

Highgate School RMC

Thermal modelling and overheating report

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Quality information

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Executive Summary

This report outlines the thermal comfort modelling undertaken for the proposed RMC building, in accordance with the requirements of Haringey's key overheating planning application requirements. For non-domestic buildings this requires compliance with CIBSE TM52 "The limits of thermal comfort in European buildings" for the 2020 High emissions, 50th percentile scenario DSY1 weather file, with additional assessments undertaken for DSY2 and 3 weather files for the 2020 high emissions, 50th percentile scenario, and DSY1 weather files for the 2050 and 2080 high emissions, 50th percentile scenarios.

It is not mandatory for compliance to be achieved under the additional weather files; however, mitigation and retrofit measures should be identified towards achieving compliance.

In the case of RMC, compliance is demonstrated under the 2020 DSY1 weather file; however, there are some non-compliant rooms when assessed against the additional weather files. The following measures are identified as appropriate for future investigation and adoption towards achieving compliance under the future weather conditions:

- Add ceiling fans to increase air movement,
- Retrofit phase-change MVHR units to provide passive temperature lopping,
- Retrofit temperature lopping systems,
- Add further mechanical cooling.

1. Introduction

This report details the thermal comfort modelling of the RMC building against the requirements of CIBSE TM52 “The limits of thermal comfort: Avoiding overheating in European buildings” (CIBSE TM52). RMC is a secondary school building, comprising teaching spaces, a drama theatre, showers for the use of the adjacent sports pitches and staff areas.

This assessment has been completed to demonstrate compliance with the requirements of The London Plan, March 2021, Policy SI4 Managing heat risk and Haringey’s key overheating planning application requirements.

1.1 CIBSE TM52 The limits of thermal comfort: Avoiding overheating in European buildings

This study has been undertaken to assess which areas are most at risk of overheating, by carrying out a CIBSE TM52 assessment. The method acknowledges that the use of a single indoor temperature limit is insufficient. Rather, the maximum acceptable temperature varies based on a running mean of outdoor conditions. A room is deemed to pass if at least two of the criteria are met:

- Criterion 1: Hours of Exceedance
 - The number of hours that the actual operative temperature in the room is one degree (°K) or more above the limiting maximum acceptable temperature shall not be more than 3 percent of occupied hours, for the period 1st May to 30th September.
- Criterion 2: Daily Weighted Exceedance
 - The weighted exceedance shall be less than or equal to 6 in any one day.
- Criterion 3: Upper Limit Temperature
 - To set an absolute maximum value for the indoor operative temperature, the operative temperature shall never be greater than 4°K above the maximum acceptable temperature i.e. ΔT shall not exceed 4°K.

1.2 CIBSE Guide A

Where cooling is applied, the relevant thermal comfort criteria are described in CIBSE Guide A, Table 1.5. For school spaces, compliance is achieved by limiting the operative temperature to less than 25°C.

1.3 The London Plan

The London Plan policy SI4 “Managing heat risk” requires the following:

- *“Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.*
- *“Major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy:*
 1. *“reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure,*
 2. *“minimise internal heat generation through energy efficient design,*
 3. *“manage the heat within the building through exposed internal thermal mass and high ceilings,*
 4. *“provide passive ventilation,*
 5. *“provide mechanical ventilation,*
 6. *“provide active cooling systems.”*

1.4 Haringey's key overheating planning application requirements (November 2021)

The general requirements of overheating assessments for planning applications in Haringey include that non-residential spaces are assessed against the requirements of CIBSE TM52.

The requirements for dynamic thermal modelling of non-residential developments are summarised as follows:

- Assessment follows the CIBSE TM52 methodology and uses the CIBSE TM49 weather files for the London Weather Centre under the high emissions 50% percentile scenario.
- The report should include results obtained for the following scenarios:
 - Mandatory compliance with Design Summer Year (DSY) 1 (2020, high emissions, 50 percentile).
 - Mitigation measures to comply as far as feasible with DSY 2 and 3 (2020, high emissions, 50 percentile).
 - Future compliance with DSY1 in 2050s and 2080s (high emissions, 50 percentile) through a retrofit plan with measures that can be implemented within the building design.
- Demonstrate the development has following the London Plan's cooling hierarchy, providing justification where measures have not been found feasible.
- Demonstrate the appropriate and robust inputs into the dynamic model.

2. Model inputs

2.1 Model geometry

The model geometry was created based on the following drawings provided by Hopkins Architects Limited.

Table 1. Architectural drawings used to create the thermal model

Drawing number	Description	Revision
A/HS-RMC2 2300	Proposed site plan	C (30.06.2018)
A/HS-RMC2 2310	Proposed GA basement plan	H (11.04.2018)
A/HS-RMC2 2311	Proposed GA ground floor plan	H (11.04.2018)
A/HS-RMC2 2312	Proposed GA first floor plan	H (11.04.2018)
A/HS-RMC2 2313	Proposed GA roof plan	H (11.04.2018)
A/HS-RMC2 2410	Proposed GA elevations – north and south	H (11.04.2018)
A/HS-RMC2 2411	Proposed GA elevations – east and west	H (11.04.2018)
A/HS-RMC2 2510	Proposed GA long section through foyer	H (11.04.2018)
A/HS-RMC2 2511	Proposed GA long section through stairs and sunken garden	C (24.07.2018)
A/HS-RMC2 2512	Proposed GA cross section through foyer	H (24.07.2018)
A/HS-RMC2 2513	Proposed GA cross section through theatre	C (24.07.2018)
A/HS-RMC2 2514	Proposed GA cross section through offices/pitch connection stair	C (24.07.2018)

