



THERMAL COMFORT ANALYSIS

MENAI AVENUE, CROESERW

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1. EXECUTIVE SUMMARY

- 1.1 This report presents the results of the thermal comfort and overheating assessment undertaken for the proposed new build residential development at Menai Avenue, Croeserw. The wider development comprises walk-up flats, flats, houses and bungalows. This assessment addresses the walk-up flats and flats only, being the 211 and 213 apartment types, which together comprise 23 units: 14 no. 211 units (10 within Sites 2 and 3 and 4 within Site 1) and 9 no. 213 units within Sites 2 and 3.
- 1.2 A representative sample of 11 units has been modelled and assessed in accordance with the CIBSE TM59 thermal comfort methodology, comprising 6 no. 211 units (Plots 1 to 4, 16 and 17) and 5 no. 213 units (Flats 0-1, 0-3, 1-6, 1-7 and 1-9). The scope of the assessment includes the principal occupied rooms within each sample unit, namely the double bedrooms, single bedrooms and kitchen/living/dining (KLD) areas, together with the separate lounge serving Flat 1-6 and the staff sleepover bedroom within the 213 building.
- 1.3 The analysis has been undertaken using IES Virtual Environment software (Version 2025.2.0.0) in accordance with CIBSE AM11: Building Energy and Environmental Modelling. The thermal model has been developed using architectural drawings and design information supplied by the project team.
- 1.4 A detailed dynamic thermal model of the sample units has been created to simulate the internal temperature profiles within occupied rooms during periods of expected use and occupancy. This modelling approach enables the proposed building design and ventilation strategy to be evaluated under realistic environmental and behavioural conditions.
- 1.5 The modelling inputs for internal heat gains, occupancy profiles, lighting loads, equipment loads, and ventilation operation have been derived from CIBSE Technical Memorandum 59 (TM59), which provides the standard methodology for assessing overheating risk in residential buildings.
- 1.6 The flats have been assessed in accordance with CIBSE TM59:2017 – *Design Methodology for the Assessment of Overheating Risk in Homes*, using the Dynamic Method as referenced in Approved Document O (2022 Edition). The assessment considers the orientation of the development, glazing exposure, opening types, and ventilation strategy in evaluating overheating risk.
- 1.7 In line with TM59 definitions, the principal occupied rooms assessed comprise the bedrooms, kitchen/living/dining (KLD) areas and lounge, where occupants are expected to spend the majority of their time. Bathrooms, circulation areas, utility spaces and storage areas have been included within the thermal model for thermal interaction purposes but have not been subject to TM59 thermal comfort evaluation.
- 1.8 All interconnected spaces within the modelled flats have been represented to account for heat transfer between rooms, airflow pathways, and the impact of purge ventilation, ensuring that the internal thermal environment is accurately simulated.
- 1.9 Based on the results of the dynamic simulations, all principal occupied rooms within the assessed flats are shown to meet the thermal comfort criteria set out in CIBSE TM59. The results therefore indicate that the proposed design and ventilation strategy are expected to provide acceptable levels of thermal comfort in accordance with CIBSE TM59:2017 and Approved Document O.

- 1.10 No active cooling systems are proposed within the development. The ventilation strategy relies primarily on natural ventilation via openable windows, supported by a mechanical ventilation with heat recovery (MVHR) system operating at continuous trickle flow rates to provide background ventilation and maintain indoor air quality.
- 1.11 Openings within the flats primarily comprise side-hung and top-hung windows, fitted with restrictors limiting the opening angle to a maximum of 15 degrees for safety. All glazed elements have been modelled with a solar transmittance (g-value) of **0.50**, which has been incorporated within the thermal modelling to assess solar gains and overheating risk.
- 1.12 Table 1 summarises the key overheating mitigation measures incorporated within the design of Menai Avenue, Croeserw, based on the results of the dynamic thermal comfort assessment.

Table 1: Menai Avenue, Croeserw: Overheating Mitigation Measures

Measure	Implementation
Glazing Orientation	Glazing serving the occupied rooms is primarily distributed across the north-north-west and south-south-east façades. This arrangement has been incorporated within the thermal modelling to capture the effects of solar exposure throughout the day.
Glazing Properties	Glazing throughout the development has been specified with a solar transmittance (glass-only g-value) of 0.50. These glazing properties have been incorporated within the thermal model to assess the influence of solar gains on internal thermal comfort.
External Shading	Passive shading elements including roof overhangs and deep window reveals have been incorporated within the thermal model to represent their contribution towards reducing direct solar exposure to glazing.
Natural Ventilation Strategy	The occupied rooms are provided with openable side-hung and top-hung windows, fitted with restrictors limiting the opening angle to a maximum of 15 degrees, to facilitate natural ventilation and purge cooling. Ground floor openings have been modelled to operate during daytime hours only for security reasons, whilst first floor openings are assumed to operate during both daytime and night-time periods in accordance with the adopted window opening strategy.
Mechanical Ventilation Strategy	The flats are served by a mechanical ventilation with heat recovery (MVHR) system operating at continuous trickle flow rates to provide background ventilation and maintain indoor air quality. The MVHR system does not provide active cooling and is not relied upon for purge ventilation, which is achieved through the operation of openable windows.

2. BACKGROUND

- 2.1 Viro have been commissioned by Morganstone to undertake a thermal comfort and overheating risk assessment for the proposed new build residential development at Menai Avenue, Croeserw. The wider development comprises walk-up flats, flats, houses and bungalows. This assessment addresses the 211 and 213 apartment types only, comprising 23 units in total, of which a representative sample of 11 units has been modelled and assessed.
- 2.2 The purpose of this assessment is to evaluate the proposed building design, glazing configuration, and ventilation strategy for the flats, and to identify any potential risk of overheating within the occupied areas. The analysis also provides recommendations to support compliance with Building Regulations Approved Document O (2022 Edition, Wales) and to ensure comfortable thermal conditions for future occupants.
- 2.3 To ensure a robust and comprehensive analysis, the sample units have been assessed using the CIBSE Technical Memorandum 59 (TM59) methodology. The assessment considers the principal occupied rooms within each unit, together with the effects of orientation, glazing exposure and ventilation strategy on the overall thermal performance of the development.
- 2.4 CIBSE TM59 (2017) establishes temperature-based performance thresholds and comfort criteria for residential spaces. It provides a consistent and robust framework for evaluating the likelihood and severity of overheating, helping to ensure that residential developments achieve appropriate internal thermal conditions during periods of warm weather.
- 2.5 This report also outlines the proposed ventilation and building services strategy adopted within the development. Mechanical ventilation with heat recovery (MVHR) is provided at continuous trickle flow rates to provide background ventilation and maintain indoor air quality. Natural ventilation is provided via openable windows, which allow for purge ventilation during warmer conditions.
- 2.6 In line with the modelling assumptions adopted for this assessment, openings serving ground floor occupied spaces are assumed to operate during daytime hours only, reflecting typical security considerations. Openings serving first floor occupied spaces are assumed to operate during both daytime and night-time periods, allowing enhanced purge ventilation during cooler night-time conditions.

3. SITE PROPOSALS

- 3.1 The overheating assessment focuses on the proposed new build residential development at Menai Avenue, Croeserw. The 211 and 213 apartment types under assessment are predominantly one-bedroom flats, with the exception of Flat 1-7 within the 213 building, which is a two-bedroom flat.
- 3.2 The sample units have been assessed in accordance with the CIBSE TM59 methodology. The assessment considers the principal occupied spaces within each unit, namely the bedrooms and the kitchen/living/dining (KLD) areas, where occupants are expected to spend the majority of their time. The assessment considers the effects of glazing orientation, window opening types, and floor level on overheating risk.
- 3.3 Figure 1 illustrates the proposed site layout and building arrangement at Menai Avenue, Croeserw. The drawing provides context for the building orientation and surrounding environment, both of which influence solar exposure, natural ventilation potential, and overheating risk, and have therefore been considered within the thermal modelling assessment.

