C80 solutions
Straightforward Building Compliance

# HAREFIELD SCHOOL, NORTHWOOD WAY

# HAREFIELD, UXBRIDGE

# UB9 6ET

*BB101 THERMAL ANALYSIS REPORT*

For:

## Edward Pearce Consulting Engineers

June 22

Project no. 13879

**C80 Solutions Ltd**
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## THERMAL ANALYSIS REPORT

## 13879

| REVISION | DATE | PREPARED BY | REVIEWED BY | COMMENTS |
|---|---|---|---|---|
| 0 | 31-05-22 | Dan Chadwick | C8o Solutions | - |
| 1 | 06-22 | DC | C8o Solutions | Layout and elevation revisions, window opening revisions, MVHR revisions |
| 2 | 07-22 | DC | C8o Solutions | Mech vent updated. Lighting gains and IT gains reduced in some areas. |
| 3 | 08-22 | DC | C8o | Mech vent added to Occ. Therapy and Library. All Room names updated. |

The results generated and analysed in this report are based upon complex arithmetical calculation that takes into consideration a number of design criteria and evaluations in a dynamic simulation. It gives an indication of the predicted environmental conditions based on climatic data and anticipated operating strategies of the building.

The predicted simulated internal temperatures may also not meet the actual internal air temperatures due to several reasons, namely change in space function, use of equipment, natural wear and tear of building elements, global climate change and meteorological changes, change in operational management of apertures etc.

C80 Solutions cannot be held liable for temperatures that vary from the simulated results as these have been calculated in a controlled virtual environment.



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# 1 Introduction

## 1.1 About C80 Solutions Ltd

C80 Solutions are independent Sustainability and Energy Consultants providing carbon reduction solutions to help the UK achieve its carbon emission reduction target of 80% by 2050 - as set out in the Government's Climate Change Act 2008.

Our range of affordable but comprehensive solutions for the construction industry are broken down into two sectors: i) Building Compliance and ii) Consultancy.

**Building Compliance:**

Our Building Compliance services include Code for Sustainable Homes Assessments, SAP Calculations, On Construction Energy Performance Certificates, Water Efficiency Calculations, SBEM Calculations, Commercial EPCs, BREEAM assessments, Thermal comfort analysis, Air Tightness Testing and Sound Testing.

**Consultancy:**

Our experience and exposure to building compliance combined with previous experience and IEMA accredited training means we have built up a vast amount of knowledge which enables us to provide our clients with invaluable advice. Our Consultancy services include Renewable Energy Feasibility Reports, Energy Statements for planning, Sustainability Statements and Building Compliance Advisory Reports.

## 1.2 Executive Summary

C80 Solutions have been instructed by Edward Pearce Consulting Engineers to prepare a BB101 Thermal Analysis Report for the analysis of summertime overheating for the proposed development at Harefield School, Northwood Way.

The project assessed anticipates the provision of an extension to an existing school building. The extension spans over two floors and consists of classrooms, group rooms and circulation spaces.

Spaces have also been looked at in the existing building which have historically had significant issues wit overheating, these rooms have been run as a category III, which covers existing buildings and has a higher allowance for overheating than new areas.

Simulations have been undertaken for the extension and some existing rooms at Harefield School using Designbuilder EnergyPlus, which is a dynamic simulation modelling software that can accurately simulate predicted internal environments and temperatures for the purposes of identifying area which are at a risk of overheating. This data is then used to assess the compliance against the criteria outlined in CIBSE TM52 the criteria of which can be used to assess overheating compliance with BB101.

The plan of the proposed development can be seen in Figures 1-4 below:

