Thermal Comfort Analysis

Charlton Brown Architecture & Interiors Limited

82 Fitzjohn's Avenue,
London,
NW3 6NP

SRE

Version	Revision	Date	Author	Reviewer	Project Manager
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Executive Summary

Executive Summary

Using dynamic simulation tools in accordance with CIBSE AM11, this analysis assesses thermal comfort measures for sample occupied spaces within the Proposed Development, take into consideration both the technical and the economic viability of the proposals in order to identify potential overheating risk.

The dwelling has been analysed for the overheating risk in for naturally ventilated spaces, in accordance with the requirements of CIBSE Guide A and TM52 and TM59 Criteria for homes predominantly naturally ventilated, against the recommended TM48 design summer years.

The results of the analysis have demonstrated that most of the assessed occupied spaces within the Development fail the requirements of TM52 & TM59 with regards to the present weather files. This indicates that the spaces will most likely overheat, and an uncomfortable thermal environment can be expected within the dwelling with the proposed design considerations.

Therefore, we would recommend comfort cooling to be incorporated where feasible, to optimise thermal comfort conditions and minimise the overheating risks through a combination of VRF fan coil unit and mechanical ventilation, to comply with the relevant criteria outlined in CIBSE Guide A, TM52, and TM59 under current weather conditions and therefore eliminating the overheating risk within extreme summer conditions.

Introduction

1.0 Introduction

This thermal comfort analysis has been undertaken by SRE for the proposed residential development at 82 Fitzjohn's Avenue, London (The Proposed Development) on behalf of Charlton Brown Architects Ltd (the Client) in order to assess the risks of overheating and the thermal comfort conditions in the occupied areas.

In accordance with the Camden Planning Guidance of Camden Policy CC2: Adaption to Climate Change, a dynamic model would be required to assess whether the site will overheat without the use of any form of comfort cooling installed.

This document will detail the assumptions used in the TM52 and TM59 overheating assessment. The purpose of this study is to assess the Proposed Development's thermal comfort levels in relation to Policy CC2, to the intensity of heat gains, occupancy patterns, internal layout, construction type and ventilation method.

All results are based on the output from dynamic thermal simulation software IES-VE 2019, which is fully compliant with CIBSE Applications Manual AM11, and should be taken as an indication of the likely final situation. However, these conditions cannot be guaranteed.

It is important to note that with any modelling exercise, there are assumptions and approximations that must be made. As far as possible, details of all assumptions made, and approximations used are supplied as part of the report.

The Application Site currently consists of a residential dwelling which has been extended numerous times over the years and is a mix of architectural styles and construction quality as a result - many of which are in a poor state of repair. The Proposed Development consists of the part removal of the existing structures – all of which were extensions to the original house on the site – and the extension of the original house to form a modern residential dwelling of 2 no. stories in height with pool hall and basement level plant space. Total floor area of the dwelling is to be 860m^2.

Elements of the original dwelling on the site are to be retained, with extensions to be constructed to a high quality of architectural design, with finishes and design elements which complement and enhance the existing, retained property.

Figure 1 – South Elevation of the Proposed Development (Charlton Brown Architecture & Interiors)

1.1 Methodology

1.1.1 CIBSE Guide A: Environmental Design

CIBSE Guide A 'Environmental Design' (2015) gives general guidance and recommendations for buildings on suitable winter and summer temperatures for a range of room and building types. Table 1 summarises the comfort criteria for relevant room types within the Proposed Development:

Environmental Design		Living Rooms	Bedrooms	Dining Room/Kitchen	Study
Winter period (Oct-Apr)	Operative Temperatures (°C)	17-19	17-19	17-19	17-19
	Activity (met)	1.6	1.6	1.6	1.6
	Clothing (clo)	1.0	1.0	1.0	1.0
Summer period (May-Sep)	Operative Temperatures (°C)	21-25	21-25	21-25	21-25
	Activity (met)	1.5	1.5	1.5	1.5
	Clothing (clo)	0.5	0.5	0.5	0.5

Table 1 - CIBSE Guide A, recommended comfort criteria

According to CIBSE Guide A guidance, secondary spaces which are occupied only briefly (less than 30 minutes), such as toilets, storage rooms and circulation areas are outside the scope of this analysis.

