Overheating Risk Assessment

for

Burnside PRU

Rev C04

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Project Revision Sheet

Burnside PRU

Overheating Risk Assessment

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Rev C04

Revision	Date	Details	Author	Checked
C01	11/10/2023	Info exchange 3	BKR	JdB
C02	19/10/2023	Info Exchange 3	BKR	JdB
C03	25/10/2024	Plans and elevations updated	BKR	JdB
C04	06/01/2025	Planning requirements overheating risk assessment added	BKR	JdB

CONTENTS

Overheating Risk Assessment

Burnside PRU

1 INTRODUCTION

This document set out the approach to and results of the overheating risk assessment for Burnside PRU.

1.1 Description of Site and Building

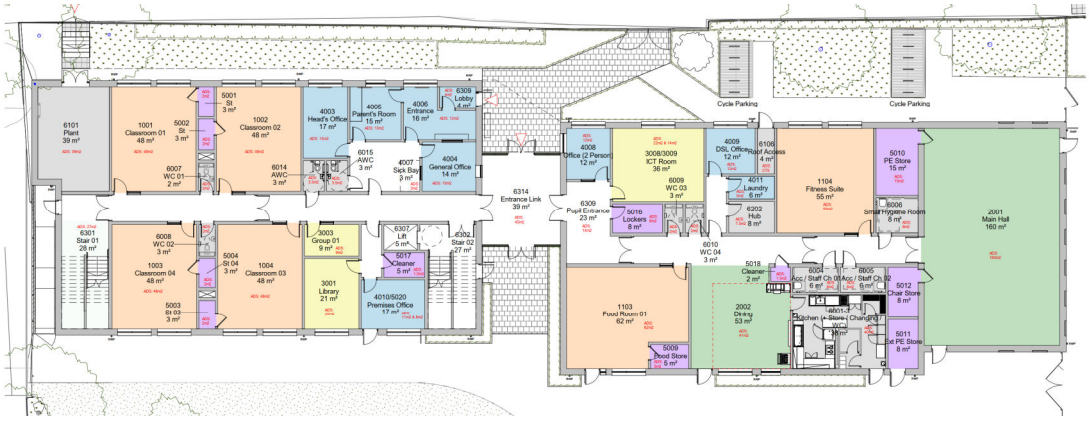
The site is currently occupied by a 48 pupil Secondary Alternative Provision school in a single storey block (originally designed as a primary school), making use of the adjacent Burwood Centre building and also a separate gym / classroom block. The site is proposed to be redeveloped to provide a new Secondary Pupil Referral Unit for 48 pupils in a two-storey building to be constructed in two phases.

The area of the school is approximately 1600m².

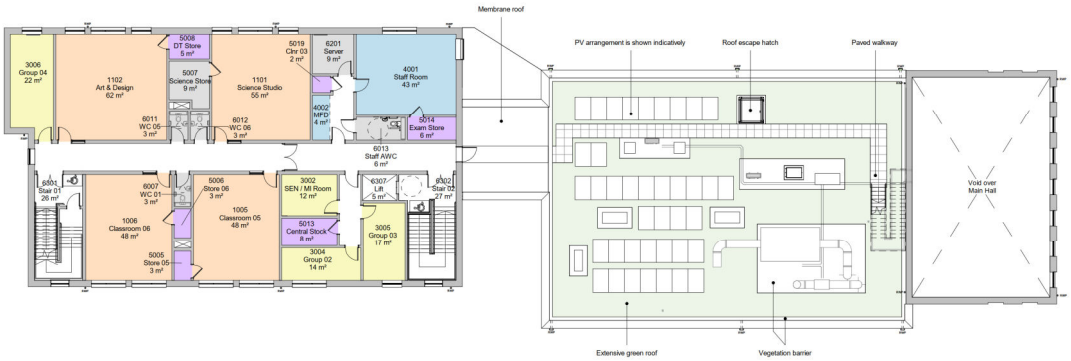
The building has a capacity of 48 pupils with 35 full-time equivalent staff.

1.2 General Arrangement Drawings

Ground Floor



First Floor

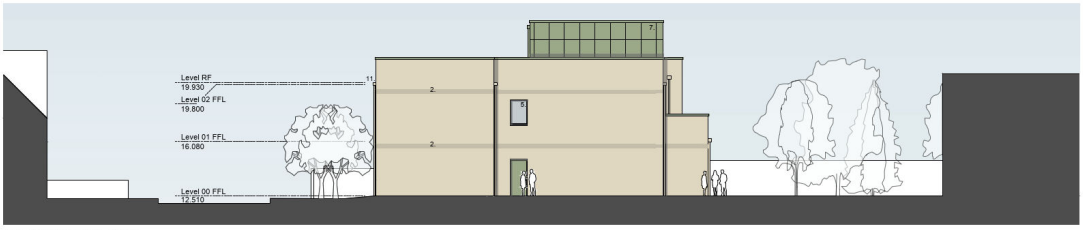


1.3 Building Elevations

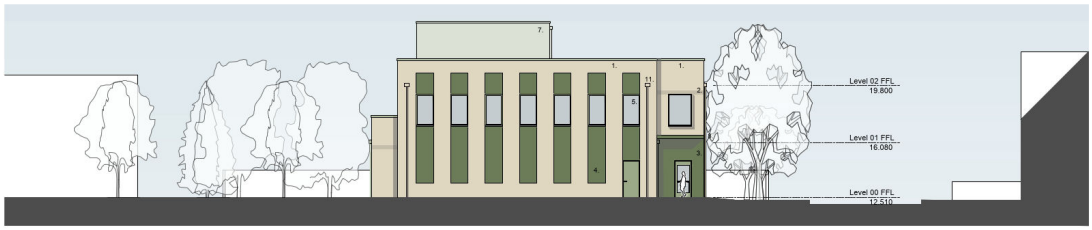
Proposed Elevation 1 - North

Proposed Elevation 2 - South

KEY PLAN



Proposed Elevation 3 - West



1.4 Basis of Model

Model is based on the following drawings and architectural model:

SRP1055-RSS-XX-00-D-A-1210 C06 General Arrangement Proposed Ground Floor Plan

SRP1055-RSS-XX-01-D-A-1211 C07 General Arrangement Proposed First Floor Plan

SRP1055-RSS-XX-RF-D-A-1212 C06 General Arrangement Proposed Roof Plans

SRP1055-RSS-XX-ZZ-D-A-1401 C06 Proposed North & South Elevations

SRP1055-RSS-XX-ZZ-D-A-1402 C05 Proposed West & East Elevations

SRP1055-RSS-01-ZZ-M-A-0001.rvt and agreed amendments

2 PLANNING REQUIREMENTS

2.1 London Borough of Waltham Forest Local Plan

Policy 92 of the London Borough of Waltham Forest Local Plan, Adopted 2024, states that:

Policy 92

Overheating

To avoid exacerbation of the Urban Heat Island (UHI) effect, improve micro-climate conditions, and provide thermally comfortable environments, overheating will be prevented by:

A. Optimising the layout, orientation, materials, technology and design of new development to minimise any adverse impacts on internal and external temperature, reflection, overshadowing, micro-climate and wind movement;

B. Ensuring major development proposals follow the cooling hierarchy in alignment with the London Plan, considering future climate change;

C. Implementing adequate mitigation measures to minimise overheating, including landscaping, tree planting and the use of blue and green infrastructure; and

D. Ensuring all major developments undertake dynamic overheating assessments in line with Chartered Institute of Building Services Engineers (CIBSE) Technical Memorandum 59 (TM59) or equivalent.

Further explanation is provided in paragraph 8.29:

> To analyse their risk of overheating, new developments will be required to undertake overheating assessments in line with Chartered Institute of Building Services Engineers (CIBSE) guidance as set out in the GLA's guidance on preparing energy assessment guidance as part of planning applications. Development proposals should also adopt the London Plan's cooling hierarchy to mitigate overheating and avoid reliance on air conditioning systems. This cooling hierarchy includes measures such as passive ventilation, active low-carbon cooling systems, mechanical ventilation, energy efficient design, high ceilings, shading and green infrastructure, which can all serve to reduce internal temperatures. To reinforce this, new development will also be expected to provide appropriate mitigation measures to address overheating, and the Plan strongly encourages the use of blue and green infrastructure and urban greening as sustainable cooling options for both internal and external environments.

