# Ross, Sevenoaks

## Overheating Risk Assessment

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## 1.0 INTRODUCTION

Holland Green has conducted a comprehensive overheating risk assessment for the proposed Sevenoaks residential development in Hampton, London, TW12 2SX, using the CIBSE TM59 Part O methodology.

This assessment has been carried out through thermal modelling in the IES Virtual Environment software to demonstrate that the development can maintain suitable indoor temperatures during summer.

The study was integrated with the architectural design process, leading to several iterations aimed at enhancing thermal performance of the development and insuring the comfort of future occupants.

Key design strategies include:

- Large overhangs to minimize solar gains.
- Vertical shading to further reduce solar gains..
- Cross ventilation in most spaces.
- Stack ventilation in the main staircase.
- Improved U-values for enhanced thermal performance.

The results show that when assessed with the 2020 weather file, all internal bedrooms, living rooms, and circulation spaces comply with CIBSE TM52 and TM59 standards.

The ventilation strategy for all dwellings has been provided via façade mark-ups within the report.

Consequently, the development meets the requirements of the Approved Document through the use of openable windows for natural ventilation accompanied with an MVHR for background ventilation.

The figure to the opposite shows a 3D view of the created model.

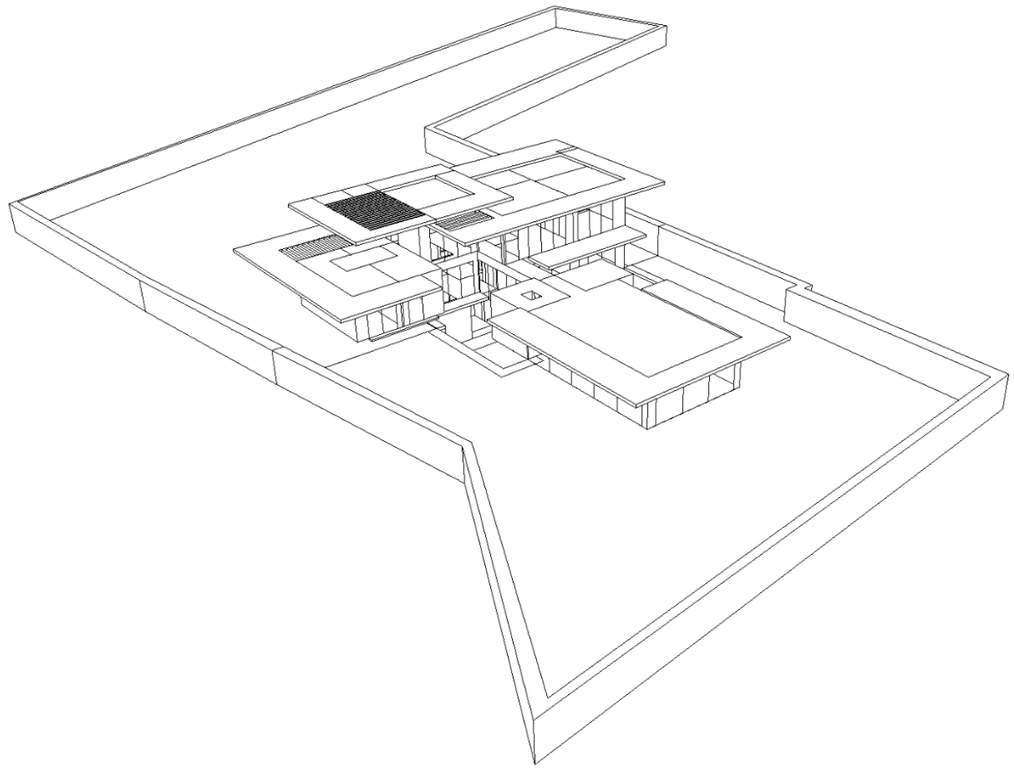


Figure 1: View of the Proposed Development

## 2.0 PROPOSED DEVELOPMENT

The proposed development is understood to include the demolition of the exiting building and the erection of a new residential development. The proposal is to be a three-storey building including a studio, playroom, and gym on the basement floor, 4 bedrooms, 2 ensuites, a bathroom and a living/dining/kitchen space in addition to a snug and an office on the ground floor. The 1st floor includes a master bedroom with a dressing and ensuites and a relaxation area.

The figure opposite represents a view of the proposed development. The drawings the assessment has been based on are shown in at the end of this report.