**Figure 1: Plan of the proposed ground floor**

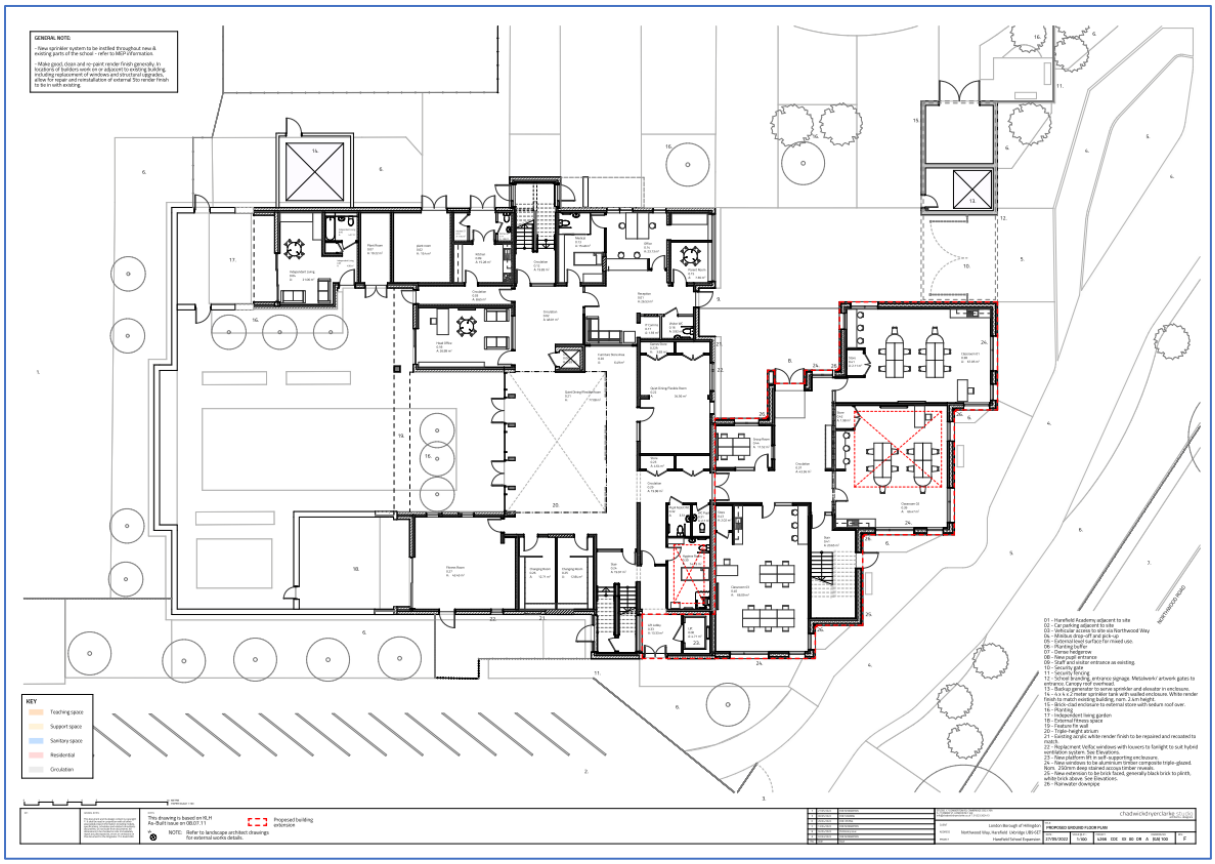

**Figure 2: Plan of the