Internal Daylight and Sunlight Report

Panther House

Project No: 9109

13 February 2017

Client	Duke Lease
Architect	AHMM Architects
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1. EXECUTIVE SUMMARY

The purpose of this report is to ascertain whether the proposed development will provide residential accommodation considered acceptable in terms of Daylight and Sunlight.

In order to understand the levels of daylight within the scheme, each habitable room from 1st to 3rd floor has been technically assessed for Average Daylight Factor (ADF), No Sky Line (NSL) and Room Depth Criterion (RDC). With excellent levels of light seen on the second and third floors, it can be concluded that all rooms on the floors above will also be excellently daylit.

Of the 42 residential rooms proposed within the development, therefore, all but three on the first floor (93%) will see excellent levels of light. Of the three rooms falling technically short of the recommended levels of ADF, two are large living areas that are acceptably daylit and the third is a bedroom within a one bedroom flat where occupants will be able to enjoy excellent levels of both daylight and sunlight within their living area.

In relation to sunlight, all living rooms relevant for assessment will see well in excess of the levels recommended both throughout the year and during the winter months.

Overall therefore, the proposed development is considered to perform very well in terms of both daylight and sunlight and will provide future occupants with access to good levels of natural light.

2. INTRODUCTION AND OBJECTIVE

GIA has been instructed to provide a report upon the potential availability of Daylight and Sunlight within the proposed residential accommodation. GIA was specifically instructed to carry out the following:

- To create a 3D computer model.
- Carry out a daylight assessment using the methodologies set out in the BRE guidance for Average Daylight Factor, No-Sky Line and Room Depth Criterion.
- Carry out a sunlight assessment using the methodologies set out in the BRE guidance for Annual Probable Sunlight Hours (APSH) to the fenestration facing within 90 degrees of due south.
- Carry out an overshadowing assessment using the methodology set out in the BRE guidance for Sun Hours On Ground (SHOG) for all relevant amenity areas.
- Prepare a report setting out the analysis and our findings.

3. BRE GUIDELINES

The Building Research Establishment (BRE) have set out in their handbook *Site Layout Planning for Daylight and Sunlight a Guide to Good Practice (2011)*, guidelines and methodology for the measurement and assessment of daylight and sunlight within proposed buildings. This document states that it is also intended to be used in conjunction with the interior daylight recommendations found within the *British Standard BS8206-2:2008* and *The Applications Manual on Window Design* of the Chartered Institution of Building Services Engineers (CIBSE).

The guide also provides advice on site layout planning to determine the quality of daylight and sunlight within open spaces between buildings.

It is important to note, however, that this document is a guide whose stated aim *"is to help rather than constrain the designer"*.

The document provides advice, but also clearly states that it *"is not mandatory and this document should not be seen as an instrument of planning policy."* The report acknowledges also in its introduction that *"in special circumstances the developer or planning authority may wish to use different target values. For example, in a historic City centre a higher degree of obstruction may be unavoidable if new developments are to match the height and proportions of existing buildings."*

It is an inevitable consequence of the built up urban environment that daylight and sunlight will be more limited in these areas. It is well acknowledged that in such situations there may be many other conflicting and potentially more important planning and urban design matters to consider other than just the provision of ideal levels of daylight and sunlight.

3.1. DAYLIGHT

The BRE set out various methods for assessing the daylight within a proposed building within section 2.1 and Appendix C of the handbook. The summary of this, given at the end of section 2.1 of the guide, states as follows:

> *"In general, a building will retain the potential for good interior diffused daylighting provided that on all its main faces:*
>
> *A. No obstruction, measured in a vertical section perpendicular to the main face, from a point two metres above ground level, subtends an angle of more than 25 degrees to the horizontal;*
>
> *Or*
>
> *B. If (A) is not satisfied, then all points on the main face on a line two metres above ground level are within four metres (measured sideways) of a point which has a vertical sky line component of 27% or more."*

3.1.1. VERTICAL SKY COMPONENT (VSC)

This method of assessment can be undertaken using a skylight indicator or a Waldram diagram. It measures from a single point, at the centre of the window (if known at the early design stage), the quantum of sky visible taking into account all external obstructions. Whilst these obstructions can be either other buildings or the general landscape, trees are usually ignored unless they form a continuous or dense belt of obstruction.

The VSC method is a useful 'rule of thumb' but has some significant limitations in determining the true quality of daylight within a proposed building. It does not take into account the size of the window, any reflected light off external obstructions, any reflected light within the room, or the use to which that room is put. Appendix C of the guide goes into more detail on these matters and sets forward alternative methods for assessment to overcome these limitations.

