application site.

The risk of overheating was also assessed with more onerous weather files and guidance has been provided that can be included in a user guide for future residents.

Taking everything into account, the proposed development complies with RBC's overheating related emerging policies.

Appendix A – Detailed results

The criteria are as follows. When co-living units are modelled as naturally ventilated (windows open):

- **Test A: May-September:** % of occupied hours $\Delta T > 1^{\circ}\text{K}$ (<3%), for all co-living units.
- **Test B: Night-time test:** Annual night hours $\text{Top} > 26^{\circ}\text{C}$ (<33 hours), for all co-living units.

When co-living units are modelled as predominantly mechanically ventilated (windows closed):

- **Test C: Annual:** $\text{Top} > 26^{\circ}\text{C}$ (<3% of annual hours), for all co-living units.

Detailed results are shown in the tables below. Cells in green show that metrics are met while orange cells indicate deviation. Compliance with DSY2 and DSY3 weather files is not a regulatory or policy requirement.

Table 10. Detailed Part O results with DSY1 weather file. Cells highlighted in green indicate compliance with Part O while any orange cells indicate non-compliance with Part O.

Room name	Iteration 1 <u>without</u> window useability constraints		Iteration 2 (windows closed, MVHR and air tempering coil)	Iteration 2 (windows closed, MVHR and air tempering coil)	Iteration 2 (windows closed, MVHR and air tempering coil)
	Test A (DSY1)	Test B (DSY1)	Test C (DSY1)	Test C (DSY2)	Test C (DSY3)
0F Studio 1	0.5	20	0	0.5	0
0F Studio 2	0.6	23	0	0.4	0
0F Studio 3	0.7	21	0	0.3	0
0F Studio 4	0.8	21	0	0.3	0
0F Studio 5	0.8	21	0	0.3	0
0F Studio 6	0.8	21	0	0.3	0
0F Studio 7	0.7	21	0	0.3	0
0F Studio 8	0.7	21	0	0.4	0
0F Studio 9	0.7	23	0	0.9	0.3
0F Studio 10	0.8	24	0	0.6	0.2
1F Studio 1	0.8	24	0	0.6	0.2
1F Studio 2	0.9	24	0	0.5	0
1F Studio 3	0.8	23	0	0.5	0.1
1F Studio 4	0.8	24	0	0.3	0
1F Studio 5	0.8	25	0	0.3	0
1F Studio 6	0.8	22	0	0.3	0
1F Studio 7	0.8	22	0	0.3	0
1F Studio 8	0.8	21	0	0.3	0
1F Studio 9	0.8	21	0	0.3	0
1F Studio 10	0.8	21	0	0.3	0
1F Studio 11	0.8	22	0	0.3	0
1F Studio 12	0.8	26	0	1.2	0.7

Room name	Iteration 1 <u>without</u> window useability constraints		Iteration 2 (windows closed, MVHR and air tempering coil)	Iteration 2 (windows closed, MVHR and air tempering coil)	Iteration 2 (windows closed, MVHR and air tempering coil)
	Test A (DSY1)	Test B (DSY1)	Test C (DSY1)	Test C (DSY2)	Test C (DSY3)
1F Studio 13	0.9	24	0	0.8	0.5
1F Studio 14	0.9	24	0	0.6	0.4
1F Studio 15	0.9	21	0	0.9	0.5
1F Studio 16	0.9	24	0	1.5	1
1F Studio 17	0.9	27	0	1.4	0.9
1F Studio 18	0.9	25	0	0.9	0.5
1F Studio 19	0.9	23	0	0.5	0.1
1F Studio 20	1	23	0	0.4	0.1
1F Studio 21	1	23	0	0.4	0.1
1F Studio 22	1	23	0	0.4	0.1
1F Studio 23	1	23	0	0.4	0.1
1F Studio 24	1	23	0	0.4	0.1
1F Studio 25	0.8	24	0	0.5	0.1
1F Studio 26	0.9	25	0	0.6	0.4
1F Studio 27	0.9	25	0	0.6	0.4
2F Studio 1	0.8	27	0	0.9	0.4
2F Studio 2	1	24	0	0.6	0.2
2F Studio 3	0.9	24	0	0.7	0.2
2F Studio 4	0.8	24	0	0.3	0
2F Studio 5	0.8	25	0	0.3	0
2F Studio 6	0.8	23	0	0.3	0
2F Studio 7	0.8	23	0	0.3	0
2F Studio 8	0.8	23	0	0.3	0
2F Studio 9	0.8	22	0	0.3	0
2F Studio 10	0.8	23	0	0.3	0
2F Studio 11	0.8	22	0	0.3	0
2F Studio 12	1	29	0	1.7	1
2F Studio 13	0.9	25	0	1.1	0.7
2F Studio 14	1	25	0	1	0.7
2F Studio 15	1	25	0	1.2	0.9
2F Studio 16	1.1	27	0	2.4	1.7
2F Studio 17	1.1	28	0	2.3	1.7
2F Studio 18	0.9	25	0	1.3	0.9

