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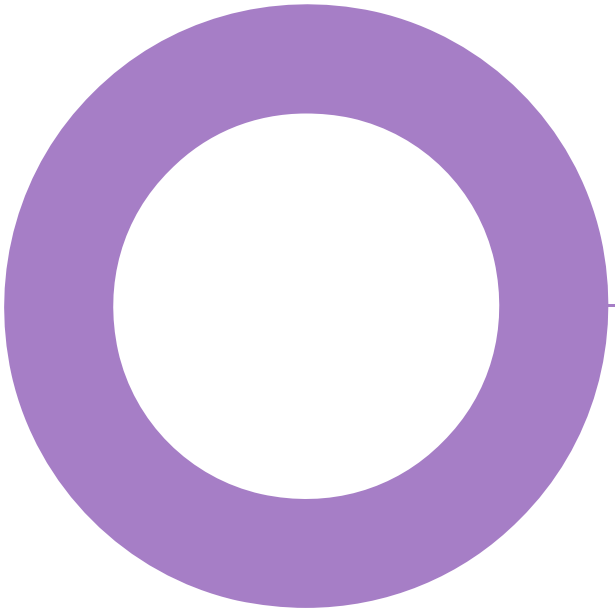
Elmsbrook Local Centre. Bicester.
A2Dominion.

SUSTAINABILITY
OVERHEATING ANALYSIS
RESIDENTIAL
REVISION 02 – 28 MAY 2019



Audit sheet.

Rev.	Date	Description of change / purpose of issue	Prepared	Reviewed	Authorised
01	08/03/2019	First Issue	JT	RG	TK
02	28/05/19	Update following comments from Client	JT	RG	JF

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Contents.

Executive summary

This report has been produced in support of the planning application for the development of a new Local Centre comprising Retail, Commercial and Community floorspace (flexible use Class A1/A2/A3/B1/D1), with a total GEA of 1,476 sqm, and 38 residential units (use class C3) with associated access, servicing, landscaping and parking. The three ground floor units consist of:

1. Unit 1: Flexible use classes D1 and/or A3;
2. Unit 2: Flexible use classes A1, B1 and/or D1;
3. Unit 3: Flexible use classes A1, B1 and/ or D1.

For the purpose of developing this overheating risk assessment, assumptions have been made on the predicted usage of these spaces. This has been performed to allow estimation of internal gains.The reference scheme is as follows:

1. Nursery: 490 sqm (GIA) of floorspace to be used as a nursery (Use Class D1)
2. Retail: 170 sqm (GIA) of floorspace to be used as retail (flexible Use Class A1/ A3/ A5), to be split into two units on ground floor;
3. Community Centre: A mix of 447 sqm (GIA) of floorspace to be used as a community hall (Use Class D1) and 125 sqm (GIA) of floorspace to be used as a retail (Use Class A3), to be located adjacent to the community hall;

This report reviews the overheating risk assessment carried out in line with CIBSE Guide A (2015) and TM52 Adaptive Comfort (2016) for the proposed non-residential buildings in Elmsbrook Local Centre. The occupied spaces in the Nursery and the A2D Office space has been evaluated. The occupied areas in the Community Centre will have active cooling to provide thermal comfort in the summer, given the high occupancy densities expected in these spaces, and therefore have not been included in this analysis.

The thermal simulations show that all the Nursery spaces achieve compliance with the requirements in CIBSE TM52 with the use of mechanical ventilation and the use of blinds. The support/admin office would not achieve compliance with the aforementioned requirements without the use of internal blinds equal to or better than the performance criteria stated in Section 3.7.

The A2D Office does not achieve compliance with CIBSE Guide A with an increased mechanical ventilation level and the inclusion of blinds. Alternative methods to achieve compliance have been suggested in Section 4

Full results are included in Section 3 of this report.

1. Introduction

This report reviews the overheating risk assessment for the occupied spaces of the proposed Nursery and A2D Offices as part of the Elmsbrook development, using dynamic simulation modelling following the guidance detailed in *CIBSE Guide A (2015)* and *CIBSE TM52 Adaptive Thermal Comfort* (2016).