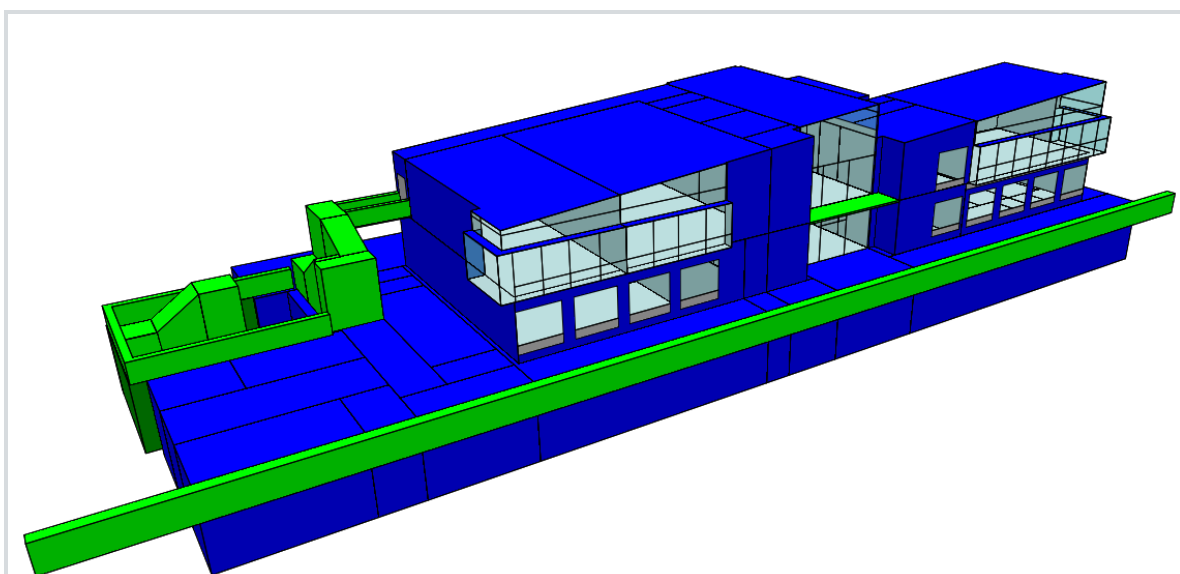
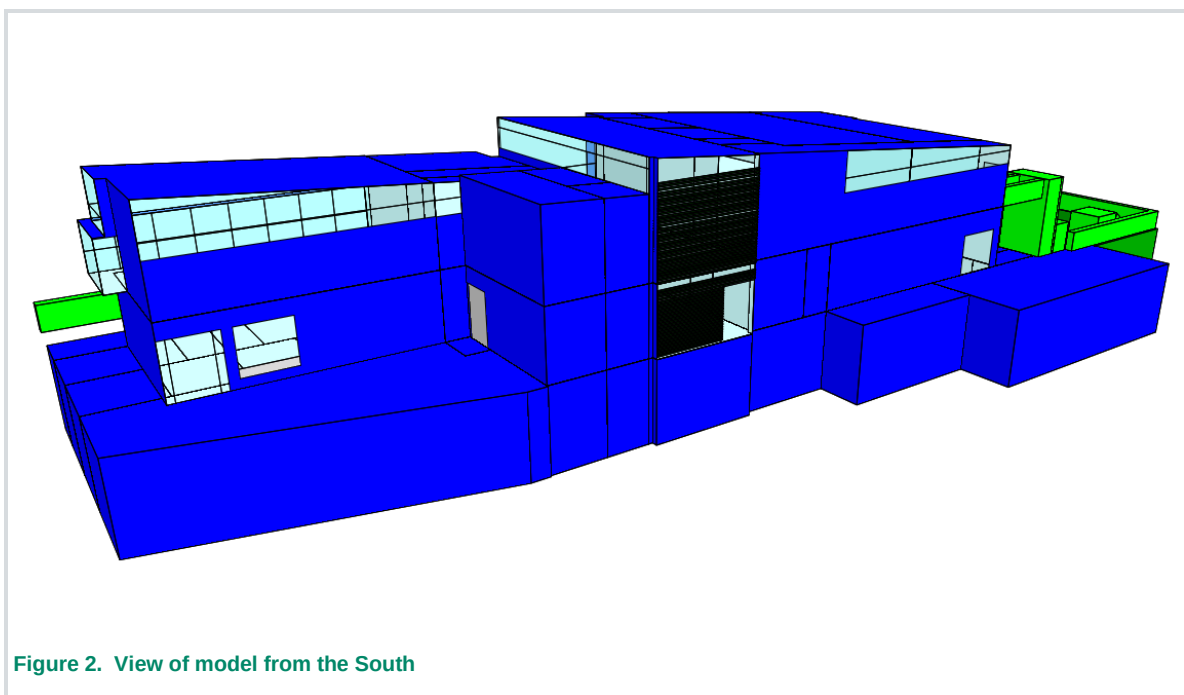


Figure 1. View of model from the North



2.2 Building fabric and air infiltration

The building fabric was assumed to have the following properties, as agreed with Hopkins Architects Ltd.