Paragraph 2.1.21 of the BRE states that:

"Obstructions can limit access to light from the sky. This can be checked by measuring or calculating the angle of visible sky 'theta' , angle of obstruction or Vertical Sky Component (VSC) at the centre of the lowest window where daylight is required. If VSC is:

- *at least 27% ('theta' is greater than 65 degrees, obstruction angle less than 25 degrees) conventional window design will usually give reasonable results.*
- *between 15% and 27 % ('theta' is between 45 degrees and 65 degrees, obstruction angle between 25 degrees and 45 degrees) special measures (larger windows, changes to room layout) are usually needed to provide adequate daylight.*
- *between 5% and 15% ('theta' is between 25 degrees and 45 degrees, obstruction angle between 45 degrees and 65 degrees) it is very difficult to provide adequate daylight unless very large windows are used.*
- *less than 5% ('theta' less than 25 degrees, obstruction angle more than 65 degrees) it is often impossible to achieve reasonable daylight, even if the whole window wall is glazed."*

Appendix C of the BRE guide: Interior Daylighting Recommendations, states:

> *"The British Standard for daylighting, and the CIBSE Applications manual: window design, contain advice and guidance on interior daylighting. This guide to good practice is intended to be used in conjunction with them, and its guidance is intended to fit in with their recommendations.*
>
> *For skylight, the British Standard and the CIBSE manual put forward three main criteria, based on the average daylight factor, room depth, and the position of the no skyline."*

3.1.2. AVERAGE DAYLIGHT FACTOR (ADF)

> *"If a predominantly daylit appearance is required, then adf should be 5% or more if there is no supplementary electric lighting, or 2% or more if supplementary electric lighting is provided. There are additional recommendations for dwellings of 2% for kitchens, 1.5% for living rooms and 1% for bedrooms. These are minimum values of Average Daylight Factor, and should be attained even if a predominantly daylit appearance is not required."*

This method of assessment takes into account the total glazed area to the room, the transmittance quality of the glazing proposed, the total area of the room surfaces including ceilings and floors, and the internal average reflectance for the room being assessed. The method also takes into account the Vertical Sky Component and the quantum of reflected light off external surfaces.

This is, therefore, a significantly more detailed method of assessment than the Vertical Sky Component method set out above.

3.1.3. ROOM DEPTH CRITERION (RDC)

Where it has access to daylight from windows in one wall only, the depth of a room can become a factor in determining the quantity of light within it. The BRE guidance provides a simple method for examining the ratio of room depth to window area. However, whilst it does take into account internal surface reflections, this method also has significant limitations in that it does not take into account any obstructions outside the window and therefore draws no input from the quantity of light entering the room.

3.1.4. NO SKY LINE (NSL)

This third method of assessment is a simple test to establish where within the proposed room the sky will be visible through the windows, taking into account external obstructions. The assessment is undertaken at working plane height (850mm above floor level) and the method of calculation is set out in Appendix D of the BRE handbook.

Appendix C of the BRE handbook states *"if a significant area of the working plane lies beyond the no skyline (i.e., it receives no direct skylight), then the distribution of daylight in the room will look poor and supplementary electric lighting will be required."* To guarantee a satisfactory daylight uniformity, the area which does not receive direct skylight should not exceed 20% of the floor area, as quantified in the BS 8206 Part2 2008.

3.1.5. SUMMARY

The Average Daylight Factor gives a more detailed assessment of the daylight within a room and takes into account the highest number of factors in establishing a quantitative output.

However, the conclusion of Appendix C of the BRE guide states:

"All three of the criteria need to be satisfied if the whole of the room is to look adequately daylit. Even if the amount of daylight in a room (given by the Average Daylight Factor) is sufficient, the overall daylight appearance will be impaired if its distribution is poor."

In most urban areas it is important to recognise that the distribution of daylight within a room may be difficult to achieve, given the built up nature of the environment. Consequently, most local authorities seek to ensure that there is sufficient daylight within the room as determined by the Average Daylight Factor calculation. However, the additional recommendations of the BRE and British Standard for residential accommodation, set out above, ought not to be overlooked.

3.2. SUNLIGHT

The BRE provide guidance in respect of sunlight quality for new developments within section 3.1 of the handbook. It is generally acknowledged that the presence of sunlight is more significant in residential accommodation than it is in commercial properties, and this is reflected in the BRE document.

It states, *"in housing, the main requirement for sunlight is in living rooms, where it is valued at any time of the day, but especially in the afternoon. Sunlight is also required in conservatories. It is viewed as less important in bedrooms and in kitchens where people prefer it in the morning rather than the afternoon."*

The BRE guide considers the critical aspects of orientation and overshadowing in determining the availability of sunlight at a proposed development site.

