# HAMPTON MEWS

OVERHEATING ASSESSMENT

February 2016

# Dynamic Overheating Assessment

UK Pacific Hampton Station LLP

## Former Hampton Traffic Unit

Final

Author: **Scott Caldwell**
BEng (Hons)

Date: February 2016

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# DOCUMENT CONTROL RECORD
## REPORT STATUS: FINAL

| Version | Date | Reason for issue | Author | Project Manager | Checked by |
|---|---|---|---|---|---|
| v.1 | 11.02.16 | Draft | S Caldwell | R Schofield | C Booth |
| v.1.1 | 11.02.16 | Final | S Caldwell | R Schofield | Client |
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Our team of technical specialists offer advanced levels of expertise and experience to our clients. We have a wide experience of the construction and development industry and tailor teams to suit each individual project.

We are able to advise at all stages of projects from planning applications to handover.

Our emphasis is to provide innovative and cost effective solutions that respond to increasing demands for quality and construction efficiency.

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# Executive Summary

This report details the methodology and findings of a study into the overheating risk of three worst case dwellings on the proposed development at the Former Hampton Traffic Unit site on Station Road, Hampton in the London Borough of Richmond upon Thames, using dynamic thermal modelling. The reason for undertaking the work is to investigate the potential overheating risk within the dwellings under current and future climate changes scenarios.

## Assessment Criteria

The performance of the units has been assessed against guidance published by the Chartered Institute of Building Services Engineers (CIBSE) guidance document *TM52: The Limits of Thermal Comfort* (2013). This recommends that three criteria are assessed, **two** of which must be met in order to demonstrate overheating levels are within acceptable limits:

> **Criterion 1: Hours of Exceedance** – the number of hours where the operative temperature is more than 1$^{o}$C above the maximum acceptable temperature must not be more than 3% of occupied hours.

> **Criterion 2: Daily Weighted Exceedance** – sets a limit to the severity of overheating within one day.

> **Criterion 3: Upper Limit Temperature** – sets an absolute maximum temperature for a room where the operative temperature must not be more than 4$^{o}$C greater than the maximum acceptable temperature.

Maximum acceptable temperatures are not absolute fixed values; they are calculated according to the running mean of the external temperature. This means that as external temperatures increase, the maximum acceptable operative temperature also increases.

## Weather Data & Climate Change

Representative units have been modelled against a range of weather data to assess performance in both current and predicted future climates.

CIBSE TM49 weather data for London Heathrow Airport (representative of urban areas outside the Mayors Central Activity Zone) has been used for all scenarios assessed. This reflects lower density urban and suburban areas.

Overheating modelling has been conducted using three design weather years and one future weather scenario:

**1976** design weather year: a year with a prolonged period of sustained warmth;

**1989** design weather year: a moderately warm summer (current design year for London);

**2003** design weather year: a year with a very intense single warm spell;

**Future weather data**:  2050's high emissions scenario.

As the UKCP09 predictions are probabilistic, data for the 50% percentile change likelihood (encompassing 50% of the projected changes to climate) has been used to represent the middle or 'best guess' range of possible changes to weather conditions.

## Results

Results show that the worst-case units simulated demonstrate **an acceptable level of overheating** against the TM52 criteria for all **three baseline weather data scenarios** .This is based on some key design features:

> Solar control glazing with a G-value of 0.50 to dwellings;

> Openable windows to provide purge ventilation to habitable rooms when occupied;

> Continuous mechanical ventilation to achieve minimum Part F ventilation requirements;

> High thermal mass construction, using concrete floors.

For the **future 2050's high emissions scenario** TM52 Criterion 1 and 2 are not met in some habitable rooms. As two of the three criteria are not met for this scenario, an overheating risk is deemed present. In order to demonstrate compliance with the CIBSE TM52 criteria, solar control glazing with a **G-value of 0.28** and **external overhangs** were simulated to reduce solar gains and provide shading. These mitigation measures eliminated the overheating risk and demonstrate a passive strategy that could be incorporated in the future should it be required.

# CONTENTS

# 1. INTRODUCTION

**1.1** This dynamic overheating assessment has been completed by Hodkinson Consultancy, a specialist energy and environmental consultancy, in support of the planning application for the proposed development at the Former Hampton Traffic Unit on Station Road in the London Borough of Richmond upon Thames.

