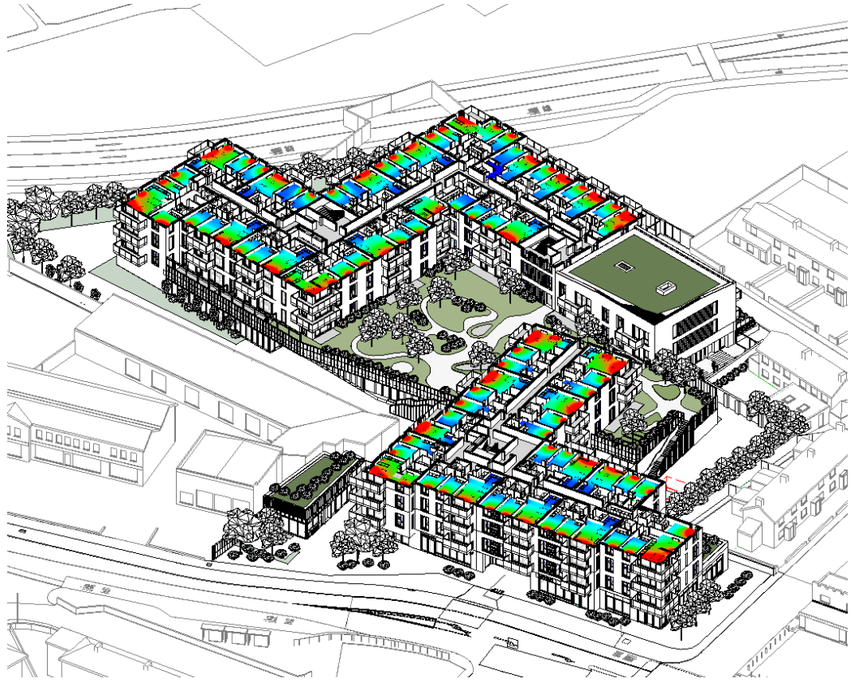
Castle Street Residential



Daylight & Sunlight Analysis

IN2 Project No. D2101

14/04/2022

Planning Issue

Revision History

Date	Revision	Description
07/04/2022	00	Issued for Planning
14/04/2022	01	Revised to reflect comments

Registered Office: Unit E, Mount Pleasant Business Park, Upper Mount Pleasant Avenue, Dublin 6

Company Registration No.: 466565

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1.0 Executive Summary

The report has been prepared as a desktop exercise with 3D massing and survey information provided by others. No site visits took place as information provided included all relevant required information and our understanding is that any survey information or 3D models provided were carried out by relevant suitably qualified professionals.

Various software programs were utilised in the analysis of the proposed development. These included:

- Radiance Lighting Software
- TAS by EDSL

Section 4.0 introduces the various Guidelines and Standards utilised throughout the Daylight / Sunlight analysis undertaken. The specific methodology for each topic (as relevant) is detailed in the relevant section in the body of this report as identified.

Analysis Type	**Relevance**	**Assessment Methodology**	**Compliance Guidelines Targets**	**Reference section of this report**
Daylight	Proposed Development	Average Daylight Factors	BRE 209	Section 7.0 – Internal Daylight Analysis
Daylight	Existing Neighbouring Buildings	Vertical Sky Component	BRE 209	Section 5.0 – Impact on Neighbouring Buildings
Sunlight	Proposed Development	Compliance with dual aspect requirements	2020 Apartment Guidelines	Not covered in this report. Refer to Architectural documentation.
Sunlight	Existing Neighbouring Buildings	Annual Probable Sunlight Hours	BRE 209	Section 5.0 – Impact on Neighbouring Buildings
Sunlight	Proposed Development Amenity Spaces	Sunlight Hours	BRE 209	Section 6.0 – Site Sunlighting and Shading
Sunlight	Existing Neighbouring Buildings Amenity Spaces	Sunlight Hours	BER 209	Section 5.0 – Impact on Neighbouring Buildings

This report provides a full assessment of the daylight and sunlight availability for the proposed development at Castle Street.

The report summarises the analysis undertaken, and conclusions determined for the proposed arrangements.

The impact on neighbouring building is assessed in detail in section 5.0. The analysis determined that one space is marginally impacted by the proposed development for VSC. However, it is noted that this is a bedroom at ground floor which will still avail of excellent daylight availability.

Section 6.0 illustrates the results from the amenity sunlight analysis as undertaken based on the BRE best practice for garden amenities. The proposed first-floor podium amenity space was found to receive excellent sunlight availability with 99% of the amenity space receiving more than two hours of daylight on March 21st significantly more than the BRE minimum of 50%. Due to proposed massing and orientation, the overall amenity space was found to receive a sunlight availability of 78% well in excess of the BRE 50% guideline.

The internal daylight analysis, as detailed in section 7.0, has been undertaken for all units across the development. The analysis determined that 99% of rooms were in excess of the prescribed BRE/BS guidelines as set out within this report, for average daylight factors (ADF). This extent of compliance was achieved through design development, with increased glazing/ reduced balcony depths / balcony locations etc. applied to ensure the residences can benefit from maximised daylight availability.

The 2020 apartment guidelines advise that "*Where an applicant cannot fully meet all of the requirements of the daylight provisions above(...BR 209…), this must be clearly identified and a rationale for any alternative, compensatory design solutions must be set out, which planning authorities should apply their discretion in accepting taking account of its assessment",* therefore section 7.0 identifies these alternative, compensatory solutions.

We note the BRE guide should be seen as advisory only as the guide was developed for low density urban housing, and was developed to inform design rather than to constrain it. Although the guide provides numerical guidelines, these should be interpreted flexibly since natural lighting is only one of many factors in site layout design.

Whilst it should be noted that the current applicable guideline for calculation of daylight is the BRE'S BR 209, a comparative analysis has also been provided in Appendix A. This compares results under BR 209, BS EN.17037 and IS EN.17037, as defined in the standards and guidelines section of this report. This analysis determined generally good correlation between BR 209 and BS EN17037, which are both relevant for residential application. Unlike these documents, IS EN17037 does not provide specific guidance for residential application and is therefore more suited to commercial application.

Additionally, a set of shadow diagrams have been provided, however it can be noted that these images can be subjective so please refer to section 5.0 for quantitative assessment of sunlight impacts.

In summary, the scheme has been designed and developed to address the issues of daylight and sunlight and is presented as majority compliance. Areas not meeting compliance have been identified and compensatory measures or justification within wider context of the application, have been included within design team reports as relevant.

2.0 Project description

Silverbow Limited, intend to apply to An Bord Pleanála for permission for a strategic housing development at the former Heiton Buckley site on Castle Street; St. Anthony's Dwyer Park and No. 20 Dwyer Park, Bray, Co. Wicklow (Eircodes A98 V973, A9 XW31 and A98 YC44).

1. The proposed Strategic Housing Development will consist of the following:-
2. Demolition of all existing vacant commercial and residential buildings and sections of boundary wall;
3. Construction of a mixed-use residential and commercial development in 2 blocks ranging in height from 1 to 7 storeys set around a central podium level amenity space and a separate single storey pavilion building;
4. The residential element will accommodate 139 no. apartments comprising 33 no. 1-bedroom units, 91 no. 2-bedroom units and 15 no. 3-bedroom units, with associated balconies;
5. Block A (3-7 storeys) will accommodate 93 no. apartments and a creche at ground floor;
6. Block B (1-6 storeys) will accommodate 46 no. apartments, 2 no. commercial units fronting Castle Street and a communal resident's room;
7. The pavilion building will accommodate a community facility on Castle Street;
8. Vehicular access from Castle Street to 59 no. undercroft car parking spaces and 3 no. creche drop-off spaces;
9. Pedestrian access from Castle Street and Dwyer Park;
10. New surface water sewer along Castle Street from the site to Bray Bridge;
11. The development will include landscaped communal open spaces, boundary treatments, substation, plant rooms, bin stores, bicycle parking, signage and all associated site works and services.

3.0 Glossary :

Working Plane

The working plane is the notional plane where visual tasks and on which predicted light levels would normally be undertaken. For a residential assessment, the working plane is defined by BR209 and EN 17037 at 850mm above floor level.

Daylight Factor

The Daylight Factor (DF) is the ratio of the illuminance at a point on a working plane in a room, due to the combination of light received directly and indirectly from a sky, over the illuminance on an external horizontal plane based on an unobstructed sky. Daylight factor, as defined here, excludes the contribution of direct sunlight. The sky utilised for ADF and MDF assessments, as defined below, is the (theoretical) CIE Overcast Sky, which is unidirectional, therefore a north facing window is assumed to receive the same light as south etc.

Average Daylight Factor

Average Daylight Factor, also referred to as ADF, is a measure of daylight availability to a room based on the average values of multiple calculation points at the working plane within a space. ADF was utilised in BS.8206-2 standard, inferred also in BR.209, where it is used for daylight assessment of proposed developments (with impact on existing utilising VSC/ NSL as defined below).

Median Daylight Factor

Median Daylight Factor, also referred to as MDF, is a measure of daylight availability to a room based on the median daylight value, i.e., the value that is achieved for at least 50% of the space (50% of the calculation points on the working plane). MDF is calculated for compliance with EN 17037 Method 1.

Climate Based Daylight Assessment

Climate based daylight assessments, also referred to as CBD, involves the use of a detailed daylight calculation methods where hourly (or sub-hourly) internal daylight illuminance values for a typical year are computed using hourly (or sub-hourly) sky and sun conditions derived from climate data appropriate to the site. Unlike the DF methodology, CBD assessments are therefore orientation dependent: i.e. a south facing window would be expected to receive more daylight than north facing etc.

This calculation method determines daylight provision directly from simulated illuminance values on the working plane with results determined in lux (a measure of light). CBD is calculated for compliance with EN 17037 Method 2.

Probable Sunlight Hours

Annual probable sunlight hours and winter probable sunlight hours, also referred to as APSH and WPSH, are used for the assessment of impact on neighbouring buildings by a proposed development. APSH and WPSH are a measure of probable direct sunlight to a window or surface and therefore are only relevant to windows within 90 degrees of south for buildings in the northern hemisphere. Therefore, any window with a northerly aspect (i.e. orientated between North and East and North and West) is therefore not assessed within the methodology.

Vertical Sky Component

Vertical Sky Component, also referred to as VSC, is used for the assessment of impact on neighbouring buildings by a proposed development with respect to daylight availability. VSC is a measure of the percentage of illuminance that a point can receive from the CIE Overcast Sky as percentage of that received at unobstructed horizontal locations. In simple terms, how much of the sky that can be seen for a given point. VSC assessments do not included reflected light. VSC is calculated for compliance with BR209 as detailed below.

No Sky Line

No sky line, also referred to as NSL, is used to assess the internal impact on neighbouring buildings by a proposed building when VSC assessment of the external façade determined further calculation is required. They can only be carried out where internal layouts of existing buildings are known, but do not require knowledge of internal room surface reflectance's.

No sky line is the delineation on the working plane between where the sky can and cannot be seen due to obstructions, such as walls, window reveals, external buildings. No sky line assessments do not include reflected light in terms of assessment of existing buildings. No sky line is calculated for compliance with BR209 as detailed below.

Amenity Sunlight

Amenity sunlight is a measure of direct daylight received on an area over the duration of 21st March based on the sun's solar position for a geographical location. As the 21st March is the solar equinox, the sun is at its mid- point of travel position through the year, therefore representing an average condition throughout the year of how well sunlit an amenity space will be. It may be noted that in the Northern Hemisphere, the sun rises due east and sets due west. Amenity sunlight is calculated for compliance with BR209 as detailed below.

4.0 Standards and Guidelines

The following standards and guidance documents have been consulted when compiling this report to ensure compliance with the various Daylight and Sunlight requirements as applicable and relevant:

a) Sustainable Urban Housing: Design Standards for New Apartments (December 2020) (the **"2020 Apartment Guidelines").** These are guidelines issued under section 28 of the 2000 Planning and Development Act.

b) The Building Research Establishment's (BRE) Site Layout Planning for Daylight and Sunlight: A guide to good practice (BRE 209) (2nd edition) (the **"BRE Guide").**

c) British Standard BS 8206-2:2008 – "Lighting for Buildings – Part 2: Code of Practice for Daylighting" (the "**2008 British Standard**").

d) British Standard BS EN 17037:2018 – Daylight in Buildings (the "**2018 British EN Standard**").

e) Irish Standard IS EN 17037:2018 (the "**2018 Irish EN Standard**").

It should be noted at the outset that the 2008 British Standard has been superseded by the 2018 British Standard. This is the UK implementation of EN 17037:2018, which was approved by the CEN on 29 July 2018. In Ireland, EN 17037:2018 has been implemented by the 2018 Irish Standard. The texts of the 2018 British Standard and the 2018 Irish Standard are the same, with one exception. The exception is that the 2018 British Standard contains an additional "National Annex" which specifically sets out requirements within dwellings, to ensure some similarity to the now superseded 2008 British Standard.

The 2020 Apartment Guidelines state:

"[6.5] The provision of acceptable levels of natural light in new apartment developments is an important planning consideration as it contributes to the liveability and amenity enjoyed by apartment residents. In assessing development proposals, planning authorities must however weigh up the overall quality of the design and layout of the scheme and the measures proposed to maximise daylight provision with the location of the site and the need to ensure an appropriate scale of urban residential development.

[6.6] Planning authorities should have regard to quantitative performance approaches to daylight provision outlined in guides like the BRE guide 'Site Layout Planning for Daylight and Sunlight' (2nd edition) or BS 8206-2:2008 – 'Lighting for Buildings – Part 2: Code of Practice for Daylighting' when undertaken by development proposers which offer the capability to satisfy minimum standards of daylight provision.

[6.7] Where an applicant cannot fully meet all of the requirements of the daylight provisions above, this must be clearly identified and a rationale for any alternative, compensatory design solutions must be set out, which planning authorities should apply their discretion in accepting taking account of its assessment of specific. This may arise due to a design constraints associated with the site or location and the balancing of that assessment against the desirability of achieving wider planning objectives. Such objectives might include securing comprehensive urban regeneration and or an effective urban design and streetscape solution."

It can be noted from this section that the 2020 Apartment Guidelines continue to refer to the BRE Guide (published in 2011) and to the 2008 British Standard. They do not take into account of the 2018 British Standard and/or the 2018 Irish Standard and as the BRE Guide is still current and applicable, the 2011 edition will therefore provide the basis for the assessments detailed within this report.

The BRE Guide

The BRE Guide describes its purpose in the following terms in the "Summary" section (v):

> *"This guide gives advice on site layout planning to achieve good sunlighting and daylighting both within buildings and in the open spaces between them. It is intended to be used in conjunction with the interior daylight recommendations in the [2008] British Standard… It contains guidance on site layout to provide good natural lighting within a new development; safeguarding of daylight and sunlight within existing buildings nearby; and the protection of daylighting of adjoining land for future development."*

The BRE Guide also notes that:

> *"It (the guide) is purely advisory and the numerical target values within it may be varied to meet the needs of the development and its location. Appendix F explains how this can be done in a logical way, while retaining consistency with the British Standard recommendations on interior daylighting."*

> *"The guide is intended for building designers and their clients, consultants and planning officials. The advice given here is not mandatory and the guide should not be seen as an instrument of planning policy; its aim is to help rather than constrain the designer. Although it gives numerical guidelines, these should be interpreted flexibly since natural lighting is only one of many factors in site layout design (see Section 5). In special circumstances the developer or planning authority may wish to use different target values. For example, in a historic city centre, or in an area with modern high rise buildings, a higher degree of obstruction may be unavoidable if new developments are to match the height and proportions of existing buildings."*

Therefore, if the situation arises where the targets identified within the Guide are not achieved, these should be highlighted and either justified in the context of the development / site or where relevant and applicable, compensatory measure will be proposed. In the context of this report, any deviations from the Guides recommendations have therefore been identified, with an approach throughout to ensure that good quality daylight/sunlight in achieved through analysis and design improvements as far a s practicable and viable as detailed in the report as relevant.

The main sections in the guide that the assessments within in this report will reference (as applicable) are:

1. Light from the Sky (Daylight) – *Based on a theoretical mathematical uniform sky (CIE overcast sky) which does not alter based on orientation.*

    1.1. New Development – Within this section the guide sets values for internal Average Daylight Factors (ADF) for various space types and relevant calculation methodologies.

    1.2. Existing Buildings – The guide sets a quantitative assessment method for determining the impact of new developments on light from the sky (VSC) on existing neighbouring buildings.

2. Sunlighting – *Based on site location, longitude and latitude, and solar azimuths. i.e. buildings south of a site will not be impacted for sunlight in the northern hemisphere.*

    2.1. New Development – This topic is addressed in the 2020 Apartment Guidelines under the issue of dual aspect units and is not covered within this report.

    2.2. Existing Buildings – As above, the guide has quantitative assessment for determining the impact of sunlight on existing neighbouring buildings.

    2.3. Gardens and open spaces – The amenity criteria set out is used for both proposed new amenity and the impact on existing neighbouring amenities.

The specific methodology for each topic (as relevant) is detailed in the relevant section in the body of this report.

The 2008 British Standard

The BRE guide specifically refers to this standard and most of the quantitative criteria set out have already been mentioned in relation to the BRE Guide above. However the BRE guide provides more detail as to context and implementation. In relation to average daylight factor (ADF), the standard states the following:

> *"The average daylight factor… is used as the measure of general illumination from skylight. It is considered good practice to ensure that rooms in dwellings and in most other buildings have a predominantly daylit appearance. In order to achieve this the average daylight factor should be at least 2%."*

However, the standard then acknowledges that lower lighting levels may be applicable for dwellings, offering minimum ADFs for different room types within dwellings, i.e. 1% for bedrooms; 1.5% for living rooms; and 2% for kitchens (Table 2), and notes that:

> *"Where one room serves more than one purpose, the minimum average daylight factor should be that for the room type with the highest value. For example, in a space which combines a living room and a kitchen the minimum average daylight factor should be 2%."*

Whilst specifically applicable to houses, it should be noted that there is no specific reference within the British Standard to apartment internal galley type kitchens as recognised in the BRE Guide which states:

> *"2.1.14 Non-daylit internal kitchens should be avoided wherever possible, especially if the kitchen is used as a dining area too. If the layout means that a small internal galley-type kitchen is inevitable, it should be directly linked to a well daylit living room."*

The standard's guidance on loss of daylight and sunlight to existing buildings is similar to, but less extensive or detailed than, that contained in the BRE Guide, and in particular Appendix F of the BRE Guide.