Figure 1: Menai Avenue, Croeserw Site Layout Plan



4. METHODOLOGY

CIBSE TM59

- 4.1 The latest criteria for the assessment of overheating risk have been specified by the Chartered Institute of Building Services Engineers (CIBSE), within CIBSE TM59: Design methodology for the assessment of overheating risk in homes (2017).
- 4.2 CIBSE TM59 is based on CIBSE TM52 and CIBSE Guide A guidance documents and provides a standardised approach to predicting overheating risk for both naturally and mechanically ventilated residential buildings.
- 4.3 The CIBSE TM59 guidance suggests that the following criteria must be met to demonstrate compliance for dwellings that are predominantly naturally ventilated:
 - a. *For living rooms, kitchens and bedrooms: the number of hours during which the operative temperature exceeds the comfort threshold temperature is greater than or equal to one degree (°C) during the period May to September inclusive, shall not be more than 3% of occupied hours (CIBSE TM52 Criterion 1: Hours of exceedance).*
 - 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 (CIBSE Guide A Fixed temperature threshold). It should be noted that 1% of the annual hours between 22:00 and 07:00 for bedrooms is 32.85 hours, so 33 or more hours above 26 °C will be recorded as a fail.*
- 4.4 CIBSE has recognised that where there is limited means of providing natural ventilation, for example for spaces with restricted window openings due to acoustic concerns, the above criteria will not be practical therefore a separate assessment standard is applied. Where this applies, rooms are assessed against the following criterion:
 - a. *For homes with restricted window openings, the CIBSE fixed temperature test must be followed, i.e. all occupied rooms should not exceed an operative temperature of 26 °C for more than 3% of the annual occupied hours (CIBSE Guide A (2015a)).*
- 4.5 For this assessment, the flats are considered predominantly naturally ventilated, as the primary means of removing excess heat is through openable windows providing purge ventilation. All principal occupied rooms under assessment, comprising the bedrooms, the kitchen/living/dining (KLD) areas and the lounge, have therefore been assessed against the TM52 adaptive comfort criterion and the fixed temperature bedroom criterion described in paragraph 4.3. Openings serving ground floor occupied spaces are assumed to operate during daytime hours only, reflecting typical security considerations, whilst openings serving first floor occupied spaces are assumed to operate during both daytime and night-time periods. Although all openable windows are fitted with restrictors limiting the opening angle to a maximum of 15 degrees, the openings retain sufficient free area to provide effective purge ventilation. On this basis, the

flats are considered to retain sufficient natural ventilation capability and are therefore appropriately assessed under the predominantly naturally ventilated criteria.

- 4.6 The flats are also provided with a mechanical ventilation with heat recovery (MVHR) system operating at continuous trickle flow rates, providing background ventilation and supporting indoor air quality. However, the MVHR system does not provide purge cooling, and therefore the flats remain classified as predominantly naturally ventilated for the purposes of the TM59 overheating assessment.
- 4.7 Other types of mechanical ventilation included for occasional use such as purge ventilation fans, should not be assumed in the overheating risk analysis for the summer months.
- 4.8 Although overheating standards are not strictly set for communal corridors and stairways, CIBSE TM59 recommends that as good practice, these spaces should not exceed 28°C for more than 3% of annual hours.
- 4.9 CIBSE TM59: The Limits of thermal comfort: avoiding overheating in European buildings sets out definitions of building categories for assessing overheating for which different temperature standards are applicable.

Table 2: CIBSE building categories for assessing overheating

Category	Explanation	Suggested acceptable temperature range (°C)
Category I	High level of expectation only used for spaces occupied by very sensitive and fragile persons	±2
Category II	Normal expectation (for new buildings and renovations)	±3
Category III	A moderate expectation (used for existing buildings)	±4

- 4.10 This assessment has been conducted under Category I criteria which is considered the most stringent as a more restricted acceptable temperature range is adopted. This method considers the possibility that vulnerable occupants such as the elderly or young children may occupy the flats in use.

Approved Document O – 2022 Edition

- 4.11 Part O of the Building Regulations sets out the requirements for assessing and mitigating overheating risk in new residential developments in Wales. These standards are applicable to the proposed new build development at Menai Avenue, Croeserw, which has been assessed using the Dynamic Method in accordance with CIBSE TM59.
- 4.12 Approved Document O sets out two methods of assessment: a Simplified Method and a Dynamic Method. This assessment adopts the Dynamic Method as it provides a more detailed and robust evaluation of the proposed development's thermal comfort performance under realistic occupancy and environmental conditions.

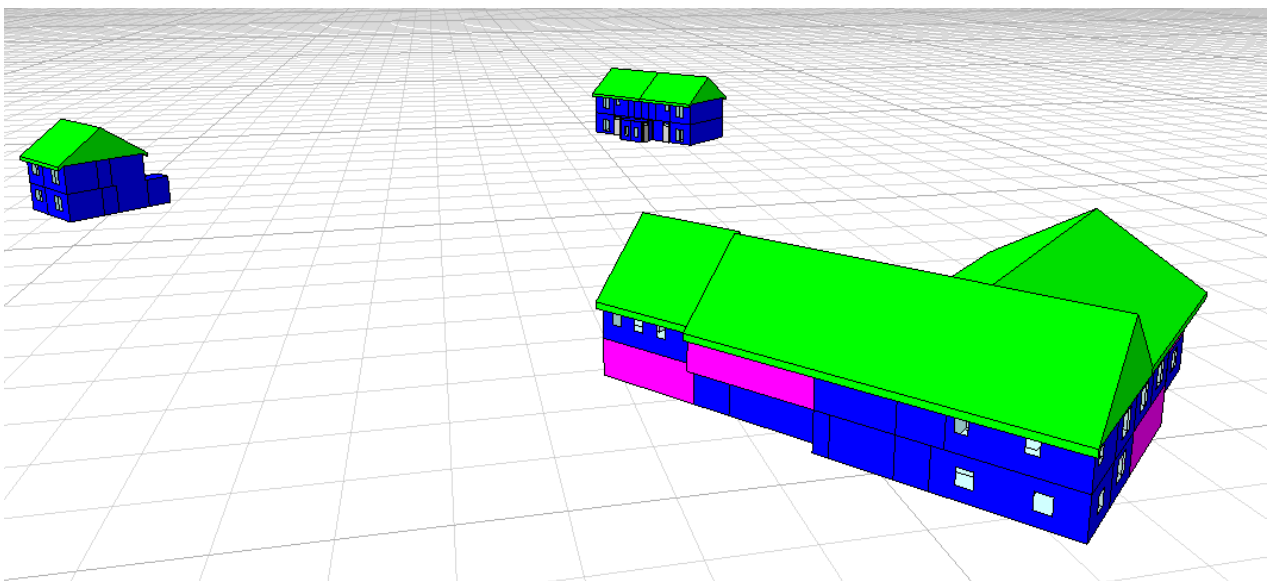
5. MODEL SPECIFICATION

- 5.1 The dynamic thermal modelling software IES Virtual Environment (Version 2025.2.0.0) has been used to develop the thermal model and undertake dynamic simulations to assess overheating risk within the proposed development.

Assessment

- 5.2 The performance of the proposed development at Menai Avenue, Croeserw has been assessed in accordance with the CIBSE TM59 adaptive comfort model, based on a predominantly naturally ventilated scenario. The flats rely primarily on openable windows to provide purge ventilation, while a mechanical ventilation with heat recovery (MVHR) system operating at continuous trickle flow rates provides background ventilation and maintains indoor air quality.
- 5.3 The assessment has been undertaken for the proposed new build flats to evaluate the potential risk of overheating arising from the building orientation, glazing distribution, ventilation strategy, and proposed construction. This approach ensures that the thermal performance of the completed development is represented within the analysis.
- 5.4 The overheating assessment focuses on the principal occupied spaces within each sample unit, namely the bedrooms and the kitchen/living/dining (KLD) areas, together with the separate lounge serving Flat 1-6 and the staff sleepover bedroom, where occupants are expected to spend the majority of their time.
- 5.5 A detailed 3D thermal model of the sample units has been developed using design-stage architectural drawings. All internal spaces have been included within the model to account for heat transfer between rooms and airflow pathways. Internal doors have also been modelled within the buildings to allow for cross-ventilation between rooms. The thermal comfort assessment has focused on the principal occupied rooms described above.