The occupied areas in the Community Centre will have active cooling to provide thermal comfort in the summer, given the high occupancy densities expected in these spaces, and therefore have not been included in this analysis.

1.1 CIBSE Guide A (2015) & CIBSE TM52 Adaptive Thermal Comfort

CIBSE Guide A (2015) introduces the recommendation of using the adaptive approach (detailed in CIBSE TM52: The limits of thermal comfort) to determine if a building or room is likely to overheat in free running naturally ventilated buildings. This supersedes the single temperature overheating limit approach included in the 2006 version of CIBSE Guide A, which recommended limiting the expected occurrence of operative temperatures above 28°C to 1% of the annual occupied period; setting the maximum acceptable indoor operative temperature to 30°C.

There are a few reasons that support this change in the methodology. According to the 'adaptive' approach to thermal comfort, the temperature at which the majority of people are comfortable 'tracks' the mean indoor temperature as a result of the correlation between indoor and outdoor temperature. This means that comfort temperature varies with outdoor temperature in free-running buildings, as shown in Figure 1.

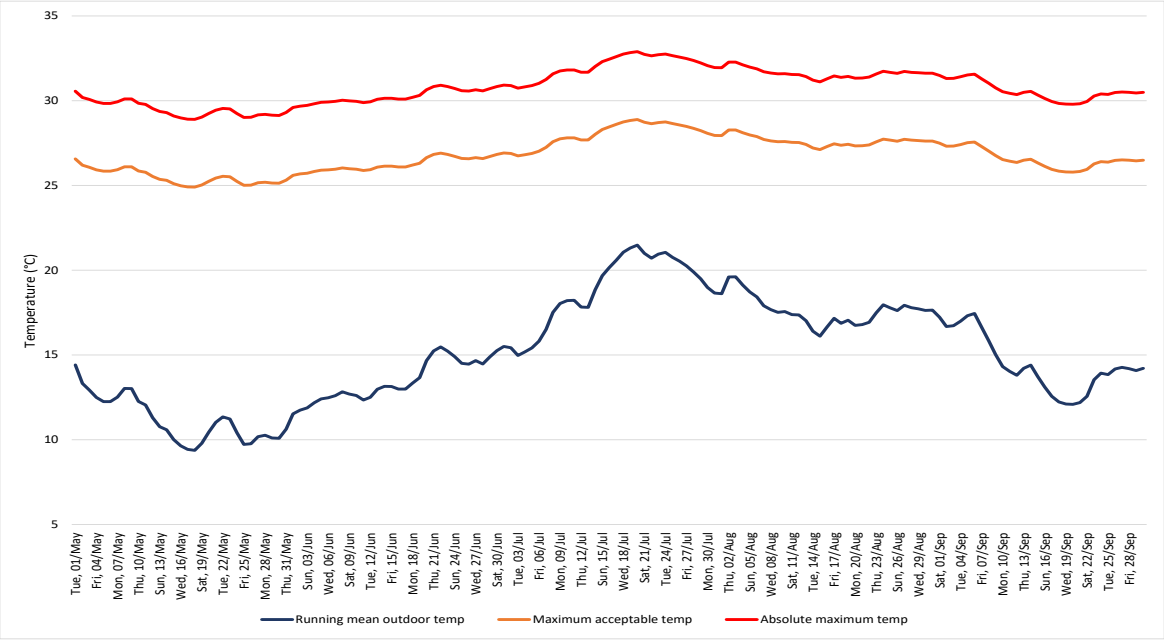


Figure 1: Adaptive Comfort – Running mean outdoor temperature (Trm), maximum acceptable temperature (Tmax) and absolute maximum temperature (Tupp) (based on Swindon DSY1 weather file)

The spaces in the Nursery have been assessed against the adaptive comfort criteria following the 'free-running' building definition under *BB101 Ventilation, thermal comfort and indoor air quality in schools (2018),* which states that for thermal modelling and overheating assessment purposes mechanical ventilation is classified as 'free-running' in the absence of mechanical cooling and tight temperature control,

The A2D Office has been evaluated against the criteria in CIBSE Guide A for mechanically cooled spaces.