The 2018 British and Irish Versions of the EN Standards

The EN 17037:2018 standard—which is the basis of both the 2018 British EN Standard and the 2018 Irish EN Standard—approaches the assessment of daylight provision on a different basis from that utilised in the 2008 British Standard and the BRE Guide. Instead of **average** daylight factors the standard assess a new metric based on **median** daylight, in order to ensure both extent and a degree of uniformity of daylight.

> *"A space is considered to provide adequate daylight if a target illuminance level is achieved across a fraction of the reference plane within a space for at least half of the daylight hours."*

EN 17037:2018 also address other aspects in addition to daylight - including sunlight, glare and quality of view, which are not addressed in the context of this report.

The National Annex

As is noted above, the 2018 British Standard includes a "National Annex", containing "Further recommendations and data for daylight provision in the UK and Channel Islands". This is referenced further in the appendix of this report. As there is no equivalent in the 2018 Irish Standard the 2018 British Standard National Annex will be referenced, which states:

> *"NA.1 Introduction: The UK committee supports the recommendations for daylight in buildings given in BS EN 17037:2018; however, it is the opinion of the UK committee that the recommendations for daylight provision in a space (see Clause A.2) may not be achievable for some buildings, particularly dwellings. The UK committee believes this could be the case for dwellings with basement rooms or those with significant external obstructions (for example, dwellings situated in a dense urban area or with tall trees outside), or for existing buildings being refurbished or converted into dwellings. This National Annex therefore provides the UK committee's guidance on minimum daylight provision in all UK dwellings."*

NA.2 addresses minimum daylight provision in UK dwellings. It contains a table, in which target illuminance, ET (lx), levels are recommended for different room types. These are: bedroom at 100 lx; living room at 150 lx; and kitchen at 200 lx, which may be compared to EN 17037's recommendation of 300 lux (irrespective of room application). The commentary is as follows:

> *"Even if a predominantly daylit appearance is not achievable for a room in a UK dwelling, the UK committee recommends that the target illuminance values given in Table NA.1 are exceeded over at least 50% of the points on a reference plane 0.85 m above the floor, for at least half of the daylight hours."*

5.0 Impact on Neighbouring Dwellings

5.1 Guidance

As set out within the introduction, the impact on existing buildings has been assessed utilising quantitative assessment method as detailed in the BRE publication “Site Layout Planning for Daylight and Sunlight – A guide to good Practice (Second Edition)”

BRE Guidelines state:

Light from the Sky

“If any part of a new building or extension, measured in a vertical section perpendicular to a main window wall of an existing building, from the centre of the lowest window, subtends an angle of more than 25° to the horizontal, then the diffuse daylighting of the existing building may be adversely affected. This will be the case if either:

The VSC (Vertical Sky Component) measured at the centre of an existing main window is less than 27%, and less than 0.8 times its former value.

The analysis is based on measuring the VSC at the existing main windows. Main windows included, living rooms, kitchens, and bedrooms. Existing windows with VSC above 27% after proposed development are considered to still receive good daylight availability.

Sunlighting

If a living room of an existing dwelling has a main window facing within 90° of due south, and any part of a new development subtends an angle of more than 25° to the horizontal measured from the centre of the window in a vertical section perpendicular to the window, then the sunlighting of the existing dwelling may be adversely affected. This will be the case if the centre of the window:

- *receives less than 25% of annual probable sunlight hours, or less than 5% of annual probable sunlight hours between 21 September and 21 March and*
- *receives less than 0.8 times its former sunlight hours during either period and*
- *has a reduction in sunlight received over the whole year greater than 4% of annual probable sunlight hours.*

An analysis was carried out on the neighbouring residential unit on:

- Dwyer Park

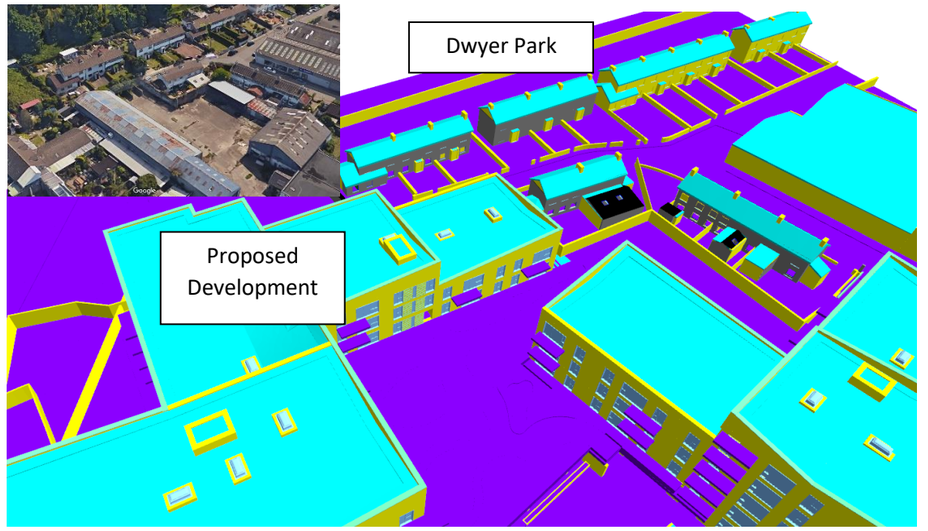


Fig 5.1 – Proposed 3D Model

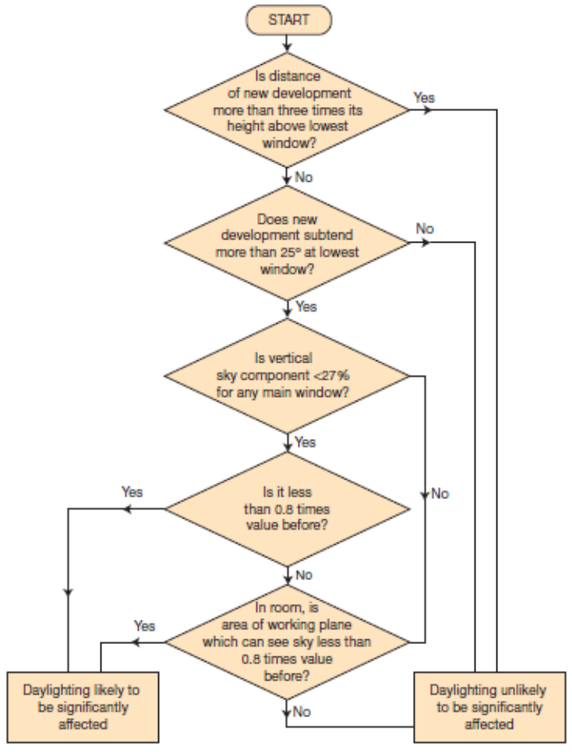


Fig 5.2 – BR 209 Decision Chart

Impact on Neighbouring Dwellings

5.2 The Existing Condition:

The exiting conditions include high walls covered in planting and eaves and walls of previous industrial buildings Fig 5.2.1.

Due to the close proximity of some of these walls to the residential windows, the existing buildings/walls results in poorer daylight than for the proposed development.

Fig 5.2.1 – Existing 3D Model

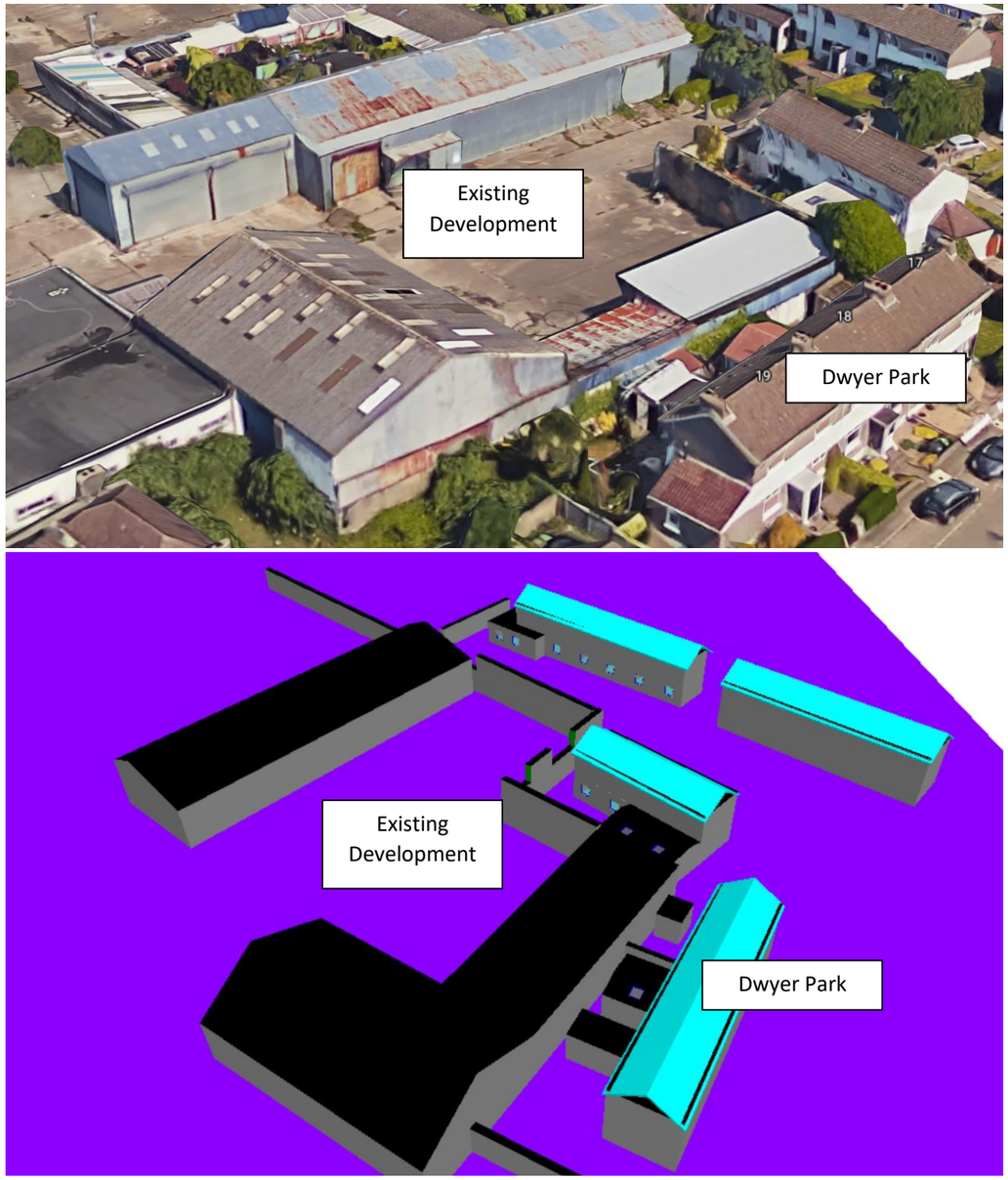


Fig 5.2.2 –3D Model of Existing Buildings

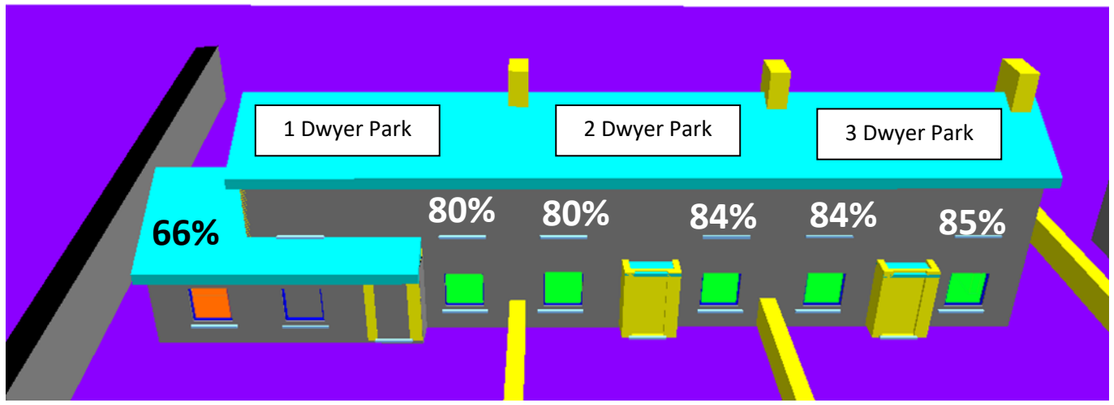
Impact On Neighbouring Dwellings

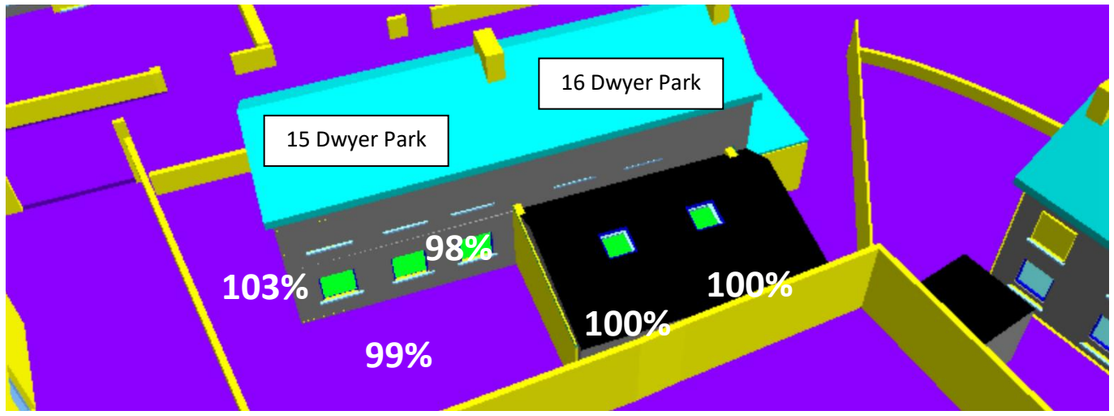
5.3 Results - VSC

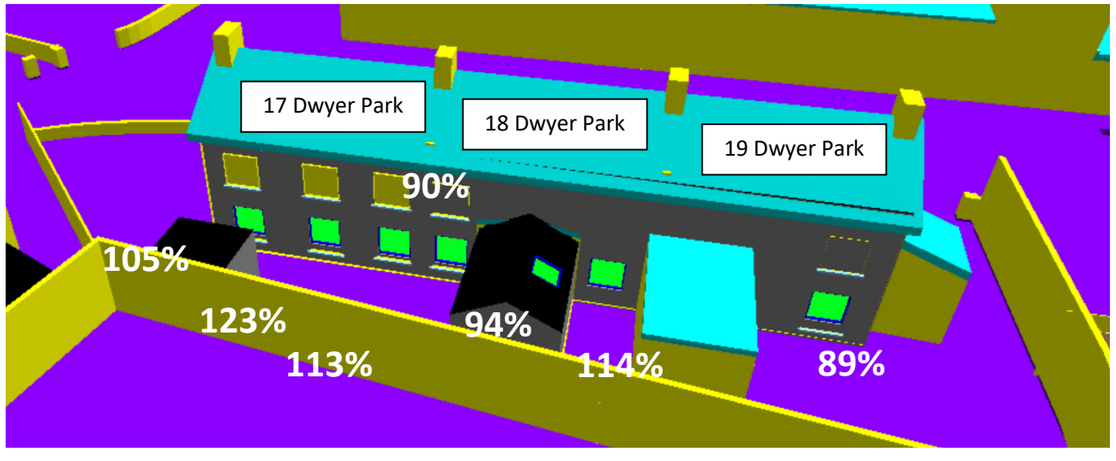
The analysis determined that VSC would be reduced below 80% for one window as per the results shown. It can be noted that some results are >100%, this is where the exiting condition will be improved as a result of the proposed development due to the removal of shed walls on the proposed site etc..

The room that is below 80% is a bedroom on the extension, and is discussed further on the following page.