2.2 Mayor of London Energy Assessment Guidance

2.2.1 Approach

Section 8 of the Guidance sets out the approach that should be taken to cooling and heating, including a requirement for a detailed analysis of the risk of overheating.

Table 6 states that the GLA overheating requirements for overheating risk assessments for non-residential developments are to:

> Undertake dynamic overheating modelling in line with the guidance and data sets in CIBSE TM52 and TM49 respectively

And Paragraph 8.7 states that for non-residential buildings:

> CIBSE guide TM52, entitled 'The Limits of Thermal Comfort: Avoiding Overheating in European Buildings', contains guidance on the limits of thermal comfort. 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 should be considered when carrying out dynamic thermal modelling.

The use of CIBSE TM59, CIBSE's Design Methodology for the Assessment of Overheating Risk in Homes, is not relevant to this development.

2.2.2 Design Weather Files

The Guidance states the following with regard to the Design weather files

> 8.13. Overheating modelling for both residential and non-residential developments should be conducted using the following design weather file:
>
> • DSY1 (Design Summer Year) for the 2020s, high emissions, 50% percentile scenario
>
> 8.14. It is expected that the CIBSE compliance criteria is met for the DSY1 weather scenario.
>
> 8.15. Additional testing should be undertaken using the 2020 versions of the following more extreme design weather years:
>
> • DSY2 – 2003: a year with a very intense single warm spell.
>
> • DSY3 – 1976: a year with a prolonged period of sustained warmth.

2.3 Interpretation

An overheating risk assessment should be undertaken following the approach recommended in section 6 of TM52 using the 2020, high emissions, 50 percentile scenario versions of the DSY1, 2 and 3 weather files appropriate for the site.

The following weather files will be utilised to demonstrate compliance with planning requirements:

- LHR1989_2020High50% (DSY1)
- LHR2003_2020High50% (DSY2)
- LHR1976_2020High50% (DSY3)

These weather files are in addition to the requirements outlined in the School Output Specification, Technical Annex 2F: Mechanical Services and Public Health Engineering (November 2022).

The results for the overheating risk assessment using the 2020 weather files in accordance with the planning requirements are in section 6 of this report.

Building Bulletin 101: Guidelines on Ventilation, Thermal Comfort, and Indoor Air Quality in Schools (August 2018) specifies that the number of hours during which the actual operative temperature in a room exceeds the limiting maximum acceptable temperature by one degree or more must be less than 40 (refer to Section 3 for further explanation). This threshold is higher than that recommended by TM52; however, since BB101 is a more recent document and is issued by the Education and Skills Funding Agency as guidance for the design of new school buildings, the requirements outlined in BB101 are considered to take precedence.

3 ADAPTIVE THERMAL COMFORT

Technical Annex 2F of the Output specification requires that an overheating risk assessment be undertaken for buildings that are not mechanically cooled. The assessment is based on the adaptive comfort model following the methodology and recommendations from EN 15251, and modelling has been undertaken following the procedure set out in CIBSE TM52.

The thermal modelling has been carried out using EDSL TAS v9.5.5. software. This modelling software is approved by 2021 Building Regulations and is also compliant with CIBSE AM11 requirements. This modelling has been used to test various strategies for ventilation, solar gain reduction, and the use of building's structure to absorb heat, in order to arrive at a solution that meets the OS criteria in a cost effective way and allows the other key environmental criteria relating to daylight and acoustics to be satisfied.

The modelling has been undertaken using the guidance provided in the DfE's Generic Design Brief, Technical Annex 2F, and BB101 (2018).

3.1 Overheat Risk Criteria

The assessment of overheating risk considers three criteria, all based on the difference between the current room operative temperature (Top) and the maximum acceptable temperature (Tmax). This difference is referred to as 'delta T' (ΔT). These criteria are evaluated during the summer period from May to September, assuming continuous occupancy, including half terms and summer holidays.

The three criteria are:

Criterion 1 – Hours of Exceedance (He): The number of hours that the actual operative temperature in the room (T_{op}) exceeds the limiting maximum acceptable temperature (T_{max}) by one degree (K) or more, must be less than 40.

> This criterion provides an understanding of how often a room is likely to exceed its comfort range and can provide a good first assessment of acceptability.

Criterion 2 - Weighted Exceedance (We): The sum of the weighted hours that T_{op} is above T_{max} must be less than or equal to 6 on each day.

> This criterion covers the severity of overheating and considers that, for example, 3 hours with an exceedance of 2 degrees is equivalent to 6 hours with an exceedance of 1 degree. Since this tests the severity of overheating it could be considered to be more important than frequency, and sets a daily limit of acceptability.

Criterion 3 - Threshold/Upper Limit Temperature (Tupp): The predicted operative temperature should not exceed the Tmax by 4 degrees or more at any time.

> This sets a limit beyond which normal adaptive actions will be insufficient to restore personal comfort and the vast majority of occupants will complain of being 'too

hot'. This criterion covers the extremes of hot weather conditions and future climate scenarios.

3.2 Evaluation of Overheating Risk

The evaluation method establishes four thermal comfort categories, each with distinct maximum acceptable temperatures. Category I represents the highest thermal comfort level, while category IV is the lowest. Generally, the difference between (e.g.) a category II space and a category III space lies in the fact that the category III space can be 1°C warmer than the category II space.

The table below sets out the thermal comfort category that is applied to the various spaces in the building.

Space	Adaptive thermal comfort category
Teaching and learning, drama, dance, exams, multi-purpose halls Offices	II
Atria, circulation, reception and corridors – not continuously occupied	III

Each room will be deemed to have an unacceptable risk of overheating if the room fails to meet the 40 hour standard set under Criterion 1. The results for criteria 2 and 3 are presented for information.

DEFINITIONS

Operative Temperature

T_{OP} = 0.5 T_{air} (AirTemp) + 0.5 T_{mrt} (Mean Radiant Temp)

Maximum acceptable temperature

TMAX = 0.33Trm + 21.8 (Category II)

TMAX = 0.33Trm + 22.8 (Category III)

TMAX = 0.33Trm + 23.8 (Category IV)

where:

Running Mean Temperature, Trm, is the running average of recent external temperatures. The running mean is calculated using a complicated equation that weights the significance of external temperatures according how recently they occurred. This weighting gives a greater influence for recent days,

3.3 Summary of Overheating Risk Assessment Model Inputs

The following table summarises the various constructions used within the simulation model along with details of the weather file used and aperture operating profiles.

3.3.1 Building Fabric

Parameter	Modelling Input
Window Properties	Window U value: 1.1W/m^{2}K Glazing G value: 0.39 Glazing Light Transmittance: 0.68 Internal Blind – No
External wall construction	Lightweight SIPs construction with 15mm Rigidur H high density board internal wall
Internal wall construction (Stud)	Plasterboard stud walls with 25mm Rigidur H high density board both sides
Intermediate floor, no ceiling	Concrete planks, screed, Carpet
Floating acoustic rafts	Lightweight acoustic panels with insulation above. Free air movement between acoustic rafts and ceiling.
Intermediate floor with ceiling	Plasterboard ceiling, void, concrete planks, screed, Carpet
Ground Floor	Floor covering, screed, concrete, Insulation, Sub soil.
Roof	Plasterboard, structural cassette, Insulation, Waterproof barrier, 200mm soil for biodiverse roof

3.3.2 Ventilation

Parameter	Modelling Input
Classroom Ventilation, Staffroom, Dining	Hybrid ventilation using Monodraught HVR Zero X+. Assume 10l/person ventilation daytime to meet air quality and night purge 500 litres/s Windows assumed to be closed due to acoustic environment.
Library	Hybrid ventilation using Monodraught HVR Zero X+. Assume 10l/person ventilation daytime to meet air quality and night purge 250 litres/s

Parameter	Modelling Input
	Windows assumed to be closed due to acoustic environment.
Office Ventilation	Mechanical ventilation at 10 litres/second/person during occupied period Windows assumed to be closed due to acoustic environment.
Group rooms, SEN MI	Mechanical ventilation at 10 litres/second/person during occupied period

3.3.3 Other Parameters

Parameter	Modelling Input
Lighting Gains	Daylight control using calculated daylight factors for all rooms. No dimming when blinds (if provided) in use to reduce solar gain. Gains taken from lighting calculations: Classrooms – 4 W/m² Group rooms – 6 W/m² Offices – 4 W/m² Circulation – 2.5 W/m² WCs – 2.5 W/m²
Infiltration	0.15 air changes per hour
Equipment Gains	Classrooms – 10 W/m² Transition room (IT intensive) – 25 W/m² Hall – 5 W/m² Group rooms – 0 W/m² Offices – 10 W/m² Parent's Room - 0 W/m² Circulation – 0 W/m² WCs – 0 W/m²
Weather File	CIBSE London Design Summer Year DSY1 GTW1989_2080Low50%.

