



Method Consulting

Intelligent engineering,
sustainable buildings

Brunner House

Thermal Comfort Report

Channing School

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Document History

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Executive Summary

Method Consulting LLP has been appointed to carry out a thermal comfort analysis for the proposed development of Brunner House, on behalf of Channing School. The proposed development consists of both a refurbished existing building and an extension, which have been assessed individually according to the appropriate and relevant criteria.

Based on the methodology and assumptions adopted, the development was modelled using dynamic simulation software with the following results:

- Achieves compliance with BB101 (2018) mandatory overheating criteria.
- Achieves compliance with BB101 (2018) CO₂ concentration criteria.

These results were achieved based on the primary design measures listed below being implemented for the current (2020) DSY1, DSY2 and DSY3 weather files, as well as those covered in the body of this report. These measures have been agreed with and adopted by the relevant members of the design team.

- U-values to meet LETI standards for schools for the extension.
- The majority of the existing external building fabric is to be refurbished and improved to reduce u-values, minimise heat loss and improve thermal comfort.
- Exposed concrete soffit and walls to classrooms and staff areas within the extension.
- Blockwork partitions within the first floor of the existing building.
- Natural and mechanical ventilation through openable windows and hybrid ventilation units in occupied spaces.
- Ground floor glazing in the refurbished existing portion of the development to be modelled as side-hung openable to 90 degrees without restrictors.
- Ground floor glazing in the extension portion of the building to be side-hung and restricted to 130mm.
- All other vertical glazing to be side hung and restricted to 300mm.
- Internal blinds included in all occupied spaces.

The spaces within the proposed development have been assessed according to their relevant thermal comfort category, depending on whether they are part of the existing/refurbished section of the building, or the extension:

- Category II spaces include all spaces as part of the new extension,
- Category III spaces include all spaces as part of the refurbishment,
- Unoccupied spaces have been assessed under the same category as occupied spaces for the respective part of the building, to produce a more conservative set of results.

While not required for compliance, it is recommended for additional window openings to be provided in 01 – Circulation Stairs, located in the extension portion of the building, as it is currently at risk of overheating and knocking on adjacent spaces.

In addition to the above results, a further scenario was tested where upper floor windows were restricted to 130mm, limiting natural ventilation to these spaces. All occupied spaces met BB101 overheating criteria for the 2020 DSY1 and DSY2 weather files, with only 2 spaces failing for the most onerous DSY3 weather file. However, as majority of occupied spaces still comply with targets, and air tempering is available for the development by running the ASHP in reverse during peak summer conditions, this is deemed an acceptable result in terms of overheating compliance.

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1 Introduction

Method Consulting LLP has been appointed to carry out a thermal comfort analysis for the proposed development, Brunner House, on behalf of Channing School. This report has been written to summarise the process undertaken and outline the results of the thermal comfort analysis.

Thermal modelling has been carried out to ensure the building is designed to meet the temperature and CO₂ requirements as set out in BB101:2018. The detailed analysis and results can be seen in Section 6.

The following weather files have been used:

- London Heathrow Design Summer Year (DSY1) 2020 50% High emissions
- London Heathrow Design Summer Year (DSY2) 2020 50% High emissions
- London Heathrow Design Summer Year (DSY3) 2020 50% High emissions

2 Methodology

Analysis was carried out using simulation software IES Virtual Environment Version 2022.4.1.0. The analysis was conducted by a qualified and competent person.

The following Revit model was used to set up the initial model in the Virtual Environment:

- CHA-NVB-BHR-ZZ-M3-A-0010-P06-S1-Brunner House Model.rvt (NVB Architects)

The following Revit model was then used to update the model glazing in the virtual Environment:

- CHA-NVB-BHR-ZZ-M3-A-0010-P07-S1-Brunner House Model.rvt (NVB Architects)

The final constructed model can be seen in Figure 2.1 & Figure 2.2.

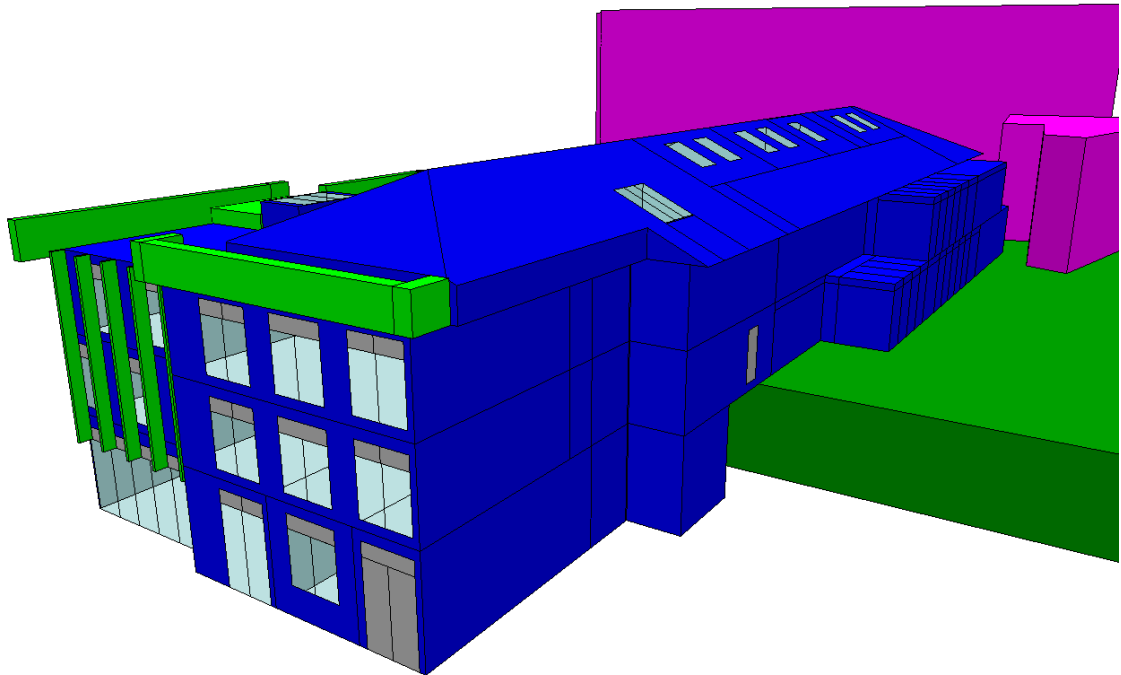


Figure 2.1: IES Virtual Environment model of Channing School - View from the north