Room Reference	VSC Existing (%)	VSC Proposed (%)	Proposed/Existing	
Bedroom 1 Dwyer Park	30.2	19.8	0.66	Fail
1 Dwyer Park	29.05	23.25	0.8	Pass
2 Dwyer Park	31.51	25.12	0.8	Pass
2 Dwyer Park	31.83	26.67	0.84	Pass
3 Dwyer Park	32.21	26.92	0.84	Pass
3 Dwyer Park	32.86	27.96	0.85	Pass
15 Dwyer Park	22.4	22.98	1.03	Pass
15 Dwyer Park	23.28	23.03	0.99	Pass
15 Dwyer Park	19.84	19.41	0.98	Pass
16 Dwyer Park	88.39	89.25	1	Pass
16 Dwyer Park	88.86	89.79	1	Pass
17 Dwyer Park	20.59	21.58	1.05	Pass
17 Dwyer Park	20.4	25.02	1.23	Pass
17 Dwyer Park	20.72	23.35	1.13	Pass
18 Dwyer Park	76.96	72.27	0.94	Pass
18 Dwyer Park	17.29	15.55	0.9	Pass
18 Dwyer Park	18.37	20.94	1.14	Pass
19 Dwyer Park	22.29	19.95	0.89	Pass



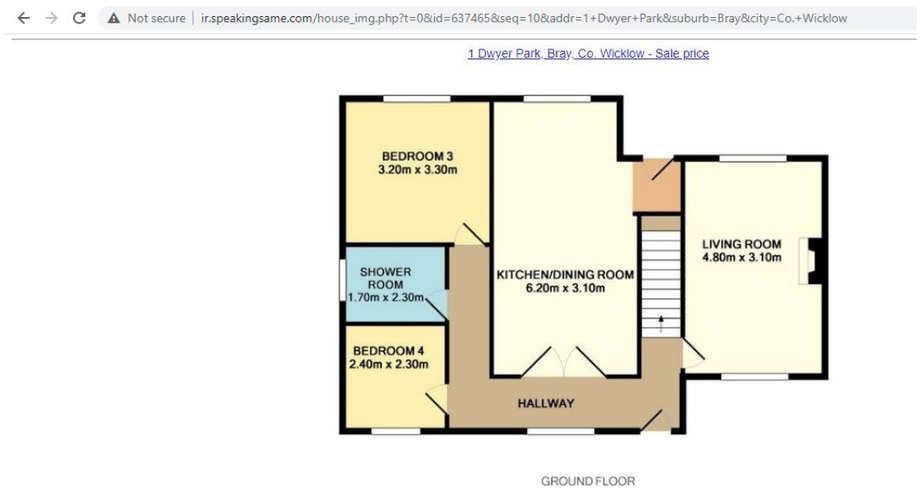




Impact On Neighbouring Dwellings

5.3 Results

The one window with reduced VSC is a bedroom as per the illustrative floor plan below:



In order to assess the impact of a proposed development on a existing dwelling, an alternative metric as per the BRE guidance is:

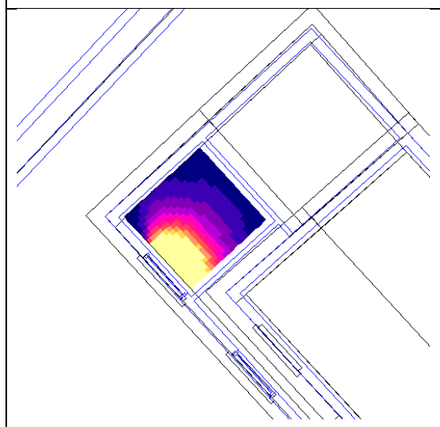
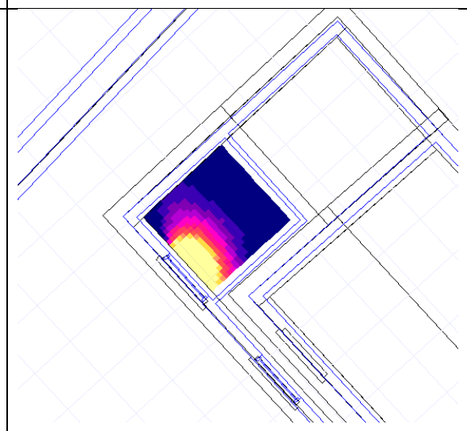
- *The area of the working plane in a room which can receive direct skylight is reduced to less than 0.8 times its former value.*

The analysis determined that reduction in area which can receive direct skylight was 22%, just below the 0.8 times its former value suggested.

The caveat should be applied that the assessment is based on available information at time of assessment and a verification of internal space dimensions and window dimensions has not been carried out.

It should be noted that the internal average daylight factor for the bedroom, as a result of the proposed developments, would be in the region of 2.5% (based on typical reflectance values).

It can therefore be noted that whilst the room in question will experience a minor loss in direct skylight the internal average daylight factor remains at a very high level for a bedroom.

Existing Condition	Proposed Condition
	
Area receiving direct skylight: 5.60m^2	Area receiving direct skylight: 4.34m^2
	Reduction:22%

Impact On Neighbouring Dwellings

5.4 Results – Annual Probable Sunlight Hours

The results determined that for all relevant windows (within 90deg of south) there will be no negative impact for sunlight and in fact improved sunlight to some dwellings due to removal of some existing buildings located on the site boundary.

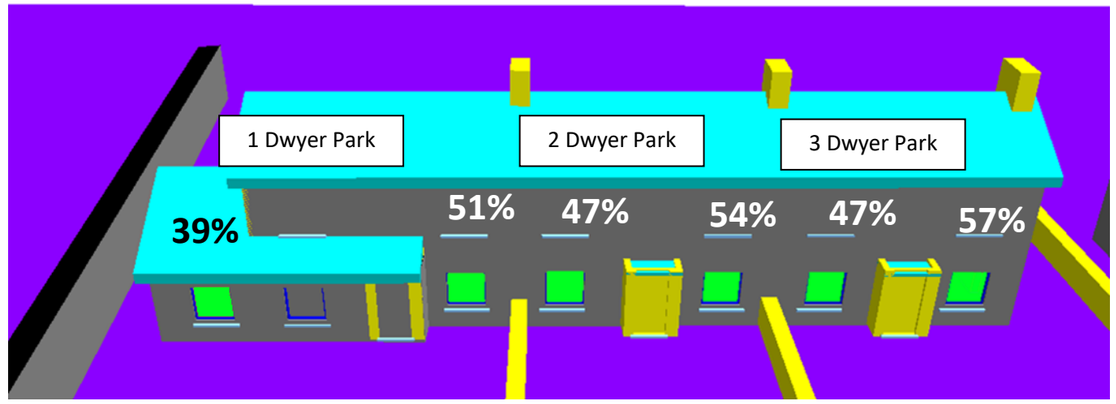
i.e. negatively impacted if:

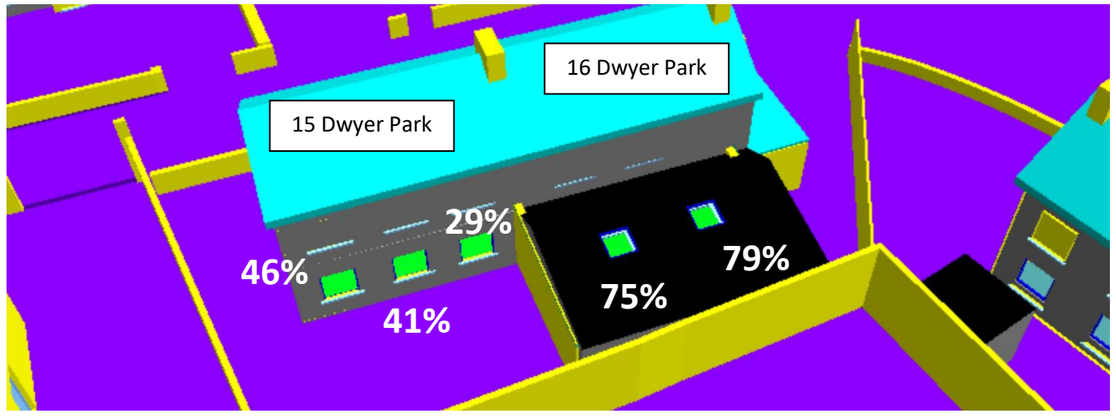
- *receives less than 25% of annual probable sunlight hours, or less than 5% of annual probable sunlight hours between 21 September and 21 March and*
- *receives less than 0.8 times its former sunlight hours during either period and*
- *has a reduction in sunlight received over the whole year greater than 4% of annual probable sunlight hours.*

All windows analysed were determined to receive greater than 25% of annual probable sunlight hours between 21 September and 21 March, (as shown in the summary table below and Fig. 5.4.2) and are therefore determined to be fully compliant on that basis.

Room Reference	Annual Existing (%)	Annual Proposed (%)	Proposed / Existing (%)	Winter Existing (%)	Winter Proposed (%)	Winter Proposed / Existing (%)	
Bedroom 1 Dwyer Park	58.30	39.41	68%	21.45	14.63	68%	Pass
Dual lit Living Room 1 Dwyer Park	59.44	50.71	85%	22.49	18.40	82%	Pass
2 Dwyer Park	59.50	46.62	78%	22.54	13.86	62%	Pass
2 Dwyer Park	59.50	53.98	91%	22.54	19.92	88%	Pass
3 Dwyer Park	59.50	46.67	78%	22.54	12.66	56%	Pass
3 Dwyer Park	58.62	56.99	97%	21.67	20.91	97%	Pass
15 Dwyer Park	45.85	46.07	101%	10.04	15.83	158%	Pass
15 Dwyer Park	42.19	41.05	97%	6.50	8.95	138%	Pass
15 Dwyer Park	31.99	28.98	91%	0.60	1.80	300%	Pass
16 Dwyer Park	72.27	74.84	104%	21.78	25.38	117%	Pass
16 Dwyer Park	75.33	78.93	105%	22.11	25.44	115%	Pass
18 Dwyer Park	45.58	38.43	84%	6.93	3.98	58%	Pass

Fig 5.4.1 – Annual Probable Sunlight Hours Availability Results Summary Table





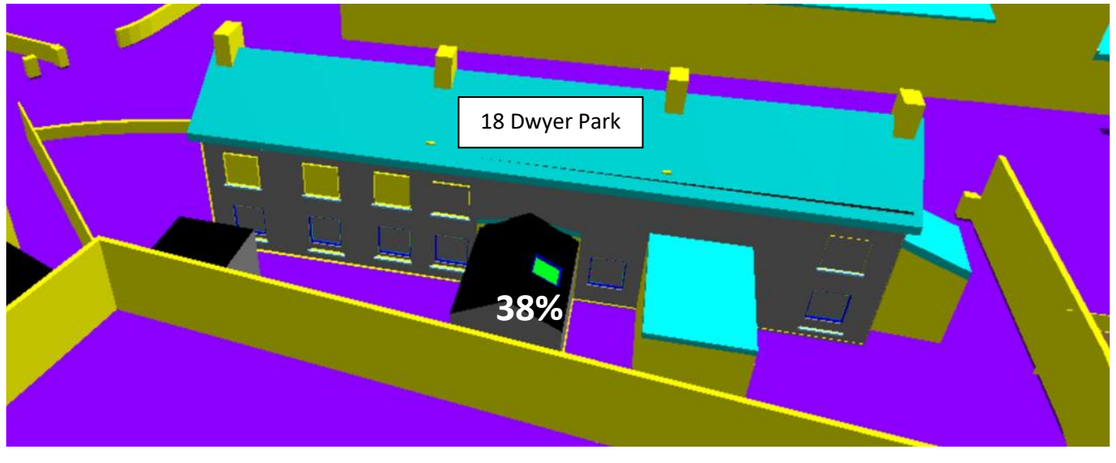


Fig 5.4.2 – Annual Probable Sunlight Hours Availability to Windows Analysed in Proposed Condition

Impact On Neighbouring Dwellings

5.5 Amenity Space Methodology

The BRE Site Layout Planning for Daylight and Sunlight Design Guide 209 provides guidance with regards to sunlighting and shading to external Amenity spaces within proposed developments and neighbouring sites.

The BRE guidance recommends:

> "*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*".

The results in Figures 5.5.1 and 5.5.2 illustrate the extent of area which receive over 2 hours of sunlight on 21st March under existing vs proposed conditions.

As part of the proposed scheme there is an amendment proposed to the rear gardens of Dwyer Park. The "lit area" (the space achieving at least 2 hours sunlight) has been calculated for the revised areas in the proposed situation, i.e. as a result of the development.

The analysis determined that as a result of the proposed scheme the neighbouring would either have no impact (100% area as previous) or improved, increased sunlit amenity areas.

Fig 5.5.1 – Existing and Proposed Amenity Sunlight Compliance

	Existing Lit Area	Proposed Lit Areas	Ex / Pr (%)	Compliant
15 Dwyer Park	24.0	34.5	144%	YES
16 Dwyer Park (Side)	35.24	35.1	100%	YES
17 Dwyer Park (Side)	85.91	85.9	100%	YES
17 Dwyer Park	3.54	9.9	279%	YES
18 Dwyer Park	0.00	0.1	100%	YES
19 Dwyer Park	43.26	45.6	105%	YES

Fig 5.5.2 – Impact on Neighbouring Amenity

6.0 Site Sunlighting and Shading

6.1 Proposed Amenity Space Methodology

The BRE Site Layout Planning for Daylight and Sunlight Design Guide BR 209 provides guidance with regards to sunlighting and shading to external Amenity spaces within proposed developments.

The guidance recommends “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 21st March”.

The methodology assesses sunlight performance at the Equinox, as this is the mid solar position throughout the year (as illustrated in Fig.6.1), with compliance indicative of spaces that will receive adequate sunlight and appealing useful spaces, including that the following attributes will be achieved as identified in BR 209:

- Provide attractive sunlit views (all year)
- Make Outdoor Activities like sitting out and children’s play more pleasant (mainly warmer months).
- Encourage plant growth (mainly spring and summer).
- Dry out the ground, reducing moss and slime (mainly in colder months).

An example analysis of Amenity Spaces is indicated in Figure 6.1. In this development, the main amenity space (to right hand side) is located to the North of a building block which provides some degree of overshadowing (dark green contours).

Results

For the proposed development, Figure 6.2, the main amenity space located on the first - floor podium was found to be in excess of 99% compliant. The amenity space as a whole was found to be 78% compliant, comfortably exceeding the BRE guidance.

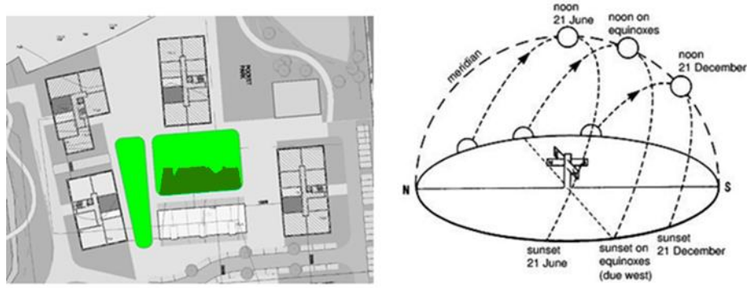
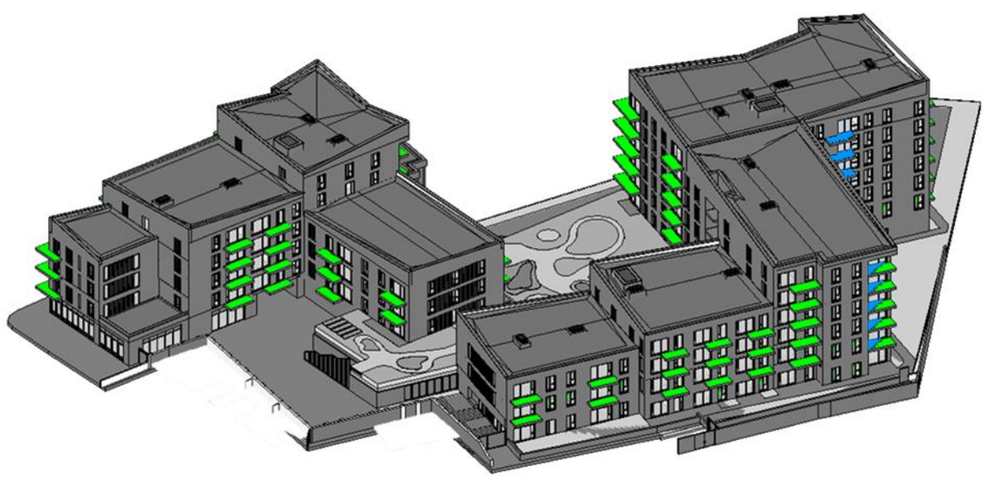


Fig 6.1 – Example Amenity Spaces

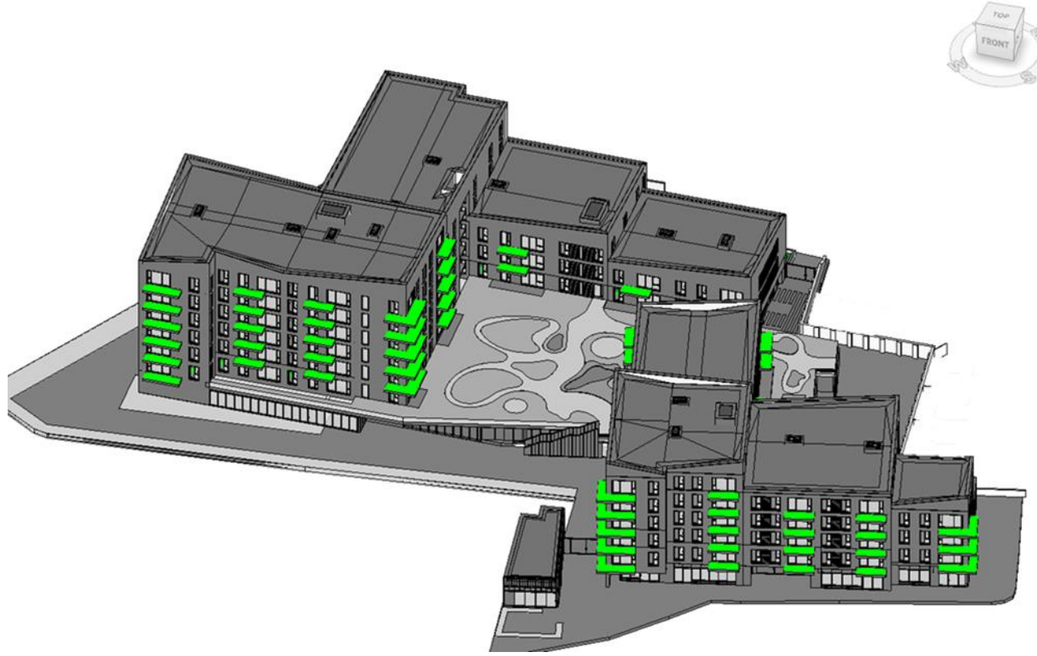
Fig 6.2 –Sunlight Availity to Amenity Spaces for Proposed Development

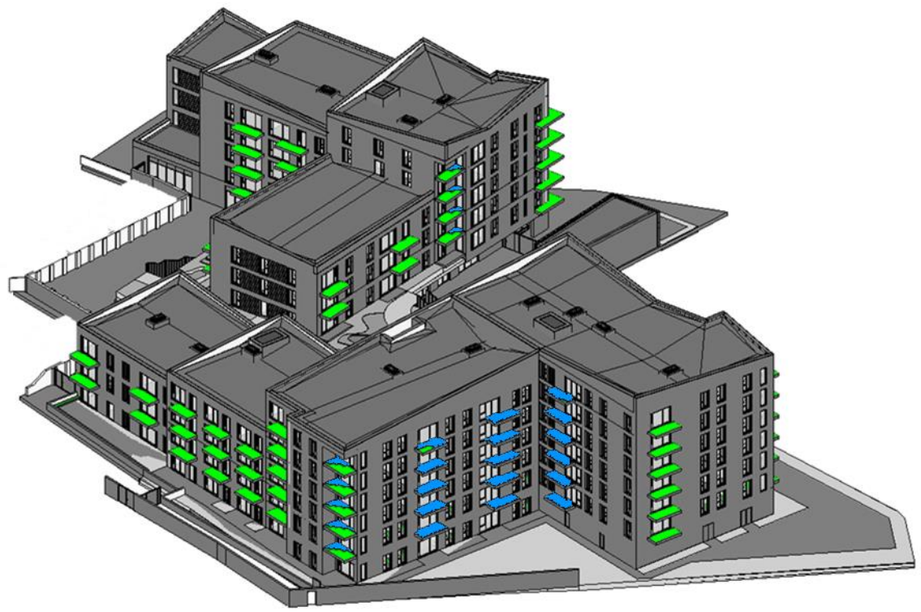
6.2 Balcony Sunlight

Sunlight to the balconies has also been assessed under the same BR 209 metric. The analysis determined that the vast majority of the balconies, 99 of 115, will be provided with sunlight in exceedance of the 50% for 2 hours as illustrated in the accompanying images. There are some balconies to the north end of the scheme that do not achieve 2 hours of sunlight for at least 50% of the space on the 21st March, however, the aspect of these balconies is such that they face north west and north east towards the mature tree filled aspect facing towards Dublin City and the coast.