The guide proposes minimizing the number of dwellings whose living room face solely north unless there is some compensating factor such as an appealing view to the north, and it suggests a number of techniques to do so. Further more, it discusses massing solutions with a sensitive approach to overshadowing, so as to maximize access to sunlight.

At the same time it acknowledges that the site's existing urban environment may impose orientation or overshadowing constraints which may not be possible to overcome.

To quantify sunlight access for interiors where sunlight is expected, it refers to the BS 82606-2 criterion of Annual Probable Sunlight Hours. APSH is defined as *"the total number of hours in the year that the sun is expected to shine on unobstructed ground, allowing for average levels of cloudiness at the location in question."* In line with the recommendation, APSH is measured from a point on the inside face of the window, should the locations have been decided. If these are unknown, sunlight availability is checked at points 1.6m above the ground or the lowest storey level on each main window wall, and no more than 5m apart. If a room has multiple windows on the same wall or on adjacent walls, the highest value of APSH should be taken into account. If a room has two windows on opposite walls, the APSH for each can be added together.

The summary of section 3.1 of the guide states as follows:

"In general, a dwelling or non-domestic building which has a particular requirement for sunlight, will appear reasonably sunlit provided that:

At least one main window faces within 90 degrees of due south;

and

The centre of at least one window to a main living room can receive 25% of annual probable sunlight hours, including at least 5% of annual probable sunlight hours in the winter months between 21 September and 21 March. "

In paragraph 3.1.11 the BRE guidance suggests that if a room faces significantly North of due East or West it is unlikely to meet the recommended levels proposed by the BS 8206-2. As such, it is clear that only windows facing within 90 degrees of due South can be assessed using this methodology.

It is also worth noting how paragraph 5.3 of the BS 8206-2 suggests that with regards to sunlight duration *"the degree of satisfaction is related to the expectation of sunlight if a room is necessarily north facing or if the building is in a densely-built urban area, the absence of sunlight is more acceptable than when its exclusion seems arbitrary".*

3.3. OVERSHADOWING

The BRE guidance in respect of overshadowing of amenity spaces is set out in section 3.3 of the handbook. Here it states as follows:

"Sunlight in the spaces between buildings has an important impact on the overall appearance and ambiance of a development. It is valuable for a number of reasons:

- *To provide attractive sunlit views (all year)*
- *To make outdoor activities, like sitting out and children's play more pleasant (mainly during the warmer months)*
- *To encourage plant growth (mainly in spring and summer)*
- *To dry out the ground, reducing moss and slime (mainly during the colder months)*
- *To melt frost, ice and snow (in winter)*
- *To dry clothes (all year)"*

Again, it must be acknowledged that in urban areas the availability of sunlight on the ground is a factor which is significantly controlled by the existing urban fabric around the site in question and so may have very little to do with the form of the development itself. Likewise there may be many other urban design, planning and site constraints which determine and run contrary to the best form, siting and location of a proposed development in terms of availability of sun on the ground.

The summary of section 3.3 of the guide states as follows:

"3. 3 .17 It is recommended that for it to appear adequately sunlit throughout the year, at least half of a garden or amenity area should receive at least two hours of sunlight on 21 March. If as a result of new development an existing garden or amenity area does not meet the above, and the area which can receive two hours of sun on 21 March is less than 0.8 times its former value, then the loss of sunlight is likely to be noticeable. If a detailed calculation cannot be carried out, it is recommended that the centre of the area should receive at least two hours of sunlight on 21 March."

4. METHODOLOGY

In order to undertake the daylight and sunlight assessments set out above, we have prepared a three dimensional computer model and used specialist lighting simulation software.

The three dimensional representation of the proposed development has been modelled using the scheme drawings provided to us by AHMM Architects. This has been placed in the context of its surrounding buildings which have been modelled from survey information, photogrammetry, OS and site photographs. This allows for a precise model, which in turn ensures that analysis accurately represents the amount of daylight and sunlight available to the building facades, internal and external spaces, considering all of the surrounding obstructions and orientation.

4.1. SIMULATION ASSUMPTIONS

Where no values for reflectance, transmittance and maintenance factor were specified by the designer the following values from *BS 8206-2:2008, Annex A, tables A.1-A.6* were used for the calculation of Average Daylight Factor values. These values are shown in Table 1. A medium veneer has been assumed for the reflectance value of the internal floor.