Table 2. Building fabric

Element	U-value (W/m ² K)	g-value (EN ISO 410)	Visible light transmittance
Roof	0.13	N/A	N/A
Exposed walls	0.15	N/A	N/A
Basement walls	0.15	N/A	N/A
Exposed floors and ground floors	0.13	N/A	N/A
Windows and glazed doors	1.20	0.29	0.60
Louvred glazing	1.20	0.29	0.60
Opaque pedestrian doors and high usage entrance doors	2.20	N/A	N/A

An air tightness result of 3m³/m².hr at 50Pa is being targeted for the building, this is equivalent to an infiltration rate of 0.15 ach⁻¹.

2.3 Thermal templates

Internal gains in the overheating assessment model are largely input based on room type, although some details, such as number of occupants, are input on a room-by-room basis. Full details of the internal gains are given in Appendix A and were agreed with Highgate School based on their specific requirements.

2.3.1 Operation patterns

The CIBSE TM52 overheating assessment considers the period May to September inclusive. A number of profiles are used to model the anticipated usage pattern of each room type, accounting for the school calendar. The school calendar has been input on the basis of a typical academic year, as described below, with the autumn term modelled as starting a week earlier to take account of pre-term use by teachers.

Table 3. Term time dates occupancy/ operation patterns

Term/holiday	Occupied?	First day	Last day
Spring 1	Occupied	08-Jan	09-Feb
Spring half term	Unoccupied	10-Feb	18-Feb
Spring 2	Occupied	19-Feb	23-Mar
Easter	Unoccupied	24-Mar	15-Apr
Summer 1	Occupied	16-Apr	25-May
Summer half term	Unoccupied	26-May	03-Jun
Summer 2	Occupied	04-Jun	06-Jul
Summer holidays	Unoccupied	07-Jul	26-Aug
Autumn 1	Occupied	27-Aug	12-Oct
Autumn half term	Unoccupied	13-Oct	21-Oct
Autumn 2	Occupied	22-Oct	21-Dec
Christmas holiday	Unoccupied	22-Dec	31-Dec

During occupied periods identified in the table above, several different operation profiles are used to model the anticipated usage of the building, as shown below.

Table 4. Occupancy/ operation patterns

Number	Occupancy/operational pattern
1	16:30 – 18:00 Mon -Fri
2	08:30 – 18:00 Monday - Friday
3	07:00 – 18:00 Monday – Friday
4	100% 08:30-13:00, 50% 13:00-14:15, 100% 14:15-16:00, 50% 16:00 - 18:00 Monday – Friday
5	08:30-13:00, 14.15-16:00 Mon - Fri
6	13:00 – 14:15 Mon - Fri
7	50% 07:00-08:30, 100% 08:30-13:00, 50% 13:00-14:15, 100% 14:15-16:00, 50% 16:00-18:00
8	0830-1800, with 81% diversity background gains outside these times

2.4 Weather files

As required by the Haringey overheating assessment requirements for planning applications, the following CIBSE TM49 weather files have been used during this study:

- London weather centre DSY 1 2020, high emissions, 50 percentile (mandatory compliance).
- London weather centre DSY 2 and 3 2020, high emissions, 50 percentile (compliance as far as feasible using mitigation measures).
- London weather centre DSY 1 for 2050 and 2080, high emissions, 50 percentile (future compliance through a retrofit plan with measures that can be implemented).

3. The cooling hierarchy

The cooling hierarchy as defined in Policy SI4 of The London Plan (March 2021) is summarised as follows:

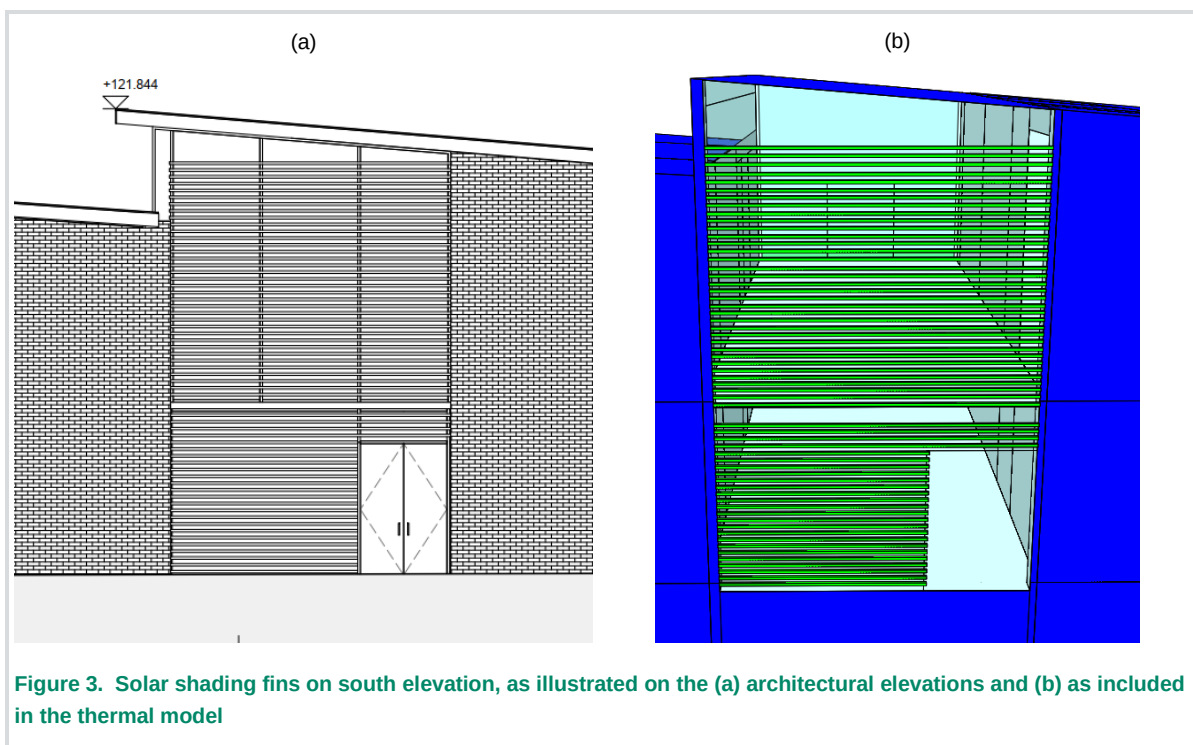
1. Reduce the amount of heat entering the building
2. Minimise internal heat generation
3. Manage the heat within the building
4. Provide passive ventilation
5. Provide mechanical ventilation
6. Provide active cooling systems