1.1.2 CIBSE TM52: The limits of thermal comfort: avoiding overheating in European buildings.

CIBSE TM52 is a Technical Memorandum (TM) about predicting overheating in buildings. It outlines the approach adopted by CIBSE to ensure that a building is comfortable for its occupants and how the likelihood of discomfort due to overheating can be predicted.

As summarised in Table 2, TM52 outlines three criteria to identify overheating in free-running buildings. A room that fails any two of the three criteria is classed as overheating.

Criterion	Definition
1	**Hours of exceedance (H_e):** The number of hours (H_e) during which the operative temperature is greater than the threshold comfort temperature by 1°C during the period May to September inclusive shall not be more than 3 per cent of the occupied hours.
2	**Daily weighted exceedance (W_e):** The weighted exceedance (W_e) shall be less than or equal to 6 in any one day.
3	**Upper limit temperature (T_{upp}):** The indoor operative temperature shall not exceed the threshold comfort temperature by 4°C.

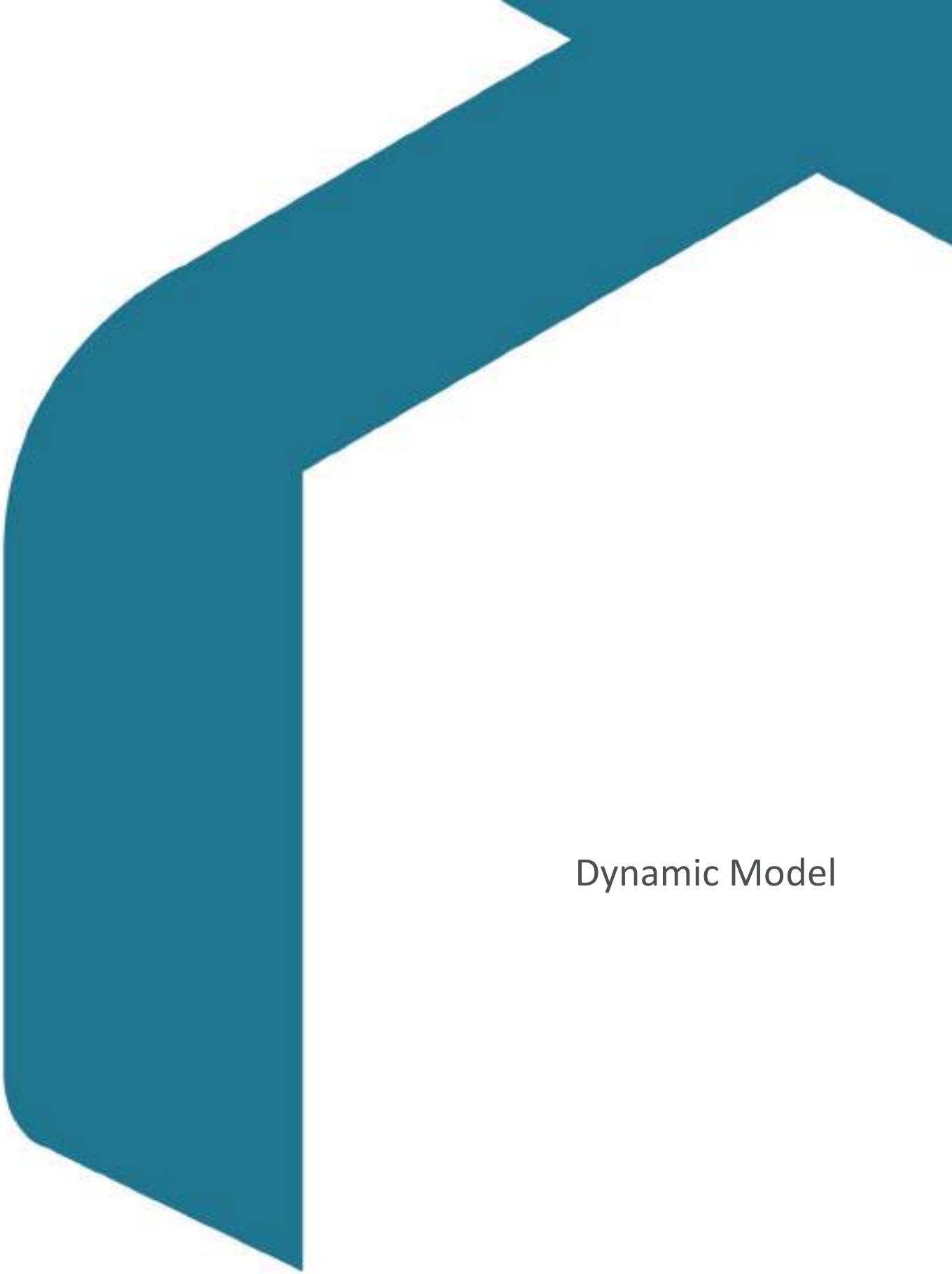
Table 2 - CIBSE TM52 Overheating Criteria

