

**135-149 Shaftesbury Avenue
London
WC2H 8AH**

Overheating Analysis

**Prepared For:
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Table of Contents

1.	Purpose and Scope	3
3.	Simulation Parameters	5
4.	Testing Criteria	6
5.	Results	7
6.	Results Discussion	8
7.	Conclusion	9

1. Purpose and Scope

The purpose of this document is to present the results of the overheating analysis for 135-149 Shaftesbury Avenue, London.

2. Thermal Model

A full dynamic simulation has been developed in accordance with the Chartered Institute of Building Services Engineers (CIBSE) TM49 and TM52 to assess the overheating. This is in line with the Greater London Authority (GLA) Guidance On Preparing Energy Assessments (2016).

IES modelling software has been used to produce a full dynamic simulation model of the typical glazed hotel room floor, and rooftop bar. CIBSE Design Summer Year (DSY) weather files for London Weather Centre data for 1976, 1989 and 2003 have been used within the model, in line with CIBSE TM49 guidance. The London Central Weather Centre data weather files have been used because the site is considered to be within the Mayor's Central Activity Zone (CAZ).

Within each area the rooms are required to pass the overheating criteria as set out in TM52, for further details refer to Section 4 Testing Criteria.

A typical hotel room floor near the top the extension has been modelled, these are considered to be more susceptible to overheating since they are more exposed to solar gain by being fully glazed (fritted glass).

In addition the roof top bar has also been modelled.

Refer to Figure ,

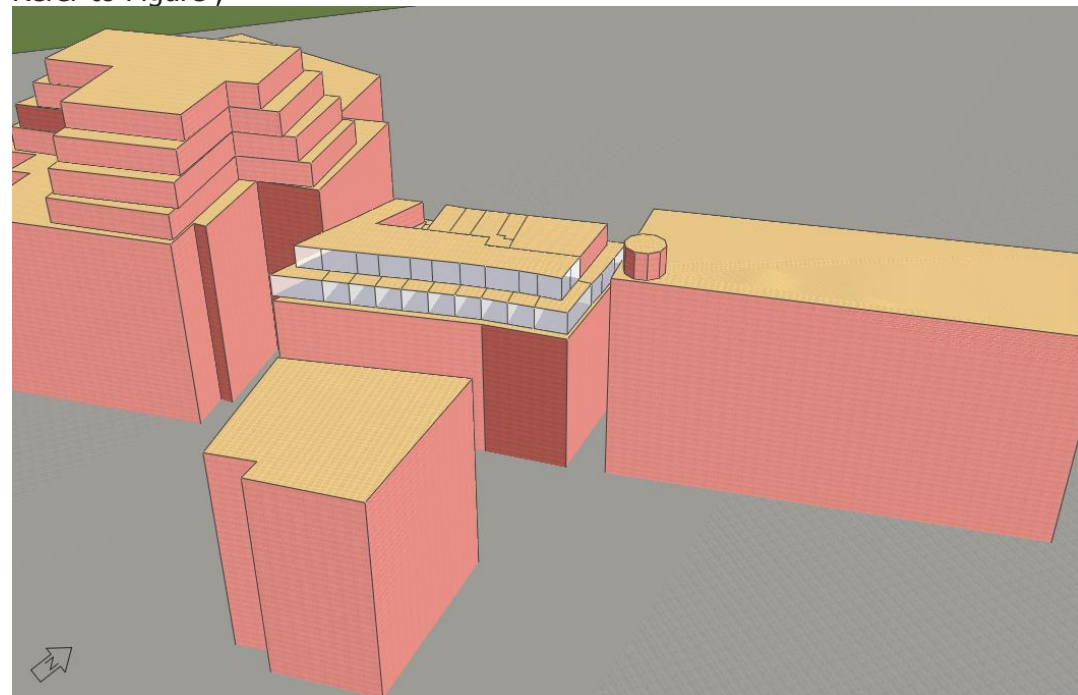


Figure for images of the model showing the top hotel room floor, and rooftop bar.