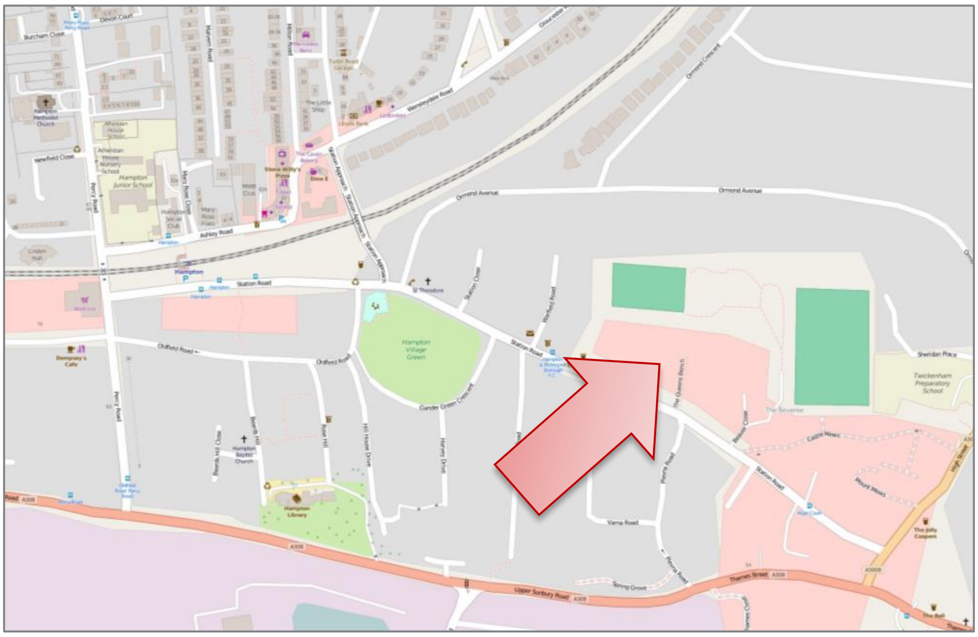

**Figure 1: Site Location - © OpenStreetMap Contributors. Go to www.openstreetmap.org/copyright**

**1.2** Maintaining thermal comfort conditions in the face of increased temperatures is one of the biggest challenges now facing designers of buildings in the UK. Initially the challenge has been recognised in more southerly locations, but in due course projects across the whole of the UK will engage with the issue. A particular concern will be to achieve thermal comfort without recourse to conventional air-conditioning systems, where typical technologies involve the emission of greenhouse gases.

**1.3** A dynamic assessment has been undertaken to determine if dwellings within the development are at risk of overheating under current and future climate conditions spanning the anticipated lifetime of the building.

**1.4** Dynamic thermal simulations (using Design Builder Software, DBS) have been carried out for three worst-case representative dwelling types. These have been modelled to assess their potential for overheating and to determine appropriate mitigation measures to minimise any risk identified.

# 2. REQUIRED STANDARDS

## Regional Policy: London Plan

**2.1** The **London Plan** (2015) sets out an integrated framework for the development of London over the next 20 – 25 years. On 10 March 2015, the Mayor adopted the Further Alterations to the London Plan (FALP). From this date, the FALP are operative as formal alterations to the London Plan and form part of the development plan for Greater London.

**2.2** **Policy 5.9 Overheating And Cooling** in the London Plan outlines key policies relevant to the Proposed Development and this Overheating Assessment:

***Strategic***

*A) The Mayor seeks to reduce the impact of the urban heat island effect in London and encourages the design of places and spaces to avoid overheating and excessive heat generation, and to reduce overheating due to the impacts of climate change and the urban heat island effect on an area wide basis.*

***Planning decisions***

*B) Major development proposals should reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the following cooling hierarchy:*

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

*C) Major development proposals should demonstrate how the design, materials, construction and operation of the development would minimise overheating and also meet its cooling needs. New development in London should also be designed to avoid the need for energy intensive air* *conditioning systems as much as possible. Further details and guidance regarding overheating and cooling are outlined in the London Climate Change Adaptation Strategy. LDF preparation*

*D) Within LDFs boroughs should develop more detailed policies and proposals to support the avoidance of overheating and to support the cooling hierarchy.*

**2.3** Further guidance on overheating modelling is given in the **Greater London Authority (GLA)'s guidance on preparing energy assessments (April 2015)**.

**2.4** It is expected that dynamic thermal modelling of the overheating risk will be undertaken to support the energy assessment, unless the applicant can demonstrate exceptional circumstances where opportunities for reducing cooling demands via passive measures are constrained.

**2.5** The dynamic thermal modelling should be in addition to any assessment of overheating risk obtained from the Part L Building Regulation compliance tools SAP and SBEM. Evidence of how the development performs against the overheating criteria should be presented along with an outline of the assumptions made (e.g. around internal gains).

**2.6** Where dynamic modelling is carried out, it should be undertaken in accordance with the guidance and data sets in TM49. As it is impossible to prejudge the impact of warm weather conditions on a building in a general sense, overheating modelling should be conducted using three design weather years:

> **1976**: a year with a prolonged period of sustained warmth;

> **1989**: a moderately warm summer (current design year for London);

> **2003**: a year with a very intense single warm spell.

**2.7** To enable the urban heat island effect in the locality of the development to be taken into account, weather year data for three different locations are provided. The most representative weather data set for the project location should be used:

> The **Greater London Authority Central Activity Zone** (CAZ) and other high density urban areas (e.g. Canary Wharf): **London Weather Centre data**;

> **Lower density** urban and suburban areas: **London Heathrow Airport data**;

> **Rural and peri-urban areas** around the edge of London: **Gatwick Airport data**.

**2.8** CIBSE guide TM52 contains additional guidance on the limits of thermal comfort. Entitled 'The Limits of Thermal Comfort: Avoiding Overheating in European Buildings', the TM provides guidance on predicting overheating in buildings. It is intended to inform designers, developers and others responsible for defining the indoor environment in buildings and it is recommended that this is considered when carrying out modelling.

# Technical Guidance

## CIBSE Guidance TM52: The Limits of Thermal Comfort

**2.9** Criteria for the assessment of overheating risk have been specified by the Chartered Institute of Building Services Engineers (CIBSE) *in CIBSE TM52: The Limits of Thermal Comfort*.

**2.10** This document recommends 3 criteria are assessed, as follows:

> **Criterion 1: Hours of exceedance**: The number of hours (He) during which ΔT is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3 per cent of occupied hours.

> **Criterion 2: Daily Weighted Exceedance**: The weighted exceedance (We ) shall be less than or equal to 6 in any one day where:

$W_e = (\sum h_c) \times WF$

$= (h_{e0} \times 0) + (h_{e1} \times 1) + (h_{e2} \times 2) + (h_{e3} \times 3)$

Where the weighting factor WF = 0 if $\Delta T \leq 0$, otherwise WF = $\Delta T$, and $h_{ey}$ is the time (h) when WF = y.

> **Criterion 3: Upper limit temperature**: To set an absolute maximum value for the indoor operative temperature the value of ΔT shall not exceed 4K.

**2.11** For all three criteria, the definition of ***ΔT*** is the difference between the operative temperature and the *limiting maximum acceptable temperature*.