+2 Hours	
<2 Hours	





7.0 Daylight Analysis

7.1 Methodology

Daylighting analysis was undertaken for the proposed residential development using radiance lighting software to determine Average Daylight Factors (ADF's) in accordance with BRE 209 and BS. 8206-2, as referenced in the Sustainable Urban Housing: Design Standards for New Apartments (December 2020), as well as an assessment comparison to BS EN 17037 (National Annex). These guidelines and standards have been outlined in section 2.0.

ADF's were determined for a CIE Overcast Sky equivalent to providing an external, unobstructed ground illumination level of 10,000 Lux. CIE Overcast skies are theoretical sky models, with brightness highest at the zenith and reducing to the horizon, but also unidirectional (as illustrated in Figure 5.0.1); therefore ADF's do not differ for façade orientation, with North facing rooms achieving identical metric performance to South facing, (all else being equal), as results account for diffuse natural light only and exclude any direct sunlight effects.

The daylight analysis accounted for all aspects that can potentially restrict natural light availability including any adjacent / opposing buildings, along with explicitly modelling sample building details as illustrated in Figure 5.0.2 such as balcony structures, window frames, reveal and cill depth etc. in accordance with the architectural design.

The daylighting models were calculated based on the following assumptions regarding transmittance and reflectance (based on measured manufacturer's test data):

- Glazing Transmission = 70%
- Ceilings: 82% reflectance (BS 00E55 White)
- Walls: 62% reflectance (BS 10C31 Ivory)
- Floors: 36% reflectance (BS 00A05 Platinum Grey)

Daylight Factors for each space were then calculated for a working plane height of 0.85m on a 0.25 x 0.25m grid basis to enable a detailed calculation within each room, the average of which was then determined to calculate ADF.

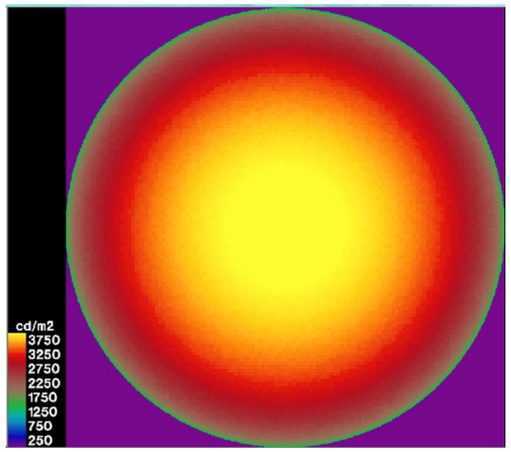


Fig 7.0.1 - CIE Overcast sky as viewed from below.

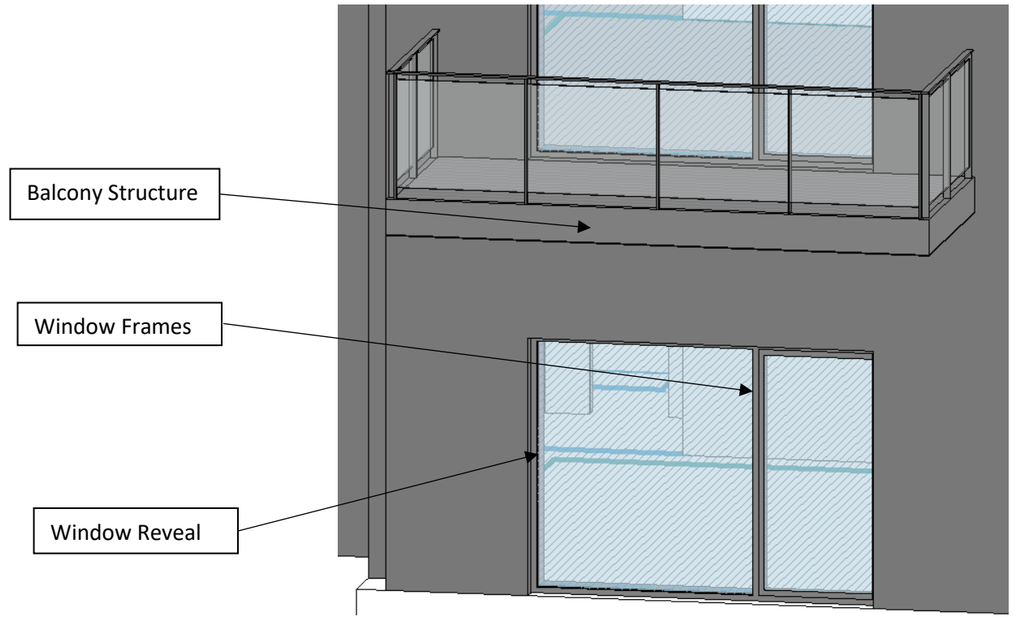


Fig 7.0.2 – Sample Building Details included within Daylight Analysis

7.0 Methodology (Cont'd)

In relation to daylight, the BRE Guide suggest that:

> *"Daylight provision in new rooms may be checked using the average daylight factor (ADF). The ADF is a measure of the overall amount of daylight in a space… [The 2008 British Standard] recommends an ADF of 5% for a well daylit space and 2% for a partly daylit space. Below 2% the room will look dull and electric lighting is likely to be turned on. In* ***housing*** *[the 2008 British Standard] also gives minimum values of ADF of 2% for kitchens, 1.5% for living rooms and 1% for bedrooms." (emphasis added)*

The 2008 British Standard further clarifies the targets by stipulating:

> *"Where one room serves more than one purpose, the minimum average daylight factor should be that for the room type with the highest value. For example, in a space which combines a living room and a kitchen the minimum average daylight factor should be 2%."*

With regard to the above, the minimum values targeted for relevant spaces are:

- > 2.0% for KLD Areas
- > 1.0% for Bedrooms

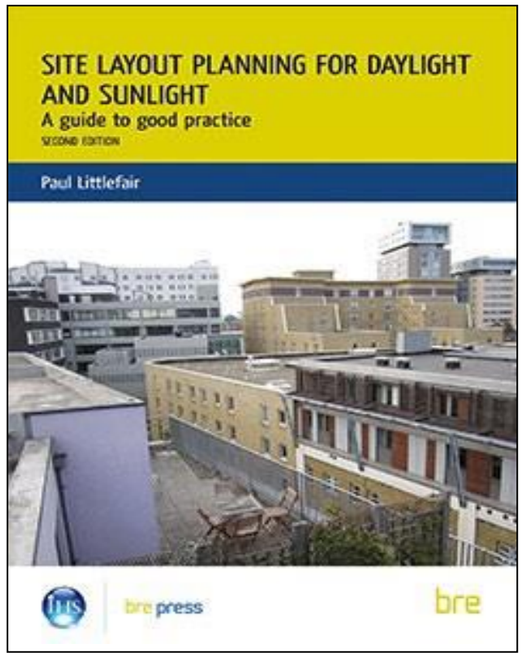


Fig 7.0.3 – The BRE Guide

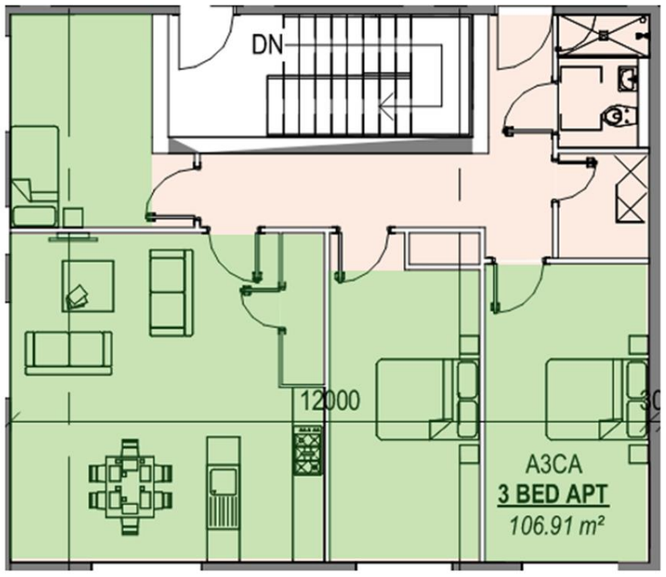


Fig 7.0.4 – Sample analysis Spaces

7.1 Results

The results determined that 99% of all rooms exceeded the BRE minimum guidelines, with only 3 rooms marginally below these target values.

The images below illustrate the results for all floors of the development demonstrating compliance value of 99%.

Compensatory measures:

One KLD and two bedrooms do not achieve the minimum guidelines values, however, these spaces have been oversized to provide tangible compensatory measures for the spaces.

Block A	Pass	Fail	Total
Ground Floor	16	0	16
First Floor	53	2	55
Second Floor	54	1	55
Third Floor	45	0	45
Fourth Floor	36	0	36
Fifth Floor	36	0	36
Sixth Floor	20	0	20
Total	260	3	263
	99%	**1%**	

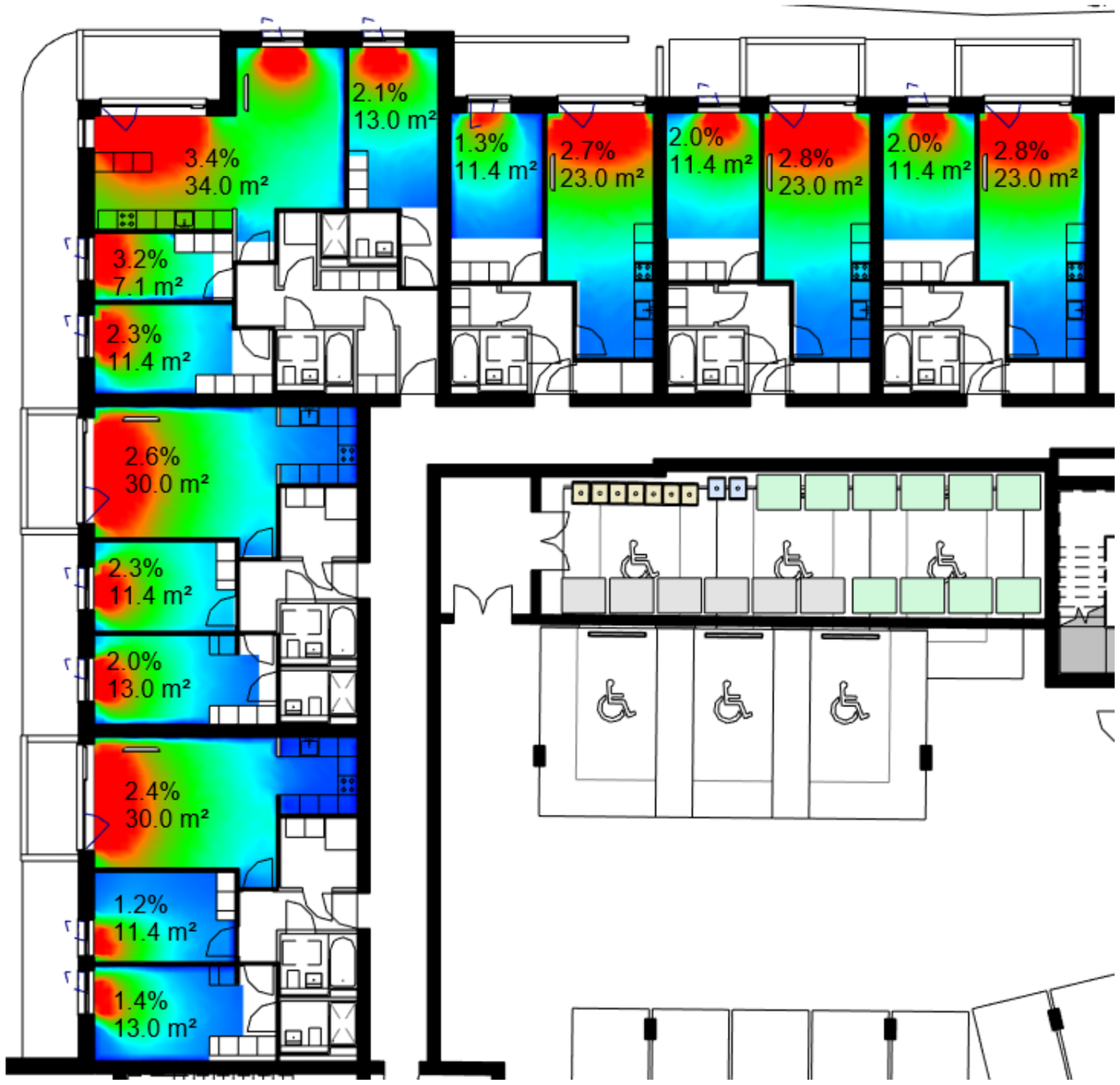
Block B	Pass	Fail	Total
First Floor	36	0	36
Second Floor	36	0	36
Third Floor	36	0	36
Fourth Floor	20	0	20
Fifth Floor	8	0	8
Total	136	0	136
	100%	**0%**	

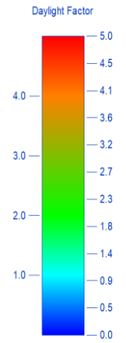
	Pass	Fail	Total
Block A	260	3	263
Block B	136	0	136
	396	**3**	399
	99%	**1%**	

7.2 Block A

Ground Floor

All spaces were found to exceed the BRE target values.



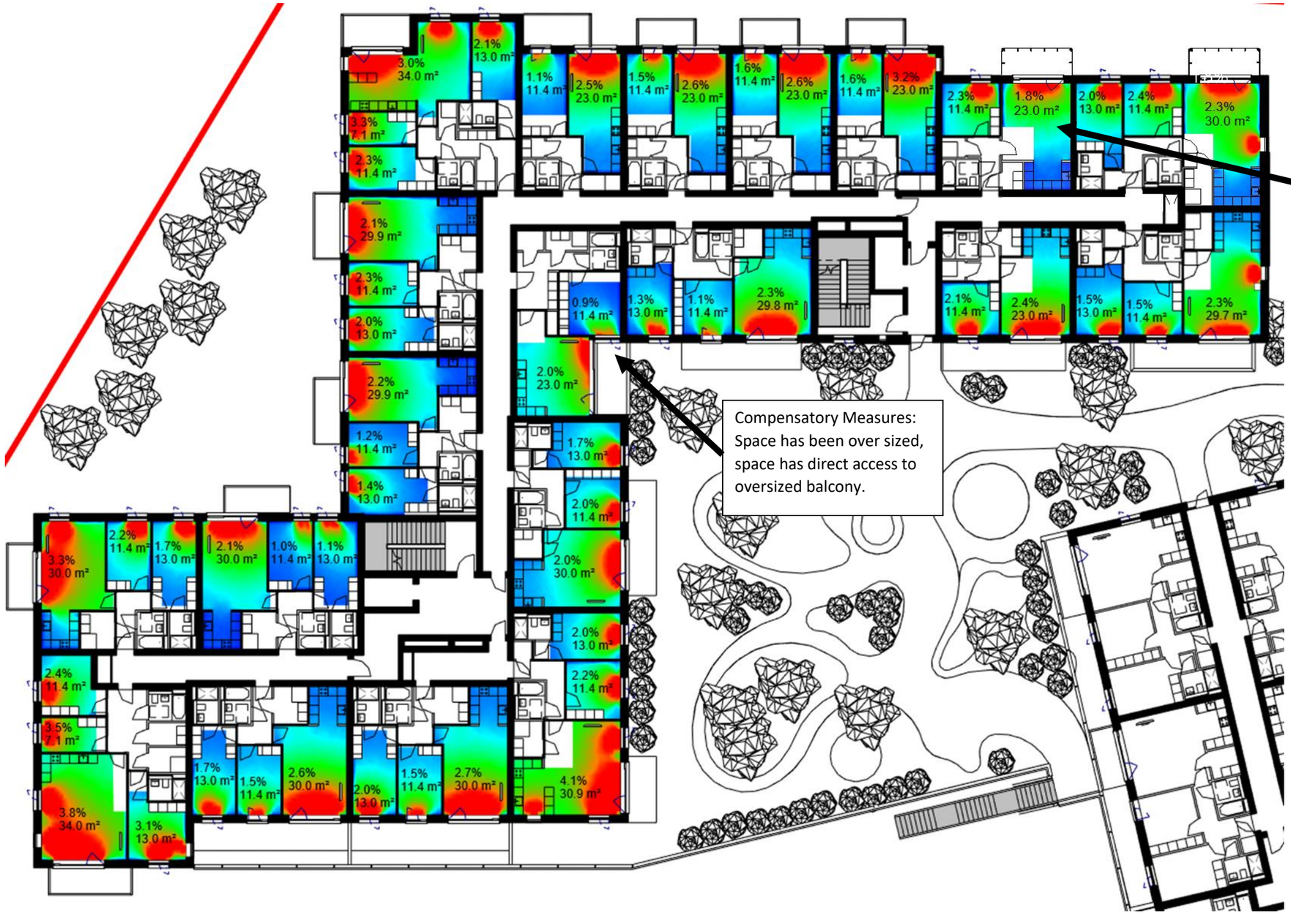


ADF Targets	
Bedrooms	> 1.0%
K/L/D Areas	> 2.0%

7.3 Block A

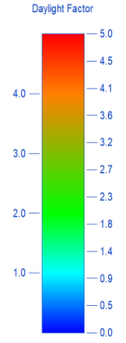
First Floor

Most spaces were found to exceed the BRE target values. One KLD was determined to be marginally below the BRE target value at 1.8% as a direct impact of the privacy screening on the balcony. The one bedroom just below the target 1.0% achieved 0.9% ADF. Both units are oversized and both spaces have direct access to oversized balconies.