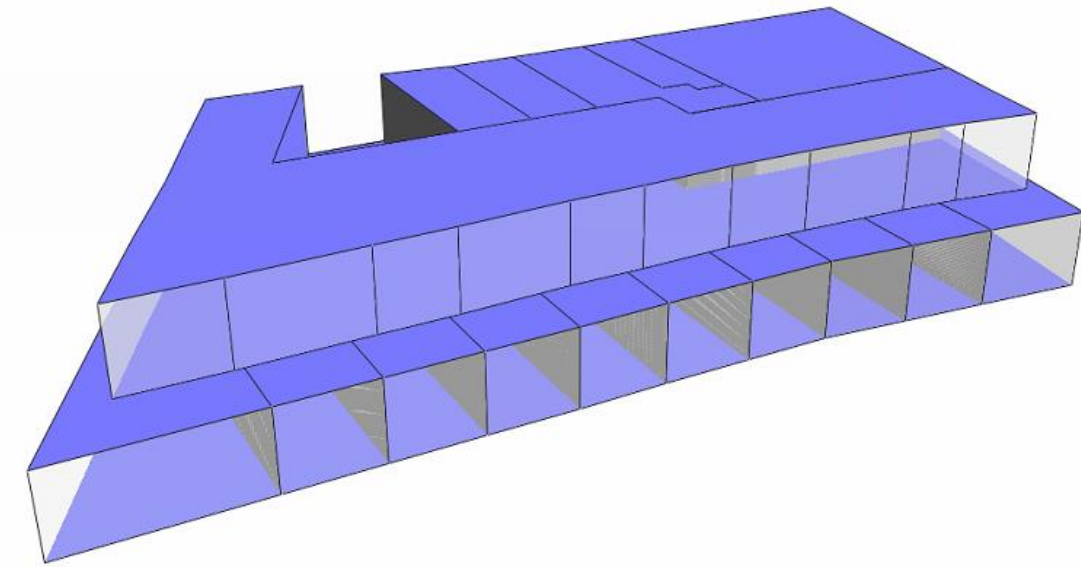


Figure 1 - IES modelling image showing the rooftop bar and Level 6 hotel rooms modelled

In order to reflect the overshadowing effect caused by the adjoining properties, the tallest of the neighbouring buildings have been included in the model, all others were deemed to not have a significant impact on shading the proposed development. Only the following buildings were included in the simulation:

- 125 Shaftesbury Avenue (South West of the site)
- 151 Shaftesbury Avenue (North East of the site)
- 164 Shaftesbury Avenue (South of the site)