**2.12** The ***limiting maximum acceptable temperature*** ($T_{MAX}$) is calculated from the running mean of the outdoor temperature ($T_{rm}$) using the formula:

$$T_{MAX} = 0.33\, T_{rm} + 21.8$$

**2.13** In order to demonstrate compliance, at least two of the three criteria must be passed.

# 3. SITE EXTERNAL WEATHER CONDITIONS

**3.1** External temperatures and incidental solar gains are greatest during summer months, coinciding with periods of lower wind speeds. However, solar altitude is highest during summer months, increasing the effects of facade shading from balcony overhangs and window reveals. Such considerations should be accounted for when designing for overheating risk.

**3.2** The effects of external conditions are vital in an overheating assessment as, in particular, they influence:

> Solar heat gains (a function of incident direct & diffuse solar radiation and solar altitude);

> Calculated natural ventilation rates (a function of external temperature, wind directions and speeds).

**3.3** CIBSE TM49 weather data for the **London Heathrow Airport** (representative of urban areas outside the Mayors Central Activity Zone) has been used for all scenarios assessed. This reflects lower density urban and suburban area.

**3.4** Overheating modelling has been conducted using three design weather years:

> **1976**: a year with a prolonged period of sustained warmth;

> **1989**: a moderately warm summer (current design year for London);

> **2003**: a year with a very intense single warm spell.

**3.5** Figure 2 presents the daily weather data for the **London Heathrow Airport** for the **three design weather years**.

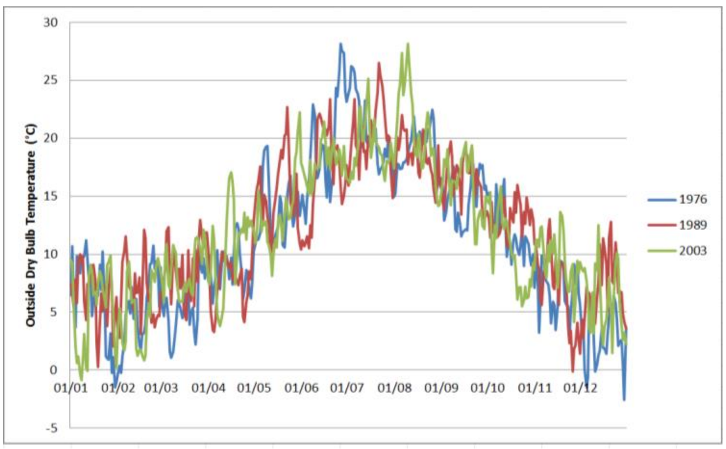


**Figure 2: CIBSE TM49 London Heathrow Airport weather data for the three design years**

**3.6** TM49 provides data on anticipated weather conditions under climate change scenarios. These are based on 'low, medium and high' carbon emissions paths. For each emissions scenario, three sets of weather data have been produced covering different time periods based on the UK Climate Predictions 2009 (UKCP09):

> **2020s** (2011 - 2040);

> **2050s** (2041 - 2060);

> **2080s** (2061 – 2090).

**3.7** For the purposes of this report, weather data based on the following has been selected to demonstrate that the proposed development does not carry an unacceptable level of overheating risk in the future:

> A **2050s scenario** (representative of 2041 - 2060);

> A '**high' emissions scenario** is used as recent reports show global emissions to follow this trajectory;

> A moderate **50% probability level** is used throughout since the occupancy demographic is not assumed to be particularly vulnerable, e.g. elderly or sick. Data for the 50% percentile change likelihood (encompassing 50% of the projected changes to climate) have been used to represent the middle or 'best guess' range of possible changes to weather conditions;

> Weather data morphed from the **1976 weather data** set, a year with a prolonged period of sustained warmth.

**3.8** Figure 3 represents the 1976 weather data 'morphed' to reflect the climate change predictions of UKCP09 for the year 2050 under the High Emissions path.

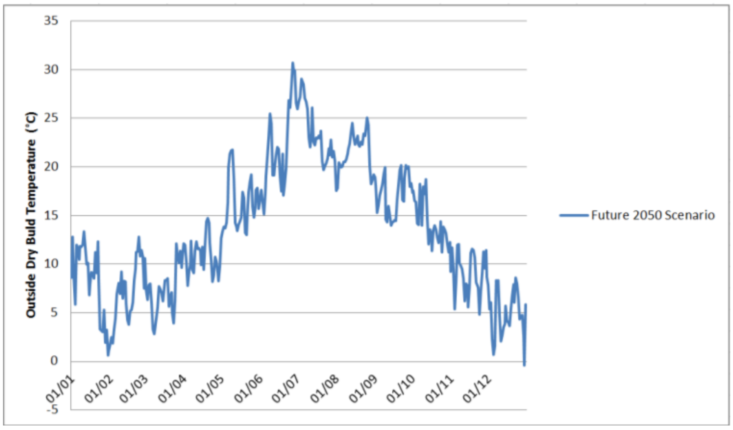


**Figure 3: CIBSE TM49 London Heathrow Airport Weather Data for the Selected Future Scenario (2050s, High emissions scenario, 50% Probability Level)**

# 4. DESIGN BUILDER MODEL

**4.1** The dynamic thermal modelling software Design Builder has been used to set up the model and run dynamic simulations for overheating risk. The units that were chosen as most likely to suffer from overheating were those that did not benefit from shading from neighbouring dwellings and had high levels glazing facing and were facing east/west or south. West facing glazing is particularly susceptible to summertime solar gains in late afternoon/evening when the solar angle is low.