3.3.4 Occupancy

The assumed occupancy and equipment gains for each room are generally as per the occupancy rate from the School Specific Brief Schedule of Accommodation.

The standard occupancy periods are:

1st May – 30th September

Monday to Friday – No holidays.

Teaching Spaces: Times applied: 9.00 – 12.00 and 13.00 – 16.00

Offices and Corridors: Times applied: 9.00 – 16.00

The occupancy rate for the rooms below is set out in the following table in greater detail:

Parameter	**Modelling Input**
Classrooms and science studio, teaching transition room	1 person – 08.00-09.00 14 people 09.00-12.00 14 people 13.00-16.00 1 person – 16.00-17.00
Art and design and food room	1 person – 08.00-09.00 10 people 09.00-12.00 10 people 13.00-16.00 1 person – 16.00-17.00
Fitness	1 person – 08.00-09.00 18 people 09.00-12.00 18 people 13.00-16.00 1 person – 16.00-17.00
Dining	10 people 09.00-12.00 33 people 12.00-13.00 10 people 13.00-16.00
Main Hall	92 people 09.00-10.00 30 people 10.00-14.00 92 people14.00-15.00 30 people15.00-16.00
Group Rooms 01-03	5 people 09.00-12.00 5 people 13.00-17.00
Group Rooms 04	11 people 09.00-12.00 11 people 13.00-17.00
Library	9 people 09.00-12.00 9 people 13.00-17.00

Parameter	Modelling Input
SEN MI	3 people 09.00-12.00 6 people 13.00-14.00 3 people 14.00-16.00 SOA occupancy states 6. Assumed that room is part occupied for most of the day.
Staff Room	25 people – 08.00-09.00 5 people – 09.00-12.00 25 people – 12.00-13.00 5 people – 13.00-16.00 25 people – 16.00-17.00
Head teacher office	1 person – 08.00-11.00 6 people – 11.00-12.00 1 person – 12.00-15.00 4 person – 15.00-16.00 1 person – 16.00-17.00
General Office	2 people – 08.00-09.00 4 people – 09.00-12.00 2 people – 12.00-13.00 4 people – 13.00-16.00 2 people – 16.00-17.00
Parent's Room, Office/meeting rooms (2 person)	2 people – 08.00-09.00 6 people – 09.00-10.00 2 people – 12.00-13.00 4 people – 13.00-14.00 2 people – 14.00-15.00 4 people – 15.00-16.00 2 people – 16.00-17.00
Premises office	1 people – 08.00-09.00 3 people – 09.00-10.00 1 people – 12.00-13.00 2 people – 13.00-14.00 1 people – 14.00-15.00 2 people – 15.00-16.00 1 people – 16.00-17.00

4 OVERHEATING RISK ASSESSMENT - 2°C SCENARIO RESULTS

The results of the overheating risk assessment have been broken down by room type:

4.1 General teaching

Zone Name	Occupied Summer Hours	Max. Exceedable Hours	Criterion 1: #Hours Exceeding Comfort Range	Criterion 2: Peak Daily Weighted Exceedance	Criterion 3: #Hours Exceeding Absolute Limit	Result
1001 Classroom 01	654	40	0	0	0	Pass
1002 Classroom 02	654	40	1	1	0	Pass
1003 Classroom 04	654	40	1	1	0	Pass
1004 Classroom 03	654	40	7	2	0	Pass
1005 Classroom 05	654	40	26	5	0	Pass
1006 Classroom 06	654	40	17	4	0	Pass
1101 Class Science Studio	654	40	7	2	0	Pass
1102 Class Art and Design Studio	654	40	1	1	0	Pass
1103 Class Food room 01	654	40	0	0	0	Pass
1104 Class Fitness Suite	654	40	5	2	0	Pass
3008 TeachTransition Room	654	40	124	11	0	Fail

4.2 Specialist teaching

Zone Name	Occupied Summer Hours	Max. Exceedable Hours	Criterion 1: #Hours Exceeding Comfort Range	Criterion 2: Peak Daily Weighted Exceedance	Criterion 3: #Hours Exceeding Absolute Limit	Result
3001 Teach Library	654	40	20	3	0	Pass
3002 SEN MI	654	40	2	2	0	Pass
3003 Group 01	654	40	4	1	0	Pass
3004 Group 02	654	40	23	6	0	Pass
3005 Group 03	654	40	3	2	0	Pass
3006 Group 04	654	40	0	0	0	Pass

4.3 Dining/Social/Halls

Zone Name	Occupied Summer Hours	Max. Exceedable Hours	Criterion 1: #Hours Exceeding Comfort Range	Criterion 2: Peak Daily Weighted Exceedance	Criterion 3: #Hours Exceeding Absolute Limit	Result
2001 Hall grd floor	654	40	0	0	0	Pass
2002 Dining	654	40	20	5	0	Pass

4.4 Staff and Administration

Zone Name	Occupied Summer Hours	Max. Exceedable Hours	Criterion 1: #Hours Exceeding Comfort Range	Criterion 2: Peak Daily Weighted Exceedance	Criterion 3: #Hours Exceeding Absolute Limit	Result
4001 Office Staff room	654	40	28	5	0	Pass
4003 Office Head's office	654	40	0	0	0	Pass
4004 Office Gen Office	654	40	0	0	0	Pass
4005 Office Parent's Room	654	40	1	1	0	Pass
4008 Office	654	40	9	3	0	Pass
4009 Office DSL	654	40	14	3	0	Pass
4010 Office Premises Office	654	40	0	0	0	Pass

4.5 Conclusions

The building complies with the thermal comfort criteria with the exception of the IT intensive transition classroom, which due to the high casual gains from the equipment will require active comfort cooling.

5 OVERHEATING RISK ASSESSMENT - 4°C SCENARIO RESULTS

The majority of the spaces in the building do not meet the overheating criteria when tested against the 4° C global warming scenario weather file when tested against the modelling inputs in section 2.

The weather file used is CIBSE London Design Summer Year DSY1 GTW1989_2080high50% weather file.