1.1.3 CIBSE TM59: Design Methodology for the Assessment of Overheating Risk in Homes

CIBSE TM59: 2017 have been used to assess the overheating risk within the Proposed Development. Compliance is based on passing both of the following two criteria:

a) For living rooms, kitchens and bedrooms: the number of hours during which the operative temperature exceeds the threshold comfort temperature by 1°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: the operative temperature in the bedroom from 10 pm to 7 am shall not exceed 26°C for more than 1% of occupied hours. (Note: 1% of occupied hours between 22:00 and 07:00 for bedrooms is 32 hours, so 33 or more hours will be recorded as a fail).

The requirements of TM59 as outlined above exclude all non-habitable spaces from the assessment as these are not anticipated to be occupied for long periods of time and therefore comfort levels are less of a concern. As such, circulation spaces, pool areas and basements are not covered by this assessment.



Dynamic Model

2.0 Dynamic Model

A 3D thermal model of the Proposed Development has been created using IES-VE 2019 based on the architectural drawings provided by Charlton Brown Architects Ltd.

Development	Floor Area (m^2)	Dwelling Type
82 Fitzjohn's Avenue	860m^2	Detached House

Table 3 - dwellings included in the assessment.

The proposed building has been divided into different zones in relation to use. Occupancy profiles and internal gains have been assigned in all assessed areas in line with NCM or TM59 guidance, but only the results of the main occupied (habitable) spaces have been assessed in this study. Secondary spaces occupied only briefly (less than 30 min), such as toilets and storage rooms are outside the scope of this study.

2.1 Building Fabric

High performance fabric has been specified to eliminate heat transfer between the internal conditioned areas and the ambient environment. Table 4 summarises the U-Values of all the fabric elements in the model.

Element	Proposed Residential U-Values
Existing Roof retrofitted	0.12
New pitched Roof	0.11
New flat roof	0.10
Retrofitted External Wall type M	0.15
New External Wall type A	0.13
New External Wall type K	0.15
New Ground Floor	0.09
Existing Windows	4.8
New Windows/roof lights	0.8
Existing Glazed/Solid Doors	3.0
New Glazed /solid doors	1.0

Table 4 - Construction details of the Proposed Development

2.2 Occupancy and internal gain profiles

Within the residential spaces, heat gains from equipment are also included in the assessment, which are summarised in Table 5. Lighting load of 2 W/m² is applied for all occupied spaces, and an occupancy density for the 7-bedroom house is set at 2 person per room for the double bedroom rooms and 1 person per room for the single bedrooms.

Usage	Peak Load (W)
Bedroom	80
Combined Living / Kitchen	450
Living Room	150
Study	100

Table 5- Equipment peak load for residential usages

The occupancy and internal gain profiles have been based on the methodology described in CIBSE TM59 or NCM standard profiles according to usage.

These profiles represent a robust test that ensures the key aspects of overheating are captured, which include the following characteristics:

- Bedrooms are set with a 24-hour occupancy profile: one person is always considered in each bedroom during the daytime and two people in each double bedroom at night.
- Kitchens/living rooms are unoccupied during the sleeping hours and occupied during the rest of the day.
- No differences between weekdays and weekends are considered and the dwelling is modelled as occupied for 24 hours.

The occupancy and internal gain profiles have been based on the methodology described in NCM standard profiles according to usage.