**4.2** The units selected for dynamic simulation are highlighted below in Figure 4.


**Figure 4: Location of units modelled within the development.**

**4.3** Figures 5 and 6 show the full model and details the suns path around the site.

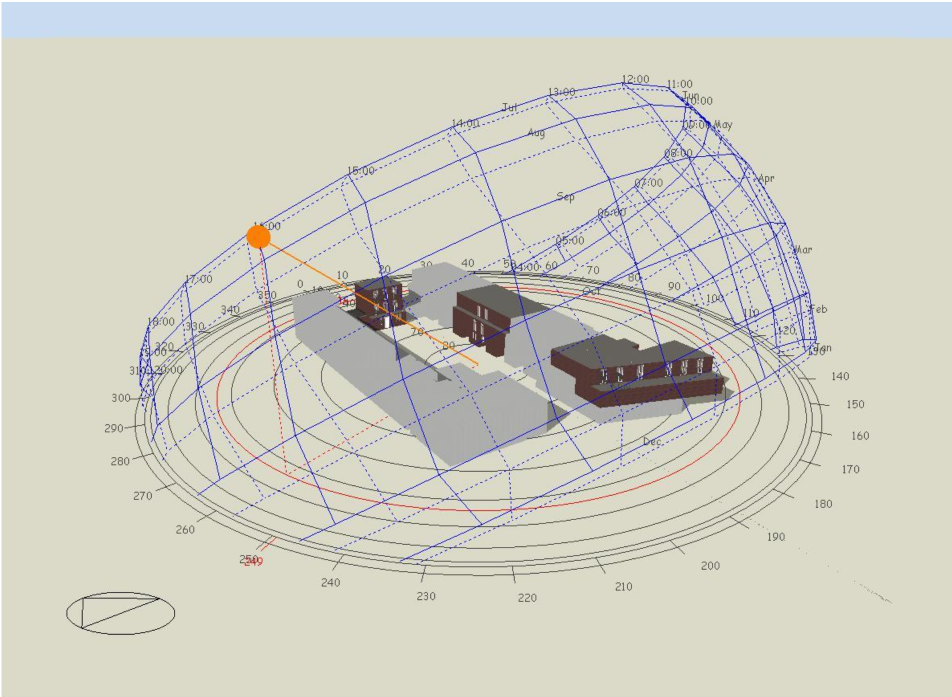


**Figure 5: Sun path diagram showing units modelled (15th July, 16:00)**

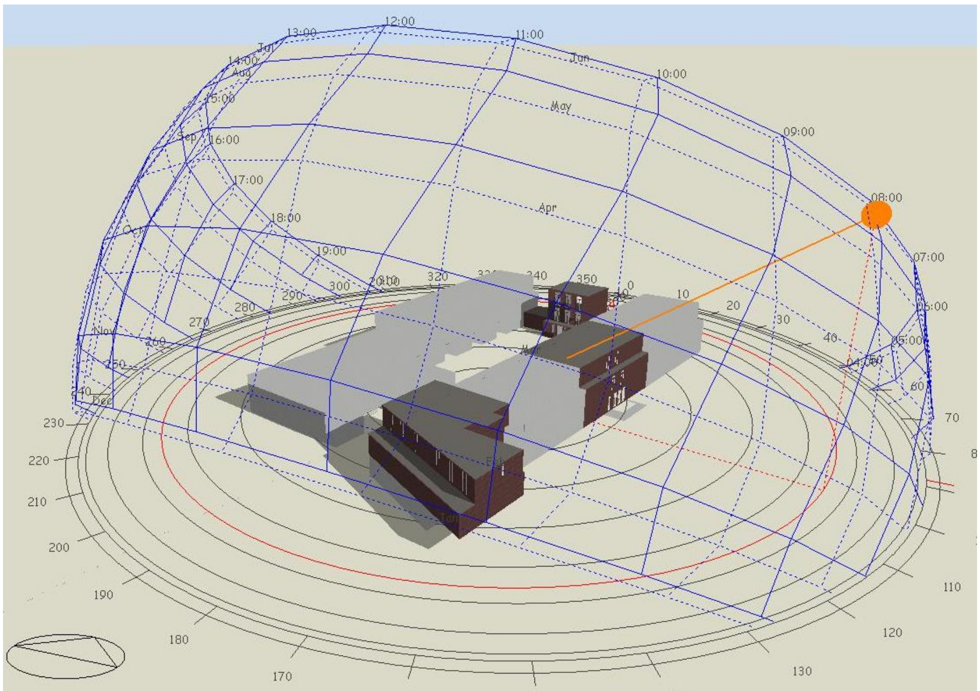


**Figure 6: Sun path diagram showing units modelled (15th July, 08:00)**

# 5. DYNAMIC MODELLING ASSUMPTIONS

**5.1** The following modelling inputs (Table 1) have been set up in the baseline dynamic thermal simulation, in line with SAP calculation inputs. NCM (National Calculation methodology) has been used for all occupancy rates and internal heat gain assumptions which will contribute to the risk of overheating:

