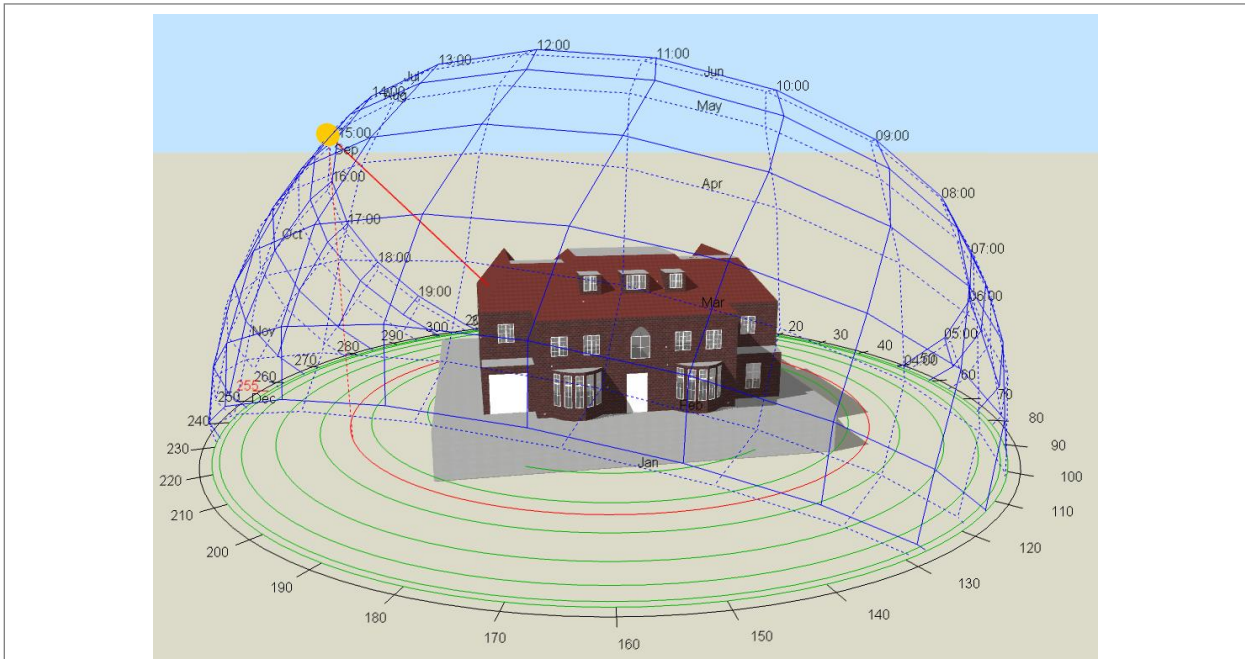




Domestic Overheating Assessment

Part O - Dynamic Thermal Modelling

41 Sheldon Avenue

26th September 2024

Document Status

Client: Eva Stengaard and Mark Tognolini

Site: 41 Sheldon Avenue, London

Proposals: The construction of one new build dwelling

Contents:

1	Scope	3
2	Executive Summary	4
3	Part O: Dynamic Thermal Modelling Method	5
4	CIBSE TM59 Assessment Criteria	7
5	The Model	8
6	Results	14
7	Summary	15

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1 Scope

This report has been prepared to assess the likelihood of overheating for the proposed detached 5-bedroom house on Sheldon Avenue in Highgate, London.

The intention is that this study helps inform and verify the design proposals, thereby providing the basis for mitigating overheating risk and producing houses that provide comfortable environmental conditions for occupants.

It is important to note that with any modelling exercise there are assumptions and approximations that must be made. As far as possible, details of all assumptions and approximations are supplied within the report. These were predominantly informed by information provided and should be reviewed carefully.

All results are based on the output from computer modelling software and should be taken as an indication of the likely final situation, but these conditions cannot be guaranteed.