Figure 2: IES 3D model image of the development at Menai Avenue, Croeserw



Climate Conditions

- 5.6 The CIBSE Design Summer Year (DSY) weather data for Cardiff has been used for the 2020s, high emissions, 50th percentile scenario, in accordance with the guidance set out in CIBSE TM59. This weather file is considered representative of the climatic conditions for Croeserw and the wider South Wales region and is therefore appropriate for assessing overheating risk for the proposed development at Menai Avenue, Croeserw.
- 5.7 The dynamic thermal simulation software used for this assessment calculates operative temperatures using CIBSE weather datasets in combination with inputs such as building fabric specifications, glazing areas, window opening characteristics, solar gains, internal heat gains, and natural ventilation airflows. The results of these simulations have been evaluated against the CIBSE TM59 overheating assessment criteria, and recommendations are provided where necessary to mitigate the risk of overheating.

Model Inputs – Building Fabric

- 5.8 The building fabric inputs used within the dynamic thermal simulation have been configured to reflect the proposed construction build-ups for the external walls, roofs, floors, glazing, and doors at Menai Avenue, Croeserw. The development comprises new build timber frame construction throughout, in accordance with the proposed design.
- 5.9 The thermal performance of these elements, together with the mechanical and electrical inputs adopted within the model, has been based on the specifications used on previous residential projects undertaken for Morganstone.
- 5.10 An infiltration rate of 0.15 air changes per hour (ACH) has been applied within the model. This value corresponds to an assumed air permeability of approximately 3 m³/h·m² at 50 Pa, representing the anticipated airtightness performance of the completed flats.
- 5.11 Glazing throughout the development has been modelled with the specified thermal performance and a solar transmittance (g-value) of 0.50, in accordance with the glazing specification adopted for the assessment. These inputs form the basis for assessing thermal comfort performance and overheating risk within the flats under the proposed design.

Table 3: Proposed building fabric specification for development at Menai Avenue, Croeserw

Element	Details
FABRIC U-VALUES	
Timber frame external wall	0.13 W/m ² K
Ground floor	0.12 W/m ² K
Roof	0.11 W/m ² K
Glazed windows/doors	1.30 W/m ² K (g-value = 0.50)
Solid doors	1.00 W/m ² K
AIR TIGHTNESS	
Infiltration rate	0.15 ach

Model Inputs – Building Services

- 5.12 The building services for the flats have been incorporated into the dynamic thermal model to represent the proposed ventilation, heating, and domestic hot water systems. These inputs are summarised in Table 4 and are intended to provide a realistic representation of the internal conditions within the model.
- 5.13 The flats are served by a mechanical ventilation with heat recovery (MVHR) system operating at continuous trickle flow rates, providing background ventilation and maintaining indoor air quality. Natural ventilation is provided via openable windows, which provide the primary means of purge ventilation during warmer periods.
- 5.14 The primary heating system for the flats comprises an air-source heat pump (ASHP) serving radiators. Domestic hot water is also provided via an air-source heat pump system connected to a hot water cylinder, with the system modelled in line with typical operational assumptions for residential buildings.
- 5.15 While these building services contribute to the internal conditions of the flats, they are not considered to have a significant influence on overheating risk, as no active cooling systems are included within the design. The inputs are therefore included primarily to provide a complete representation of the building systems within the thermal model.

Table 4: Proposed building services specification for Menai Avenue, Croeserw

Services	Details
Primary Heating	Air-source heat pump
Heating Controls	Programmer and appliance thermostats
Heating Emitters	Radiators
Hot Water	Air-source heat pump serving hot water cylinder
Lighting	100% low energy lighting (LED)
Mechanical Ventilation	Mechanical ventilation with heat recovery (MVHR)

Model Inputs – Internal Gains

- 5.16 The CIBSE TM59 methodology specifies typical occupancy rates and internal heat gain assumptions for residential occupied spaces. For this assessment, the standard TM59 assumptions have been applied to the bedrooms, the kitchen/living/dining (KLD) areas and the lounge within the assessed flats. Non-occupied or transient spaces, including circulation areas, bathrooms, utility spaces, and storage areas, have been included within the thermal model for completeness but are not subject to TM59 thermal comfort evaluation.
- 5.17 These inputs have been incorporated within the dynamic thermal model to calculate internal heat gains within each assessed space, accounting for occupancy, lighting, and small power loads in accordance with the TM59 methodology. The mechanical ventilation with heat recovery (MVHR) system operating at continuous trickle flow rates has also been included within the model to represent background ventilation, while purge ventilation is provided through openable windows.

5.18 Table 5 presents the assumed occupancy densities, equipment gains, and lighting gains applied to the occupied spaces in accordance with the CIBSE TM59 methodology. The inputs reflect the occupancy characteristics of the proposed one- and two-bedroom flats. Further details regarding the occupancy profiles and operational schedules used within the model are provided in Appendix A.

Table 5: Occupancy, equipment, and lighting gains of occupied spaces

Space	Occupancy Gains		Occupancy Profile
	Sensible (W/Person)	Latent (W/Person)	
Double Bedroom	75	55	2 people at 70% gains from 11pm to 8am 2 people at full gains from 8am to 9am & 10pm to 11pm 2 people at 50% gains from 9am to 10pm
Single Bedroom	75	55	1 person at 70% gains from 11pm to 8am 1 person at full gains from 8am to 9am & 10pm to 11pm 1 person at 50% gains from 9am to 10pm
1 Bedroom Living/Kitchen	75	55	2 people at 75% gains from 9am to 10pm
2 Bedroom Living/Kitchen	75	55	3 people at 75% gains from 9am to 10pm
Lounge	75	55	2 people at 75% gains from 9am to 10pm
Space	Equipment Profile		
Double Bedroom	Peak load of 80W from 8am to 11pm 13% load from 11pm to 8am		
Single Bedroom	Peak load of 80W from 8am to 11pm 13% load from 11pm to 8am		
1 Bedroom Living/Kitchen	Peak load of 450W from 6pm to 10pm 40% load from 10pm to 12am & 9am to 6pm 23% load from 12am to 9am		
2 Bedroom Living/Kitchen	Peak load of 450W from 6pm to 10pm 40% load from 10pm to 12am & 9am to 6pm 23% load from 12am to 9am		
Lounge	Peak load of 150W from 6pm to 10pm 40% load from 10pm to 12am & 9am to 6pm 23% load from 12am to 9am		
Space	Lighting Profile		
All Spaces	2 W/m ² from 6pm to 11pm		

6. OVERHEATING MITIGATION STRATEGY

Limiting Solar Gains

- 6.1 A well-considered building design can strike an effective balance between beneficial solar heat gains during the winter months and limiting excessive solar gains during the summer. As such, the first stage of any overheating mitigation strategy is to minimise unwanted solar heat gains entering the building.
- 6.2 A review of the building design is provided in the following section, outlining the key measures incorporated within the proposed development to limit solar heat gains and reduce the risk of overheating within the flats.

Fixed Shading Devices

- 6.3 Fixed shading devices such as shutters, external blinds, overhangs, and awnings can be effective measures for reducing solar heat gains, as they provide shading to glazing and limit direct solar exposure.
- 6.4 Horizontal shading devices are generally most effective at reducing solar exposure on south-facing façades, where glazing is exposed to higher solar altitudes during the summer months. Conversely, vertical shading devices tend to be more effective for east- and west-facing glazing, where the sun is lower in the sky during the morning and evening.
- 6.5 These measures reduce incoming solar radiation through glazing, which is typically one of the primary contributors to internal heat gains within residential buildings.
- 6.6 For the proposed development at Menai Avenue, Croeserw, elements such as roof overhangs and deep window reveals have been included within the dynamic thermal model to represent the shading effect provided by the architectural design. No additional external shading devices such as shutters or external blinds have been included within the assessment.

Glazing Design

- 6.7 In addition to external shading elements, the design of the glazing itself plays an important role in controlling solar heat gains. Factors such as glazing area, façade orientation, solar transmittance (g-value), and the depth of the window reveal influence the amount of solar radiation entering the occupied spaces.
- 6.8 For the development at Menai Avenue, Croeserw, the glazing has been designed to provide adequate levels of natural daylight while allowing the thermal performance of the proposed design to be assessed. All glazing has been specified with a solar transmittance (g-value) of 0.50, which has been incorporated within the dynamic thermal model to assess solar gains and overheating risk.
- 6.9 These glazing properties have been reviewed as part of the thermal modelling process and the values presented in Table 6 have been applied consistently within the simulation calculations.