| Data Input | | | Discussion |
|---|---|---|---|
| Building Fabric Construction Details | External Walls | U-Value 0.18W/m$^2$/K. | Although thermally-massive materials are used, they are generally outside the insulation envelope and so will have little effect on the heat storage of the building. Lightweight steel infill construction assumed. |
| | Ground and Basement Floor | U-Value 0.12W/m$^2$/K. | Slab on ground assumed. Thermally massive construction. |
| | External Roof | U-Value 0.15W/m$^2$/K. | Inverted flat roof construction assumed. Thermally massive construction. |
| | Internal Ceilings/ Floors | Adiabatic<br>- 200mm concrete and carpet<br><br>Adiabatic: Where there is a dwelling above or below the assumption is that there is no heat loss through ceilings and floors in order to analyse the worst case scenario. | As concrete floors are thermally massive they will add to the thermal capacity of the building. |
| | Party Wall and Walls to Corridors | 2 layers of lightweight block fully filled with mineral wool insulation. | Walls adjacent to other dwellings are assumed to be adiabatic (no heat loss). |
| | Stud walls in dwellings | Metal-stud partitions. | Assumed construction. |
| Glazing | Windows and Glazed Doors | U value 1.2W/m$^2$K. | In line with Energy Statement SAP calculations. |
| | | G-value 0.50. | G-value specified to control solar gain. |
| | | Openable. | No restrictions due to noise or pollution issues. Email confirmation Greg Pitt 12.01.16 |
| | Internal Blinds | Not provided. | Internal blinds have not been accounted for in the simulation. |
| | Reveal Depth | External reveal: 225mm. | Measured from drawings. |
| | | Internal reveal: 100mm. | |
| | | Inside sill depth: 100mm. | |
| Ventilation and Infiltration | Airtightness | 4m$^3$/hr-m$^2$@50 Pascal's. | Assumed in line with SAP calculations. |
| | Natural Ventilation | Windows assumed openable in rooms when occupied. | It is assumed that occupants will be able to open the windows in rooms when occupied. |
| | Mechanical Ventilation | Mechanical Ventilation Air Change Rate Summary<br>- House Type 1 - 0.5 ach<br>- House Type 2 - 0.6 ach<br>- Apartment Type 1 - 0.6 ach | MVHR has been assumed in line with the Energy Statement SAP calculations. Calculated air change rates are based on achieving minimum Part F ventilation rates. |
| Occupancy | Varied in each zone | DB default according to activity. | National Calculation Methodology defaults. |
| Internal Gains | Varied in each zone | Metabolic, equipment, low energy lighting (3W/m$^2$). | National Calculation Methodology defaults used for relevant zones. |

**Table 1: Dynamic Overheating Modelling Inputs**

# 6. SUMMARY OF RESULTS

**6.1** The performance of the units has been assessed against three criteria, as set out in CIBSE Guidance document *TM52: The limits of Thermal Comfort (2013)*. **Two out of the three criteria must be met** in order to demonstrate that overheating is within acceptable levels.

**6.2** Tables 2-4 summarise the outputs given by running dynamic thermal simulations under the three baseline Design Summer Years. Cells in pale orange pass the overheating criterion, those in red fail to meet the required standard.

**6.3** All rooms meet at least two of the criteria for all Baseline scenarios. In line with TM52, this indicates that **all units demonstrate an acceptable level of overheating risk.**

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| Table 2: Overheating Results for Baseline year 1976 (A year with a prolonged period of sustained warmth) | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1976 Baseline | House Type 1 | | | | | | | House Type 2 | | | | | Apartment Type 1 | | | | |
| | Basement Lounge | Lounge | Kitchen | Bedroom 1 | Bedroom 2 | Bedroom 3 | Bedroom 4 | Lounge | Kitchen | Bedroom 1 | Bedroom 2 | Bedroom 3 | Lounge | Kitchen | Bedroom 1 | Bedroom 2 | Bedroom 3 |
| Criterion 1 - Hours of exceedance (Pass - <3%) | 0.00% | 3.23% | 1.76% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| Criterion 2 - Daily Weighted (Pass - < 6) | 0.00 | 5.50 | 4.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Criterion 3 - Upper limit temperature (Pass - 0) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| PASS 2 OF 3 CRITERIA? | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS |

| Table 3: Overheating Results for Baseline year 1989 (A moderately warm summer (current design year for London)) | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1989 Baseline | House Type 1 | | | | | | | House Type 2 | | | | | Apartment Type 1 | | | | |
| | Basement Lounge | Lounge | Kitchen | Bedroom 1 | Bedroom 2 | Bedroom 3 | Bedroom 4 | Lounge | Kitchen | Bedroom 1 | Bedroom 2 | Bedroom 3 | Lounge | Kitchen | Bedroom 1 | Bedroom 2 | Bedroom 3 |
| Criterion 1 - Hours of exceedance (Pass - <3%) | 0.00% | 0.81% | 0.46% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| Criterion 2 - Daily Weighted (Pass - < 6) | 0.00 | 3.67 | 2.50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Criterion 3 - Upper limit temperature (Pass - 0) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| PASS 2 OF 3 CRITERIA? | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS |

| Table 4: Overheating Results for Baseline year 2003 (A year with a very intense single warm spell) | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2003 Baseline | House Type 1 | | | | | | | House Type 2 | | | | | Apartment Type 1 | | | | |
| | Basement Lounge | Lounge | Kitchen | Bedroom 1 | Bedroom 2 | Bedroom 3 | Bedroom 4 | Lounge | Kitchen | Bedroom 1 | Bedroom 2 | Bedroom 3 | Lounge | Kitchen | Bedroom 1 | Bedroom 2 | Bedroom 3 |
| Criterion 1 - Hours of exceedance (Pass - <3%) | 0.00% | 1.80% | 1.09% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.20% | 0.00% | 0.00% | 0.00% | 0.00% |
| Criterion 2 - Daily Weighted (Pass - < 6) | 0.00 | 6.33 | 3.33 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.50 | 0.00 | 0.00 | 0.00 | 0.00 |
| Criterion 3 - Upper limit temperature (Pass - 0) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| PASS 2 OF 3 CRITERIA? | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS |

# 7. DISCUSSION

## Criterion 1: Hours of Exceedance

**7.1** CIBSE TM52 Criterion 1 states that the number of hours where the operative temperature is more than 1°C above the maximum acceptable temperature must not be more than 3% of occupied hours.

**7.2** Results presented in Tables 2-4 indicate the predicted percentage of occupied hours where the operative temperature is more than 1°C above the maximum acceptable temperature in a single year.