Room name	Iteration 1 <u>without</u> window useability constraints		Iteration 2 (windows closed, MVHR and air tempering coil)	Iteration 2 (windows closed, MVHR and air tempering coil)	Iteration 2 (windows closed, MVHR and air tempering coil)
	Test A (DSY1)	Test B (DSY1)	Test C (DSY1)	Test C (DSY2)	Test C (DSY3)
2F Studio 19	1.4	25	0	0.9	0.5
2F Studio 20	1.6	25	0.1	0.9	0.5
2F Studio 21	1.7	25	0.1	0.9	0.5
2F Studio 22	1.7	25	0.1	0.9	0.5
2F Studio 23	1.7	25	0.1	0.9	0.5
2F Studio 24	1.6	25	0.1	0.9	0.5
2F Studio 25	1.1	26	0	0.9	0.5
2F Studio 26	1	25	0	1	0.7
2F Studio 27	0.9	25	0	0.9	0.6
3F Studio 1	0.8	27	0	1.1	0.6
3F Studio 2	1	27	0	0.9	0.3
3F Studio 3	0.9	24	0	0.8	0.2
3F Studio 4	0.8	25	0	0.3	0
3F Studio 5	0.8	25	0	0.3	0
3F Studio 6	0.8	23	0	0.3	0
3F Studio 7	0.8	23	0	0.3	0
3F Studio 8	0.8	23	0	0.3	0
3F Studio 9	0.8	23	0	0.3	0
3F Studio 10	0.8	23	0	0.3	0
3F Studio 11	0.8	23	0	0.3	0
3F Studio 12	1	30	0	1.9	1.2
3F Studio 13	1	25	0	1.3	0.9
3F Studio 14	1	25	0	1.2	0.9
3F Studio 15	1	25	0	1.5	1
3F Studio 16	1.1	29	0	2.8	2.1
3F Studio 17	1.1	30	0	2.8	2.1
3F Studio 18	1	25	0	1.6	1.2
3F Studio 19	1.6	25	0.2	1	0.7
3F Studio 20	1.9	25	0.2	1.1	0.7
3F Studio 21	1.9	25	0.2	1.1	0.7
3F Studio 22	2	25	0.2	1.1	0.7
3F Studio 23	2	25	0.2	1.1	0.7
3F Studio 24	1.9	25	0.2	1.1	0.7

Room name	Iteration 1 <u>without</u> window useability constraints		Iteration 2 (windows closed, MVHR and air tempering coil)	Iteration 2 (windows closed, MVHR and air tempering coil)	Iteration 2 (windows closed, MVHR and air tempering coil)
	Test A (DSY1)	Test B (DSY1)	Test C (DSY1)	Test C (DSY2)	Test C (DSY3)
3F Studio 25	1.1	27	0.1	1.1	0.6
3F Studio 26	1	25	0	1.2	0.8
3F Studio 27	1	25	0	1.2	0.8
4F Studio 1	0.9	27	0.1	1.3	0.7
4F Studio 2	1	27	0	1.2	0.3
4F Studio 3	1	24	0	1.1	0.3
4F Studio 4	0.8	25	0	0.3	0
4F Studio 5	0.8	25	0	0.4	0
4F Studio 6	0.8	23	0	0.3	0
4F Studio 7	0.8	23	0	0.3	0
4F Studio 8	0.8	22	0	0.3	0
4F Studio 9	0.8	22	0	0.3	0
4F Studio 10	0.8	23	0	0.3	0
4F Studio 11	0.8	23	0	0.3	0
4F Studio 12	1	30	0	2	1.4
4F Studio 13	1	25	0	1.4	0.9
4F Studio 14	1	25	0	1.3	0.9
4F Studio 15	1	25	0	1.6	1.1
4F Studio 16	1.1	29	0	3	2.3
4F Studio 17	1.1	29	0	3.1	2.3
4F Studio 18	1	25	0	1.7	1.2
4F Studio 19	1.6	25	0.2	1.1	0.8
4F Studio 20	1.9	25	0.2	1.1	0.7
4F Studio 21	2	25	0.2	1.2	0.7
4F Studio 22	2	25	0.3	1.2	0.7
4F Studio 23	2	25	0.3	1.2	0.8
4F Studio 24	1.9	25	0.2	1.2	0.8
4F Studio 25	1.2	26	0.1	1.1	0.7
4F Studio 26	1	25	0	1.3	0.9
4F Studio 27	1	25	0	1.2	0.9
5F Studio 1	0.8	27	0.1	1.7	1
5F Studio 2	1	26	0	1.5	0.5
5F Studio 3	1	24	0	1.4	0.5