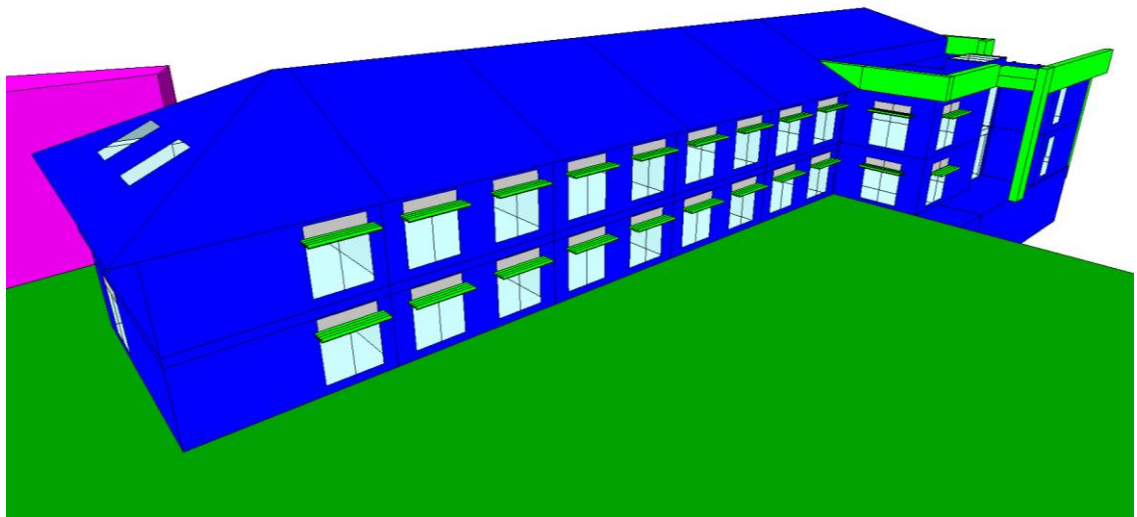


Figure 2.2: IES Virtual Environment model of Channing School - View from the south

2.1 Shading

2.1.1 Brise Soleil

The model contains horizontal brise soleil above all existing southwest facing windows. There is also brise soleil above glazing in general science classroom 2 on the ground and first floors in the extension. Additionally, there is vertical brise soleil on northeast facing classroom glazing above the DT workshop in the extension.

3 Assumptions

3.1 Building Fabric

The U-values and G-values of the building constructions are described in Table 3.1.1

Existing (Refurbished)		
Construction type	U-value (W/m ² K)	G-value
Ground floor	0.45	-
External walls	0.26	-
Dividing wall between existing & extension	0.26	-
Pitched roof	0.16	-
All glazing	1.4	0.4
Louvres/doors	1.6	-
Air Permeability – 5 m ³ /(h.m ²)		
Extension		
Construction type	U-value (W/m ² K)	G-value
Ground floor	0.12	-
External walls incl. plant	0.15	-
Flat roof	0.12	-
All glazing	1.4	0.4
Louvres/doors	1.6	-
Air Permeability – 3 m ³ /(h.m ²)		

Table 3.1.1: Fabric U-values and g-values for the proposed development

The thermal mass of the building constructions is as described in Table 3.1.2.

Existing (Refurbished)		
Element	Construction type	Thermal mass
Ground floor	Concrete slab	Heavyweight
External walls	Masonry with external insulated cladding	Mediumweight
Pitched roof	Slate, membrane, insulation between timbers, Plasterboard	Lightweight
Internal walls	GF - timber frame FF - masonry partition	GF - lightweight FF - mediumweight
Internal floor	Timber joists build up	Lightweight
Extension		
Element	Construction type	Thermal mass
Ground floor	Concrete slab	Heavyweight
External walls	200mm Concrete SFS (or blockwork), 120mm cavity, insulation, 200mm brickwork	Mediumweight
Flat roof	Concrete slab with insulation on top	Mediumweight
Internal walls	SFS	Lightweight

Table 3.1.2: Fabric constructions and thermal mass for the proposed development

Exposed thermal mass has been utilised in external walls and soffits of classrooms within the extension. It has also been used in the internal partitions on the first floor of the existing/refurbished spaces. This higher thermal mass improves the thermal performance of these spaces and reduces the overall temperature of the building.

3.2 Ventilation Strategy

The building is naturally and mechanically ventilated, as well as ventilated using hybrid units, as described below.

3.2.1 Natural Ventilation

Classroom windows on the ground floor are assumed to be opened when the rooms are occupied (07:00 to 17:00 in staff spaces, 09:00 to 16:00 in classrooms) and the internal temperature reaches 21°C or the CO₂ concentration reaches 1000ppm. Upper floor windows follow the same opening criteria but operate 24/7 to allow for night purging.

The assumed opening types are described in

	Opening type	Dimensions (WxH)	Restrictors/ Opening Angle	Location	Colour
C	Fixed glazing/ louvres	Varies	n/a	All	
D	Plant room louvre	Varies	25% free area	Basement - Plant room	
E	Side-hung	905x1760	130mm/ 8.3°	Ground floor - DT office	
F	Side-hung	905x1760	300mm/19.4°	Ground & first floor - teaching	
G	Side-hung	1010x2175	130mm/7.4°	Ground floor - teaching space	
H	Side-hung	1010x2175	300mm/17.3°	First floor - prep room	
I	Side-hung	1240x1715	300mm/14.0°	Extension - ground & first floor	
J	Side-hung	905x1715	90°	Ground floor - teaching	
K	Side-hung	905x1715	300mm/19.4°	First Floor - teaching	
L	Roof light – top hung	630x2060	130mm/3.62°	Extension circulation	
M	Roof light – top hung	800x1800	130mm/4.14°	Extension circulation	
N	Roof light – top hung	1200x1800	130mm/4.14°	Existing - teaching	< < >
O	Roof light – top hung	1200x1800	130mm/4.14°	Existing - Staff	< < >
P	Side-hung	905x1715	130mm/8.26°	Ground floor - teaching	< < >
Q	Side-hung	905x1760	90°	Ground floor - existing teaching	< < >
R	Side-hung	905x1760	90°	Ground floor - existing staff	< < >

Table 3.2.1.1 and shown in the 3D model images, Figure 3.2.1.1 to Figure 3.2.1.3.

