Hawkins environmental

Daylight Assessment –36a Courthope Road, London

Dr Amit Patel

27th July 2010

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1. INTRODUCTION

Hawkins Environmental Ltd has been instructed by Dr Amit Patel to carry out a daylight assessment for the redevelopment of 36a Courthope Road, London.

The building is currently a number of flats, including a flat occupying the ground floor, with a basement. It is proposed to create an extension to the rear of the ground floor, as well as convert the basement into two bedrooms. During the planning process, the Planning Officer has raised concerns regarding daylighting and has requested that a daylight assessment for the basement bedrooms is conducted to determine whether the basement of the redevelopment will receive enough daylight.

2. THE NATURE AND EFFECT OF DAYLIGHT AND SUNLIGHT

The provision of daylight is as important as ensuring low levels of noise, or low levels of odour, in maintaining the enjoyment of one's property. Adequate levels of daylight are important not only to light and heat the home, but also for an occupant's emotional well being. Daylight is widely accepted to have a positive psychological effect on human beings and there is a great deal of evidence to suggest that people who are deprived of daylight are more susceptible to depression and mood swings. This is common in northern countries, such as Norway, Iceland and Canada where daylight is scarce during the winter months.

When assessing the effects of proposed building projects on the potential to cause issues relating to light, it is important to recognise the distinction between daylight and sunlight. Daylight is the combination of all direct and indirect sunlight during the daytime, whereas sunlight (for the purposes of this report) comprises only the direct elements of sunlight. On a cloudy or overcast day diffused daylight still shines through windows, even when sunlight is absent.

Any development within a built up area has the potential to alter the amount of daylight, direct sun and degree of overshadowing received by nearby residential properties. Care should be taken when designing new buildings in built-up areas, especially when the proposed development is relatively tall or situated to the south of existing buildings, as in the northern hemisphere the majority of the sunlight comes from the south. In the UK (and other northern hemisphere countries) south-facing facades will, in general, receive most sunlight, while north facing facades will receive sunlight on only a handful of occasions, specifically early-mornings and late evenings during the summer months.

It is therefore important to ensure that buildings to the south of any development do not cause an adverse amount of overshadowing to existing gardens and amenity areas, nor cause overshadowing to existing dwellings and therefore reduce their capacity to receive sunlight.

3. ASSESSMENT CRITERIA

3.1. National Policy

The Department for Communities and Local Government (DCLG) sets national planning policy. Their document 'The Planning System: General Principles (2005), published in conjunction with Planning Policy Statement 1: Delivering Sustainable Development, discusses the need to protect amenities in the public's interest, of which the need for daylight/sunlight could be considered one such amenity. However, the government does not have an adopted policy on daylight, sunlight and the effects of overshadowing, and does not have targets, criteria or relevant planning guidance, in the way it has for other environmental impacts such as noise, landscape or air quality. However three documents are relevant when considering daylight, sunlight and overshadowing in dwellings:

- **The Building Research Establishment (BRE) report, *"Site layout planning for daylight and sunlight – a guide to good practice"* by PJ Littlefair.** Although not Government guidance, this report is commonly referenced as the main guide in the UK in determining the minimum standards of daylight and sunlight and for determining the impact of a development;
- **British Standard BS 8206:2008 Lighting for buildings – Part 2: Code of practice for daylighting.** BS 8206:2008 contains guidance on the minimum recommended levels of interior daylighting and introduces some of the calculation procedures used in the BRE report;
- **The Code for Sustainable Homes – Technical Guidance.** The Code's Technical Guidance document determines its target criteria for well lit homes, building upon the calculation procedures within the BRE report and BS 8206:2008. It should be noted that the daylighting element of the Code is not mandatory.

3.2. The BRE Report

As this report is assessing the impact of a new development on an existing property, the BRE report is the appropriate guidance to use to assess daylight and sunlight. The BRE report contains guidance on how to design developments, whilst minimising the impacts on existing buildings from overshadowing and reduced levels of daylight and sunlight. As well as advice, the report contains a methodology to assess levels of daylight, sunlight and overshadowing, and contains criteria to determine the potential impacts of a new development on surrounding buildings. However, the report does state that the guidelines are not mandatory, but should be considered a guide to help rather than constrain the designer.

The BRE document looks at three separate areas when considering the impacts on lighting:

- **Daylight** – i.e. the impacts of all direct and indirect sunlight during the daytime;
- **Sunlight** – i.e. the impacts of only the direct sunlight; and
- **Overshadowing of Gardens and Open spaces**.

Appendix 2 details the BRE Report, including the methodologies and full details of the criteria. **Table 3.1** summarises the criteria used to assess the impacts from new development on the daylight and sunlight reaching existing properties.