The results for a sample of rooms are shown below:

Zone Name	Occupied Summer Hours	Max. Exceedable Hours	Criterion 1: #Hours Exceeding Comfort Range	Criterion 2: Peak Daily Weighted Exceedance	Criterion 3: #Hours Exceeding Absolute Limit	Result
1001 Classroom 01	654	40	9	3	0	Pass
1004 Classroom 03	654	40	44	8	0	Fail
1005 Classroom 05	654	40	78	14	0	Fail
1006 Classroom 06	654	40	62	12	0	Fail
1101 Class Science Studio	654	40	37	7	0	Pass
1104 Class Fitness Suite	654	40	35	6	0	Pass
2001 Hall grd floor	654	40	16	4	0	Pass
2002 Dining	654	40	65	10	0	Fail
3001 Teach Library	654	40	81	10	0	Fail
3002 SEN MI	654	40	26	7	0	Pass
3005 Group 03	654	40	49	8	0	Fail
3006 Group 04	654	40	28	6	0	Pass
3008 TeachTransition Room	654	40	214	14	8	Fail
4001 Office Staff room	654	40	95	13	0	Fail
4003 Office Head's office	654	40	11	4	0	Pass
4005 Office Parent's Room	654	40	25	5	0	Pass
4008 Office	654	40	62	11	0	Fail

5.1 Mitigation

The following adaptation measures will allow the building achieve compliance with the overheating criteria under the more severe global warming scenario:

- Increased thermal mass by replacing plasterboard ceiling below roof with 30mm Rigidur H high density board.
- Remove the false ceiling from below the concrete structural slab in the two-storey part of the school. This exposes the thermal mass of the intermediate floor.
- Provide temperature trimming in classrooms 5 and 6, the dining space, the teaching library, group rooms 2 and 3, the two offices, and the staff room. The temperature trimming will be provided by operating the heating system and ASHPs in “reverse”, distributing water at around 20°C through the pipework and heat emitters. Compliance with the overheating criteria was achieved by providing heat extraction at a rate of 10 W/m² in the above rooms. This system could be extended to all rooms to further improve thermal comfort throughout the building.

5.2 General teaching

Zone Name	Occupied Summer Hours	Max. Exceedable Hours	Criterion 1: #Hours Exceeding Comfort Range	Criterion 2: Peak Daily Weighted Exceedance	Criterion 3: #Hours Exceeding Absolute Limit	Result
1001 Classroom 01	654	40	2	1	0	Pass
1002 Classroom 02	654	40	5	2	0	Pass
1003 Classroom 04	654	40	10	4	0	Pass
1004 Classroom 03	654	40	16	4	0	Pass
1005 Classroom 05	654	40	32	6	0	Pass
1006 Classroom 06	654	40	20	5	0	Pass
1101 Class Science Studio	654	40	24	6	0	Pass
1102 Class Art and Design Studio	654	40	10	4	0	Pass
1103 Class Food room 01	654	40	0	0	0	Pass
1104 Class Fitness Suite	654	40	21	4	0	Pass
3008 TeachTransition Room	654	40	196	14	4	Fail

5.3 Specialist teaching

Zone Name	Occupied Summer Hours	Max. Exceedable Hours	Criterion 1: #Hours Exceeding Comfort Range	Criterion 2: Peak Daily Weighted Exceedance	Criterion 3: #Hours Exceeding Absolute Limit	Result
3001 Teach Library	654	40	38	7	0	Pass
3002 SEN MI	654	40	16	6	0	Pass
3003 Group 01	654	40	16	3	0	Pass
3004 Group 02	654	40	28	5	0	Pass
3005 Group 03	654	40	13	3	0	Pass
3006 Group 04	654	40	17	4	0	Pass

5.4 Dining/Social/Halls

Zone Name	Occupied Summer Hours	Max. Exceedable Hours	Criterion 1: #Hours Exceeding Comfort Range	Criterion 2: Peak Daily Weighted Exceedance	Criterion 3: #Hours Exceeding Absolute Limit	Result
2001 Hall grd floor	654	40	12	2	0	Pass
2002 Dining	654	40	22	5	0	Pass

5.5 Staff and Administration

Zone Name	Occupied Summer Hours	Max. Exceedable Hours	Criterion 1: #Hours Exceeding Comfort Range	Criterion 2: Peak Daily Weighted Exceedance	Criterion 3: #Hours Exceeding Absolute Limit	Result
4001 Office Staff room	654	40	35	7	0	Pass
4003 Office Head's office	654	40	3	1	0	Pass
4004 Office Gen Office	654	40	3	2	0	Pass
4005 Office Parent's Room	654	40	10	3	0	Pass
4008 Office	654	40	21	5	0	Pass
4009 Office DSL	654	40	24	5	0	Pass
4010 Office Premises Office	654	40	20	5	0	Pass

5.6 Conclusions

With the proposed mitigation measures the building complies with the thermal comfort criteria with the exception of the IT intensive transition classroom, which due to the high casual gains from the equipment will require active comfort cooling.

6 OVERHEATING RISK ASESSMENT – PLANNING REQUIREMENTS.

The results of the overheating risk assessment are shown below.

6.1 2020 DSY1 Weather File

Zone Name	Occupied Summer Hours	Max. Exceedable Hours	Criterion 1: #Hours Exceeding Comfort Range	Criterion 2: Peak Daily Weighted Exceedance	Criterion 3: #Hours Exceeding Absolute Limit	Result
1001 Classroom 01	654	40	0	0.0	0	Pass
1002 Classroom 02	654	40	0	0.0	0	Pass
1004 Classroom 03	654	40	2	2.0	0	Pass
1003 Classroom 04	654	40	0	0.0	0	Pass
1005 Classroom 05	654	40	19	4.0	0	Pass
1006 Classroom 06	654	40	10	3.0	0	Pass
1103 Class Food room 01	654	40	0	0.0	0	Pass
1104 Class Fitness Suite	654	40	2	1.0	0	Pass
1102 Class Art and Design Studio	654	40	0	0.0	0	Pass
1101 Class Science Studio	654	40	5	2.0	0	Pass
3003 Group 01	654	40	0	0.0	0	Pass
3005 Group 03	654	40	0	0.0	0	Pass
3006 Group 04	654	40	0	0.0	0	Pass
3004 Group 02	654	40	14	4.0	0	Pass
2001 Hall grd floor	763	40	0	0.0	0	Pass
2001 Hall upper level	0	40	0	0.0	0	Pass
3001 Teach Library	763	40	9	2.0	0	Pass
3008 TeachTransition Room	981	40	123	12.0	0	Fail
4001 Office Staff room	981	40	32	6.0	0	Pass
4010 Office Premises Office	981	40	0	0.0	0	Pass
2002 Dining	763	40	8	3.0	0	Pass
4003 Office Head's office	981	40	0	0.0	0	Pass
4004 Office Gen Office	981	40	0	0.0	0	Pass
4005 Office Parent's Room	981	40	0	0.0	0	Pass
4006 Visitor Entrance	0	40	0	0.0	0	Pass
4008 Office	981	40	6	2.0	0	Pass
4009 Office DSL	981	40	9	2.0	0	Pass
3002 SEN MI	654	40	0	0.0	0	Pass
4002 Multi function bay	0	40	0	0.0	0	Pass

6.2 2020 DSY2 Weather File

Zone Name	Occupied Summer Hours	Max. Exceedable Hours	Criterion 1: #Hours Exceeding Comfort Range	Criterion 2: Peak Daily Weighted Exceedance	Criterion 3: #Hours Exceeding Absolute Limit	Result
1001 Classroom 01	654	40	12	6.0	2	Pass
1002 Classroom 02	654	40	13	6.0	2	Pass
1004 Classroom 03	654	40	22	9.0	4	Fail
1003 Classroom 04	654	40	20	9.0	3	Fail
1005 Classroom 05	654	40	30	6.0	9	Pass
1006 Classroom 06	654	40	26	7.0	7	Fail
1103 Class Food room 01	654	40	10	9.0	0	Pass
1104 Class Fitness Suite	654	40	17	8.0	2	Fail
1102 Class Art and Design Studio	654	40	16	6.0	2	Pass
1101 Class Science Studio	654	40	22	9.0	3	Fail
3003 Group 01	654	40	15	8.0	2	Fail
3005 Group 03	654	40	23	9.0	2	Fail
3006 Group 04	654	40	16	8.0	2	Fail
3004 Group 02	654	40	39	11.0	6	Fail
2001 Hall grd floor	763	40	14	9.0	1	Fail
2001 Hall upper level	0	40	0	0.0	0	Pass
3001 Teach Library	763	40	27	9.0	6	Fail
3008 TeachTransition Room	981	40	117	13.0	14	Fail
4001 Office Staff room	981	40	44	12.0	9	Fail
4010 Office Premises Office	981	40	39	12.0	4	Fail
2002 Dining	763	40	28	13.0	4	Fail
4003 Office Head's office	981	40	15	10.0	2	Fail
4004 Office Gen Office	981	40	16	15.0	0	Pass
4005 Office Parent's Room	981	40	21	11.0	3	Fail
4006 Visitor Entrance	0	40	0	0.0	0	Pass
4008 Office	981	40	29	13.0	4	Fail
4009 Office DSL	981	40	30	11.0	6	Fail
3002 SEN MI	654	40	20	9.0	3	Fail
4002 Multi function bay	0	40	0	0.0	0	Pass

