Hayes Park

Overheating Assessment

May 2023

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Hayes Park.
Hillingdon.
Shall Do Hayes Development Limited.

SUSTAINABILITY
STAGE 2 REPORT – RESIDENTIAL TM59 ASSESSMENT

REVISION 04 – 13 JUNE 2023

STAGE 2

Audit sheet.

Rev.	Date	Description of change /purpose of issue	Prepared	Reviewed	Authorised
01	25/04/2023	RIBA Stage 2 Draft Issue	A. Lane	J. Pollard	J. Drane
02	05/05/2023	Draft Issue for Planning	A. Lane	J. Pollard	J. Drane
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Contents.

1. Executive Summary.

This thermal comfort report has been prepared on behalf of Shall Do Hayes Development Limitedin the context of the planning application for the buildings Hayes Park South and Central, hereafter the proposed development.

The Proposed Development

Location: Hayes Park, Hayes End Road, Hayes, Greater London, UB4 8FE

Local Authority: London Borough of Hillingdon.

The refurbishment of Hayes Park Central and Hayes Park South office buildings into 124 C3 Residential dwellings.

Site: Current Use and Allocation

Hayes Park extends to 3.73 hectares and comprises two office buildings situated amongst generous parklands grounds.

The study set out within this report was undertaken to determine occupant thermal comfort conditions during the summer months within proposed dwellings, in accordance with CIBSE TM59 and GLA Overheating requirements. A representative sample of 13 dwellings was assessed across the two residential buildings.

Figure 1: Image of the Proposed Development

1.1 CIBSE TM59 assessment methodology.

Compliance with the requirements of CIBSE TM59 can be demonstrated using either the Simplified method or the Dynamic Thermal Modelling method. The Dynamic Thermal Modelling method has been used in this assessment.

The risk of overheating within sample apartments selected has been assessed using the thermal comfort criteria within the methodology set out in CIBSE Technical Memorandum 59 (TM59): 'Design methodology for the assessment of overheating risk in homes' with the principles and restrictions of TM59 applied.

The Proposed Development was modelled in a virtual environment with assigned parameters and then assessed against criteria within the recognised CIBSE TM59 methodology.

1.2 Thermal comfort study.

Determining the risk of overheating within the occupied spaces of the proposed dwellings has considered:

- Fabric performance;
- Ventilation strategy;
- Internal gains;
- Occupancy profiles; and
- External weather conditions taken from CIBSE Leeds weather centre future climate data: DSY1_London_2020High50 (Design Summer Year 1: 2020, high emissions scenario (50th percentile)).

GLA Policy SI 4 requires the assessment includes further climate scenarios represented by weather sets DSY2 and DSY3, to potentially assess the overheating risks in excessive future climate scenarios.

The variations between each DSY file are briefly summarised below:

- DSY 1: moderately warm summer
- DSY 2: short, intense warm spell
- DSY 3: long, less intense warm spell

The results of the further climate scenarios are located in the Appendix D.

1.3 Heritage Constraints

Summary of the heritage and listing requirements found in the link below which affect energy and sustainability achievements of the development.

Mitigation of the overheating risk is limited by the following factors:

- Listed/Fixed glazing ratio
- Large overhang without possibility for additional external shading
- Glazing modules restrict opening sizes
- Security on the ground floor prevents overnight window opening

1.4 Latest Modelling Summary.

The proposed tested dwellings within Hayes Park Central & South were tested under four different scenarios using a cumulative cooling hierarchy. Each sample dwelling assessed within this study has been shown to satisfy the CIBSE TM59 thermal comfort criteria using a mixed-mode ventilation strategy under the DSY1 climate scenario except ground floor spaces. Results could be concluded as the following.

Based on the recent noise assessment conducted by NRG Consulting, detailed in the report "Hayes Park Noise and Overheating Assessment - DRAFT March 2023", concluded that the windows within the proposed development may be open for natural ventilation between the hours of 23:00-07:00.

During the design development, 10 iterations of the overheating assessments were completed, modelling a sample of 4 apartments; this was refined to the following four iterations:

1. Natural Ventilation with Ambient MVHR at 1ACH +g-Value reduced to 0.4
   a. RESULTS: 88% PASS
2. Natural Ventilation with Ambient MVHR at 1ACH +g-Value reduced to 0.4 + Internal Blinds
   a. RESULTS: 88% PASS
3. Tempered Mech Ventilation at 16^{0}C MVHR at 1ACH +g-Value reduced to 0.4
   a. RESULTS: 27% PASS
4. Tempered Mech Ventilation at 16^{0}C MVHR at 1ACH +g-Value reduced to 0.4+ Internal Blinds
   a. RESULTS: 47% PASS

Communal corridors were included in the analysis inline with TM59 and GLA recommendations. Only one corridor element on each building has been modelled. Community heating pipework runs through the corridors although the proposed ambient loop heat loss is very small.

Hayes Park Central has mainly open gantry corridors.

The results of overheating modelling have improved during the design process due to the allowable window opening overnight. Certain assumptions have been made interms of window operability and security. High level casements to all Ground Floor landscape windows are being proposed to be operable during the night time, whilst windows and sliding doors fronting onto a secure inner courtyard are also deemed operable, aiding compliance with criterion B. Under Criteria A problem daytime areas (even allowing for blinds) still exist. Typically these are west elevations and/or corner plots.

The mechanical ventilation tempered air scenarios yield worse results due to the practical limitations of the air flow possible through the MVHR unit.

The conclusion of this report is to provide active cooling within the proposed development based on the result from CIBSE Design Summer Year (DSY) 1.

The DSY 2 & DSY 3 weather files required by the GLA presented some major failures across the sample so provision for active cooling is a informed move for future proofing the proposed development.

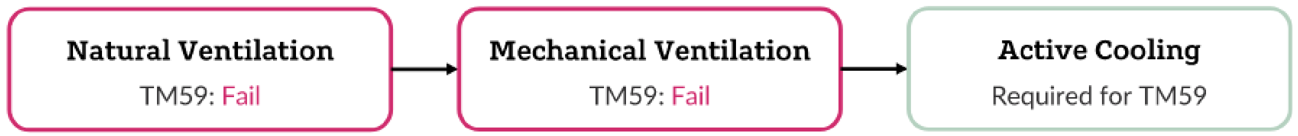


Figure 2: Modelling scenario results

2. Introduction.

The interaction between people and buildings takes place in a number of ways, and many aspects of the internal environment are important, such as thermal comfort. Temperature is usually the most important environmental variable affecting thermal comfort and therefore occupant health and wellbeing. GLA Policy SI 4 requires the assessment of thermal comfort using the CIBSE Technical Memorandum 59 (TM59): Design methodology for the assessment of overheating risk in homes.

This report has been prepared on behalf of Shall Do Hayes Development Limited for the proposed residential development within the Hayes Park scheme, to determine compliance with the GLA Policy requirements, using dynamic thermal modelling to better identify the potential risk of overheating.

2.1 CIBSE TM59 Overview

Overheating in all spaces was previously quantified by the number of occupied hours annually that the internal temperature exceeds a maximum temperature irrespective of external temperature.

The CIBSE TM59 criteria for predominantly naturally ventilated spaces use both an adaptive comfort and a fixed threshold approach.

Adaptive comfort:
Adaptive comfort is where the overheating threshold is dynamic. It is based on the comparison of the anticipated internal conditions against criteria which establishes a maximum acceptable room temperature calculated from the running 'mean' outdoor temperature. Research has shown that comfortable room temperatures vary with the external temperature conditions and occupants are generally more accepting of warmer room temperatures if the weather is also warm outside.

Fixed threshold:
CIBSE TM59 criterion (b), used to assess bedrooms only, uses a static measurement where the threshold is fixed. The risk of overheating is quantified by the number of occupied hours annually that the internal conditions exceed a maximum temperature, irrespective of external temperature. It therefore does not vary in line with the external conditions like the adaptive comfort approach. This criterion is required to be satisfied within bedrooms only.

2.2 CIBSE TM59 Criteria

CIBSE TM59 considers the risk of overheating by assessing occupied spaces against two criteria for natural ventilation and one for mechanical ventilation as detailed in the Table 1 and 2 below.

Table 1 - CIBSE TM59 Natural Ventilation criteria

Criterion (a)	For Living Rooms, Kitchens, and Bedrooms: Criteria sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature. To satisfy Criterion a, the following must not occur for more than 3% of occupied hours: The difference between the actual operative temperature, and the maximum acceptable temperature* is equal to or greater than 1 degree during May to September.
Criterion (b)	For Bedrooms Only: Criteria states that peak bedroom temperatures should not exceed an absolute threshold of 26 °C. To satisfy Criterion b, the operative temperature in the bedrooms from 10 pm to 7 am shall not exceed 26 °C for more than 1% of annual hours.

* Maximum acceptable temperature: CIBSE sets a maximum acceptable temperature of 3°C above the comfort temperature (for new buildings).

Table 2 - CIBSE TM59 Mechanical Ventilation criteria

Fixed Comfort Criterion	For Living Rooms, Kitchens and Bedrooms: Criteria sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature. Fixed comfort criterion All living rooms, kitchens and bedrooms must not exceed the maximum operative temperature threshold of 26 degrees for 3% of the total annual occupied hours.

Communal Corridor Overheating Check
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.

The reported study was undertaken to assess the thermal comfort conditions during occupied periods within sample dwellings of the residential blocks. The representative sample of dwellings selected for assessment account for a range of orientations and dwelling types. The representative sample of dwellings selected for assessment also matches the tested sample for PL1A compliance, as reported in the document "REP-2324806-5A-AL-20230331-GLA Energy Strategy Refurbished Residential-Rev01".

Based on the recent noise assessment conducted by NRG Consulting, detailed in the report "Hayes Park Noise and Overheating Assessment - DRAFT March 2023", concluded that the windows within the proposed development may be open for natural ventilation between the hours of 23:00-07:00.

The assessment has utilised dynamic simulation modelling to anticipate the internal temperatures likely to be experienced within the apartments during the summer months. The model developed for this study consists of the following input parameters to determine the thermal conditions within the occupied spaces:

- Fabric performance,
- Ventilation strategy,
- Internal gains,
- Occupancy profiles, and
- External weather conditions taken from CIBSE Manchester weather centre future climate data:
  DSY1_London_2020High50 (Design Summer Year 1: 2020, high emissions scenario (50th percentile)).

The DSY 1 weather file is recommended to be used as a minimum requirement when assessing thermal comfort, as stated within CIBSE TM59. The most appropriate weather file for the schemes' location is deemed to be London.

In line with the TM59 methodology, the study will analyse the thermal comfort conditions between the months of May to September where the risk of overheating is most likely to occur.