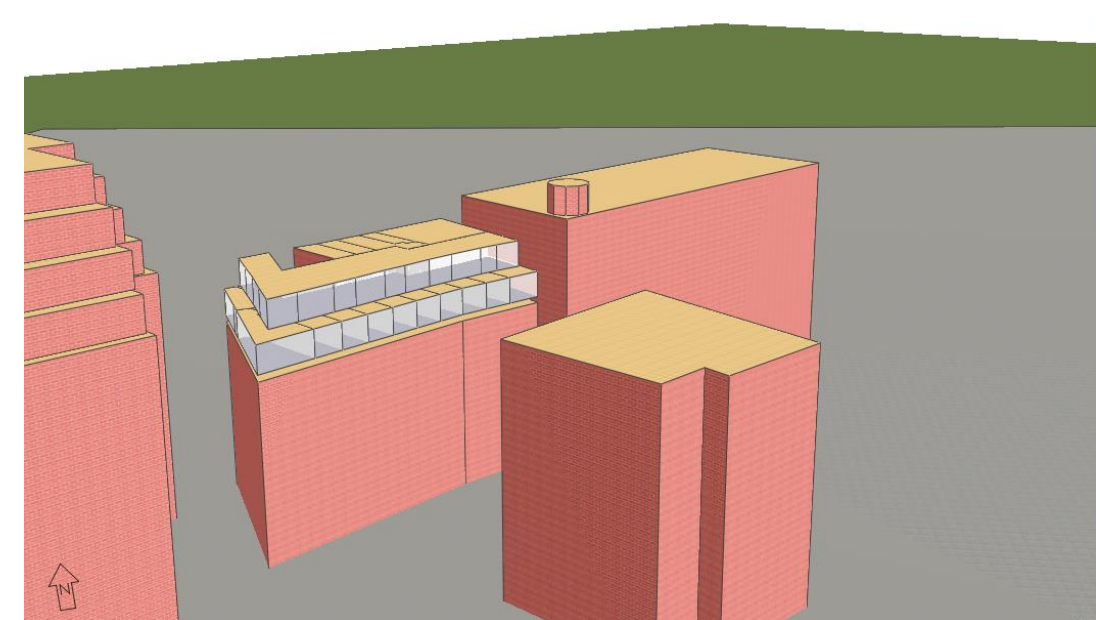


Figure 2 - IES modelling image showing the proposed development with neighbouring properties (125, 151, and 164 Shaftesbury Avenue).

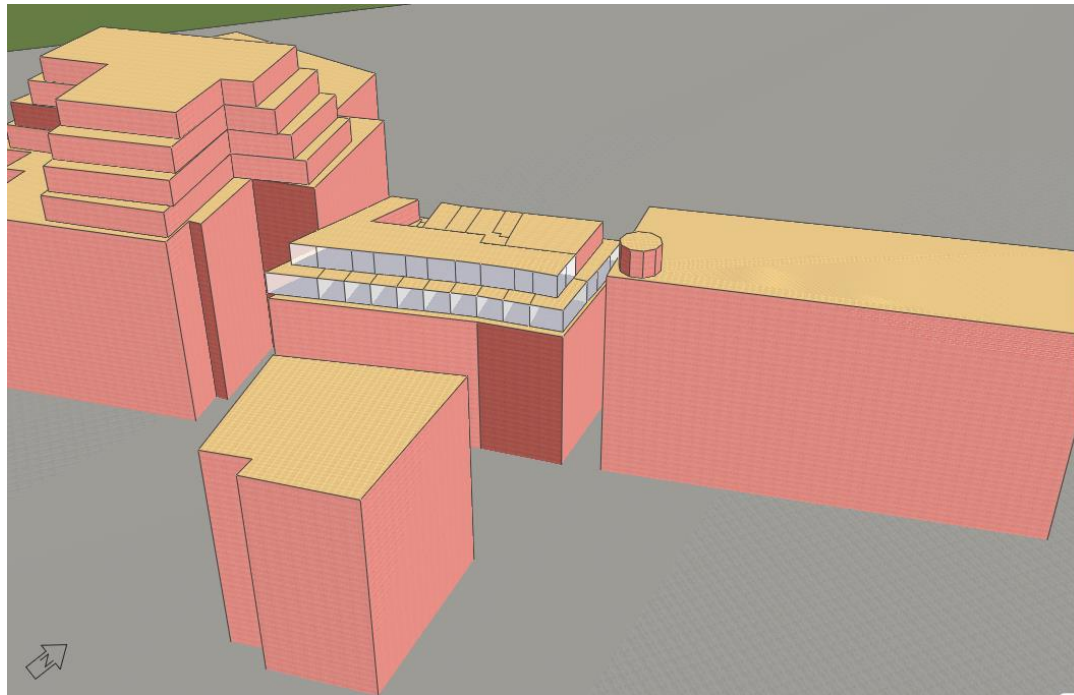


Figure 3 - IES modelling image showing the proposed development with neighbouring properties (125, 151, and 164 Shaftesbury Avenue).

In addition the nearby high rise tower at 5 Upper St Martin's Lane (Orion House) to the South of the site, was initially included in the model to understand its effect on the sun path analysis for our site. Initial iterations of the simulation demonstrated that this had no effect on the results, and therefore was removed from the model for all subsequent simulations.