proposed first floor**

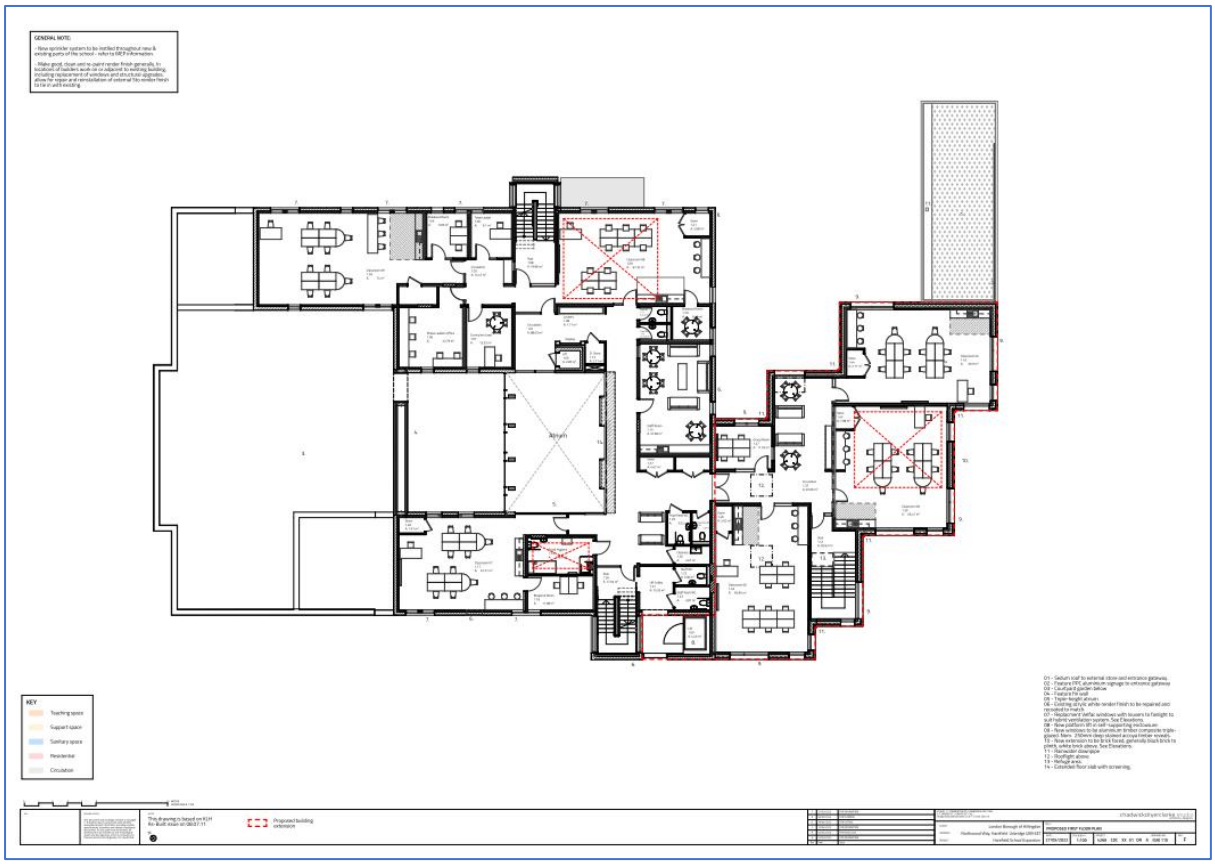

**Figure 3: Plan of the proposed second floor**