The following sections demonstrate how the design of RMC has adhered to this hierarchy.

3.1 Reduce the amount of heat entering the building

Several features have been employed to reduce heat gains entering RMC, these include:

- Use of solar control glazing with a low g-value of 0.29 to reduce solar gains.
- Insulated building fabric (refer to Table 2 for details) to reduce conductive gains.
- Provision of horizontal shading fins on the southern elevation, as illustrated in Figure 3, to reduce afternoon solar gains to the foyer.



3.2 Minimise internal heat generation

The design will use energy efficient lighting to minimise the internal heat gains. Other sources of internal heat, such as plug-in equipment, will be energy efficient where possible to reduce the heat gains generated from these sources.

3.3 Manage heat within the building

Where possible, considering the space required for plant distribution and acoustic attenuation etc., rooms have been provided with exposed soffits, as illustrated in Figure 4. These will help to moderate internal conditions by absorbing and discharging heat over a 24 hour period.

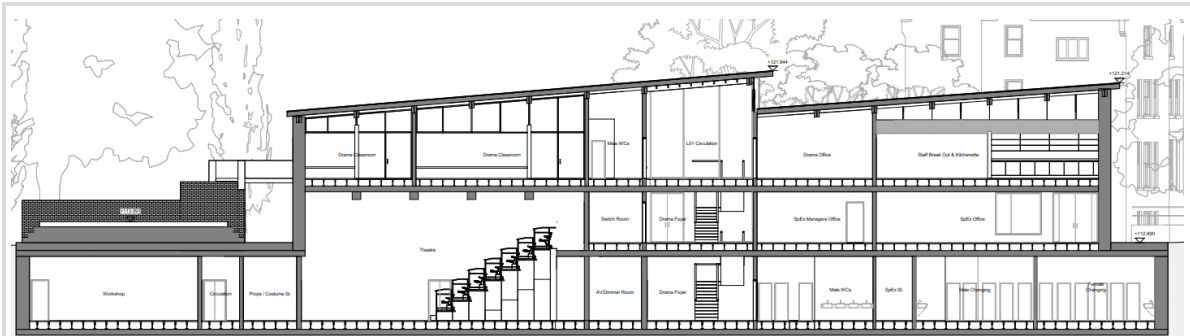


Figure 4. Exposed soffits

3.4 Use passive ventilation

Where possible, the baseline design is to use natural ventilation in all spaces to meet the overheating requirements. Cross-ventilation has been maximised and high level clerestory ventilation louvres drive natural ventilation through buoyancy. Large openable areas have been included in the window design to aid free-flowing air movement through the occupied spaces.

3.5 Use mechanical ventilation

MVHR units provide background minimum ventilation and mean that heat recovery can be used to reduce winter heat demands. This ventilation runs throughout the school year and is also able to provide night ventilation to remove heat from the space and thermal mass, ready for the next day. This night ventilation is assumed to only work when outside is cooler than inside and inside is above 18°C.

3.6 Use active cooling systems

For those spaces where both the natural and mechanical ventilation approach would be unable to meet the thermal comfort conditions, it is proposed to provide active cooling in order to meet the overheating criteria. In this case, cooling is included in those rooms where it is known that there will be particularly high internal loads that cannot be avoided. All other rooms will have overheating controlled via natural ventilation with MVHR for minimum fresh air only.

4. Baseline scenario

The baseline scenario simulated incorporates the measures designed to mitigate the effects of gains in the spaces (stages 1 to 3 in the cooling hierarchy), and includes:

- Natural ventilation via opening windows in all possible locations, apart from ground floor entrance doors which are assumed to be shut for security.

Full details of the ventilation included in the baseline model are described in Appendix B. In general, offices have centre pivot windows open to 100mm, drama classrooms have full height sliding Juliet balconies, with high level clerestory louvres to drive buoyancy and cross ventilation flow.