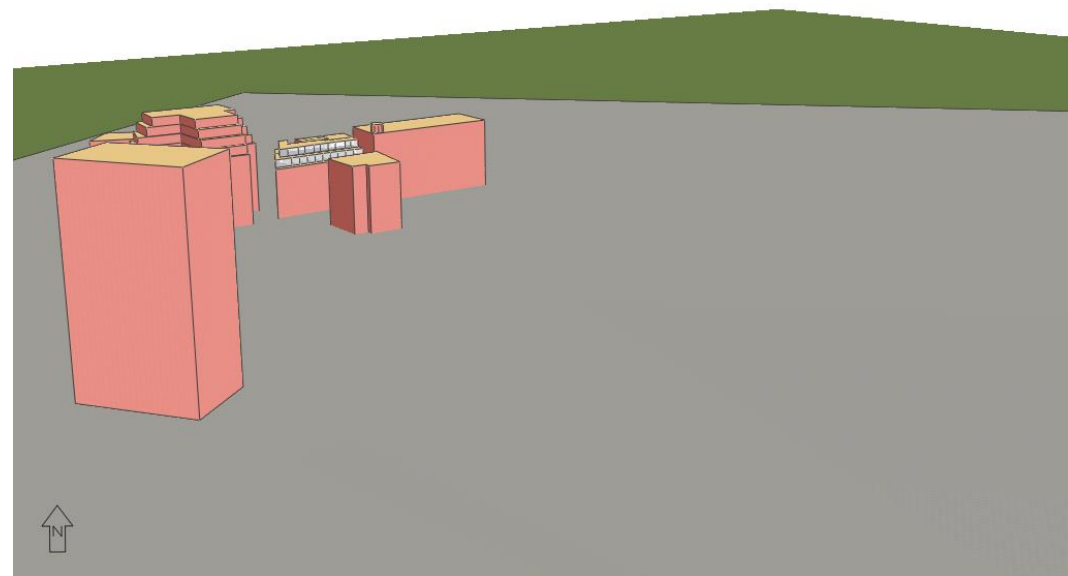


Figure 4 - IES modelling image— South view showing Orion House which was subsequently ignored on all simulations

3. Simulation Parameters

This section lists the input parameters used within the model.

The following fabric parameters have been used within the thermal model. These are significantly below the Building Regulation minimum and serve to reduce the susceptibility of the building to overheating.

Element	U-value (W/m ² K)
External Wall	0.2
Ground Floor	0.2
Roof	0.18
Glazing	1.3
Glazing G-Value	0.35 / 0.08 (fritted)

Hotel Rooms

The following internal gains and occupancy profiles have been used within the model for the hotel rooms.

Internal Gains – Hotel Rooms	
Occupancy	2
Lighting gain	6 W/m ²
Equipment gain	0 W
Occupancy Profile	19:00 to 07:00

The hotel rooms have been modelled with no opening windows.

Rooftop Bar

The following internal gains and occupancy profiles have been used within the model for the rooftop bar.

Internal Gains – Rooftop Bar	
Occupancy	5m ² / person
Lighting gain	6 W/m ²
Equipment gain	0 W
Occupancy Profile	19:00 to 07:00

The following window openings have been used within the model for the rooftop bar.

Window Openings	
Glazed Opening %	25% of Glazing
Balcony doors openings	Fully Open

4. Testing Criteria

Each hotel room and rooftop bar will be required to pass the following overheating criteria as set out in CIBSE TM52, they are defined as:

Criterion 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 (1 May to 30 September).

Criterion 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 temperature rise and its duration. This criterion sets a daily limit for acceptability.

Criterion 3

The third criterion sets an absolute maximum daily temperature for a room, beyond which the level of overheating is unacceptable.

Each space must pass at least 2 of the 3 criteria to be considered to have passed the overheating test.

