150 HOLBORN
DAYLIGHT & SUNLIGHT AMENITY WITHIN THE SITE

DAH REAL ESTATES SARL

APRIL 2016

DARPLUS

gia

Client	DAH Real Estate sarl
Architect	PW
Project Title	150 - Holborn
Project Number	5538
Report Title	Internal Daylight and Sunlight Report
Dated	10 March 2016

Prepared by	JF
Checked by	ML
Type	Planning

Revisions		Date:	Notes:	Signed:
	--	--/--/--	--	--

1. EXECUTIVE SUMMARY

The purpose of this report is to ascertain whether the residential component of the proposed development at 150 Holborn will offer acceptable accommodation in terms of daylight and sunlight amenity.

The site faces the typical constraint of a central London location, namely the dense urban fabric which restricts the daylight and sunlight availability. Furthermore, the main aspect of the site is north-facing and therefore the sunlight availability is limited to the early morning and late afternoon in the summer.

In order to address these constraints, GIA has worked alongside the design team to optimise the daylight amenity and as a consequence most rooms achieve daylight levels in line with guidance, which is a remarkable result for a scheme located in such a densely built urban environment.

The rooms falling short of recommendation are either located on the lowest floors, where the obstruction caused by the surrounding buildings is greatest, or below balconies which reduce the sky visibility. The shortfalls are therefore a consequence either of the site's location or of the provision of private amenity areas.

With most rooms achieving good levels of daylight despite the restricted sky visibility, we believe the design of the proposed scheme has made the most of the daylight available and so the proposed accommodation will offer good daylight amenity.

Due to the main aspect of the site being north-facing, the results of the sunlight assessments show levels below those recommended, however these are a consequence of the site's orientation rather than of the design.

2. INTRODUCTION AND OBJECTIVE

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

- To create a 3D computer model of the proposal based upon drawings prepared by PW.
- Carry out a daylight assessment using the methodologies set out in the BRE guidelines for Average Daylight Factor, No-Sky Line and Room Depth Criterion.
- Carry out a sunlight assessment using the methodologies set out in the BRE guidelines for Annual Probable Sunlight Hours (APSH) to the fenestration facing within 90 degrees of due south.
- 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 last 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".*

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 PW. 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 light veneer has been assumed for the reflectance value of the internal and balconies floor.

Reflectance values:	
Surrounding	0.2
Pavement	0.2
Grass	0.1
Water	0.1
Yellow brick	0.3
Red brick	0.2
Portland Stone	0.6
Concrete	0.4
Internal walls (light grey)	0.68
Internal ceiling (white paint)	0.85
Internal floor (medium veneer)	0.3
Internal floor (light veneer)	0.4
Transmittance values:	
Triple glazing:	
Pilkington K Glass 4/12/4/12/4 Argon filled 90%	Tv= 0.63
Double glazing:	
Pilkington K Glass 4/16/4 Argon filled 90%	Tv= 0.75
Single glazing:	
Pilkington Optifloat Clear, Annealed, 4mm	Tv=0.90
Translucent glazing:	
Pilkington Optifloat Opal - 4mm K /16/4mm Opal	Tv= 0.74

Maintenance factors:	**Tv(normal)**	**A.3**	**A.4**	**A.5**	**A.6**	**Tv(total)**
Triple Low-E (frames modelled)	0.63	8	1	1	1	0.58
Triple Low-E (frames not modelled)	0.63	8	1	1	0.8	0.46
Triple Low-E (inclined, frames modelled)	0.63	8	2	1	1	0.53
Triple Low-E (inclined, frames not modelled)	0.63	8	2	1	0.8	0.42
Triple Low-E (horizontal, frames modelled)	0.63	8	3	1	1	0.48
Triple Low-E (horizontal, frames not modelled)	0.63	8	3	1	0.8	0.38
Double Low-E (frames modelled)	0.75	8	1	1	1	0.69
Double Low-E (frames not modelled)	0.75	8	1	1	0.8	0.55
Double Low-E (inclined, frames modelled)	0.75	8	2	1	1	0.63
Double Low-E (inclined, frames not modelled)	0.75	8	2	1	0.8	0.50
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
Single (frames modelled)	0.9	8	1	1	1	0.83
Single (frames not modelled)	0.9	8	1	1	0.8	0.66
Single (inclined, frames modelled)	0.9	8	2	1	1	0.76
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
Single (horizontal, frames not modelled)	0.9	8	3	1	0.8	0.55
Double Translucent Low-E (frames modelled)	0.74	8	1	1	1	0.68
Double Translucent Low-E (frames not modelled)	0.74	8	1	1	0.8	0.54
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
Double Translucent Low-E (horizontal, frames modelled)	0.74	8	3	1	1	0.56
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

The site faces the constraint that is typical of a central London location, namely the dense urban fabric which restricts the daylight and sunlight availability. In order to address this constraint, GIA has worked alongside the design team to optimise the daylight and sunlight amenity. This has resulted in:

- Internal layouts optimised for uniform daylight distribution and for maximum daylight ingress within the living areas, where daylight is regarded as more important;
- Aperture sizes and locations designed according to the room usage and daylight availability on the facades;
- The use of a light finish for the internal and balcony floors in order to maximise the interreflection of light;
- The use of folding external shutters rather than sliding screens. Future occupants will be able to regulate the shutters according to their needs of privacy, outlook and daylight and sunlight and, when folded back, the shutters will allow for maximum daylight ingress whilst sliding screens would have obscured part of the windows at all times.

5.1. CONCLUSION ON DAYLIGHT

All habitable rooms within the residential element of the scheme have been technically assessed for Average Daylight Factor (ADF), No Sky Line (NSL) and Room Depth Criterion (RDC).

The results show that the daylight amenity has been optimised given the constraints inherent to the site's location and most rooms achieve daylight levels in line with guidance.

Where possible, living areas have been designed as dual aspect in order to allow for maximum daylight ingress. As a result, only four living areas located on the lowest floors, where the obstruction caused by the surrounding buildings is greatest, see ADF levels lower than those suggested by BRE. These are one living room and one L/K/D at first floor, which has been provided with a winter garden for future occupants to enjoy good levels of daylight in their private amenity space throughout the year, and one living room and one L/K/D at the second floor, which both still see an ADF level greater than that recommended for bedrooms. All these living areas are located within units where the bedrooms will achieve good levels of daylight and therefore the flats overall are considered to offer adequate daylight.

The levels of NSL are lower than BRE's recommendation in the majority of the rooms on the four lowest floors with the exception of the dual aspect living areas and bedrooms no. 9, 16, 20 and 23, where the outside walls are fully glazed. Such levels of sky visibility are typically seen within the dense urban grain of central London but PW's design has taken this constraint into account and strived to achieve good levels of daylight indoors as measured by the ADF. All rooms have been designed with good proportions for optimal daylight distribution, as is demonstrated by the RDC being met in all rooms where it is applicable.

Overall therefore, we believe the design of the proposed scheme has made the most of the daylight available on site and so the proposed accommodation will offer good daylight amenity, which is a remarkable result for a building located within such a dense urban environment.