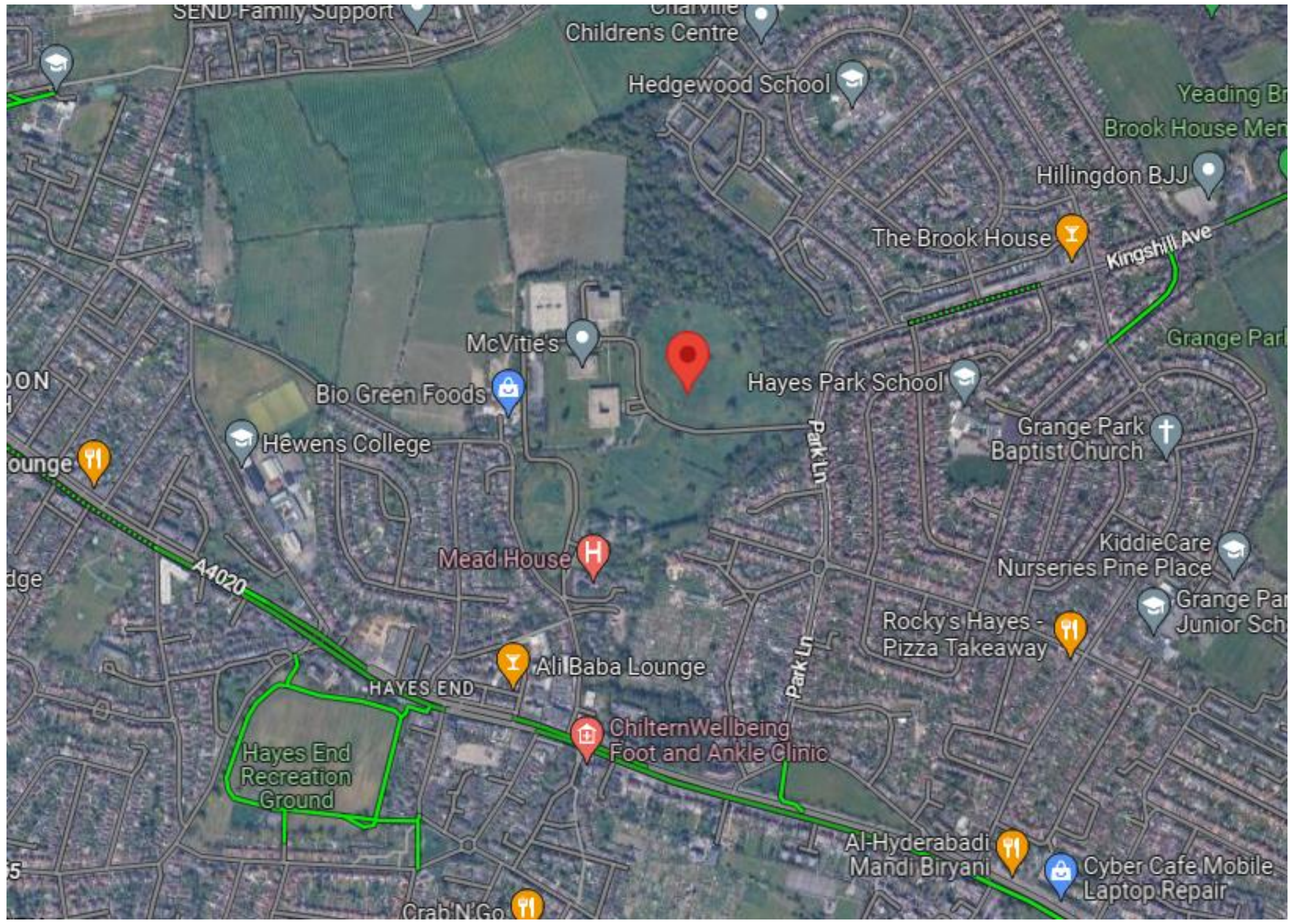


Figure 4: Map of the Local Area

2.3 Assessment Methodology.

Thermal comfort methodology has been used to assess the occupied spaces within a representative sample of 13 apartments (36 zones) to determine their risk of overheating during the summer period (May to September inclusive), as shown in Figure 5. The spaces have been assessed against criteria stated within, and in accordance with the dynamic thermal modelling method detailed in CIBSE TM59 of the building regulations.

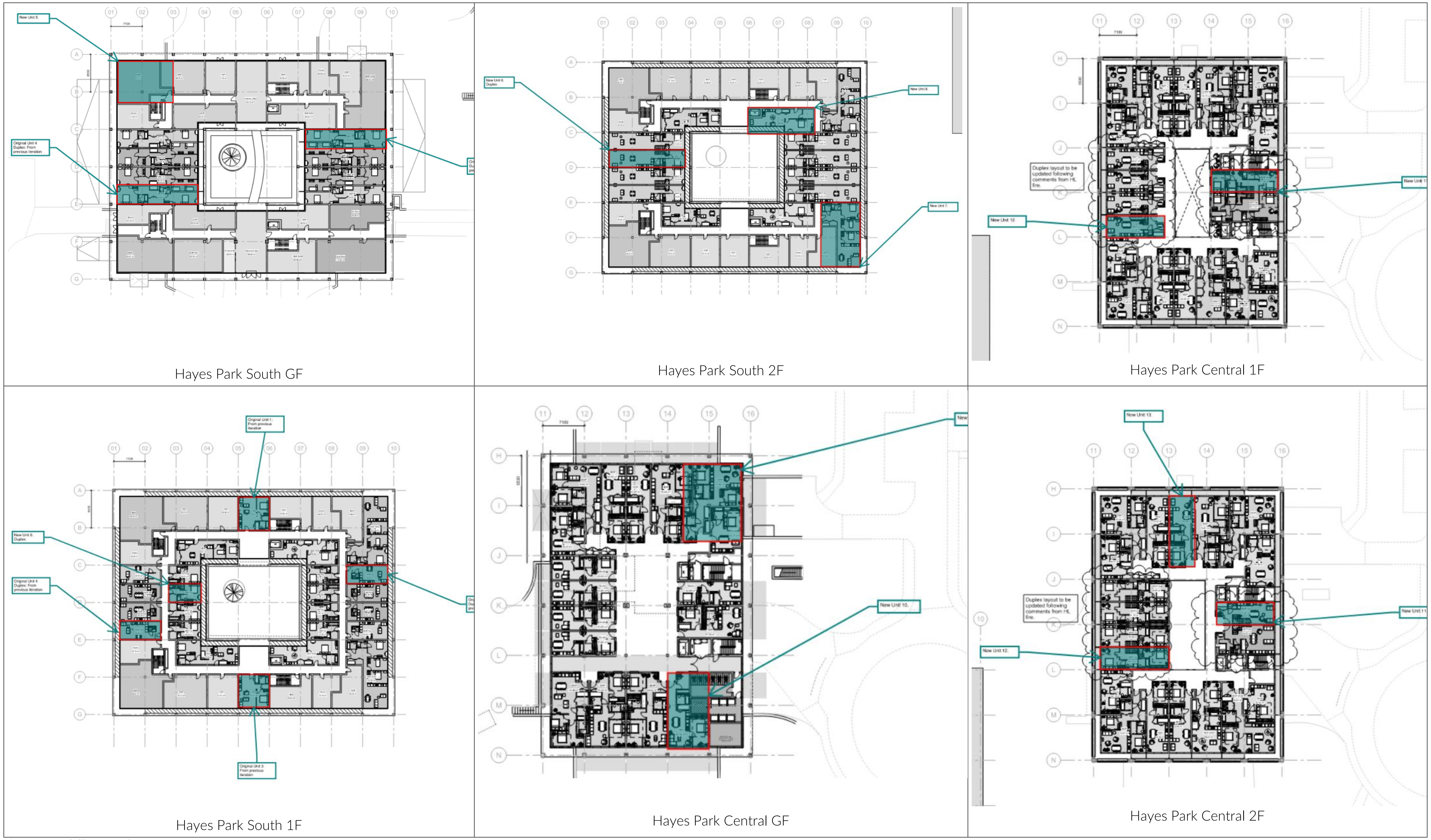


Figure 5: Modelling Sample

3. Thermal Comfort Methodology.

The proposed dwellings have been modelled in a virtual environment with the assigned parameters and then tested against criteria within thermal comfort methodology.

3.1 What is 'risk of overheating'

'Overheating' is a widely used term, but it is not precisely defined or understood. Overheating within a space implies that occupants feel uncomfortably hot and that discomfort is caused by indoor temperatures that are too high for comfort. The risk of overheating happens in a building either through poor design, bad management and/or inadequate services and results in an internal environment that is too warm for comfort.

CIBSE state that most people begin to feel 'warm' at 25°C and 'hot' at 28°C. Contributing factors can be from gains derived from occupancy, lighting, solar and electrical appliances among others.

Thermal comfort is subjective and complex. The diagram below illustrates the control system for ensuring the internal body temperature is kept constant.

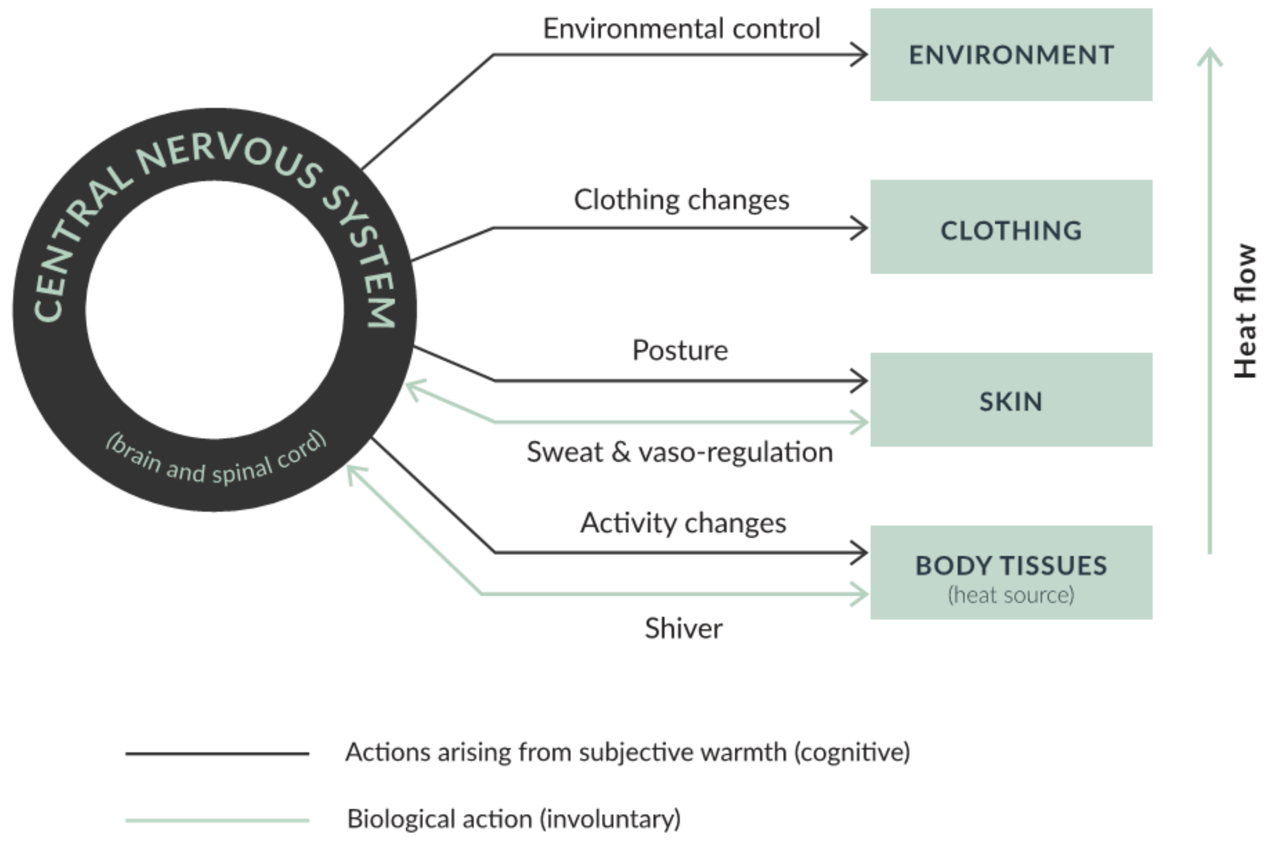


Figure 6 - Diagram to Illustrate Factors in order to maintain Constant Body Temperature

3.2 Assessing the risk of overheating

Thermal comfort methodologies provide guidance and assessment methods to quantify the overheating risk within occupied spaces. The methodologies consist of criteria by which a space can be categorised as 'at a risk of overheating'.

To determine the risk of overheating within the Proposed Development, the methodology set out in the following guidance document has been selected as most appropriate for this assessment: CIBSE TM59.

The following section details the criteria set out in the CIBSE TM59 guidance methodology in which the Proposed Development has been assessed against.

4. Thermal Comfort Calculation Parameters.

The thermal comfort study for the selected sample dwellings has been undertaken with the consideration of the external climate, applied mechanical ventilation, natural ventilation, internal gains and profiles which are detailed in this section.

The thermal comfort calculation has been undertaken using the government approved, dynamic simulation software IES VE 2022. Appendix A provides further details on the software and modelling procedure.

4.1 Architecture.

The geometry used to assess proposed dwellings was determined by drawings received from the project architect, Studio Egret West. The data source is shown in Table 3.