1.2 Compliance Requirements – 'Free Running'

The TM52 thermal comfort criteria are based upon the adaptive comfort model, a variable (adaptive) temperature threshold that is related to the outside running-mean dry-bulb temperature based upon a CIBSE Design Summer Year (DSY) weather file.

For all free-running buildings the values for the maximum acceptable temperature (Tmax) are calculated from the running mean of the outdoor temperature (Trm) as follows:

$$T_{rm} = (\Theta_{ed-1} + \Theta_{ed-2} + \Theta_{ed-3} + \Theta_{ed-4} + \Theta_{ed-5} + \Theta_{ed-6} + \Theta_{ed-7})/3.8$$

Θ_{ed-1} is the daily mean external temperature for the previous day

Θ_{ed-2} is the daily mean external temperature for the day before and so on

The maximum acceptable temperature can be calculated by the following formula:

$$T_{max} = 0.33T_{rm} + 21.8$$

There are three criteria for overheating and <u>at least two</u> of the three criteria must be achieved in order to comply with Adaptive Comfort:

<u>Criterion 1 – Hours of Exceedance (H_e)</u>

The first criterion sets a limit for the number of hours (He) that the operative temperature can exceed the threshold comfort temperature (upper limit of the range of comfort temperature) by 1K or more during the occupied hours of a typical non-heating season (1st May to 30th September). The number of hours (i.e. H_e=hours of exceedance) during which ΔT is greater than or equal to 1K 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= T_{op}-T_{max},). ΔT is rounded to the nearest whole degree.

<u>Criterion 2 – Daily Weighted Exceedance (W_e)</u>

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 temperature rise and its duration. The sum of the weighted exceedance for each degree K above T_{max} (1K, 2K and 3K) shall be less than or equal to 6 in any one day; where W_e = ΣH_e (1,2,3)*(ΔT)(1,2,3) and ΔT (T_{op}-T_{max}), rounded to a whole number.

<u>Criterion 3 – Upper Limit Temperature (T_{upp})</u>

The third criterion sets an absolute maximum daily temperature for a room, beyond which the level of overheating is unacceptable. To set an absolute maximum value for the indoor operative temperature the value of ΔT (T_{op}-T_{max}) shall not exceed 4K.

1.3 Compliance criteria for predominantly mechanically ventilated spaces

For spaces where mechanical ventilation is the primary source of ventilation, the conditions of a CIBSE fixed temperature test must be followed, i.e. all occupied rooms should not exceed an operative temperature of 26 ˚C for more than 3% of the annual occupied annual hours (CIBSE Guide A (2015a)).

2. Input Criteria & Assumptions

2.1 Profile templates & internal gains

The Nursery has been assumed to be occupied from 9am to 4pm. The office has been assumed to be occupied from 8am to 6 pm. Full variance profiles can be found in Appendix A

2.2 Geometry

The thermal model been based on the drawings received from ADP on the 11th of February 2019.

2.3 Assessed spaces

All occupied spaces without active cooling have been included in this overheating assessment. These spaces have a range of orientations and adjacent shade. All non-residential spaces are located on the ground floor. Full mark-ups can be found in Appendix B