5.2. CONCLUSION ON SUNLIGHT

The BRE guidance states that sunlight is most appreciated in living areas and the greatest expectation of sunlight is in south facing rooms, therefore an assessment of Annual Probable Sunlight Hours (APSH) should be undertaken on all main windows serving living areas facing within 90 degrees of due south.

Due to the orientation of the site, the main aspect of the residential element of the scheme is north-facing and therefore the main windows serving living areas fall outside the scope of the APSH assessment and the expectation of sunlight will be limited. The west and east-facing secondary windows, instead, have been assessed. Whilst technically falling within the scope of the assessments, these windows are expected to have limited sunlight potential due to their orientation which means they will receive direct sunlight either in the early morning or in the late afternoon only during the summer months. As expected therefore, the results of the assessments show levels of APSH lower than those suggested.

Balconies further reduce the amount of sunlight reaching the windows located below and behind them by acting as shading devices in the summer. The balconies' balustrades have also been assessed to show that future occupants will be able to enjoy sunlight through the use of their private amenity spaces during the summer months.

In conclusion, the sunlight availability to the proposed scheme, whilst technically falling short of recommendation, is in line with expectation for a north-facing site.

5538 - 150 - Holborn Site

Overview

Figure 1: Top View

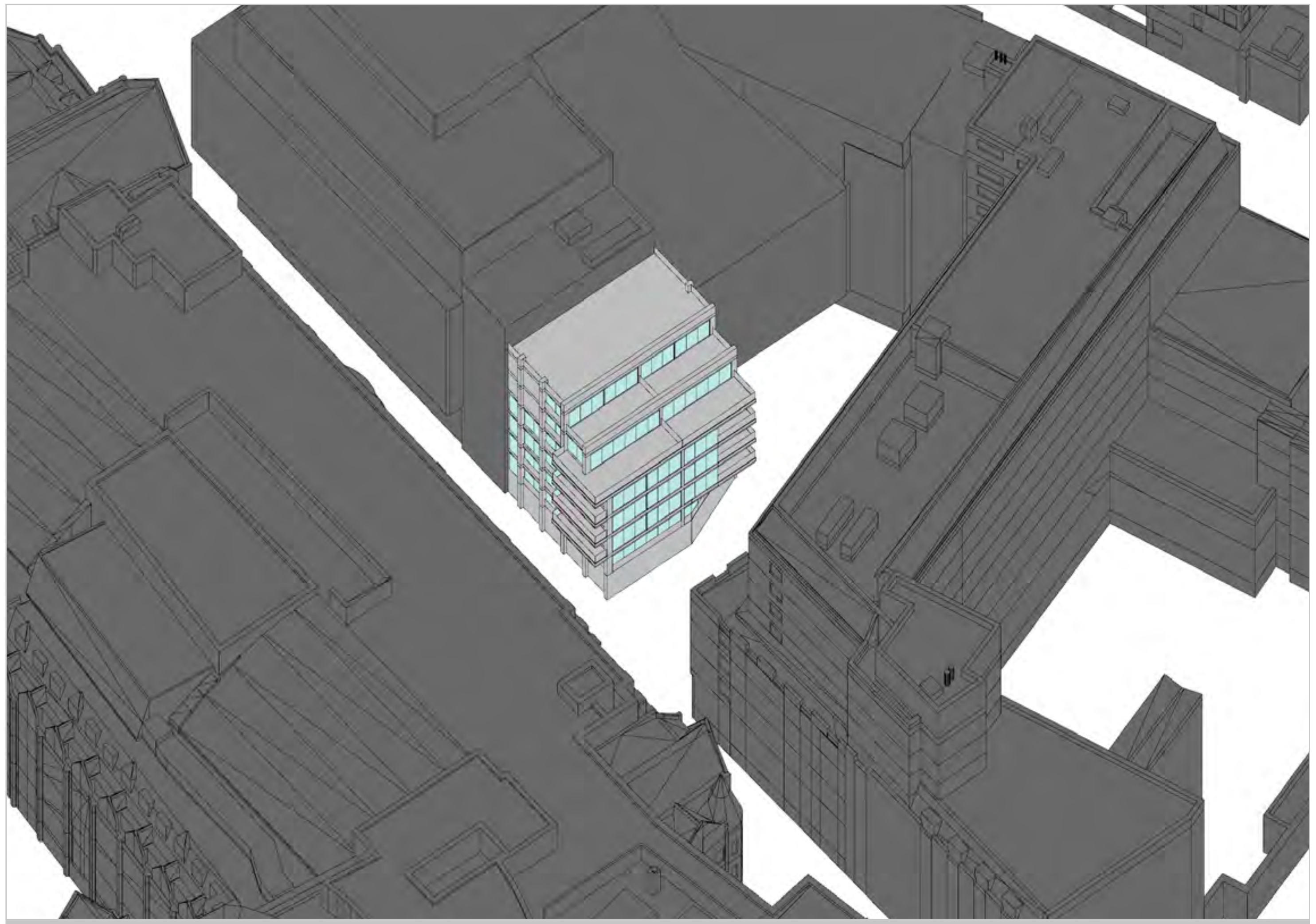


Figure 2: Perspective View

		Daylight Quantum	Distribution of Daylight	
Room Ref.	Room Use	ADF (%)	NSL (%)	RDC
First Floor				
0	Bedroom	1.2	44	Met
1	Bedroom	1.1	25	N/A
2	Living Room	0.9	21	Met
3	L/K/D	1.9	95	N/A
4	Bedroom	1.3	36	Met
5	Bedroom	1.2	26	Met