Table 3 – IES Geometry information

Drawing Type	Document Package	Data Type	Date Received
Plans, Sections, Elevations	20230308 – SEW DESIGN FREEZE	PDF/DWG/REVIT	09/03/2023

4.2 Climate Data.

A building's thermal performance means the buildings' response to external environmental conditions. The more dependant a building is on passive features to achieve acceptable internal comfort, the more important the use of accurate external weather information becomes.

Climate data is assigned to the virtual environment of the dynamic model to simulate external weather conditions that are likely to occur. Thermal comfort calculations require the simulation to be tested against DSY climate data.

CIBSE weather files are available for 14 locations in the United Kingdom: Belfast, Birmingham, Cardiff, Edinburgh, Glasgow, Leeds, London, Manchester, Newcastle, Norwich, Nottingham, Plymouth, Southampton and Swindon.

DSY Climate File Variations.

The variations between each DSY file are summarised below:

- DSY 1: moderately warm summer
- DSY 2: short, intense warm spell
- DSY 3: long, less intense warm spell

The DSY files have been developed using a combination of emissions scenarios and timelines, based on the UKCIP09 climate projections:

- 2020s (2010 - 2039) - High emissions scenario
- 2050s (2040 - 2069) - High and medium emissions scenarios
- 2080s (2070 - 2099) - High, medium, and low emissions scenarios

For each timeline/scenario probabilistic data is assigned covering the 10th, 50th, and 90th percentile probabilities of the temperatures being realised.

Climate File Applied.

The CIBSE London Weather Centre DSY climate file has been selected as the scheme is within the London city boundary. The following variant of this DSY has been selected for this thermal comfort assessment in accordance with guidance methodology: DSY 1: 2020, high emissions scenario (50th percentile).

The DSY 1 weather file is recommended as a minimum requirement for assessing thermal comfort, as stated within CIBSE TM59.

4.3 Fabric Parameters.

The fabric performance of the proposed dwellings within the proposed development are listed below and used within our thermal comfort assessment. The LETI Constrained retrofit values are targeted in lieu of bespoke project information.

Table 4 - Fabric parameters

Air Permeability ($m^3/h.m^2$ at (50Pa))	3.00
External Wall U-value (W/m²K)	0.32
Roof U-value (W/m²K)	0.22
Floor U-value (W/m²K)	0.80
Glazing U-value (including frame, W/m²K)	1.00 (Based on Schuco Quotation)
Glazing g-value	40%

There is an anticipation based on initial architectural details that post planning during the design development stage that these proposed U-Values for Wall/Roof & Floor will be improved upon.

4.4 Internal Gains.

The internal gains within the assessed occupied spaces of the proposed residential development are listed below for occupancy (Table 5), lighting (Table 6) and small power gains. Additionally, 1.4kWh/day for domestic hot water storage cylinder located in the service cupboards of each apartment is considered.

Occupancy Gains

The occupancy gain inputs are listed below

Table 5 - Number of occupants per space type

Space Type	Maximum Number of Occupants*
Single Bedroom	1
Double Bedroom	2
1 Bed Apartment: Kitchen/Living	1
2 Bed Apartment: Kitchen/Living	2
3 Bed Apartment: Kitchen/Living	3

* Gains associated per occupant (Source: CIBSE TM59 table 2):

- Sensible gain: 75 W/person
- Latent gain: 55 W/person
- **Total gain: 130 W/person**

Lighting and Equipment Gains

The lighting and equipment gain inputs are listed below for each space type.

Table 6 - Lighting and equipment gains per space type. Source: CIBSE TM59 table 2.

Space Type	Lighting Gain	Lighting radiant fraction	Equipment Max. Sensible Gain
Bedrooms	2 W/m^2	0.45	80 W
Kitchen/Living & Studios	2 W/m^2	0.45	450 W

Internal Gain Profiles

The occupancy, lighting and equipment profiles associated with the internal gains for each day are outlined in Appendix B. These are specified from CIBSE TM59 guidance methodology.

4.5 Ventilation Strategy

Thermal comfort is subjective, and the perception of overheating can be reduced by air movement even if the air is warm. Our bodies sweat as an automatic physiological reaction when it's hot so when air passes across skin, such as a breeze through an open window, this increases the body's heat loss through evaporation and results in a sense of feeling cooler.

Natural Ventilation

Within all assessed dwellings, the design has incorporated manually openable windows to help occupants feel more comfortable in warmer weather.

It should be noted that this run of TM59 assessment has taken into account the effect of environmental constraints, such as noise or air quality, which recommend that windows can be relied on for natural ventilation during specific hours of the day. Although for security reasons, some windows on the ground floor bedrooms facing onto the landscape are considered to be shut during the assessment, bar casements above 2m.

Opening Profile

The test sample windows and fully glazed doors stated to be openable by modelling assumptions not by the architect's drawings, as demonstrated in Figure 5, are specified to be open in line with CIBSE TM59 guidance, which states that:

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.*

However, due to security risks for the ground floor apartments, CIBSE TM59 states:

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.*
>
> *ii. At night, windows, patio doors and balcony doors should be modelled as closed*

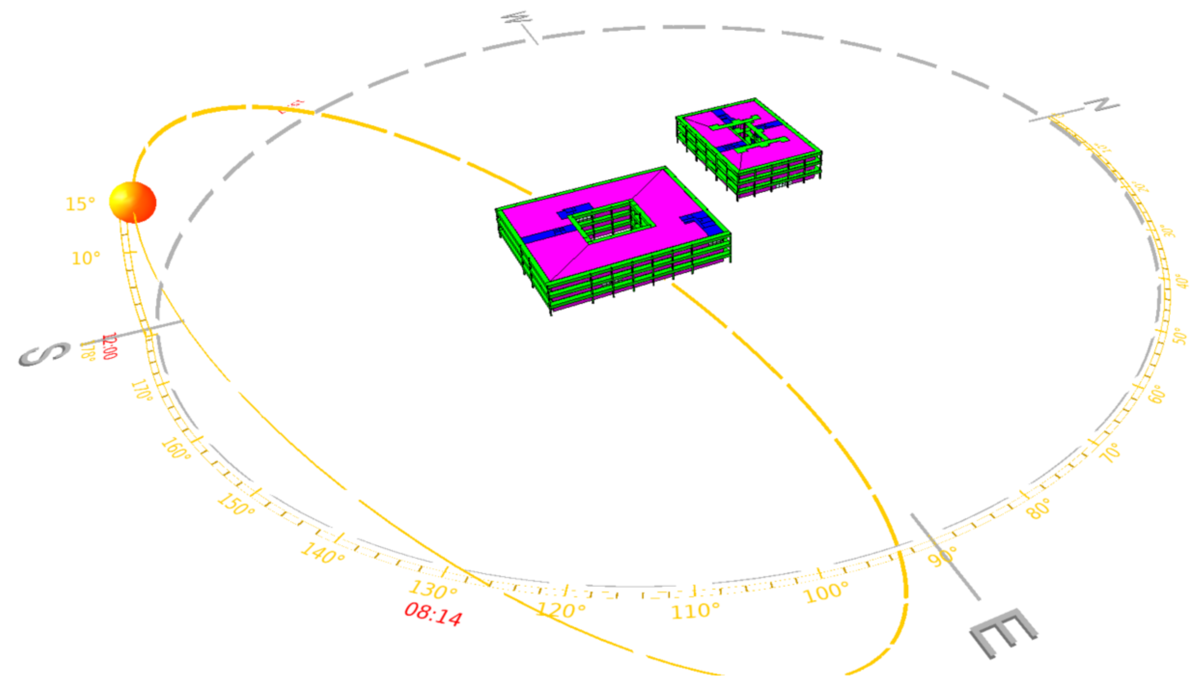


Figure 7: IESVE Model Orientation

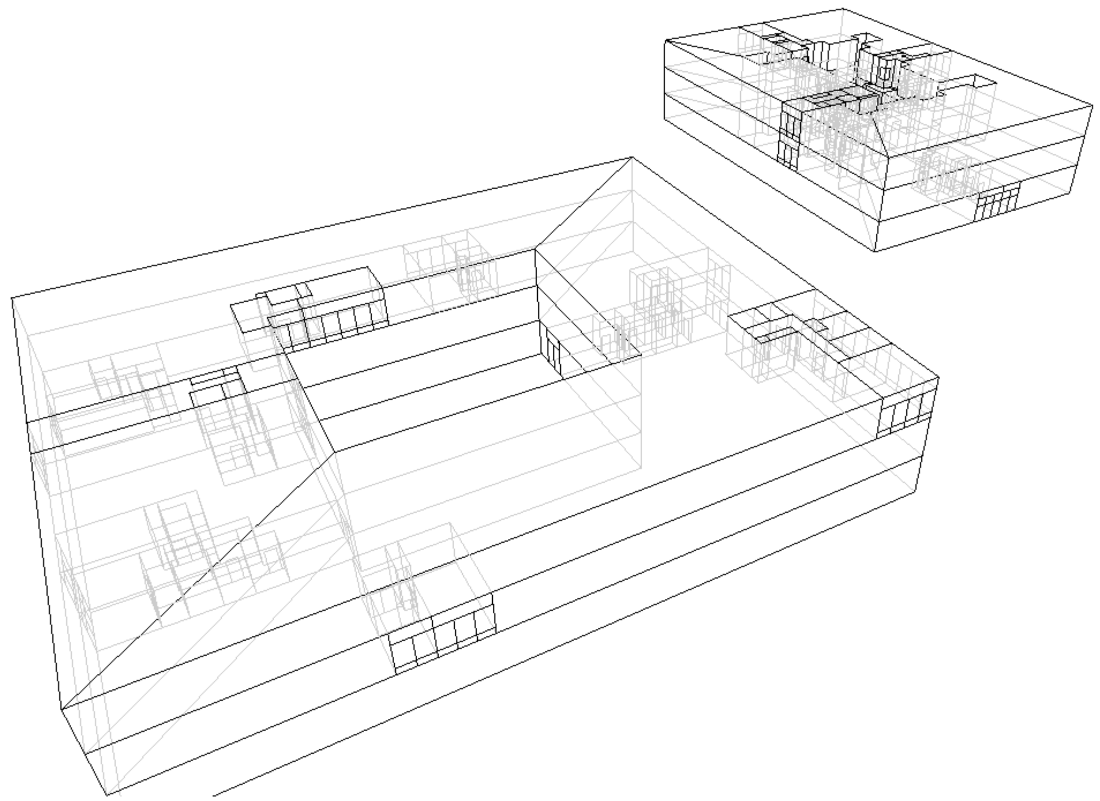


Figure 8: IESVE Model Apartment Sample

Windows Opening Assumptions

Below are listed the assumptions made for window openings across Hayes Park South & Central within the IESVE TM59 Modelling completed with a view to security with some supporting images to aid the descritptions.

NB: NRG acoustic and air quality surveys facilitate night time opening from a noise and pollution standpoint.

Under the 2 different natural ventilation scenarios the following assumptions have been simulated with regard to openable windows. The first scenario (i.e. baseline) assumes the use of windows for natural ventilation without any passive measures. This run is important to understand the impact of solar gains and internal gains on the habitable spaces internal air temperature. Hence the overall response to the TM59 daytime and night-time criteria. The second scenario includes the affect of internal blinds.

