SKELLY & COUCH

Overheating Report

Contents

Audit History

Rev	Date of Issue	Status	Issued By	Checked By	Summary of Changes
4.0	**14/02/2022**	**Information**	**JA**	**JC**	**Revised for ASHP planning application**
3.0	03/03/2020	Information	JA	JC	Reading rooms added
2.0	10/02/2020	Information	JA	JC	Added cooling options, updated
1.0	April 2019	Information	JV	JC	

1. Introduction

Overheating is a widely used term that implies that building occupants feel uncomfortably hot and that this discomfort is caused by the internal environment. Building spaces can be prone to overheating if they have high solar gains through the building envelope and high internal casual heat gains generated by occupants and equipment.

This report summarises the results of the dynamic overheating modelling carried out using IESVE ApacheSim and uses the CIBSE TM52 overheating design methodology to provide an overheating assessment of the proposed Lecture theatre and the new and existing reading rooms at the University of London Warburg Institute.

In addition to the CIBSE TM52 assessment, the overheating study also looked at peak temperatures in spaces where sensitive materials will be viewed, or specialist equipment will be in use.

This version of the report is an update of the original report, accounting for design development of the lecture theatre and the new and existing reading rooms, and the introduction of a 35kW air source heat pump which will be providing cooling to the following spaces:

- Existing Ground Floor Reading Room
- New Lower Ground Floor Reading Room
- Lecture Theatre
- IT Server Room
- AV Rack Room

1.1.1. Site Location

The Warburg Institute is part of the University of London and is located in Bloomsbury in a built-up area of central London, surrounded by similar educational buildings. The top floor of the Warburg Institute building is occupied by the Slade School of Fine Art and does not form part of the proposed development.

Site address: Woburn Square, Bloomsbury, London WC1H 0A

1.2. University of London Cooling Policy

The comfort cooling provision for the Warburg Institute is in line with the University of London Cooling Policy which includes the following requirements for non-residential areas:

- No area shall be actively cooled to a temperature below 26°C (± 2°C to allow for control variances).
- Corridors and circulation space shall not normally have mechanical cooling supplied.

Location of the Warburg Institute

2. Assessment Criteria for Overheating

The planning requirements for developments in London to prevent overheating are set out in the London Plan which states that developments should be assessed based on the CIBSE document *TM52. The limits of thermal comfort: avoiding overheating in European buildings.* The lecture theatre and reading rooms have been assessed against CIBSE TM52 in which two of the following criteria need to be met:

(a) **Criterion 1:** The percentage of hours during which the difference between the external and internal temperatures (dT) is greater than or equal to 1°C during the period May to September inclusive shall not be more than 3% of occupied hours.

(b) **Criterion 2:** The weighted exceedance (We) shall be less than or equal to 6 on any one day.

(c) **Criterion 3:** dT of indoor air temperature to outdoor shall not exceed 4°C.

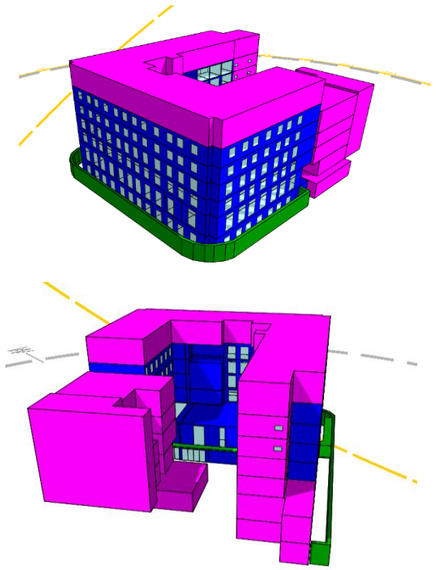
It is important to note that passing these criteria does not necessarily mean that all the occupied spaces won't feel too hot at times. It does however suggest that the frequency and intensity of these occasions could be low enough to be considered acceptable.