For further information on the overheating criteria refer directly to TM 52 The Limits of Thermal Comfort: Avoiding Overheating in European buildings.

5. Results

All rooms that have been modelled have been analysed for overheating using the 3 separate DSY files. The table below summarises the results of the overheating analysis.

Floor	Room Name	Design Summer Year (DSY)		
		1976	1989	2003
Level 6	Hotel Room 1	Pass	Pass	Pass
Level 6	Hotel Room 2	Pass	Pass	Pass
Level 6	Hotel Room 3	Fail	Pass	Fail
Level 6	Hotel Room 4	Fail	Pass	Fail
Level 6	Hotel Room 5	Pass	Pass	Pass
Level 6	Hotel Room 6	Pass	Pass	Pass
Level 6	Hotel Room 7	Pass	Pass	Pass
Level 6	Hotel Room 8	Pass	Pass	Pass
Level 6	Hotel Room 9	Pass	Pass	Pass
Level 6	Hotel Room 10	Pass	Pass	Pass
Level 6	Hotel Room 11	Pass	Pass	Pass
Level 6	Hotel Room 12	Pass	Pass	Pass
Level 6	Hotel Room 13	Pass	Pass	Pass
Level 6	Hotel Room 14	Pass	Pass	Fail
Level 6	Hotel Room 15	Pass	Pass	Pass
Level 7	Rooftop Bar	Fail	Pass	Fail
Level 7	Corridor	Fail	Pass	Fail
Level 7	Stairs	Fail	Pass	Fail

Table 1 IES TM52 Modelling Results showing that results for all three DSY files

In addition the full tabulated results for all rooms and all three DSY files tested can be found in Appendix A.

6. Results Discussion

The results show that the majority of all habitable rooms pass the TM52 criteria for all 3 DSY files.

All hotel rooms modelled and the rooftop bar pass the current London summer design year.

The hotel rooms that do fall short for the other two DSY files are on the south western elevation of the building. These rooms are particularly susceptible to overheating since they will experience high solar gain at the same time as elevated air temperature at the end of the day.

For all habitable rooms tested in this analysis it should be noted that:

- The internal gains for the hotel rooms have been considered at maximum occupancy and lights on all day. This is very conservative and it is unlikely that the hotel room will be fully occupied throughout the day and the lights will be on all day on a warm summer's day.
- The overheating testing does not discriminate between daytime and evening occupancy. The hotel rooms will typically be occupied early mornings and in the evening when air temperature and solar gain will be significantly lower, hence are very unlikely to overheat during occupied hours.
- Similarly internal gains for the rooftop bar have been considered at maximum occupancy and lights on all day. This is very conservative and will most likely be only fully occupied in the evenings, when the air temperatures and solar gains will be lower. It is unlikely that the hotel room will be fully occupied throughout the day and the lights will be on all day on a warm summer's day.

Furthermore the development needs to strike a balance between naturally daylighting and limiting the levels of glazing to reduce solar gain and the resulting overheating.

7. Conclusion

The results show that although all rooms pass the current London DSY file, 6 of the 94 proposed hotel rooms fall short of the TM52 criteria for the other 2 DSY files.

The rooms that fall short are typically west facing where high solar gain coupled with elevated air temperature at the end of the day, increase the rooms' susceptibility to overheating.

The top floors of the development have been carefully designed to not outshine the historic building's existing fabric, and at request of the council, been adapted from partly solid to fully glazed elevations to 'lighten' the feel of the new extension. In order to design a 'lighter' fully glazed structure, and at the same time reduce the effects of solar gain and overheating, the development has been designed to incorporate a fritted glazing pattern.

Since only a very small number of rooms fall short of all the TM52 criteria over the 3 DSY years this is deemed acceptable.

Overall it is concluded that the proposed development performs very well in terms of overheating when measured against the CIBSE TM52.