Reflectance values:		**Maintenance factors:**	**Tv(normal)**	**A.3**	**A.4**	**A.5**	**A.6**	**Tv(total)**
Surrounding	0.2	Triple Low-E (frames modelled)	0.63	8	1	1	1	0.58
Pavement	0.2	Triple Low-E (frames not modelled)	0.63	8	1	1	0.8	0.46
Grass	0.1	Triple Low-E (inclined, frames modelled)	0.63	8	2	1	1	0.53
Water	0.1	Triple Low-E (inclined, frames not modelled)	0.63	8	2	1	0.8	0.42
Yellow brick	0.3	Triple Low-E (horizontal, frames modelled)	0.63	8	3	1	1	0.48
Red brick	0.2	Triple Low-E (horizontal, frames not modelled)	0.63	8	3	1	0.8	0.38
Portland Stone	0.6							
Concrete	0.4	Double Low-E (frames modelled)	0.75	8	1	1	1	0.69
Internal walls (light grey)	0.68	Double Low-E (frames not modelled)	0.75	8	1	1	0.8	0.55
Internal ceiling (white paint)	0.85	Double Low-E (inclined, frames modelled)	0.75	8	2	1	1	0.63
Internal floor (medium veneer)	0.3	Double Low-E (inclined, frames not modelled)	0.75	8	2	1	0.8	0.50
Internal floor (light veneer)	0.4	Double Low-E (horizontal, frames modelled)	0.75	8	3	1	1	0.57
		Double Low-E (horizontal, frames not modelled)	0.75	8	3	1	0.8	0.46
Transmittance values:		Single (frames modelled)	0.9	8	1	1	1	0.83
		Single (frames not modelled)	0.9	8	1	1	0.8	0.66
Triple glazing:		Single (inclined, frames modelled)	0.9	8	2	1	1	0.76
Pilkington K Glass 4/12/4/12/4 Argon filled 90%	Tv= 0.63	Single (inclined, frames not modelled)	0.9	8	2	1	0.8	0.60
		Single (horizontal, frames modelled)	0.9	8	3	1	1	0.68
Double glazing:		Single (horizontal, frames not modelled)	0.9	8	3	1	0.8	0.55
Pilkington K Glass 4/16/4 Argon filled 90%	Tv= 0.75							
		Double Translucent Low-E (frames modelled)	0.74	8	1	1	1	0.68
Single glazing:		Double Translucent Low-E (frames not modelled)	0.74	8	1	1	0.8	0.54
Pilkington Optifloat Clear, Annealed, 4mm	Tv=0.90	Double Translucent Low-E (inclined, frames modelled)	0.74	8	2	1	1	0.62
		Double Translucent Low-E (inclined, frames not modelled)	0.74	8	2	1	0.8	0.50
Translucent glazing:		Double Translucent Low-E (horizontal, frames modelled)	0.74	8	3	1	1	0.56
Pilkington Optifloat Opal - 4mm K /16/4mm Opal	Tv= 0.74	Double Translucent Low-E (horizontal, frames not modelled)	0.74	8	3	1	0.8	0.45

Table 1: Typical reflectance, transmittance and maintenance factors

5. CONCLUSIONS

5.1. CONCLUSION ON DAYLIGHT

In order to understand the levels of daylight and sunlight within the scheme, each habitable room from 1st to 3rd floor has been technically assessed for ADF, NSL and RDC. The assessments can be seen in pages 9 to 12 of this report and show generally excellent levels of both daylight and sunlight.

All rooms within the second and third floors see levels of daylight well in excess of those recommended by BRE and as such will be excellently daylit. With such good levels seen on these floors it also follows that the upper floors will see even greater levels of light and so will also be excellently daylit.

Slightly lower levels of light can be seen on the first floor but, with similar design principles to the upper floors, this is a consequence of the increased obstruction from neighbouring buildings at this floor. However, even on the first floor the levels of light are generally very good with the majority (six) of the nine rooms proposed seeing very good levels of light.

The only three rooms in the whole scheme falling short of the daylight targets are two generously sized combined Living/Kitchen/Dining (L/K/D) spaces and one bedroom all located on the lowest floor of residential.

The first of these rooms (room 3) in Flat 4 is a dual aspect L/K/D located at the rear of the building served by with four large windows and a balcony. This room sees 1.4% ADF which, whilst lower than the 2% recommended for kitchens, is only 0.1% short of the 1.5% ADF recommended for living rooms. A difference of 0.1% ADF is generally considered to be imperceptible and as such we can conclude this to be an acceptably daylit living room. Whilst it is true that the kitchen area at the back will be more reliant on supplementary artificial lighting, this is an expected consequence of modern combined L/K/Ds and the living and dining spaces will be very well daylit. In addition; this room sees 81% NSL, the bedroom of this unit sees well above the 1% ADF recommended for its usage. Overall we therefore conclude that the future occupants of this flat will have access to very good levels of light.