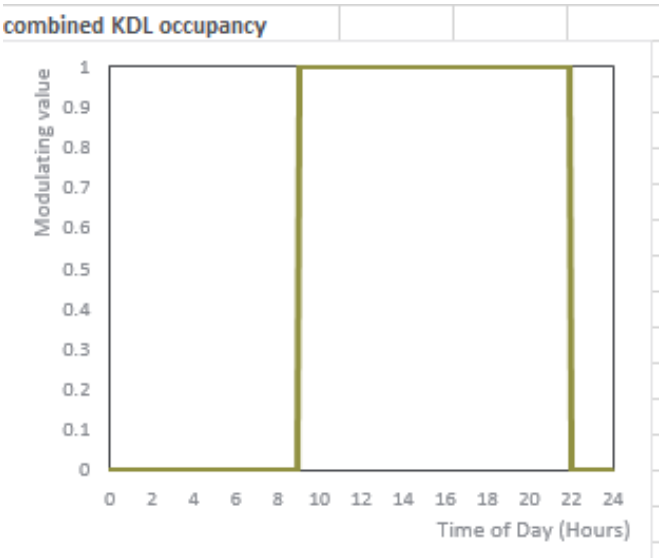
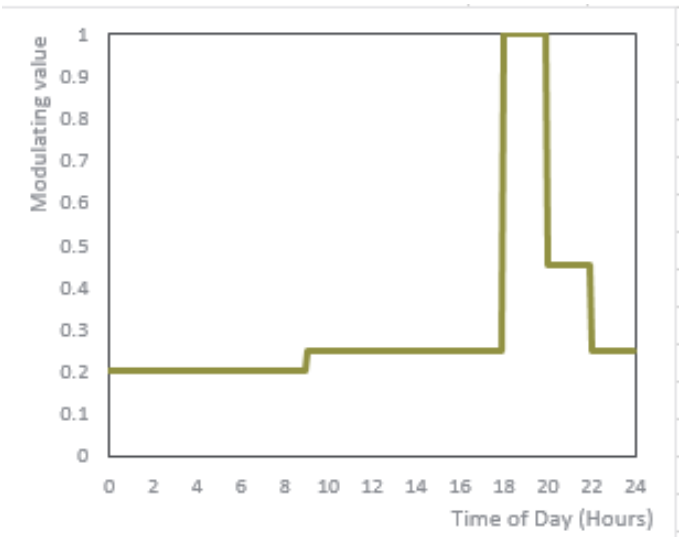
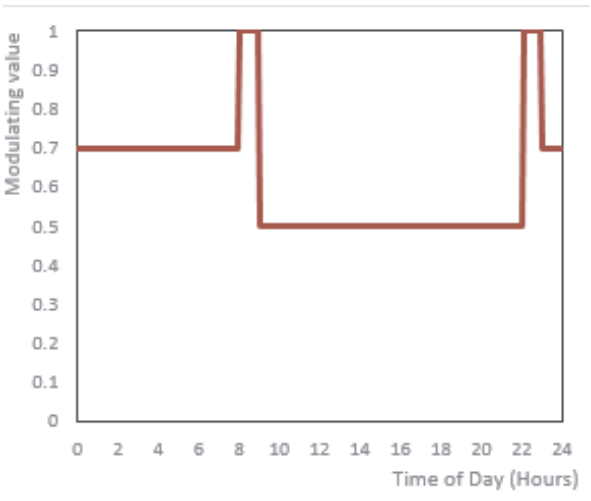
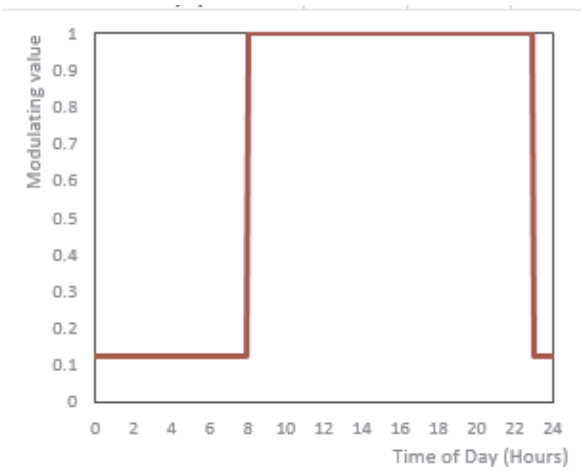
Combined Living, Dining Occupancy	Combined Living, Dining Equipment
	