Table 6: Glazing properties at Menai Avenue, Croeserw

Measure	Implementation
Glazing Properties	Glazing throughout the development is specified with a solar transmittance (g-value) of 0.50

Building Design

- 6.10 Across Menai Avenue, Croeserw, glazing serving the occupied rooms is primarily distributed across the north-north-west and south-south-east façades. This arrangement has been considered within the thermal modelling to assess the effects of solar exposure throughout the day while maintaining appropriate levels of natural daylight.
- 6.11 South-south-east-facing glazing can be more susceptible to elevated solar gains during the summer months, particularly during the morning and around the middle of the day. However, the extent and distribution of glazing, together with the roof overhangs and deep window reveals incorporated within the design, have been considered within the thermal modelling to ensure the potential impact on internal temperatures is appropriately assessed.

Adjacent Building and Site Features

- 6.12 No adjacent or neighbouring buildings have been included within the thermal model to provide external shading. The development has therefore been assessed based on its direct solar exposure, with roof overhangs and deep window reveals representing the architectural shading features included within the model.

Internal Shading Devices

- 6.13 Internal shading devices such as blinds or curtains can provide some reduction in solar heat gains. However, in accordance with the guidance provided in Approved Document O, internal shading devices have not been included within the dynamic simulation model, and compliance with the TM59 overheating criteria is therefore not dependent on the operation of such devices.

Removing Excess Heat

- 6.14 The second stage of the overheating mitigation strategy is to ensure that there are effective means of removing excess heat from the flats. In most cases, this relies on purge ventilation through openable windows. For this development, a combination of natural ventilation and background mechanical ventilation via the MVHR system has been considered, with natural ventilation remaining the primary method for dissipating excess heat gains.

Natural Ventilation

- 6.15 A natural ventilation strategy is incorporated throughout the development to assist in maintaining comfortable internal temperatures. Openable windows provide the primary route for purge ventilation within the occupied spaces, allowing excess internal heat gains to be dissipated during warmer periods.
- 6.16 The dynamic simulation model accounts for window openings when calculating natural ventilation air change rates. The model incorporates factors such as window opening type, opening angle, and the environmental conditions under which windows are assumed to operate, enabling the software to estimate the airflow rates and associated cooling effects provided by natural ventilation.
- 6.17 For the purposes of the thermal modelling, the windows serving the occupied spaces have been modelled to reflect the proposed design, with the majority of openings modelled as side-hung and top-hung windows fitted with restrictors limiting the opening angle to a maximum of 15 degrees. The model

accounts for the opening characteristics of each opening type to determine the airflow rates and cooling potential provided by natural ventilation.

- 6.18 Openings serving ground floor occupied spaces have been assumed to operate during daytime hours only, reflecting typical security considerations. Openings serving first floor occupied spaces have been modelled to operate during both daytime and night-time hours, allowing additional purge ventilation during cooler night-time conditions.
- 6.19 These assumptions are consistent with the modelling guidance provided within Approved Document O and CIBSE TM59.

Table 7: Natural Ventilation Strategy within ADO section 1.15

NATURAL VENTILATION STRATEGY	
Room Occupied During the day (8am to 11pm)	
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.
Night-time openings (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.
Easily Accessible Openings	
i.	In the day, windows, patio doors and balcony doors should be modelled as open, if this can be done securely.
ii.	At night, windows, patio doors and balcony doors should be modelled as closed.
Entrance Doors	
i.	Entrance doors should be included, which should be shut all the time

- 6.20 Table 8 summarises the window opening strategy adopted for the assessed flats at Menai Avenue, Croeserw. The table outlines the assumed opening behaviour applied to the windows serving the occupied spaces within the dynamic thermal model.
- 6.21 Within the thermal model, openings serving ground floor occupied spaces have been assumed to operate during daytime hours only, while openings serving first floor occupied spaces have been modelled to operate during both daytime and night-time hours. These assumptions have been incorporated within the dynamic thermal model to provide a realistic representation of airflow potential and occupant behaviour. All openable windows have been modelled with restrictors limiting the opening angle to a maximum of 15 degrees, reflecting the proposed window design and associated safety requirements.

Table 8: Natural Ventilation Strategy at Menai Avenue, Croeserw

NATURAL VENTILATION STRATEGY	
Window Type	Opening Strategy

Side-hung (Day Only)	Side-hung windows serving ground floor flats assumed to open during day only to a maximum angle of 15°, in line with ADO Section 1.15 described in Table 7 above.
Top-hung (Day Only)	Top-hung windows serving ground floor flats assumed to open during day only to a maximum angle of 15°, in line with ADO Section 1.15 described in Table 7 above.
Side-hung (Day & Night)	Side-hung windows serving first floor flats assumed to open both during day and night to a maximum angle of 15°, in line with ADO Section 1.15 described in Table 7 above.
Top-hung (Day & Night)	Top-hung windows serving first floor flats assumed to open both during day and night to a maximum angle of 15°, in line with ADO Section 1.15 described in Table 7 above.
Internal Doors	Internal doors within the flats have been modelled as open during daytime to assist with heat purging via cross-ventilation.
Fixed/Closed	Fixed or closed windows/doors

6.22 Indicative window opening strategies for the assessed flats at Menai Avenue, Croeserw are illustrated in Figures 3 and 4. The openings are colour-coded to represent the different window types and their associated opening behaviours, comprising side-hung and top-hung windows operating during the day only and during both day and night. A legend is provided within each figure for reference.

Figure 3: Indicative opening types for the 211 developments at Menai Avenue, Croeserw

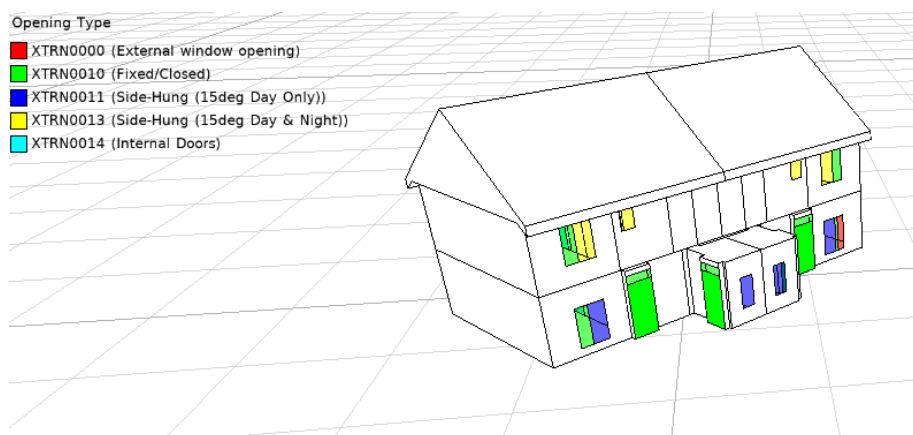
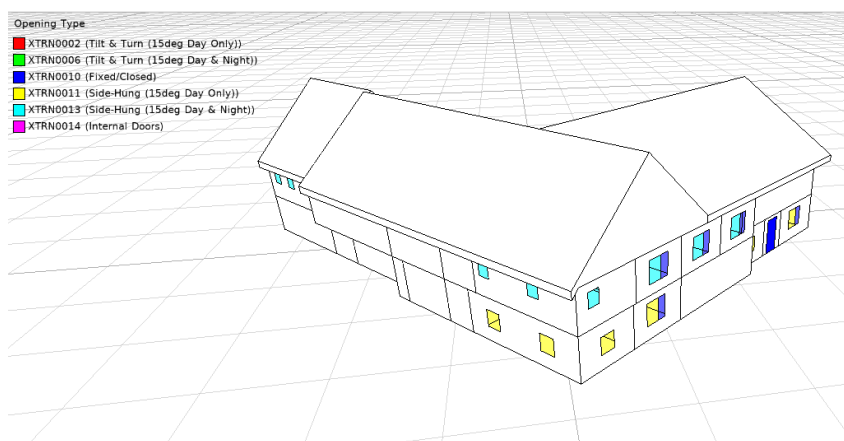


Figure 4: Indicative opening types for the 213 development at Menai Avenue, Croeserw



Mechanical Ventilation

- 6.23 In addition to natural ventilation provided through openable windows, the flats at Menai Avenue, Croeserw are equipped with a mechanical ventilation with heat recovery (MVHR) system. The system operates at continuous trickle flow rates, providing background ventilation and maintaining indoor air quality throughout the flats.
- 6.24 The MVHR system supplies and extracts air from the internal spaces in accordance with a typical residential ventilation strategy. While the MVHR contributes to maintaining indoor air quality and background ventilation, it does not provide active cooling or purge ventilation. Excess heat within the flats is therefore primarily removed through openable windows, which provide purge ventilation in accordance with the window opening strategy described in the preceding section.