The second room falling slightly short of the levels of ADF recommended is also a generously sized L/K/D (room 8) within Flat 3. This room sees 1.7% ADF from its three large windows facing Grays Inn Road which given the size of the room is considered to be very good. This is above the 1.5% recommended for living rooms and so again we can conclude this to be a well daylit living area. In addition, both bedrooms of this two bedroom flat are excellently daylit and so overall we find this flat to perform very well in terms of daylight.

The final room seeing levels of light below recommended is room 6; the bedroom of a one bedroom flat. This bedroom is provided with a bay window but, as it looks out onto the entranceway, the room sees low levels of light. However in reviewing this it should be noted that the living room of this one bedroom flat is excellently daylit with 2.2% ADF and 91% NSL. In a one bedroom flat, low levels of light within the bedroom are considered to be more acceptable provided good levels of light can still be enjoyed within the living areas. As is shown in the following section, this living area also sees excellent levels of sunlight. Should increased levels of light in the bedroom be wished for this could only be achieved through sacrificing the levels of light within the living area to some extent. Overall it is considered preferential in one bedroom flats to have an excellently daylit living room and darker bedroom than a compromised living area and well daylit bedroom.

To conclude, of the 42 residential rooms proposed within the development, all but three on the first floor (93%) will see excellent levels of light. Of the three rooms falling technically short of recommendation, two are living areas which have been shown to in fact be acceptably daylit and the third is a bedroom within a one bedroom flat where occupants will be able to enjoy excellent levels of both daylight and sunlight in their living areas.

Overall therefore, the proposed scheme is considered to perform well in terms of daylight.

5.2. CONCLUSION ON SUNLIGHT

In order to ascertain the levels of sunlight within the proposed scheme, all living rooms facing within 90 degrees of due south have been assessed for APSH as recommended by BRE.

The results have shown that all rooms assessed will see well in excess of the levels of APSH recommended both throughout the year and during the winter months.

The scheme is therefore considered to perform excellently in terms of APSH and future occupants of these units will be able to enjoy excellent levels of sunlight throughout the year in their living rooms.