4.1 Summary of CIBSE TM52 free-running results for baseline scenario

Full results for each of the assessed occupied spaces are provided in Appendix D.1, and summarised below. It is seen that most spaces comply with the CIBSE TM52 overheating requirements in the baseline scenario.

Table 5. Summary of CIBSE TM52 free-running results for baseline scenario (DSY1)

	Number of Rooms	% of assessed rooms
Number of rooms assessed	9	-
CIBSE TM52 compliant rooms	8	89
CIBSE TM52 non-compliant rooms	1	11

All rooms assessed meet the requirements of TM52, apart from the Technician Room in the sunken courtyard. Therefore, the first improvement measure will be to improve natural ventilation to the Technician Room.

5. Testing mitigation measures

As shown in the previous section, one space does not comply with the overheating criteria. The following section describes the mitigation measures investigated to evaluate how CIBSE TM52 compliance can be achieved for all free-running assessed spaces.

The following table summarises the results obtained from the scenarios tested, with full details provided beneath.

Table 6. Summary of CIBSE TM52 free-running results for scenarios tested (DSY1 2020)

Scenario	Description of measures	Number of CIBSE TM52 compliant rooms
Baseline	-	8 / 9 (89%)
1	Increased centre pivot window opening distance from 100mm to a maximum of 20° in Technician Room	9 / 9 (100%)

5.1 Scenario 1: Increased centre pivot window openings to Technician Room

In the baseline scenario, the centre pivot window opening distance was limited to 100mm as pedestrians are expected to walk past and sit beneath the windows. However, the Technician Room overheats with this restriction. As it is in the sunken courtyard with no-one expected to walk past the windows the window opening was increased to allow a 20° angle. No other changes were made to the model.

6. Results

6.1 Current weather conditions

The following tables show the results obtained from Scenario 1 for the London weather centre DSY1 2020 high emissions scenario 50th percentile, for which the Haringey overheating policy requires mandatory compliance. All rooms comply with the heating policy requirements.

Table 7. CIBSE TM52 results for Scenario 1 (weather file: London weather centre DSY1 2020 high emissions scenario 50th percentile)

Room Name	Criterion 1 result	Criterion 2 result	Criterion 3 result	Which criteria are failed?	Overall result
<i>CIBSE TM52 criteria</i>	<i>3</i>	<i>6</i>	<i>4</i>		
B Green room	2.4	6	2	-	Pass
B Technician	1.7	6	2	-	Pass
B Workshop	2.8	5	1	-	Pass
L0 SpEx Managers Office	0	0	0	-	Pass
L0 SpEx Office	0	0	0	-	Pass
L1 Drama classroom 01	1	3	1	-	Pass
L1 Drama classroom 02	1.6	6	2	-	Pass
L1 Drama Office	0.8	3	1	-	Pass
L1 Staff breakout kitchenette	4.6	4	2	1	Pass

Table 8. CIBSE Guide A results for scenario 1 (weather file: London weather centre DSY1 2020 high emissions scenario 50th percentile)

Room name	Number of occupied hours with an operative temperature greater than 25°C	Overall result
B Theatre	0	Pass
L0 Control room	0	Pass

6.2 Future weather conditions

The following table summarises the results obtained for Scenario 1 under all weather files assessed. Full results are presented in Appendix E.

Table 9. Summary of results for all weather files assessed

Weather file	Number of CIBSE TM52 compliant rooms	Number of CIBSE Guide A compliant rooms
DSY1 2020	9 / 9 (100%)	2 / 2 (100%)
DSY2 2020	9 / 9 (100%)	2 / 2 (100%)
DSY3 2020	0 / 9 (0%)	2 / 2 (100%)
DSY1 2050	4 / 9 (44%)	2 / 2 (100%)
DSY1 2080	1 / 9 (11%)	2 / 2 (100%)

6.3 Future mitigation measures

The building is found to comply with the mandatory standard as set out in Haringey's key overheating requirements, i.e. compliance with CIBSE TM52 for the 2020 DSY1 weather file. Under the additional weather

files assessed, some spaces continue to comply, although there is a proportion that do not. The following measures have been considered as retrofit proposal to be adopted toward achieving compliance:

- Ceiling fans to increase air movement. These reduce the perceived temperature by up to 2°C without adding mechanical cooling and with controlled internal air speeds
- Retrofit phase-change MVHR units to provide passive temperature lopping,
- Retrofit MVHR units with mechanical cooling from the heat pumps to provide temperature lopping systems,
- Add further mechanical cooling.

Within the current design, occupants will also be able to mitigate overheating. The model does not consider the effect of internal blinds, and occupants can be encouraged to close windows in times of particularly high external temperatures when internal temperature is below that out outside.