8. Appendix 1

DSY Year 1976

Overall
Passed: 13 rooms:
Failed: 5 rooms:
Unoccupied: 9 rooms:

Data:
Days data= 365 1-Jan 31/12
Days (summer)= 153 5-Jan 30/9
Data OK? OK Full summer

Occupancy:
Note: This report assesses occupied periods only. Please be aware that TMS2 should be conducted for occupied and/or "available hours". Use of educational NCM profiles may be seen as inappropriate due to prolonged unoccupied periods during summer months. See Section 6.1.2 (a) of TMS2 for further information.

Passed: 13 rooms:

Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
HOTEL BEDROOM 2	HT000000	100	1.8	10.6	3	2
HOTEL BEDROOM 1	HT000001	100	0.9	6.6	2	2
HOTEL BEDROOM 5	HT000004	100	2.9	12.8	2	2
HOTEL BEDROOM 6	HT000005	100	2.5	12.2	2	2
HOTEL BEDROOM 7	HT000006	100	2.3	12	2	2
HOTEL BEDROOM 8	HT000007	100	2.2	12	2	2
HOTEL BEDROOM 9	HT000008	100	2.2	12	2	2
HOTEL BEDROOM 10	HT000009	100	2.2	11.9	2	2
HOTEL BEDROOM 11	HT00000A	100	2.3	12.1	2	2
HOTEL BEDROOM 12	HT00000B	100	1.9	12.5	3	2
HOTEL BEDROOM 13	HT00000C	100	1.3	9.3	3	2
HOTEL BEDROOM 14	HT00000D	100	0.9	10	3	2
HOTEL BEDROOM 15	HT00000E	100	0.9	8.3	2	2

Failed: 5 rooms:

Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
HOTEL BEDROOM 3	HT000002	100	4.6	24.5	5	1 & 2 & 3
HOTEL BEDROOM 4	HT000003	100	3.8	16.8	3	1 & 2
HOTEL BAR	HT00000F	100	3	39.9	5	2 & 3
CORRIDOR	CR000002	100	3.7	15.5	2	1 & 2
STAIRS	ST000003	100	5.5	16.6	2	1 & 2

Unoccupied: 9 rooms:

Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
STAIRS 2	ST000000	0	0	0	0	-
STAIRS 1	ST000001	0	0	0	0	-
CORRIDOR	CR000000	0	0	0	0	-
VOID	VD000000	0	0	0	0	-
CORRIDOR	CR000001	0	0	0	0	-
VOID	VD000001	0	0	0	0	-
LIFTS	LF000000	0	0	0	0	-
LIFTS	LF000001	0	0	0	0	-
PLANTROOMS	PL000000	0	0	0	0	-

DSY Year 1989

Overall
Passed: 18 rooms:
Failed: 0 rooms:
Unoccupied: 9 rooms:

Data:
Days data= 365 1-Jan 31/12
Days (summer)= 153 5-Jan 30/9
Data OK? OK Full summer

Occupancy:
Note: This report assesses occupied periods only. Please be aware that TMS2 should be conducted for occupied and/or "available hours". Use of educational NCM profiles may be seen as inappropriate due to prolonged unoccupied periods during summer months. See Section 6.1.2 (a) of TMS2 for further information.

Passed: 18 rooms:

Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
HOTEL BEDROOM 2	HT000000	100	0.4	6.2	3	2
HOTEL BEDROOM 1	HT000001	100	0.1	1.7	1	-
HOTEL BEDROOM 3	HT000002	100	1.6	13.7	4	2
HOTEL BEDROOM 4	HT000003	100	1	8.6	2	2
HOTEL BEDROOM 5	HT000004	100	0.7	5.5	2	-
HOTEL BEDROOM 6	HT000005	100	0.5	5	1	-
HOTEL BEDROOM 7	HT000006	100	0.5	5	1	-
HOTEL BEDROOM 8	HT000007	100	0.5	5	1	-
HOTEL BEDROOM 9	HT000008	100	0.5	5	1	-
HOTEL BEDROOM 10	HT000009	100	0.5	5	1	-
HOTEL BEDROOM 11	HT00000A	100	0.5	5	1	-
HOTEL BEDROOM 12	HT00000B	100	0.5	6.1	2	2
HOTEL BEDROOM 13	HT00000C	100	0.2	4	2	-
HOTEL BEDROOM 14	HT00000D	100	0.2	2.6	1	-
HOTEL BEDROOM 15	HT00000E	100	0.2	2.9	1	-
HOTEL BAR	HT00000F	100	0.9	20.2	3	2
CORRIDOR	CR000002	100	0.6	8	1	2
STAIRS	ST000003	100	1.1	8.5	1	2