6.3 2020 DSY3 Weather File

Zone Name	Occupied Summer Hours	Max. Exceedable Hours	Criterion 1: #Hours Exceeding Comfort Range	Criterion 2: Peak Daily Weighted Exceedance	Criterion 3: #Hours Exceeding Absolute Limit	Result
1001 Classroom 01	654	40	36	12.0	2	Fail
1002 Classroom 02	654	40	41	12.0	5	Fail
1004 Classroom 03	654	40	45	11.0	11	Fail
1003 Classroom 04	654	40	44	10.0	8	Fail
1005 Classroom 05	654	40	55	12.0	20	Fail
1006 Classroom 06	654	40	50	12.0	17	Fail
1103 Class Food room 01	654	40	31	10.0	0	Pass
1104 Class Fitness Suite	654	40	43	9.0	8	Fail
1102 Class Art and Design Studio	654	40	42	9.0	5	Fail
1101 Class Science Studio	654	40	46	9.0	11	Fail
3003 Group 01	654	40	44	9.0	6	Fail
3005 Group 03	654	40	55	12.0	7	Fail
3006 Group 04	654	40	50	11.0	8	Fail
3004 Group 02	654	40	73	12.0	21	Fail
2001 Hall grd floor	763	40	51	14.0	2	Fail
2001 Hall upper level	0	40	0	0.0	0	Pass
3001 Teach Library	763	40	58	12.0	16	Fail
3008 TeachTransition Room	981	40	164	11.0	42	Fail
4001 Office Staff room	981	40	96	15.0	32	Fail
4010 Office Premises Office	981	40	77	18.0	4	Fail
2002 Dining	763	40	57	12.0	18	Fail
4003 Office Head's office	981	40	52	17.0	3	Fail
4004 Office Gen Office	981	40	64	19.0	0	Fail
4005 Office Parent's Room	981	40	64	15.0	5	Fail
4006 Visitor Entrance	0	40	0	0.0	0	Pass
4008 Office	981	40	77	15.0	18	Fail
4009 Office DSL	981	40	71	13.0	19	Fail
3002 SEN MI	654	40	47	10.0	10	Fail
4002 Multi function bay	0	40	0	0.0	0	Pass

6.4 Conclusions

With the exception of the Teach Transition Room, all rooms meet the overheating criteria for the DSY1 weather file. The Transition Room, being an IT-intensive space, will be equipped with comfort cooling to ensure acceptable conditions. Although the room is north-facing and experiences minimal solar gains, the combined internal heat gains of 55W/m² (comprising 30W/m² from occupancy and 25W/m² from IT equipment) exceed the capacity of passive measures to meet the comfort criteria.

For the DSY2 weather file, all rooms, except the Transition Room and the Staff Room, meet the requirements of Criterion 1. The failure of the Staff Room is marginal. While the majority of rooms fail under Criteria 2 and 3, schools are assessed based on compliance with Criterion 1, with Criteria 2 and 3 provided for information purposes only

For the DSY3 weather file, the classrooms and group rooms either meet Criterion 1 or fail by a small margin of 1–15 hours per year (less than 2.5% of the occupied hours). The offices have a slightly greater margin of failure, experiencing overheating for an additional 4–5% of the occupied hours..

The building is designed to address the current risk of overheating through the strategic sizing of windows, achieving an optimal balance between minimizing solar gains and ensuring adequate natural light, which is essential in a teaching environment. The building services strategy incorporates high-capacity, energy-efficient hybrid ventilation units. The use of opening windows has been excluded due to the surrounding noise environment, which would create an unacceptable internal noise level, particularly for individuals with special educational needs.

The ventilation units are designed to operate outside of occupied hours to maximize the thermal mass of the building, enabling passive cooling. Long-term increases in overheating risk are mitigated through the measures outlined in Section 5 of this report.

7 COOLING HIERARCHY

The development responds to the cooling hierarchy as set out below

Reduce the amount of heat entering the building - The orientation of the building is dictated by site constraints. However, the building's main axis runs east-west, ensuring that rooms on the north side experience limited solar gains. Spaces with the highest internal heat generation, such as those with high occupancy or IT equipment, are located on the northern façade to reduce overheating risk and minimize the need for active cooling. Additionally, the glazing on the south façade has been specified with a g-value of 0.40 to limit solar gains. While shading options were considered, external shading would reduce daylighting levels and lead to non-compliance with the Department for Education's daylighting criteria.

Minimize internal heat generation through energy-efficient designs - The excellent provision of daylighting minimizes internal heat gains by enabling artificial lighting to be controlled through daylight dimming, reducing energy use during sunny periods. The space heating system will not operate during the summer, and domestic hot water is generated by point-of-use water heaters. This reduces heat gains from pipework distribution systems.

Manage heat within the building through exposed internal thermal mass and high ceilings - The first floor is constructed using precast concrete planks. However, per the client's brief, the concrete will not be exposed to the rooms, as the overheating criteria are already satisfied. To address long-term global warming adaptation, the proposed mitigation measures include exposing the first-floor slab in the future to increase the building's thermal mass.

Provide passive ventilation - Passive ventilation is not feasible due to the strict acoustic requirements of the teaching spaces.

Provide mechanical ventilation - Energy-efficient hybrid ventilation units are included in the design. These units combine natural ventilation with fan assistance. During periods when the outdoor temperature is higher than the indoor temperature, the hybrid units supply fresh air to maintain indoor air quality. When the outdoor temperature is lower than the indoor temperature, the units operate at full airflow to maximize the "free cooling" potential of outside air. Additionally, the ventilation units will operate overnight to cool the building fabric and maximize its cooling potential.

Provide active cooling systems – Split air conditioning units are provided for the server room and IT-intensive Transition Teaching space only. The mitigation measures for future global warming and the increased overheating risk, include the use of temperature trimming by operating the heating system and ASHPs in "reverse", distributing water at around 20°C through the pipework and heat emitters. This report demonstrates that compliance with the overheating criteria was achieved by providing heat extraction at a rate of 10 W/m² in rooms with the greatest overheating risk. This system can also be extended to all rooms to further improve thermal comfort throughout the building.

8 INDOOR AIR QUALITY

8.1 Design Criteria

From BB101:

Where mechanical ventilation is used, or when hybrid systems are operating in mechanical mode in general teaching and learning spaces, sufficient outdoor air should be provided to achieve a daily average concentration of carbon dioxide (CO2) of less than 1000 ppm, during the occupied period, when the number of room occupants is equal to, or less than the design occupancy.

The maximum concentration should also not exceed 1500 ppm for more than 20 consecutive minutes each day when the number of room occupants is equal to, or less than the design occupancy.

In general teaching and learning spaces where natural ventilation is used or when hybrid systems are operating in natural mode the following standards apply:

- sufficient outdoor air should be provided to achieve a daily average concentration of CO2 of less than 1500 ppm, during the occupied period, when the number of room occupants is equal to, or less than the design occupancy.

- the maximum concentration should also not exceed 2000 ppm for more than 20 consecutive minutes each day, when the number of room occupants is equal to, or less than the design occupancy.

- the system should be designed to achieve a carbon dioxide level for the majority of the time of less than 1200 ppm for a new building (800 ppm above the outside carbon dioxide level, taken as 400ppm) for the majority of the occupied time during the year - this is the criterion for a category II building

8.2 Building Performance

The overheating modelling included an assessment of the air quality in all spaces modelled. The modelling included for carbon dioxide to be exhaled by each person at a rate of 20 l/hour. The concentration of carbon dioxide was used as a control input to the hybrid ventilation systems to ensure that not only is the temperature adequately controlled, but there is always a sufficient fresh air to keep the air quality within the required limits. The settings in the model were to control the carbon dioxide concentration in each room to no more than 950 PPM. The only room that exceeded this value is the dining hall, which when fully occupied with 33 people briefly reaches around 1200 PPM during the lunchtime hour.