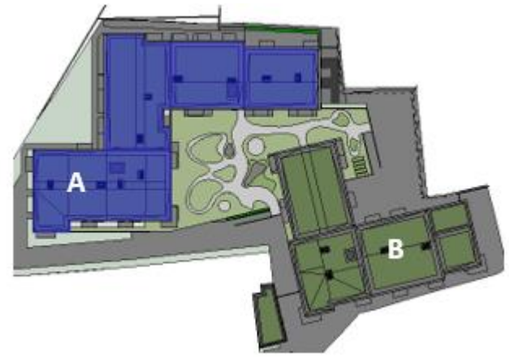
Compensatory Measures: Space has been over sized, space has direct access to oversized balcony.

Compensatory Measures: Space has been over sized, space has direct access to oversized balcony.



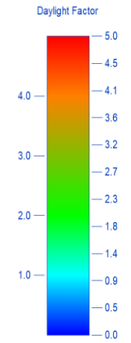
ADF Targets	
Bedrooms	> 1.0%
K/L/D Areas	> 2.0%

7.4 Block A



Second Floor

Most spaces were found to exceed the BRE target values. One bedroom was determined to be just below the target 1.0%, achieving 0.9% ADF. Both the space and the unit are oversized by way of compensatory measure.

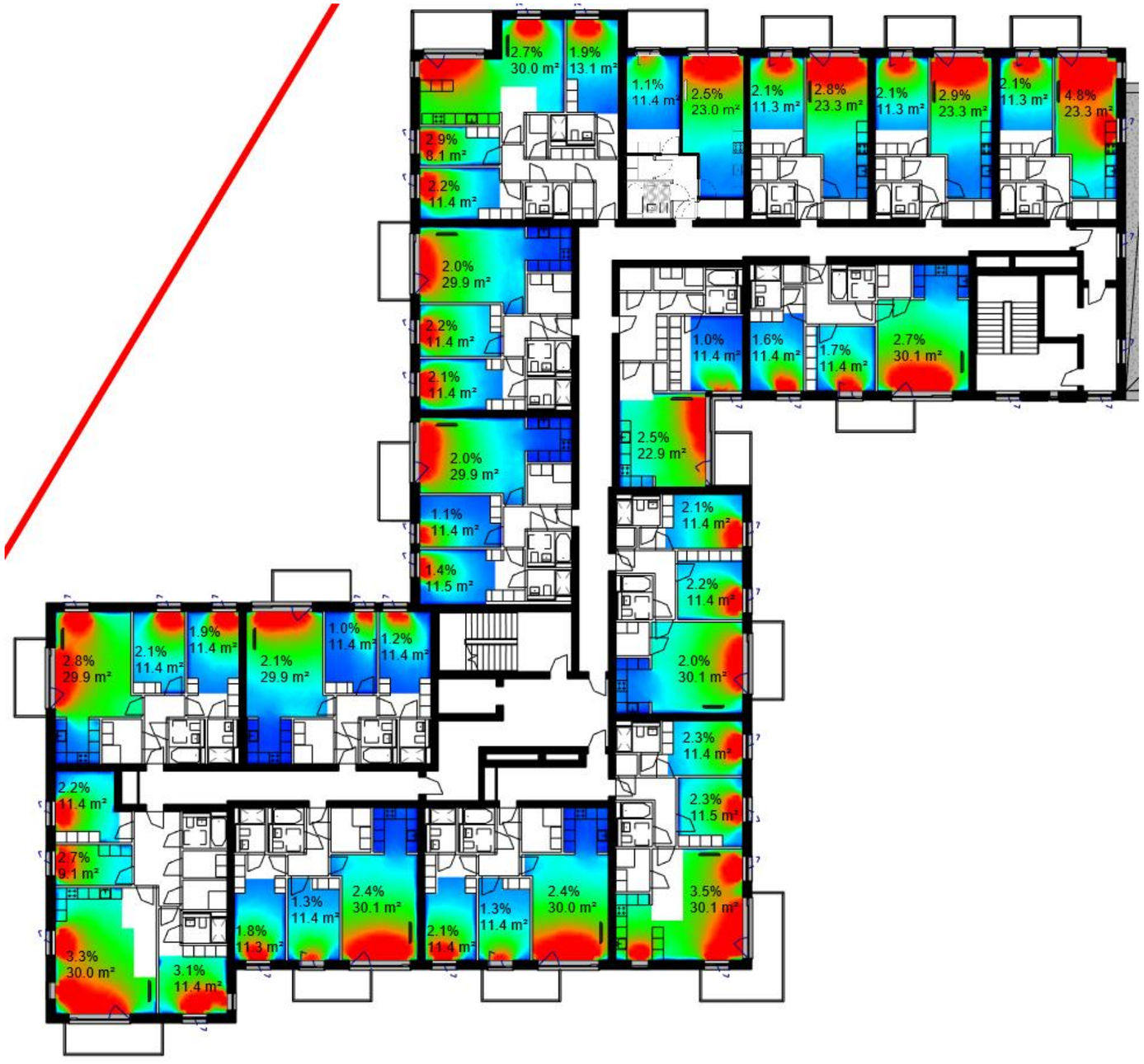


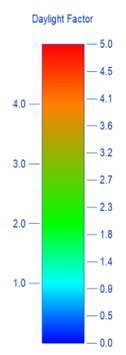
ADF Targets	
Bedrooms	> 1.0%
K/L/D Areas	> 2.0%

7.5 Block A

Third Floor

All spaces were found to exceed the BRE target values.



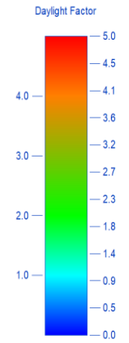


ADF Targets	
Bedrooms	> 1.0%
K/L/D Areas	> 2.0%

7.6 Block A

Fourth Floor

All spaces were found to exceed the BRE target values.

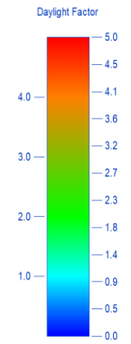


ADF Targets	
Bedrooms	> 1.0%
K/L/D Areas	> 2.0%

7.7 Block A

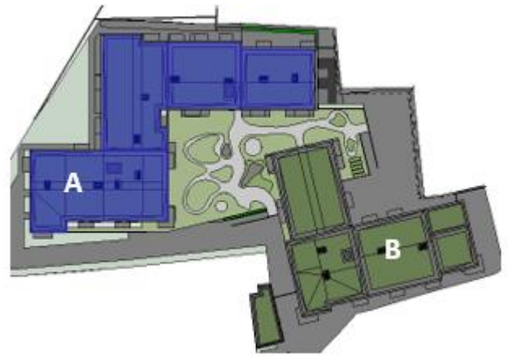
Fifth Floor

All spaces were found to exceed the BRE target values.



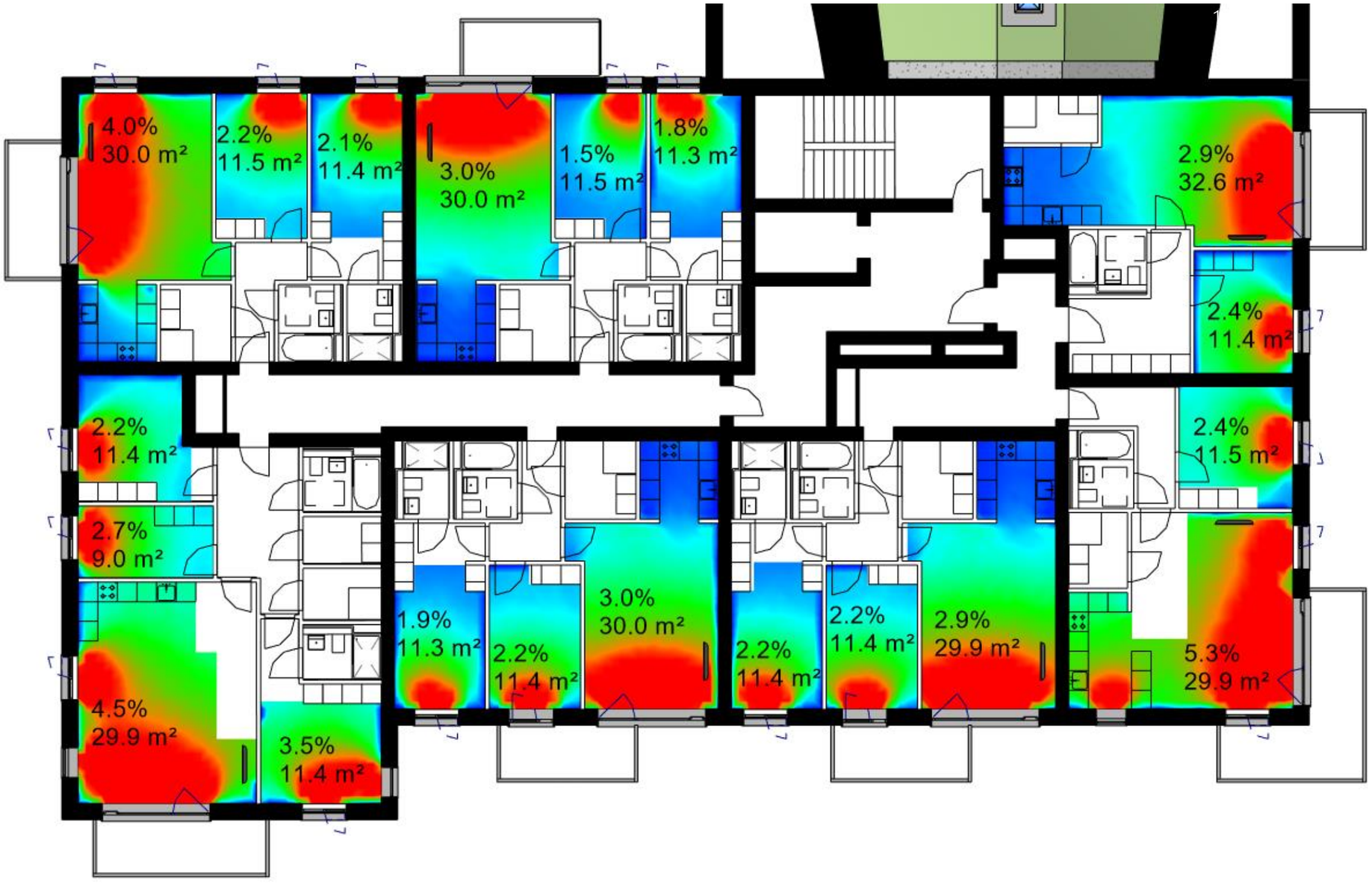
ADF Targets	
Bedrooms	> 1.0%
K/L/D Areas	> 2.0%

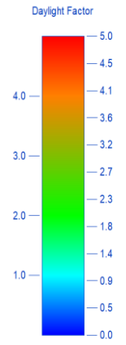
7.8 Block A



Sixth Floor

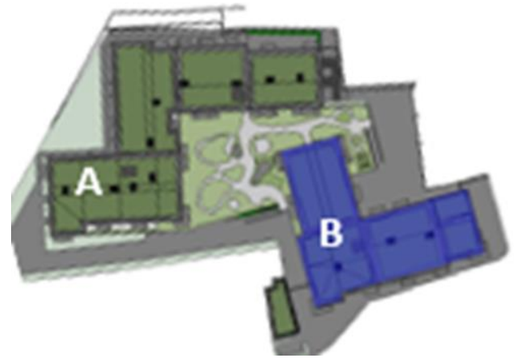
All spaces were found to exceed the BRE target values.





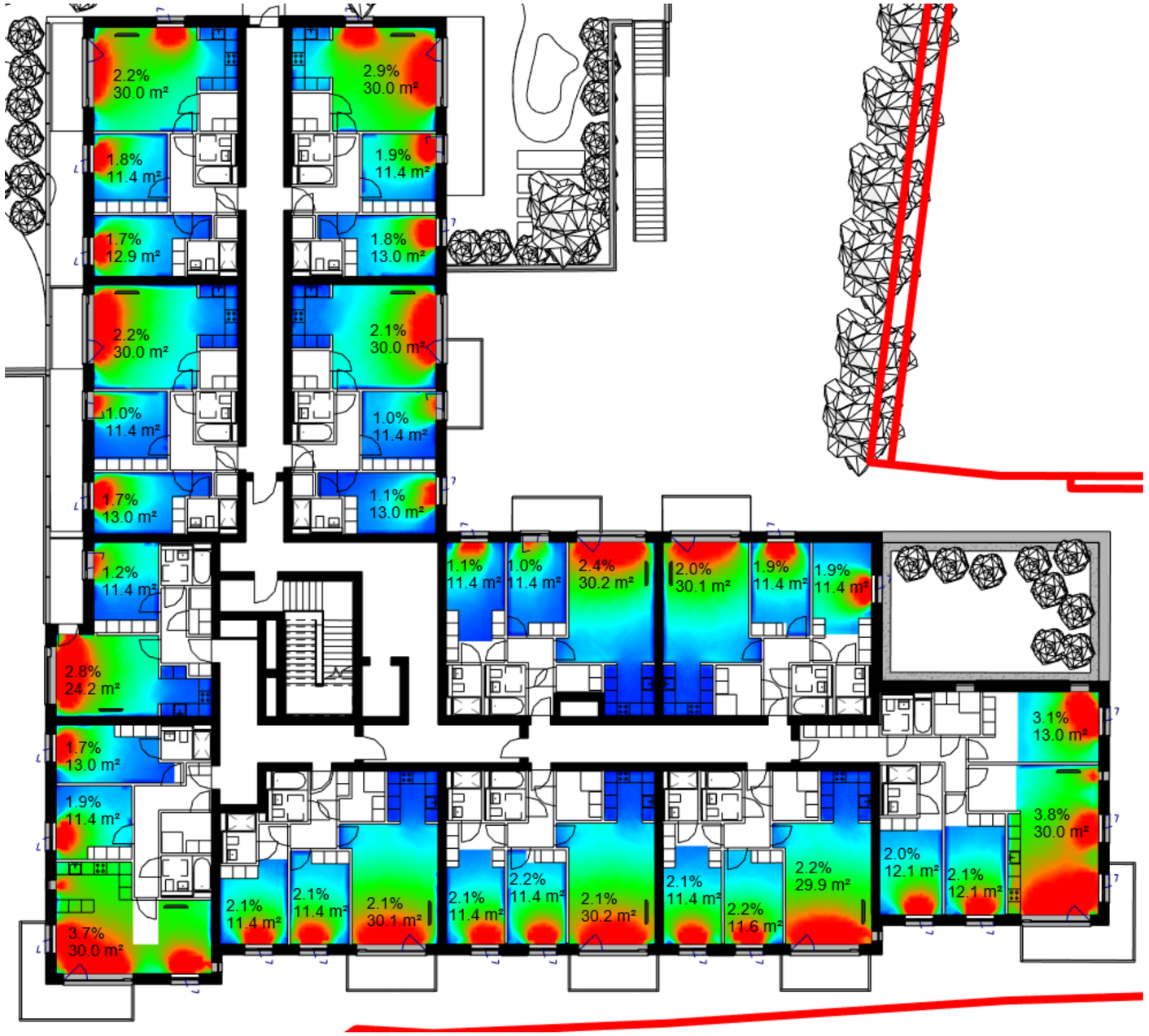
ADF Targets	
Bedrooms	> 1.0%
K/L/D Areas	> 2.0%

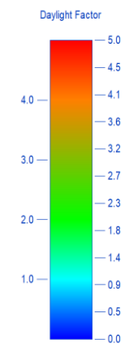
7.9 Block B



First Floor

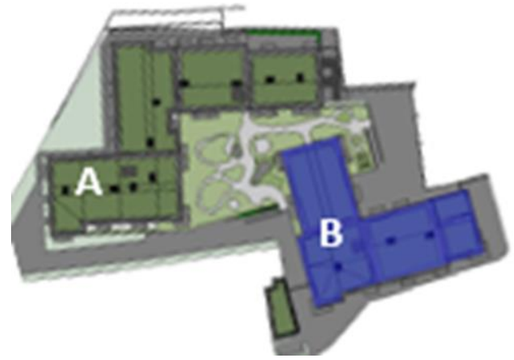
All spaces were found to exceed the BRE target values.