Room name	Iteration 1 <u>without</u> window useability constraints		Iteration 2 (windows closed, MVHR and air tempering coil)	Iteration 2 (windows closed, MVHR and air tempering coil)	Iteration 2 (windows closed, MVHR and air tempering coil)
	Test A (DSY1)	Test B (DSY1)	Test C (DSY1)	Test C (DSY2)	Test C (DSY3)
5F Studio 4	0.8	25	0	0.4	0
5F Studio 5	0.8	24	0	0.4	0
5F Studio 6	0.8	22	0	0.3	0
5F Studio 7	0.8	22	0	0.3	0
5F Studio 8	0.8	22	0	0.3	0
5F Studio 9	0.8	22	0	0.3	0
5F Studio 10	0.8	22	0	0.3	0
5F Studio 11	0.8	22	0	0.3	0
5F Studio 12	1	29	0	2.3	1.6
5F Studio 13	1	24	0	1.6	1
5F Studio 14	1	24	0	1.5	1
5F Studio 15	1	24	0	1.7	1.2
5F Studio 16	1.1	28	0	3.2	2.4
5F Studio 17	1.1	28	0	3.3	2.5
5F Studio 18	0.9	25	0	1.8	1.3
5F Studio 19	1.5	25	0.2	1.3	0.8
5F Studio 20	1.7	25	0.2	1.3	0.8
5F Studio 21	1.7	25	0.2	1.3	0.8
5F Studio 22	1.7	25	0.2	1.3	0.8
5F Studio 23	1.7	25	0.2	1.3	0.8
5F Studio 24	1.7	25	0.2	1.3	0.8
5F Studio 25	1.1	26	0.1	1.2	0.8
5F Studio 26	1	24	0	1.4	0.9
5F Studio 27	0.9	24	0	1.4	0.9

Table 11. Part O results summary. Compliance with DSY2 and DSY3 weather files is not a regulatory or policy requirement.

	Iteration 1 <u>without</u> window useability constraints		Iteration 2 (windows closed, MVHR and air tempering coil)	Iteration 2 (windows closed, MVHR and air tempering coil)	Iteration 2 (windows closed, MVHR and air tempering coil)
	Test A (DSY1)	Test B (DSY1)	Test C (DSY1)	Test C (DSY2)	Test C (DSY3)
Rooms meeting criteria	145	145	145	142	145
Applicable number of rooms	145	145	145	145	145
% of rooms complying	100%	100%	100%	98%	100%

Appendix B – Model inputs

The building has been modelled using dynamic thermal simulation software which is fully compliant with CIBSE Applications Manual AM11.

The tables in this appendix summarise the thermal model inputs for the calculations carried out.

The weather file used for most of the thermal modelling analysis is CIBSE TM49 London Gatwick DSY1 2020's High50.epw, based on CIBSE TM49 guidance. DSY2 and DSY3 versions of the same period were also modelled in line with guidance.

Residential window opening profiles were based on paragraph 2.6 of Approved Document Part O (2021).

Table 12: Thermal model building fabric.

Element	Specification
External wall U-value	0.15 W / m².K
External wall thermal mass (software default)	76 kJ / m².K (very lightweight)
Floor U-value	0.10 W / m².K
Floor thermal mass (software default)	66 kJ / m².K (very lightweight)
Roof U-value	0.11 W / m².K
Roof thermal mass (software default)	8 kJ / m².K (very lightweight)
Glazing U-value	1.2 W / m².K
Glazing g-value	0.4
Air permeability	3m³ / m².h at 50 Pa

Table 13: TM59 Residential occupancy gains and profiles.