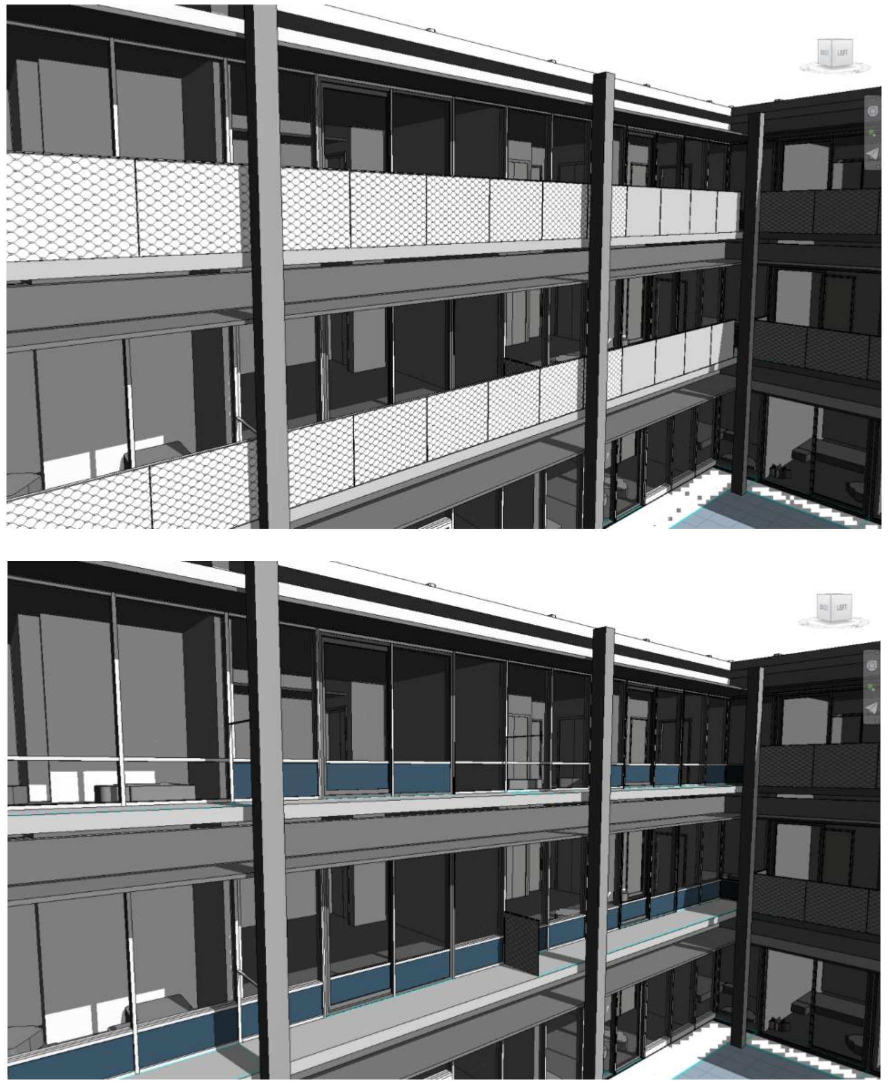
The general principle for first Floor and above enables the living room sliding doors to be open in daytime only, and bedrooms during daytime and night-time.

For windows at ground or upper floors fronting onto the internal courtyard (at ground floor) or communal access gantries (upper floors) we have concluded these could remain openable during the night time period due to secure access required to enter these communal areas, who will only be accessed by resident and their guests. HPC, the living room sliding door can be open at night, with a restrictor or locked from inside.

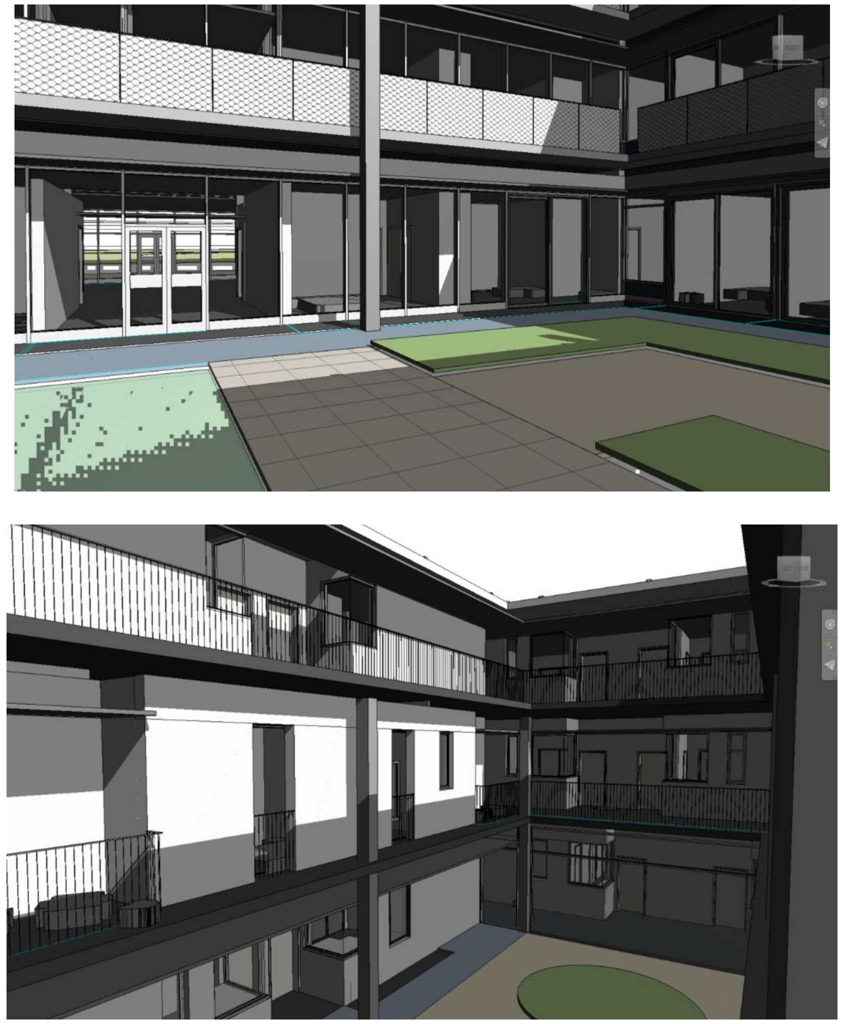
Small windows onto the communal gantries that are openable we have assumed side hung casements.

The ground floor fronting onto the landscape areas we have enabled the living room sliding doors to open day time only. For bedrooms the sliding doors can be open during the day only and then the top sections of bedrooms have been assumed openable at night-time. Upper windows above 2m of façade fronting onto external landscaping assumed open at night allowable under CIBSE TM59, we have assumed bottom hung casements.

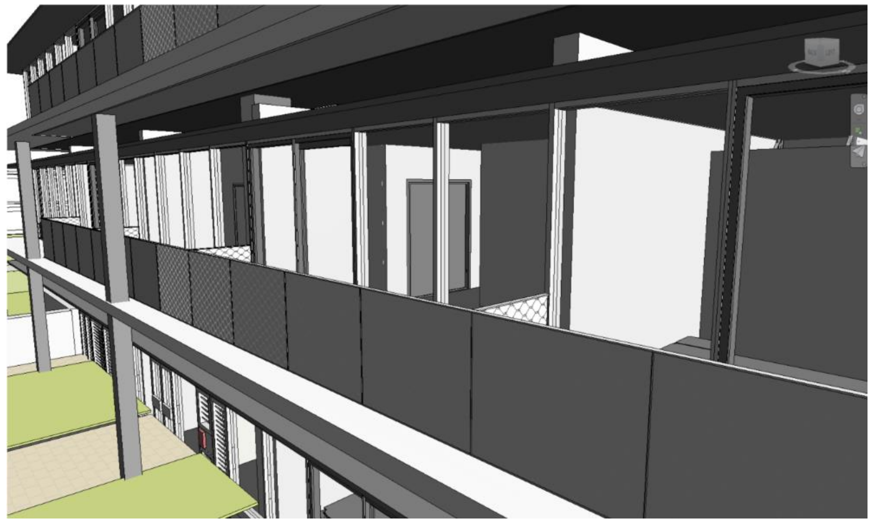
REVIT Model: Hayes Park South upper floors of internal courtyard private balconies with sliding doors. Upper image with balustrading shown, and lower image with balustrades hidden to show window casements.

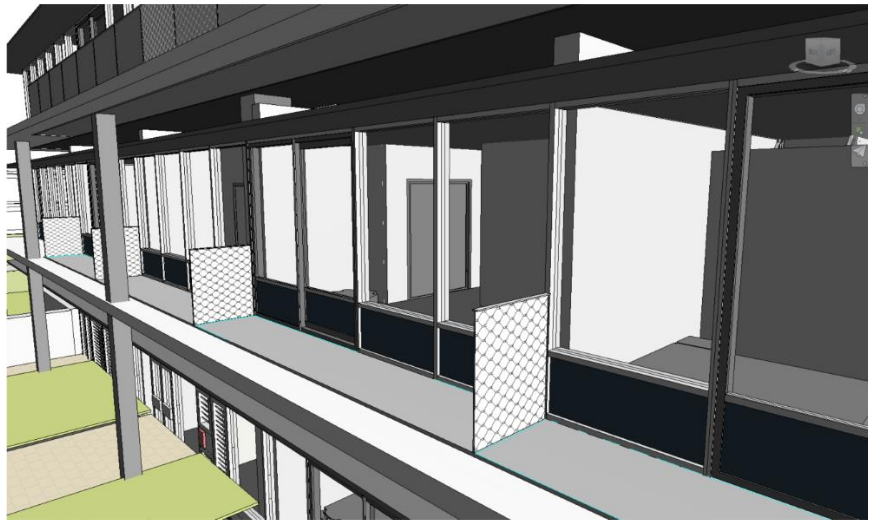


REVIT Model: Hayes Park South ground floor internal courtyard with sliding doors (Top Image) and Hayes Park Central internal courtyard with upper floor gantry and ground floor access, with openable windows/patio doors (Lower Image).

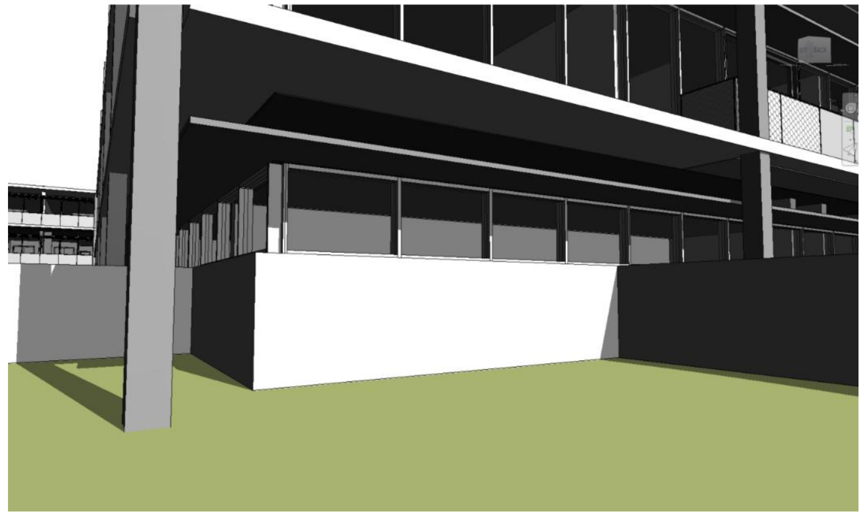


REVIT Model: Hayes Park South upper floors of landscape facing private balconies with sliding doors. Upper image with balustrading shown, and lower image with balustrades hidden to show window casements.





REVIT Model: Hayes Park South and Hayes Park Central ground floor landscape facing elevation with sliding doors and high level casementsto bedrooms.