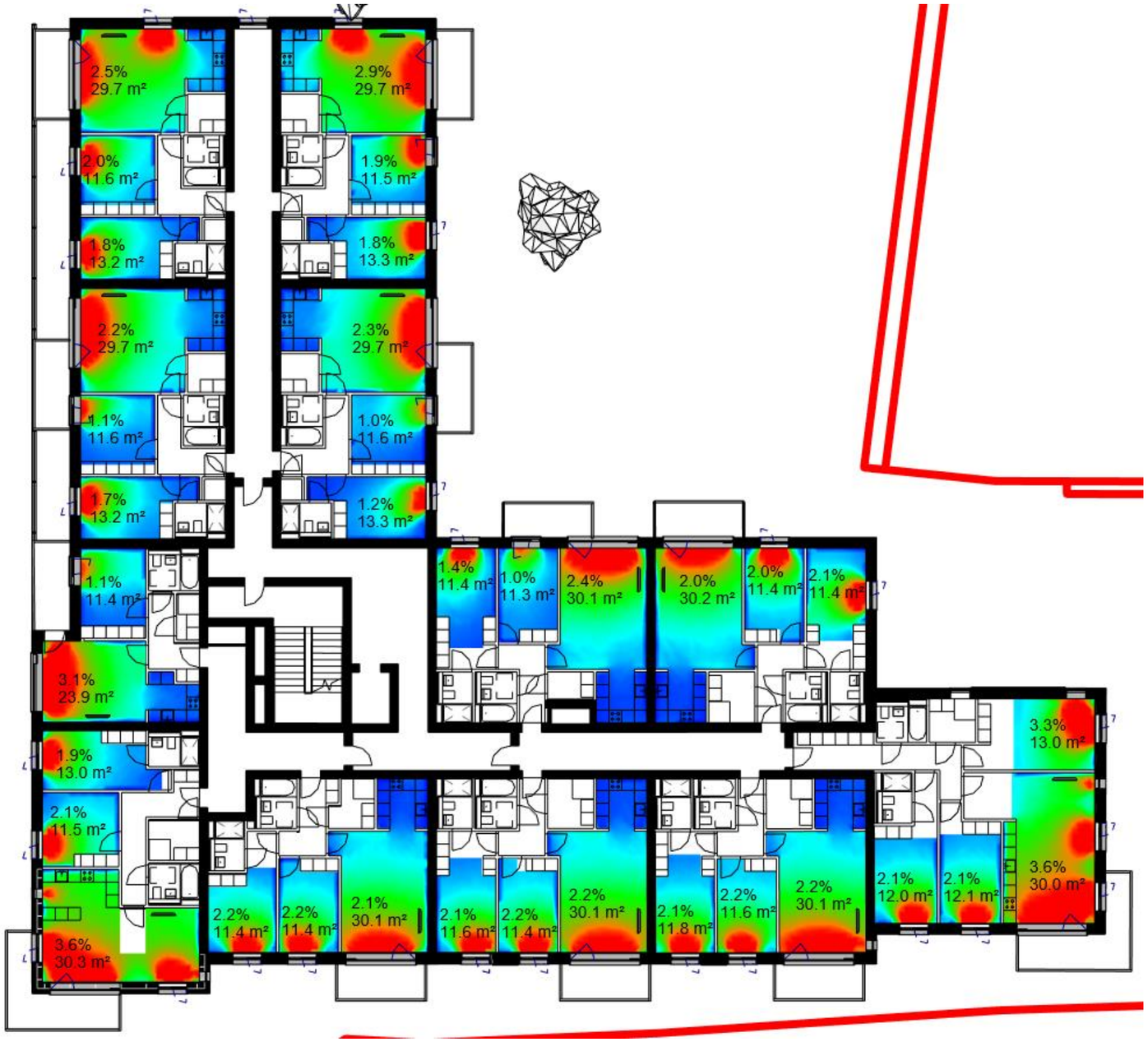
ADF Targets	
Bedrooms	> 1.0%
K/L/D Areas	> 2.0%

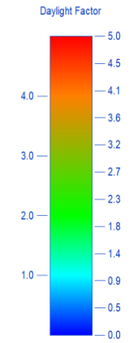
7.10 Block B



Second Floor

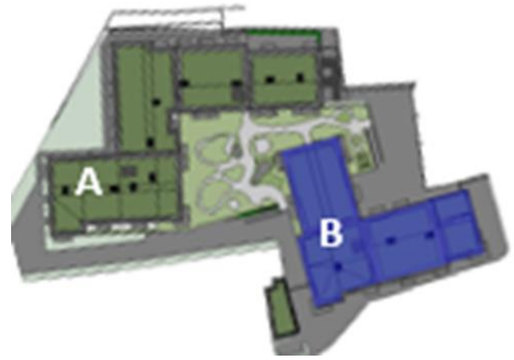
All spaces were found to exceed the BRE target values.





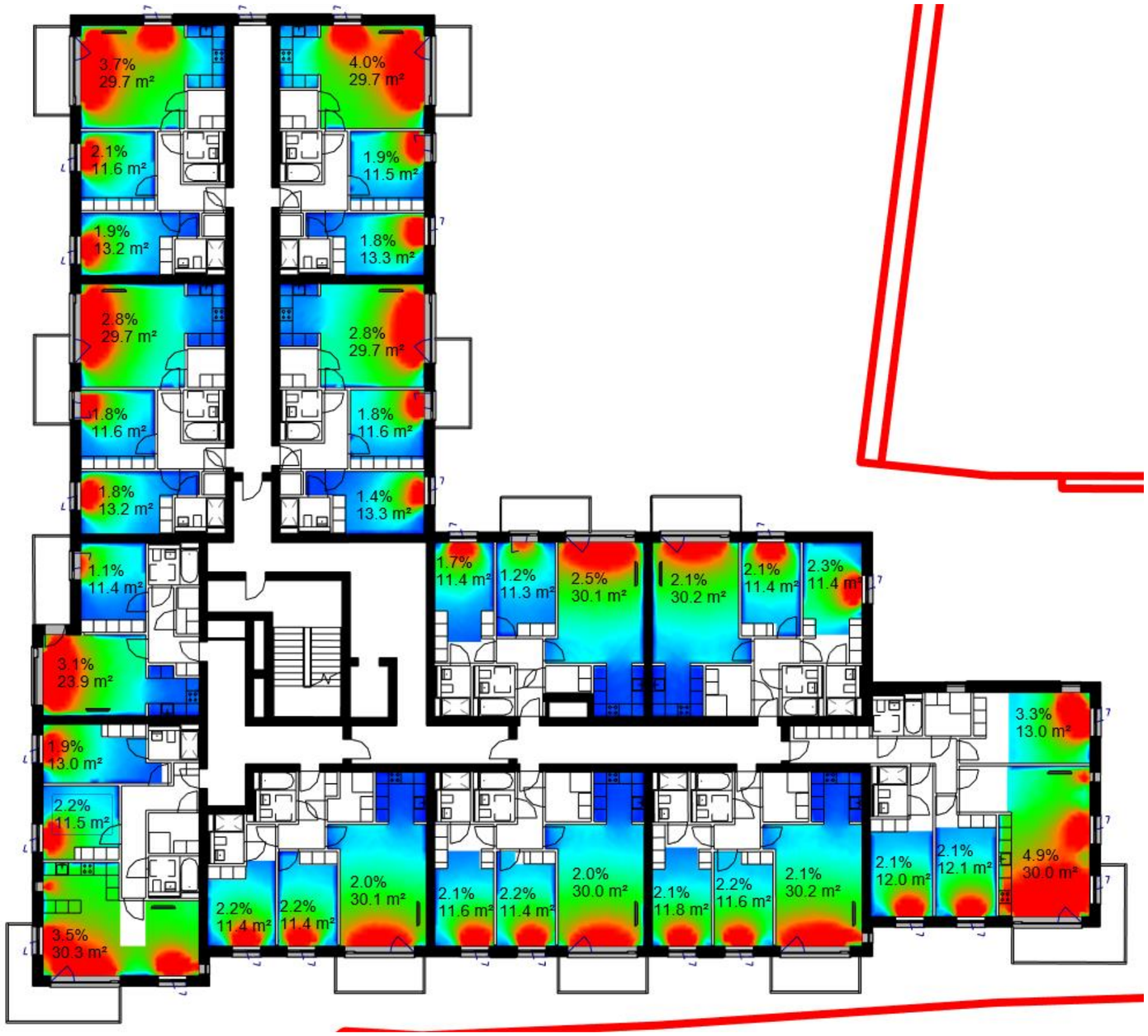
ADF Targets	
Bedrooms	> 1.0%
K/L/D Areas	> 2.0%

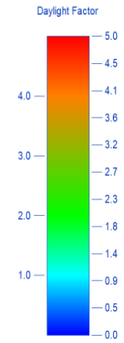
7.11 Block B



Third Floor

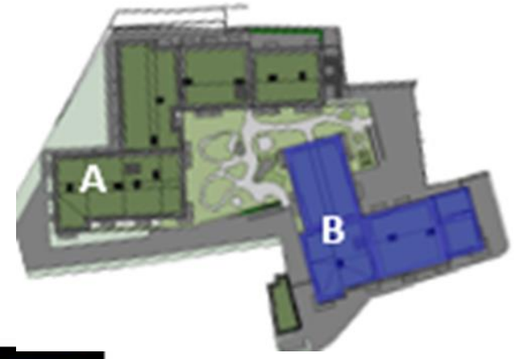
All spaces were found to exceed the BRE target values.





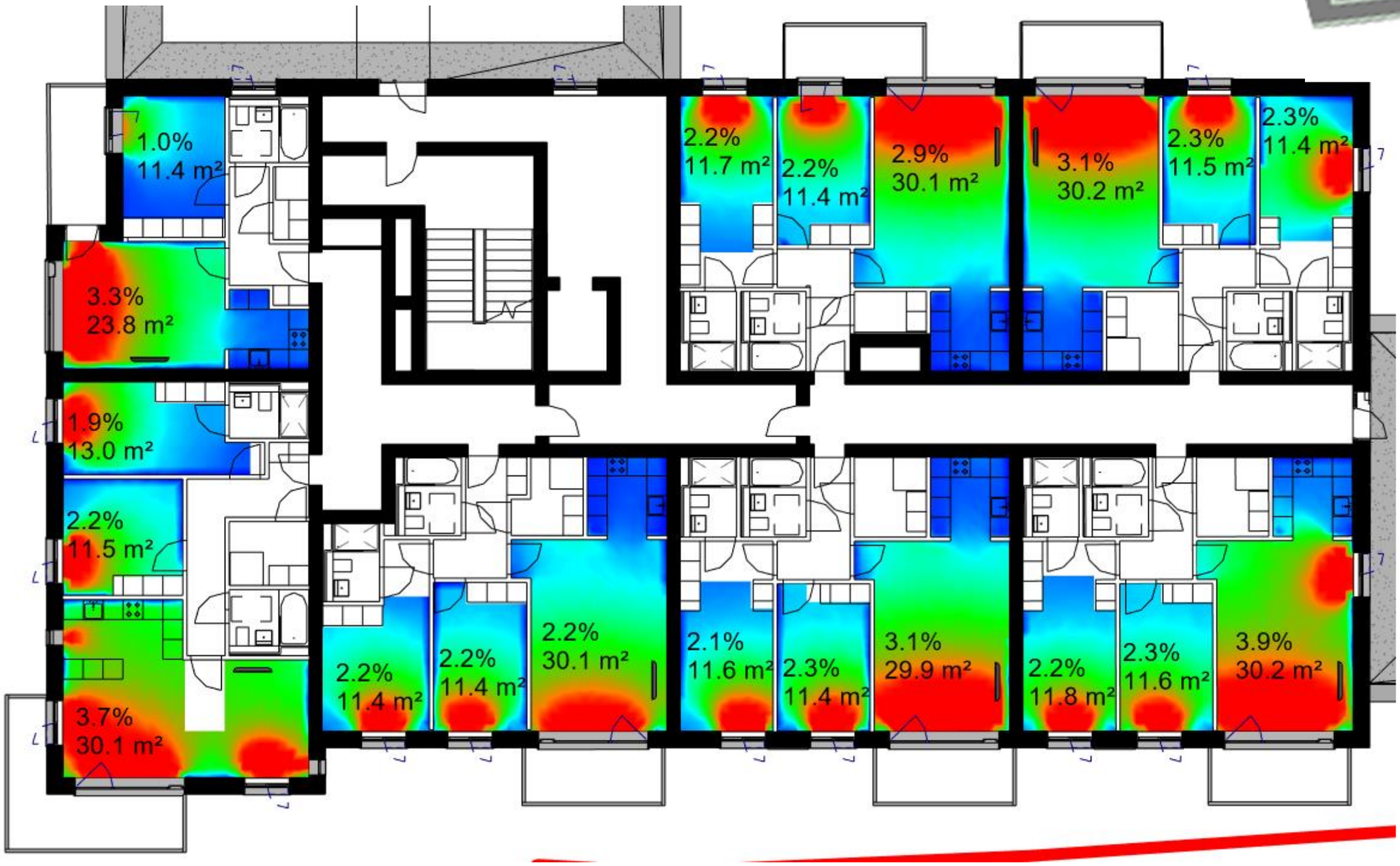
ADF Targets	
Bedrooms	> 1.0%
K/L/D Areas	> 2.0%

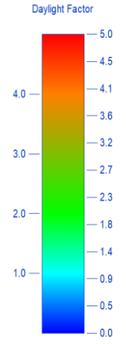
7.12 Block B



Fourth Floor

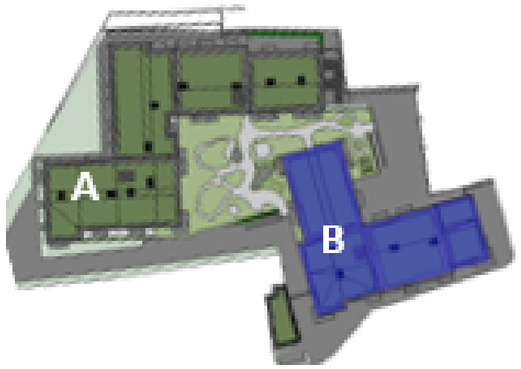
All spaces were found to exceed the BRE target values.





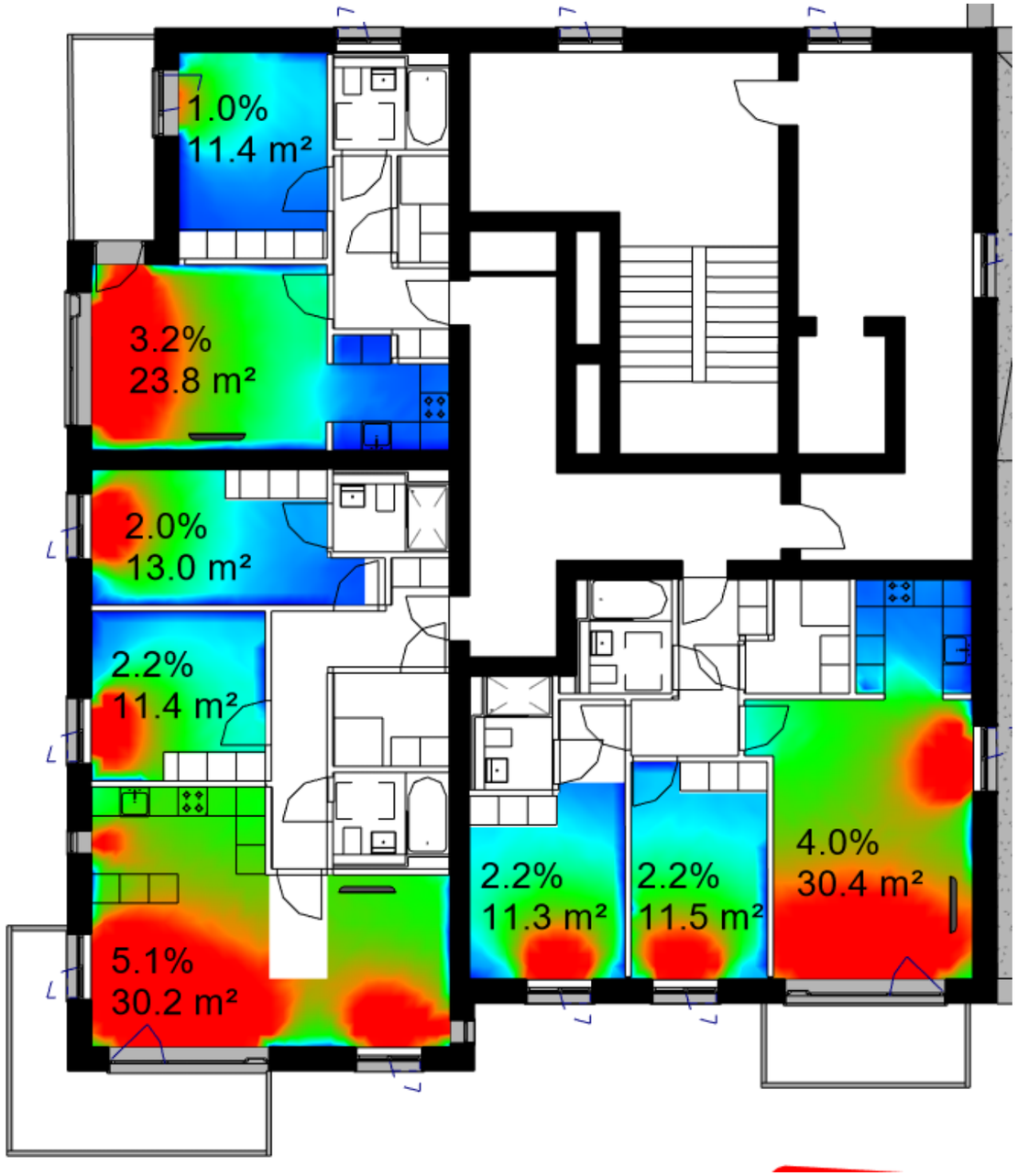
ADF Targets	
Bedrooms	> 1.0%
K/L/D Areas	> 2.0%

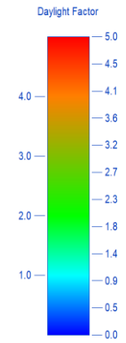
7.13 Block B



Fifth Floor

All spaces were found to exceed the BRE target values.