For the existing reading room, where occupants are expected to stay for long durations of time, comfort was also assessed in terms of hours over 26°C based on feedback from the institute.

3. Overheating Assessment

3.1. Introduction

The overheating assessment was carried out using dynamic modelling in IESVE ApacheSim.



Images of the Warburg Institute overheating model

The façade, ventilation opening areas, internal geometry and construction materials are based on the architect's scheme.

U-values and G-values have been applied as described below:

Existing building

Building Element	Description	
Glazing	Existing single glazed, steel framed windows with secondary glazing and new solar control film	G=0.38
Walls	Brick cavity wall, uninsulated	U= 1.08 W/m^{2}K*
Floor	Uninsulated concrete slab	U= 0.31 W/m^{2}K*

*Assumed values.

New-build Extension

Building Element	
Glazing	G=0.50
Flat roof	U= 0.15 W/m^{2}K
Walls	U= 0.22 W/m^{2}K
Floor	U= 0.21 W/m^{2}K

3.2. Existing Reading Room

3.2.1. Description

The Existing Reading Room is located on the Ground Floor of the existing building with most of its windows facing west onto Torrington Square and east into the Warburg Institute courtyard.

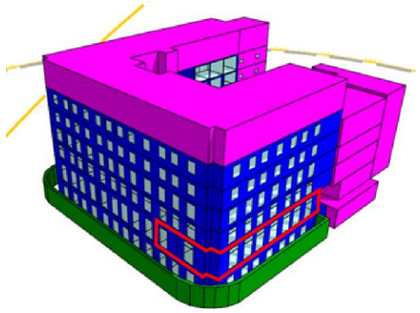


Image of the Warburg Institute overheating model from IESVE showing the location of the existing reading room

The ground floor reading room is used as a general reading room for the Institute for viewing less sensitive material, and so occupant comfort is the main criteria when evaluating the internal conditions in this space.

The client frequently receives complaints about the high temperatures in the existing reading room.

Passive design measures

The following passive design measures are incorporated into the design of the space:

- The ground floor reading room is located in the existing building and has high floor to ceiling height and exposed thermal mass in the floor, ceiling and walls.
- New solar control film to be added to the existing windows which will result in a G-value of 0.38.
- Natural ventilation - Natural ventilation to the existing reading room will continue to be provided through existing windows, however, as part of the new courtyard extension the majority of the windows facing into the courtyard will become internal windows into the new lightwell. These windows will therefore not be used for ventilation and so the natural ventilation capacity for the reading room will be reduced.

Measures such as external shading has been discounted for the existing reading room due the historic nature of the building and location in a conservation area.

The majority of the existing lighting in the space will be retained, but any new or replacement lighting will be highly efficient LED lighting.

3.2.2. Assumptions

The existing reading room have been assessed with the following worst-case occupancy profile:

Worst Case Day	
08.00-18.00	50 People

Along with the occupancy the following have been assumed:

- High-level and low-level external windows are openable
- Low-level windows are closed between 18.00 and 08.00
- High-level windows are to be left open at night when the external temperature >19°C
- Existing windows with new solar control film with a resulting G-value of 0.38

3.2.3. Results

The table below shows how the room performs against the criteria in TM52.

Conditions	TM52 Results		
	Crit. 1	Crit. 2	Crit. 3
Natural ventilation	2%	13	3°C

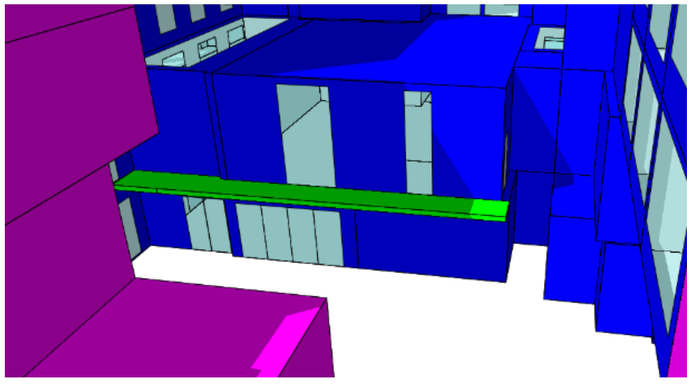
From the results above it can be seen that the existing reading room passes two of the TM52 criteria with high-level and low-level windows open during the day and high-level windows open during the night. However, passing the criteria of TM52 does not mean that the space is comfortable, and the Warburg Institute has in the past had numerous complaints over the conditions in the Existing Reading Room. Based on the results from the overheating assessment, the improvements to the internal conditions seen from the introduction of new passive measures is insufficient to mitigate this.