Table 3.1: Summary criteria contained within the BRE Report to assess minimum levels of daylight and sunlight

Parameter	BRE Report Ref.	Criteria	Acceptability Criteria
Daylight	Section 2.2	Angle to sky from horizontal	Maximum 25°
		Vertical Sky Component (VSC)	Greater than 27%
	Appendix C	Average Daylight Factor (ADF)	Greater than 2%*
Sunlight	Section 3.1 & 3.2	Annual Probable Sunlight Hours (APSH) (Full Year)	Greater than 25%†
		Annual Probable Sunlight Hours (APSH) (Winter Months)	Greater than 5%†
Overshadowing	Section 3.3	Area of amenity space prevented from receiving any sun at all on the 21st March	Maximum 40%

*= Varies depends on room use. See **Appendix 2** for full details.
+= Whilst the BRE Report describes the methodology for determining the percentage of the Working Plane that is in full sun, it does not give an acceptability criterion. However, the Code for Sustainable Homes and BS 8206: 2008 suggests that each room requires a minimum of 80%.
†= Applies only to main living rooms, not to bedrooms, kitchens or other non-habitable rooms.

3.3. Assessment Criteria

Different daylight criteria should be used in different situations. The angle to the sky from the horizontal is an ideal assessment tool to determine whether a building has the potential to receive the minimum recommended levels of sunlight. If it fails the *"25° Rule"*, other assessment techniques can be applied.

When looking at the impact of one development on another, the VSC is commonly the most appropriate method to use, although this does have limitations as the calculation procedure only calculates the amount of light falling on the wall in question, it does not take into account the size of the windows or the size of the room that it is intending to light or the reflectance of the surfaces within the room to be lit. Consequently, it is possible to design a room that would be adequately daylit through sensible room and window design (e.g. shallow rooms and large windows, the use of highly reflective interiors, or the use of roof lights), but the VSC will still show a low level of light falling on the wall.

If the assessment is to determine whether a room in a proposed dwelling is adequately day lit, the ADF and the percentage of the working plane that is in full sun are the most accurate methods to determine daylight. However, these calculations rely on details plans of the room dimensions, window positions and window dimensions.

The criteria to assess levels of sunlight in a dwelling or overshadowing to a garden or outdoor amenity space remain constant regardless of whether the assessment is to determine if a new development impacts upon another or whether it assesses if a new development would be adequately sunlit.

3.4. Local Policy

Section 1.42 of the London Borough of Camden's Unitary Development Plan (Dated June 2006) states that regarding both daylight and sunlight, the Council will apply the standards recommended in the Building Research Establishment's 'Site Layout Planning for Daylight and Sunlight - A Guide to Good Practice' (1991). Consequently, the BRE report will the criteria used as the basis for this assessment.

4. CALCULATION INPUT DATA

The calculations are carried out utilising Hawkins Environmental's own calculation spreadsheets, based upon the methodology contained within the Building Research Establishment (BRE) report, *"Site layout planning for daylight and sunlight – a guide to good practice"* by PJ Littlefair and BS 8206-2:2008 Lighting for buildings – Part 2: Code of practice for daylighting. Full details of methods used can be found in these documents.

It should be noted that all distances, heights and locations required for all of the calculations in this report have been sourced from the proposed floor plans and elevations that will accompany the planning submission.

5. INTERIOR DAYLIGHTING REQUIREMENTS

To assess the amount of daylight within the proposed residential properties, two main assessment criteria have been utilised – one to assess the quantity of daylight in the room (the average daylight factor), the other to assess the distribution of daylight throughout the room (the room depth test).

5.1. Average Daylight Factor

The average daylight factor assessment has been calculated for all of the proposed development. The results of the assessment are detailed in **Table 5.1**. Under the BRE guidelines, the minimum ADF recommended for bedrooms is 1.0%. **Table 5.1** shows that both bedrooms achieve the minimum ADF of 1.0% for bedrooms.

Table 5.1: Daylight Factor Assessment

Room Identifier	Floor	Room Type	Average Daylight Factor
Bedroom 1	Basement	Bedroom	1.1%
Bedroom 2	Basement	Bedroom	1.0%

The ADF is calculated by the following formula provided within the Building Research Establishment (BRE) report, *"Site layout planning for daylight and sunlight – a guide to good practice"* by PJ Littlefair:

$$ADF = \frac{T A_w \theta}{A (1 - R^2)}$$

Where:

T is the diffuse visible transmittance of the glazing (normally 0.8);

A_w is the net glazed area of the windows (in m^2);

θ is the angle of visible sky in degrees;

A is the total area of room surfaces (in m^2), which includes walls, ceilings and floors; and

R is the average room reflectance (normally 0.5).

Whilst most of the values in the calculation are self explanatory, the angle of visible sky (θ) is more complicated to calculate. **Figure 5.1** graphically shows the angle of concern. θ (the angle of visible sky), can be calculated by subtracting β (the angle of sky obscured by the thickness of the wall) and α (the angle to the sky from the horizontal) from 90°. The angle to the sky from the horizontal is the most important angle, and this is a function of the height of the main obstruction to the window, as well as the distance to this obstruction. **Table 5.2** outlines how θ is calculated for each of the calculations. **Table 5.3** outlines the values used in the ADF calculation. As per the advice given in the BRE guidance, for Bedroom 1, three separate calculations have been carried out, as there are three separate windows servicing the bedroom. Bedroom 1 is serviced by a bay window, with one main window and two side windows.