Moreover, this Overheating Assessment demonstrates that the proposed development complies with the relevant current guidance CIBSE TM59: Design Methodology for the Assessment of Overheating Risk in Homes (2017) and the requirements of the Dynamic Simulation of the building regulation in England setting standards for overheating in new residential buildings: Overheating: Approved Document Part O.



Figure 01.- *DesignBuilder Rendered visuals of the proposed development*

2 Executive Summary

This overheating assessment has shown that the proposed residential dwelling at 41 Sheldon Avenue in London presents a low risk of overheating based on the current design and specification.

As there is a large amount of glazing to the family room and the bedrooms windows are restricted to open to a maximum of 100mm as part of the overheating strategy (as the Part O 1100mm guarding requirement is not met), compliance cannot be achieved based on passive measures alone.

Therefore, it is proposed for the proposed development to be provided with a comfort cooling solution to enhance the overall thermal performance. The cooling system shall assist with maintaining suitable comfort levels due to extreme peak weather events and climate change.

The overheating mitigation strategy is as follows:

Overheating Strategy	Part O Compliance	Notes
- Natural Ventilation via openable windows - Solar control glazing (centre pane g-value of 0.4) - MVHR Ventilation (basement level) - Mechanical cooling to bedrooms and family room	☒	Overheating strategy sufficient

3 Part O: Dynamic Thermal Modelling Method

In order to demonstrate compliance with the requirements settled by the requirement O1 of the Approved document Part O, the present report has used the Dynamic thermal modelling method approved by the aforementioned document.

To demonstrate compliance using the dynamic thermal modelling method, all of the following have been followed:

- a) CIBSE TM59 methodology for predicting overheating risk
- b) The limits on the use of CIBSE TM59 methodology set out below
- c) The acceptable strategies for reducing overheating risk

Limits on CIBSE's TM59 modelling

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 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 of 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 below.
 - ii. At night, windows, patio doors and balcony doors should be modelled as closed.

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

Acceptable strategies for reducing overheating risk

Limiting solar gains

Solar gains in summer should be limited by any of the following means:

- a) Fixed shading devices, comprising any of the following.
 - i. Shutters
 - ii. External blinds
 - iii. Overhangs
 - iv. Awnings
- b) Glazing design, involving any of the following solutions
 - v. Size
 - vi. Orientation
 - vii. g-value
 - viii. Depth of the window reveal
- c) Building design – for example, the placement of balconies
- d) Shading provided by adjacent permanent buildings, structures, or landscaping.

Removing excess heat

Excess heat should be removed from the residential building by any of the following means.

- a) Opening windows (the effectiveness of this method is improved by cross-ventilation)
- b) Ventilation louvres in external walls
- c) A mechanical ventilation system
- d) A mechanical cooling system

4 CIBSE TM59 Assessment Criteria

This report includes only occupied spaces such as the Kitchen/Living Room and Bedrooms. The analysis has been based on CIBSE Technical Memorandum 59 (TM59) 'Design methodology for the assessment of overheating risk in homes', that states:

Compliance is based on passing both of the following criteria:

- 1) 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 percent of occupied hours. (CIBSE TM52 Criterion 1: Hours of exceedance).**
- 2) 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).**

5 The Model

The building was modelled using DesignBuilder Energyplus software. The software complies with CIBSE Application Manual AM11: 1998 Building Energy and Environmental Modelling and provides a full dynamic simulation of thermal conditions in the building.

Geometry

A three-dimensional analysis model has been generated for the proposed scheme. The model was developed using drawn information supplied by Marek Wojciechowski Architects.

As with any modelling exercise, some approximations have been made, but care has been taken to ensure the scale and internal dimensions of the model are as close as practicable to the design drawings, and that glazing areas are as accurately represented as the provided information allows.



Figure 02.- Thermal Model images

Site Location and Climate Data

The CIBSE DSY weather file for London Heathrow (LHR DSY1 2020 High 50) has been selected as this is the most suitable weather file for the site location.

The weather file contains hourly data for air temperatures (wet bulb and dry bulb), wind speed and direction, atmospheric pressure, solar irradiation and cloud cover.

