JAW

Meadow High School, London Borough of Hillingdon

Overheating report

Version 02

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JAWSustainability

Contents

1 Introduction

This report assesses the overheating potential of the proposed new 2 storey building of Meadow High School, in order to meet the sustainability requirements of the London Plan and the London Borough of Hillingdon. The project consists of the construction of a new 2 storey building

Overheating has been assessed in line with the guidance and criteria outlined in 'BREEAM UK New Construction: Non-domestic Buildings' (2018), 'CIBSE TM 52 - The limits of thermal comfort: avoiding overheating in European buildings' (2013) and 'BB 101: Guidelines on ventilation, thermal comfort and indoor air quality in schools' (2018).

Figure 1-1 - Site location

2 Guidance

2.1 CIBSE TM 52 - The limits of thermal comfort: avoiding overheating in European buildings

CIBSE TM 52 outlines criteria to assess if a naturally ventilated building is overheating, using an adaptive temperature approach. The following three criteria, taken together, provide a robust yet balanced assessment of the risk of overheating of buildings in the UK and Europe.

1. The first criterion sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature (upper limit of the range of comfort temperature) by 1°K or more during the occupied hours of a typical non-heating season (1st May to 30th September).
2. The second criterion deals with the severity of overheating within any one day, which can be as important as its frequency, the level of which is a function of both temperatures rise and its duration. This criterion sets a daily limit for acceptability.
3. The third criterion sets an absolute maximum daily temperature for a room, beyond which the level of overheating is unacceptable.

The number of hours during which ΔT is greater than or equal to one degree (°K) during the period May to September inclusive shall not be more than 3% of occupied hours. ΔT is defined as operative temperature less the maximum acceptable temperature. ΔT is rounded to the nearest whole degree.

To allow for the severity of overheating, the weighted exceedance shall be less than or equal to 6 in any one day.

To set an absolute maximum value for the indoor operative temperature the value of ΔT shall not exceed 4°K.

2.2 BB 101: Guidelines on ventilation, thermal comfort and indoor air quality in schools

BB 101 provides design guidance and criteria for preventing and assessing overheating in schools. It provides further guidance on assumptions that should be used for assessing thermal comfort and overheating in education and school buildings.

It sets out required operative temperature ranges for the heating season for different spaces within an education building. It recommends that for spaces with a normal level of activity, such as teaching and staff areas, a normal operative temperature during the heating season of 20°C should be maintained, with an absolute maximum operative temperature of 25°C. This is equivalent to the operative temperature ranges outlined in CIBSE Guide A: Environmental Design, which list an operative temperature range of 18-22°C to maintain a Predicted Mean Vote of ±0.5.

In order to prevent a building being overdesigned to accommodate a few extreme temperature occurrences, it is recommended that there is some flexibility in allowing temperatures outside these ranges

It recommends that a school building is only required to meet TM 52 criterion 1 to pass an overheating assessment, but that the results for criterion 2 and 3 should be reported for information only.

3 Cooling Hierarchy

3.1 Minimise internal heat generation

Internal heat generation will be minimised throughout the development. Highly efficient LED lighting will be required as part of the energy strategy, which minimises internal heat generation. Daylight dimming and occupancy sensing has also been proposed to ensure lighting is adequately controlled and not operating when not needed.

3.2 Reduce the amount of heat entering a building

The development will have highly insulated external walls, which minimise any heat gain through conduction

Solar gains are a passive form of heating from the sun's radiation and are beneficial to a building during winter months as they provide an effective source of heat and reduce internal heating requirements. However, during summer months, they must be controlled in order to mitigate the risk of overheating. They can be controlled through glazing and shading design in order to allow low level winter sun to enter the building and to limit access to high level summer sun. Solar control glazing has been recommended to minimise solar gain.

3.3 Mechanical ventilation

The development has been specified with MVHR in some spaces and NVHR in teaching and study areas.

4 Assessment Methodology

The assessment was undertaken using IES Virtual Environment software, which is a CIBSE AM11 compliant thermal modelling software. A model of the proposed development was created in the IES ModelIt module using drawings provided by the architect. The surrounding school buildings have been modelled based on satellite imagery and information provided in the drawings.

A dynamic thermal assessment was conducted using the IES Apache module, using the Design Summer Year 1, London Heathrow, 2020, high emission, 50% percentile weather file. Thermal comfort is only relevant in the occupied spaces, which in this development is the teaching areas, the study areas and the stuff areas.

The assumptions used in the modelling are outlined in the Appendix.

5 Results and Discussion

5.1 Overheating

The results for the overheating assessment are presented in Table 4-2 below.

Room	Criteria 1 (%Hrs Top-Tmax>=1°K)	Criteria 2 (Max. Daily Deg. Hrs)	Criteria 3 (Max. ΔT)
Limiting Value	=< 3.0	=<6.0	=<4
Floor 00_breakout room	0	0	0
Floor 00_classroom 01	1.5	3	2
Floor 00_common room	0.9	1	1
Floor 00_food tech	0.2	1	1
Floor 00_group room	0	0	0
Floor 00_medical room	0	0	0
Floor 00_music	2.8	5	2
Floor 00_science	0.9	2	1
Floor 00_fitness room	17.9	19	4
Floor 01_classroom 04	3.1	7	2
Floor 01_classroom 06	2.3	4	2
Floor 01_hygiene room	0	0	0
Floor 01_large group room	7.3	15	3
Floor 01_quiet study	3.4	5	2
Floor 01_breakout	1.1	6	2
Floor 01_therapy	0.8	3	1
Floor 01_staff social	4	11	3
Floor 01_assist head office	1.2	2	1
Floor 01_group room	1.8	4	2
Floor 01_assist head office	0.5	1	1
Floor 01_small group room	0.6	2	1
Floor 01_classroom 05	2.4	5	2
Floor 01_classroom 02	2.1	4	2
Floor 01_Faculty leader office	1.4	3	1
Floor 01_Team leader office	1.2	3	1
Floor 01_classroom 03	1.5	4	1

Table 5-1 – Overheating results

The results show that the majority of the rooms meet the recommendation within BB 101 of passing criteria 1, and that these rooms will generally not overheat during summer. The rooms that fail to fulfil this criterion are the fitness room, Classroom 04, large group room, quiet study and staff social.