Table 2: Assessment Data

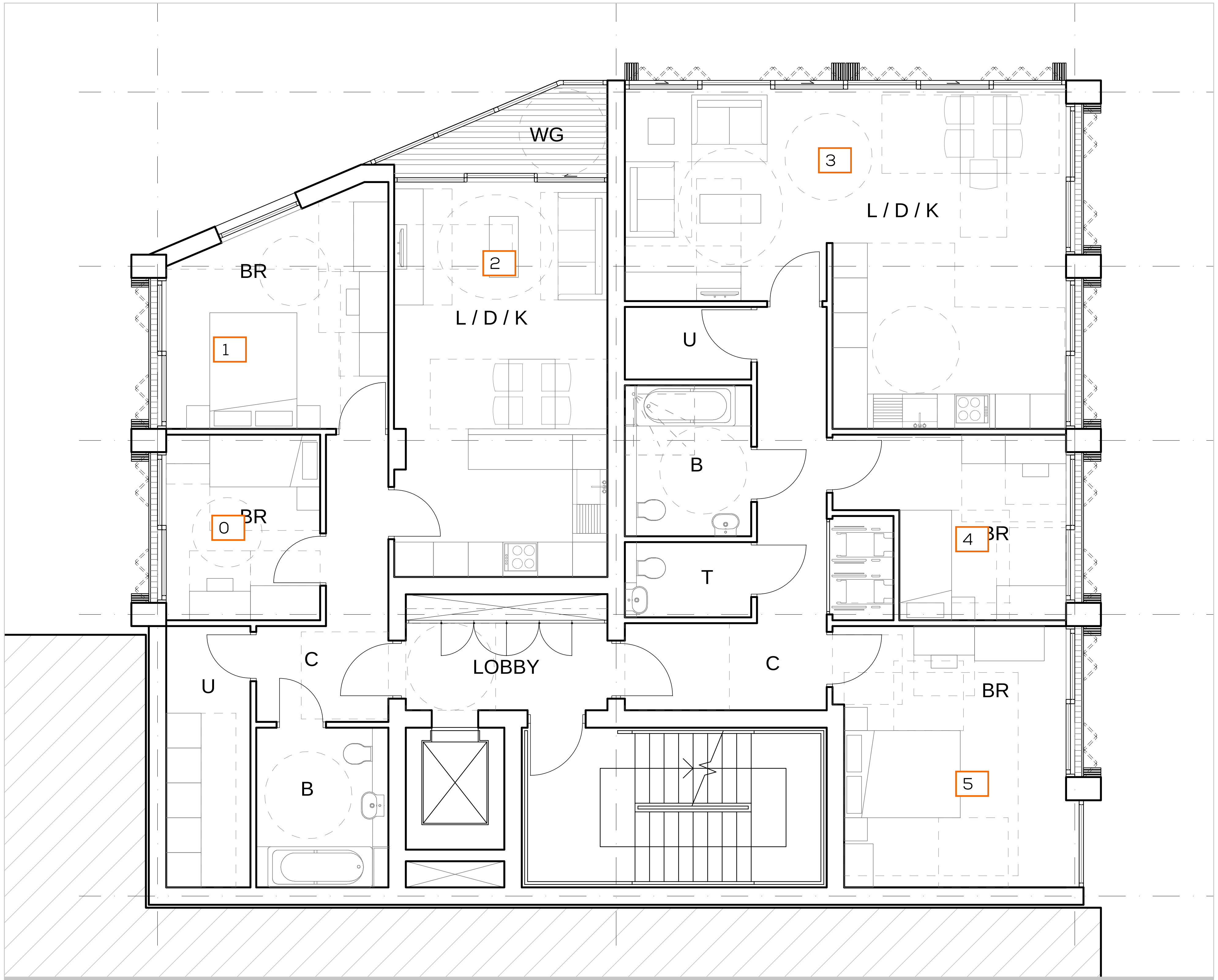


Figure 3: Floor Plan

		Daylight Quantum	Distribution of Daylight	
Room Ref.	Room Use	ADF (%)	NSL (%)	RDC
Second Floor				
6	Bedroom	1.4	54	Met
7	Bedroom	1.2	33	N/A
8	Living Room	1.4	44	N/A
9	Bedroom	2.8	94	Met
10	L/K/D	2.0	100	N/A
11	Bedroom	1.7	37	Met
12	L/K/D	1.6	30	Met

Table 3: Assessment Data

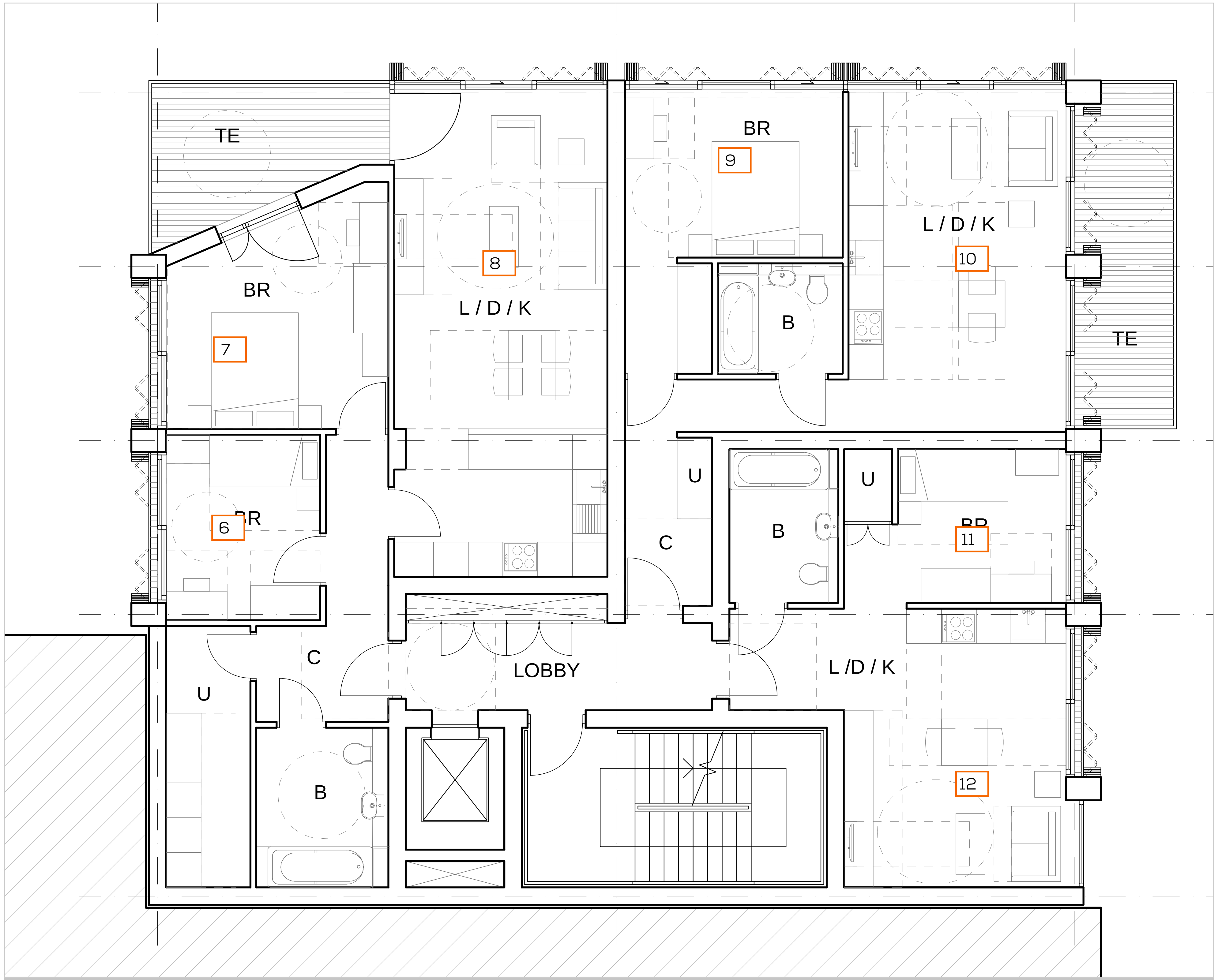


Figure 4: Floor Plan

		Daylight Quantum	Distribution of Daylight	
Room Ref.	Room Use	ADF (%)	NSL (%)	RDC
Third Floor				
13	Bedroom	2.0	66	Met
14	Bedroom	1.6	40	N/A
15	Living Room	1.7	57	N/A
16	Bedroom	3.5	96	Met
17	L/K/D	2.5	100	N/A
18	Bedroom	2.3	47	Met
19	L/K/D	2.1	39	Met