Table 9: Mechanical Ventilation Strategy at Menai Avenue, Croeserw

MECHANICAL VENTILATION STRATEGY		
Room Type	Variation Profile	Flow Rate (l/s)
Double Bedroom	MVHR flow on if room temperature is above 22 °C during the day (8am – 10pm) and 18°C during the night (10pm - 8am) May to September	8
KLD	MVHR flow on if room temperature is above 22 °C during the day (8am – 10pm) and 18°C during the night (10pm - 8am) May to September	13
Single Bedroom	MVHR flow on if room temperature is above 22 °C during the day (8am – 10pm) and 18°C during the night (10pm - 8am) May to September	8
Lounge	MVHR flow on if room temperature is above 22 °C during the day (8am – 10pm) and 18°C during the night (10pm - 8am) May to September	13

7. OVERHEATING RESULTS

- 7.1 The following section summarises the results of the dynamic thermal simulations undertaken in accordance with the methodology set out in CIBSE TM59: Design Methodology for the Assessment of Overheating Risk in Homes (2017) and the guidance contained within Approved Document O (2022 Edition).
- 7.2 For Menai Avenue, Croeserw, the flats are considered predominantly naturally ventilated, with purge ventilation and summer cooling provided through openable windows. A mechanical ventilation with heat recovery (MVHR) system operates at continuous trickle flow rates to provide background ventilation and maintain indoor air quality. The MVHR system does not provide active cooling or purge ventilation; therefore, overheating mitigation relies on the natural ventilation strategy described in Section 6.
- 7.3 As the flats are classified as predominantly naturally ventilated, the overheating assessment has been undertaken using the CIBSE TM52 adaptive comfort criteria, as described in Section 4. In summary, the following conditions must be met:
- a. *For living rooms, kitchens and bedrooms: the number of hours during which the operative temperature exceeds the comfort threshold temperature is greater than or equal to one degree (°C) during the period May to September inclusive, shall not be more than 3% of occupied hours (CIBSE TM52 Criterion 1: Hours of exceedance).*
 - 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 (CIBSE Guide A Fixed temperature threshold). It should be noted that 1% of the annual hours between 22:00 and 07:00 for bedrooms is 32.85 hours, so 33 or more hours above 26 °C will be recorded as a fail.*
- 7.4 A total of 24 occupied spaces have been assessed across the 11 sample units, comprising 11 double bedrooms, 2 single bedrooms (including the staff sleepover bedroom), 10 kitchen/living/dining (KLD) areas and 1 lounge.
- 7.5 The simulation results demonstrate that all principal occupied rooms required to be assessed under the CIBSE TM59 methodology comply with the applicable overheating criteria. All bedrooms satisfy both the TM52 Criterion 1 hours of exceedance requirement and the TM59 night-time bedroom criterion, while all kitchen/living/dining (KLD) areas and the lounge also comply with the TM52 Criterion 1 requirement. As all 24 assessed rooms pass, the sample is taken to demonstrate that the 23 units under assessment achieve compliance with the CIBSE TM59 criteria.
- 7.6 Table 10 summarises the thermal comfort assessment results for the assessed spaces. Detailed room-by-room simulation outputs are provided in Appendix A.

Table 10: Menai Avenue, Croeserw: TM59 Results

Room Name	TM59 Criterion (a) <3 (%)	TM59 Criterion (b) – <33 (hours)	Pass or Fail
Double Bedrooms	11/11	11/11	PASS
Single Bedrooms	2/2	2/2	PASS
KLD	10/10	N/A	PASS
Lounge	1/1	N/A	PASS

8. CONCLUSIONS & RECOMMENDATIONS

- 8.1 This report presents the methodology and findings of a thermal comfort and overheating risk assessment undertaken for the proposed new build residential development at Menai Avenue, Croeserw. The assessment addresses the 211 and 213 apartment types within the development, comprising 23 units in total, of which a representative sample of 11 units has been modelled and assessed.
- 8.2 The analysis has been undertaken in accordance with the methodology specified by the Chartered Institution of Building Services Engineers (CIBSE) within CIBSE TM59: Design Methodology for the Assessment of Overheating Risk in Homes (2017), together with the requirements set out within Approved Document O (2022 Edition).
- 8.3 The rooms most susceptible to overheating are typically those exposed to higher levels of solar radiation and limited opportunities for purge ventilation. At Menai Avenue, glazing serving the occupied spaces is primarily distributed across the north-north-west and south-south-east façades. Ventilation within the flats is provided through openable windows for purge ventilation, together with a mechanical ventilation with heat recovery (MVHR) system operating at continuous trickle flow rates to provide background ventilation and maintain indoor air quality.
- 8.4 A total of 24 occupied spaces have been assessed within the dynamic thermal model, comprising 11 double bedrooms, 2 single bedrooms, 10 kitchen/living/dining (KLD) areas and 1 lounge.
- 8.5 The results of the dynamic thermal simulations demonstrate that all principal occupied rooms required to be assessed under the CIBSE TM59 methodology comply with the applicable overheating criteria. All bedrooms satisfy both the TM52 Criterion 1 hours of exceedance requirement and the TM59 night-time bedroom criterion, whilst all kitchen/living/dining (KLD) areas and the lounge also comply with the TM52 Criterion 1 requirement. As all 24 assessed rooms pass, the sample is taken to demonstrate that the 23 units under assessment achieve compliance with the CIBSE TM59 criteria. It can therefore be concluded that the proposed development at Menai Avenue is expected to provide acceptable levels of thermal comfort within the principal occupied spaces under the modelled conditions.
- 8.6 The key overheating mitigation measures incorporated within the design of the development are summarised in Table 11 below.

Table 11: Menai Avenue, Croeserw: Overheating Mitigation Measures

Measure	Implementation
Glazing Orientation	Glazing serving the occupied rooms is primarily distributed across the north-north-west and south-south-east façades. This arrangement has been incorporated within the thermal modelling to capture the effects of solar exposure throughout the day.
Glazing Properties	Glazing throughout the development has been specified with a solar transmittance (glass-only g-value) of 0.50. These glazing properties have been incorporated within the thermal model to assess the influence of solar gains on internal thermal comfort.

External Shading	Passive shading elements including roof overhangs and deep window reveals have been incorporated within the thermal model to represent their contribution towards reducing direct solar exposure to glazing.
Natural Ventilation Strategy	The occupied rooms are provided with openable side-hung and top-hung windows, fitted with restrictors limiting the opening angle to a maximum of 15 degrees, to facilitate natural ventilation and purge cooling. Ground floor openings have been modelled to operate during daytime hours only for security reasons, whilst first floor openings are assumed to operate during both daytime and night-time periods in accordance with the adopted window opening strategy.
Mechanical Ventilation Strategy	The flats are served by a mechanical ventilation with heat recovery (MVHR) system operating at continuous trickle flow rates to provide background ventilation and maintain indoor air quality. The MVHR system does not provide active cooling and is not relied upon for purge ventilation, which is achieved through the operation of openable windows.

- 8.7 Internal shading devices such as blinds or curtains can provide additional mitigation against solar heat gains. However, in accordance with TM59 modelling guidance and Approved Document O, internal blinds have not been included within the dynamic simulation model, and compliance with the overheating criteria does not rely on their operation. In practice, such measures may further assist occupants in maintaining comfortable internal conditions.

REFERENCES

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

CIBSE TM59: Design methodology for the assessment of overheating risk in homes. Chartered Institute of Building Services Engineers, London, 2017.

The Building Regulations 2010: Ventilation. Means of Ventilation F1 (2010 edition incorporating 2010 and 2013 amendments). HM Government. ISBN 978 1 85946 679 7.

The Building Regulations 2010: Conservation of Fuel and Power Part L2A. Conservation of fuel and power (New buildings other than dwellings) (2013 edition incorporating 2016 amendments). HM Government. ISBN 978-1- 85946-512-7.