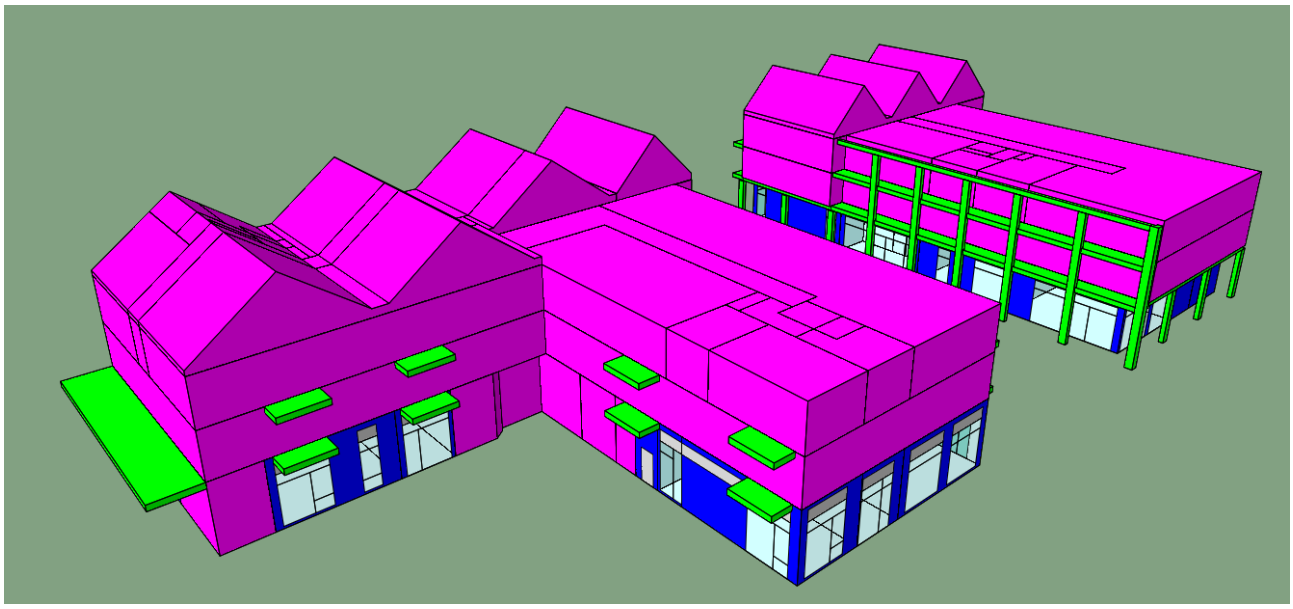


Figure 2: South and North block – South East view

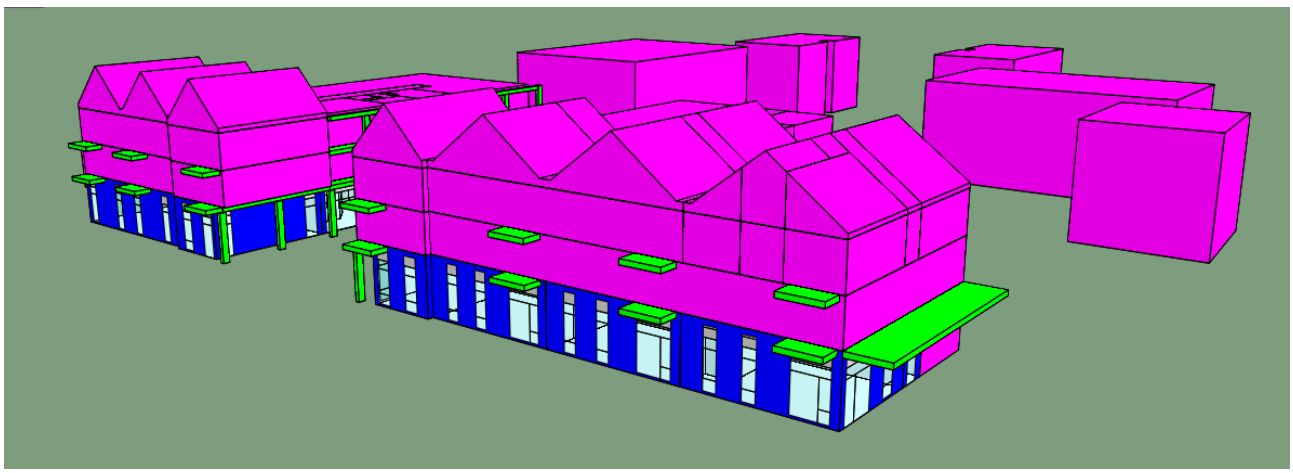


Figure 3: North and South block – South West view

2.4 Weather file

The weather file used for this analysis is the nearest CIBSE DSY1 (Design Summer Year) for the 2020s high emissions, 50% percentile scenario (i.e. Swindon_Brize_Norton DSY1 2020 High50). This is in line with current industry recommendations for overheating risk assessments, as outlined in the recently published guidance in CIBSE TM59 (2017) for residential and BB101 (2018) for schools.