A1 SUMMARY OF HEAT GAINS FOR EACH ROOM

Room	Modelled Area, m2	Maximum Lighting Gain, Watts	Maximum Solar Gain, Watts	Maximum No. Occupants	Maximum Sensible Casual Gain, Watts
1001 Classroom 01	48.1	217	434	14	481
1002 Classroom 02	47.9	215	434	14	479
1003 Classroom 04	47.8	215	933	14	478
1004 Classroom 03	47.4	213	933	14	474
1005 Classroom 05	47.4	213	929	14	474
1006 Classroom 06	47.8	215	930	14	478
1101 Class Science Studio	54.4	245	473	14	544
1102 Class Art and Design Studio	61.5	277	476	10	615
1103 Class Food room 01	60.6	273	884	10	606
1104 Class Fitness Suite	54.5	245	498	18	545
2001 Hall grd floor	155.6	622	1246	79	778
2002 Dining	50.0	225	993	34	500
3001 Teach Library	20.0	120	479	9	0
3002 SEN MI	12.4	74	0	6	0
3003 Group 01	8.6	52	0	5	0
3004 Group 02	15.4	92	478	5	0
3005 Group 03	16.1	97	230	5	0
3006 Group 04	23.5	141	124	11	0
3008 TeachTransition Room	33.2	149	211	14	830
4001 Office Staff room	41.8	188	547	25	418
4002 Multi function bay	3.5	21	0	0	0
4003 Office Head's office	17.5	105	225	6	175
4004 Office Gen Office	14.9	90	0	4	149

Room	Modelled Area, m2	Maximum Lighting Gain, Watts	Maximum Solar Gain, Watts	Maximum No. Occupants	Maximum Sensible Casual Gain, Watts
4005 Office Parent's Room	15.1	90	124	7	151
4006 Visitor Entrance	17.2	9	225	0	0
4007 Office Sick Bay	19.2	10	0	0	0
4008 Office	11.5	69	225	6	115
4009 Office DSL	11.7	70	225	6	117
4010 Office Premises Office	19.2	115	479	3	192
4011 D1_Edu_Laundry	6.0	0	0	0	0
5001 D1_Edu_Store 4	3.0	12	0	0	0
5002 D1_Edu_Store 19	1.4	6	0	0	0
5003 D1_Edu_Store 3	2.8	11	0	0	0
5004 D1_Edu_Store 20	1.4	6	0	0	0
5005 D1_Edu_Store 21	2.8	11	0	0	0
5006 D1_Edu_Store 11	1.4	6	0	0	0
5007 D1_Edu_Store 22	6.0	24	0	0	0
5008 D1_Edu_Store 10	5.2	21	0	0	0
5009 D1_Edu_Store 9	5.3	21	0	0	0
5010 D1_Edu_Store 8	14.9	59	0	0	0
5011 D1_Edu_Store 17	8.3	33	0	0	0
5012D1_Edu_Store 7	8.5	34	0	0	0
5013 D1_Edu_Store 12	7.8	31	0	0	0
5014 D1_Edu_Store 2	5.6	22	0	0	0
5016 Lockers	7.8	31	0	0	0
5017 clnr 01 D1_Edu_Store 13	5.1	20	0	0	0
5018 clnr 02 D1_Edu_Store 18	2.4	10	0	0	0
5019 clnr 03	3.2	13	0	0	0
6004 D1_Edu_Acc/staff	5.9	6	0	0	0
6005 D1_Edu_Acc/staff	6.0	6	0	0	0

Room	Modelled Area, m2	Maximum Lighting Gain, Watts	Maximum Solar Gain, Watts	Maximum No. Occupants	Maximum Sensible Casual Gain, Watts
6006 D1_Edu_Toilet 6	8.1	8	0	0	0
6007 D1_Edu_WC01	2.4	2	0	0	0
6008 D1_Edu_WC02	2.7	3	0	0	0
6009 D1_Edu_WC03	3.4	3	0	0	0
6010 D1_Edu_Toilet 8	3.4	3	0	0	0
6011 D1_Edu_Toilet 15	3.8	4	0	0	0
6012 D1_Edu_Toilet 14	3.1	3	0	0	0
6013 D1_Edu_Toilet 13	5.6	6	0	0	0
6015 D1_Edu_AWC	3.3	3	0	0	0
6016 D1_Edu_Toilet 10	2.7	3	0	0	0
6016 D1_Edu_Toilet 9	3.3	3	0	0	0
6201 Server	10.5	47	0	0	525
6202 Hub	8.0	36	0	0	803
6301 Circ Stair 02	29.5	15	491	0	0
6302 Circ Stair 01	35.4	18	491	0	0
63xA Circ Grd Phase 1	57.7	29	0	0	0
63xB Circ Grd Phase 2	74.0	37	0	0	0
63xC Circ 1st Phase 1	65.6	33	0	0	0
63xD 1st staff rm circ	9.2	5	0	0	0
63xE 1st sen circ	9.3	5	0	0	0

A2 RESULTS SUMMARY – ALL ROOMS

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Project Details

Building Designer File (.tbd): Burnside_Overheating - Copy.tbd

Simulation Results File (.tsd): Burnside_Overheating.tsd

Date: Thursday, 19 October, 2023

Building Category: Category II

Weather Data DSY1 GTW1989_2080Low50% (These results were generated without using the appropriate CIBSE DSY1 2020 High 50th percentile weather file as specified in BB101 2018.)

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BB101 Overheating Criteria

Zone Name	Space Type	Occupied Summer Hours	Max. Exceedable Hours	Criterion 1: #Hours Exceeding Comfort Range	Criterion 2: Peak Daily Weighted Exceedance	Criterion 3: #Hours Exceeding Absolute Limit	Result
63xx 1st sen circ*	Atria and Corridors	0	40	0	0	0	Pass
63xx 1st staff rm circ*	Atria and Corridors	0	40	0	0	0	Pass
63xx Circ 1st Phase 1*	Atria and Corridors	0	40	0	0	0	Pass
63xx Circ Grd Phase 1*	Atria and Corridors	0	40	0	0	0	Pass
63xx Circ Grd Phase 2*	Atria and Corridors	0	40	0	0	0	Pass
1001 Classroom 01	Teaching Spaces	654	40	0	0	0	Pass
1002 Classroom 02	Teaching Spaces	654	40	1	1	0	Pass
1003 Classroom 04	Teaching Spaces	654	40	1	1	0	Pass
1004 Classroom 03	Teaching Spaces	654	40	7	2	0	Pass
1005 Classroom 05	Teaching Spaces	654	40	26	5	0	Pass
1006 Classroom 06	Teaching Spaces	654	40	17	4	0	Pass
1101 Class Science Studio	Teaching Spaces	654	40	7	2	0	Pass
1102 Class Art and Design Studio	Teaching Spaces	654	40	1	1	0	Pass
1103 Class Food room 01	Teaching Spaces	654	40	0	0	0	Pass
1104 Class Fitness Suite	Teaching Spaces	654	40	5	2	0	Pass
2001 Hall grd floor	Teaching Spaces	654	40	0	0	0	Pass
2002 Dining	Teaching Spaces	654	40	20	5	0	Pass
3001 Teach Library	Teaching Spaces	654	40	20	3	0	Pass
3002 SEN MI	Teaching Spaces	654	40	2	2	0	Pass
3003 Group 01	Teaching Spaces	654	40	4	1	0	Pass
3004 Group 02	Teaching Spaces	654	40	23	6	0	Pass

*Zone names that have an orange coloured font do not have occupancy every Monday to Friday as per the BB101 Regulations.
**As per the 2018 regulations, sports halls used for exam purposes are only assessed between the 1st of May and the 8th July. Due to this, the max exceedable hours is reduced to 18 hours.