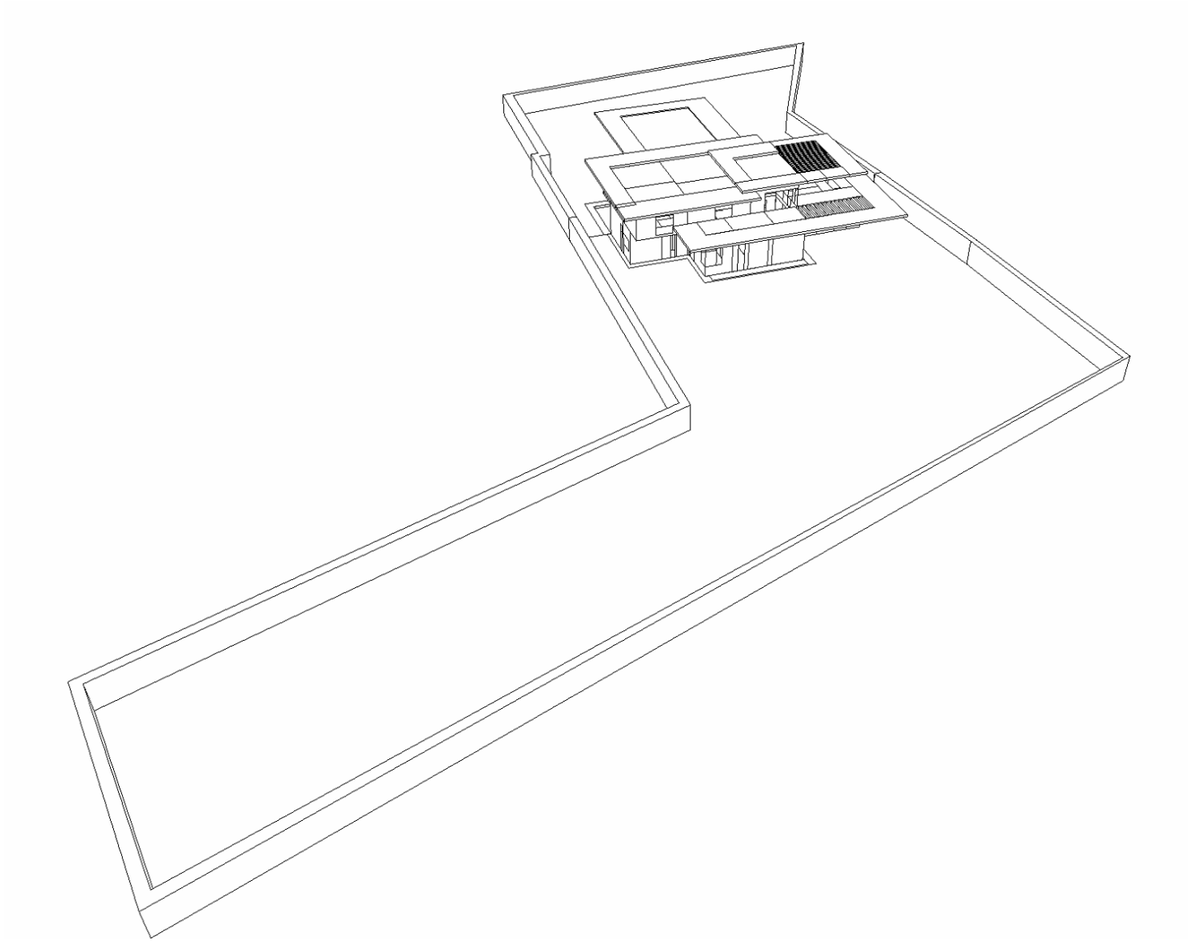


Figure 2: 3D of the Proposed Development

# 3.0 TARGETS AND CRITERIA

## 3.1 Part O Criteria

Approved Document O: Overheating provides guidance on how to comply with Part O of the Building Regulations.

Part O states that reasonable provision must be made in respect of a dwelling, institution or any other building containing one or more rooms for residential purposes to:

- Limit unwanted solar gains in summer;
- Provide an adequate means to remove heat from the indoor environment.

In meeting the obligations:

- Account must be taken of the safety of any occupant, and their reasonable enjoyment of the residence; and
- Mechanical cooling may only be used where insufficient heat is capable of being removed from the indoor environment without it.

The Approved Document O provides two methods to demonstrate compliance:

a. The simplified method for limiting solar gains and providing a means of removing excess heat.
b. The dynamic thermal modelling method.

The method adopted in this report is the Dynamic Thermal Modelling method. For Compliance using thermal modelling method, assessed spaces must meet the criteria set in TM59. TM59 has set 2 criteria's for homes predominantly naturally ventilated as follow:

*(a)* For living rooms, kitchens and bedrooms: the number of hours during which DT is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3 per cent of occupied hours. (CIBSE TM52 Criterion 1: Hours of exceedance).

*(b)* For bedrooms only: to guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10 pm to 7 am shall not exceed 26 °C for more than 1% of annual hours. (Note: 1% of the annual hours between 22:00 and 07:00 for bedrooms is 32 hours, so 33 or more hours above 26 °C will be recorded as a fail).

## 3.2 Part O Limits on Modelling

When assessing the design against Part O Criteria, PART O sets some limitations to the criteria set in TM59. These limits should be applied when following the guidance in CIBSE's TM59. These limits are as follow:

2.6 All of the following limits on CIBSE's TM59, section 3.3, apply.

a. When a room is occupied during the day (8am to 11pm), openings should be modelled to do all of the following.
  i. Start to open when the internal temperature exceeds 22°C.
  ii. Be fully open when the internal temperature exceeds 26°C.
  iii. Start to close when the internal temperature falls below 26°C.
  iv. Be fully closed when the internal temperature falls below 22°C.

b. At night (11pm to 8am), openings should be modelled as fully open if both of the following apply.
  i. The opening is on the first floor or above and not easily accessible.
  ii. The internal temperature exceeds 23°C at 11pm.

c. When a ground floor or easily accessible room is unoccupied, both of the following apply.
  i. In the day, windows, patio doors and balcony doors should be modelled as open, if this can be done securely, following the guidance in paragraph 3.7.
  ii. At night, windows, patio doors and balcony doors should be modelled as closed.

d. An entrance door should be included, which should be shut all the time.

## 3.3 Part O Limitations to the used Mitigation Strategies

Approved Document O also defines the acceptable ways to limit solar gains with some limitations:

- Although internal blinds and curtains provide some reduction in solar gains, they should not be taken into account when considering whether requirement O1 has been met. However, fixed shading like external blinds is acceptable.
- Foliage, such as tree cover, can provide some reduction in solar gains. However, it should not be taken into account when considering whether requirement O1 has been met.

Part O also states that the building should be constructed to meet the requirement using passive means as far as reasonably practicable. It should be demonstrated to the building control body that all practicable passive means of limiting unwanted solar gains and removing excess heat have been used first before adopting mechanical cooling. Any mechanical cooling (air-conditioning) is expected to be used only where requirement O1 cannot be met using openings.