2.5 Gains

Internal gains have been included in the simulations following the guidance in CIBSE TM52, as detailed in Table 1 below.

	Occupancy	Lighting	Small Power
Nursery - Classroom	24 people#	10W/m^2	5W/m^2
Nursery – Reception/Admin	10 m^2/person*	10W/m^2	15W/m^2
A2D Office – Office	6 person*	8W/m^2	15W/m^2
A2D Office - Meeting	8 person*	8W/m^2	15W/m^2

#56.25W (sensible) & 41.25W (latent) per person due to 75% adjustment for children (ASHRAE Handbook- 2009)
*75W (sensible) & 55W (latent) per person

Table 1: Internal gains

2.6 Fabric & Constructions

All assigned fabric constructions and U-Values have been assumed and are detailed in Table 2 below.

Construction element	U-value
Wall U-value	0.15 W/m^2.K
Roof U-value	0.12 W/m^2.K
Window U-value (including frame)	1.3 W/m^2.K
Retail Window U-value (including frame)	1.6 W/m^2.K
Glazing g-value	0.4
Thermal mass	Low
Infiltration	0.10ach

Table 2: Fabric performance

2.7 Internal blinds

Internal blinds have been included in the simulations to reduce the solar gains to a manageable level. The blinds in the Nursery have been assumed to have a shading coefficient (SC) of 0.6 and a short-wave radiant fraction (SWRF) of 0.1. The blinds in the Office have been assumed to have a shading coefficient (SC) of 0.3 and a short-wave radiant fraction (SWRF) of 0.6.

2.8 Mechanical ventilation

Mechanical ventilation has been included in all occupied areas, with the flowrates specified in Table 3 below. These flowrates are higher than required for minimum ventilation requirements in Building Regulations Part F.

	Vent Rates
Nursery - Classroom	12 l/s/person
Nursery – Reception/Admin	15 l/s/person
A2D Office – Office	10 – 20 l/s/person
A2D Office - Meeting	10 – 20 l/s/person

Table 3: Mechanical ventilation rates included in the model.

2.9 Opening windows

All apartments will be fit with openable windows however these cannot be included in the overheating assessment due to acoustic restrictions. Mechanical ventilation will be the primary ventilation method.

3. Results

The simulations have been run both with and without blinds to demonstrate their effect on the thermal conditions of each space.

3.1 Nursery

Room	Criterion 1 (%Hrs Top-Tmax>=1K) (Max value = 3)	Criterion 2 (Max. Daily Deg.Hrs) (Max value = 6)	Criterion 3 (Max. DeltaT) (Max value = 4)	Compliance with TM52
00_Reception	1.3	2	1	**Pass**
00_Support / Admin	5.6	14	3	**Fail**
00_Nursery Classroom 02	1.3	3	2	**Pass**
00_Nursery Classroom 01	1.7	3	2	**Pass**
00_Nursery Classroom 03	2.5	5	3	**Pass**

Table 4: TM52 Results - Without Blinds

Room	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Compliance with TM52
00_Reception	0.1	1	1	**Pass**
00_Support / Admin	2.4	6	2	**Pass**
00_Nursery Classroom 02	0.5	1	1	**Pass**
00_Nursery Classroom 01	0.7	1	1	**Pass**
00_Nursery Classroom 03	2	3	2	**Pass**

Table 5: TM52 Results - With Blinds

The results of the two simulations show that without adequate solar gain reduction the occupied spaces will not be able to achieve compliance with TM52. The suggested blind specification is the minimum required for all spaces to pass.