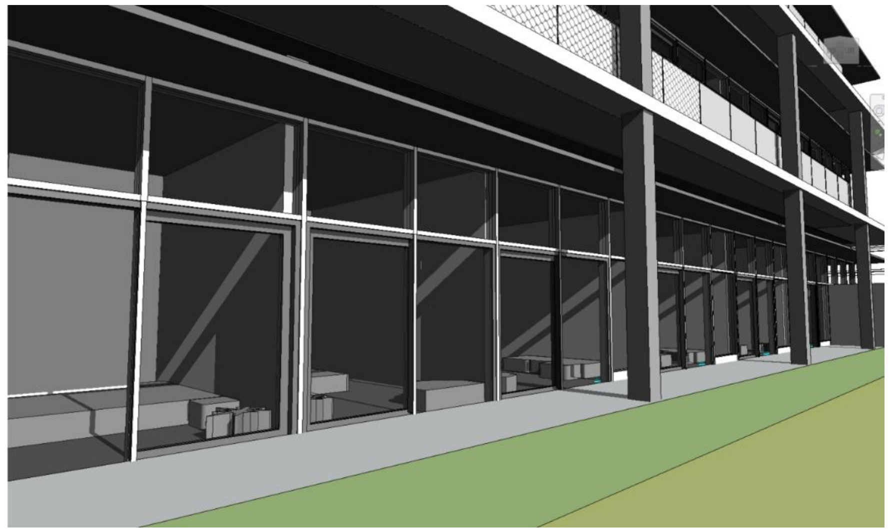


Figure 8 – REVIT Model Images

Table 7 – IESVE Model Opening Summary

Hayes Park Central	Bedroom			Living Room		
	Sliding/Patio Door	Top Casement	Top Hung	Sliding/Patio Door	Top Casement	Top Hung
Level 00						
Day (Landscape Facing)	Y	Y	N	Y	N	N
Day (Courtyard Facing)	N	N	Y	N	N	Y
Night (Landscape Facing)	N	Y	N	N	N	N
Night (Courtyard Facing)	N	N	Y	N	N	Y
Level 01/02						
Day	Y	N/A	Y	Y	N/A	N/A
Night	Y		Y	Y		

Hayes Park South	Bedroom			Living Room		
	Sliding Door	Top Casement	Top Hung	Sliding Door	Top Casement	Top Hung
Level 00						
Day (Landscape Facing)	Y	Y	N/A	Y	N	N/A
Day (Courtyard Facing)	Y	N		Y	N	
Night (Landscape Facing)	N	Y		N	N	
Night (Courtyard Facing)	Y	N		N	N	
Level 01/02						
Day	Y	N/A	N/A	Y	N/A	N/A
Night	Y			Y		

Heriage Constraints
The apartments chosen for this study represent a significant sample of typical dwellings across the Proposed Development. Due to Heritage and Listing constraints mitigation of the overheating risk has been limited by the following factors:

- Listed/Fixed glazing ratio

Table 13: Glazing ratios - Example from Hayes Park South

Elevation	Glazed area m^2	Glazed area %
North	431	55%
East	557	57%
South	460	59%
West	549	56%
Overall	1,997	56%

- Large overhang without possibility for additional external shading
- Glazing modules restrict opening sizes
- Security on the ground floor prevents overnight significant window opening

Mechanical Ventilation
In the Mechanical Ventilation scenario, supply air will be provided to the dwellings via a mechanical ventilation system in order to boost the amount of fresh air the apartments receive to minimise the risk of excessive internal temperatures during the summer months. With this, the supply air has been set to run continuously, the air temperature set at a supply temperature of 16^0C, with the assumed flow rates listed below.

Table 8 – Venilation Summary

	ACH				
	0	0.5	1	2	2
00_2B4P_Unit01-South_Bedroom 1	6	10	20	30	40
00_2B4P_Unit01-South_Bedroom 2	6	11	21	32	42
00_2B4P_Unit02-North_Bedroom 1	6	11	21	32	42
00_2B4P_Unit02-North_Bedroom 2	6	10	20	30	40
01_1B2P_Unit03-West_Bedroom	4	7	13	20	26
01_1B2P_Unit04-East_Bedroom	4	6	13	19	25
01_1B2P_Unit04-East_Living Kitchen	10	17	33	49	68
01_1B2P_Unit03-West_Living Kitchen	10	16	34	51	66
	ACH				
01_2B4P_Unit01-South_Living Kitchen	10	17	34	50	67
01_2B4P_Unit02-North_Living Kitchen	10	17	33	50	67
	l/s				
1-Bed	14	23	46	69	93
2-Bed	29	49	97	146	195
	m^3/hr				
1-Bed	50	83	167	250	333
2-Bed	105	175	350	526	702

An iteration without tempering was run during the early stage analysis and required in excess to 2ACH to get close to compliance with ambient air (below room tempartue) and this was not physically achievable and a maximum limit of 1ACH was set on the MVHR Unit selection.

- 0.5ACH is reflective of Part F Building Regulations mechanical ventilation rates.
- 2.0ACH would appear impractical from a physical perspective looking at the potential MVHR sizing in l/s or m^3/hr.

An air change rate of 1.0 ACH would be a reasonably practical limit.

5. CIBSE TM59 Results.

The results for the CIBSE TM59 assessment are shown below for each occupied space within the sample apartments assessed.

CIBSE TM59 considers the risk of overheating by assessing occupied spaces against two criteria for natural ventilation and one for mechanical ventilation as detailed in the Table 9 and 10 below.

Table 9 - CIBSE TM59 Natural Ventilation criteria

Criterion (a)	<u>For Living Rooms, Kitchens, and Bedrooms:</u> Criteria sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature. To satisfy Criterion a, the following must not occur for more than **3%** of occupied hours: The difference between the actual operative temperature, and the maximum acceptable temperature* is equal to or greater than 1 degree during May to September.
Criterion (b)	<u>For Bedrooms Only:</u> Criteria states that peak bedroom temperatures should not exceed an absolute threshold of 26 °C. To satisfy Criterion b, the operative temperature in the bedrooms from 10 pm to 7 am shall not exceed 26 °C for more than 1% of annual hours.

* Maximum acceptable temperature: CIBSE sets a maximum acceptable temperature of 3°C above the comfort temperature (for new buildings).

Table 10- CIBSE TM59 Mechanical Ventilation criteria

Fixed Comfort Criterion	<u>For Living Rooms, Kitchens and Bedrooms:</u> Criteria sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature. Fixed comfort criterion All living rooms, kitchens and bedrooms must not exceed the maximum operative temperature threshold of 26 degrees for 3% of the total annual occupied hours.

Communal Corridor Overheating Check
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.

5.1 Early Stage Modelling

A sample of four dwellings were modelled early during the design process, under a night tme closed window condition. At this stage, night time opening was pending acoustic assessment results.

The following scenarios were modelled:

- Natural ventilation:
- Mechanical ventilation:

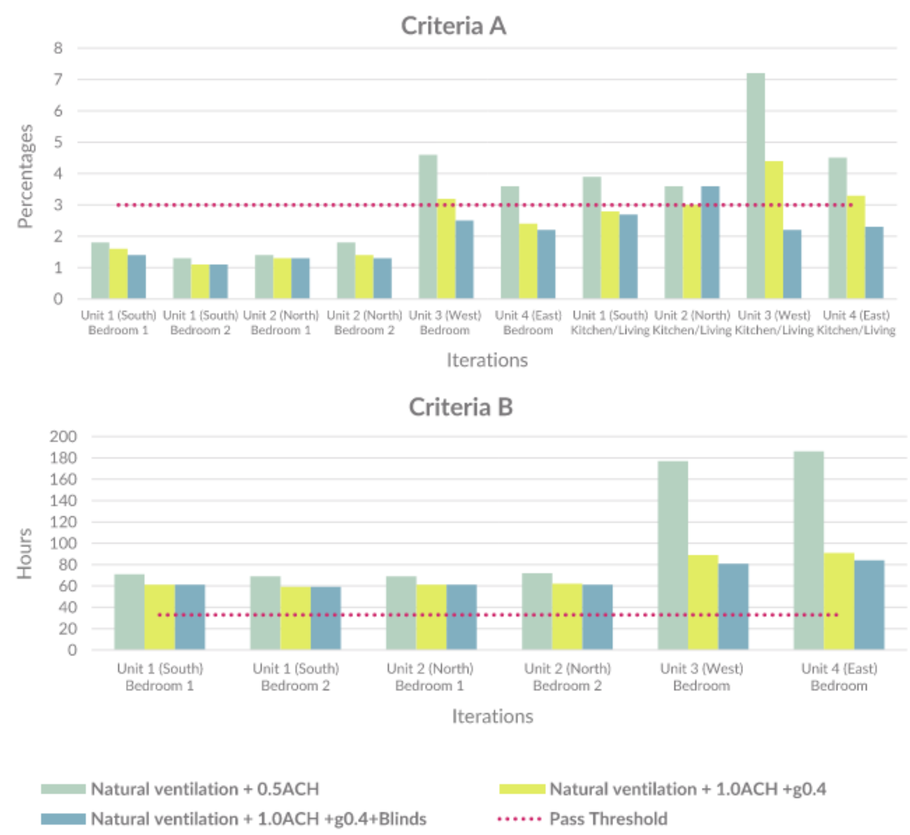


Figure 9: Previous Natural Ventilation Modelling Results

Under the natural ventilation scenario, with MVHR unit running at boost 1ACH of ambient air, and a glazing g-Value 0.4 complete with internal blinds, almost achieved Criteria A compliance, however nighttime Criterion B was unachievable due to windows being closed shut.

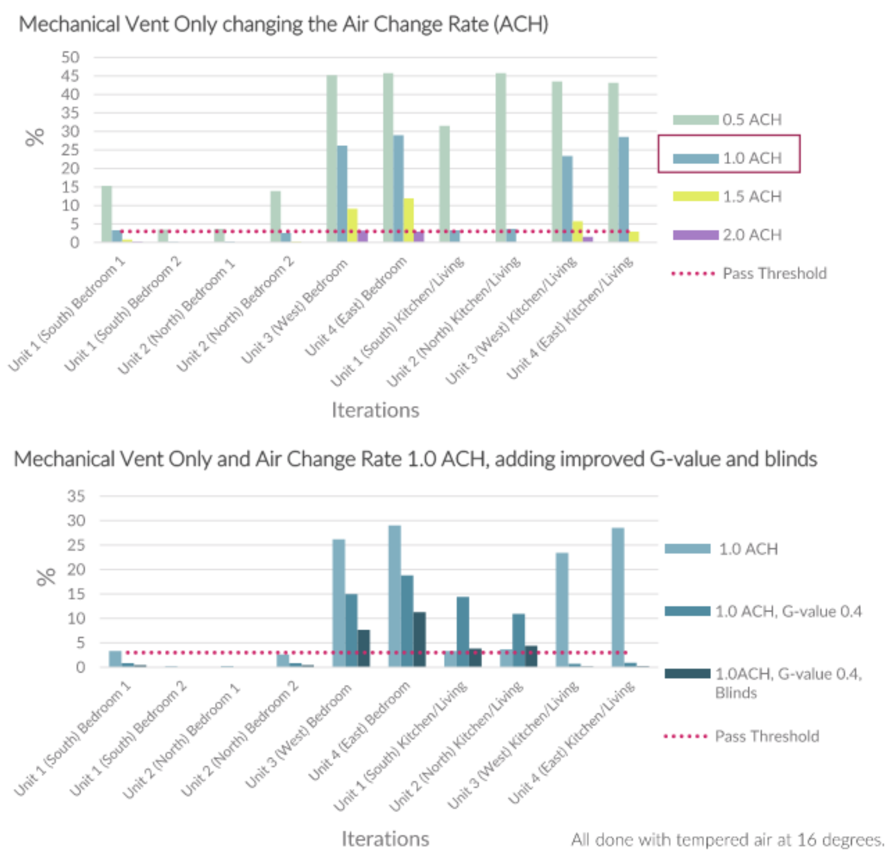


Figure 10: Previous Mechanical Ventilation Modelling Results

Under the mechanical ventilation scenario,the MVHR unit running at boost 1ACH tempered to 16^{0}C; was completed with window glazing g-Value 0.4 complete with internal blinds, almost achieved Fixed Criteria compliance, however not in all spaces especial those on the east and west elevations.

Therefore Provision for Active Cooling was been made which will also future proof the development as the results worsen under DSY2 , DSY 3 and future weather files.

Previously we had completed 10 iterations of 4 apartments at the early stage modelling of 4 apartments; this has enabled an updated study to be refined to 4 iterations of 13 apartments:

Four different scenarios have been run for the Proposed Development and both sets of results will be presented within this report.