**7.3** **Results demonstrate that the maximum exceedance is slightly exceeded in lounge of House Type 1.**

## Criterion 2: Daily Weighted Exceedance

**7.4** CIBSE TM52 Criterion 2 sets a limit to the severity of overheating within one day where the weighted exceedance (We ) shall be less than or equal to 6 in any one day where:

$$W_e = (\sum h_c) \times WF$$

$$= (h_{e0} \times 0) + (h_{e1} \times 1) + (h_{e2} \times 2) + (h_{e3} \times 3)$$

Where the weighting factor WF = 0 if ΔT ≤0, otherwise WF = ΔT, and $h_{ey}$ is the time (h) when WF = y.

**7.5** Results presented in Tables 2-4 indicate the predicted daily weighted exceedance for each habitable room.

**7.6** **Daily weighted exceedances of the Lounge of House Type 1 are slightly in excess of the acceptable threshold**.

## Criterion 3: Upper Limit Temperature

**7.7** CIBSE TM52 Criterion 3 sets an absolute maximum temperature for a room where the operative temperature must not be more than 4°C greater than the maximum acceptable temperature (determined by the running mean of the external temperature).

**7.8** Results presented in Tables 2-4 indicate the number of hours in which the operative temperature exceeds the upper limit temperature threshold.

**7.9** **The modelling demonstrated that all habitable rooms pass this Criterion.**

# 8. FUTURE CLIMATE SCENARIO

**8.1** For the purposes of this report, future weather data for a 2050's high emissions scenario has been selected to demonstrate that the proposed development does not carry an unacceptable level of overheating risk in the future.

**8.2** Table 5 summarises the outputs given by running dynamic thermal simulations under this weather scenario, suggesting that some habitable rooms would be at risk of overheating in the future in accordance with the current design. As shown in the table, the lounge and kitchen of House Type 1 and lounge of Apartment Type 1 are likely to experience high internal temperatures.

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| Table 5: Overheating Results for Future Weather Scenario (2050's high emissions scenario) | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2050 Future | House Type 1 | | | | | | | House Type 2 | | | | | Apartment Type 1 | | | | |
| | Basement Lounge | Lounge | Kitchen | Bedroom 1 | Bedroom 2 | Bedroom 3 | Bedroom 4 | Lounge | Kitchen | Bedroom 1 | Bedroom 2 | Bedroom 3 | Lounge | Kitchen | Bedroom 1 | Bedroom 2 | Bedroom 3 |
| Criterion 1 - Hours of exceedance (Pass - <3%) | 0.65% | 8.65% | 5.84% | 0.17% | 0.31% | 0.02% | 0.19% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 3.32% | 1.29% | 0.00% | 0.00% | 0.00% |
| Criterion 2 - Daily Weighted (Pass - < 6) | 2.67 | 7.00 | 6.83 | 1.83 | 2.17 | 0.17 | 1.33 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6.17 | 3.33 | 0.00 | 0.00 | 0.00 |
| Criterion 3 - Upper limit temperature (Pass - 0) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| PASS 2 OF 3 CRITERIA? | PASS | FAIL | FAIL | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | FAIL | PASS | PASS | PASS | PASS |

| Table 6: Overheating Results for Future Weather Scenario (2050's high emissions scenario) Mitigation Measures - Solar Control Glazing and External Overhangs | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2050 Future Mitigation | House Type 1 | | | | | | | House Type 2 | | | | | Apartment Type 1 | | | | |
| | Basement Lounge | Lounge | Kitchen | Bedroom 1 | Bedroom 2 | Bedroom 3 | Bedroom 4 | Lounge | Kitchen | Bedroom 1 | Bedroom 2 | Bedroom 3 | Lounge | Kitchen | Bedroom 1 | Bedroom 2 | Bedroom 3 |
| Criterion 1 - Hours of exceedance (Pass - <3%) | 0.00% | 0.00% | 0.03% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| Criterion 2 - Daily Weighted (Pass - < 6) | 0.00 | 0.00 | 0.17 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Criterion 3 - Upper limit temperature (Pass - 0) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| PASS 2 OF 3 CRITERIA? | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS |

# Future Weather Mitigation Strategy

**8.3** In order to reduce the overheating risk in habitable rooms to acceptable levels in future, it is suggested that solar control glazing with a G-value of 0.28 and external overhang of 1m deep could be applied to glazed areas, as illustrated in Figure 7.

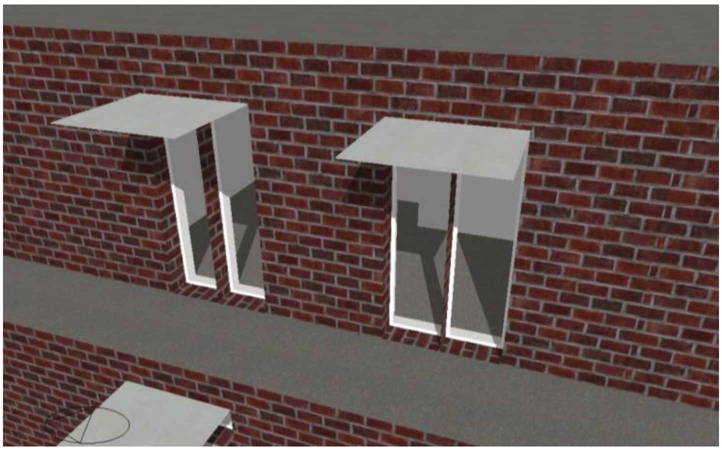

**Figure 7: Suggested Mitigation Strategy for Dwellings to Avoid Overheating – External Overhang to Provide Solar Control during Summer Months**

**8.4** Table 6 summarises the output given by running thermal simulations for the building with external Overhangs and a G-value of 0.28 under the future weather scenario.

**8.5** Results clearly show that the future application of solar control glazing with **a G-value of 0.28** and external shading via devices such as **overhangs** will be sufficient to reduce overheating to acceptable levels.