3.2 A2D Office

Room	Dry resultant temperature (°C) - % hours > 26 °C (Target is <3%)	Compliance with CIBSE Guide A
10 l/s/person – No Blinds		
00_Meeting	9.3	Fail
00_Office	14.9	Fail
10 l/s/person – Blinds		
00_Meeting	5.3	Fail
00_Office	6.9	Fail
20 l/s/person – No Blinds		
00_Meeting	4.0	Fail
00_Office	6.3	Fail
20 l/s/person – Blinds		
00_Meeting	2.6	Pass
00_Office	3.5	Fail

Evaluation of the A2D Office spaces show that even with the inclusion of blinds and increasing the ventilation rate to 20l/s/p in both occupied spaces, the space '00_Office' does not comply with CIBSE Guide A. Additional measures must be considered to achieve thermal comfort to all space users

4. Conclusion

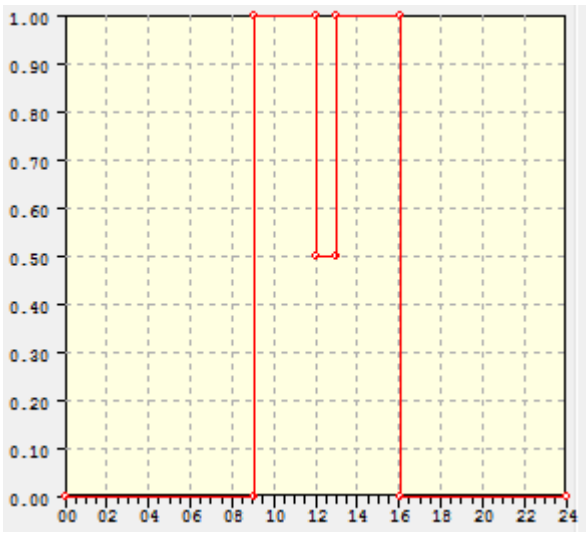
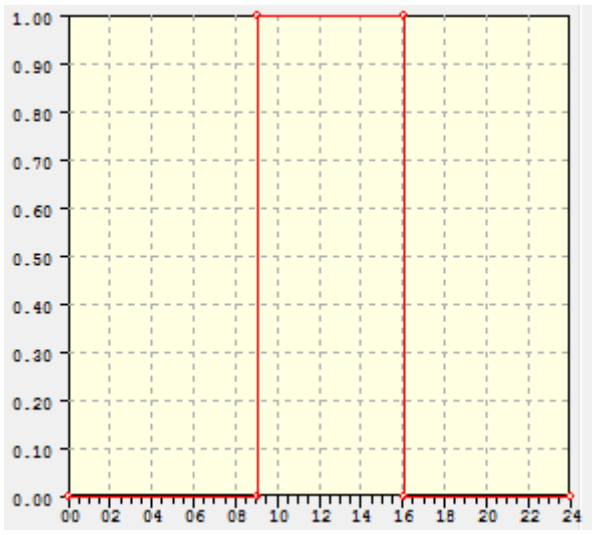
For the Nursery, the inclusion of blinds in the support/admin as a minimum will allow all spaces to be compliant. Other options that could be considered to assist in improving thermal comfort during the design development phase include:

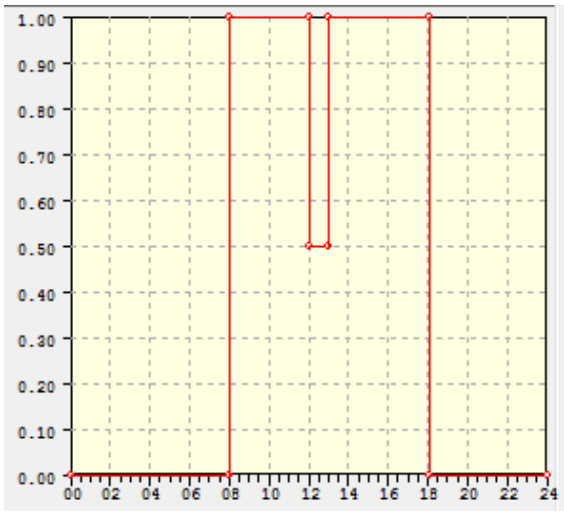
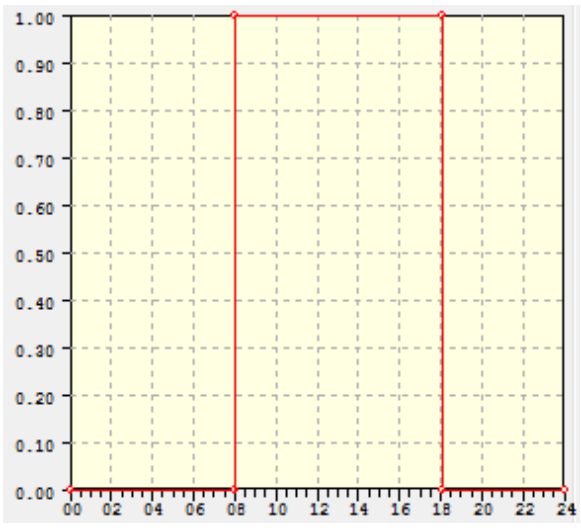
- Decreasing the percentage of glazing, thereby limiting the solar gains.
- Reducing the glazing g-value will reducing solar gain in the summer, however it will also reduce beneficial solar gains during winter.