Bedroom Occupancy	**Bedroom Equipment**
	

Table 6 - Occupancy and equipment profiles for the occupied space

2.3 Air Exchange

Windows are provided for the Proposed Developments and are modelled to be open as per Table 7. Mechanical extract ventilation has been proposed for the residential units:

- Residential Kitchen 30l/s
- Residential WC: 6 l/s

Openable windows are provided for all bedrooms in the Proposed Development and are modelled to be opened when internal temperature is above 18°C and the external temperature is lower than internal temperature.

As this is a refurbishment a design air tightness of 10 $m^3/hr/m^2$ @50 Pa has been applied in all areas. The infiltration rate is assumed at 0.15 air changes per hour (ach) for all spaces.

2.4 Window Openings

Based on the information supplied by the architect, the specification for the opening areas have been included within the thermal model.

Opening type	Opening category	Openable area (%)	Max. opening angle
Openable windows	Side hung	100	90
French doors	Side hung	100	90
Fixed window	-	0	0
Sky light	Side hung	100	90
Internal doors	Side hung	100	90

Table 7 -Openable areas specification

It is noted that Building Regulations requires restrictors to be installed on upper floor windows to prevent accidents. Whilst this could be included within the model, the assumption has been made that if a room were to potentially overheat, these windows would be opened fully with the occupants monitored if there was a potential risk.

Therefore, to provide a worst-case scenario for the modelling, the potential for all windows to opened fully has been retained within the thermal model.

2.5 Weather File

The thermal comfort analysis is conducted under current climate conditions, based on the below weather files:

Current condition:

- London DSY1 2020 high emissions 50th percentile future weather data has been used for the Summer period (May-September) and Winter period (October- April)

Results

3.0 Results

The overheating risks and thermal comfort conditions of the occupied spaces were assessed for current and future climate scenarios based on settings described in Section 2.0. Results for both current weather conditions are presented in this section.

Operative temperature calculations (used within CIBSE TM52 (2013)) require assumptions on air speed. If there is a ceiling fan or other means of consistently generating air movement the assumed elevated air speed assumptions must be reported and this should not exceed 0.8 m/s.

London DSY 2020 weather file has been used as the current weather file in this analysis.

3.1 Current Weather File – DSY2 2020

The following Table 8 summarises the results of the thermal comfort analysis relating to the DSY1 2020 current weather dataset, which identifies that summertime overheating is likely to arise within the development (shown in table 8). By installing a form of comfort cooling, the building will be able to show compliance and diminish overheating, thus making the building users generally satisfied through the whole year.

The results show that all spaces included in the analysis mostly fail the assessment criteria for the summer periods under the current weather files, which demonstrates that a poor level thermal comfort can be expected within the occupied areas.

Space	Criterion 1 (% hours top-max>=1K)	Criterion 2 (hours operative temp. >26°C)	Pass / Fail
Kitchen	4.7	-	Fail
Sitting room	4.9	-	Fail
Living room	8.3	-	Fail
Sitting room	3.6	-	Fail
Loft Room	2.6	-	Pass
Dining Room	2.2	-	Pass
Bedrooms	2.2	143	Fail
	3	207	Fail
	6.3	59	Fail
	1.4	47	Fail
	2	54	Fail
	3.9	207	Fail
	9.3	101	Fail

Table 8 – Simulation results summary – DSY2 2020 high emissions 50th naturally ventilated spaces, using the current weather file