Appendix A Internal gains

A.1 Lighting gains

Table 10. Lighting gains and profiles

Room type	Lighting gain (W/m ²)	Lighting operation profile
Armoury	8	3
AV dimmer room	-	Off
Changing	8	3
Circulation	8	3
Control room	8	3
Drama classroom	8	2
Drama foyer	8	3
Drama office	8	3
Green room	8	3
IT patch panel room	-	Off
Plant room	-	Off
Showers	8	3
SpEx manager's office	8	3
SpEx office	8	3
Staff breakout/kitchenette	8	6
Stairs	8	3
Storage	-	Off
Technician	8	3
Theatre	20	3
Viewing area	8	3
Voids	-	-
WCs	8	3
Workshop	8	3

A.2 Occupancy gains

Table 11. Occupancy gains and profiles

Room type	Occupant gains (sensible/latent) (W/person)	Max. number of occupants (people)	Occupancy profile
Armoury	-	-	-
AV dimmer room	-	-	-
Changing	-	-	-
Circulation	-	-	-
Control room	75/55	3	5
Drama classroom	75/55	25	4
Drama foyer	-	-	-
Drama office	75/55	4	3
Green room	75/55	10 m ² per person	3
IT patch panel room	-	-	-

Room type	Occupant gains (sensible/latent) (W/person)	Max. number of occupants (people)	Occupancy profile
Plant room	-	-	-
Showers	-	-	-
SpEx manager's office	75/55	2	3
SpEx office	75/55	10	3
Staff breakout/kitchenette	75/55	40	6
Stairs	-	-	-
Storage	-	-	-
Technician	75/55	2	3
Theatre	75/55	155	7
Viewing area	-	-	-
Voids	-	-	-
WCs	-	-	-
Workshop	75/55	3	3

A.3 Equipment gains

Table 12. Equipment gains and profiles

Thermal Template	Small power W	Small power pattern	Small power comments
Armoury	-	Off	
AV/ dimmer room	3500	5	Dimmer room 1.5kW from CharcoalBlue, AV equipment 2kW from CharcoalBlue
Changing	-	Off	
Circulation	-	Off	
Control room	2000	5	From CharcoalBlue report
Drama classroom	701.8	5	1 desktop – 110W average from CIBSE Guide A 1 laptop – 27W average from CIBSE Guide A Interactive whiteboard – 380W 25 tablets – 12.9inch iPad Pro, 7.7W
Drama foyer	-	Off	-
Drama office			
Drama office	108	3	5 laptops (one per occupant) – 27 W each from CIBSE Guide A
Green room	25 W/m ²	5	Typical office gains
IT patch panel room			
Plant	-	Off	
Showers	-	Off	
SpEx office	270	3	10 laptops (one per occupant) - 27W each from CIBSE Guide A
SpEx manager's office	137 W	3	1 desktop – 110W average from CIBSE Guide A 1 laptop – 27W average from CIBSE Guide A

Thermal Template	Small power W	Small power pattern	Small power comments
Staff breakout/kitchenette	44.2	8	Assumes cooker hood to remove any heat from cooker. Cooking for evening events not included. Adjusted for our occupancy hours 36W for a fridge on continuously 8.2W microwave during occupied hours from CIBSE Guide A
Stairs	-	Off	
Storage	-	Off	
Technician	25 W/m ²	3	Typical office gains
Theatre	42000	5	From CharcoalBlue report
Viewing Area	-	Off	
Voids	-	Off	
WC	-	Off	
Workshop	25 W/m ²	3	Typical office gains

Appendix B Ventilation in the baseline scenario

B.1 Opening windows

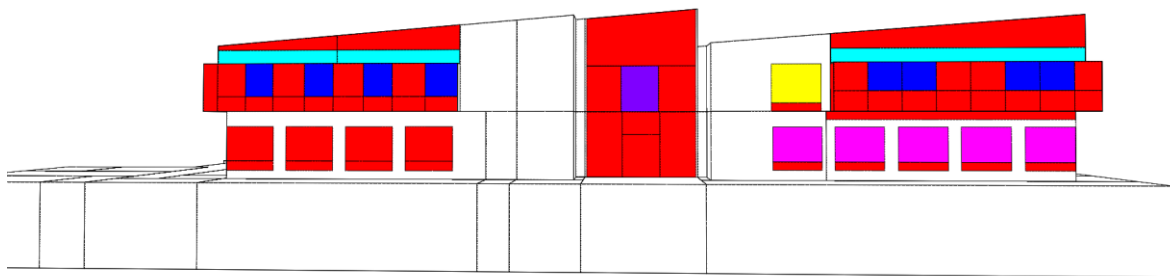
In the baseline scenario, it is assumed that the sliding doors are openable 100% behind glazed Juliet balconies. The centre pivot windows are assumed to open 100mm, and the door into the viewing area is openable 100%.

Windows are modelled as opening during occupied hours, between 07:00 and 18:00, when the internal air temperature is greater than 22°C.

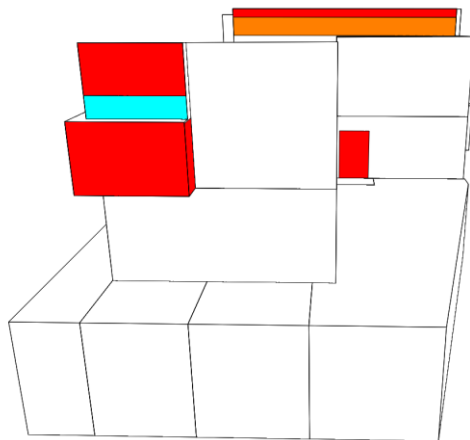
Table 13. Screenshots illustrating position of different opening types