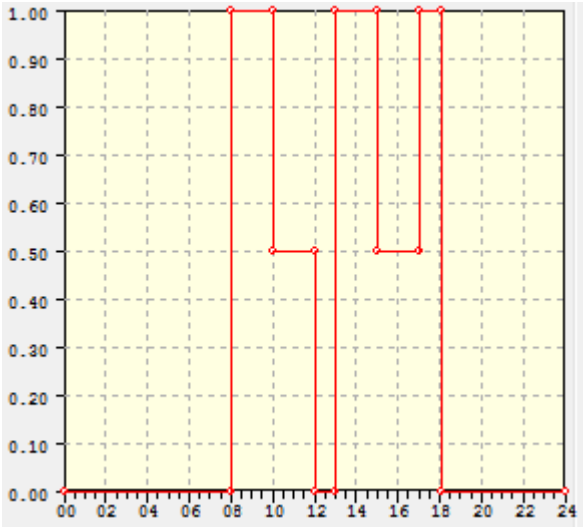
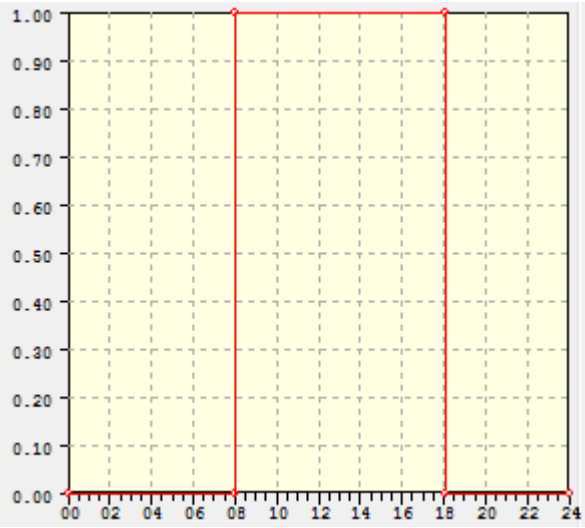
For the A2D Office, even with the inclusion of blinds and a much higher ventilation rate the space '00_Office' does not achieve compliance with CIBSE Guide A. Other options that should be considered to achieve a thermally comfortable space include:

- Allowing the opening of windows in particularly hot occasions This will have an impact on acoustic comfort, and the acoustic requirements will need to be relaxed in order for this option to be acceptable.
- Decreasing the percentage of glazing, thereby limiting the solar gains.
- Reducing the glazing g-value will reducing solar gain in the summer, however it will also reduce beneficial solar gains during winter.
- Provide active cooling.
- The analysis has been run based on the occupancy densities and profiles detailed in Section 2.5 and Appendix A. If the expected occupancy is different, compliance with the thermal comfort requirements may be achieved without the need of additional measures as highlighted above. However, further analysis will need to be carried out to determine the overheating risk.