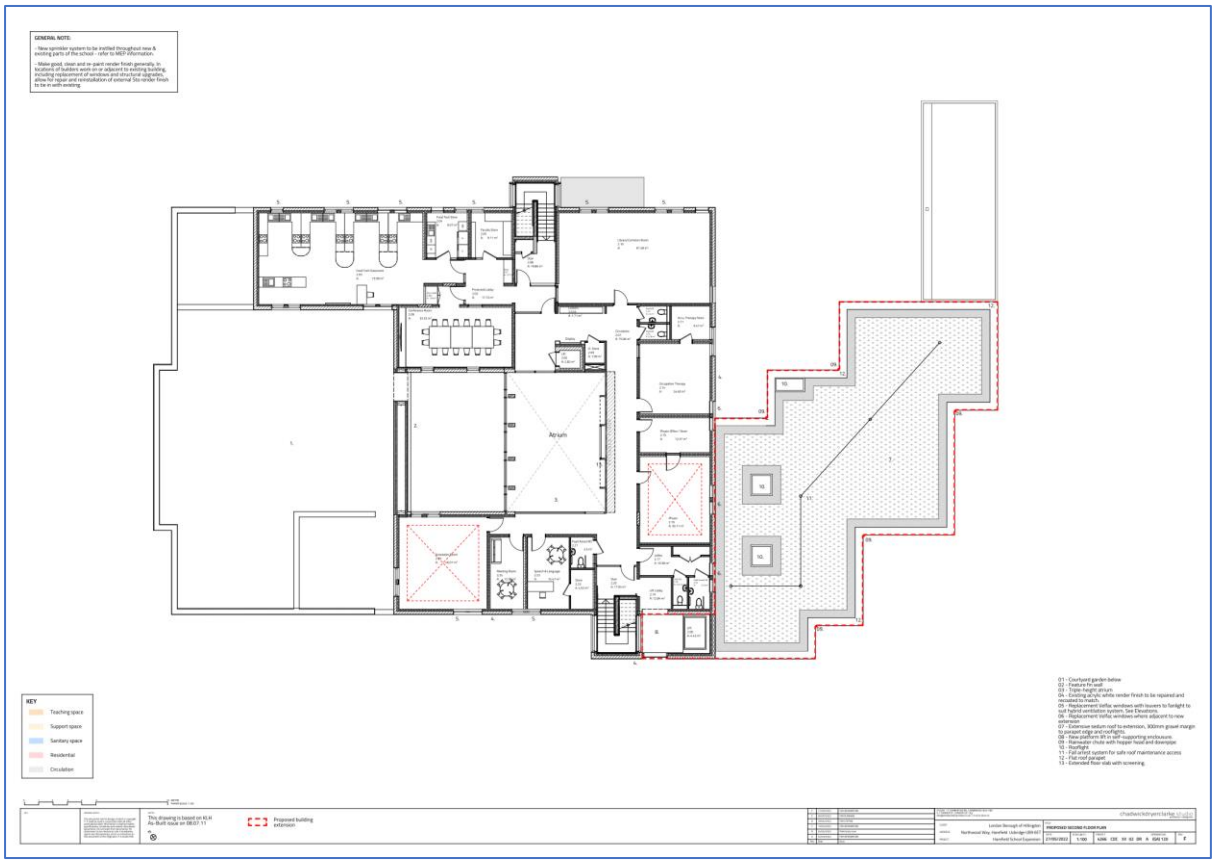

**Figure 3 : Elevation plan**

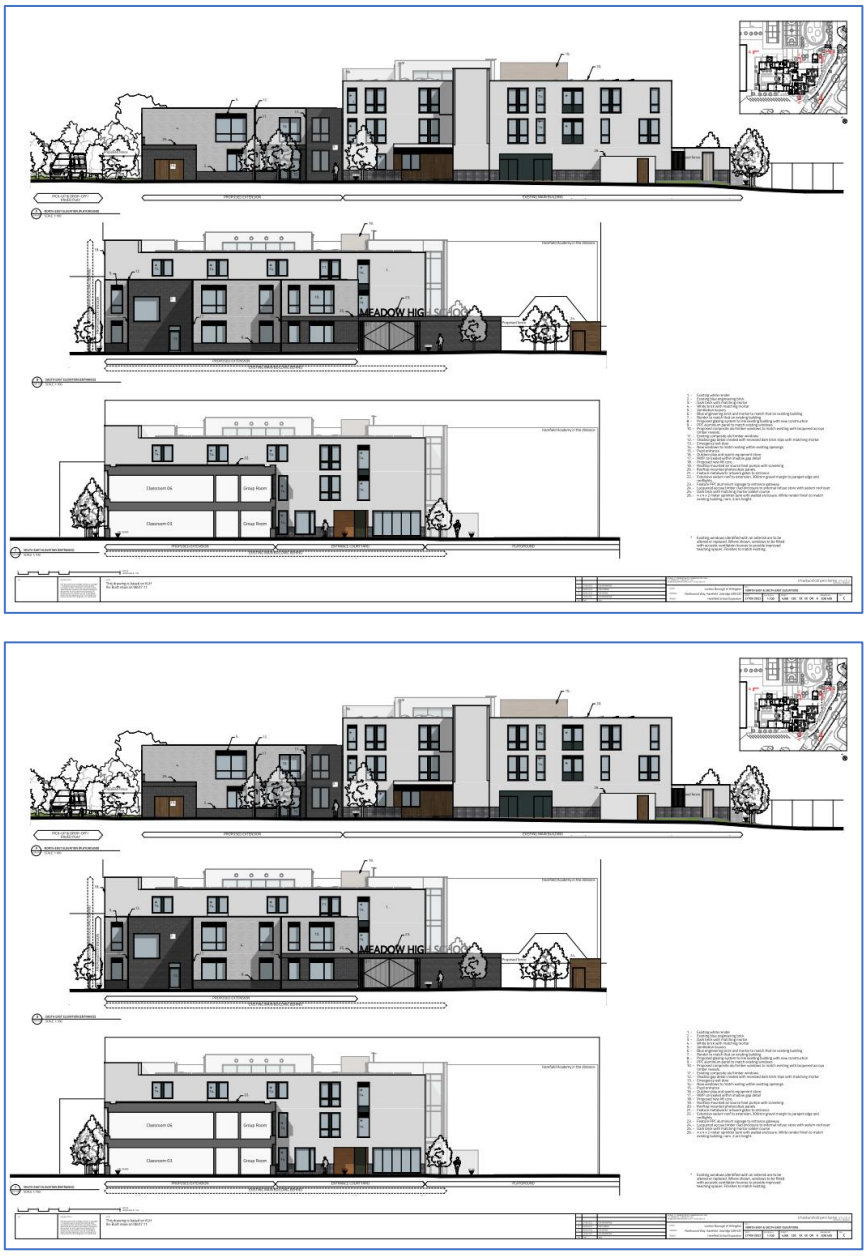