It should be noted that there are potential design changes to the window restrictors for upper floor side-hung windows that are currently openable to 300mm. The proposed change is to reduce the restrictor depth to 130mm, with the impact of this potential change discussed in Section 6.4 of this report.

	Opening type	Dimensions (WxH)	Restrictors/ Opening Angle	Location	Colour
C	Fixed glazing/ louvres	Varies	n/a	All	
D	Plant room louvre	Varies	25% free area	Basement - Plant room	
E	Side-hung	905x1760	130mm/ 8.3°	Ground floor - DT office	
F	Side-hung	905x1760	300mm/19.4°	Ground & first floor - teaching	
G	Side-hung	1010x2175	130mm/7.4°	Ground floor - teaching space	
H	Side-hung	1010x2175	300mm/17.3°	First floor - prep room	
I	Side-hung	1240x1715	300mm/14.0°	Extension - ground & first floor	
J	Side-hung	905x1715	90°	Ground floor - teaching	
K	Side-hung	905x1715	300mm/19.4°	First Floor - teaching	
L	Roof light – top hung	630x2060	130mm/3.62°	Extension circulation	
M	Roof light – top hung	800x1800	130mm/4.14°	Extension circulation	
N	Roof light – top hung	1200x1800	130mm/4.14°	Existing - teaching	< < >
O	Roof light – top hung	1200x1800	130mm/4.14°	Existing - Staff	< < >
P	Side-hung	905x1715	130mm/8.26°	Ground floor - teaching	< < >
Q	Side-hung	905x1760	90°	Ground floor - existing teaching	< < >
R	Side-hung	905x1760	90°	Ground floor - existing staff	< < >