Appendix A – Internal gain profiles

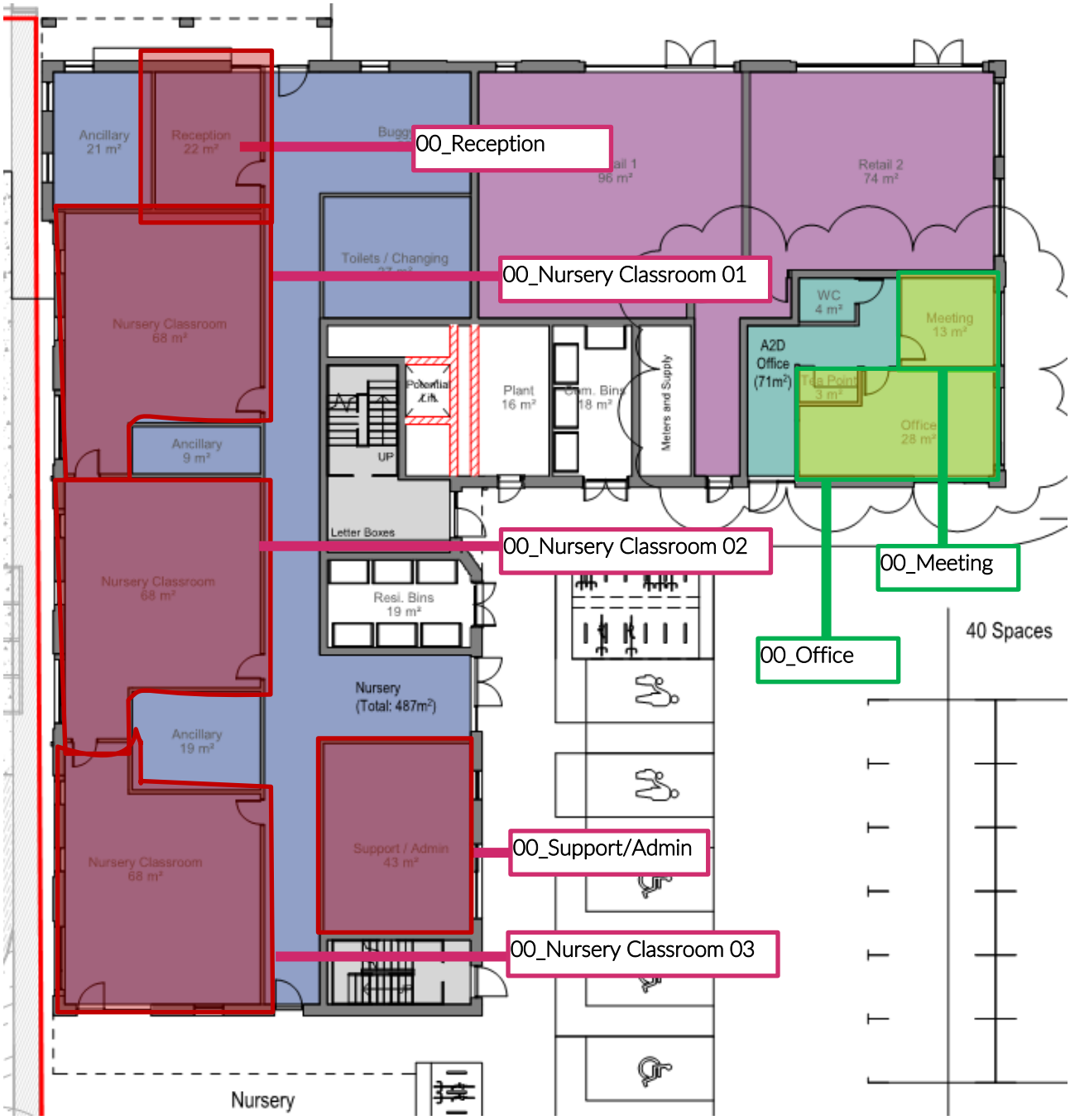
Nursery	Occupancy	Equipment/Lighting
All Spaces		

Office	Occupancy	Equipment/Lighting
00_Meeting		

Office	Occupancy	Equipment/Lighting
00_Office		

Appendix B – Space Mark-ups

Second Floor



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