ADF Targets	
Bedrooms	> 1.0%
K/L/D Areas	> 2.0%

Appendix A – Alternative Daylight Calculations

Methodology

The proposed development has been assessed against the 3 Internal Daylight standards: BR 209, IS EN 17037, and BS EN 17037. The results for each standard are illustrated in Fig A.1. A comparison of the results of each of these assessments for every room analysed across the proposed development are presented in summary overleaf.

1. <u>BR 209</u>

Within Section 7.0, daylighting analysis was undertaken to determine Average Daylight Factors (ADF's) in accordance with BR 209, as referenced in the 2020 Apartment Guidelines. Based on the follow prescribed targets:

- ADF > 2.0% for Kitchen/Living/ Dining Areas (KLD)
- ADF > 1.0% for Bedrooms

- Overall Compliance for Proposed Development = 99%

2. <u>IS EN 17037:2018</u>

Alternative calculations have been provided for IS EN 17037 Method 1. It should be noted that IS EN17037 does not provide specific guidance for residential application and only provides one target value which is:

- MDF > 2.0% for All Spaces

This means that results are overly onerous for residential application.

- Overall Compliance for Proposed Development = 17%

3. <u>BS.EN.17037:2018</u>

However, BS EN 17037 NA specifically provides guidance for residential application. The prescribed targets are:

- MDF > 1.3% for KLD Areas
- MDF > 0.7% for Bedrooms

Although the MDF calculation used is more onerous than ADF, these results are comparable to those achieved for BR 209 (as contained in the body of this report).

- Overall Compliance for Proposed Development = 95%

Fig A.1 – Compliance Results for Each Standard

A.1 Block A

The tables below detail the results for all rooms in the development for all three methodologies with cells highlighted green for compliant and orange for non-compliant.

Block A		BS8206-2	BS EN 17037	IS EN 17037
Floor	Name	ADF (%)	MDF (%)	MDF(%)
Ground Floor	KLD	2.4	1.5	1.5
Ground Floor	KLD	3.4	2.5	2.5
Ground Floor	KLD	2.6	1.7	1.7
Ground Floor	KLD	2.7	1.6	1.6
Ground Floor	KLD	2.8	1.7	1.7
Ground Floor	KLD	2.8	1.6	1.6
Ground Floor	Bedroom	1.2	0.7	0.7
Ground Floor	Bedroom	1.4	0.9	0.9
Ground Floor	Bedroom	2.0	1.3	1.3
Ground Floor	Bedroom	2.3	1.6	1.6
Ground Floor	Bedroom	2.3	1.5	1.5
Ground Floor	Bedroom	3.2	2.4	2.4
Ground Floor	Bedroom	2.1	1.4	1.4
Ground Floor	Bedroom	1.3	1.0	1.0
Ground Floor	Bedroom	2.0	1.5	1.5
Ground Floor	Bedroom	2.0	1.6	1.6

Block A		BS8206-2	BS EN 17037	IS EN 17037
Floor	Name	ADF (%)	MDF (%)	MDF(%)
First Floor	KLD	3.3	2.9	2.9
First Floor	KLD	3.8	3.1	3.1
First Floor	KLD	2.1	1.5	1.5
First Floor	KLD	2.6	1.6	1.6
First Floor	KLD	2.7	1.7	1.7
First Floor	KLD	4.1	3.4	3.4
First Floor	KLD	2.0	1.5	1.5
First Floor	KLD	2.2	1.5	1.5
First Floor	KLD	2.1	1.6	1.6
First Floor	KLD	3.0	2.4	2.4
First Floor	KLD	2.5	1.6	1.6
First Floor	KLD	2.6	1.7	1.7
First Floor	KLD	2.6	1.7	1.7
First Floor	KLD	3.2	1.9	1.9
First Floor	KLD	2.6	2.3	2.3
First Floor	KLD	2.9	2.5	2.5
First Floor	KLD	2.3	2.1	2.1
First Floor	KLD	2.4	2.0	2.0
First Floor	KLD	2.3	1.6	1.6
First Floor	KLD	2.0	1.5	1.5
First Floor	Bedroom	3.5	2.8	2.8
First Floor	Bedroom	2.4	1.6	1.6
First Floor	Bedroom	3.1	2.3	2.3
First Floor	Bedroom	2.2	1.3	1.3
First Floor	Bedroom	1.7	1.0	1.0
First Floor	Bedroom	1.0	0.6	0.6
First Floor	Bedroom	1.1	0.8	0.8
First Floor	Bedroom	1.7	1.1	1.1
First Floor	Bedroom	1.5	1.2	1.2
First Floor	Bedroom	2.0	1.3	1.3
First Floor	Bedroom	1.5	1.2	1.2
First Floor	Bedroom	2.2	1.6	1.6
First Floor	Bedroom	2.0	1.3	1.3
First Floor	Bedroom	2.0	1.3	1.3
First Floor	Bedroom	1.7	1.0	1.0
First Floor	Bedroom	1.4	0.9	0.9
First Floor	Bedroom	1.2	0.7	0.7
First Floor	Bedroom	2.0	1.4	1.4
First Floor	Bedroom	2.3	1.7	1.7
First Floor	Bedroom	2.3	1.5	1.5
First Floor	Bedroom	3.3	2.6	2.6
First Floor	Bedroom	2.1	1.4	1.4
First Floor	Bedroom	1.1	0.8	0.8
First Floor	Bedroom	1.5	1.2	1.2
First Floor	Bedroom	1.6	1.3	1.3
First Floor	Bedroom	1.6	1.3	1.3
First Floor	Bedroom	2.3	1.5	1.5
First Floor	Bedroom	2.0	1.3	1.3
First Floor	Bedroom	2.4	1.7	1.7
First Floor	Bedroom	1.5	1.0	1.0
First Floor	Bedroom	1.5	0.9	0.9
First Floor	Bedroom	2.1	1.5	1.5
First Floor	Bedroom	1.1	0.9	0.9
First Floor	Bedroom	1.3	0.9	0.9
First Floor	Bedroom	0.9	0.6	0.6

Block A		BS8206-2	BS EN 17037	IS EN 17037
Floor	Name	ADF (%)	MDF (%)	MDF(%)
Second Floor	KLD	2.8	2.2	2.2
Second Floor	KLD	3.7	3.0	3.0
Second Floor	KLD	3.4	2.4	2.4
Second Floor	KLD	3.7	2.7	2.7
Second Floor	KLD	2.9	1.6	1.6
Second Floor	KLD	2.3	1.6	1.6
Second Floor	KLD	2.2	1.7	1.7
Second Floor	KLD	2.0	1.4	1.4
Second Floor	KLD	3.5	2.8	2.8
Second Floor	KLD	2.4	1.5	1.5
Second Floor	KLD	2.4	1.5	1.5
Second Floor	KLD	2.4	1.4	1.4
Second Floor	KLD	2.3	1.4	1.4
Second Floor	KLD	2.3	1.4	1.4
Second Floor	KLD	2.9	2.3	2.3
Second Floor	KLD	2.1	1.4	1.4
Second Floor	KLD	2.0	1.3	1.3
Second Floor	KLD	2.1	1.2	1.2
Second Floor	KLD	2.8	2.3	2.3
Second Floor	KLD	3.3	2.7	2.7
Second Floor	KLD	2.1	1.3	1.3
Second Floor	Bedroom	1.8	1.1	1.1
Second Floor	Bedroom	1.8	1.0	1.0
Second Floor	Bedroom	1.9	1.1	1.1
Second Floor	Bedroom	1.4	1.1	1.1
Second Floor	Bedroom	1.1	0.8	0.8
Second Floor	Bedroom	1.5	1.0	1.0
Second Floor	Bedroom	0.9	0.6	0.6
Second Floor	Bedroom	2.0	1.1	1.1
Second Floor	Bedroom	2.2	1.5	1.5
Second Floor	Bedroom	2.2	1.5	1.5
Second Floor	Bedroom	1.4	1.1	1.1
Second Floor	Bedroom	2.1	1.4	1.4
Second Floor	Bedroom	1.3	1.0	1.0
Second Floor	Bedroom	2.3	1.5	1.5
Second Floor	Bedroom	1.4	1.1	1.1
Second Floor	Bedroom	1.3	1.0	1.0
Second Floor	Bedroom	1.9	1.2	1.2
Second Floor	Bedroom	2.9	2.0	2.0
Second Floor	Bedroom	2.2	1.5	1.5
Second Floor	Bedroom	2.2	1.5	1.5
Second Floor	Bedroom	1.1	0.6	0.6
Second Floor	Bedroom	1.4	0.9	0.9
Second Floor	Bedroom	1.2	0.8	0.8
Second Floor	Bedroom	1.0	0.5	0.5
Second Floor	Bedroom	1.8	0.9	0.9
Second Floor	Bedroom	2.0	1.1	1.1
Second Floor	Bedroom	2.2	1.4	1.4
Second Floor	Bedroom	2.7	1.8	1.8
Second Floor	Bedroom	3.1	2.2	2.2
Second Floor	Bedroom	1.7	1.1	1.1

Block A		BS8206-2	BS EN 17037	IS EN 17037
Floor	Name	ADF (%)	MDF (%)	MDF(%)
Third Floor	Bedroom	2.7	1.7	1.7
Third Floor	KLD	2.5	1.9	1.9
Third Floor	KLD	2.0	1.4	1.4
Third Floor	KLD	3.5	2.8	2.8
Third Floor	KLD	2.4	1.5	1.5
Third Floor	KLD	2.4	1.5	1.5
Third Floor	KLD	3.3	2.7	2.7
Third Floor	KLD	2.8	2.3	2.3
Third Floor	KLD	2.1	1.2	1.2
Third Floor	KLD	2.0	1.3	1.3
Third Floor	KLD	2.0	1.3	1.3
Third Floor	KLD	2.7	2.2	2.2
Third Floor	KLD	2.2	1.3	1.3
Third Floor	KLD	2.8	1.6	1.6
Third Floor	KLD	2.9	1.5	1.5
Third Floor	KLD	4.8	3.7	3.7
Third Floor	Bedroom	1.7	1.2	1.2
Third Floor	Bedroom	1.6	1.0	1.0
Third Floor	Bedroom	1.0	0.6	0.6
Third Floor	Bedroom	2.1	1.2	1.2
Third Floor	Bedroom	2.2	1.4	1.4
Third Floor	Bedroom	2.3	1.6	1.6
Third Floor	Bedroom	2.3	1.5	1.5
Third Floor	Bedroom	1.3	1.1	1.1
Third Floor	Bedroom	2.1	1.4	1.4
Third Floor	Bedroom	1.3	1.0	1.0
Third Floor	Bedroom	1.8	1.1	1.1
Third Floor	Bedroom	3.1	2.2	2.2
Third Floor	Bedroom	2.7	1.8	1.8

Third Floor	Bedroom	2.2	1.4	1.4
Third Floor	Bedroom	2.1	1.2	1.2
Third Floor	Bedroom	1.9	1.1	1.1
Third Floor	Bedroom	1.0	0.5	0.5
Third Floor	Bedroom	1.2	0.8	0.8
Third Floor	Bedroom	1.4	0.9	0.9
Third Floor	Bedroom	1.1	0.6	0.6
Third Floor	Bedroom	2.1	1.5	1.5
Third Floor	Bedroom	2.2	1.5	1.5
Third Floor	Bedroom	2.2	1.4	1.4
Third Floor	Bedroom	2.9	2.0	2.0
Third Floor	Bedroom	1.9	1.2	1.2
Third Floor	Bedroom	2.1	1.4	1.4
Third Floor	Bedroom	2.1	1.5	1.5
Third Floor	Bedroom	2.1	1.5	1.5

Block A		**BS8206-2**	**BS EN 17037**	**IS EN 17037**
Floor	**Name**	**ADF (%)**	**MDF (%)**	**MDF(%)**
Fourth Floor	KLD	2.8	2.3	2.3
Fourth Floor	KLD	3.4	2.8	2.8
Fourth Floor	KLD	2.2	1.2	1.2
Fourth Floor	KLD	2.1	1.3	1.3
Fourth Floor	KLD	2.1	1.3	1.3
Fourth Floor	KLD	2.8	2.3	2.3
Fourth Floor	KLD	3.7	2.9	2.9
Fourth Floor	KLD	3.0	2.4	2.4
Fourth Floor	KLD	2.1	1.6	1.6
Fourth Floor	KLD	3.7	3.1	3.1
Fourth Floor	KLD	2.4	1.5	1.5
Fourth Floor	KLD	2.4	1.5	1.5
Fourth Floor	Bedroom	1.3	1.0	1.0
Fourth Floor	Bedroom	2.2	1.4	1.4
Fourth Floor	Bedroom	3.2	2.2	2.2
Fourth Floor	Bedroom	2.1	1.3	1.3
Fourth Floor	Bedroom	2.0	1.1	1.1
Fourth Floor	Bedroom	1.1	0.6	0.6
Fourth Floor	Bedroom	1.5	0.9	0.9
Fourth Floor	Bedroom	1.5	0.9	0.9
Fourth Floor	Bedroom	1.2	0.6	0.6
Fourth Floor	Bedroom	2.2	1.5	1.5
Fourth Floor	Bedroom	2.2	1.5	1.5
Fourth Floor	Bedroom	2.2	1.4	1.4

Fourth Floor	Bedroom	2.9	2.0	2.0
Fourth Floor	Bedroom	2.0	1.3	1.3
Fourth Floor	Bedroom	3.3	2.8	2.8
Fourth Floor	Bedroom	2.2	1.3	1.3
Fourth Floor	Bedroom	2.2	1.4	1.4
Fourth Floor	Bedroom	2.3	1.6	1.6
Fourth Floor	Bedroom	2.4	1.6	1.6
Fourth Floor	Bedroom	1.4	1.1	1.1
Fourth Floor	Bedroom	2.2	1.4	1.4
Fourth Floor	Bedroom	1.8	1.1	1.1
Fourth Floor	Bedroom	2.6	1.7	1.7

Block A		**BS8206-2**	**BS EN 17037**	**IS EN 17037**
Floor	**Name**	**ADF (%)**	**MDF (%)**	**MDF(%)**
Fifth Floor	KLD	3.0	2.5	2.5
Fifth Floor	KLD	2.0	1.3	1.3
Fifth Floor	KLD	2.7	1.5	1.5
Fifth Floor	KLD	2.9	1.7	1.7
Fifth Floor	KLD	2.5	1.9	1.9
Fifth Floor	KLD	4.3	3.2	3.2
Fifth Floor	KLD	2.3	2.0	2.0
Fifth Floor	KLD	3.4	2.8	2.8
Fifth Floor	KLD	2.5	1.5	1.5
Fifth Floor	KLD	2.5	1.5	1.5
Fifth Floor	KLD	3.9	3.2	3.2
Fifth Floor	KLD	2.1	1.7	1.7
Fifth Floor	Bedroom	2.2	1.3	1.3
Fifth Floor	Bedroom	2.1	1.2	1.2
Fifth Floor	Bedroom	1.2	0.6	0.6
Fifth Floor	Bedroom	1.5	1.0	1.0
Fifth Floor	Bedroom	1.6	1.0	1.0
Fifth Floor	Bedroom	1.4	0.7	0.7
Fifth Floor	Bedroom	2.2	1.5	1.5
Fifth Floor	Bedroom	2.3	1.6	1.6
Fifth Floor	Bedroom	2.2	1.4	1.4
Fifth Floor	Bedroom	2.9	2.0	2.0
Fifth Floor	Bedroom	2.0	1.2	1.2
Fifth Floor	Bedroom	3.3	2.8	2.8
Fifth Floor	Bedroom	2.2	1.3	1.3
Fifth Floor	Bedroom	2.2	1.4	1.4
Fifth Floor	Bedroom	2.7	1.8	1.8
Fifth Floor	Bedroom	3.3	2.2	2.2

Fifth Floor	Bedroom	1.8	1.1	1.1
Fifth Floor	Bedroom	1.3	1.0	1.0
Fifth Floor	Bedroom	2.2	1.4	1.4
Fifth Floor	Bedroom	1.4	1.1	1.1
Fifth Floor	Bedroom	2.3	1.6	1.6
Fifth Floor	Bedroom	2.4	1.7	1.7
Fifth Floor	Bedroom	2.3	1.5	1.5

Block A		**BS8206-2**	**BS EN 17037**	**IS EN 17037**
Floor	**Name**	**ADF (%)**	**MDF (%)**	**MDF(%)**
Sixth Floor	KLD	4.0	3.1	3.1
Sixth Floor	KLD	3.0	1.7	1.7
Sixth Floor	KLD	4.5	3.5	3.5
Sixth Floor	KLD	3.0	1.7	1.7
Sixth Floor	KLD	2.9	1.6	1.6
Sixth Floor	KLD	5.3	3.9	3.9
Sixth Floor	KLD	2.9	1.7	1.7
Sixth Floor	Bedroom	2.2	1.3	1.3
Sixth Floor	Bedroom	2.1	1.3	1.3
Sixth Floor	Bedroom	1.5	0.8	0.8
Sixth Floor	Bedroom	1.8	1.1	1.1
Sixth Floor	Bedroom	2.2	1.4	1.4
Sixth Floor	Bedroom	2.7	1.8	1.8
Sixth Floor	Bedroom	3.5	2.3	2.3
Sixth Floor	Bedroom	1.9	1.2	1.2
Sixth Floor	Bedroom	2.2	1.5	1.5
Sixth Floor	Bedroom	2.2	1.4	1.4
Sixth Floor	Bedroom	2.2	1.5	1.5
Sixth Floor	Bedroom	2.4	1.6	1.6
Sixth Floor	Bedroom	2.4	1.7	1.7