## 3.4 Part O Additional Guidance

The Approved Document O also provides additional guidance on other important aspects to ensure the safety and comfort of the occupants, these areas include:

### 3.4.1 Pollution

The approved document O provides criteria in regard to air quality and pollution, as follows 'Buildings located near to significant local pollution sources should be designed to minimise the intake of external air pollutants. Guidance is given in Section 2 of Approved Document F, Volume 1: Dwellings'.

### 3.4.2 Security

When using openable windows, the approved document O sets criteria to ensure the safety of occupants. The criteria states that 'When determining the free area available for ventilation during sleeping hours, only the proportion of openings that can be opened securely should be considered to provide useful ventilation. This particularly applies in the following locations, where openings may be vulnerable to intrusion by a casual or opportunistic burglar.

a. Ground floor bedrooms.
b. Easily accessible bedrooms.'

'Open windows or doors can be made secure by using any of the following.

a. Fixed or lockable louvred shutters.
b. Fixed or lockable window grilles or railings.

### 3.4.3 Protection from falling

Regarding the protection of occupants from the risk of falling, the Approved Document O has stated the following:

- 'Openings which are intended to be open for long periods to reduce overheating risk might pose a higher risk of falls from height. Only the proportion of openings which can be opened with a very low risk of occupants falling from height should be considered to form part of the overheating mitigation strategy'.

- 'Openings that can be opened wider than 100mm may form part of the overheating mitigation strategy where they meet all of the following conditions.

  a. Window handles on windows that open outwards are not more than 650mm from the inside face of the wall when the window is at its maximum openable angle.
  b. Guarding meets the minimum standards in Table 3.1.
  c. Guarding does not allow children to easily climb it. For example, horizontal bars should generally be avoided.

- To ensure safe operation it may be necessary to reduce the size of the outward opening windows and provide more windows to meet the required free area.

- Guarding for large openings could include, but is not limited to, either of the following.

  a. Shutters with a child-proof lock.
  b. Fixed guarding.

### 3.4.4 Protection from entrapment

In the case of using louvered shading devices, the Approved Document O has stated the following 'Louvered shutters, window railings and ventilation grilles should not allow body parts to become trapped. They should comply with all of the following.

a. Not allow the passage of a 100mm diameter sphere.
b. Any hole which allows the passage of an 8mm diameter rod should also allow the passage of a 25mm diameter rod. Such holes should not taper in a way that allows finger entrapment.
c. Any looped cords must be fitted with child safety devices.

### 3.4.5 Noise

In locations where external noise may be an issue, the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11pm to 7am).

Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits.

a. 40dB LAeq,T, averaged over 8 hours (between 11pm and 7am).
b. 55dB LAFmax, more than 10 times a night (between 11pm and 7am).

# 4.0 METHODOLOGY

## 4.1 The Thermal Model

The assessment has been carried out using IES-VE 2023 thermal modelling software. The figure to the opposite shows 3D views of the thermal model created within IES software. The model has been based on the drawings showed in the appendices at the end of this report.

## 4.2 Used Weather Data

CIBSE TM59 requires the assessment to be conducted using the DSY1 file most appropriate to the site location, for the 2020s, high emissions, 50% percentile scenario. Considering the location of the proposed development in Richmond, the assessment of the proposed development has been carried out using London_LHR_DSY1_2020High50 weather file.

## 4.3 Mitigation Strategies

To mitigate the risk of overheating the design have adopted the following measures:

- Provide large horizontal overhangs to limit unwanted solar gains in summer.
- Provide external vertical shading elements that operate manually and automatically when the temperature is above 22º to reduce solar gains.
- Provide cross ventilation in most of the rooms to remove heat from the indoor environment.
- Use the main stair area for stack ventilation for better air movement.
- The use of an MVHR system for background ventilation.