Space	Occupancy
Studio	2 people at all times.

Table 14: Basement and ground floor spaces occupancy gains and profiles.

Space	Occupancy
Gym	7m² / person from 9am to 9pm. 100 W/person sensible gain, 200 W/person latent gain
Dining / Cafe	5.3m² / person from 7am to 11pm with variations throughout the day. 73 W/person sensible gain, 50 W/person latent gain
Co-working / Lounge	9.4m² / person from 7am to 7pm with variation throughout the day. 67 W/person sensible gain, 43 W/person latent gain
Multimedia room	5.5m² / person from 9am to 9pm with variation throughout the day. 85 W/person sensible gain, 55 W/person latent gain

Table 15: TM59 Residential internal gains and profiles.

Space	Equipment and lighting
Studio	Peak load of 450 W from 6 pm to 8 pm. 200 W from 8 pm to 10 pm. 110 W from 9 am to 6 pm and 10 pm to 12 pm. Base load of 85 W for the rest of the day.
All rooms	Lighting 2 W / m² from 6pm to 11pm daily.

Table 16: Basement and ground Floor spaces internal gains and profiles.

Space	Equipment and lighting
Gym	12 W/m² lighting 12 W/m² equipment Profile in line with occupancy.
Dining / Cafe	12 W/m² lighting, 10 W/m² display lighting 15 W/m² equipment Profile in line with occupancy
Co-working/ Lounge	12 W/m² lighting 13 W/m² equipment Profile in line with occupancy.
Multimedia room	12 W/m² lighting 2 W/m² equipment Profile in line with occupancy.

Table 17. Thermal model details.

Software:	IES VE version 2025.2.0.0
Are there any security, noise, or pollution issues:	Significant noise on elevation facing Friar Street. Security constraints to ground floor windows. No air quality constraints to natural ventilation.
TM59: summer elevated air speed:	0.1 m/s
TM59: occupant category:	Category II (normal)

Appendix C – CIBSE & Part O

CIBSE TM59 (2017)

CIBSE TM59 is a rigorous overheating risk performance standard for dwellings in the UK. It sets out the methodology and outlines details such as occupancy patterns, internal gains, weather files, window opening profiles etc that should be modelled.

Criteria for naturally ventilated dwellings

For living rooms, kitchens and bedrooms:

The number of hours during which the difference between operative and threshold comfort temperatures (ΔT) is greater than or equal to one degree (K), during the period of May to September inclusive, shall not be more than 3 per cent of occupied hours. (CIBSE TM52 Criterion 1: Hours of exceedance).

For bedrooms only: To evaluate 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. (Note: 1% of the annual hours between 22:00 and 07:00 for bedrooms is 32 hours, so 33 or more hours above 26°C will be recorded as a fail).

For communal corridors

CIBSE TM59 states that whilst there is no mandatory target for communal corridors, if an operative temperature of 28°C is exceeded for more than 3% of annual hours, then this should be identified as a significant risk within the TM59 overheating report.

Criteria for mechanically ventilated dwellings

For living rooms, kitchens and bedrooms:

The internal temperature should not exceed 26°C for more than 3% of the occupied hours on an annual basis.

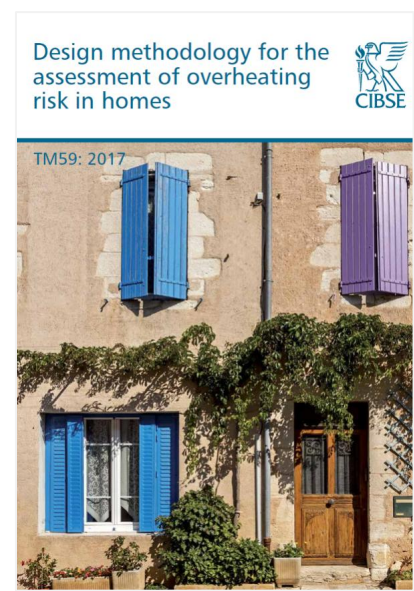
Technical definitions

The first criterion is evaluated in terms of the ΔT , which is the difference between the operative temperature T_{op} and the limiting maximum temperature T_{max} , $\Delta T = T_{op} - T_{max}$.