Figure 2: Top View

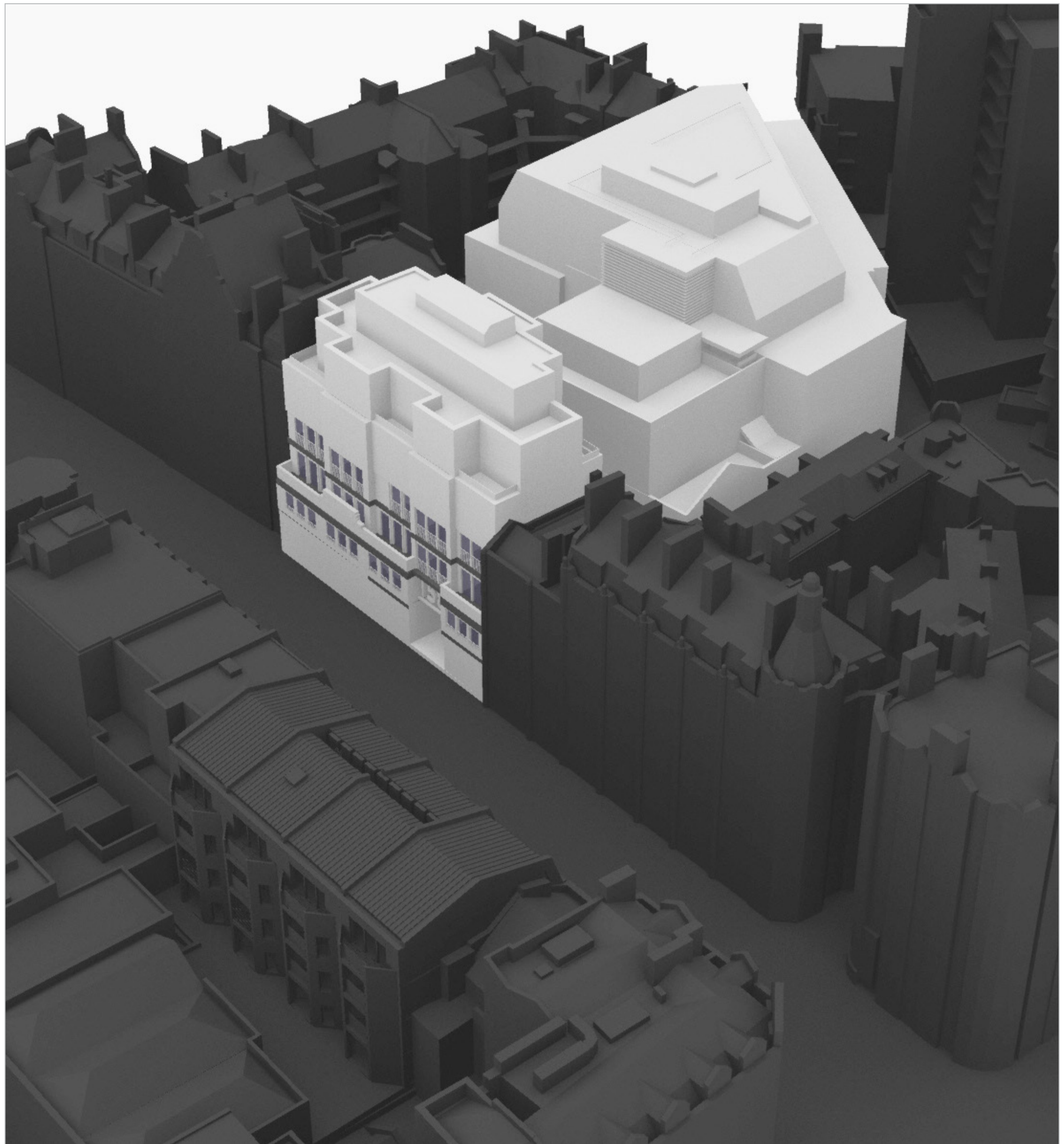


Figure 1: Perspective View

		Daylight Quantum	Distribution of Daylight	
Room Ref.	Room Use	ADF (%)	NSL (%)	RDC
First Floor				
1	Bedroom	1.3	80	Met
2	Bedroom	1.4	72	Met
3	L/K/D	1.4	81	N/A
4	Bedroom	2.7	100	Met
5	L/K/D	2.3	66	Met
6	Bedroom	0.1	22	Met
7	L/K/D	2.2	91	Met
8	L/K/D	1.7	67	Met
9	Bedroom	3.4	99	Met

Table 2: Assessment Data

Figure 3: Floor Plan

Room Ref.	Room Use	Daylight Quantum ADF (%)	Distribution of Daylight NSL (%)	RDC
Second Floor				
10	L/K/D	3.2	97	Met
11	Bedroom	1.7	85	Met
12	Bedroom	2.6	92	Met
13	Bedroom	5.2	100	Met
14	Bedroom	4.9	100	Met
15	L/K/D	2.5	92	N/A
16	L/K/D	2.4	100	Met
17	Bedroom	1.8	100	Met

Table 3: Assessment Data

Figure 4: Floor Plan

		Daylight Quantum	Distribution of Daylight	
Room Ref.	Room Use	ADF (%)	NSL (%)	RDC
Third Floor				
18	L/K/D	2.5	99	Met
19	Bedroom	3.2	98	Met
20	Bedroom	3.2	100	Met
21	Bedroom	3.2	100	Met
22	Bedroom	6.0	100	Met
23	Bedroom	5.5	100	Met
24	L/K/D	2.9	100	N/A
25	Bedroom	4.2	100	Met
26	L/K/D	2.9	100	Met