Window openings by elevation

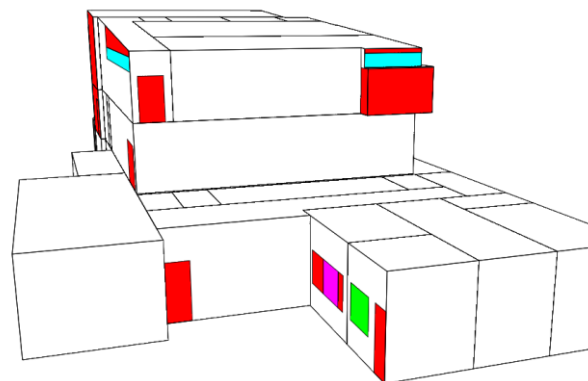
North west elevation



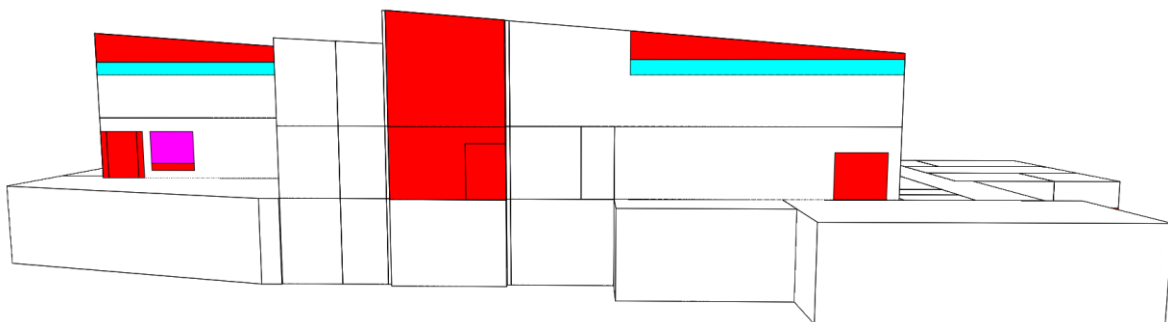
North east elevation



South west and sunken courtyard elevation



South east elevation



Window openings by elevation

Opening Type

- XTRN0000 (CLOSED)
- XTRN0002 (B Green Room Technician CH)
- XTRN0005 (L01 Sliding glazed door)
- XTRN0007 (L01 Opening windows centre hung)
- XTRN0008 (L01 Glazed louveres n & s elev)
- XTRN0009 (L0 Opening windows centre hung)
- XTRN0011 (L01 Glazed louveres- w elev)
- XTRN0013 (L01 Side hung glazed door)

B.2 Mechanical ventilation

Those rooms that are modelled with mechanical ventilation in the baseline scenario includes the minimum fresh air flow rate of 10l/s/person, supplied at the external air temperature.

For all room types, the ventilation has been modelled as:

- Operating at 100% during weekdays 07:00 to 18:00 and,
- Operating at 100% during week nights between 18:00 and 07:00 if the internal temperature is greater than 18°C and the internal temperature is greater than the outside temperature.

Table 14. Baseline mechanical ventilation

Room type	MVHR fresh air flow rate (l/s/person)	Weekday daytime ventilation hours	Weekday night time ventilation hours
Armoury	-	-	-
AV dimmer room	10	07:00 – 18:00	18:00 – 07:00
Changing	-	-	-
Circulation	-	-	-
Control room	10	07:00 – 18:00	18:00 – 07:00
Drama classroom	10	07:00 – 18:00	18:00 – 07:00
Drama foyer	-	-	-
Drama office	10	07:00 – 18:00	18:00 – 07:00
Green room	10	07:00 – 18:00	18:00 – 07:00
IT patch panel room	-	-	-
Plant room	-	-	-
Showers	-	-	-
SpEx manager's office	10	07:00 – 18:00	18:00 – 07:00
SpEx office	10	07:00 – 18:00	18:00 – 07:00
Staff breakout/kitchenette	-	07:00 – 18:00	18:00 – 07:00
Stairs	-	-	-
Storage	-	-	-
Technician	10	07:00 – 18:00	18:00 – 07:00
Theatre	10	07:00 – 18:00	18:00 – 07:00
Viewing area	10	07:00 – 18:00	18:00 – 07:00
Void	-	-	-
WC	-	-	-
Workshop	10	07:00 – 18:00	18:00 – 07:00

Appendix C Modelled scenarios

C.1 Scenario 1: Increased centre pivot window opening

The centre pivot window in the Technician Room in this scenario is assumed to open to a maximum of 20°. There are no changes to other windows.

Appendix D CIBSE TM52 results

D.1 Baseline scenario

Table 15. CIBSE TM52 results for baseline option (weather file: London weather centre DSY1 2020 high emissions scenario 50th percentile)

Room Name	Criterion 1 result	Criterion 2 result	Criterion 3 result	Which criteria are failed?	Overall result
<i>CIBSE TM52 criteria</i>	<i>3</i>	<i>6</i>	<i>4</i>		
B Green room	3.4	6	2	1	Pass
B Technician	5.2	8	2	1 & 2	Fail
B Workshop	3.2	5	2	1	Pass
L0 SpEx Managers Office	0	0	0	-	Pass
L0 SpEx Office	0	0	0	-	Pass
L1 Drama classroom 01	1	3	1	-	Pass
L1 Drama classroom 02	1.6	6	2	-	Pass
L1 Drama Office	0.8	3	1	-	Pass
L1 Staff breakout kitchenette	4.6	4	2	1	Pass