# 9. CONCLUSION

**9.1** This report details the methodology and findings of a study into the overheating risk of three worst case dwellings on the proposed development at the Former Hampton Traffic Unit on Station Road in the London Borough of Richmond upon Thames using dynamic thermal modelling. The reason for undertaking the work is to investigate the potential overheating risk within the dwellings under current and future climate changes scenarios.

## Assessment Criteria

**9.2** The performance of the units has been assessed against guidance published by the Chartered Institute of Building Services Engineers (CIBSE) guidance document *TM52: The Limits of Thermal Comfort* (2013). This recommends that three criteria are assessed, **two** of which must be met in order to demonstrate overheating levels are within acceptable limits:

> **Criterion 1: Hours of Exceedance** – the number of hours where the operative temperature is more than 1°C above the maximum acceptable temperature must not be more than 3% of occupied hours.

> **Criterion 2: Daily Weighted Exceedance** – sets a limit to the severity of overheating within one day.

> **Criterion 3: Upper Limit Temperature** – sets an absolute maximum temperature for a room where the operative temperature must not be more than 4°C greater than the maximum acceptable temperature.

**9.3** Maximum acceptable temperatures are not absolute fixed values; they are calculated according to the running mean of the external temperature. This means that as external temperatures increase, the maximum acceptable operative temperature also increases.

## Weather Data & Climate Change

**9.4** Representative units have been modelled against a range of weather data to assess performance in both current and predicted future climates.

**9.5** CIBSE TM49 weather data for London Heathrow Airport (representative of urban areas outside the Mayors Central Activity Zone) has been used for all scenarios assessed. This reflects the 'urban heat island' effect present within London.

**9.6** Overheating modelling has been conducted using three design weather years and one future weather scenario:

**1976** design weather year: a year with a prolonged period of sustained warmth;

**1989** design weather year: a moderately warm summer (current design year for London);

**2003** design weather year: a year with a very intense single warm spell;

**Future weather data**: 2050's high emissions scenario.

**9.7** As the UKCP09 predictions are probabilistic, data for the 50% percentile change likelihood (encompassing 50% of the projected changes to climate) has been used to represent the middle or 'best guess' range of possible changes to weather conditions.

## Results

**9.8** Results show that the worst-case units simulated demonstrate **an acceptable level of overheating** against the TM52 criteria for all **three baseline weather data scenarios** .This is based on some key design features:

- Solar control glazing with a G-value of 0.50 to dwellings;
- Openable windows to provide purge ventilation to habitable rooms when occupied;
- Continuous mechanical ventilation to achieve minimum Part F ventilation requirement;
- High thermal mass construction, using concrete floors.

**9.9** For the **future 2050's high emissions scenario** TM52 Criterion 1 and 2 are not met in some habitable rooms. As two of the three criteria are not met for this scenario, an overheating risk is deemed present. In order to demonstrate compliance with the CIBSE TM52 criteria, solar control glazing with a G**-value of 0.28** and **external overhangs** were simulated to reduce solar gains and provide shading. These mitigation measures eliminated the overheating risk and demonstrate a passive strategy that could be incorporated at a future date should it be required.

# APPENDICES

## APPENDIX A

OPENING DETAILS

# APPENDIX A: OPENING DETAILS

Figures A1-A5 below detail the location of glazing and doors on the modelled dwellings. Openings were modelled in line with the elevation drawings received from PRP architects. Slider opening are marked with an arrow, hinged opening are marked with a dot and un-openable windows are marked with a cross.