Table 4: Assessment Data

Figure 5: Floor Plan

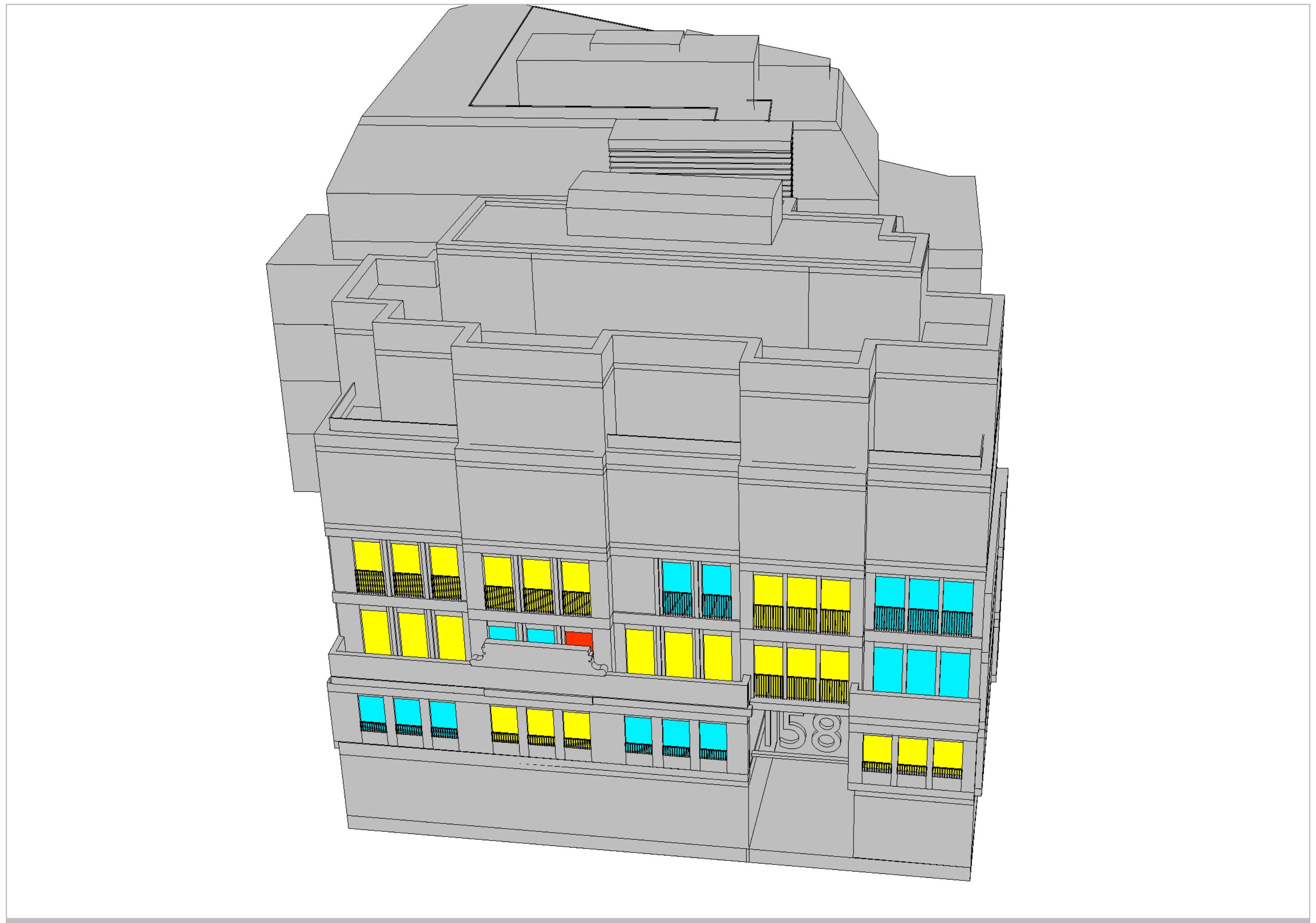


Figure 6: Annual Probable Sunlight Hours - Total

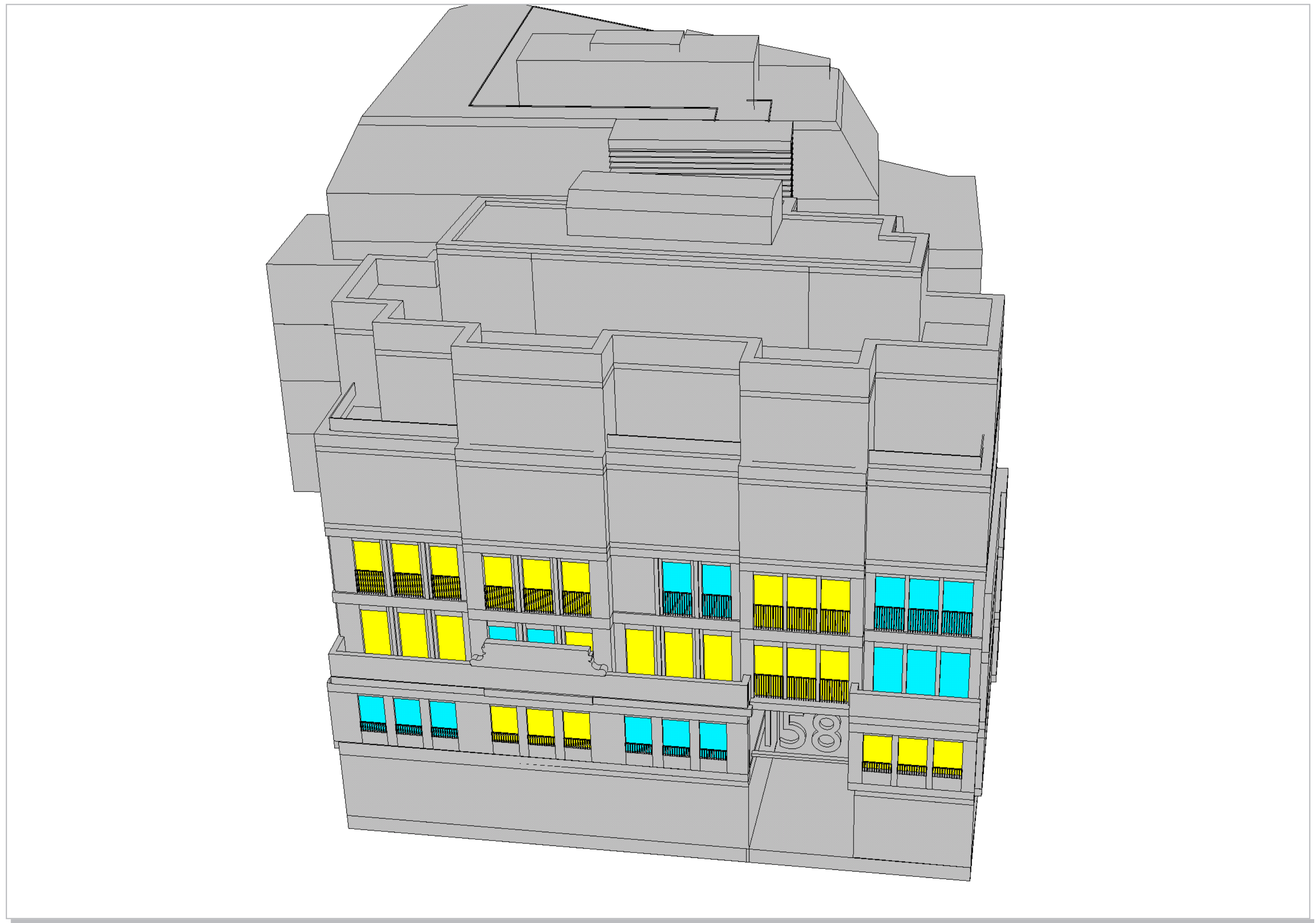
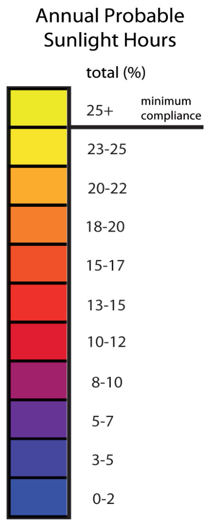