1. Natural Ventilation with Ambient MVHR at 1ACH +g-Value reduced to 0.4
2. Natural Ventilation with Ambient MVHR at 1ACH +g-Value reduced to 0.4 + Internal Blinds
3. Tempered Mech Ventilation at 16^{0}C MVHR at 1ACH +g-Value reduced to 0.4
4. Tempered Mech Ventilation at 16^{0}C MVHR at 1ACH +g-Value reduced to 0.4+ Internal Blinds

5.2 Internal Blinds

We understand use of internal blinds is not supported in general by the GLA latest 2022 guidance, as this aligns with Part O, however due to the heritage constraints and refurbishment nature of the proposed development Part O is not applicable, therefore the impact of this option was appraised and tested.

Note: The modelling iterations that include blinds haven't incorporated a reduction in natural ventilation due to obstruction.

5.3 Current Modelling Results

The results for the overheating assessment are shown below for each occupied space within the sample apartments assessed.

Table 9 – Natural Ventilation CIBSE TM59 results

Hayes Park Central & South	TM59 Criterion A Pass	TM59 Criterion A Fail	%
36 Zones – No blinds	32	4	88%
36 Zones – Blinds	32	4	88%

Hayes Park Central & South	TM59 Criterion B Pass	TM59 Criterion B Fail	%
23 Zones – No blinds	23	0	100%
23 Zones – Blinds	23	0	100%

Table 10 – Mechanical Ventilation CIBSE TM59 results

Hayes Park Central & South	TM59 Fixed Criterion Pass	TM59 Fixed Criterion Fail	%
36 Zones – No blinds	10	26	27%
36 Zones – Blinds	17	19	47%

Communal Corridor Overheating Check

Communal corridors were included in the analysis inline with TM59 and GLA recommendations, only asmall sample has been included for corridors as Hayes Park Central has mainly open gantry corridors, so only Hayes Park South, two corridor element has been modelled as community heating pipework runs through them, although ambient loop heat loss is very small.

Table 11 –CIBSE TM59 results for communal corridors

Communal Corridor Check	% Annual hours above 28°C	Result
HPS Corridor 1 – Nat Vent (No Blinds)	2.4	Pass
HPC Corridor 2 – Nat Vent (No Blinds)	0.6	Pass

Table 12 –CIBSE pipework heat loss estimate.

		Calculated pipe heat loss												
Corridor 1	Length of pipe within corridor [m]	Flow temp [°C]	Di (pipe inside radius) [mm]	Do (pipe outside radius) [mm]	Insulation thickness (radius)	Q (heat loss) [W/m]	Q (heat loss) [W]	Return temp [°C]	Di (pipe inside radius) [mm]	Do (pipe outside radius) [mm]	Q (heat loss) [W/m]	Q (heat loss) [W]	Total [W]	Total [W/m2] - IESVE input
Pipe 1	20	30	50	75	25	3.9	77.4	25	50	75	1.9	38.7	116.2	
Pipe 2	0	30	50	75	25	3.9	0.0	25	50	75	1.9	0.0	0.0	
Pipe 3	0	30	50	75	25	3.9	0.0	25	50	75	1.9	0.0	0.0	
													116.2	**3.9**

6. Conclusion.

The proposed tested dwellings within Hayes Park South & Central buildings were tested under four different scenarios using a cumulative cooling hierarchy. Not all dwellings/zones assessed within this study have been shown to satisfy the CIBSE TM59 thermal comfort criteria using a mixed-mode ventilation strategy under the DSY1 climate scenario with Living Spaces only achieving an 88% pass.

The results of overheating modelling have improved during the design process due to the the allowable window opening overnight. Certain assumptions have been made interms of window operability and security. Ground floor, high level openable casements are being proposed during the night time aiding compliance with criterion B. Under Criteria A problem daytime areas (even allowing for blinds) still exist. Typically these are west elevations and/or corner plots.

The mechanical ventilation tempered air scenarios yield worse results due to the practical limitations of the air flow possible through the MVHR unit.The following areas within the sample were shown to be failing the criteria assessed.

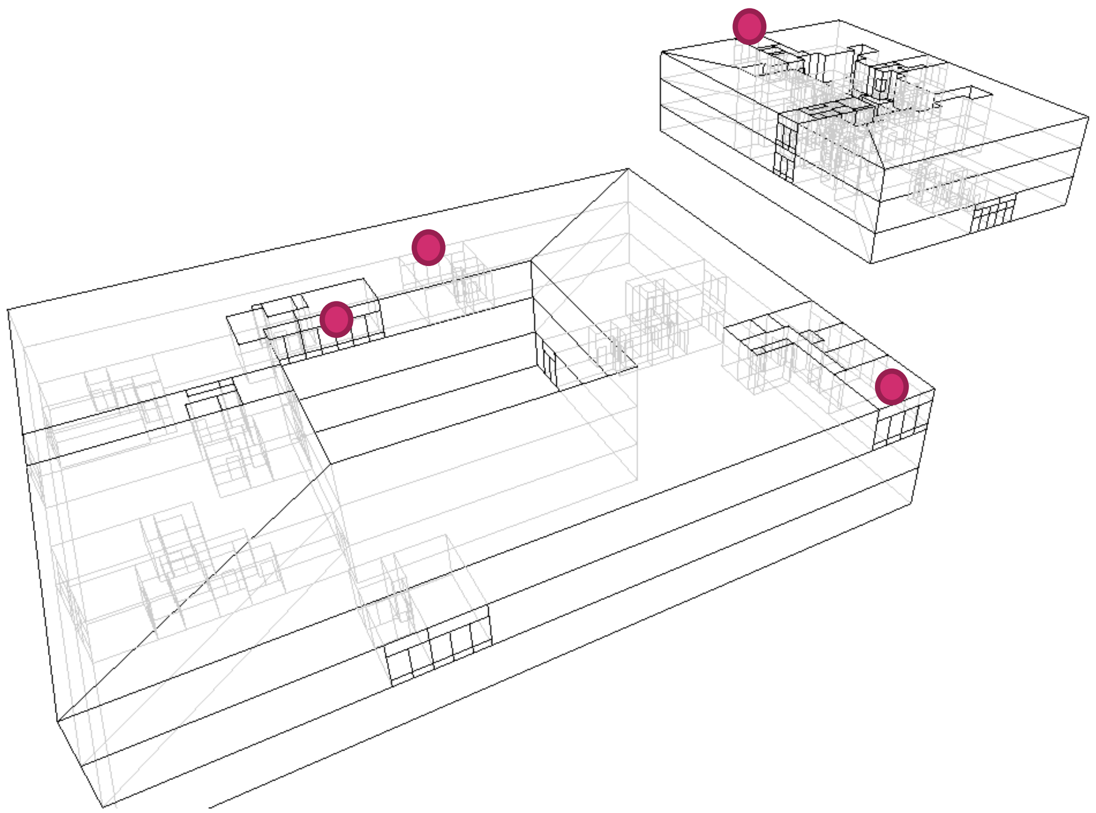


Figure 11: Zones of failure under DSY 1

Overall, natural ventilation via openable windows was a successful measure to eliminate the risk of overheating in majority of the tested spaces, except some spaces on the east and west elevations, under Criteria A. This failure rate has been minimised through the use of ambient temperature MVHR air flow, without which the results would be significantly worse. In addition to natural ventilation, a combination of improving glazing g-values and internal blinds where modelled.

The blinds had a beneficial impact but had limited impact on affecting the problematic spaces that failed to comply. Once the acoustic and air quality reports ensured windows could be open at night this enabled complete Criteria B compliance.

The mechanical tempered air scenarios failed to provide a compliant stratgey due the restriction in mechanical ventilation due design practicalities to 1ACH.

Weather files DSY2 & DSY3 required by the GLA, demonstrated major failures across the sample so provision for active cooling is a deemed to beneficial for future proofing the development given the heritage constraints.

- Under DSY 1, there were 4 spaces out of 36 which failed Criterion A, and 100% Criterion B compliance.
- Under DSY 2, there were 12 spaces out of 36 which failed Criterion A, and 87% Criterion B compliance.
- Under DSY 3, there were 30 spaces out of 36 which failed Criterion A, and 23% Criterion B compliance.

Detailed Graphical representation of the result for the four modelled scenarios and the natural ventiation case under different DSY weather conditions are included for comparison within the appendices.

The conclusion of this report is to provide active cooling within the proposed development based on the result from DSY 1.

Due to the bespoke nature of the development, the sample of 13 units, may not capture all openings and possible variations across the site, that at a later date subject to security and heritage feedback may not be openable.

- HPS landscape, all bedrooms will have a high level casement. Some bedrooms will have sliding doors too by not all,
- HPS courtyard may need to be closed at night as noted in part 2.6 of Part O; subject to review.
- HPS courtyard, no high level casement possible with tall window modulation, cooling may be required to the duplex bedrooms, and the corner flats.
- HPC landscape, all bedrooms will have a high level casement. Some bedrooms will have sliding doors too by not all,

Additionally, the DSY 2 & DSY 3 weather files required by the GLA presented some major failures across the sample so provision for active cooling will therefore future proof the proposed development.

7. Appendix A: Modelling Procedure and Software.

Dynamic simulation models were created to assess the Proposed Developments.

Integrated Environmental Solutions Virtual Environment (IES VE) is a Dynamic Simulations Modelling (DSM) software package which has the capabilities of enabling the user to create a virtual representation of a building. The results presented in this report were calculated using the approved software, IES VE 2022 feature pack 3.

The IES VE model for the Proposed Development was drawn to drawings received from Studio Egret West. The drawings used to create the model are listed within the 'calculation parameters' section of this report.

The images show the IES models created to assess thermal comfort.

7.1 IES Modelling Disclaimer.

The calculations produced by Hoare Lea have been carried out with the information provided by the received drawings, assumptions and based on gains taken from TM59 typical profiles to determine whether the Proposed Development can achieve criteria within the thermal comfort methodologies specified in this report.

It should be noted that the data generated by this work is obtained using computer simulations. These simulations are the best means of predicting the performance of the building at this stage. Full certainty can only be achieved by measuring the performance of the building and associated systems after a period of use.

The actual usage for the building once occupied may vary from the calculated values. These differences will occur due to a number of variable parameters between the modelled building and the actual building. Such differences will include the hours, levels of occupancy, how the building services plant is used and the design criteria with regards to how the rooms are environmentally controlled.

Whilst the simulations have been undertaken in good faith using reasonable skill and care, Hoare Lea can take no responsibility for differences between the computer simulations and the actual performance of the completed building due to the inherent complexity and variability of the physics in a building and its environment.

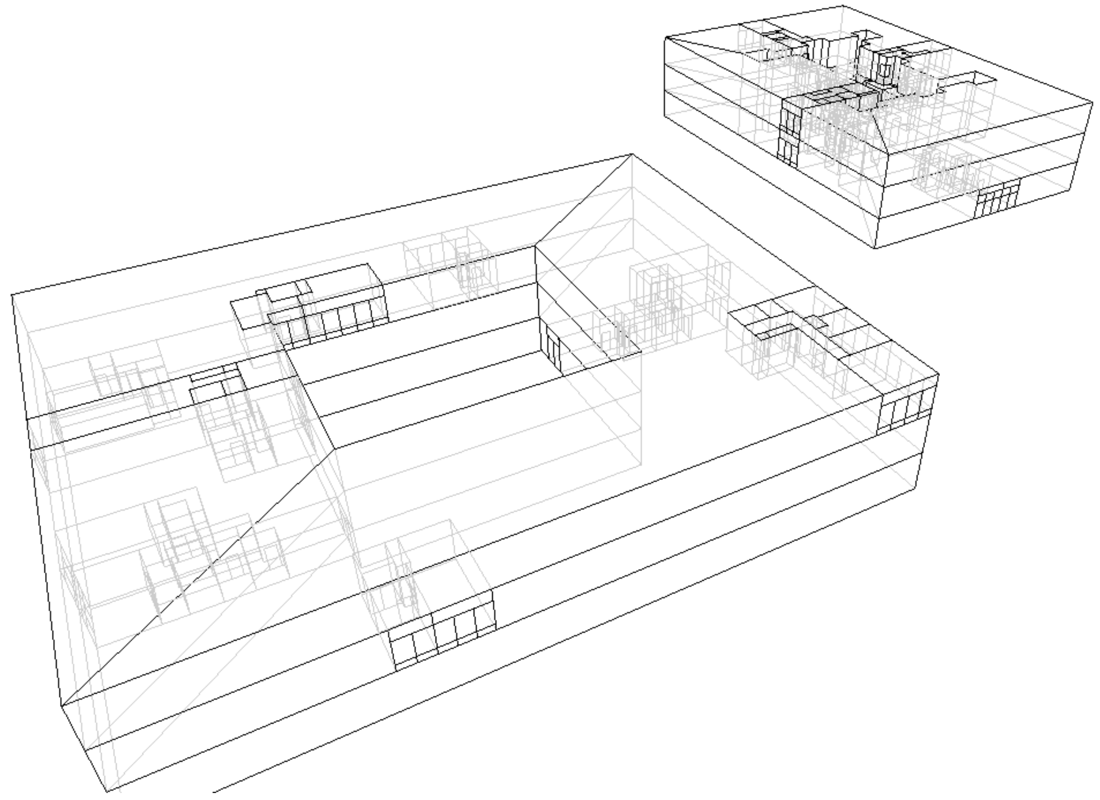


Figure 10 - Images of IES model of the Proposed Development

8. Appendix B: Occupancy Lighting & Equipment Profiles.

The profiles for occupancy, lighting and equipment are shown within this section for each occupied space as stated within CIBSE TM59.