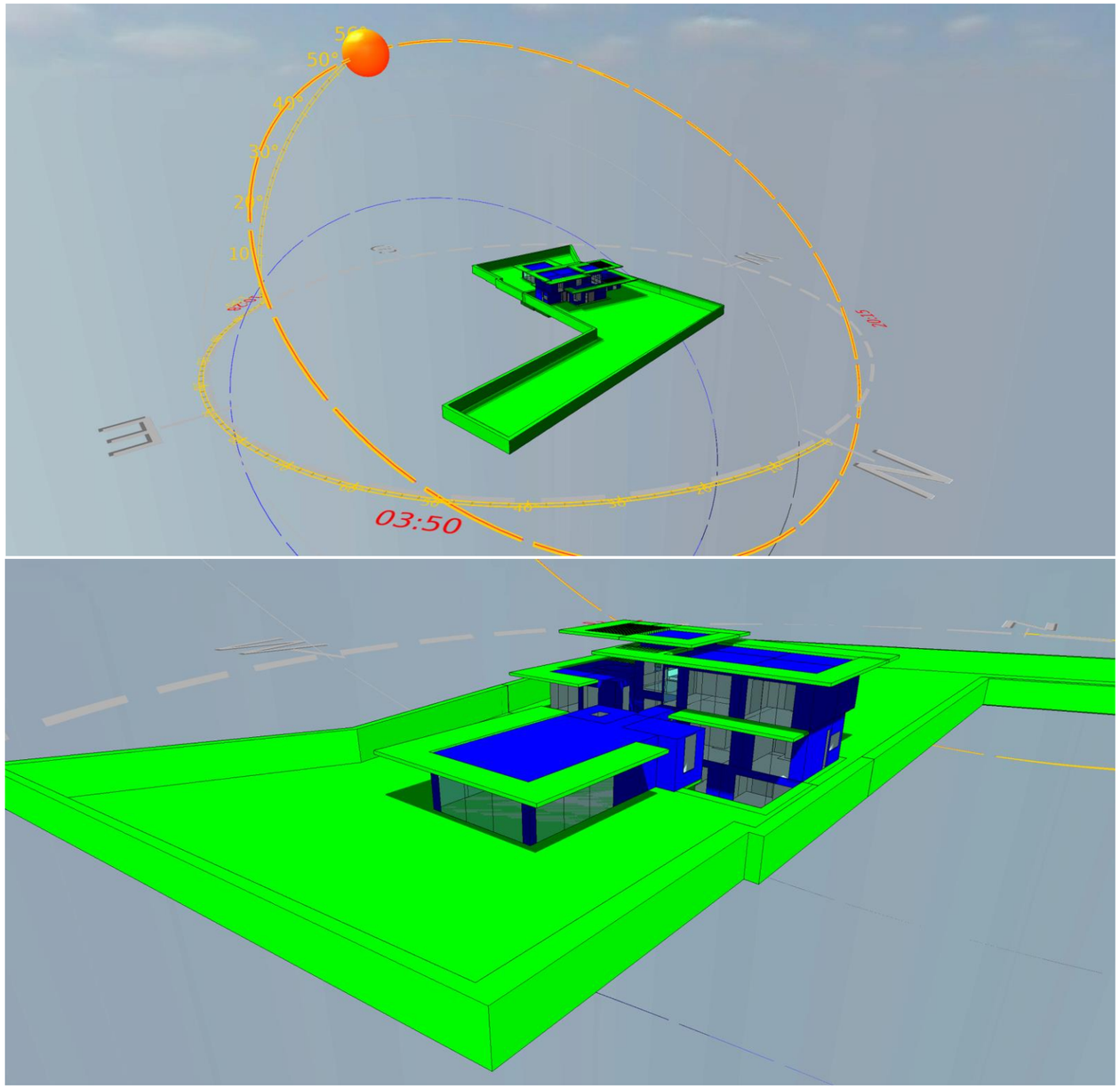



Figure 3: Views of The Thermal Model of The Proposed Development

## 4.4 Internal Gains

The used occupancy, equipment and lighting profiles gains in the thermal model are based on TM59. The spaces set in the model follow the characteristics shown in the table to the opposite.

It's important to note that TM59 defines profiles for bedrooms, living rooms, and kitchens. The used profiles for the office, studio, and play area have been created in accordance with the closest in usability to the spaces defined by TM59.

| Room Type | Occupancy | Occupancy Heat Gain | Equipment load | Lighting |
|---|---|---|---|---|
| **Kitchen/Living/Dining Room** | 6 people from 9 am to 10 pm; room is unoccupied for the rest of the day | 75 W/person and a maximum latent heat gain of 55 W/person | Peak load of 450 W from 6 pm to 8 pm.<br>200 W from 8 pm to 10 pm.<br>110 W from 9 am to 6 pm and from 10 pm to 12 pm.<br>Base load of 85 W for the rest of the day | 2 W/m2 from 6pm to 11pm 18:00 – 23:00 |
| **Bedrooms** | 2 people at 70% gains from 11 pm to 8 am<br>2 people at full gains from 8 am to 9 am and from 10 pm to 11 pm<br>1 person at full gain in the bedroom from 9 am to 10 pm | | Peak load of 80 W from 8 am to 11 pm<br>Base load of 10 W during the sleeping hours | |
| **Snug** | 3 people at 75% gains from 9 am to 10 pm; room is unoccupied for the rest of the day | | Peak load of 150 W from 6 pm to 10 pm<br>60 W from 9 am to 6 pm and from 10 pm to 12 pm<br>Base load of 35 W for the rest of the day | |
| **Relaxation Room** | 2 people at 75% gains from 9 am to 10 pm; room is unoccupied for the rest of the day | | Peak load of 150 W from 6 pm to 10 pm<br>60 W from 9 am to 6 pm and from 10 pm to 12 pm<br>Base load of 35 W for the rest of the day | |
| **Office** | 1 person at 100% gains from 9 am to 6 pm on working days; room is unoccupied for the rest of the day. | | Peak load of 100 W from 9 am to 6 pm | |
| **Play area** | 2 people at 75% gains from 9 am to 10 pm; room is unoccupied for the rest of the day. | | Peak load of 150 W from 6 pm to 10 pm<br>60 W from 9 am to 6 pm and from 10 pm to 12 pm<br>Base load of 35 W for the rest of the day | |
| **Studio** | 1 person at 100% gains from 9 am to 6 pm on working days; room is unoccupied for the rest of the day. | | Peak load of 100 W from 9 am to 6 pm | |

Table 1: Occupancy and Equipment Gain Description

## 4.5 Building Fabric

One of the main aspects in the design was taking the fabric first approach. The construction fabric data shown on the table to the opposite has been input into the simulation.

| Element | Value | Construction Type |
|---|---|---|
| U-Values | | |
| **External Walls** | 0.11 W/m²K | Lightweight Blockwork. |
| **External Roof** | 0.11 W/m²K | Lightweight timber roof. |
| **External Floor** | 0.11 W/m²K | Beam and block floor. |
| **External Glazing** | 1.1 W/m²K for most spaces | Triple glazing. |
| | 0.8 W/m²K for the main kitchen/living glazing | |
| **External Door** | 1.0 W/m²K | |
| **External Rooflight** | 1.1 W/m²K | |
| Glazing | | |
| **Glazing G-Value** | 0.4 | - |
| **Glazing Light Transmittance** | 0.79 | - |
| | | |
| **Air Permeability** | 2.0 m³/m².hr | |

Table 2: Building Constructions

## 4.6 Ventilation Strategy

To minimise risk of overheating, a number of strategies have been incorporated within the design;

- Shading through horizontal elements – Significant shading will be provided through the use of large overhangs, and as such will help to control solar gains during the summer.
- Emphasis on Cross Ventilation – allowing for cross ventilation in most spaces to help reduces the risk of overheating.
- Venetian Louvers for further reduction of solar gains.