Conclusions

4.0 Conclusions

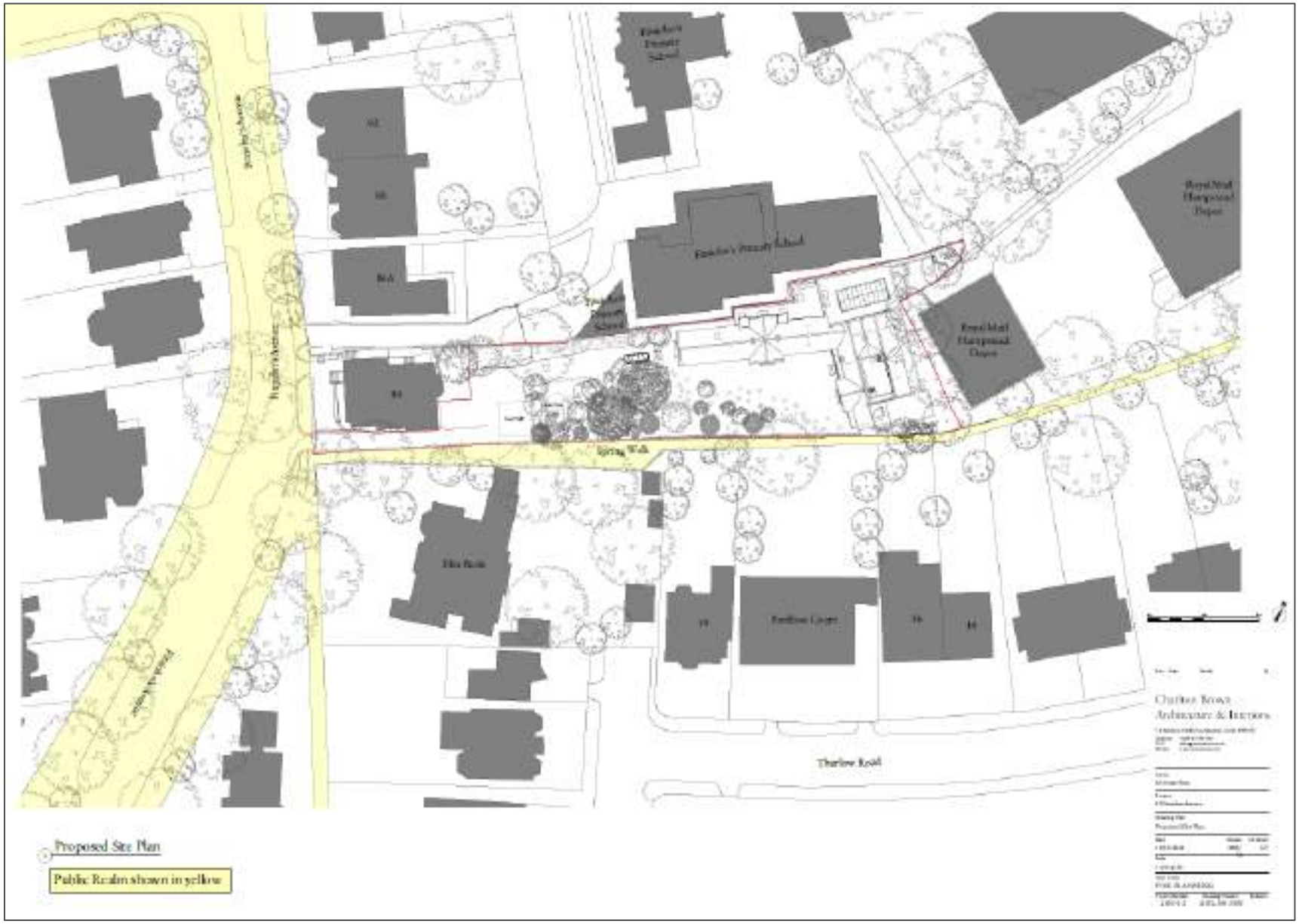
The dwelling has been analysed for the overheating risk in for naturally ventilated spaces, in accordance with the requirements of CIBSE Guide A and TM52 and TM59 Criteria for homes predominantly naturally ventilated, against the recommended TM48 design summer years.

The results of the analysis have demonstrated that most of the assessed occupied spaces within the Development fail the requirements of TM52 & TM59 with regards to the present weather files. This indicates that the spaces will most likely overheat, and an uncomfortable thermal environment can be expected within the dwelling with the proposed design considerations.

Therefore, we would recommend comfort cooling to be incorporated where feasible, to optimise thermal comfort conditions and minimise the overheating risks through a combination of VRF fan coil unit and mechanical ventilation, to comply with the relevant criteria outlined in CIBSE Guide A, TM52, and TM59 under current weather conditions and therefore alienating the overheating risk within extreme summer conditions.