DSY (Design Summer Year) is the industry standard weather file for use in overheating assessments. It should be noted that the current DSY was used, and future weather files based on various predicted climate change scenarios are available. Usage of these future weather files would result in higher predicted internal temperatures than reported here as the climate is predicted to encounter more prolonged warm spells and higher peak temperatures as time progresses.

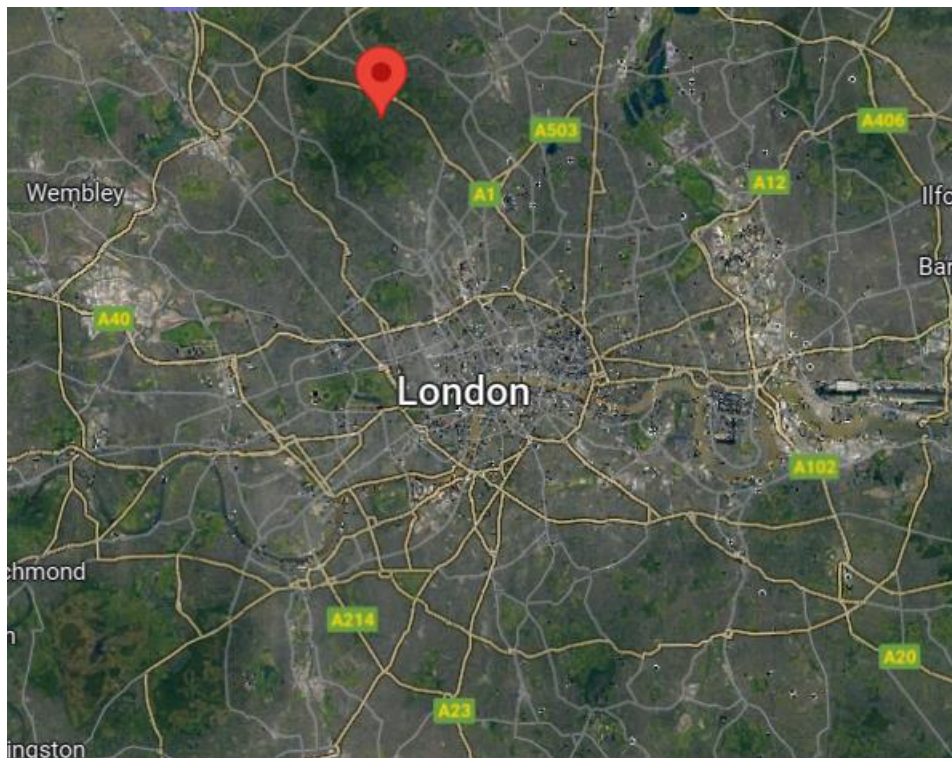


Figure 04.- Site Location

The site is located in London in the south-east of England.

Building Construction and U-Values

Drawings have been provided by the architect which were used to create the thermal model.

Table 1 shows the construction U-values and air infiltration used in the thermal model.

Table 02: *U Values applied to the Dynamic Simulation Model*

Element	Modelled U Value (W/m²K)
Basement Wall	0.13
External cavity Wall	0.13
Dormer Wall	0.26
Basement Floor	0.13
Ground Floor	0.11
Roof	0.11
Glazing	1.20
Air Leakage (m ³ (h.m ²) @ 50Pa	5.0
Glazing g Value	40%

Internal Gains

The internal heat gains and operating profiles that are applied to each occupied space have been taken from the prescriptive templates outlined in CIBSE TM59 (Design methodology for the assessment of overheating risk in homes).

Window Opening Schedule

The window opening schedules for dwelling can be seen in the below table.