Table 4: Assessment Data

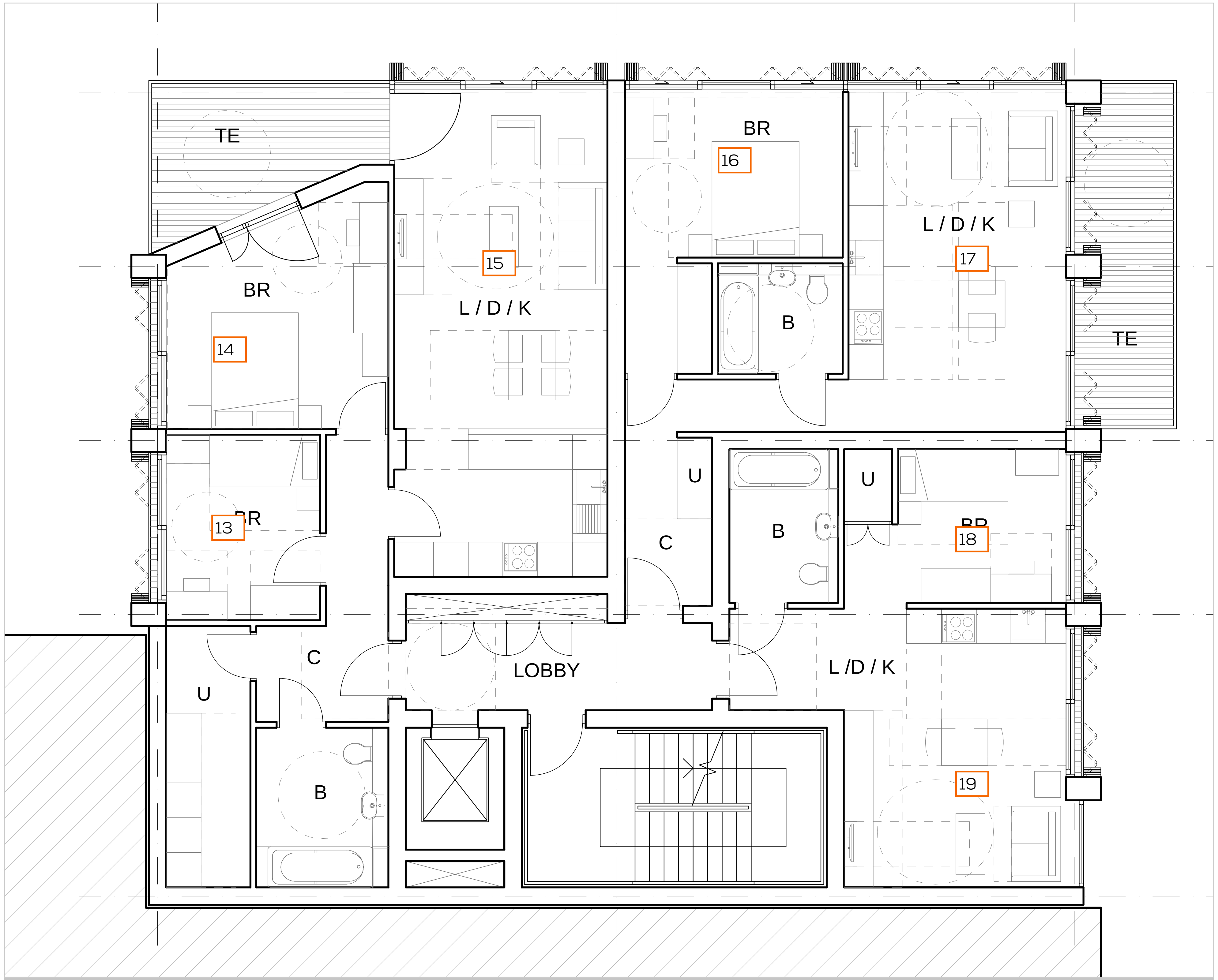


Figure 5: Floor Plan

Sources of information:
IR34, 37, 38
Rel_21_5538_DSD

Issue No: IS3-5538
Page No: 12
Date: 10 March 2016

Room Ref.	Room Use	Daylight Quantum ADF (%)	Distribution of Daylight NSL (%)	RDC
Fourth Floor				
20	Bedroom	2.6	88	Met
21	Bedroom	2.0	55	N/A
22	Living Room	1.8	70	N/A
23	Bedroom	3.8	97	Met
24	L/K/D	2.9	100	N/A
25	Bedroom	3.0	79	Met
26	L/K/D	2.7	53	Met