Operative temperature models the combined effect of convective and radiant heat transfer. It accounts for the combined of the temperature of the air, the temperature of the surfaces and air speed. To estimate T_{op} , dynamic thermal modelling is carried out to compute the predicted temperature distribution in the different thermal zones of the building.

T_{max} is the maximum acceptable temperature and is dependent on the outdoor running mean temperature and the building category with each associated acceptability range. The table details the suggested acceptability in terms of the temperature range of naturally ventilated buildings. For the assessment, we have used Category II limits.

Category	Explanation	Acceptable range (°C)
II	New build	±3



Building Regulations Part O (2021)

Part O builds on the guidance set out within CIBSE T59 and implements additional considerations. On window openings, ADO states:

“All of the following limits on CIBSE’s TM59, section 3.3, apply:

- a. When a room is occupied during the day (8am to 11pm), 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 (11pm to 8am), openings should be modelled as fully open if both of the following apply.
 - i. The opening is on the first floor or above and not easily accessible.
 - ii. The internal temperature exceeds 23°C at 11pm.
- 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, following the guidance in paragraph 3.7 below.
 - ii. At night, windows, patio doors and balcony doors should be modelled as closed.”

Paragraph 3.7 explains:

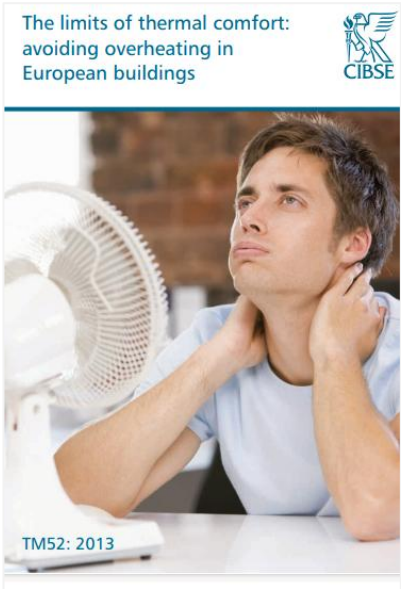
“Open windows or doors can be made secure by using any of the following.

- a. Fixed or lockable louvred shutters.
- b. Fixed or lockable window grilles or railings.”

Part O does not support the use of internal blinds as part of the overheating mitigation strategy.



TM52



This Technical Memorandum (TM) is about predicting overheating in buildings. It is intended to inform designers, developers and others responsible for defining the indoor environment in buildings.

Performance criteria

- **Hours of exceedance (H_e): H_e<3% of occupied hours**
The first criterion sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature by 1°C or more during the occupied hours of a typical non-heating season (1 May to 30 September).
- **Daily weighted exceedance (W_e): W_e<6**
The second criterion deals with the severity of overheating within any one day, which can be as important as its frequency, the level of which is a function of both temperature rise and duration. This criterion sets a daily limit for acceptability.
- **Upper limit temperature (T_{upp}): T_{op} - T_{max} <4°C**
The third criterion sets an absolute maximum daily temperature for a room,

beyond which the level of overheating is unacceptable.

At least two of the above criteria should be met.

All the criteria are evaluated in terms of the ΔT, which is the difference between the operative temperature T_{op} and the limiting maximum temperature T_{max}. ΔT=T_{op}-T_{max}.

In order to estimate T_{op}, dynamic thermal modelling is carried out to compute the predicted temperature distribution in the different thermal zones of the building. The maximum acceptable temperature is a function of the outdoor temperature and the design limits which are shown below. The table details the suggested acceptability in terms of the temperature range of naturally ventilated buildings. For the purpose of the assessment, Category II limits were used.