Thermal simulation software: IES Virtual Environment – Version 2025.2.0.0.

National Calculation Methodology, 2013 Edition: NCM Modelling Guide (for buildings other dwellings in England).

CIBSE AM11. Building Performance Modelling. Chartered Institute of Building Services Engineers, London, 2015. ISBN 978-1-906846-67-1.

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

Welsh Government. 2010: Approved Document Part O – Overheating (2022 edition – For use in Wales). Available at: <https://gov.wales/sites/default/files/publications/2022-10/building-regulations-approved-document-o.pdf>

APPENDIX A

Overheating Risk Assessment – IES Approved Document O report

Approved Document O report
Overheating risk in residential buildings
for
Menai Avenue - 211 & 213

Menai Avenue - 211 & 213

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Building details

Project name: Menai Avenue - 211 & 213	Date: 11-08-2026 11:25:40
Location: Cardiff , United Kingdom	
Address:	
Building use: Residential	
Are there any security, noise, or pollution issues: None raised	

Designer's details

Designer's name: Markos Kassapis
Designer's organisation: Viro Consult
Designer's address: Suite 2a, Kimberley House, Ty Glas Avenue, Llanishen, Cardiff, Wales, CF14 5DX

Dynamic thermal model

Software: IESVE version 2025.2.0.0	
Weather file: Cardiff_DSY1_2020High50_.epw	
Results file: Menai Avenue TM59.aps	
Number of rooms analysed: 24	
TM59: summer elevated air speed: 0.1	
TM59: occupant category: Category I (vulnerable)	
Overheating mitigation strategy: Natural & mechanical ventilation	
Has the building construction proposal been modelled accurately?	YES
Have the analysed rooms passed the assessment for Approved Doc O Dynamic Thermal Modelling Method (CIBSE TM 59)?	YES
Designer's signature:	

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Summary

CIBSE TM59 overheating methodology for predominantly naturally ventilated rooms assesses against two criteria, (a) and (b) (for Category I occupancy, T_{max} is reduced by 1K):

- Criterion (a) states that for living rooms, kitchens and bedrooms, the number of hours during which ΔT is greater than or equal to 1K from May to September (or November to March for southern hemisphere locations) shall not exceed 3% of occupied hours
- Criterion (b) states that the operative temperature of the bedrooms from 22:00-07:00 shall not exceed 26°C for more than 1% of annual hours (33 hours is therefore recorded as a fail). Approved document O applies limits to CIBSE TM59 section 3.3 (openings); these requirements are applied by appropriate assignment of MacroFlo types / scripted profiles in the model (see Modelled Openings Section).

CIBSE TM59 overheating methodology for predominantly mechanically ventilated rooms states the operative temperature of all rooms shall not exceed 26°C for more than 3% of annual occupied hours.

CIBSE TM59 also states that the inclusion of corridors in the overheating analysis is mandatory where community heating pipework runs through them. While there is no mandatory target for communal corridors, if an operative temperature of 28°C is exceeded for more than 3% of the total annual hours this should be identified as a significant risk.

Room name	Naturally ventilated Criterion a check	Naturally ventilated Criterion b check	Mechanically ventilated check	Corridor overheating risk check
FT 211 - GF - Plot 1 - KLD (1 bed)	Pass	N/A	-	-
FT 211 - GF - Plot 1 - Double Bedroom	Pass	Pass	-	-
FT 211 - 1F - Plot 2 - KLD (1 bed)	Pass	N/A	-	-
FT 211 - 1F - Plot 2 - Double Bedroom	Pass	Pass	-	-
FT 211 - GF - Plot 3 - KLD (1 bed)	Pass	N/A	-	-
FT 211 - GF - Plot 3 - Double Bedroom	Pass	Pass	-	-
FT 211 - 1F - Plot 4 - KLD (1 bed)	Pass	N/A	-	-
FT 211 - 1F - Plot 4 - Double Bedroom	Pass	Pass	-	-
FT 211 - GF - Plot 16 - KLD (1 bed)	Pass	N/A	-	-
FT 211 - GF - Plot 16 - Double Bedroom	Pass	Pass	-	-
FT 211 - 1F - Plot 17 - KLD (1 bed)	Pass	N/A	-	-
FT 211 - 1F - Plot 17 - Double Bedroom	Pass	Pass	-	-
FT 213 - 0-3 - GF - KLD (1 bed)	Pass	N/A	-	-
FT 213 - 0-3 - GF - Double Bedroom	Pass	Pass	-	-
FT 213 - Staff Bed - GF	Pass	Pass	-	-
FT 213 - 0-1 - GF - Double Bedroom	Pass	Pass	-	-

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Room name	Naturally ventilated Criterion a check	Naturally ventilated Criterion b check	Mechanically ventilated check	Corridor overheating risk check
FT 213 - 0-1 - GF - KLD (1 bed)	Pass	N/A	-	-
FT 213 - 1-9 - 1F - Double Bedroom	Pass	Pass	-	-
FT 213 - 1-9 - 1F - KLD (1 bed)	Pass	N/A	-	-
FT 213 - 1-7 - 1F - Single Bedroom	Pass	Pass	-	-
FT 213 - 1-7 - 1F - KLD (2 bed)	Pass	N/A	-	-
FT 213 - 1-7 - 1F - Double Bedroom	Pass	Pass	-	-
FT 213 - 1-6 - 1F - Lounge	Pass	N/A	-	-
FT 213 - 1-6 - 1F - Double Bedroom	Pass	Pass	-	-

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Naturally ventilated rooms – criterion (a)

Criterion (a) states that for living rooms, kitchens and bedrooms, the number of hours during which ΔT is greater than or equal to 1K from May to September (or November to March for southern hemisphere locations) shall not exceed 3% of occupied hours.

Room name	Occupied hours	No. hours $\Delta T \geq 1^\circ\text{K}$	% Occupied hours $\Delta T \geq 1^\circ\text{K}$	Criterion a check
FT 211 - GF - Plot 1 - KLD (1 bed)	1989	9	0.5	Pass
FT 211 - GF - Plot 1 - Double Bedroom	3672	8	0.2	Pass
FT 211 - 1F - Plot 2 - KLD (1 bed)	1989	13	0.7	Pass
FT 211 - 1F - Plot 2 - Double Bedroom	3672	21	0.6	Pass
FT 211 - GF - Plot 3 - KLD (1 bed)	1989	9	0.5	Pass
FT 211 - GF - Plot 3 - Double Bedroom	3672	8	0.2	Pass
FT 211 - 1F - Plot 4 - KLD (1 bed)	1989	13	0.7	Pass
FT 211 - 1F - Plot 4 - Double Bedroom	3672	21	0.6	Pass
FT 211 - GF - Plot 16 - KLD (1 bed)	1989	7	0.4	Pass
FT 211 - GF - Plot 16 - Double Bedroom	3672	1	0.0	Pass
FT 211 - 1F - Plot 17 - KLD (1 bed)	1989	13	0.7	Pass
FT 211 - 1F - Plot 17 - Double Bedroom	3672	10	0.3	Pass
FT 213 - 0-3 - GF - KLD (1 bed)	1989	0	0.0	Pass
FT 213 - 0-3 - GF - Double Bedroom	3672	0	0.0	Pass
FT 213 - Staff Bed - GF	3672	0	0.0	Pass
FT 213 - 0-1 - GF - Double Bedroom	3672	3	0.1	Pass
FT 213 - 0-1 - GF - KLD (1 bed)	1989	2	0.1	Pass
FT 213 - 1-9 - 1F - Double Bedroom	3672	8	0.2	Pass
FT 213 - 1-9 - 1F - KLD (1 bed)	1989	4	0.2	Pass
FT 213 - 1-7 - 1F - Single Bedroom	3672	16	0.4	Pass
FT 213 - 1-7 - 1F - KLD (2 bed)	1989	10	0.5	Pass

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Room name	Occupied hours	No. hours $\Delta T \geq 1^{\circ}K$	% Occupied hours $\Delta T \geq 1^{\circ}K$	Criterion a check
FT 213 - 1-7 - 1F - Double Bedroom	3672	1	0.0	Pass
FT 213 - 1-6 - 1F - Lounge	1989	4	0.2	Pass
FT 213 - 1-6 - 1F - Double Bedroom	3672	3	0.1	Pass

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Naturally ventilated rooms – criterion (b)

Criterion (b) states that the operative temperature of the bedrooms from 22:00-07:00 shall not exceed 26°C for more than 1% of annual hours (33 hours is therefore recorded as a fail). Any rooms that are not bedrooms are therefore not assessed, hence the corresponding N/A values.