Assessed Space	Total Window Glazing (m ²)	Total Window Glazing that opens (m ²)	Glazing Opening Type	Total Floor Area (m ²)	Opening Schedule
Drawing Room	6.6	1.8	Windows	32.1	Daytime Only
Family Room	20.0	20.0	French doors	42.6	Daytime Only
Kitchen	15.2	12.5	French doors	77.3	Daytime Only
Master Bedroom	7.8	7.8	French doors	21.3	Daytime & Nighttime
Bedroom 1	2.8	2.8*	Windows	20.6	Daytime & Nighttime
Bedroom 2	2.8	2.8*	Windows	22.0	Daytime & Nighttime
Bedroom 3	2.0	1.6*	Windows	20.6	Daytime & Nighttime
Bedroom 4	2.0	1.6*	Windows	21.6	Daytime & Nighttime

**As the sill height for these windows is less than the 1100mm guarding requirement of Part O, they have been modelled to open to a maximum of 100mm as part of the overheating strategy. A reduced figure has been applied for window discharge coefficient.*

It is also assumed that internal doors are left open during the day.

Opening Schedules:

- Night Closed: Glazing can be opened between the hours of 08:00-23:00 but is shut out of these hours. The Part O document stipulates any window which can be easily accessed must be closed or secured resulting in a reduced opening area (such as ground floor doors/windows where openings may be vulnerable to intrusion by a casual or opportunistic burglar).
- Night Open: Glazing can be open 24/7 if necessary as these openings are not vulnerable (such as first floor and above windows etc).

There are no assumed acoustical limitations to windows being opened during both day and night times (Part O window opening schedules are detailed within this report).

Mechanical Ventilation

Mechanical ventilation in the form of MVHR is proposed for the basement level of the dwelling.

This is a low energy, continuous mechanical ventilation system designed to replace conventional extract ventilation systems (such as intermittent systems) by drawing moisture laden air out of the kitchen and wet rooms while supplying fresh air to habitable rooms such as Bedrooms and Living spaces.

An additional benefit is an air pathway is also formed drawing warm out of habitable spaces and evacuated from the dwelling, with the makeup air being provided by mechanically supplied air from the unit in addition to any windows in habitable spaces (when opened).

The minimum whole house ventilation rates can be seen in table 1.3 – these have been taken from *Approved Document F*.

For more information, please refer to Approved Document F, Volume 1: Dwellings.

An MVHR flow rate of 0.3 l/m² has been assumed for the basement areas.

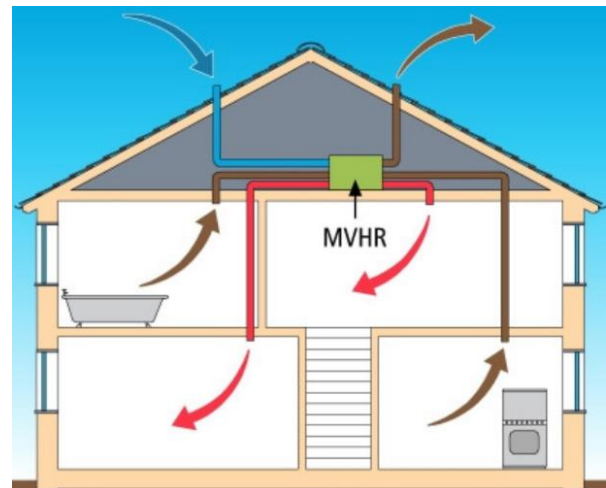


Table 1.3 Minimum whole dwelling ventilation rates by no. of bedrooms

Number of bedrooms ⁽¹⁾⁽²⁾	Minimum ventilation rate by no. of bedrooms (l/s)
1	19
2	25
3	31
4	37
5	43

NOTES:

1. If the dwelling only has one habitable room, a minimum ventilation rate of 13l/s should be used.
2. For each additional bedroom add 6l/s to the values in Table 1.3

▲ *Total Combined rate of continuous ventilation in the dwelling needs to meet the above minimum rates.*

Ensuring the Overheating Strategy is Usable

Approved Document O lists a number of measures to ensure the overheating mitigation strategy can be feasibly implemented in reality, as well as complying with overlapping building codes. The full literature can be found in *Section 3: Ensuring the overheating mitigation strategy is usable* of Approved Document O. A summary of these standards has been compiled below:

1.1 Noise

- **3.2)** In locations where external noise may be an issue (for example, where the local planning authority considered external noise to be an issue at the planning stage), the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11pm to 7am).