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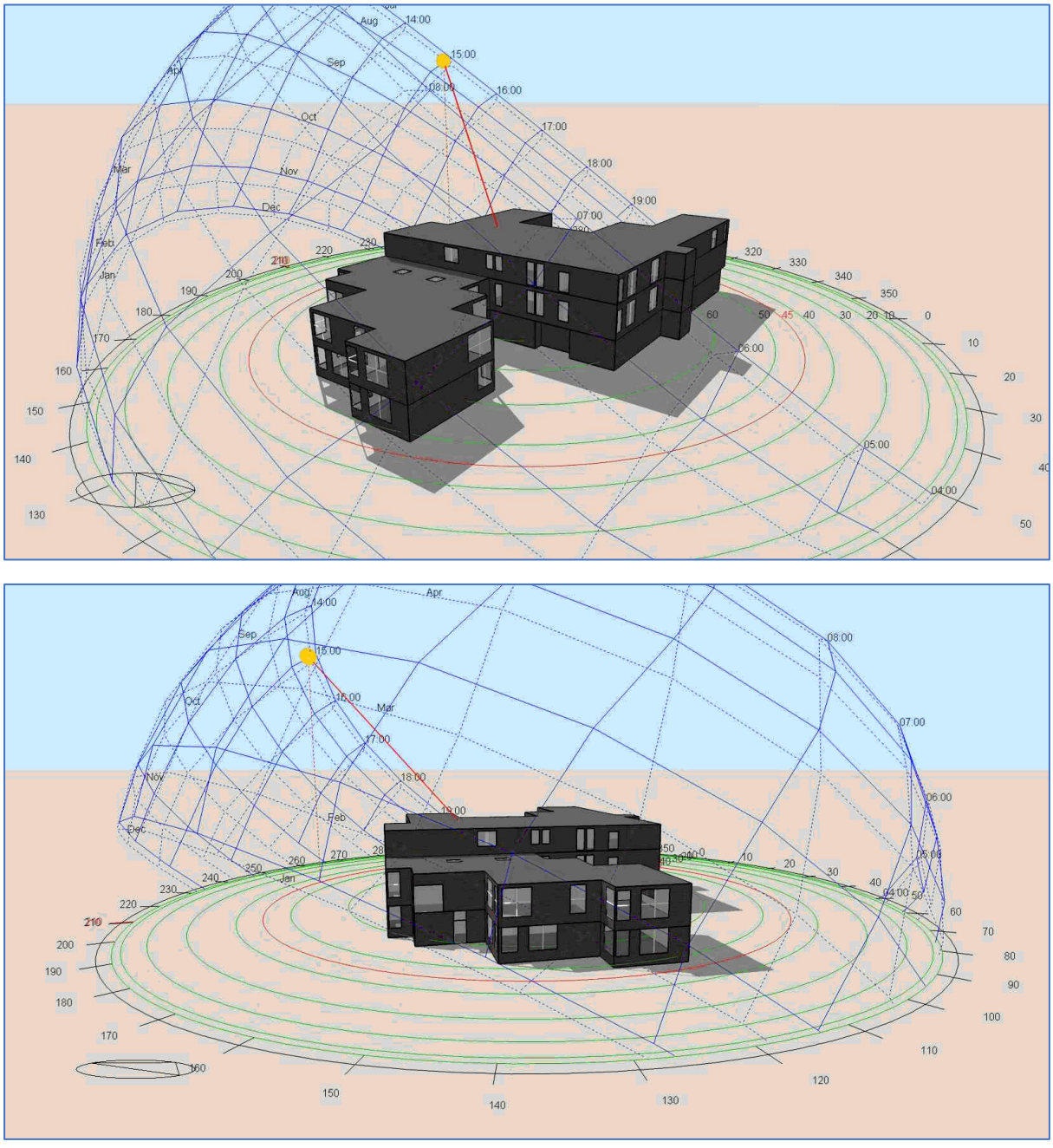
**Figure 4: Model Images**