Room name	No. hours > 26°C 22:00-24:00	No. hours > 26°C 00:00-07:00	Total hours > 26°C	Criterion b check
FT 211 - GF - Plot 1 - KLD (1 bed)	N/A	N/A	N/A	N/A
FT 211 - GF - Plot 1 - Double Bedroom	3	0	3	Pass
FT 211 - 1F - Plot 2 - KLD (1 bed)	N/A	N/A	N/A	N/A
FT 211 - 1F - Plot 2 - Double Bedroom	3	0	3	Pass
FT 211 - GF - Plot 3 - KLD (1 bed)	N/A	N/A	N/A	N/A
FT 211 - GF - Plot 3 - Double Bedroom	3	0	3	Pass
FT 211 - 1F - Plot 4 - KLD (1 bed)	N/A	N/A	N/A	N/A
FT 211 - 1F - Plot 4 - Double Bedroom	3	0	3	Pass
FT 211 - GF - Plot 16 - KLD (1 bed)	N/A	N/A	N/A	N/A
FT 211 - GF - Plot 16 - Double Bedroom	3	0	3	Pass
FT 211 - 1F - Plot 17 - KLD (1 bed)	N/A	N/A	N/A	N/A
FT 211 - 1F - Plot 17 - Double Bedroom	3	0	3	Pass
FT 213 - 0-3 - GF - KLD (1 bed)	N/A	N/A	N/A	N/A
FT 213 - 0-3 - GF - Double Bedroom	0	0	0	Pass
FT 213 - Staff Bed - GF	0	0	0	Pass
FT 213 - 0-1 - GF - Double Bedroom	1	0	1	Pass
FT 213 - 0-1 - GF - KLD (1 bed)	N/A	N/A	N/A	N/A
FT 213 - 1-9 - 1F - Double Bedroom	3	0	3	Pass
FT 213 - 1-9 - 1F - KLD (1 bed)	N/A	N/A	N/A	N/A
FT 213 - 1-7 - 1F - Single Bedroom	8	1	9	Pass
FT 213 - 1-7 - 1F - KLD (2 bed)	N/A	N/A	N/A	N/A

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Room name	No. hours > 26°C 22:00-24:00	No. hours > 26°C 00:00-07:00	Total hours > 26°C	Criterion b check
FT 213 - 1-7 - 1F - Double Bedroom	0	0	0	Pass
FT 213 - 1-6 - 1F - Lounge	N/A	N/A	N/A	N/A
FT 213 - 1-6 - 1F - Double Bedroom	3	0	3	Pass

Mechanically ventilated rooms

CIBSE TM59 overheating methodology for predominantly mech. vent. rooms states the operative temperature of all rooms shall not exceed 26°C for more than 3% of annual occupied hours.

Room name	No. hours > 26°C	% Annual hours > 26°C	Mechanically ventilated check
No mech vent rooms	N/A	N/A	N/A

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.

Room name	No. hours > 28°C	% Annual hours > 28°C	Corridor overheating risk check
No corridors	N/A	N/A	N/A

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Modelled details & overheating mitigation strategy

Approved document O: Providing Information & Appendix B requires information about the model and the overheating mitigation strategy. The following tables detail the modelling method and mitigation strategies applied to each analysed room. Where multiple active openings per space (windows & louvres) exist they are all listed. Occupancy, equipment and lighting profiles for occupied rooms comply with TM59 section 5.

Modelled occupancy

Room name	Floor area m ²	Thermal template	Occupancy profile	Equipment profile	Lighting profile
FT 211 - GF - Plot 1 - KLD (1 bed)	22.46	TM59 - 1 Bedroom - Living / Kitchen	Living / Kitchen Occupancy	Living / Kitchen Equipment	18-23h
FT 211 - GF - Plot 1 - Double Bedroom	13.71	TM59 - Double Bedroom	Double Bedroom Occupancy	Double Bedroom Equipment	18-23h
FT 211 - 1F - Plot 2 - KLD (1 bed)	22.22	TM59 - 1 Bedroom - Living / Kitchen	Living / Kitchen Occupancy	Living / Kitchen Equipment	18-23h
FT 211 - 1F - Plot 2 - Double Bedroom	12.91	TM59 - Double Bedroom	Double Bedroom Occupancy	Double Bedroom Equipment	18-23h
FT 211 - GF - Plot 3 - KLD (1 bed)	22.46	TM59 - 1 Bedroom - Living / Kitchen	Living / Kitchen Occupancy	Living / Kitchen Equipment	18-23h
FT 211 - GF - Plot 3 - Double Bedroom	13.71	TM59 - Double Bedroom	Double Bedroom Occupancy	Double Bedroom Equipment	18-23h
FT 211 - 1F - Plot 4 - KLD (1 bed)	22.22	TM59 - 1 Bedroom - Living / Kitchen	Living / Kitchen Occupancy	Living / Kitchen Equipment	18-23h
FT 211 - 1F - Plot 4 - Double Bedroom	12.91	TM59 - Double Bedroom	Double Bedroom Occupancy	Double Bedroom Equipment	18-23h
FT 211 - GF - Plot 16 - KLD (1 bed)	22.46	TM59 - 1 Bedroom - Living / Kitchen	Living / Kitchen Occupancy	Living / Kitchen Equipment	18-23h
FT 211 - GF - Plot 16 - Double Bedroom	13.71	TM59 - Double Bedroom	Double Bedroom Occupancy	Double Bedroom Equipment	18-23h
FT 211 - 1F - Plot 17 - KLD (1 bed)	22.22	TM59 - 1 Bedroom - Living / Kitchen	Living / Kitchen Occupancy	Living / Kitchen Equipment	18-23h
FT 211 - 1F - Plot 17 - Double Bedroom	12.91	TM59 - Double Bedroom	Double Bedroom Occupancy	Double Bedroom Equipment	18-23h
FT 213 - 0-3 - GF - KLD (1 bed)	20.89	TM59 - 1 Bedroom - Living / Kitchen	Living / Kitchen Occupancy	Living / Kitchen Equipment	18-23h
FT 213 - 0-3 - GF - Double Bedroom	15.46	TM59 - Double Bedroom	Double Bedroom Occupancy	Double Bedroom Equipment	18-23h
FT 213 - Staff Bed - GF	14.83	TM59 - Single Bedroom	Single Bedroom Occupancy	Single Bedroom Equipment	18-23h
FT 213 - 0-1 - GF - Double Bedroom	16.41	TM59 - Double Bedroom	Double Bedroom Occupancy	Double Bedroom Equipment	18-23h

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Room name	Floor area m ²	Thermal template	Occupancy profile	Equipment profile	Lighting profile
FT 213 - 0-1 - GF - KLD (1 bed)	24.42	TM59 - 1 Bedroom - Living / Kitchen	Living / Kitchen Occupancy	Living / Kitchen Equipment	18-23h
FT 213 - 1-9 - 1F - Double Bedroom	12.87	TM59 - Double Bedroom	Double Bedroom Occupancy	Double Bedroom Equipment	18-23h
FT 213 - 1-9 - 1F - KLD (1 bed)	22.44	TM59 - 1 Bedroom - Living / Kitchen	Living / Kitchen Occupancy	Living / Kitchen Equipment	18-23h
FT 213 - 1-7 - 1F - Single Bedroom	7.83	TM59 - Single Bedroom	Single Bedroom Occupancy	Single Bedroom Equipment	18-23h
FT 213 - 1-7 - 1F - KLD (2 bed)	22.96	TM59 - 2 Bedroom - Living / Kitchen	Living / Kitchen Occupancy	Living / Kitchen Equipment	18-23h
FT 213 - 1-7 - 1F - Double Bedroom	14.13	TM59 - Double Bedroom	Double Bedroom Occupancy	Double Bedroom Equipment	18-23h
FT 213 - 1-6 - 1F - Lounge	11.2	TM59 - 1 Bedroom - Living	Living Occupancy	Living Equipment	18-23h
FT 213 - 1-6 - 1F - Double Bedroom	12.87	TM59 - Double Bedroom	Double Bedroom Occupancy	Double Bedroom Equipment	18-23h