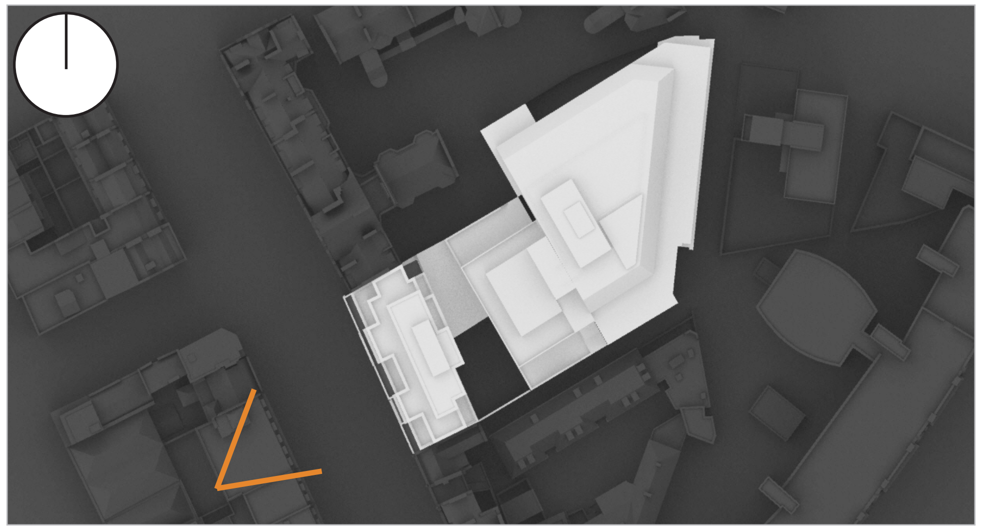
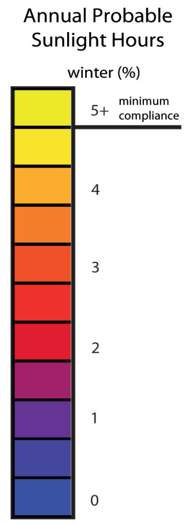


Figure 7: Annual Probable Sunlight Hours - Winter







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