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## 1.3 Software Calculation Specification

This overheating analysis was conducted using the Designbuilder EnergyPlus software package.

Calculation Engine: DesignBuilder EnergyPlus

Calculation Engine Version: v6.1.0.6

## 1.4 Weather File Detail

In accordance with CIBSE Technical Memorandum 52, the development is required to pass the overheating criteria using the DSY1 weather file for the most appropriate location nearest to the development.

The DSY represents warmer than typical year and is used to evaluate overheating risk within buildings.

The specific weather location chosen for this assessment was London Heathrow.

# 2 Methodology for Overheating analysis

BB101 encourages the use of TM52 and the criteria contained within to show compliance with summertime overheating limitations. As such, the methodology within TM52 has been applied to this assessment.

The risk of overheating in buildings is becoming more prevalent as changing climates and global energy insecurity make the control of indoor climate increasingly problematic. Overheating occurs in a building either through inappropriate design, poor management or inadequate services. Features of a design that support lower winter heating demand (such as large areas of south facing windows, high levels of insulation, low air permeability rates and low thermal mass) can result in excessively high internal temperatures during summer months.

In response to this increasing level of risk, CIBSE have developed an adaptive methodology to assess the predicted level of thermal comfort within a building. This assessment can be carried out at the detailed design stage by way of Dynamic Simulation Model. CIBSE TM52 sets three criteria for compliance. A building that fails two or more of the criteria is deemed to be at unacceptable risk of overheating:

1. Criterion 1: Hours of Exceedance
2. Criterion 2: Daily Weighted Exceedance
3. Criterion 3: Upper Limit Temperature

**Criterion 1** sets a limit of 3% on the number of occupied hours that the operative temperature can exceed the threshold comfort temperature, Tmax, by 1K or more during the occupied hours of a typical non-heating season – 1 May to 30 September. Tmax is a function of the outdoor running-mean temperature.

**Criterion 2** deals with the severity of overheating within any one day, which can be as important as its frequency. This is a function of both temperature above Tmax and its duration. This criterion sets a daily limit for acceptability. If each hour (or part-hour) in which the temperature exceeds Tmax by at least 1K is multiplied by the number of degrees by which it is exceeded, then this 'excess' should not be more than six degree-hours.

**Criterion 3** sets an absolute maximum temperature of (Tmax + 4) °C for a room (Tupp), beyond which the level of overheating is unacceptable. The overheating risk is assessed between the 1st of May and the 31st of September.

CIBSE TM52 overheating criteria only apply to "free-running" spaces, i.e. where the peak internal temperature is not controlled by air conditioning.

# 3 Overheating Model Inputs

## 3.1 Building Fabric

The fabric performance detailed in Table 1 has been based on the proposed performance detailed in the project design brief and anticipated construction where this information was readily available, where this is unknown, the information has been assumed.

The information detailed should be reviewed in detail for consistency with the design proposals.

| Building Element | G Value/ Visible Light Transmission | U Value (W/m²k) | Notes |
|---|---|---|---|
| Walls | - | 0.14 | Build Up assumed |
| Floor | - | 0.10 | Build Up assumed |
| Roof | - | 0.11 | Build Up assumed |
| Windows | 0.40 | 1.0 | Build Up assumed |
| Ext Door | - | 1.2 | Build Up assumed |
| | | | |

*Table 2*

| | | |
|---|---|---|
| **Design Air Pressure Value** | 3/10 (Existing) | **m³/h-m² @ 50 Pa** |