The overheating modelling shows that the operative temperature in the reading room exceeds 26°C for 12.4% of the occupied hours, equating to 304h. Mechanical cooling supplied by the air source heat pump is therefore proposed for the Existing Reading Room. The cooling system will only be in use when temperatures exceed 26°C in line with University of London policy.

3.3. New Reading Room

3.3.1. Description

The new reading room is to be located on the lower ground floor in the new courtyard extension. Daylighting is provided to the space through rooflights and south facing windows.



Extract of the Warburg Institute overheating model from IESVE showing the New Reading Room on the lower ground floor.

The New Reading Room will be used for viewing highly sensitive materials that are ordinarily stored in the special collections archive. Changes in the environmental conditions, including temperature and relative humidity, could cause damage to these materials, and so the impact on these materials is therefore the main consideration when evaluating the internal conditions in this space. For conservation of the archive materials a max. temperature of 23°C is recommended, the conditions should remain as close to the storage conditions as possible.

Ventilation

Natural ventilation has been discounted as an option for the new reading room as the materials that are to be viewed in the space are highly sensitive to changes in environmental conditions, and so great differences between conditions in the special collections archive, where the materials are stored, and the reading room need to be avoided. There is also a need to limit noise ingress into the room to ensure quiet working conditions. For these reasons the new reading room will be provided with mechanical ventilation.

Passive design measures

The following passive design measures have been incorporated into the design of the space:

- Some exposed thermal mass in the form of exposed concrete structure
- Glazing G-value of 0.5
- External shading in the form of an overhang to south facing windows

The new reading room will also be provided with energy efficient LED lighting with daylight dimming and PIR control to reduce lighting gains.

3.3.2. Assumptions

The Reading rooms have been assessed with the following worst-case occupancy profile:

Worst Case Day Occupancy	
08.00-18.00	15 People

Along with the occupancy the following have been assumed:

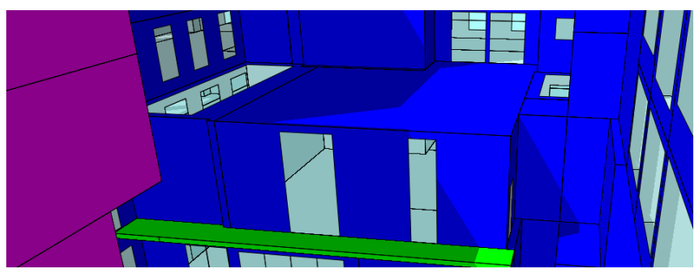
- G-value of new windows and roof lights is 0.5
- Some exposed thermal mass in the form of exposed concrete structure
- Plasterboard ceiling below lecture theatre

3.3.3. Results

The modelling found that it is not possible to meet the conservation requirements and noise criteria without mechanical cooling.

3.4. Lecture Theatre

The lecture theatre is to be located on the ground floor in the new courtyard extension.



Extract of the Warburg Institute overheating model from IESVE showing the Lecture Theatre on the ground floor above the new reading room.

Ventilation

The need to limit noise ingress into the room to ensure a suitably quiet environment for lectures resulted in natural ventilation being discounted as an option for the space. The ventilation is designed to meet the acoustic consultant's requirement of NR30.