The assessed development relies predominantly on natural ventilation through openable windows. This is accompanied by the use of an MVHR system.

The openings have been modelled based on the provided elevations and incorporate the limits, set out within the Approved Document Part O, placed upon CIBSE's TM59 methodology.

The windows are modelled as starting to open at 22 °C and being fully open by 26 °C during occupied hours. If the temperature is above 22 °C at 11pm, the windows at the bedrooms will remain open overnight.

All windows within other spaces are set to open between 8am and 11pm and are set to be closed at night for security purpose.

The used infiltration rate for the building is 0.15 air changes per hour (ACH).

## 4.7 Open Ventilation Areas

The figures below provide the open areas used within the thermal model

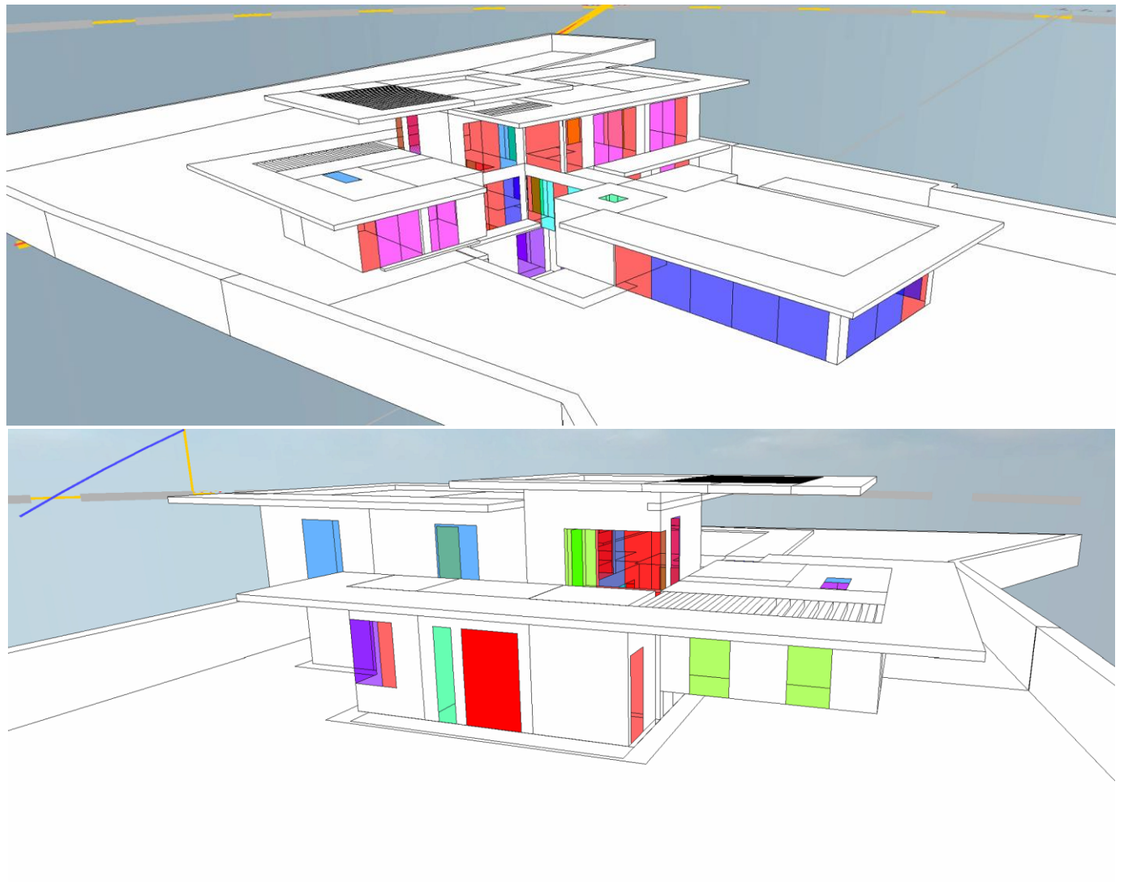


Figure 4: Open Ventilation Areas

- Closed Glazing
- Sliding Glazing – open during the day and secured at night
- Sliding Glazing – half open during the day closed at night
- Sliding Door – open during the day closed at night
- Inward opened glazing – half open during the day closed at night
- Inward opening window – half open during the day and secured at night
- Inward opening window – half open during the day closed at night

# 5.0 PART O SIMULATION RESULTS

## 5.1 Design Summer Year (DSY) 2020 High 50th percentile

The tables to the opposite show the results for all the assessed spaces. The results are based on the use of London_LHR_DSY1_2020High50 weather data.

The results show that with the applied passive measures in the design from the use of cross ventilation, robust U-values and horizontal and vertical shading. It shows that all of the assessed spaces pass the required Part O criteria (TM59 Criteria A & B).

It is important to note that there is no specific standard to meet studio, office, play area, and circulation spaces within Part O. But they have been included in the assessment to better understand how they are performing.

For the main stair and circulation spaces, they have been assessed against the CIBSE TM59 (2017) guidance, which suggests a threshold temperature of 28°C for less than 3% of the total annual hours. It is seen that none of the circulation spaces will exceed that percentage, and all of the assessed spaces pass.