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Zone Name	Space Type	Occupied Summer Hours	Max. Exceedable Hours	Criterion 1: #Hours Exceeding Comfort Range	Criterion 2: Peak Daily Weighted Exceedance	Criterion 3: #Hours Exceeding Absolute Limit	Result
3005 Group 03	Teaching Spaces	654	40	3	2	0	Pass
3006 Group 04	Teaching Spaces	654	40	0	0	0	Pass
3008 TeachTransition Room	Teaching Spaces	654	40	124	11	0	Fail
4001 Office Staff room	Offices	654	40	28	5	0	Pass
4002 Multi function bay*	Offices	0	40	0	0	0	Pass
4003 Office Head's office	Offices	654	40	0	0	0	Pass
4004 Office Gen Office	Offices	654	40	0	0	0	Pass
4005 Office Parent's Room	Offices	654	40	1	1	0	Pass
4006 Visitor Entrance*	Offices	0	40	0	0	0	Pass
4007 Office Sick Bay*	Atria and Corridors	0	40	0	0	0	Pass
4008 Office	Offices	654	40	9	3	0	Pass
4009 Office DSL	Offices	654	40	14	3	0	Pass
4010 Office Premises Office	Offices	654	40	0	0	0	Pass
4011 D1_Edu_Laundry*	Other	0	40	0	0	0	Pass
5001 D1_Edu_Store 4*	Other	0	40	0	0	0	Pass
5002 D1_Edu_Store 19*	Other	0	40	0	0	0	Pass
5003 D1_Edu_Store 3*	Other	0	40	0	0	0	Pass
5004 D1_Edu_Store 20*	Other	0	40	0	0	0	Pass
5005 D1_Edu_Store 21*	Other	0	40	0	0	0	Pass
5006 D1_Edu_Store 11*	Other	0	40	0	0	0	Pass
5007 D1_Edu_Store 22*	Other	0	40	0	0	0	Pass
5008 D1_Edu_Store 10*	Other	0	40	0	0	0	Pass
5009 D1_Edu_Store 9*	Other	0	40	0	0	0	Pass
5010 D1_Edu_Store 8*	Other	0	40	0	0	0	Pass

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Zone Name	Space Type	Occupied Summer Hours	Max. Exceedable Hours	Criterion 1: #Hours Exceeding Comfort Range	Criterion 2: Peak Daily Weighted Exceedance	Criterion 3: #Hours Exceeding Absolute Limit	Result
5011 D1_Edu_Store 17*	Other	0	40	0	0	0	Pass
5012D1_Edu_Store 7*	Other	0	40	0	0	0	Pass
5013 D1_Edu_Store 12*	Other	0	40	0	0	0	Pass
5014 D1_Edu_Store 2*	Other	0	40	0	0	0	Pass
5016 Lockers*	Other	0	40	0	0	0	Pass
5017 clnr 01 D1_Edu_Store 13*	Other	0	40	0	0	0	Pass
5018 clnr 02 D1_Edu_Store 18*	Other	0	40	0	0	0	Pass
5019 clnr 03*	Other	0	40	0	0	0	Pass
6004 D1_Edu_Acc/staff*	Other	0	40	0	0	0	Pass
6005 D1_Edu_Acc/staff*	Other	0	40	0	0	0	Pass
6006 D1_Edu_Toilet 6*	Other	0	40	0	0	0	Pass
6007 D1_Edu_WC01*	Other	0	40	0	0	0	Pass
6008 D1_Edu_WC02*	Other	0	40	0	0	0	Pass
6009 D1_Edu_WC03 *	Other	0	40	0	0	0	Pass
6010 D1_Edu_Toilet 8*	Other	0	40	0	0	0	Pass
6011 D1_Edu_Toilet 15*	Other	0	40	0	0	0	Pass
6012 D1_Edu_Toilet 14*	Other	0	40	0	0	0	Pass
6013 D1_Edu_Toilet 13*	Other	0	40	0	0	0	Pass
6015 D1_Edu_AWC *	Other	0	40	0	0	0	Pass
6016 D1_Edu_Toilet 9*	Other	0	40	0	0	0	Pass
6016 D1_Edu_Toilet 10*	Other	0	40	0	0	0	Pass
6016 Roof access*	Atria and Corridors	0	40	0	0	0	Pass
6201 Server*	Other	918	40	0	0	0	Pass
6202 Hub*	Other	918	40	0	0	0	Pass

*Zone names that have an orange coloured font do not have occupancy every Monday to Friday as per the BB101 Regulations.

**As per the 2018 regulations, sports halls used for exam purposes are only assessed between the 1st of May and the 8th July. Due to this, the max exceedable hours is reduced to 18 hours.

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Zone Name	Space Type	Occupied Summer Hours	Max. Exceedable Hours	Criterion 1: #Hours Exceeding Comfort Range	Criterion 2: Peak Daily Weighted Exceedance	Criterion 3: #Hours Exceeding Absolute Limit	Result
6301 Circ Stair 02*	Atria and Corridors	0	40	0	0	0	Pass
6302 Circ Stair 01*	Atria and Corridors	0	40	0	0	0	Pass
Entrance Lobby*	Atria and Corridors	0	40	0	0	0	Pass

*Zone names that have an orange coloured font do not have occupancy every Monday to Friday as per the BB101 Regulations.
**As per the 2018 regulations, sports halls used for exam purposes are only assessed between the 1st of May and the 8th July. Due to this, the max exceedable hours is reduced to 18 hours.

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BB101 CO_2 Criteria

External Pollutant Level: 397 (ppmv)

Zone Name	System Type	Max CO_2 Concentration Limit (ppmv)	Peak CO_2 Level (ppmv)	Was Max CO_2 Concentration Limit Exceeded for 20 Consecutive Minutes?	Daily Average CO_2 Limit (ppmv)	Maximum Daily Average CO_2 Level (ppmv)	Average Limit Exceeded?	Annual Occupied Hours	Number of Hours Where CO_2 Level Was 800 ppmv Above the External Level	Are the Majority of Hours Over the Outside Limit?	Pass or Fail CO_2 Criteria
63xx 1st sen circ	Natural Ventilation	2000	N/A	No	1500	N/A	No	N/A	0	No	Pass
63xx 1st staff rm circ	Natural Ventilation	2000	N/A	No	1500	N/A	No	N/A	0	No	Pass
63xx Circ 1st Phase 1	Natural Ventilation	2000	N/A	No	1500	N/A	No	N/A	0	No	Pass
63xx Circ Grd Phase 1	Natural Ventilation	2000	N/A	No	1500	N/A	No	N/A	0	No	Pass
63xx Circ Grd Phase 2	Natural Ventilation	2000	N/A	No	1500	N/A	No	N/A	0	No	Pass
1001 Classroom 01	Hybrid	Variable*	973	No	Variable*	896	No	690	0	No	Pass
1002 Classroom 02	Hybrid	Variable*	963	No	Variable*	889	No	690	0	No	Pass
1003 Classroom 04	Hybrid	Variable*	970	No	Variable*	891	No	690	0	No	Pass
1004 Classroom 03	Hybrid	Variable*	965	No	Variable*	888	No	690	0	No	Pass
1005 Classroom 05	Hybrid	Variable*	940	No	Variable*	875	No	690	0	No	Pass
1006 Classroom 06	Hybrid	Variable*	946	No	Variable*	878	No	690	0	No	Pass
1101 Class Science Studio	Hybrid	Variable*	962	No	Variable*	898	No	690	0	No	Pass
1102 Class Art and Design Studio	Hybrid	Variable*	846	No	Variable*	802	No	690	0	No	Pass
1103 Class Food room 01	Hybrid	Variable*	839	No	Variable*	790	No	690	0	No	Pass
1104 Class Fitness Suite	Hybrid	Variable*	1023	No	Variable*	926	No	690	0	No	Pass
2001 Hall grd floor	Mechanical Ventilation	1500	1057	No	1000	890	No	805	0	No	Pass
2002 Dining	Mechanical Ventilation	1500	1461	No	1000	917	No	805	70	No	Pass