Table 3.2.1.1: Building opening profiles

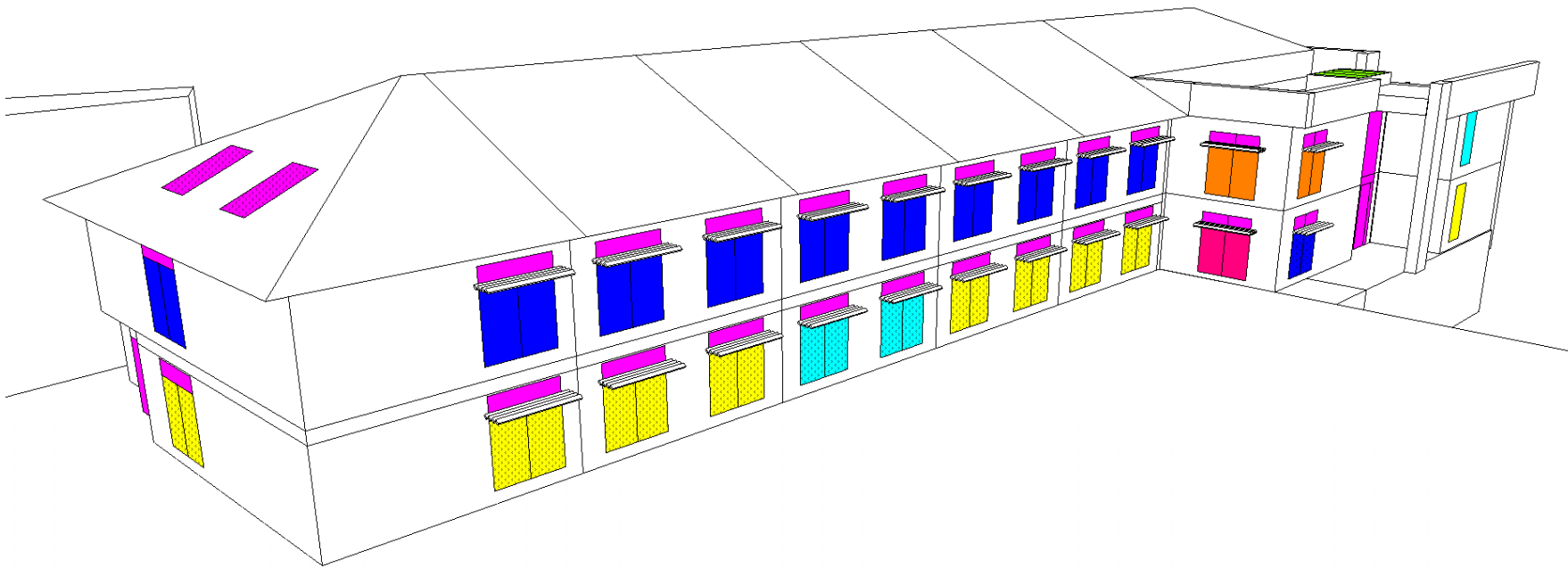


Figure 3.2.1.1: Opening types - View from south

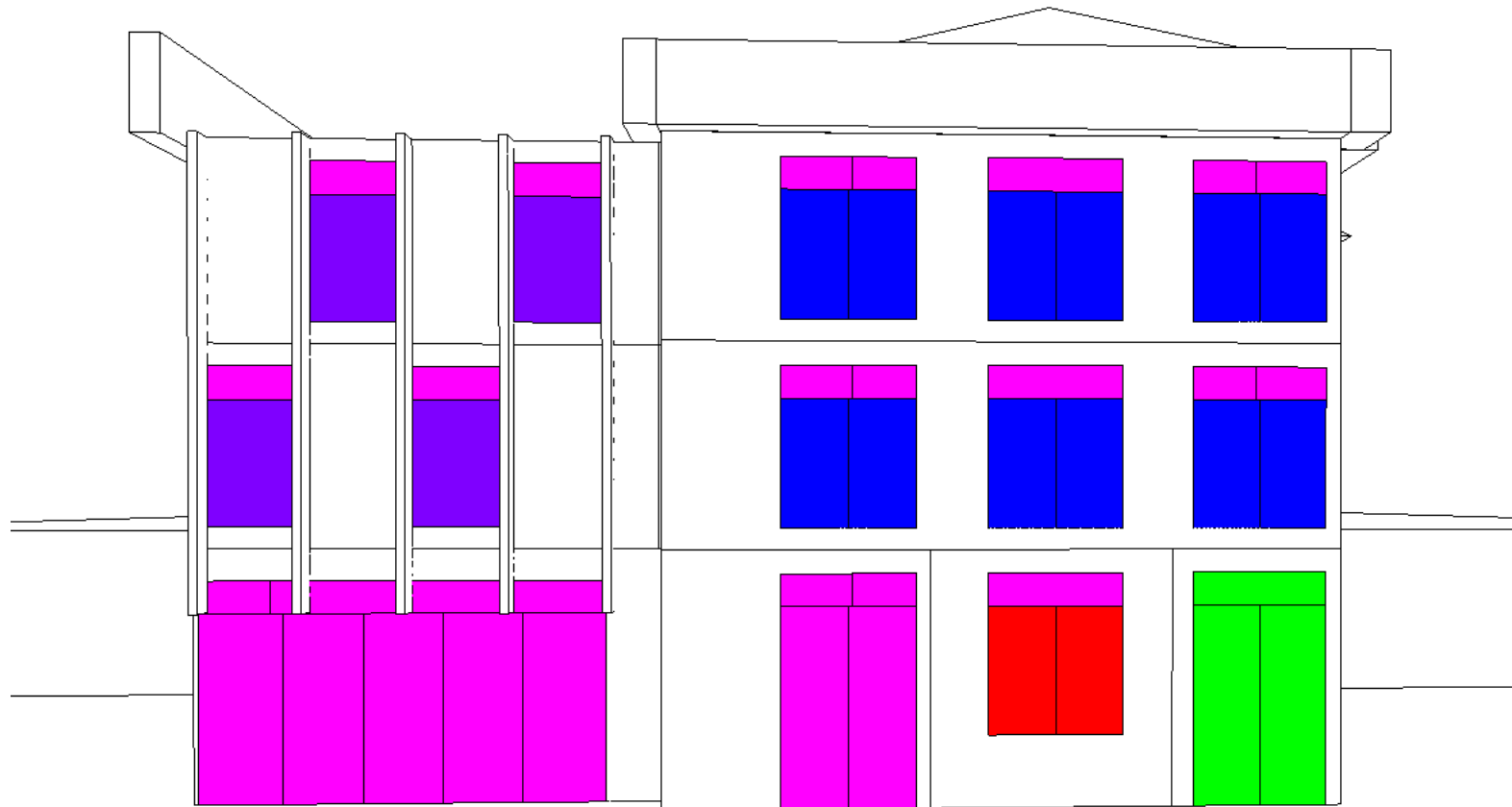


Figure 3.2.1.2: Opening types - View from northeast

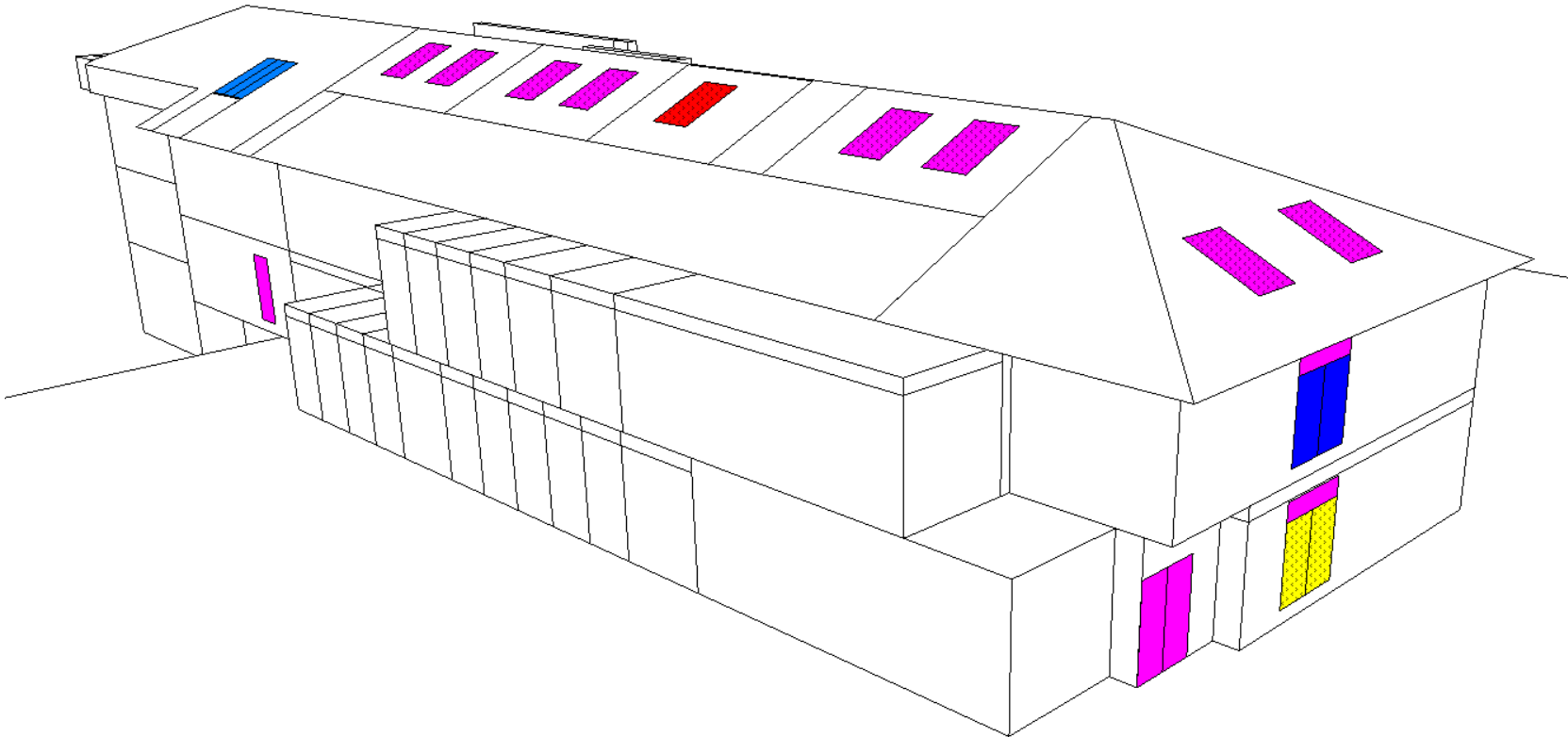


Figure 3.2.1.3: Opening types - View from west

3.2.2 Mechanical Ventilation

The following spaces are mechanically ventilated via hybrid units supplying 130l/s when a space is occupied and 250l/s when unoccupied. For classrooms, a boosted rate of 180l/s is supplied during lunch hour (12:00 to 13:00).