Appendices

Appendix A – Proposed Site Plan



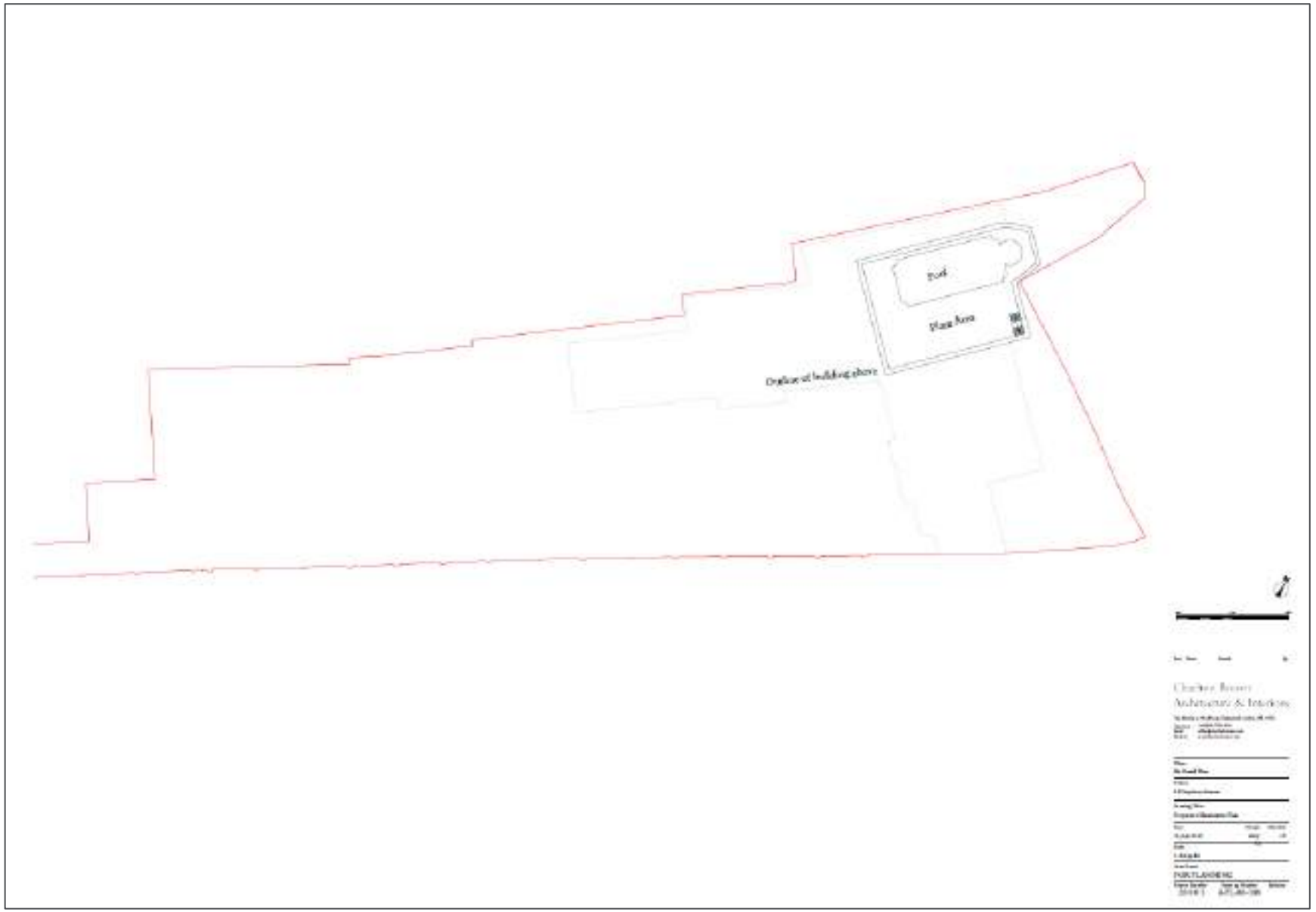
Appendix B – Proposed Floor Plans

Ground Floor

First Floor

Second Floor

Basement Plan



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