Table 5: Assessment Data

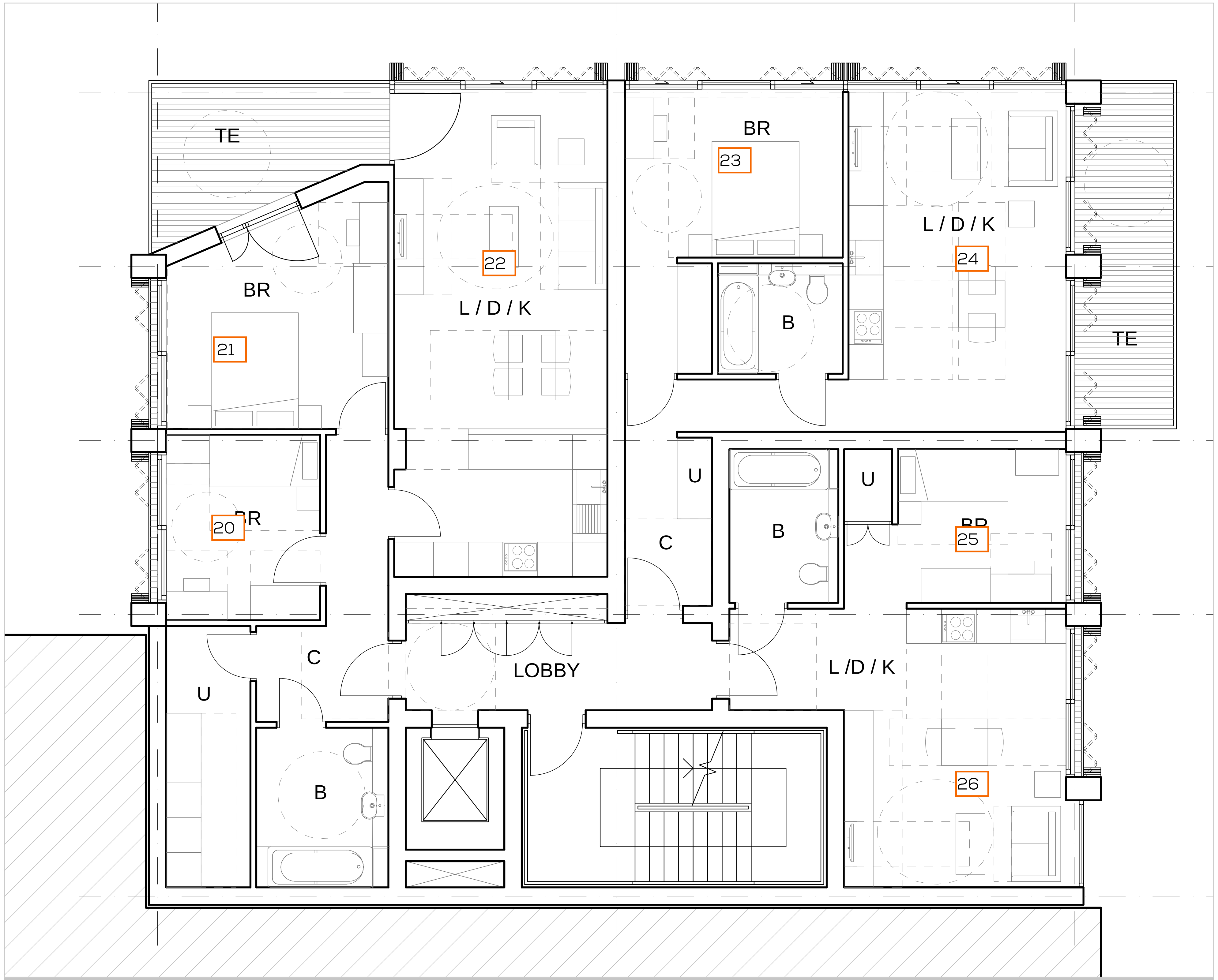


Figure 6: Floor Plan

		Daylight Quantum	Distribution of Daylight	
Room Ref.	Room Use	ADF (%)	NSL (%)	RDC
Fifth Floor				
27	Bedroom	3.6	100	Met
28	L/K/D	5.7	88	N/A
29	L/K/D	6.8	100	N/A
30	Bedroom	3.4	92	Met

Table 6: Assessment Data

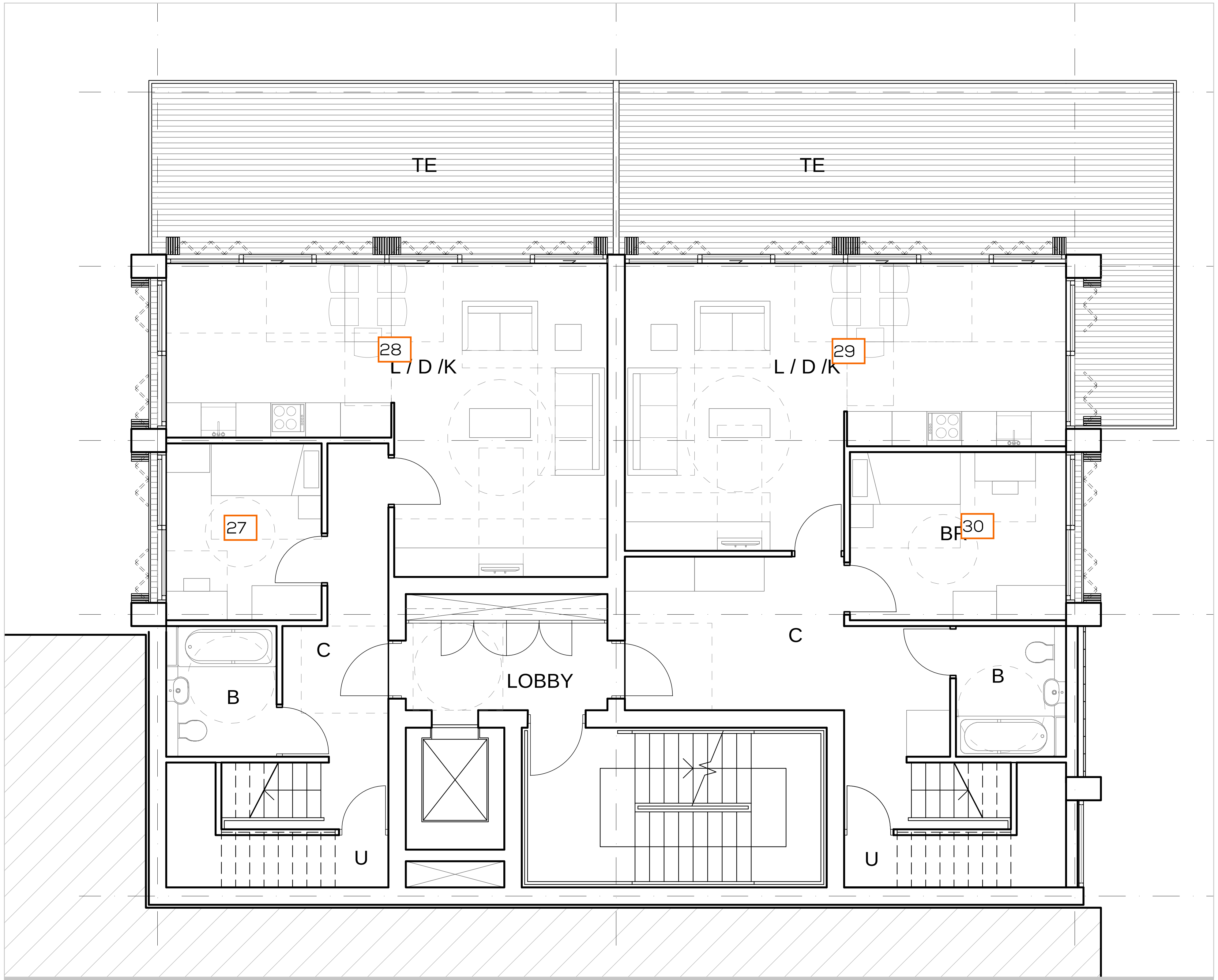


Figure 7: Floor Plan

Sources of information:
IR34, 37, 38
Rel_21_5538_DSD

Issue No: IS3-5538
Page No: 14
Date: 10 March 2016

Room Ref.	Room Use	Daylight Quantum ADF (%)	Distribution of Daylight NSL (%)	RDC
Sixth Floor				
31	Bedroom	4.8	97	Met
32	Bedroom	4.5	91	Met
33	Bedroom	9.0	100	N/A
34	Bedroom	10.9	100	N/A