A.2 Block B

Block B		BS8206-2	BS EN 17037	IS EN 17037
Floor	Name	ADF (%)	MDF (%)	MDF(%)
First Floor	KLD	2.2	1.8	1.8
First Floor	KLD	2.9	2.5	2.5
First Floor	KLD	2.1	1.4	1.4
First Floor	KLD	2.4	1.1	1.1
First Floor	KLD	2.0	1.1	1.1
First Floor	KLD	3.8	3.3	3.3
First Floor	KLD	2.2	1.5	1.5
First Floor	KLD	2.1	1.5	1.5
First Floor	KLD	2.1	1.5	1.5
First Floor	KLD	3.7	2.9	2.9
First Floor	KLD	2.8	1.7	1.7
First Floor	KLD	2.2	1.4	1.4
First Floor	Bedroom	1.8	1.0	1.0
First Floor	Bedroom	1.0	0.7	0.7
First Floor	Bedroom	1.9	1.2	1.2
First Floor	Bedroom	1.8	1.1	1.1
First Floor	Bedroom	1.0	0.7	0.7
First Floor	Bedroom	1.8	1.1	1.1
First Floor	Bedroom	1.0	0.7	0.7
First Floor	Bedroom	1.1	0.7	0.7
First Floor	Bedroom	1.1	0.6	0.6
First Floor	Bedroom	1.9	1.3	1.3
First Floor	Bedroom	1.9	1.3	1.3
First Floor	Bedroom	3.1	1.9	1.9
First Floor	Bedroom	2.1	1.4	1.4
First Floor	Bedroom	2.0	1.3	1.3
First Floor	Bedroom	2.2	1.5	1.5
First Floor	Bedroom	2.1	1.5	1.5
First Floor	Bedroom	2.2	1.4	1.4
First Floor	Bedroom	2.1	1.3	1.3
First Floor	Bedroom	2.1	1.4	1.4
First Floor	Bedroom	2.1	1.4	1.4
First Floor	Bedroom	1.9	1.1	1.1
First Floor	Bedroom	1.7	1.0	1.0
First Floor	Bedroom	1.2	1.0	1.0
First Floor	Bedroom	1.7	1.0	1.0
First Floor	Bedroom	1.0	0.7	0.7
First Floor	Bedroom	1.7	1.1	1.1

Block B		BS8206-2	BS EN 17037	IS EN 17037
Floor	Name	ADF (%)	MDF (%)	MDF(%)
Second Floor	KLD	2.9	2.5	2.5
Second Floor	KLD	2.5	2.0	2.0
Second Floor	KLD	2.2	1.4	1.4
Second Floor	KLD	2.3	1.5	1.5
Second Floor	KLD	3.1	1.9	1.9
Second Floor	KLD	3.6	2.9	2.9
Second Floor	KLD	2.1	1.3	1.3
Second Floor	KLD	2.4	1.2	1.2
Second Floor	KLD	2.0	1.2	1.2
Second Floor	KLD	3.6	3.1	3.1
Second Floor	KLD	2.2	1.4	1.4
Second Floor	KLD	2.2	1.4	1.4
Second Floor	Bedroom	1.9	1.1	1.1
Second Floor	Bedroom	1.8	1.1	1.1
Second Floor	Bedroom	2.0	1.2	1.2
Second Floor	Bedroom	1.8	1.2	1.2
Second Floor	Bedroom	1.1	0.7	0.7
Second Floor	Bedroom	1.7	1.0	1.0
Second Floor	Bedroom	1.1	1.0	1.0
Second Floor	Bedroom	1.9	1.2	1.2
Second Floor	Bedroom	2.1	1.2	1.2
Second Floor	Bedroom	2.2	1.5	1.5
Second Floor	Bedroom	2.2	1.5	1.5
Second Floor	Bedroom	1.0	0.7	0.7
Second Floor	Bedroom	1.2	0.8	0.8
Second Floor	Bedroom	1.4	0.8	0.8
Second Floor	Bedroom	1.0	0.7	0.7
Second Floor	Bedroom	2.0	1.4	1.4
Second Floor	Bedroom	2.1	1.5	1.5
Second Floor	Bedroom	3.3	2.1	2.1
Second Floor	Bedroom	2.1	1.4	1.4
Second Floor	Bedroom	2.1	1.3	1.3
Second Floor	Bedroom	2.2	1.5	1.5
Second Floor	Bedroom	2.1	1.5	1.5
Second Floor	Bedroom	2.2	1.4	1.4
Second Floor	Bedroom	2.1	1.3	1.3

Block B		BS8206-2	BS EN 17037	IS EN 17037
Floor	Name	ADF (%)	MDF (%)	MDF(%)
Third Floor	KLD	3.7	2.9	2.9
Third Floor	KLD	2.8	1.7	1.7
Third Floor	KLD	3.1	1.9	1.9
Third Floor	KLD	3.5	2.8	2.8
Third Floor	KLD	2.0	1.3	1.3
Third Floor	KLD	2.0	1.3	1.3
Third Floor	KLD	2.1	1.3	1.3
Third Floor	KLD	4.9	3.7	3.7
Third Floor	KLD	2.1	1.2	1.2
Third Floor	KLD	2.5	1.3	1.3
Third Floor	KLD	2.8	1.7	1.7
Third Floor	KLD	4.0	3.1	3.1
Third Floor	Bedroom	2.1	1.3	1.3
Third Floor	Bedroom	1.9	1.2	1.2
Third Floor	Bedroom	1.8	1.1	1.1
Third Floor	Bedroom	1.8	1.1	1.1
Third Floor	Bedroom	1.1	1.0	1.0
Third Floor	Bedroom	1.9	1.2	1.2
Third Floor	Bedroom	2.2	1.3	1.3
Third Floor	Bedroom	2.2	1.4	1.4
Third Floor	Bedroom	2.2	1.4	1.4
Third Floor	Bedroom	2.2	1.4	1.4
Third Floor	Bedroom	2.1	1.3	1.3
Third Floor	Bedroom	2.2	1.4	1.4
Third Floor	Bedroom	2.1	1.4	1.4
Third Floor	Bedroom	2.2	1.5	1.5
Third Floor	Bedroom	2.1	1.3	1.3
Third Floor	Bedroom	2.1	1.4	1.4
Third Floor	Bedroom	3.3	2.1	2.1
Third Floor	Bedroom	2.3	1.6	1.6
Third Floor	Bedroom	2.1	1.4	1.4
Third Floor	Bedroom	1.2	0.9	0.9
Third Floor	Bedroom	1.7	1.1	1.1
Third Floor	Bedroom	1.4	0.8	0.8
Third Floor	Bedroom	1.8	1.1	1.1
Third Floor	Bedroom	1.8	1.0	1.0
Third Floor	Bedroom	1.9	1.1	1.1

Block B		BS8206-2	BS EN 17037	IS EN 17037
Floor	Name	ADF (%)	MDF (%)	MDF(%)
Fourth Floor	KLD	3.3	2.0	2.0
Fourth Floor	KLD	3.7	3.0	3.0
Fourth Floor	KLD	2.2	1.4	1.4
Fourth Floor	KLD	3.1	1.8	1.8
Fourth Floor	KLD	3.9	3.0	3.0
Fourth Floor	KLD	3.1	1.8	1.8
Fourth Floor	KLD	2.9	1.6	1.6
Fourth Floor	Bedroom	1.0	0.7	0.7
Fourth Floor	Bedroom	1.9	1.2	1.2
Fourth Floor	Bedroom	2.2	1.4	1.4
Fourth Floor	Bedroom	2.2	1.5	1.5
Fourth Floor	Bedroom	2.2	1.4	1.4
Fourth Floor	Bedroom	2.1	1.3	1.3
Fourth Floor	Bedroom	2.3	1.6	1.6
Fourth Floor	Bedroom	2.2	1.5	1.5
Fourth Floor	Bedroom	2.3	1.5	1.5
Fourth Floor	Bedroom	2.3	1.6	1.6
Fourth Floor	Bedroom	2.3	1.6	1.6
Fourth Floor	Bedroom	2.2	1.5	1.5
Fourth Floor	Bedroom	2.2	1.5	1.5

Block B		BS8206-2	BS EN 17037	IS EN 17037
Floor	Name	ADF (%)	MDF (%)	MDF(%)
Fifth Floor	KLD	3.2	2.0	2.0
Fifth Floor	KLD	5.1	3.6	3.6
Fifth Floor	KLD	4.0	3.2	3.2
Fifth Floor	Bedroom	1.0	0.8	0.8
Fifth Floor	Bedroom	2.0	1.3	1.3
Fifth Floor	Bedroom	2.2	1.3	1.3
Fifth Floor	Bedroom	2.2	1.5	1.5
Fifth Floor	Bedroom	2.2	1.5	1.5

Appendix B – Shadow Diagrams

Equinox March 21st

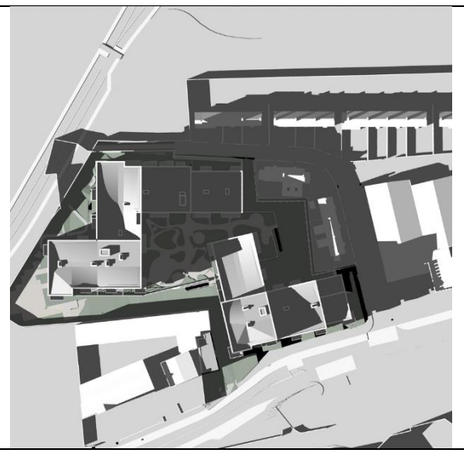
			
10:00	**11:00**	**12:00**	**13:00**
			
14:00	**15:00**	**16:00**	**17:00**

Fig B1: Sunlight and Site Shading Diagrams - Equinox (March 21st): 08:00-17:00 hrs

Summer Solstice June 21st

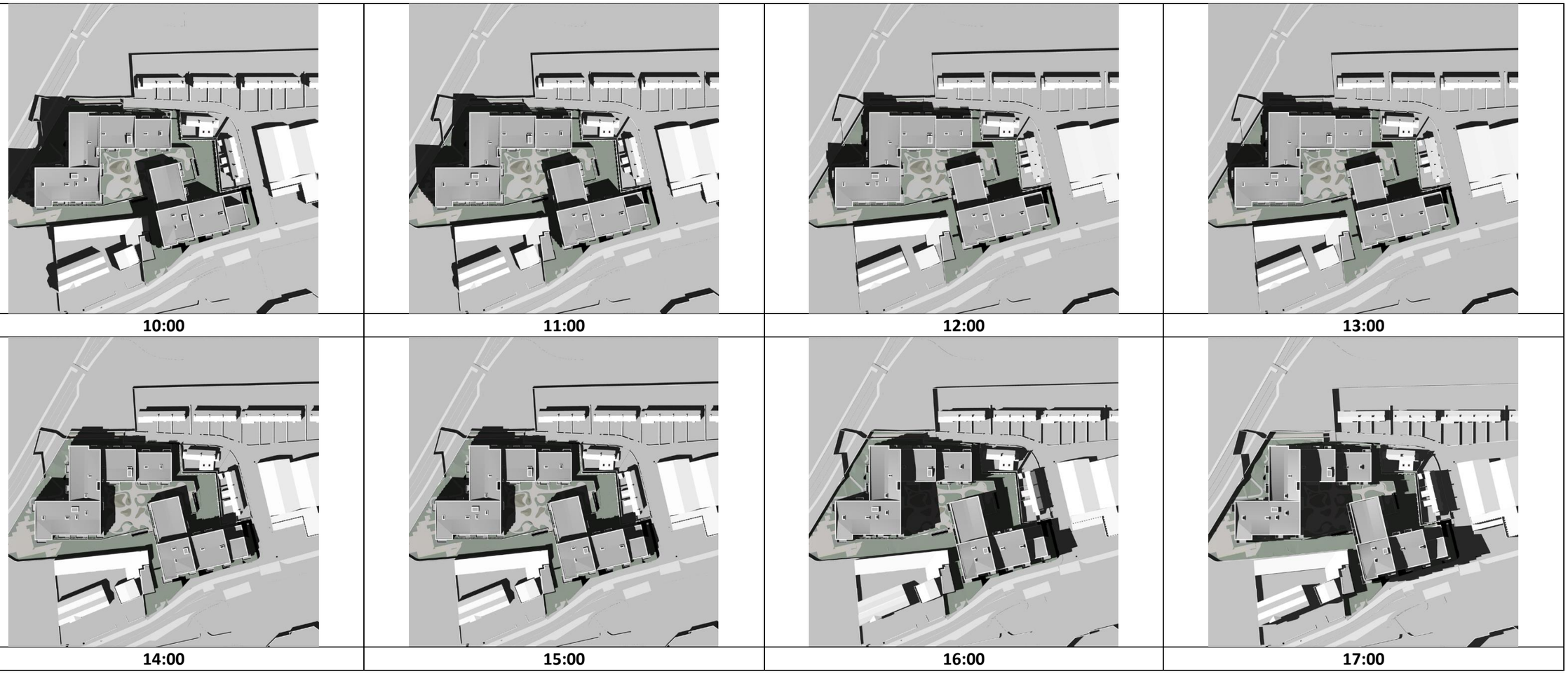


Fig B2: Sunlight and Site Shading Diagrams - Summer Solstice (June 21st): 08:00-17:00 hrs

Whilst both winter and summer solstices have been included, it should be noted that the statistics of Met Eireann, the Irish Meteorological Service, indicate that the sunniest months in Ireland are May and June. During December, Dublin receives a mean daily duration of 1.7 hours of sunlight out of a potential 7.4 hours sunlight each day (i.e. only 22% of potential sunlight hours). This can be compared with a mean daily duration of 6.4 hours of sunlight our of a potential 16.7 hours each day received by Dublin during June (i.e. 38% of potential sunlight hours). Therefore, impacts caused by overshadowing are generally most noticeable during the summer months and least noticeable during the winter months. Due to the low angle of the sun in mid-winter, the shadow environment in all urban and suburban areas are generally dense tending to make the images confusing and superfluous.

Winter Solstice December 21st

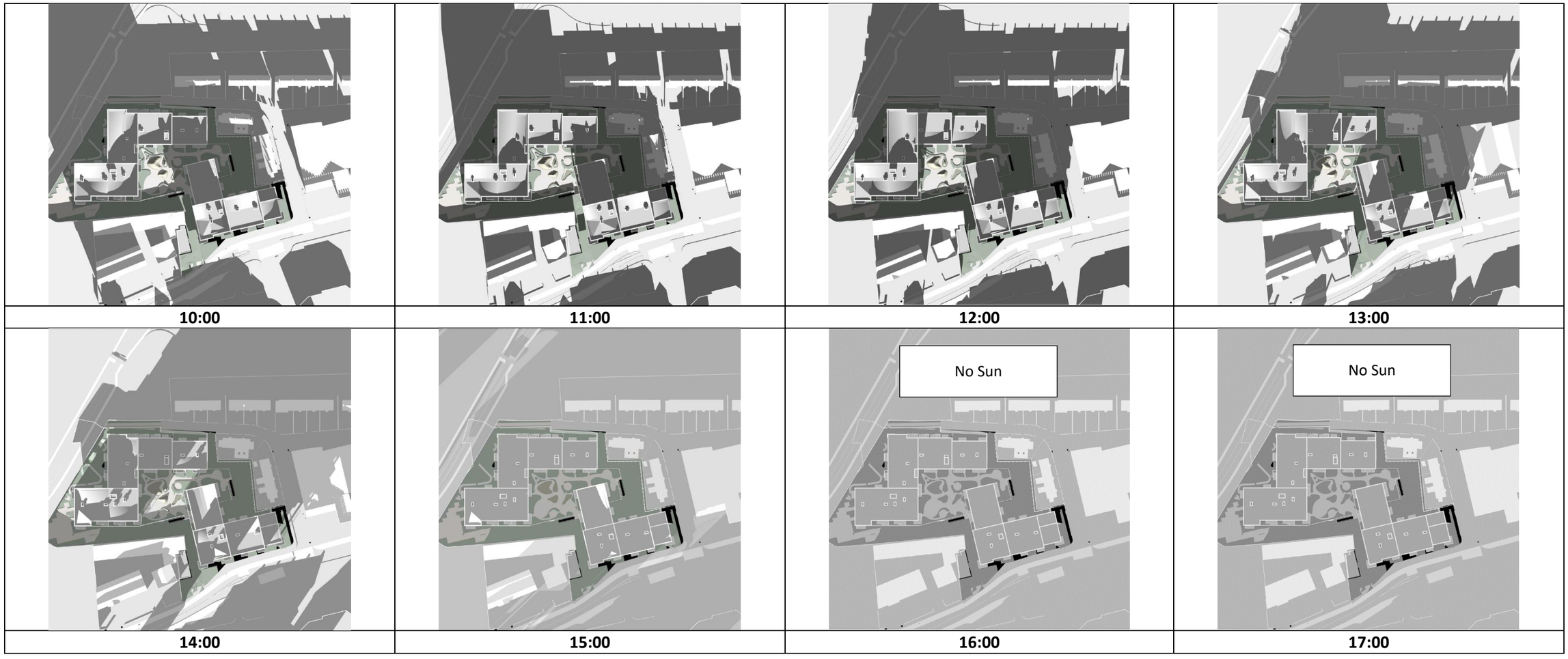


Fig B3: Sunlight and Site Shading Diagrams - Winter Solstice (December 21st): 08:00-17:00 hrs

Whilst both winter and summer solstices have been included, it should be noted that the statistics of Met Eireann, the Irish Meteorological Service, indicate that the sunniest months in Ireland are May and June. During December, Dublin receives a mean daily duration of 1.7 hours of sunlight out of a potential 7.4 hours sunlight each day (i.e. only 22% of potential sunlight hours). This can be compared with a mean daily duration of 6.4 hours of sunlight our of a potential 16.7 hours each day received by Dublin during June (i.e. 38% of potential sunlight hours). Therefore, impacts caused by overshadowing are generally most noticeable during the summer months and least noticeable during the winter months. Due to the low angle of the sun in mid-winter, the shadow environment in all urban and suburban areas are generally dense tending to make the images confusing and superfluous.