## 3.2 Internal Gains

| Area | Lighting W/m² | Occupancy | Equipment W/m² |
|---|---|---|---|
| Classrooms | 7.4 | 14 | 4.70 |
| Group Rooms | 7.4 | 4 | 4.70 |
| Physio | 7.4 | 4 | 2 |
| Speech and Language | 7.4 | 4 | 4.70 |
| Library | 7.4 | 14 | 4.70 |
| Staff Room | 5 | 12 | 2 |

### 3.3 Proposed Cooling and Ventilation

| **Mechanical Ventilation** | | | |
|---|---|---|---|
| **Type** | **Flow Rates (l/s)** | **Schedule** | **Rooms** |
| NVHR Units | 130 l/s (2 Units where shown on drawings)<br><br>180 l/s purge (2 units where shown on drawings) | between 08:00 and 17:00<br><br>between 17:00 and 08:00 | As drawings:<br>21168-PM11-P2 Grd Floor Vent - A1.<br>21168-PM12-P2 First Floor Vent - A1<br>21168-PM13-P2 Second Floor Vent - A1<br><br>**Additionally, 2 units in Library and 1 unit in occupational Therapy.** |

### 3.4 Proposed shading

| Shading Type | Windows applicable | Schedule | Shade data |
|---|---|---|---|
| External blinds | N/a | N/a | N/a |
| Internal blinds | All | As occupancy | Generic Medium Transmittance |

To optimize air flow into the zones and the use of the specified mechanical units, blinds have been discounted from the assessment for the purpose of utilizing the free aperture area provided by the windows.

### 3.5 Glazing openable area

| Area | Windows applicable | Free Aperture area (%) |
|---|---|---|
| Areas which do not have hybrid venting | All | 5% min. |

### 3.6 Other applicable information

# 4 Results

| Block | Zone | Criterion 1 (%) | Criterion 2 (K.hr) | Criterion 3 (hr) | Pass/Fail |
|---|---|---|---|---|---|
| 0 | 0.35 Group Room | 0 | 0 | 0 | Pass |
| 0 | 0.36 Classroom 01 | 0.41 | 2.83 | 0 | Pass |
| 0 | 0.37 Classroom 02 | 0.69 | 4.83 | 0 | Pass |
| 0 | 0.38 Classroom 03 | 0.36 | 2.83 | 0 | Pass |
| 1 | 1.10 Classroom 08 | 0.82 | 4 | 0 | Pass |
| 1 | 1.15 Staff Room | 7.35 | 12.5 | 0 | Fail |
| 1 | 1.17 Classroom 07 | 0 | 0 | 0 | Pass |
| 1 | 1.32 Classroom 05 | 0.87 | 5.83 | 0 | Pass |
| 1 | 1.31 Classroom 04 | 0.49 | 4.5 | 0 | Pass |
| 1 | 1.28 Classroom 06 | 0.49 | 4.67 | 0 | Pass |
| 1 | 1.30 Group Room | 0 | 0 | 0 | Pass |
| 2 | 2.08 Library | 0 | 0 | 0 | Pass |
| 2 | 2.17 Occupational Therapy | 0 | 0 | 0 | Pass |
| 2 | 2.20 Speech Language | 0.08 | 0.5 | 0 | Pass |

# 5 Conclusion

Under the criteria of the CIBSE TM52 methodology, the spaces assessed predominantly pass the overheating assessment for the scenarios calculated, most of the assessed areas are predicted to meet the limited overheating requirements according to the TM52 methodology, with rooms expected to stay at temperatures below the upper limits allowed.

Group rooms, classrooms, library and occupational therapy do show to have tolerable levels with only the staff room exceeding the requirements, though this should be noted that the actual occupancy periods within the staff room are presumably far less than assumed for the purpose of analysis and is more assessed as an office space. A key element to ensuring overheating is kept to a minimum is the correct use of the hybrid ventilation units, with the ventilation units providing sufficient ventilation to counteract any overheating.

Whilst there may be periods of time that there are elevated temperatures within zones which some occupants may deem uncomfortable, these temperatures have a low enough occurrence to be considered acceptable against the requirements.

It should be noted that any changes to the openable areas of windows, ventilation strategies or the fabric thermal parameters will affect the results and further assessment will be required.