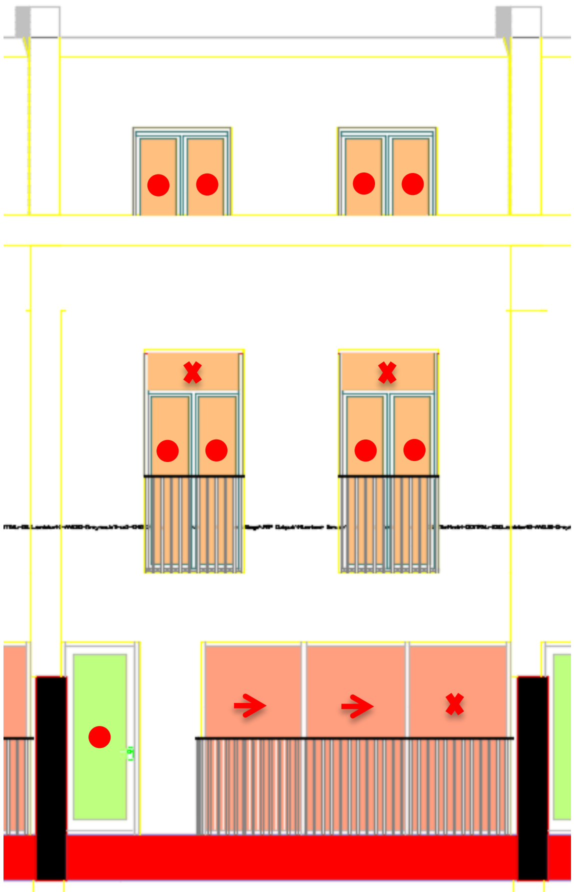

**Figure A1: House Type 1 East Facing Elevation: Location of Openings**

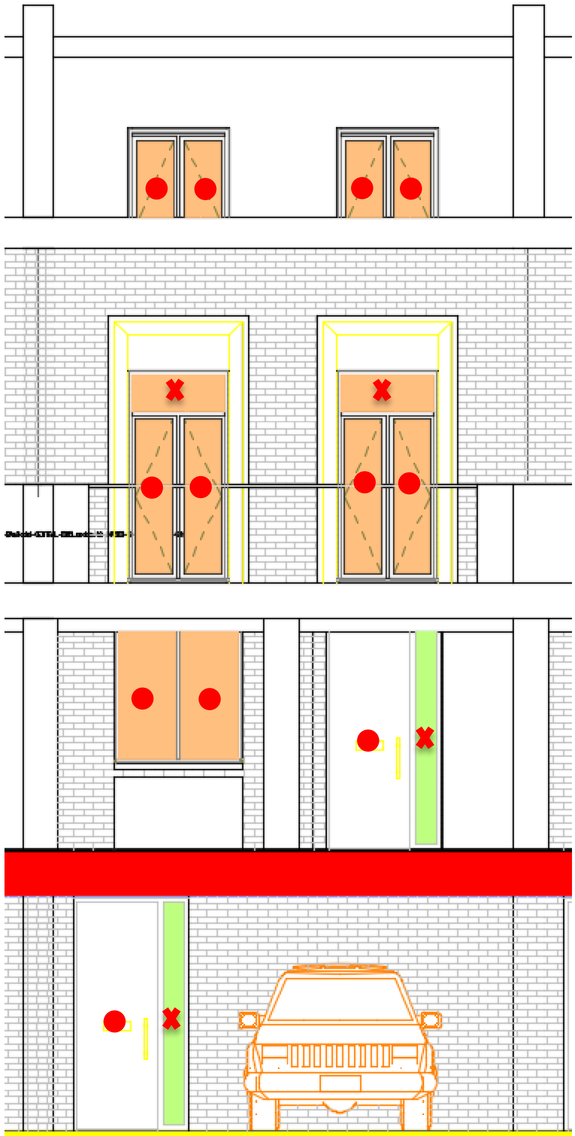

Figure A2: House Type 1 West Facing Elevation: Location of Openings

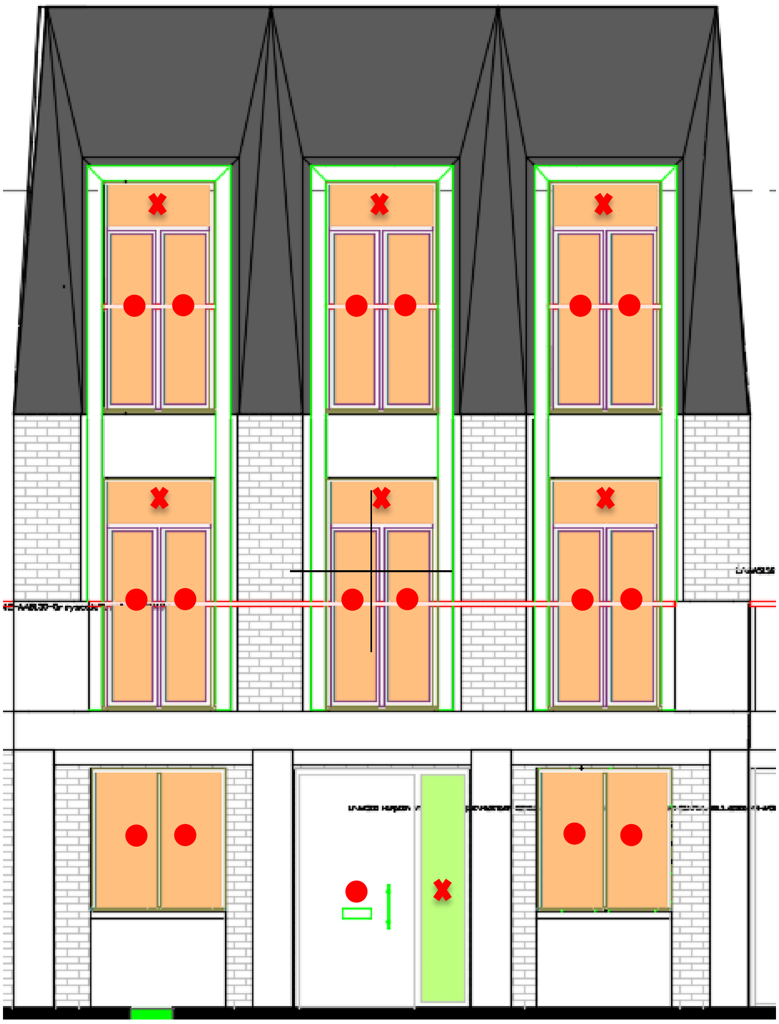

**Figure A3: House Type 2 South Facing Elevation: Location of Openings**

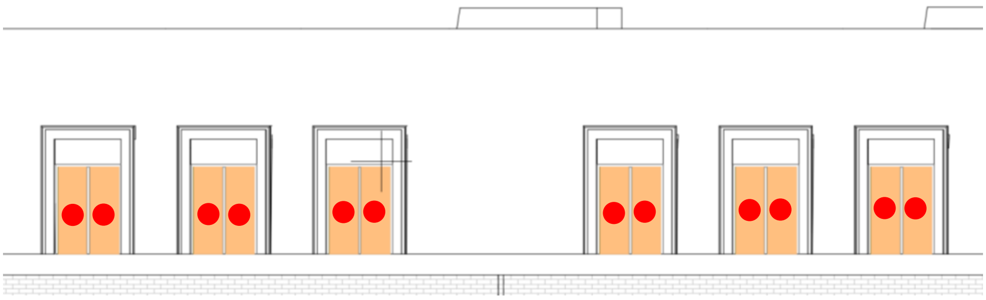

**Figure A4: Apartment Type 1 South Facing Elevation: Location of Openings**

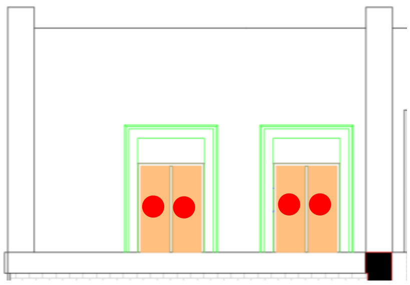

**Figure A5: Apartment Type 1 North Facing Elevation: Location of Openings**