Passive design measures

The following passive design measures have been incorporated into the design of the space:

- Limited glazing on the south facing façade
- Glazing G-value of 0.42

The architectural and acoustic design of the space do not allow sufficient amounts of thermal mass to be exposed for this to be a useful passive design measure.

The lecture theatre will be provided with energy efficient LED lighting with daylight dimming and PIR control to reduce lighting gains.

3.4.1. Assumptions

The lecture theatre has been assessed with the following worst-case occupancy profile:

Worst Case Day Occupancy	
10.00-11.30	Lecture style 135
12.00-13.00	Classroom style 35
14.00-15.30	Lecture style 135
18.00-19.30	Lecture style 135

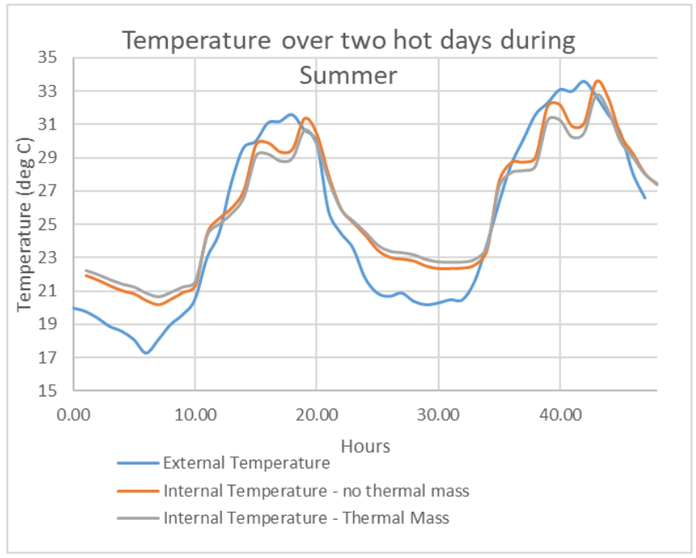
Along with the occupancy the following has been assumed:

- Mechanical ventilation rate of 1600l/s, which will be on continuously during hot periods.
- G-value of window is 0.42 based on Pilkington Suncool 70/40.

The lecture theatre will also be provided with energy efficient LED lighting with daylight dimming and PIR control to reduce lighting gains.

3.4.2. Results

Based on the above internal conditions, the graph below indicates how the lecture theatre will perform during a typical hot spell of two days during the summer.



The graph shows that with the thermal mass exposed, the temperature of the room will be approximately one degree cooler during the hottest part of the day. However, the architecture and acoustic design of the space do not allow for this amount of thermal mass to be exposed, and so the scenario to be without thermal mass reflect the expected conditions in the space.

The table below shows how the room performs against the criteria 1 and 3 from CIBSE TM52, and from these results it can be seen that the lecture theatre does not pass.

Conditions	TM52 Results - No Thermal Mass	
	Crit. 1	Crit. 3
Mechanical Ventilation	**3 %**	**5°C**

As comfortable conditions cannot be achieved without mechanical cooling, mechanical cooling supplied by the air source heat pump is therefore proposed for the lecture theatre. The cooling system will only be in use when temperatures exceed 26°C in line with University of London policy.

4. IT Server Room and AV Rack Room

IT Server Room

The IT racks located in the Server Room will generate equipment heat gains to the space of 2kW. As the racks need to be kept below 25°C in order to function properly, and the Server Room is located in an internal room on the lower ground floor it is not feasible to achieve sufficient cooling through ventilation alone. Therefore, it is proposed to provide the space with mechanical cooling supplied by the air source heat pump.

AV Rack Room

The AV rack located in a storeroom on the ground floor that faces onto to Woburn Square. The rack will generate equipment heat gains to the space of 3kW.The rack needs to be kept below 25°C in order to function properly, which is not achievable through natural ventilation at high external temperatures. Therefore, it is proposed to provide the space with mechanical cooling supplied by the air source heat pump. The cooling for the AV Rack is only expected to be running when sufficient cooling cannot be achieved through natural ventilation.