Room	Flow rate (l/s/p)
B1 - DT Office	250 night, 130 day, 180 lunch
00 - Classroom (IT)*	500 night, 260 day, 360 lunch
All other staff and teaching spaces	500 night, 260 day, 360 lunch

*Active cooling is provided

Table 3.2.2.1: MVHR ventilation flow rates

The following spaces are mechanically ventilated with extract ventilation. Active cooling is not provided.

Room	Flow rate
Toilets /WC	8 l/s
Stores	15 l/s

Table 3.2.2.2: Mechanical extract flow rates

4 NCM Profiles

The Department of Communities and Local Government set up the NCM database to support the implementation of the Energy Performance of Buildings Directive. This database takes data from the BRE, CIBSE and BS/ISO standards to form templates of typical energy demand, occupancies, lighting gains, equipment gains, etc. for a range of different room and building types. These templates are used to provide data for our buildings where alternatives are not provided. See Appendix A for which NCM templates have been selected for each space.

5 Internal Gains

See Appendix B for lighting, occupancy and equipment gains used in the model.

6 BB101 (2018)

Building Bulletin 101: Ventilation of School Buildings was updated in October 2018 and is referenced in Approved Document F of Building regulations for school buildings. The document sets out standards for acceptable temperature requirements and acceptable CO₂ levels in teaching and learning areas.

6.1 BB101: Thermal Comfort Requirements

Three criteria have been developed which indicate when overheating is likely to be problematic. These criteria should be applied outside the heating season and for the hours of 09:00 to 16:00, Monday to Friday, from 1st May to 30th September, including the summer holiday period, as if the school was occupied normally through the summer. A lunchbreak 12pm to 1pm with no internal heat gains during this period may be allowed for in classrooms.

The first of these criteria (Criterion 1) defines a minimum requirement for the overheating risk assessment. The two additional criteria (Criterion 2 and Criterion 3) are primarily measures of short-term discomfort and should be reported for information only.

Criterion 1: “Hours of Exceedance” The number of hours where $\Delta T > 1^{\circ}\text{C}$ should not exceed 40 of the occupied hours.

*When sports halls are used for exam purposes the duration for this activity shall be taken as weekdays 09:00 to 16:00 from 1st May to 8th July, with a lunchbreak 12pm to 1pm with no internal heat gains during this period. Criterion 1 should be calculated for this period with the number of hours reduced from 40 to 18.

Criterion 2: “Daily Weighted Exceedance” As the extent of overheating is as important as the frequency, “We” is calculated which combines the frequency and severity of overheating into one number. In any one day, $We \leq 6$.

Criterion 3: “Upper Limit Temperature” $\Delta T \leq 4^{\circ}\text{C}$ at all times.

6.2 BB101: CO₂ Requirements

In order to show compliance with BB101’s CO₂ criteria, the following criteria must be met:

1. Where mechanical ventilation is used, or when hybrid systems are operating in mechanical mode in general teaching and learning spaces, the following two criteria must be met:

- I. 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.
- II. 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.

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

- I. 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.
- II. 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.
- III. 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 category II building.

As the thermal comfort assessment covered in this report has been performed assuming hybrid units running in mechanical ventilation mode in order to accommodate for high summer temperatures, spaces with hybrid units have been assessed more stringently as mechanically ventilated spaces, as opposed to naturally ventilated.

6.3 BB101: Thermal Comfort Categories

BB101 guidance deems thermal comfort criteria to be based on the relevant category of the respective spaces, as shown in Table 7-8 in Building Bulletin 101 (2018). The spaces within the proposed development have been assessed

according to their relevant category, depending on whether they are part of the existing/refurbished section of the building, or the extension.

Category II spaces include all spaces as part of the new extension. Category III spaces include all spaces as part of the refurbishment.

Unoccupied spaces have been assessed under the same category as occupied spaces for the respective part of the building to produce a more conservative set of results.

6.4 Results

For the DSY1 (2020) weather file, all learning and teaching spaces comply with both mandatory overheating and CO₂ requirements, as shown in the results tables in Appendix C for overheating and Appendix F for CO₂ requirements. Additionally, all circulation spaces are not at risk of overheating.

It should be noted for the DSY1 weather file that while all mandatory criteria have been met, roughly half of the occupied spaces within the building do not meet non-mandatory criterion 2 of BB101. However, multiple measures have been implemented in order to mitigate overheating risk where possible. These measures include:

- External shading via horizontal and vertical brise, see Section 2.1.1,
- Internal shading via blinds,
- High quality building fabric, see Section 3.1.
- Openable rooflights in circulation spaces, see Section 3.2.1,
- Natural ventilation via openable windows and rooflights in occupied spaces, see Section 3.2.1,
- Mechanical ventilation via hybrid units in occupied spaces with access to vertical openings, see Section 3.2.2.

For the DSY2 (2020) weather file, all learning and teaching spaces comply with mandatory overheating requirements, as shown in the results tables in Appendix D. Additionally, all circulation spaces are not at risk of overheating.

For the DSY3 (2020) weather file, all learning and teaching spaces comply with mandatory overheating requirements, as shown in the results tables in Appendix E. However, although compliance with overheating criteria for unoccupied spaces is not mandatory, 01 – Circulation Stairs (extension) is at risk of overheating. The provision of further openings for natural ventilation or the introduction of

mechanical ventilation is recommended to reduce the internal temperature of the space. It is also noted the aforementioned circulation space, along with 01 - Circulation (existing) and 01 – Science Store, do not meet non-mandatory overheating criterion 2 of BB101.