Table 7: Assessment Data

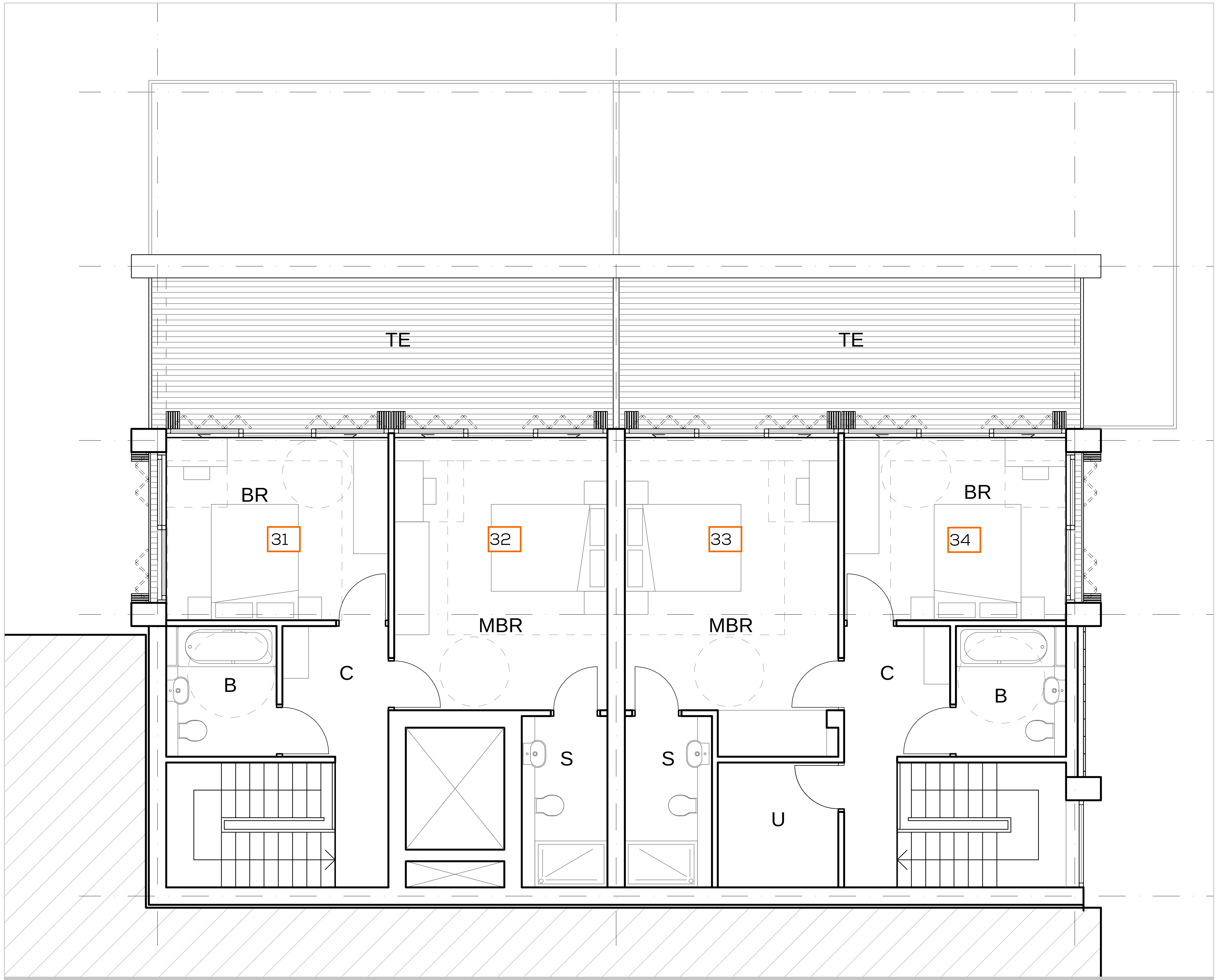


Figure 8: Floor Plan

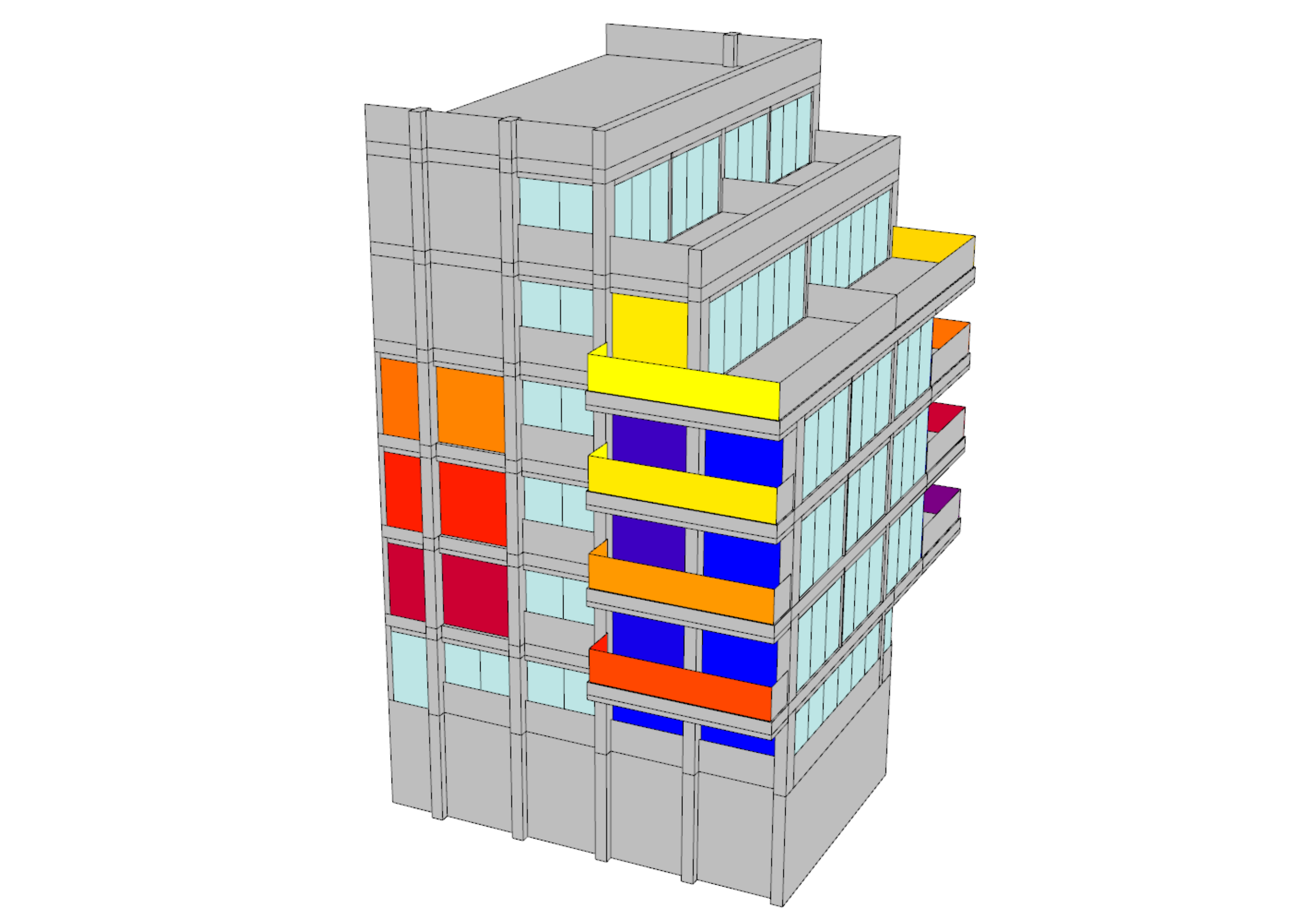


Figure 9: Annual Probable Sunlight Hours - Total