In line with BB 101, it has been assumed that the fitness room is fully occupied between 9:00 and 16:00, with a lunch hour. In reality this is unlikely to reflect the actual occupancy of the room, which is unlikely to be fully occupied at all times.

Moreover because of the nature of activities that are going to take place in the room higher sensible and latent occupancy heat gains have been chosen for the model from CIBSE Guide A, but the available numbers correspond to an adult male body during certain activities. In reality the heat gains from pupils using the room are expected to be lower, but the estimation of an accurate amount is impossible. As such these instances of overheating are unlikely to occur in practice.

After analysing the results of the simulation, the risk of overheating beyond the guidance withing Classroom 04 and quiet study is predicted to take place outside of school term time and therefore the occupants won't be affected by them. The overheating assessment assumes that the building will be occupied throughout the year which does not reflective of the actual use of the building.

The risk of overheating within the staff social and the large group room will probably be above guidance on certain days during June and July. The current occupancy assumptions for these spaces are based on assumptions that came up from conversions with the designing team and the school. In reality, the occupancy may be much lower and sensible alterations to these assumptions will reduce the risk of overheating down.

6 Conclusion

The proposed development of Meadow High School building has been evaluated for overheating potential. A dynamic thermal simulation was conducted using IES Virtual Environment to complete the assessment in line with the guidance and criteria set out in the BREEAM manual, CIBSE TM 52 and BB 101.

As shown in Table 5-1, the majority of the occupied rooms do not overheat, with only the ground level fitness room not meeting the recommendations of the assessment. The reasons for this were outlined, and it was conducted that these overheating instances are unlikely to occur in practice. The development follows the cooling hierarchy.

7 Appendix

7.1 Model Assumptions

The building and modelling assumptions used in the assessment are outlined below. The building fabric used are outlined in Table 7-1.

Building Element	U – Value (W/m²K)	G - Value
External Walls	0.14	
Roof	0.11	
Floor	0.11	
External Glazing	0.8	0.53
Rooflights	0.8	0.53

Table 7-1 – Building fabric properties

In line with the guidance in BB 101, the building was assumed to be occupied from 9:00 to 16:00, Monday to Friday, including the holiday periods. The heating setpoint was set to 19ºC and was in operation 1 hour either side of the occupied period, from 8:00 to 17:00, Monday to Friday, including the holiday periods.

Different occupancy profiles have been created for :

- Staff social setting 100% occupancy for 1 hours at lunch , 80% between 8am and 9am and also between 3pm and 6pm and 30% outside of these hours
- Group room and quiet study setting 100% occupancy between 10am and 12pm and also between 1pm and 3pm and 30% outside these hours
- Common room setting 100% between 12pm and 13pm and 30% all the other hours
- Fitness room setting the same occupancy profile as the rest of the classrooms with extra 30% occupancy between 4pm and 8pm

Internal gains used in the model are outlined in Table 7-2 and were taken from BB 101 which provide specific internal heat gain assumptions for school buildings, and CIBSE Guide A. The numbers of occupants in each room was based on the information provided by the designing team.

Rooms	Internal gains				
	Number of people	Sensible Heat Gains	Latent Heat Gains	Lighting gains	Equipment gains
Standard Classroom	13	70 W/person	55 W/person	7.2 W/m^2	5 W/m^2
ICT Rich Classroom	13	70 W/person	55 W/person	7.2 W/m^2	10 W/m^2
Science	13	70 W/person	55 W/person	7.2 W/m^2	5 W/m^2
Music room	13	70 W/person	55 W/person	7.2 W/m^2	5 W/m^2
Common room	32	70 W/person	55 W/person	7.2 W/m^2	1 W/m^2
Staff social	23	70 W/person	55 W/person	7.2 W/m^2	5 W/m^2
Therapy room	6	70 W/person	55 W/person	7.2 W/m^2	1 W/m^2
Assistant Head Offices	1	70 W/person	55 W/person	7.2 W/m^2	1 W/m^2
Leader Offices	5	70 W/person	70 W/person	7.2 W/m^2	5 W/m^2
Food tech class	13	70 W/person	55 W/person	7.2 W/m^2	5 W/m^2
Medical Room	3	70 W/person	55 W/person	7.2 W/m^2	-
Hygiene Room	3	70 W/person	55 W/person	7.2 W/m^2	-
Group room	9	70 W/person	55 W/person	7.2 W/m^2	-
Small Group room	6	70 W/person	55 W/person	7.2 W/m^2	-
Large Group room	18	70 W/person	55 W/person	7.2 W/m^2	-
Quite Study room	12	70 W/person	55 W/person	7.2 W/m^2	-
Breakout rooms	4	70 W/person	55 W/person	7.2 W/m^2	-
Gym	13	140 W/person	125 W/person	7.2 W/m^2	-
Circulation	-	-	-	7.2 W/m^2	-
WC	-	-	-	7.2 W/m^2	-

Table 7-2 – Internal gains

Natural ventilation was modelled through both the operable windows in the natural ventilated rooms using the IES MacroFlo Module. Operable windows were set to start opening when internal air temperatures reach 20ºC and be fully open once internal air temperature reaches 22 ºC, from 09:00 – 16:00, Monday to Friday.