**Criteria A:** states that the number of hours during which DT is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3 percent of occupied hours (Kitchens, Living Rooms, & Bedrooms Only).

| Floor | Room Type | Criteria a (%Hrs Top-Tmax>=1K) | Pass/Fail |
|---|---|---|---|
| **Ground Floor** | 02-UG-BEDROOM 02 | 1.0 | Pass |
| **Ground Floor** | 01-GF-OFFICE | 2.0 | Pass |
| **Ground Floor** | 02-UG-BEDROOM 01 | 0.9 | Pass |
| **Ground Floor** | 01-GF-BEDROOM 02 | 0.7 | Pass |
| **Ground Floor** | 01-GF-BEDROOM 01 | 0.5 | Pass |
| **Ground Floor** | 01-GF-LIV/KIT/DIN | 2.0 | Pass |
| **Ground Floor** | 01-GF-SNUG | 2.2 | Pass |
| **Basement Floor** | 00-BF-PLAY AREA | 2.4 | Pass |
| **Basement Floor** | 00-BF-STUDIO | 2.1 | Pass |
| **First Floor** | 02-FF-RELAXATION ROOM | 0.6 | Pass |
| **First Floor** | 02-FF-MASTER BEDROOM | 0.4 | Pass |

Table 3: Criteria a Results for DSY1 2020 High 50th Percentile Weather Data

**Criteria B:** states that to guarantee comfort during the sleeping hours the operative temperature Top in the bedroom from 10 pm to 7 am shall not exceed 26 °C for more than 1% of annual hours. (Note: 1% of the annual hours between 22:00 and 07:00 for bedrooms is 32 hours, so 33 or more hours above 26 °C is recorded as a fail) (bedrooms only).

| Floor | Room Type | Criteria b (No.Hrs Top>26Deg 22:00-07:00) | Pass/Fail |
|---|---|---|---|
| **Ground Floor** | 02-UG-BEDROOM 02 | 17 | Pass |
| **Ground Floor** | 02-UG-BEDROOM 01 | 17 | Pass |
| **Ground Floor** | 01-GF-BEDROOM 02 | 24 | Pass |
| **Ground Floor** | 01-GF-BEDROOM 01 | 25 | Pass |
| **First Floor** | 02-FF-MASTER BEDROOM | 17 | Pass |

Table 4: Criteria b Results for DSY1 2020 High 50th Percentile Weather Data

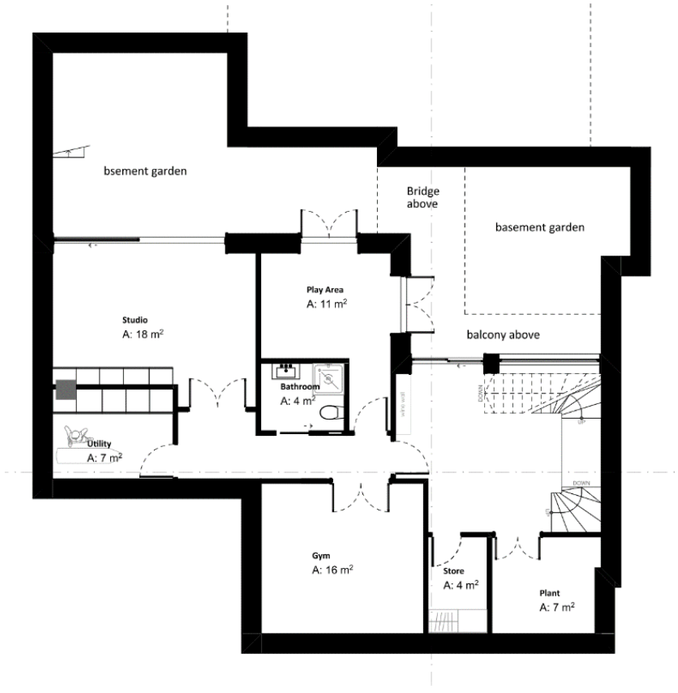
| Floor | Room Type | (% Total Hrs>28) | Pass/Fail |
|---|---|---|---|
| **First Floor** | 02-FF-STAIR/CIR | 1% | Pass |
| **Ground Floor** | 01-GF-CIRCULATION | 1% | Pass |
| **Basement Floor** | 00-BF-STAIR/CIR | 1% | Pass |
| **Basement Floor** | 00-BF-CIRCULATION | 1% | Pass |
| **Ground Floor** | 01-GF-LOBBY & CIRCULATION | 1% | Pass |

Table 5: Circulation Spaces Results for DSY1 2020 High 50th Percentile Weather Data