Category	Explanation	Acceptable range (C)
II	New build	±3

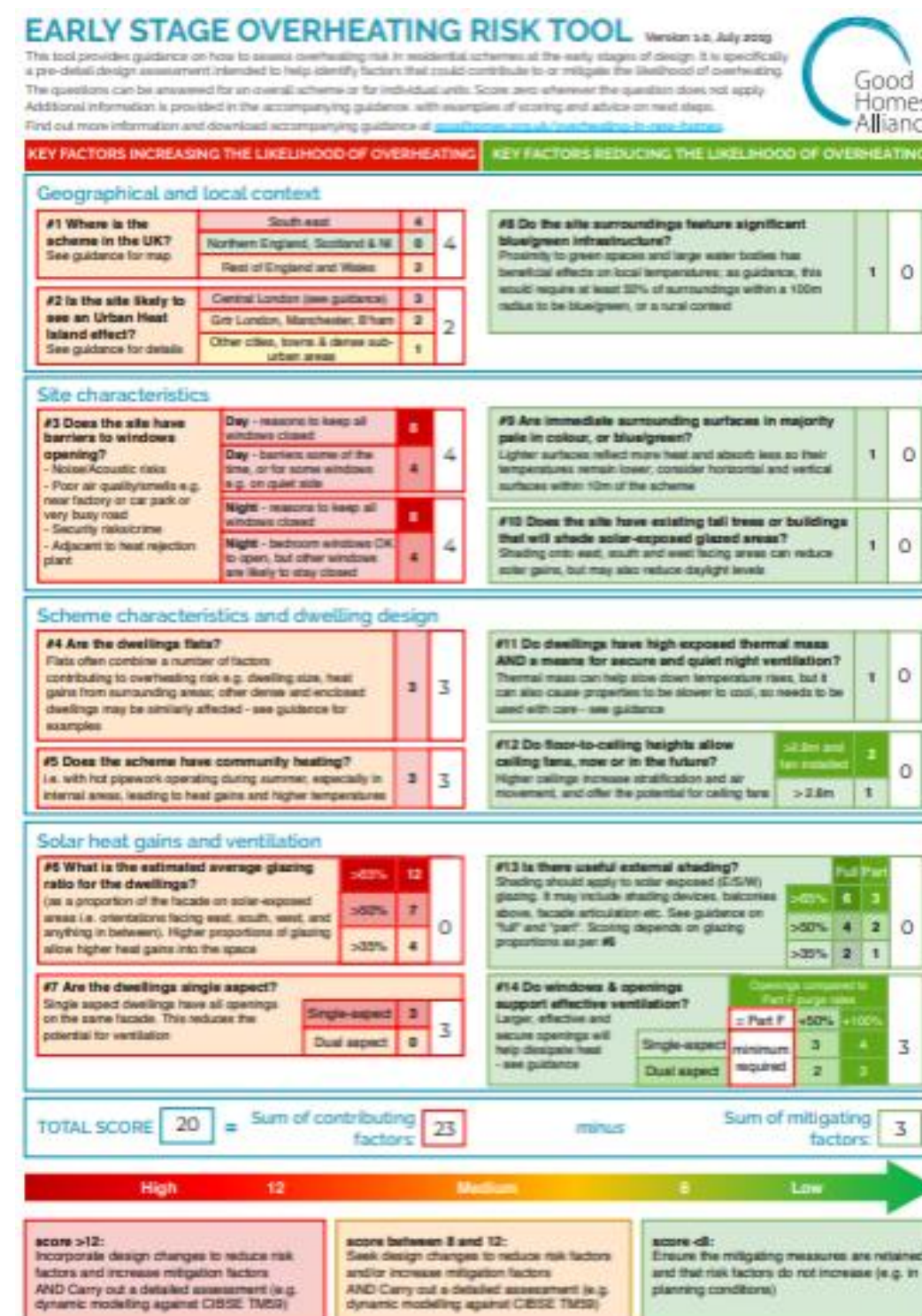
Definitions

T_{op}: Operative temperature models the combined effect of convective and radiant heat transfer. It accounts for the combined of the temperature of the air, the temperature of the surfaces and air speed.

T_{max}: is the maximum acceptable temperature and is dependent on the outdoor running mean temperature and the building

The image to the right shows the initial overheating assessment using Good Homes Alliance Overheating Checklist. This identified that the proposed co-living units are at significant risk of overheating.

Subsequently, more detailed overheating assessments were carried out using Part O and CIBSE TM59 methodology, which revealed measures that are proposed for the scheme to mitigate overheating risks.



Appendix E – Overheating markups

The markups on the following pages show the proposed window opening to enable compliance with Part O (2021) and CIBSE TM59 (2017).