8.1 Lighting Profile

In line with CIBSE TM59, lighting energy is assumed to be proportional to floor area and the load is measured in W/m^2:

- From 6pm to 11pm: 2 W/m^2 lighting gains.

8.2 Occupancy & Equipment Profiles

The occupancy and equipment gains, as prescribed by CIBSE TM59, are summarised below:

1-bedroom apartment: living room/kitchen	1 person from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
2-bedroom apartment: living room/kitchen	2 people from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
3-bedroom apartment: living room/kitchen	3 people from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
Double bedroom	2 people at 70% gains from 11 pm to 8 am 2 people at full gains from 8 am to 9 am and from 10 pm to 11 pm 1 person at full gain in the bedroom from 9 am to 10 pm	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during the sleeping hours

Figure 11 – Standard Internal Gains

9. Appendix C: TM59 DSY 1 Results.

9.1 Natural Ventilation Criteria A

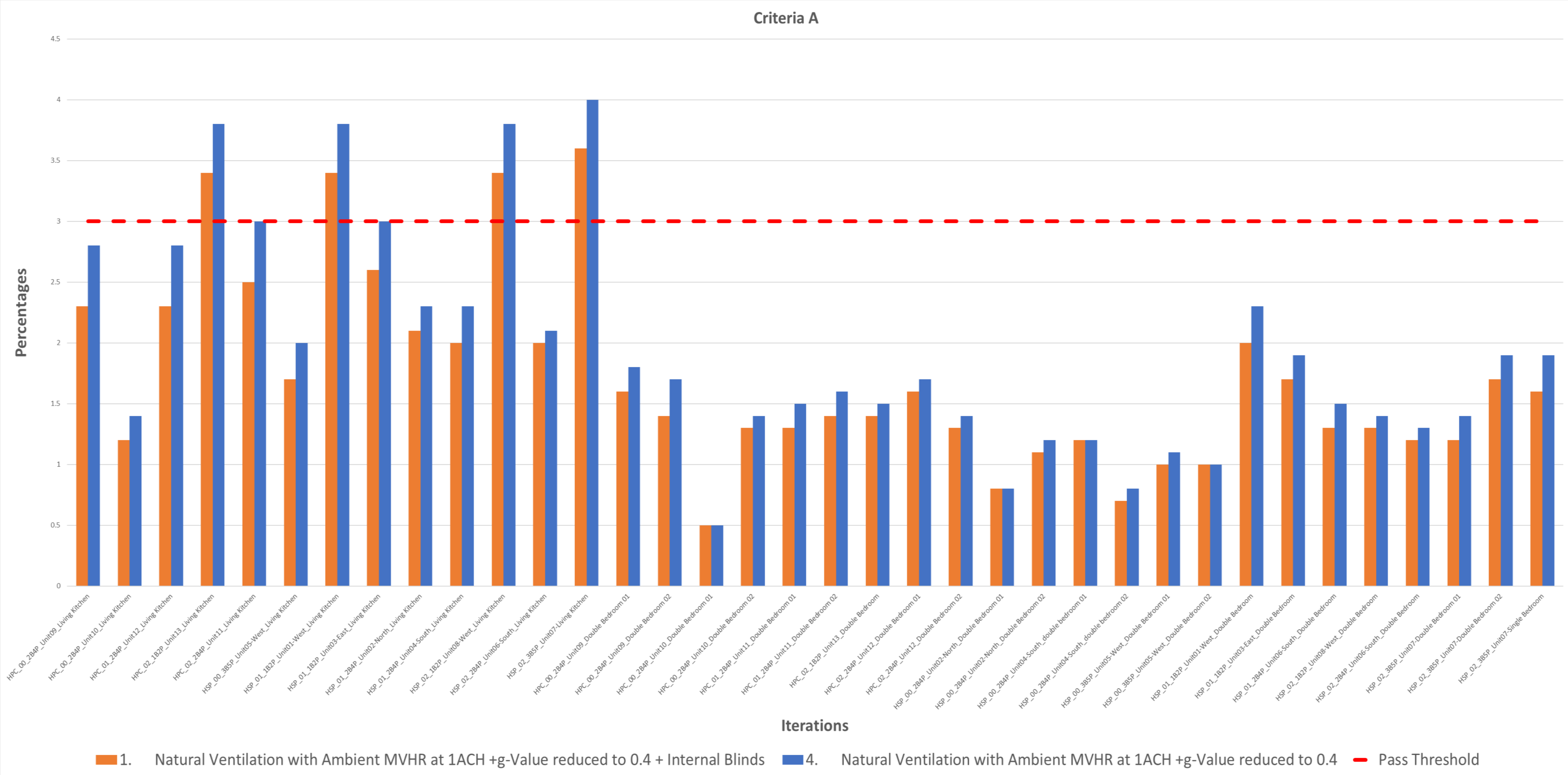


Figure 12 – Natural Ventilation Criteria A

9.2 Natural Ventilation Criteria B

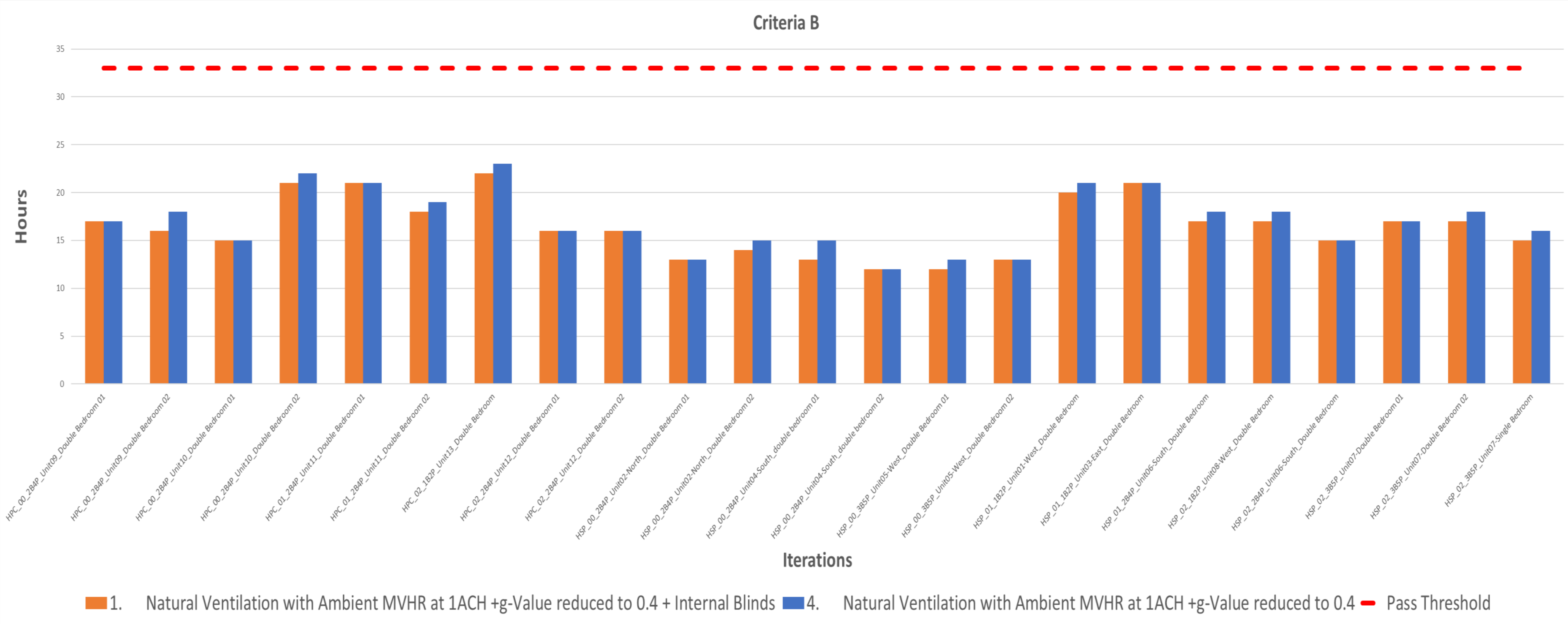


Figure 13 – Natural Ventilation Criteria B

9.3 Tempered Mechanical Ventilation Living Spaces

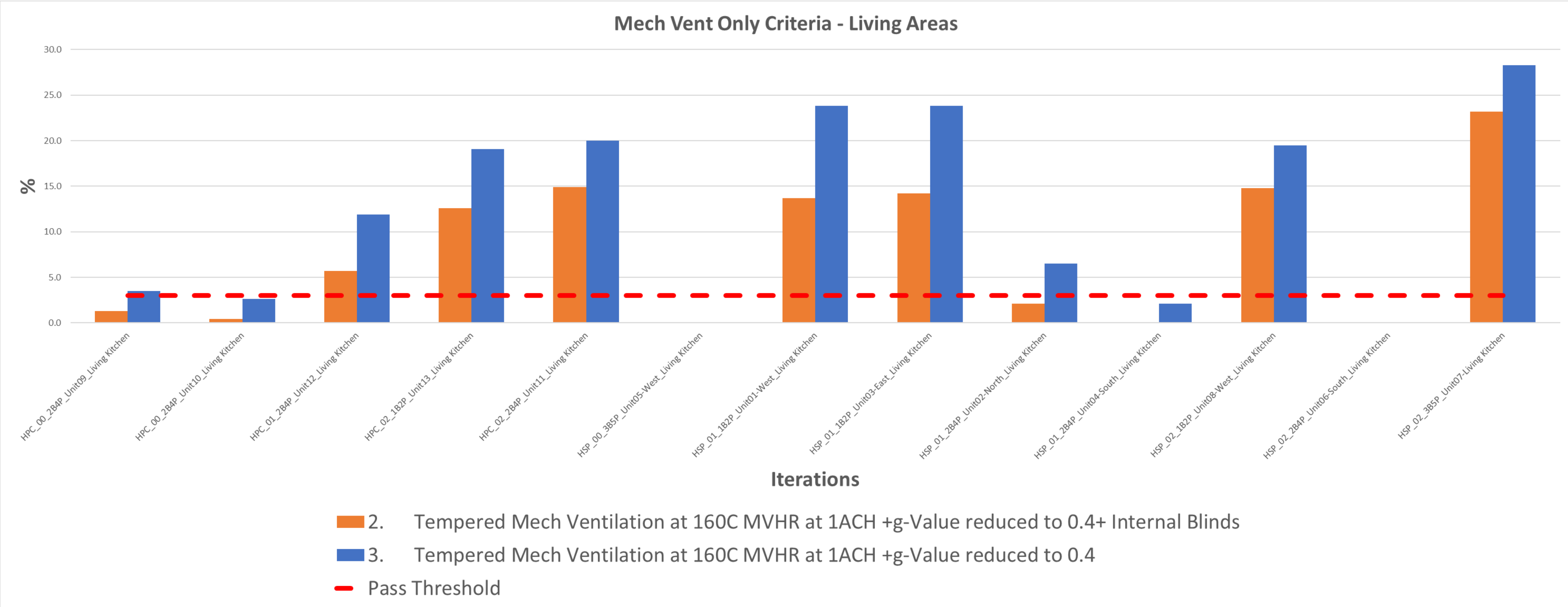


Figure 14a: Mechanical Ventilation Criteria

9.4 Tempered Mechanical Ventilation Bedroom Spaces

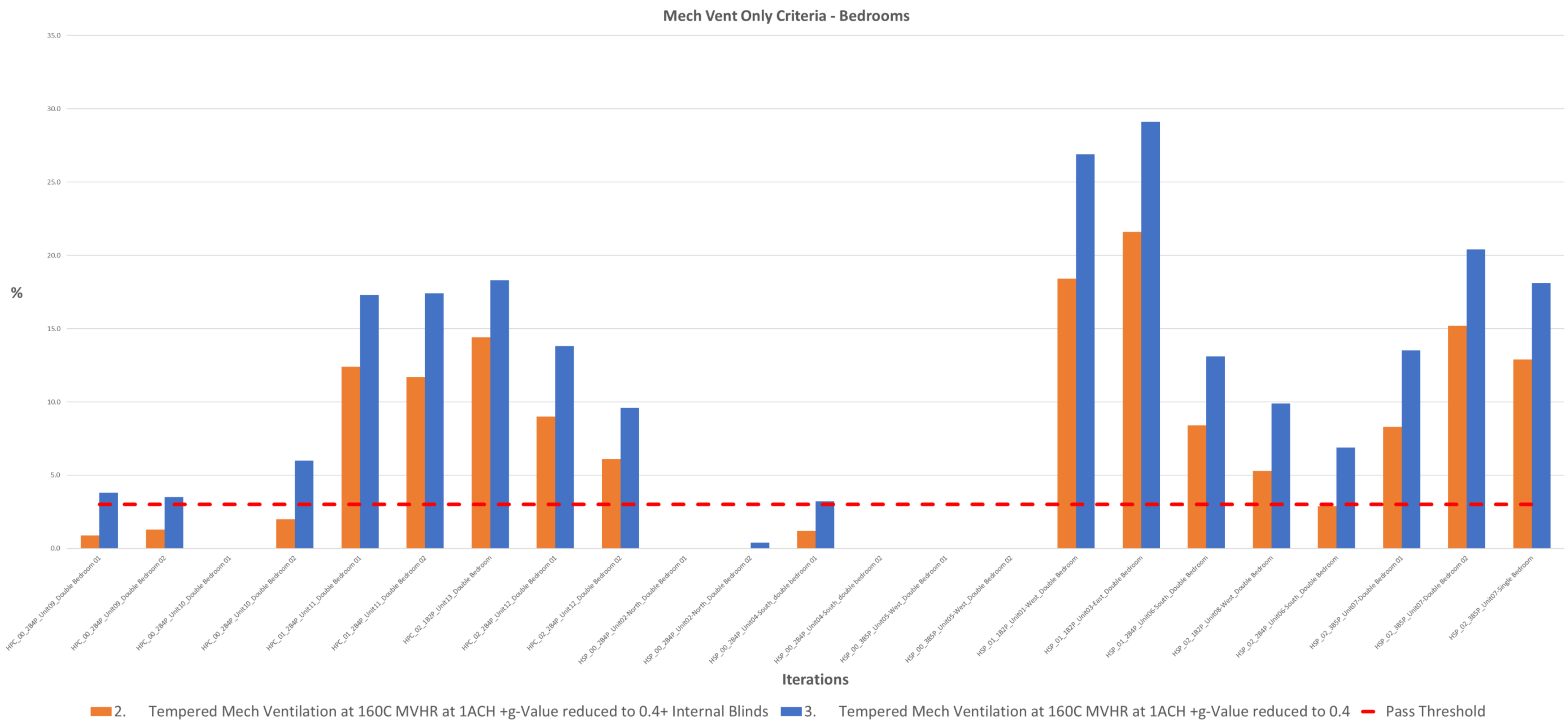


Figure 14b: Mechanical Ventilation Criteria

10. Appendix D: TM59 DSY1,2&3 Results Comparison.

10.1 Criteria A

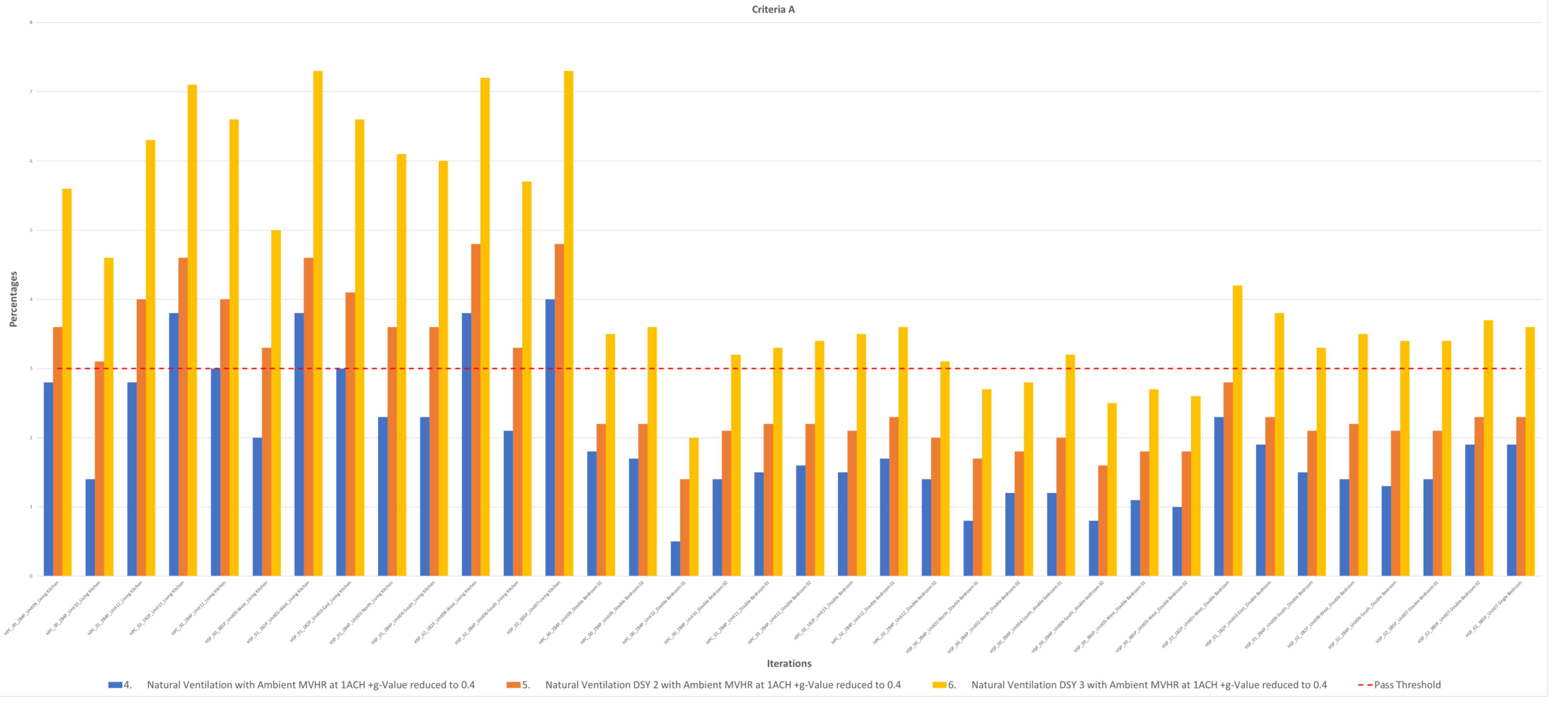


Figure 15 – Natural Ventilation Criteria A DSY 1, 2 & 3.

10.2 Criteria B

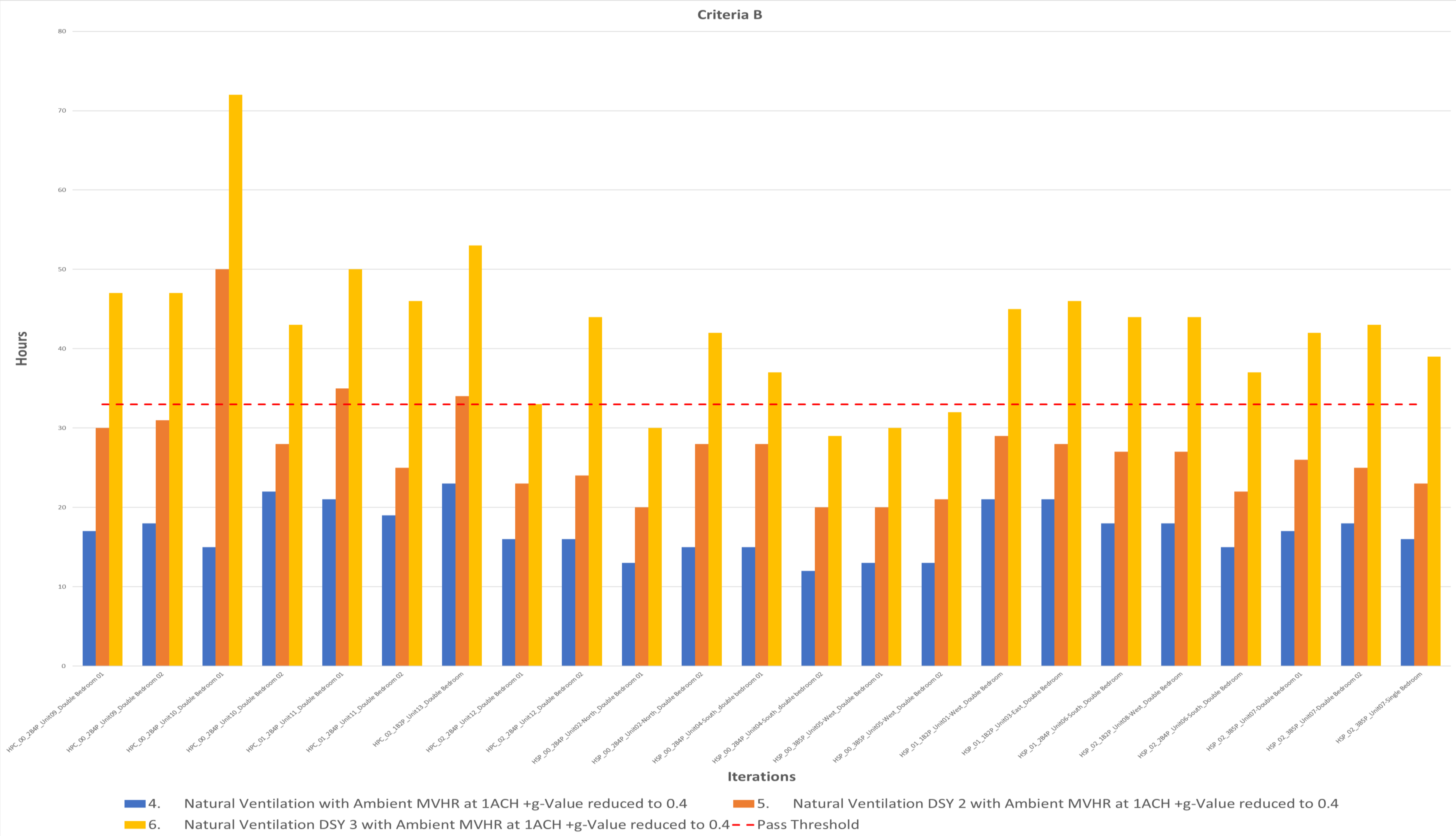


Figure 16 – Natural Ventilation Criteria B DSY 1, 2 & 3.

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