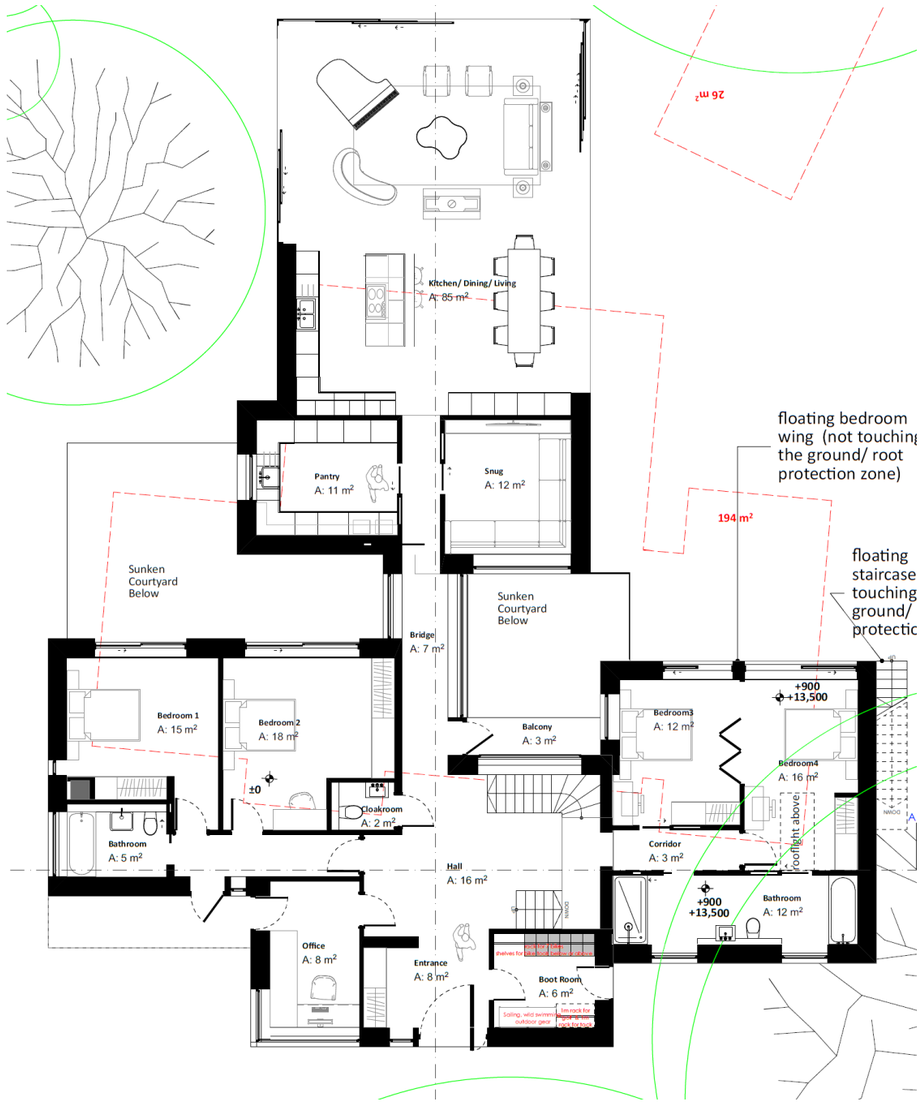
## 6.0 APPENDIX

### a. Proposed Drawings – Plans

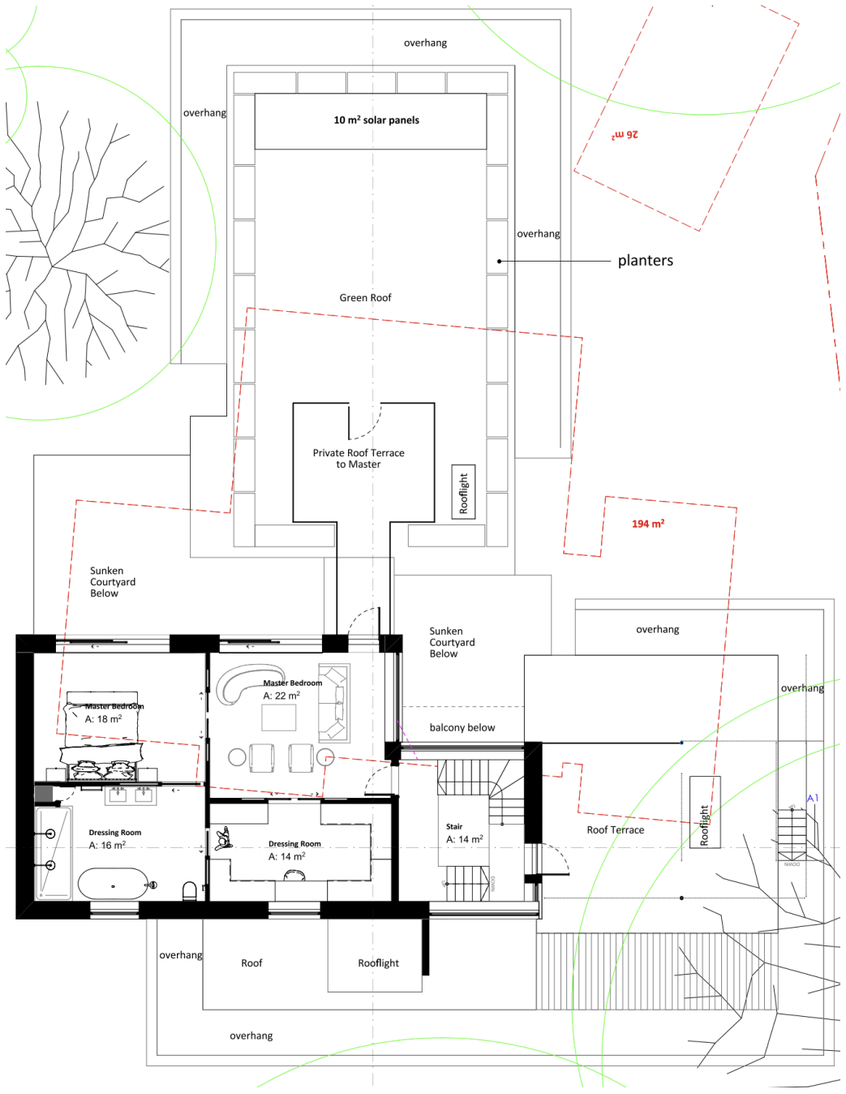
Basement Floor



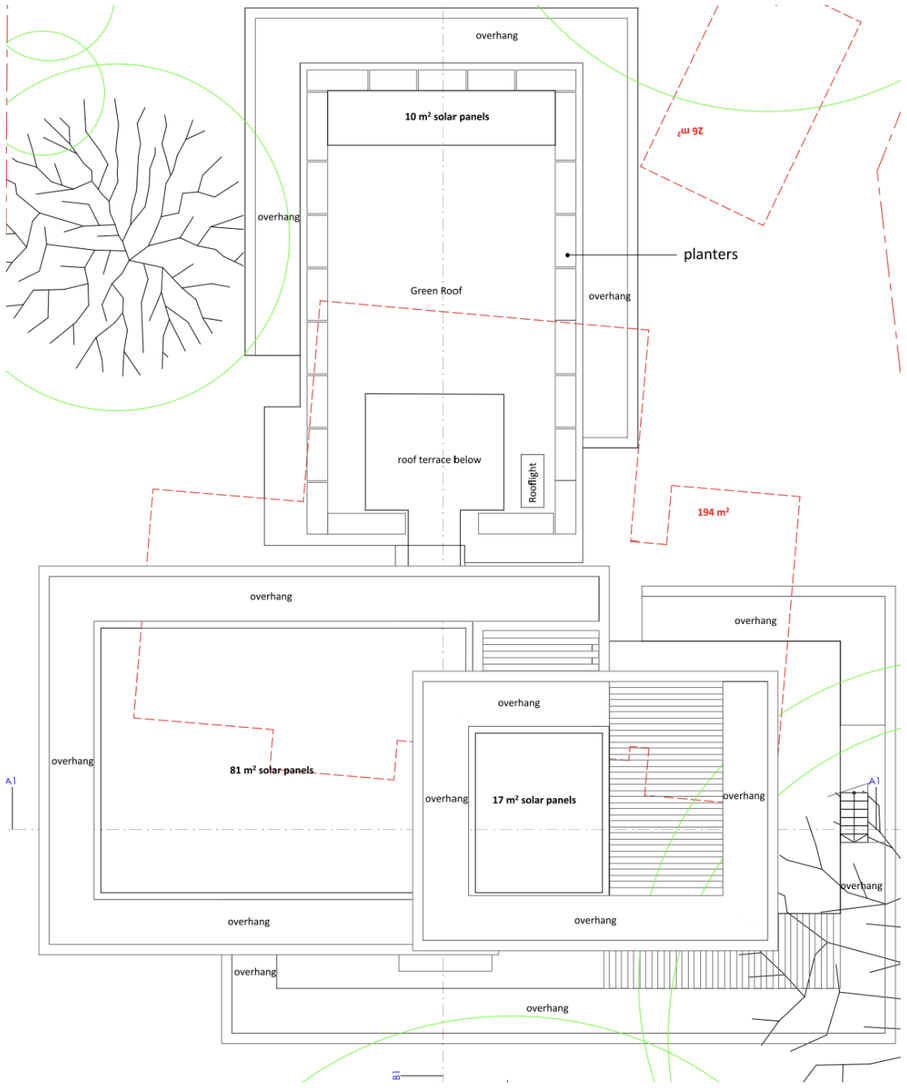

Ground Floor