Approved Document O (2021)
notes for overheating:

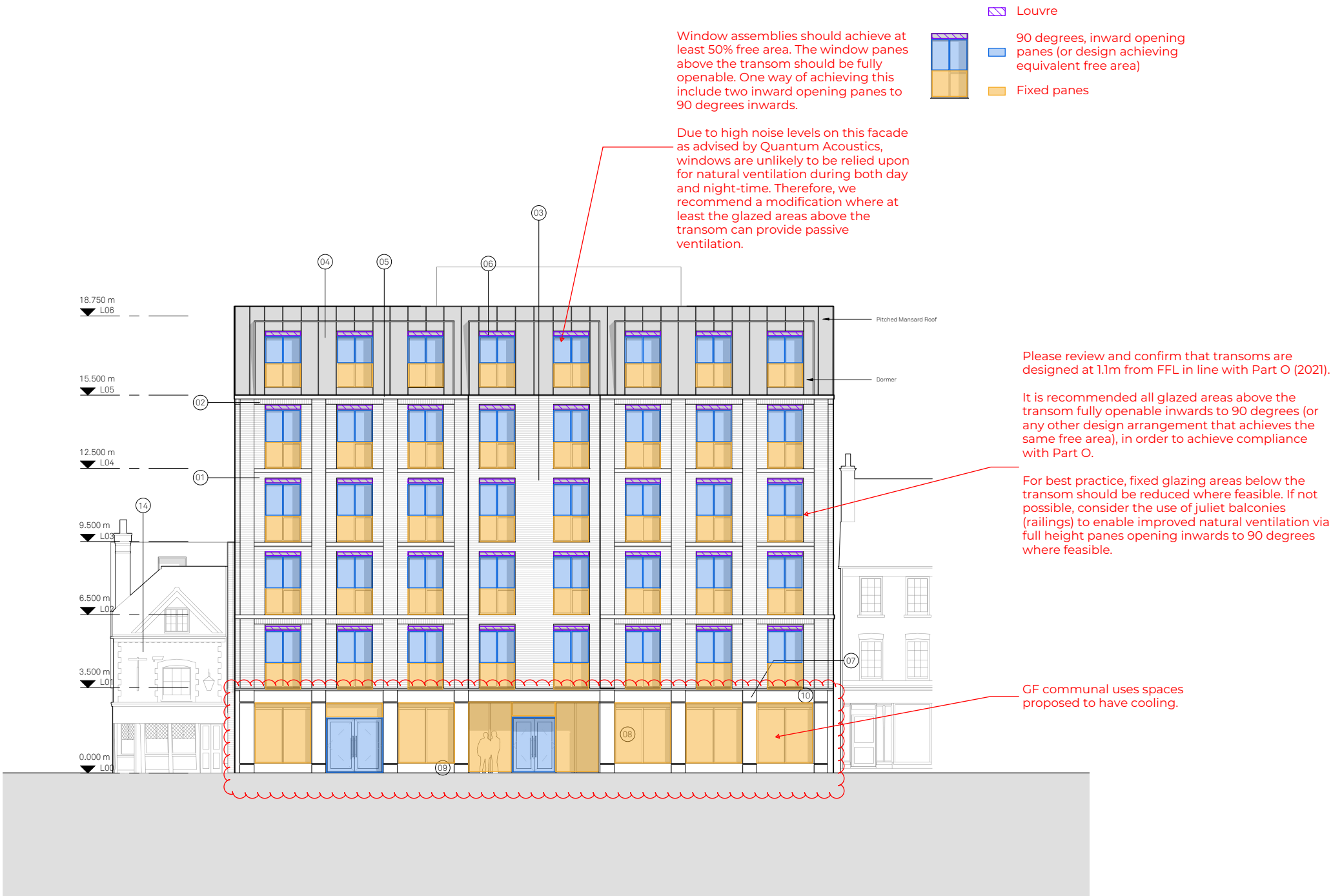
1) All windows to have a g-value of 0.4.

2) Please review transom or bottom of window heights for all window assemblies on upper floors where there is risk of falling. Part O (2021) guidance requires transoms to be at 1.1m above FFL to enable openable windowpanes above the transom to be fully openable.

3) Based on input from Noise Consultants Quantum Acoustics, studio windows cannot be relied upon for night-time ventilation as ADO noise criteria cannot be achieved. The co-living units should have MVHR systems with integrated air tempering coils installed.

4) MVHRs with cooling coils should be capable of delivering at least 60 l/s per co-living unit.

5) Current assessment based on ADO (2021) and CIBSE TM59 (2017). Final strategy to be confirmed based on ADO calculations to be carried out at detailed design and construction stages post-planning with the applicable guidance and regulations at the time of detailed design and construction stages.