Table 16. CIBSE Guide A results for baseline (weather file: London weather centre DSY1 2020 high emissions scenario 50th percentile)

Room name	Number of occupied hours with an operative temperature greater than 25°C	Overall result
B Theatre	0	Pass
L0 Control room	0	Pass

D.2 Scenario 1

Table 17. CIBSE TM52 results for scenario 1 (weather file: London weather centre DSY1 2020 high emissions scenario 50th percentile)

Room Name	Criterion 1 result	Criterion 2 result	Criterion 3 result	Which criteria are failed?	Overall result
<i>CIBSE TM52 criteria</i>	<i>3</i>	<i>6</i>	<i>4</i>		
B Green room	2.4	6	2	-	Pass
B Technician	1.7	6	2	-	Pass
B Workshop	2.8	5	1	-	Pass
L0 SpEx Managers Office	0	0	0	-	Pass
L0 SpEx Office	0	0	0	-	Pass
L1 Drama classroom 01	1	3	1	-	Pass
L1 Drama classroom 02	1.6	6	2	-	Pass
L1 Drama Office	0.8	3	1	-	Pass
L1 Staff breakout kitchenette	4.6	4	2	1	Pass

Appendix E Additional results for final scenario

Table 18. CIBSE TM52 results for scenario 1 (weather file: London weather centre DSY2 2020 high emissions scenario 50th percentile)

Room Name	Criterion 1 result	Criterion 2 result	Criterion 3 result	Which criteria are failed?	Overall result
CIBSE TM52 criteria	3	6	4		
B Green room	2.1	9	2	2	Pass
B Technician	1.8	8	2	2	Pass
B Workshop	3.9	5	1	1	Pass
L0 SpEx Managers Office	0	0	0	-	Pass
L0 SpEx Office	0	0	0	-	Pass
L1 Drama classroom 01	0.1	1	1	-	Pass
L1 Drama classroom 02	0.6	4	1	-	Pass
L1 Drama Office	0.4	3	1	-	Pass
L1 Staff breakout kitchenette	1.5	2	1	-	Pass

Table 19. CIBSE TM52 results for scenario 1 (weather file: London weather centre DSY3 2020 high emissions scenario 50th percentile)

Room Name	Criterion 1 result	Criterion 2 result	Criterion 3 result	Which criteria are failed?	Overall result
CIBSE TM52 criteria	3	6	4		
B Green room	11.9	27	4	1 & 2	Pass
B Technician	9.7	26	4	1 & 2	Pass
B Workshop	10.9	22	4	1 & 2	Pass
L0 SpEx Managers Office	3.4	9	2	1 & 2	Pass
L0 SpEx Office	5.2	13	3	1 & 2	Pass
L1 Drama classroom 01	5.8	18	4	1 & 2	Pass
L1 Drama classroom 02	6.9	22	5	1 & 2 & 3	Pass
L1 Drama Office	7.8	22	4	1 & 2	Pass
L1 Staff breakout kitchenette	13.8	10	5	1 & 2 & 3	Pass

Table 20. CIBSE TM52 results for scenario 1 (weather file: London weather centre DSY1 2050 high emissions scenario 50th percentile)

Room Name	Criterion 1 result	Criterion 2 result	Criterion 3 result	Which criteria are failed?	Overall result
CIBSE TM52 criteria	3	6	4		
B Green room	10.2	13	3	1 & 2	Fail
B Technician	7.6	13	3	1 & 2	Fail
B Workshop	10.9	12	2	1 & 2	Fail
L0 SpEx Managers Office	0.1	1	1	-	Pass
L0 SpEx Office	0.6	4	1	-	Pass
L1 Drama classroom 01	2.8	9	2	2	Pass
L1 Drama classroom 02	3.6	12	3	1 & 2	Fail

Room Name	Criterion 1 result	Criterion 2 result	Criterion 3 result	Which criteria are failed?	Overall result
CIBSE TM52 criteria	3	6	4		
L1 Drama Office	3.5	7	2	1 & 2	Fail
L1 Staff breakout kitchenette	9.2	6	3	1	Pass

Table 21. Table 22. CIBSE TM52 results for scenario 1 (weather file: London weather centre DSY1 2080 high emissions scenario 50th percentile)

Room Name	Criterion 1 result	Criterion 2 result	Criterion 3 result	Which criteria are failed?	Overall result
CIBSE TM52 criteria	3	6	4		
B Green room	19.6	22	4	1 & 2	Fail
B Technician	13.8	21	4	1 & 2	Fail
B Workshop	27.3	20	4	1 & 2	Fail
L0 SpEx Managers Office	2.1	7	2	2	Pass
L0 SpEx Office	5.2	10	2	1 & 2	Fail
L1 Drama classroom 01	5.7	15	4	1 & 2	Fail
L1 Drama classroom 02	6.9	19	4	1 & 2	Fail
L1 Drama Office	8	15	3	1 & 2	Fail
L1 Staff breakout kitchenette	15.4	8	4	1 & 2	Fail

Table 23. CIBSE Guide A results for scenario 1 for additional weather files

Room name	DSY2 2020	DSY3 2020	DSY1 2050	DSY1 2080
B Theatre	0	0	0	0
L0 Control room	0	0	0	0

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