## 1st Floor



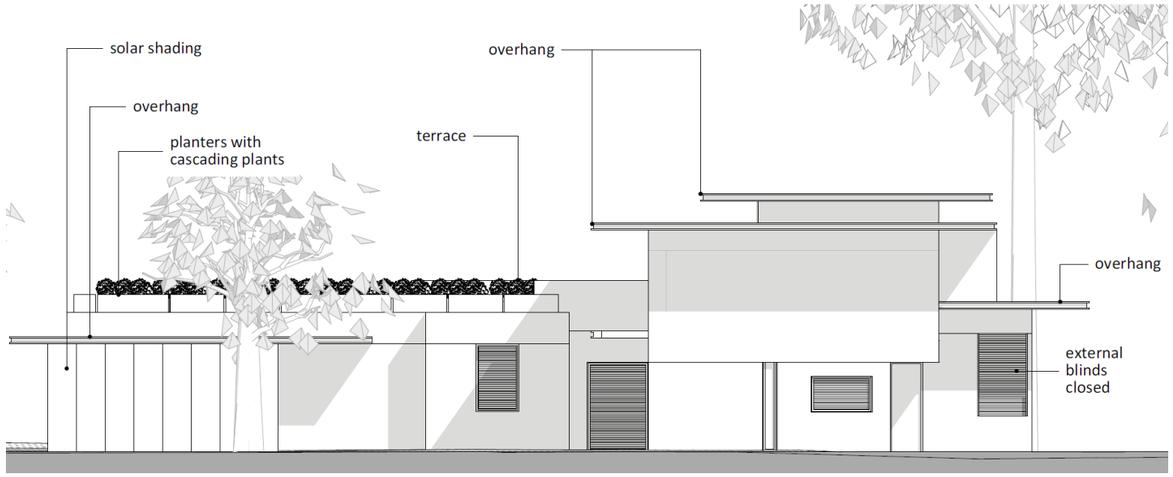

## Roof Plan



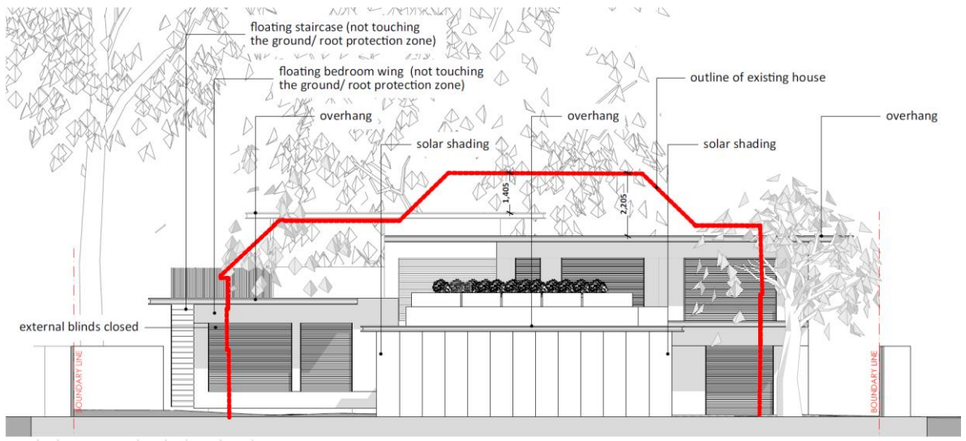
## Proposed Drawings – Elevations

### Front – North Elevation


### Side – East Elevation




### Rear – South Elevation




### Side – West Elevation