As with the DSY1 weather file, although the DSY2 and DSY3 weather files comply with all mandatory overheating criteria, several occupied spaces within the building do not meet non-mandatory criterion 2 and 3 of BB101. Despite this, multiple measures have been implemented in order to mitigate overheating risk where possible, as discussed above.

6.4.1 *Results following potential change to upper floor window restrictors*

The results contained within this report have been achieved based on upper floor side-hung windows being openable to 300mm. This restriction has been deemed viable due to the 300mm recesses in which the glazing sits, and hence there is no risk of falling when windows are fully open.

However, there have been recent discussions raised on restricting windows on the upper floors to 130mm. This design change was tested using the same set up covered earlier in this report, with all occupied spaces passing for the current 2020 DSY1 and more onerous DSY2 weather files. However, 2 rooms within the extension failing mandatory overheating criteria for the most onerous DSY3 2020 weather file. These spaces are 00 – Science Classroom (Chemistry), and 01 – Science Classroom (Chemistry). This still meets London Plan requirements as majority of spaces meet the targets for this DSY3 weather file. Additionally, overheating requirements can still be met through the implementation of air tempering in affected spaces where necessary, by running the proposed ASHP in reverse during peak summer conditions.

7 Conclusion

Method Consulting LLP has been appointed to carry out a thermal comfort analysis for the proposed development, Channing School, on behalf of Channing School. The proposed development consists of both a refurbished existing building and an extension, which have been assessed individually according to the appropriate and relevant criteria.

The following weather files have been used:

- London Heathrow Design Summer Year (DSY1) 2020 50% High emissions
- London Heathrow Design Summer Year (DSY2) 2020 50% High emissions
- London Heathrow Design Summer Year (DSY3) 2020 50% High emissions

Based on the methodology and assumptions adopted, the development was modelled using dynamic simulation software with the following results:

- Achieves compliance with BB101 (2018) mandatory overheating criteria.
- Achieves compliance with BB101 (2018) CO2 concentration criteria.

These results were achieved based on the primary design measures listed below being implemented for the current (2020) DSY1, DSY2 and DSY3 weather files, as well as those covered in the body of this report. These measures have been agreed with and adopted by the relevant members of the design team.

- U-values to meet LETI standards for schools for the extension.
- The majority of the existing external building fabric is to be refurbished and improved to reduce u-values, minimise heat loss and improve thermal comfort.
- Exposed concrete soffit and walls to classrooms and staff areas within the extension.
- Blockwork partitions within the first floor of the existing building.
- Natural and mechanical ventilation through openable windows and hybrid ventilation units in occupied spaces.
- Ground floor glazing in the refurbished existing portion of the development to be modelled as side-hung openable to 90 degrees without restrictors.
- Ground floor glazing in the extension portion of the building to be side-hung and restricted to 130mm.
- All other vertical glazing to be side hung and restricted to 300mm for the whole building.
- Internal blinds included in all occupied spaces.

8 Appendices

8.1 Appendix A – Assigned NCM Templates

Space	NCM template
Chemistry classrooms	D1EduS: Laboratory
01 – Food Tech	D1EduS: Food preparation area (SecSchl)
Teaching and learning spaces	D1EduS: Teaching areas (SecSchl)
B1 – DT Workshop	D1EduS: Workshop – small scale
B1 – DT Office	D1EduS: Office (SecSchl: Meeting)
Toilets	D1EduS: Toilet (SecSchl)
Plant	D1EduS: Light plant room (SecSchl)
Storage	D1EduS: Cupboard (SecSchl)
Corridors/Staircases	D1EduS: Circulation area (SecSchl)

8.2 Appendix B – Internal Gains

8.2.1 Occupancy Lighting and Equipment Gains

Occupancy numbers, lighting gains and equipment gains have been included in the model as per the table below. The variation profile for classrooms is based on BB101 guidance (9:00 to 16:00 with a one-hour lunch break). The variation profile for staff spaces is based on typical working hours (07:00 to 17:00). The remaining spaces are based on NCM templates.

Location	Lighting gain	Max occupancy	Equipment gains	
	(W/m ²)	(People)	(W/m ²)	(W)
00 - Acc. WC	7.2	9.1* (m ² /person)	0	0
00 - Circulation (existing)	7.2	9.1* (m ² /person)	0	0
00 - Circulation Stairs (existing)	7.2	9.1* (m ² /person)	0	0
00 - Circulation Stairs (extension)	7.2	9.1* (m ² /person)	0	0
00 - CI Store	7.2	8.3* (m ² /person)	0	0
00 - Classroom (General)	7.2	18.0	10.0	349.4
00 - Classroom (IT)	7.2	26.0	25.0	1368.6
00 - Science Classroom (Chemistry)	7.2	26.0	25.0	1509.7

Location	Lighting gain	Max occupancy	Equipment gains	
	(W/m ²)	(People)	(W/m ²)	(W)
00 - Science Classroom (General) 1	7.2	26.0	10.0	552.2
00 - Science Classroom (General) 2	7.2	26.0	10.0	549.3
00 - Science Classroom (Physics) 1	7.2	26.0	10.0	537.8
00 - Science Classroom (Physics) 2	7.2	26.0	10.0	552.8
00 - Science Prep Room (Physics)	7.2	2.0	10.0	406.2
00 - Science Store	7.2	8.3* (m ² /person)	0	0
00 - WC 1	7.2	9.1* (m ² /person)	0	0
00 - WC 2	7.2	9.1* (m ² /person)	0	0
00 - WC 3	7.2	9.1* (m ² /person)	0	0
00 - WC 4	7.2	9.1* (m ² /person)	0	0
00 - WC 5	7.2	9.1* (m ² /person)	0	0
00 - WC 6	7.2	9.1* (m ² /person)	0	0
00 - WC 7	7.2	9.1* (m ² /person)	0	0
00 - WC 8	7.2	9.1* (m ² /person)	0	0
00 - WC 9	7.2	9.1* (m ² /person)	0	0
01 - Acc. WC	7.2	9.1* (m ² /person)	0	0
01 - Circulation Stairs (Extension)	7.2	9.1* (m ² /person)	0	0
01 - Circulation (existing)	7.2	9.1* (m ² /person)	0	0
01 - Circulation Stairs (existing)	7.2	9.1* (m ² /person)	0	0
01 - CI Store	7.2	8.3* (m ² /person)	0	0
01 - Science Classroom (Biology)	7.2	26.0	10.0	591.0
01 - Science Classroom (Biology) 1	7.2	26.0	10.0	591.7
01 - Science Classroom (Chemistry)	7.2	26.0	25.0	1509.4
01 - Science Classroom (General)	7.2	26.0	10.0	606.0