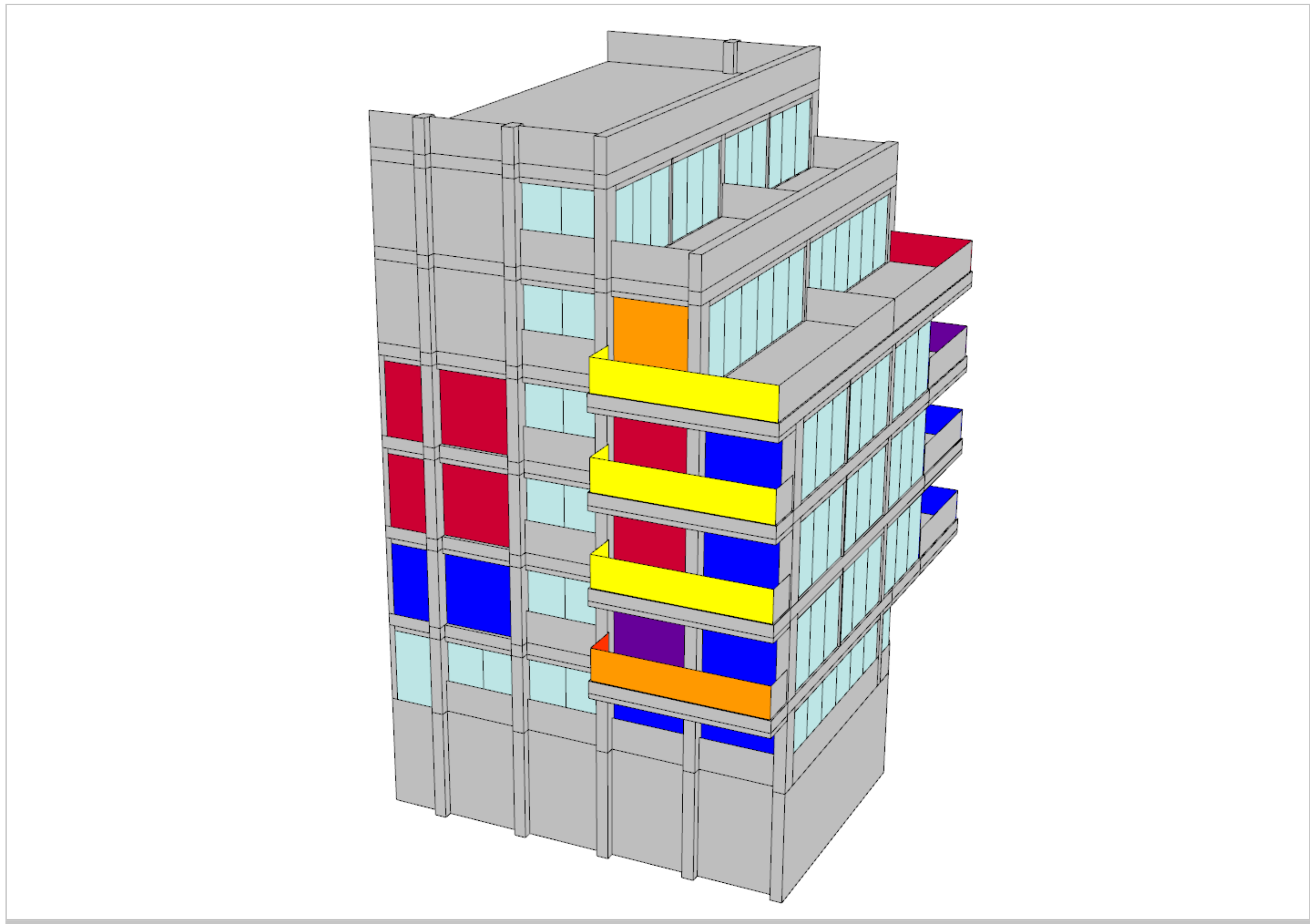
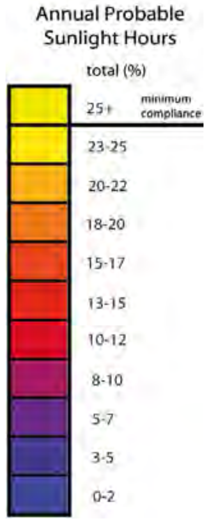
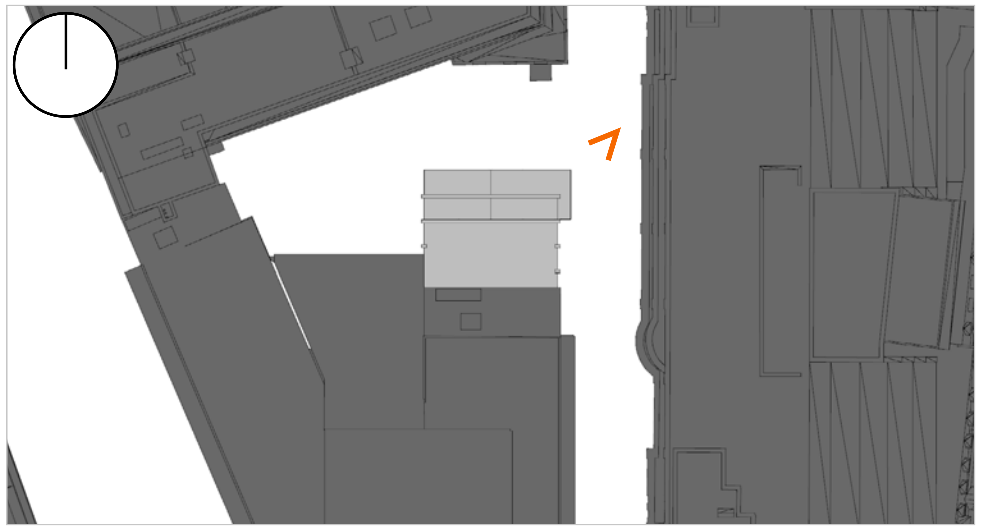
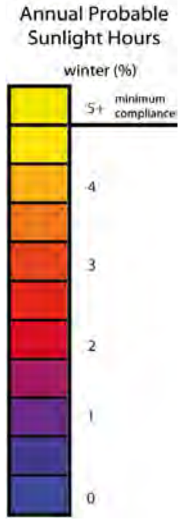