- **3.3)** 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).

1.2 Pollution

- **3.5)** 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.

1.3 Security

- **3.6)** 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

1.4 Protection from Falling

- **3.8)** 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.

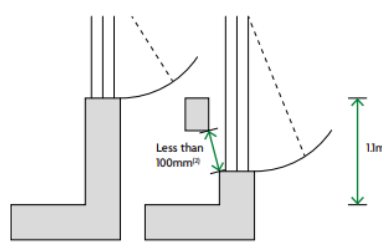
- **3.9)** Openings that can be opened wider than 100mm may form part of the overheating mitigation strategy where they meet all of the following conditions:

- 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.

For more information, please refer to *Approved Document K*.

Table 3.1 Guarding heights

Change in floor level between inside and outside	Guarding height ⁽¹⁾
Less than 600mm	See Approved Document K
More than 600mm	1.1m



NOTES:

1. This approved document has increased levels of protection from falling compared to Approved Document K. Where applicable, the higher standard applies.
2. Guarding should be sized to prevent the passage of a 100mm sphere.

6 Results

An baseline set of results is shown in the table below.

Room	Criterion 1 (%)	Criterion 2 (Hr)	Pass/Fail
Drawing Room	0.00	N/A	Pass
Media Family Room	0.00	N/A	Pass
Family Room	6.21	N/A	Fail
Kitchen	0.33	N/A	Pass
Master Bedroom	0.18	26.5	Pass
Bedroom 1	0.16	75.0	Fail
Bedroom 2	0.12	83.5	Fail
Bedroom 3	0.33	99.5	Fail
Bedroom 4	0.94	157.5	Fail

As it can be seen from the results, the family room and bedrooms 1-4 fail to comply with TM59 criteria. This is due to a large amount of glazing on the family room and bedrooms windows that do not open wider than 100mm as part of the overheating strategy as the Part O guarding requirement is not met.

It is understood that the new dwelling should match the appearance of the existing dwelling so alterations to sill heights and window dimensions are not considered as part of the overheating mitigation strategy. In addition, options for external shading have been excluded as this is likely to change the external appearance of the building.

Passive measures have been included in the form of optimised thermal mass in the construction materials and a glazing centre pane g-value of 0.40 (this is the lowest g-value possible for planning targets for energy/carbon and Part L compliance to be achieved).

Mechanical ventilation in the form of MVHR was explored as a potential option but even at high flow rates (>30 l/s in bedrooms) did not result in compliance.

Therefore, it is proposed for the proposed development to be provided with a comfort cooling solution to enhance the overall thermal performance. The cooling system shall assist with maintaining suitable comfort levels due to extreme peak weather events and climate change.

Results for the dwelling with comfort cooling incorporated are shown below.

Room	Criterion 1 (%)	Criterion 2 (Hr)	Pass/Fail
Drawing Room	0.00	N/A	Pass
Media Family Room	0.00	N/A	Pass
Family Room	2.99	N/A	Pass
Kitchen	0.33	N/A	Pass
Master Bedroom	0.18	26.5	Pass
Bedroom 1	0.16	5.0	Pass
Bedroom 2	0.12	3.0	Pass
Bedroom 3	0.33	9.0	Pass
Bedroom 4	0.94	6.5	Pass

The dwelling has also been modelled against additional weather files: DSY1 (2050s and 2080s), DSY2 and DSY3. This shows that the family room and some of the bedrooms fail to comply against the alternative weather scenarios. It should be noted that internal shading, such as blinds, has been excluded from the overheating assessment as they are not permitted under Part O. The use of internal shading and reduced cooling set-points are likely to ensure that compliance is achieved for future weather conditions.

7 Summary

The assessment has shown that the proposed residential dwelling at 41 Sheldon Avenue in London presents a low risk of overheating.