Location	Lighting gain	Max occupancy	Equipment gains	
	(W/m ²)	(People)	(W/m ²)	(W)
01 - Science Classroom (General) 2	7.2	26.0	10.0	549.2
01 - Science Prep Room (Biology)	7.2	2.0	10.0	444.9
01 - Science Prep Room (Chemistry)	7.2	2.0	25.0	873.5
01 - Science Store	7.2	8.3* (m ² /person)	0	0
01 - WC 1	7.2	9.1* (m ² /person)	0	0
01 - WC 2	7.2	9.1* (m ² /person)	0	0
01 - WC 3	7.2	9.1* (m ² /person)	0	0
01 - WC 4	7.2	9.1* (m ² /person)	0	0
01 -Food Tech	7.2	16.0	10.0	839.3
B1 - Acc. WC	7.2	9.1* (m ² /person)	0	0
B1 - Circulation	7.2	9.1* (m ² /person)	0	0
B1 - DT Office	7.2	2.0	10.0	251.7
B1 - DT Workshop	7.2	16.0	25.0	3197.8
B1 - Plant	7.2	9.1* (m ² /person)	50.5*	900.9*
B1 - Store	7.2	8.3* (m ² /person)	0	0

* Taken from NCM Template

8.3 Appendix C – BB101 Results Current Weather File (London Heathrow DSY1 2020 High 50% Weather File)

Room name	Category	BB101 2018 Criteria 1	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
Occupied					
00 - Classroom (General)	II	6	4	2	-
00 - Science Classroom (Chemistry)		13	10	3	2
00 - Science Classroom (General) 2		8	5	2	-
01 - Science Classroom (Chemistry)		14	10	3	2
01 - Science Classroom (General) 2		8	5	2	-

Room name	Category	BB101 2018 Criteria 1	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
01 - Science Prep Room (Chemistry)	II	2	1	1	-
B1 - DT Office		1	1	1	-
B1 - DT Workshop		7	3	2	-
00 - Classroom (IT)	III	0	0	0	-
00 - Science Classroom (General) 1		9	7	3	2
00 - Science Classroom (Physics) 1		8	7	3	2
00 - Science Classroom (Physics) 2		10	9	4	2
00 - Science Prep Room (Physics)		5	4	2	-
01 - Science Classroom (Biology)		11	8	4	2
01 - Science Classroom (Biology) 1		11	8	4	2
01 - Science Classroom (General)		12	9	4	2
01 - Science Prep Room (Biology)		2	3	2	-
01 -Food Tech		10	7	3	2
Unoccupied					
00 - Circulation Stairs (extension)	II	0	0	0	-
01 - Circulation Stairs (Extension)		9	3	1	-
B1 - Acc. WC		0	0	0	-
B1 - Acc. WC (c-void)		0	0	0	-
B1 - Circulation		0	0	0	-
B1 - Store		0	0	0	-
00 - Acc. WC	III	0	0	0	-
00 - Circulation (existing)		0	0	0	-
00 - Circulation Stairs (existing)		0	0	0	-
00 - CI Store		0	0	0	-
00 - Science Store		1	1	1	-

Room name	Category	BB101 2018 Criteria 1	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
00 - WC 1	III	0	0	0	-
00 - WC 2		0	0	0	-
00 - WC 3		0	0	0	-
00 - WC 4		0	0	0	-
00 - WC 5		0	0	0	-
00 - WC 6		0	0	0	-
00 - WC 7		0	0	0	-
00 - WC 8		0	0	0	-
00 - WC 9		0	0	0	-
01 - Acc. WC		0	0	0	-
01 - Circulation (existing)		4	2	1	-
01 - Circulation Stairs (existing)		0	0	0	-
01 - CI Store		0	0	0	-
01 - Science Store		5	4	2	-
01 - WC 1		0	0	0	-
01 - WC 2		0	0	0	-
01 - WC 3		0	0	0	-
01 - WC 4		0	0	0	-

8.4 Appendix D – BB101 Results Current Weather File (London Heathrow DSY2 2020 High 50% Weather File)

Room name	Category	BB101 2018 Criteria 1	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
Occupied					
00 - Classroom (General)	II	13	10	4	2
00 - Science Classroom (Chemistry)		5	6	2	-
00 - Science Classroom (General) 2		14	10	4	2
01 - Science Classroom (Chemistry)		5	6	2	-
01 - Science Classroom (General) 2		15	12	4	2

Room name	Category	BB101 2018 Criteria 1	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
01 - Science Prep Room (Chemistry)	II	13	10	3	2
B1 - DT Office		8	8	3	2
B1 - DT Workshop		16	7	3	2
00 - Classroom (IT)	III	0	0	0	-
00 - Science Classroom (General) 1		17	15	6	2 & 3
00 - Science Classroom (Physics) 1		17	16	6	2 & 3
00 - Science Classroom (Physics) 2		18	17	6	2 & 3
00 - Science Prep Room (Physics)		16	16	5	2 & 3
01 - Science Classroom (Biology)		18	15	6	2 & 3
01 - Science Classroom (Biology) 1		17	15	6	2 & 3
01 - Science Classroom (General)		19	15	6	2 & 3
01 - Science Prep Room (Biology)		10	10	4	2
01 -Food Tech		16	15	6	2 & 3
Unoccupied					
00 - Circulation Stairs (extension)	II	0	0	0	-
01 - Circulation Stairs (Extension)		12	6	2	-
B1 - Acc. WC		0	0	0	-
B1 - Acc. WC (c-void)		0	0	0	-
B1 - Circulation		0	0	0	-
B1 - Store		0	0	0	-
00 - Acc. WC	III	1	1	1	-
00 - Circulation (existing)		0	0	0	-
00 - Circulation Stairs (existing)		1	1	1	-
00 - CI Store		0	0	0	-
00 - Science Store		0	0	0	-