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Modelled openings

Room name	Window to wall ratio %	Window g-value (EN 410)	Opening gross area m ²	Opening free area (avg) %	Opening free area / floor area ratio %	Opening profile(s)
FT 211 - GF - Plot 1 - KLD (1 bed)	8.8	0.5003, 0.5003	0.9, 0.45, 0.74, 0.98, 2.1	90.0, 20.0, 20.0, 90.0, 90.0	17.01	ADO.AlwaysOff, ADO.s115a, ADO.s115ab
FT 211 - GF - Plot 1 - Double Bedroom	14.82	0.5003	0.91, 0.84, 2.1	90.0, 20.0, 90.0	20.98	ADO.AlwaysOff, ADO.s115a, ADO.s115ab
FT 211 - 1F - Plot 2 - KLD (1 bed)	8.84	0.5003, 0.5003	0.74, 0.98, 0.9, 0.45, 2.1	20.0, 90.0, 90.0, 20.0, 90.0	17.19	ADO.AlwaysOff, ADO.s115ab
FT 211 - 1F - Plot 2 - Double Bedroom	14.71	0.5003	0.91, 0.84, 2.1	90.0, 20.0, 90.0	22.29	ADO.AlwaysOff, ADO.s115ab
FT 211 - GF - Plot 3 - KLD (1 bed)	8.8	0.5003, 0.5003	0.9, 0.45, 0.98, 0.22, 0.52, 2.1	90.0, 20.0, 90.0, 20.0, 0.0, 90.0	16.54	ADO.AlwaysOff, ADO.s115a, ADO.s115ab, off continuously
FT 211 - GF - Plot 3 - Double Bedroom	14.82	0.5003	0.91, 0.84, 0.04, 2.06	90.0, 20.0, 90.0, 90.0	20.98	ADO.AlwaysOff, ADO.s115a, ADO.s115ab
FT 211 - 1F - Plot 4 - KLD (1 bed)	8.84	0.5003, 0.5003	0.74, 0.98, 0.9, 0.45, 2.1	20.0, 90.0, 90.0, 20.0, 90.0	17.19	ADO.AlwaysOff, ADO.s115ab
FT 211 - 1F - Plot 4 - Double Bedroom	14.71	0.5003	0.91, 0.84, 1.86	90.0, 20.0, 90.0	20.61	ADO.AlwaysOff, ADO.s115ab
FT 211 - GF - Plot 16 - KLD (1 bed)	8.8	0.5003, 0.5003	0.9, 0.45, 0.98, 0.22, 0.52, 2.1	90.0, 20.0, 90.0, 20.0, 0.0, 90.0	16.54	ADO.AlwaysOff, ADO.s115a, ADO.s115ab, off continuously
FT 211 - GF - Plot 16 - Double Bedroom	8.92	0.5003	0.91, 0.84, 0.04, 2.06	90.0, 20.0, 90.0, 90.0	20.98	ADO.AlwaysOff, ADO.s115a, ADO.s115ab
FT 211 - 1F - Plot 17 - KLD (1 bed)	8.84	0.5003, 0.5003	0.74, 0.98, 0.9, 0.45, 2.1	20.0, 90.0, 90.0, 20.0, 90.0	17.19	ADO.AlwaysOff, ADO.s115ab
FT 211 - 1F - Plot 17 - Double Bedroom	9.11	0.5003	0.91, 0.84, 1.86	90.0, 20.0, 90.0	20.61	ADO.AlwaysOff, ADO.s115ab
FT 213 - 0-3 - GF - KLD (1 bed)	9.41	0.5003, 0.5003	0.77, 0.76, 0.77, 2.1	90.0, 90.0, 90.0, 90.0	18.96	ADO.s115a, ADO.s115ab
FT 213 - 0-3 - GF - Double Bedroom	19.81	0.5003	0.6, 1.02, 2.1	20.0, 90.0, 90.0	18.94	ADO.AlwaysOff, ADO.s115a, ADO.s115ab

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Room name	Window to wall ratio %	Window g-value (EN 410)	Opening gross area m ²	Opening free area (avg) %	Opening free area / floor area ratio %	Opening profile(s)
FT 213 - Staff Bed - GF	12.98	0.5003	0.77	90.0	4.67	ADO.s115a
FT 213 - 0-1 - GF - Double Bedroom	8.64	0.5003	0.6, 1.02, 2.1	20.0, 90.0, 90.0	17.84	ADO.AlwaysOff, ADO.s115a, ADO.s115ab
FT 213 - 0-1 - GF - KLD (1 bed)	9.44	0.5003, 0.5003	0.5, 0.6, 1.02, 2.1	90.0, 20.0, 90.0, 90.0	13.83	ADO.AlwaysOff, ADO.s115a, ADO.s115ab
FT 213 - 1-9 - 1F - Double Bedroom	9.67	0.5003	0.6, 1.02, 2.1	20.0, 90.0, 90.0	22.75	ADO.AlwaysOff, ADO.s115ab
FT 213 - 1-9 - 1F - KLD (1 bed)	6.78	0.5003	0.49, 0.49, 0.49, 2.1	90.0, 90.0, 90.0, 90.0	14.32	ADO.s115ab
FT 213 - 1-7 - 1F - Single Bedroom	0.0				0.0	
FT 213 - 1-7 - 1F - KLD (2 bed)	6.28	0.5003, 0.5003	0.49, 0.49, 0.49, 2.1	90.0, 90.0, 90.0, 90.0	13.99	ADO.s115ab
FT 213 - 1-7 - 1F - Double Bedroom	20.93	0.5003	0.6, 1.02, 2.1	20.0, 90.0, 90.0	20.72	ADO.AlwaysOff, ADO.s115ab
FT 213 - 1-6 - 1F - Lounge	20.83	0.5003	0.6, 1.02, 2.1	20.0, 90.0, 90.0	26.14	ADO.AlwaysOff, ADO.s115ab
FT 213 - 1-6 - 1F - Double Bedroom	17.38	0.5003	0.6, 1.02, 2.1	20.0, 90.0, 90.0	22.75	ADO.AlwaysOff, ADO.s115ab

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Modelled ventilation

Room name	Infiltration rate ACH	Mech vent flow rate ACH
FT 211 - GF - Plot 1 - KLD (1 bed)	0.15	0.8
FT 211 - GF - Plot 1 - Double Bedroom	0.15	0.81
FT 211 - 1F - Plot 2 - KLD (1 bed)	0.15	0.81
FT 211 - 1F - Plot 2 - Double Bedroom	0.15	0.86
FT 211 - GF - Plot 3 - KLD (1 bed)	0.15	0.8
FT 211 - GF - Plot 3 - Double Bedroom	0.15	0.81
FT 211 - 1F - Plot 4 - KLD (1 bed)	0.15	0.81
FT 211 - 1F - Plot 4 - Double Bedroom	0.15	0.86
FT 211 - GF - Plot 16 - KLD (1 bed)	0.15	0.8
FT 211 - GF - Plot 16 - Double Bedroom	0.15	0.81
FT 211 - 1F - Plot 17 - KLD (1 bed)	0.15	0.81
FT 211 - 1F - Plot 17 - Double Bedroom	0.15	0.86
FT 213 - 0-3 - GF - KLD (1 bed)	0.15	0.97
FT 213 - 0-3 - GF - Double Bedroom	0.15	0.81
FT 213 - Staff Bed - GF	0.15	0.84
FT 213 - 0-1 - GF - Double Bedroom	0.15	0.76
FT 213 - 0-1 - GF - KLD (1 bed)	0.15	0.83
FT 213 - 1-9 - 1F - Double Bedroom	0.15	0.97
FT 213 - 1-9 - 1F - KLD (1 bed)	0.15	0.91
FT 213 - 1-7 - 1F - Single Bedroom	0.15	1.6
FT 213 - 1-7 - 1F - KLD (2 bed)	0.15	0.89
FT 213 - 1-7 - 1F - Double Bedroom	0.15	0.89
FT 213 - 1-6 - 1F - Lounge	0.15	1.82
FT 213 - 1-6 - 1F - Double Bedroom	0.15	0.97