Introduction

Light defines space and time. Light, artificial or natural, is an indicator of time, and allows the body to complete the daily cycle of sleep and alertness. Appropriate lighting, ideally daylight, can contribute to health and wellbeing.

In creating new homes, especially in a dense, urban context, a holistic approach is required, considering the benefits of each aspect of the design from the perspective of all users.

Daylight and sunlight are very important elements of the user experience, but can require certain trade-offs with other considerations. If, for example, it is desirable to have access to a large proportion of daylight and sunlight in the habitable spaces of a new property, implying large windows, this may: require a reduced density in the built volumes (to avoid blocking the daylight); cause increased energy loss or potential overheating from solar gain, or; reduce the level of privacy enjoyed by occupants. Thus the final design needs to balance the various competing requirements.

Daylight and sunlight are very important in a dwelling as they:

- give occupants a sense of time and help regulate their circadian rhythms
- connect the inside of buildings to the external environment
- contribute to the well-being of occupants
- have the potential to boost the sustainability of a design
Key priorities for action

Provision and quality of daylight and sunlight are assessed by these elements:

- access to daylight
- uniformity of daylight
- access to sunlight
- access to views
- access to sunlight for open amenity areas

These are the fundamental points which are used to measure how successful a design is in providing a good daylight experience for occupants. Factors that influence the performance of sunlight and daylight are:

- massing of buildings
- layout of rooms
- orientation of windows
- size of windows and light transmission
- type of materials and room surfaces finishes
- external obstructions
- location of amenity areas

Thus the key priorities are to ensure that the building massing is suitable for the site, that exterior amenity areas are located in the least obstructed areas, that rooms have the correct proportion (i.e. that they are not too deep or narrow), that windows are sized correctly to balance daylight and solar gains and privacy, with good orientation for sunlight and privacy, that materials with high reflectance are used, and that external obstructions are minimised (for example by staggering balconies).

In general, the design will be carried out as an iterative process which will include consideration of the effects of the proposed design on its future users as well as the effects of the design on the surrounding properties.

Specific design advice

Planning stage

At preliminary planning stage the focus of the designer is in determining the appropriate building massing that meets programme requirements whilst not affecting the quality of daylight and sunlight for surrounding buildings users and future users of the proposed building.

There are a number of techniques which can be used to determine such volume so that the effects on surrounding properties are minimised.

Some of these techniques are more simplistic than others and use a basic geometrical construction: a tilted plane, drawn from the surrounding building windows, is used to determine the height of the proposed massing. In reality the problem is more complex than a simple geometrical construction and can be approached using other tools\(^1\), or simply by a trial and error process.

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\(^1\) For example, parametric tools which allow adjustment of the massing of a development by computational optimisation.
It should be noted that the BRE 209 methodology was designed for suburban and rural properties, and the recommended daylight factors within it can be challenging to achieve in dense, urban areas. In urban areas we recommend the establishment of an ‘urban signature’ by running an analysis of an existing urban setting with similar density and orientation to the one proposed. By doing so a set of suitable alternative targets, still based on the guidance of BRE 209, can be defined.2

In some cases, the proposed massing may reduce the light availability in surrounding properties. If this is the case, there may be scope for a ‘Right to Light’ litigation. The Right to Light is a particular type of Easement which gives a landowner the right to receive light through defined apertures in buildings on his or her land.3 There are methods to quantify the loss of light, but these methods are not suitable as design tools. The analytical methods to quantify the loss of light are illustrated in the document BRE 209.

Another element to consider in planning the massing of a development is glare (and solar focusing) due to solar reflections. Current guidance is lacking a common methodology to demonstrate glare from reflective facades. However, there are some methods which can be used to estimate the glare sensation to passing motorists, such as the Hassal method4. The technique can be used to check whether a design introduces glare to a defined observer located in the surrounding area of the proposed building.

The general advice is not to use highly reflective façade materials and to avoid parabolic geometries as these could focus sunlight to a very narrow area with risks of glare and overheating due to focused light. The orientation of any reflective façade should be assessed with sun path analysis to ensure that road users (or train or aircraft) are not hindered by the reflected sunlight.

Once the volume is set, then daylight and sunlight are refined looking at the proposed windows and rooms layout.

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2 Appendix F of BRE 209 (2011) suggests a methodology to define tailored daylight and sunlight targets.
3 For more on Right to Light see: https://www.gov.uk/government/publications/rights-to-light
4 Reflectivity, Dealing with rogue solar reflections, by David N. H. Hassall, 1991
**Daylight**

It is desirable for daylight to appear as the main source of light in a room during daylight hours. For this the size of the windows should be determined analytically.

Typically, this is achieved by means of the Average Daylight Factor (ADF) ratio. This metric is based on a ‘worst case scenario’ principle, thus it allows the designer to size windows (or re-configure room layouts) so that a certain amount of daylight will be available when the natural lighting is limited, such as on a dull, overcast day.

This metric does not consider the distribution of light in a room, nor the variability of light with weather and time or the sunlight contribution. Sunlight is assessed separately and will be discussed in the next section.

Current guidance and standards provide Average Daylight Factor (ADF) values for three typical room uses: kitchens, living rooms and bedrooms. These targets are minimum values, which should be exceeded by a design, although as stated earlier, this can be challenging in an urban context.