Room name	Category	BB101 2018 Criteria 1	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
00 - WC 1	III	1	1	1	-
00 - WC 2		1	1	1	-
00 - WC 3		1	1	1	-
00 - WC 4		1	1	1	-
00 - WC 5		1	1	1	-
00 - WC 6		1	1	1	-
00 - WC 7		1	1	1	-
00 - WC 8		1	1	1	-
00 - WC 9		0	0	0	-
01 - Acc. WC		0	0	0	-
01 - Circulation (existing)		1	1	1	-
01 - Circulation Stairs (existing)		0	0	0	-
01 - CI Store		0	0	0	-
01 - Science Store		2	2	1	-
01 - WC 1		1	1	1	-
01 - WC 2		1	1	1	-
01 - WC 3		0	0	0	-
01 - WC 4		0	0	0	-

8.5 Appendix E – BB101 Results Current Weather File (London Heathrow DSY3 2020 High 50% Weather File)

Room name	Category	BB101 2018 Criteria 1	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
Occupied					
00 - Classroom (General)	II	11	9	3	2
00 - Science Classroom (Chemistry)		32	17	4	2
00 - Science Classroom (General) 2		16	9	3	2
01 - Science Classroom (Chemistry)		31	18	4	2

Room name	Category	BB101 2018 Criteria 1	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
01 - Science Classroom (General) 2	II	19	10	4	2
01 - Science Prep Room (Chemistry)		8	8	3	2
B1 - DT Office		8	5	2	-
B1 - DT Workshop		21	6	2	-
00 - Classroom (IT)	III	0	0	0	-
00 - Science Classroom (General) 1		24	12	4	2
00 - Science Classroom (Physics) 1		21	11	4	2
00 - Science Classroom (Physics) 2		28	13	5	2 & 3
00 - Science Prep Room (Physics)		13	10	3	2
01 - Science Classroom (Biology)		22	13	5	2 & 3
01 - Science Classroom (Biology) 1		23	13	5	2 & 3
01 - Science Classroom (General)		25	13	5	2 & 3
01 - Science Prep Room (Biology)		7	7	3	2
01 -Food Tech		20	12	5	2 & 3
Unoccupied					
00 - Circulation Stairs (extension)	II	12	5	1	-
01 - Circulation Stairs (Extension)		60	12	2	1 & 2
B1 - Acc. WC		0	0	0	-
B1 - Acc. WC (c-void)		0	0	0	-
B1 - Circulation		0	0	0	-
B1 - Store		0	0	0	-
00 - Acc. WC	III	1	1	1	-
00 - Circulation (existing)		1	1	1	-
00 - Circulation Stairs (existing)		11	5	1	-
00 - CI Store		2	2	1	-

Room name	Category	BB101 2018 Criteria 1	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
00 - Science Store	III	3	4	2	-
00 - WC 1		2	2	1	-
00 - WC 2		2	2	1	-
00 - WC 3		2	2	1	-
00 - WC 4		2	2	1	-
00 - WC 5		3	3	1	-
00 - WC 6		3	3	1	-
00 - WC 7		3	3	1	-
00 - WC 8		3	3	1	-
00 - WC 9		0	0	0	-
01 - Acc. WC		4	3	1	-
01 - Circulation (existing)		20	9	2	2
01 - Circulation Stairs (existing)		4	2	1	-
01 - CI Store		2	2	1	-
01 - Science Store		11	11	3	2
01 - WC 1		4	3	1	-
01 - WC 2		4	3	1	-
01 - WC 3		4	3	1	-
01 - WC 4		0	0	0	-

8.6 Appendix F – BB101 CO₂ Results

Room name	BB101			BB101			
	CO ₂			CO ₂			
	Mechanical ventilation			Natural ventilation			
	Criteria 1 (Average CO ₂ must not exceed 1000ppm)	Criteria 2 (CO ₂ must not exceed 1500ppm for more than 20 consecutive minutes)	Criteria failing	Criteria 1 (Average CO ₂ must not exceed 1500ppm)	Criteria 2 (CO ₂ must not exceed 2000ppm for more than 20 consecutive minutes)	Criteria 3 (System designed to achieve a CO ₂ level < 1200ppm for new and 1750 for refurbished buildings) – Category II	Criteria failing
00 - Classroom (General)	Pass	Pass	-	-	-	-	-
00 - Classroom (IT)	Pass	Pass	-	-	-	-	-
00 - Science Classroom (Chemistry)	Pass	Pass	-	-	-	-	-
00 - Science Classroom (General) 1	Pass	Pass	-	-	-	-	-
00 - Science Classroom (General) 2	Pass	Pass	-	-	-	-	-
00 - Science Classroom (Physics) 1	Pass	Pass	-	-	-	-	-
00 - Science Classroom (Physics) 2	Pass	Pass	-	-	-	-	-
00 - Science Prep Room (Physics)	Pass	Pass	-	-	-	-	-
01 - Science Classroom (Biology)	Pass	Pass	-	-	-	-	-
01 - Science Classroom (Biology) 1	Pass	Pass	-	-	-	-	-

Room name	BB101			BB101			
	CO ₂			CO ₂			
	Mechanical ventilation			Natural ventilation			
	Criteria 1 (Average CO ₂ must not exceed 1000ppm)	Criteria 2 (CO ₂ must not exceed 1500ppm for more than 20 consecutive minutes)	Criteria failing	Criteria 1 (Average CO ₂ must not exceed 1500ppm)	Criteria 2 (CO ₂ must not exceed 2000ppm for more than 20 consecutive minutes)	Criteria 3 (System designed to achieve a CO ₂ level < 1200ppm for new and 1750 for refurbished buildings) – Category II	Criteria failing
01 - Science Classroom (Chemistry)	Pass	Pass	-	-	-	-	-
01 - Science Classroom (General)	Pass	Pass	-	-	-	-	-
01 - Science Classroom (General) 2	Pass	Pass	-	-	-	-	-
01 - Science Prep Room (Biology)	Pass	Pass	-	-	-	-	-
01 - Science Prep Room (Chemistry)	Pass	Pass	-	-	-	-	-
01 - Food Tech	Pass	Pass	-	-	-	-	-
B1 - DT Office	Pass	Pass	-	-	-	-	-
B1 - DT Workshop	Pass	Pass	-	-	-	-	-



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