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Zone Name	System Type	Max CO_2 Concentration Limit (ppmv)	Peak CO_2 Level (ppmv)	Was Max CO_2 Concentration Limit Exceeded for 20 Consecutive Minutes?	Daily Average CO_2 Limit (ppmv)	Maximum Daily Average CO_2 Level (ppmv)	Average Limit Exceeded?	Annual Occupied Hours	Number of Hours Where CO_2 Level Was 800 ppmv Above the External Level	Are the Majority of Hours Over the Outside Limit?	Pass or Fail CO_2 Criteria
3001 Teach Library	Hybrid	Variable*	950	No	Variable*	927	No	690	0	No	Pass
3002 SEN MI	Mechanical Ventilation	1500	397	No	1000	397	No	690	0	No	Pass
3003 Group 01	Hybrid	Variable*	397	No	Variable*	397	No	690	0	No	Pass
3004 Group 02	Mechanical Ventilation	1500	397	No	1000	397	No	690	0	No	Pass
3005 Group 03	Hybrid	Variable*	397	No	Variable*	397	No	690	0	No	Pass
3006 Group 04	Hybrid	Variable*	397	No	Variable*	397	No	690	0	No	Pass
3008 TeachTransition Room	Hybrid	Variable*	988	No	Variable*	929	No	690	0	No	Pass
4001 Office Staff room	Mechanical Ventilation	1500	397	No	1000	397	No	805	0	No	Pass
4002 Multi function bay	Mechanical Ventilation	1500	N/A	No	1000	N/A	No	N/A	0	No	Pass
4003 Office Head's office	Mechanical Ventilation	1500	397	No	1000	397	No	805	0	No	Pass
4004 Office Gen Office	Mechanical Ventilation	1500	397	No	1000	397	No	805	0	No	Pass
4005 Office Parent's Room	Mechanical Ventilation	1500	397	No	1000	397	No	805	0	No	Pass
4006 Visitor Entrance	Mechanical Ventilation	1500	N/A	No	1000	N/A	No	N/A	0	No	Pass
4007 Office Sick Bay	Natural Ventilation	2000	N/A	No	1500	N/A	No	N/A	0	No	Pass
4008 Office	Mechanical Ventilation	1500	397	No	1000	397	No	805	0	No	Pass
4009 Office DSL	Mechanical Ventilation	1500	397	No	1000	397	No	805	0	No	Pass
4010 Office Premises Office	Mechanical Ventilation	1500	397	No	1000	397	No	805	0	No	Pass
4011 D1_Edu_Laundry	Natural Ventilation	2000	N/A	No	1500	N/A	No	N/A	0	No	Pass
5001 D1_Edu_Store 4	Natural Ventilation	2000	N/A	No	1500	N/A	No	N/A	0	No	Pass
5002 D1_Edu_Store 19	Natural Ventilation	2000	N/A	No	1500	N/A	No	N/A	0	No	Pass
5003 D1_Edu_Store 3	Natural Ventilation	2000	N/A	No	1500	N/A	No	N/A	0	No	Pass

BB101 Report

Zone Name	System Type	Max CO_2 Concentration Limit (ppmv)	Peak CO_2 Level (ppmv)	Was Max CO_2 Concentration Limit Exceeded for 20 Consecutive Minutes?	Daily Average CO_2 Limit (ppmv)	Maximum Daily Average CO_2 Level (ppmv)	Average Limit Exceeded?	Annual Occupied Hours	Number of Hours Where CO_2 Level Was 800 ppmv Above the External Level	Are the Majority of Hours Over the Outside Limit?	Pass or Fail CO_2 Criteria
5004 D1_Edu_Store 20	Natural Ventilation	2000	N/A	No	1500	N/A	No	N/A	0	No	Pass
5005 D1_Edu_Store 21	Natural Ventilation	2000	N/A	No	1500	N/A	No	N/A	0	No	Pass
5006 D1_Edu_Store 11	Natural Ventilation	2000	N/A	No	1500	N/A	No	N/A	0	No	Pass
5007 D1_Edu_Store 22	Natural Ventilation	2000	N/A	No	1500	N/A	No	N/A	0	No	Pass
5008 D1_Edu_Store 10	Natural Ventilation	2000	N/A	No	1500	N/A	No	N/A	0	No	Pass
5009 D1_Edu_Store 9	Natural Ventilation	2000	N/A	No	1500	N/A	No	N/A	0	No	Pass
5010 D1_Edu_Store 8	Natural Ventilation	2000	N/A	No	1500	N/A	No	N/A	0	No	Pass
5011 D1_Edu_Store 17	Natural Ventilation	2000	N/A	No	1500	N/A	No	N/A	0	No	Pass
5012D1_Edu_Store 7	Natural Ventilation	2000	N/A	No	1500	N/A	No	N/A	0	No	Pass
5013 D1_Edu_Store 12	Natural Ventilation	2000	N/A	No	1500	N/A	No	N/A	0	No	Pass
5014 D1_Edu_Store 2	Natural Ventilation	2000	N/A	No	1500	N/A	No	N/A	0	No	Pass
5016 Lockers	Natural Ventilation	2000	N/A	No	1500	N/A	No	N/A	0	No	Pass
5017 clnr 01 D1_Edu_Store 13	Natural Ventilation	2000	N/A	No	1500	N/A	No	N/A	0	No	Pass
5018 clnr 02 D1_Edu_Store 18	Natural Ventilation	2000	N/A	No	1500	N/A	No	N/A	0	No	Pass
5019 clnr 03	Natural Ventilation	2000	N/A	No	1500	N/A	No	N/A	0	No	Pass
6004 D1_Edu_Acc/staff	Mechanical Ventilation	1500	N/A	No	1000	N/A	No	N/A	0	No	Pass
6005 D1_Edu_Acc/staff	Mechanical Ventilation	1500	N/A	No	1000	N/A	No	N/A	0	No	Pass
6006 D1_Edu_Toilet 6	Mechanical Ventilation	1500	N/A	No	1000	N/A	No	N/A	0	No	Pass
6007 D1_Edu_WC01	Mechanical Ventilation	1500	N/A	No	1000	N/A	No	N/A	0	No	Pass
6008 D1_Edu_WC02	Mechanical Ventilation	1500	N/A	No	1000	N/A	No	N/A	0	No	Pass
6009 D1_Edu_WC03	Mechanical Ventilation	1500	N/A	No	1000	N/A	No	N/A	0	No	Pass
6010 D1_Edu_Toilet 8	Mechanical Ventilation	1500	N/A	No	1000	N/A	No	N/A	0	No	Pass

BB101 Report

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6011 D1_Edu_Toilet 15	Mechanical Ventilation	1500	N/A	No	1000	N/A	No	N/A	0	No	Pass
6012 D1_Edu_Toilet 14	Mechanical Ventilation	1500	N/A	No	1000	N/A	No	N/A	0	No	Pass
6013 D1_Edu_Toilet 13	Mechanical Ventilation	1500	N/A	No	1000	N/A	No	N/A	0	No	Pass
6015 D1_Edu_AWC	Mechanical Ventilation	1500	N/A	No	1000	N/A	No	N/A	0	No	Pass
6016 D1_Edu_Toilet 9	Mechanical Ventilation	1500	N/A	No	1000	N/A	No	N/A	0	No	Pass
6016 D1_Edu_Toilet 10	Mechanical Ventilation	1500	N/A	No	1000	N/A	No	N/A	0	No	Pass
6016 Roof access	Natural Ventilation	2000	N/A	No	1500	N/A	No	N/A	0	No	Pass
6201 Server	Mechanical Ventilation	1500	397	No	1000	397	No	1127	0	No	Pass
6202 Hub	Mechanical Ventilation	1500	397	No	1000	397	No	1127	0	No	Pass
6301 Circ Stair 02	Natural Ventilation	2000	N/A	No	1500	N/A	No	N/A	0	No	Pass
6302 Circ Stair 01	Natural Ventilation	2000	N/A	No	1500	N/A	No	N/A	0	No	Pass
Entrance Lobby	Natural Ventilation	2000	N/A	No	1500	N/A	No	N/A	0	No	Pass

*The limits a hybrid system is compared to change depending on the unit's operation mode.