Figure 10: Annual Probable Sunlight Hours - Winter







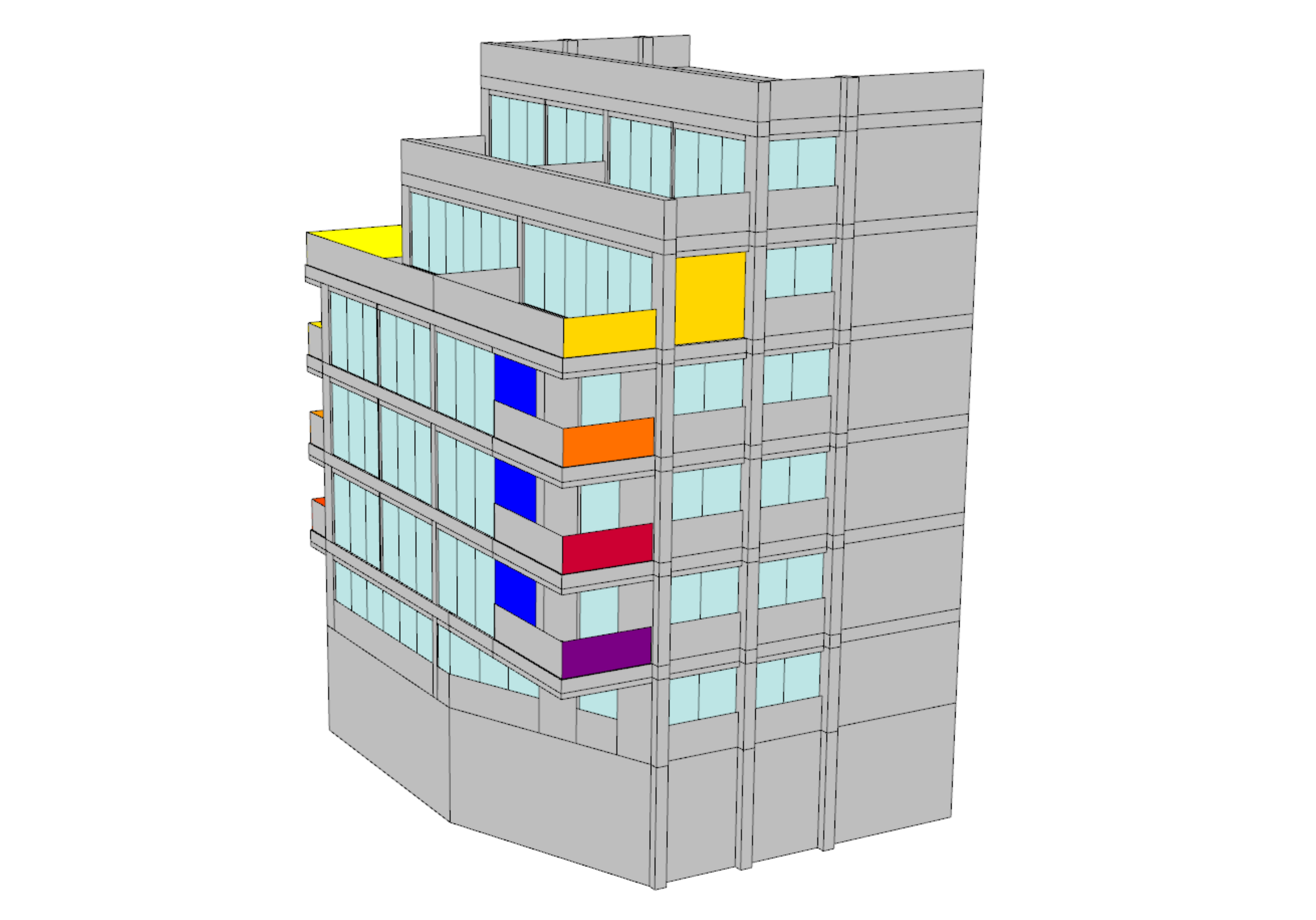


Figure 11: Annual Probable Sunlight Hours - Total

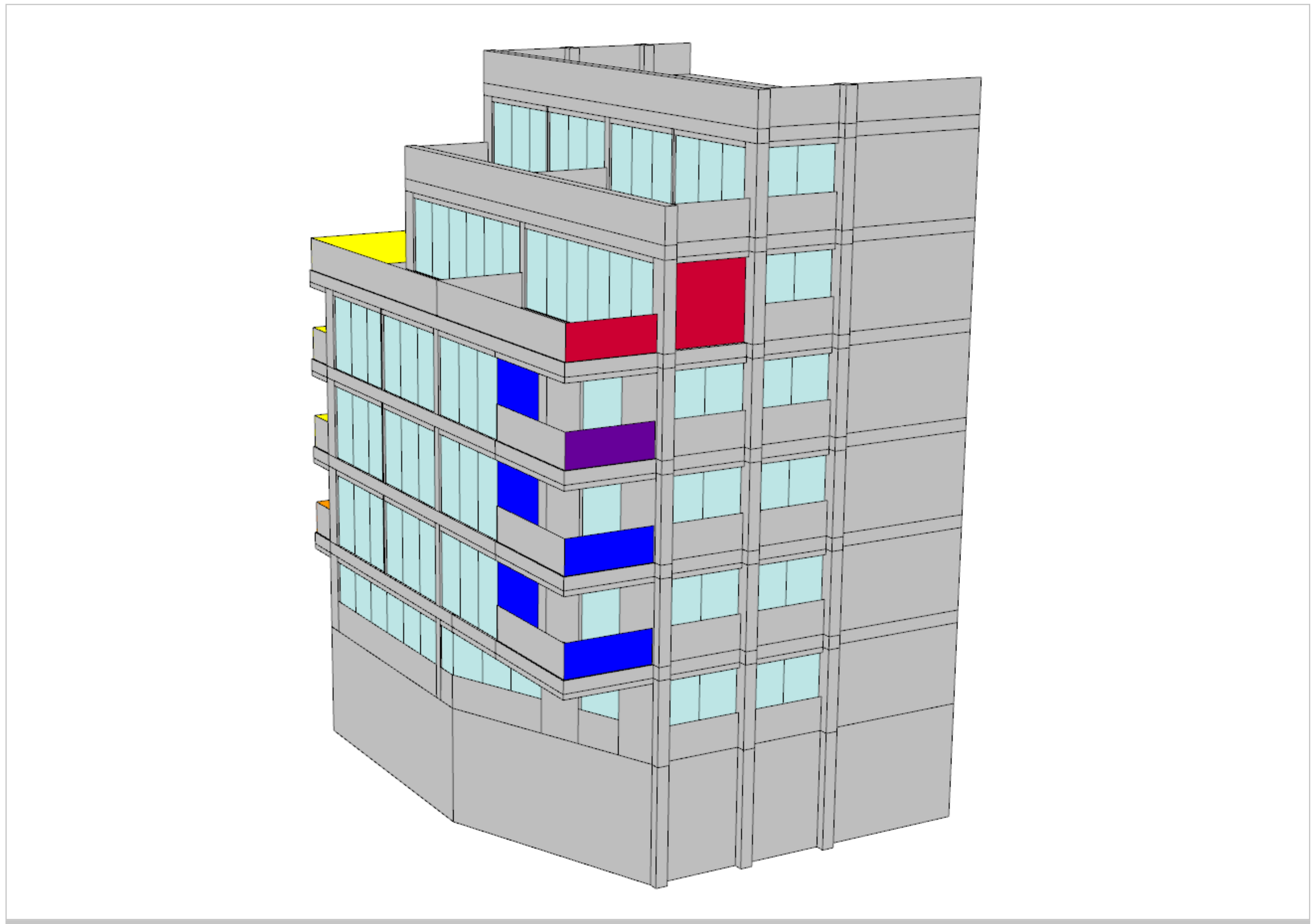


Figure 12: Annual Probable Sunlight Hours - Winter