Targets are:

- >2% ADF for Kitchens
- >1.5% ADF for Living Rooms
- >1% ADF for Bedrooms

The general rule is that for a room to appear sufficiently daylit a value of at least 2% average daylight factor should be provided. A value of 5% or more is recommended whenever the expectation is to be able to switch off artificial lighting for most of the daytime. The BRE guidance states that an ADF over 6% is an indicator of situations where problems of overheating may occur, particularly where windows face south or west.\(^5\)

Meeting the average daylight factor minimum requirement ensures that the minimum daylight provision is achieved, but this is not a sufficient condition to describe the experience of daylight in a space.

In order to capture to some degree the quality of daylight in a space, another parameter is considered – the uniformity of daylight. Uniformity of daylight is measured by means of the ‘No-sky Line’ and by checking that the limiting depth of a room has not been exceeded. These two metrics look at the proportion of room that is left without direct view of the sky (No-sky Line) and the ratio of room width/height and depth. Typically, it is required to meet the following targets:

- No-sky Line ensuring 80% of the working plane surface (typically a plane 0.85m above the floor for residential properties) can see direct sky through the window;
- Assessment of room dimensions to ensure that the following formula is verified \(L/W + L/H \leq 2/(1-Rb)\), where \(L\), \(W\) and \(H\) are the length, width and height of the room, and \(Rb\) is the area-weighted average reflectance of the interior surfaces of the half of the room remote from the window. Note that windows are mostly effective when above the working plane and it is possible to improve a room’s daylight uniformity by having a higher ceiling and taller windows.

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\(^5\) A very high ADF indicates that the window area is large compared to the room surfaces, which means that the room is well exposed to daylight and direct solar penetration may be excessive, with the potential for overheating.
In order to provide good daylight uniformity, it is important that rooms are compact and not too deep. Most of the working plane should be exposed to direct view of the sky, often requiring windows to be located on more than one elevation, where possible. The room should avoid being too narrow and deep as this would exacerbate the contrast and render the space dull or dim.

Finishes of rooms are important and black rooms with a large windows will look darker than white rooms with the same size window.
One possible design workflow is to iteratively carry out the following process:

- Arrange rooms to meet programme requirements;
- Verify limiting depth requirement and re-arrange as necessary;
- Calculate ADF and size windows to exceed desired targets;6
- Calculate no-sky line distribution and adjust windows location to meet the requirements.
- Whilst striving for good levels of natural daylight, avoid window oversizing that may cause overheating.

6 Targets for ADF are defined by BS 8206-2. Normally the designer should try to achieve these targets.
Sunlight

Sunlight is generally desirable in a domestic space. In order to ensure that sunlight is available to a room, a suitable orientation of the building is key. Where limited sunlight is available, access to sunlight should be provided as a priority to living rooms and areas of the house which are likely to be used the most during the day.

The minimum amount of sunlight provided to a space is assessed as a percentage of the annual hours of sun which are available to a specific geographic area (i.e. considering local weather conditions and latitude). The usual rule is to provide a minimum of 25% of overall annual sunlight and 5% of winter sunlight. These targets are applied only to elevations facing within 90 degrees due South.

The BRE publishes methods\(^7\) to assess the sunlight availability for properties in the UK, and there are also a number computer-based methods to do this, using climatic weather data\(^8\).

Glare from sunlight is less of a concern for residential properties as windows are usually fitted with curtains or blinds and normally the occupants are free to locate furniture anywhere within the rooms. The provision of curtains or blinds is advisable to provide the flexibility for shading when needed.

Views

Views are driven by the external environment as well as by the size and placement of windows in a property. It may not be possible to provide a view over a park or a busy street if the neighbouring building is too close. As British Standard guidance suggests, having any view is better than having none and this is one of the key function of windows.

Windows should be located on the more pleasing elevation, to allow daylight but also views.

In locating windows, one other key element to consider is privacy – windows, needed to allow daylight and sunlight into a room, are of no use if curtains are always drawn for privacy.

Therefore, locating, angling or staggering windows may be necessary to provide privacy without the need to deploy curtains or blinds most of the time the space is occupied.

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\(^7\) BRE 209
\(^8\) Solar dazzle reflected from sloping glazed facades BRE IP 3/87.
Sunlight in external open areas

The quality of sunlight in open areas is determined by considering the percentage of area which has the potential to receive a minimum of 2 hours’ sunlight (3 hours in some jurisdictions) on the 21st of March (equinox).9

If this area is higher than 50%, then the open area is said to have sufficient solar penetration.10

In practice the massing of the proposed development and surrounding properties and the relative position of the open area are the main factors in determining the amount of solar penetration. Typically, an area which has an open view to the south will perform well. Areas that are facing north are unlikely to meet the requirement unless the East and West directions are completely free.

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9 Note that this is a planning target, it does not necessarily reassure quality. In order to better analyse the open area exposure to sunlight an alternative method based on shading masks may be used. See Assessing daylight and sunlight access in the built environment: a new tool for planners and designers, Compagnon, Longato Rotsch, Antonutto, PLEA, 2015
10 BRE 209
Further information and guidance

The following standards and guidance should be read in conjunction with this paper:

- Approved Document L1A: conservation of fuel and power in new dwellings, 2016
- Assessing daylight and sunlight access in the built environment: a new tool for planners and designers, Compagnon, Longato Rotsch, Antonutto, PLEA, 2015
- BRE 209, Site layout Planning for daylight and sunlight, a guide to good practice, 2011
- BREEAM, developed by the BRE, www.breeam.com
- Reflectivity, Dealing with rogue solar reflections, by David N. H. Hassall, 1991

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