The overheating mitigation measures include the following:

- MVHR ventilation to basement floor areas
- Openable windows to provide natural ventilation
- Solar control glazing (centre pane g-value of 0.40)
- Mechanical cooling to family room and bedrooms

As there are limitations to incorporating additional passive measures to ensure compliance, it is proposed for the proposed development to be provided with a comfort cooling solution to enhance the overall thermal performance. The cooling system shall assist with maintaining suitable comfort levels due to extreme peak weather events and climate change.

Though the regulations do not permit the use of blinds and curtains in the calculations, if the sun shines directly into a living space, the occupant should consider closing the curtains or blinds to limit solar gains and try and keep rooms as cool as possible.

The cooling hierarchy as stated in the London Plan has been followed as summaries in the table below:

Table 07: Cooling Hierarchy Demonstration

#	Cooling Hierarchy measure	Implementation of measure	Measure effect
1	Reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure	Solar control glazing to limit solar gains	Reduction in solar gains entering the dwellings
2	Minimise internal heat generation through energy efficient design	This can be achieved by measures such as fully insulated pipework.	N/A
3	Manage the heat within the building through exposed internal thermal mass and high ceilings	At the jurisdiction of the site architect. Materials with increased thermal mass used – 3m high ceilings proposed.	N/A
4	Provide passive ventilation	Passive ventilation via unrestricted opening windows and doors (as permitted by ADO and ADK). Limited option for altering windows due to preserving existing aesthetics of dwelling.	Limited impact on internal temperatures.
5	Provide mechanical ventilation	Mechanical ventilation via MVHR in combination with natural ventilation via opening windows	Limited impact on internal temperatures
6	Provide active cooling systems	Mechanical cooling modelled to bedrooms and family room to avoid peak summer overheating	All assessed rooms satisfy TM59 criteria and are Part L compliant

Appendix A: TM59 Future weather file results

DSY1 2050s:

Room	Criterion 1 (%)	Criterion 2 (Hr)	Pass/Fail
Drawing Room	0.20	N/A	Pass
Media Family Room	0.00	N/A	Pass
Family Room	6.36	N/A	Fail
Kitchen	1.08	N/A	Pass
Master Bedroom	0.22	46.50	Fail
Bedroom 1	0.15	30.00	Pass
Bedroom 2	0.12	28.50	Pass
Bedroom 3	0.48	32.50	Fail
Bedroom 4	0.75	30.00	Pass

DSY1 2080s:

Room	Criterion 1 (%)	Criterion 2 (Hr)	Pass/Fail
Drawing Room	0.87	N/A	Pass
Media Family Room	0.00	N/A	Pass
Family Room	12.35	N/A	Fail
Kitchen	3.06	N/A	Fail
Master Bedroom	1.24	142.50	Fail
Bedroom 1	0.83	93.50	Fail
Bedroom 2	0.79	89.00	Fail
Bedroom 3	1.09	107.50	Fail
Bedroom 4	1.71	91.50	Fail

DSY2:

Room	Criterion 1 (%)	Criterion 2 (Hr)	Pass/Fail
Drawing Room	0.03	N/A	Pass
Media Family Room	0.00	N/A	Pass
Family Room	3.67	N/A	Fail
Kitchen	1.32	N/A	Pass
Master Bedroom	0.58	35.50	Fail
Bedroom 1	0.38	40.50	Fail
Bedroom 2	0.40	38.50	Fail
Bedroom 3	0.36	34.00	Fail
Bedroom 4	0.77	35.50	Fail

DSY3:

Room	Criterion 1 (%)	Criterion 2 (Hr)	Pass/Fail
Drawing Room	0.20	N/A	Pass
Media Family Room	0.00	N/A	Pass
Family Room	7.06	N/A	Fail
Kitchen	1.57	N/A	Pass
Master Bedroom	0.75	56.00	Fail
Bedroom 1	0.15	32.00	Pass
Bedroom 2	0.12	31.50	Pass
Bedroom 3	0.48	45.00	Fail
Bedroom 4	0.75	42.50	Fail