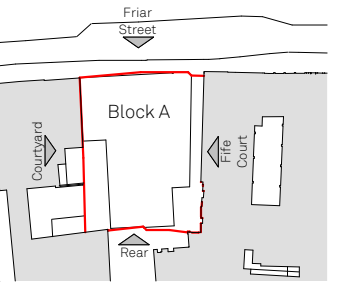
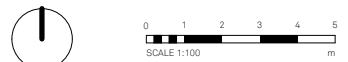


Notes

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This drawing contains the following model files:

PXXXX-FCH-XX-XX-M3-A-XXXX (P0.1) [60]



Material Key

- 01 Red / brown multi brick in stretcher bond
- 02 Red / brown multi brick in soldier bond
- 03 Dark brown multi brick in stretcher bond
- 04 Standing seam zinc cladding in VM Zinc ANTHRA-ZINC
- 05 Off white precast concrete banding
- 06 Aluminium window with integrated vent RAL 7021 (PPC)
- 07 Off white precast concrete
- 08 Curtain wall to ground floor spaces with integrated vents (PPC Aluminium in RAL 7021 to match windows)
- 09 Glazed tiles in dark grey
- 10 Aluminium signage plate in dark grey (RAL 7021)
- 11 Rainscreen with high quality render finish in off white
- 12 Projecting banding within render
- 13 Recessed brick detail
- 14 Existing Bugle Elevation

P03	29/05/26	AW	MH	Design Update
P02	08/05/26	AW	MH	Annotations Amended
P01	05/05/26	AW	MH	Draft Issue
Rev	Date	By	Chk	Description

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Project Title Friar Street - Reading	Revision P03
Client Thackery Estates	Drawn By AW
Drawing Title General Arrangement - Friar Street	Checked By MH
Drawing No. P21109-FCH-XX-XX-DR-A-1400	
Status S2	Issue suitable for: Planning
Job No. P21-109	Drawing Stage Stage 2
	Scale As indicated
	Date DD/MM/YY
	@ A1

Prelim Overheating Markup
Planning Stage
June 2026

Approved Document O (2021)
notes for overheating:

2) Please review transom or bottom of window heights for all window assemblies on upper floors where there is risk of falling. Part O (2021) guidance requires transoms to be at 1.1m above FFL to enable openable windowpanes above the transom to be fully openable.

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4) MVHRs with cooling coils should be capable of delivering at least 60 l/s per co-living unit.

5) Current assessment based on ADO (2021) and CIBSE TM59 (2017). Final strategy to be confirmed based on ADO calculations to be carried out at detailed design and construction stages post-planning with the applicable guidance and regulations at the time of detailed design and construction stages.

Principles on this markup apply to all elevations except Friar Street.

Proportion of glazing area of the curtain wall to these studios that should be fully openable (e.g. side-hung 90 degrees inwards)

To enable compliance with requirement O1(l) of Part O, it is recommended these window assemblies on all elevations except Friar Street incorporate Juliet balconies and have fully openable windows.

All facades except Friar Street could rely more on natural ventilation during daytime as advised by Quantum Acoustics, therefore the openable areas of windows should be maximised to demonstrate compliance with requirement O1(f). The use of a design similar to Friar Street elevation was not found to be sufficient to enable compliance.

 Louvre

90 degrees, inward opening panes (or design achieving equivalent free area)

- Juliet balconies (railings)

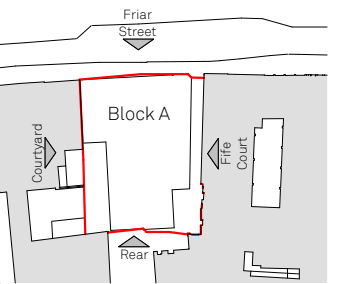
 Fixed panes

Notes

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This drawing contains the following model files

PXXXXX-FCH-XX-XX-M3-A-XXXX [P0.1] [S0]



Material Key

- | | |
|----|---|
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P03	29/05/26	AW	MH	Design Update
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Rev	Date	By	Chk	Description

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Project Title
Friar Street - Reading

Client

Thackery Estate

V

General Arrangement **Courtesy**

General Arrangement - Courtyard

Drawing No. **201100, 201101, 201102, 201103**

P21109-FCH-XX-XX-DR-A-1402

Status	Issue suitable for:	Date
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S2	Planning	DD
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Job No.	Drawing Stage	Scale
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P21-109 Stage 2 As

Revisions

PN3

F03

Drawn by

AW

Checker

MH

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