Failed: 0 rooms:

Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
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Unoccupied: 9 rooms:

Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
STAIRS 2	ST000000	0	0	0	0	-
STAIRS 1	ST000001	0	0	0	0	-
CORRIDOR	CR000000	0	0	0	0	-
VOID	VD000000	0	0	0	0	-
CORRIDOR	CR000001	0	0	0	0	-
VOID	VD000001	0	0	0	0	-
LIFTS	LF000000	0	0	0	0	-
LIFTS	LF000001	0	0	0	0	-
PLANTROOMS	PL000000	0	0	0	0	-

DSY Year 2003

Overall
Passed: 13 rooms:
Failed: 5 rooms:
Unoccupied: 9 rooms:

Data:
Days data= 365 1-Jan 31/12
Days (summer)= 153 5-Jan 30/9
Data OK? OK Full summer

Occupancy:
Note: This report assesses occupied periods only. Please be aware that TMS2 should be conducted for occupied and/or "available hours".
Use of educational NCM profiles may be seen as inappropriate due to prolonged unoccupied periods during summer months.
See Section 6.1.2 (a) of TMS2 for further information.

Passed: 13 rooms:

Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
HOTEL BEDROOM 2	HT000000	100	1.3	11.4	4	2
HOTEL BEDROOM 1	HT000001	100	1.1	8.8	3	2
HOTEL BEDROOM 5	HT000004	100	2.9	20.8	4	2
HOTEL BEDROOM 6	HT000005	100	2.6	18.6	4	2
HOTEL BEDROOM 7	HT000006	100	2.5	18.1	4	2
HOTEL BEDROOM 8	HT000007	100	2.4	18	4	2
HOTEL BEDROOM 9	HT000008	100	2.4	17.9	4	2
HOTEL BEDROOM 10	HT000009	100	2.5	18.1	4	2
HOTEL BEDROOM 11	HT00000A	100	2.5	18.1	4	2
HOTEL BEDROOM 12	HT00000B	100	2.1	15.2	4	2
HOTEL BEDROOM 13	HT00000C	100	1.2	10.2	4	2
HOTEL BEDROOM 15	HT00000E	100	1	10.7	4	2
CORRIDOR	CR000002	100	2.3	27.9	3	2

Failed: 5 rooms:

Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
HOTEL BEDROOM 3	HT000002	100	4.2	28.1	6	1 & 2 & 3
HOTEL BEDROOM 4	HT000003	100	3.3	24.4	5	1 & 2 & 3
HOTEL BEDROOM 14	HT00000D	100	0.9	12	5	2 & 3
HOTEL BAR	HT00000F	100	2.1	44.8	7	2 & 3
STAIRS	ST000003	100	3.1	29.4	3	1 & 2

Unoccupied: 9 rooms:

Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
STAIRS 2	ST000000	0	0	0	0	0 -
STAIRS 1	ST000001	0	0	0	0	0 -
CORRIDOR	CR000000	0	0	0	0	0 -
VOID	VD000000	0	0	0	0	0 -
CORRIDOR	CR000001	0	0	0	0	0 -
VOID	VD000001	0	0	0	0	0 -
LIFTS	LF000000	0	0	0	0	0 -
LIFTS	LF000001	0	0	0	0	0 -
PLANTROOMS	PL000000	0	0	0	0	0 -