Figure 5.1: Calculating the Angle of Visible Sky

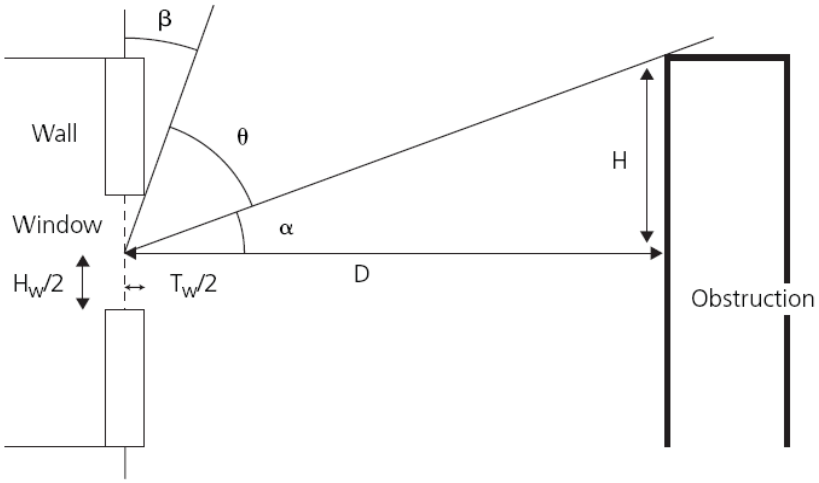


Table 5.2: Angle of Visible Sky Calculations

Parameter	Bedroom 1			Bedroom 2
	Main Window	Side Window 1	Side Window 2	
Distance to Obstruction	0.8m	1.1m	1.1m	2.2m
Height of Obstruction above Window Mid-Point	1.25m	1.25m	1.25m	4m
α (angle of sky to horizontal)	57.4°	48.7°	48.7°	61.2°
β (sky obscured by wall)	10.1°	10.1°	10.1°	6.5°
θ (angle of visible sky)	90° - 57.4° - 10.1° = 22.5°	90° - 48.7° - 10.1° = 31.2°	90° - 48.7° - 10.1° = 31.2°	90° - 61.2° - 6.5° = 22.3°

Table 5.3: Daylight Factor Calculations

Parameter	Bedroom 1			Bedroom 2
	Main Window	Side Window 1	Side Window 2	
T	0.8	0.8	0.8	0.8
A_w	1.54 m^2	0.7 m^2	0.7 m^2	2.42 m^2
θ	22.5°	31.2°	31.2°	22.3°
A	73.196 m^2	73.196 m^2	73.196 m^2	54.841 m^2
R	0.5	0.5	0.5	0.5

Therefore, for Bedroom 1 - Main Window:

$$ADF = \frac{0.8 \times 1.54\ m^2 \times 22.5°}{73.196\ m^2 \times (1-0.5^2)} = \frac{27.72}{54.897} = 0.5\%$$

Side Window 1:

$$ADF = \frac{0.8 \times 0.7\ m^2 \times 31.2°}{73.196\ m^2 \times (1-0.5^2)} = \frac{17.472}{54.897} = 0.3\%$$

Side Window 2:

$$ADF = \frac{0.8 \times 0.7\ m^2 \times 31.2°}{73.196\ m^2 \times (1-0.5^2)} = \frac{17.472}{54.897} = 0.3\%$$

Therefore, when taking into account all three windows, the ADF is 0.5% + 0.3% + 0.3% = 1.1%

For Bedroom 2:

$$ADF = \frac{0.8 \times 2.42\ m^2 \times 22.3°}{54.841\ m^2 \times (1-0.5^2)} = \frac{43.173}{41.131} = 1.0\%$$

5.2. Room Depth Calculations

In accordance with the BRE guidance, it is possible to determine whether a room has an adequate distribution of light, based upon it's depth. The following equation is used:

$$\frac{L}{W} + \frac{L}{H} \leq \frac{2}{1 - R_b}$$

Where:

L is the depth of the room;

W is the room width;

H is the head height of the window above the floor; and

R_b is the average reflectance of surfaces in the rear half of the room (commonly 0.5).

Presuming R_b is 0.5, the right hand side of the equation equals 4. Therefore, if the left hand side of the equation is equal to or less than 4, the room is evenly lit. If the left hand side of the equation exceeds 4, the rear half of the room will appear gloomy and supplementary electric lighting would be required.

Table 5.4 summarises the room depth calculations and shows that for each of the bedrooms, the factor is less than 4. Consequently it is possible to conclude that the room is a good size considering the size of the windows and the light within the rooms should be fairly well distributed.

Table 5.4: Room Depth Calculations

Room Identifier	Depth of Room	Width of Room	Window Head Height	$\frac{L}{W} + \frac{L}{H}$
Bedroom 1	4.5m	3.86m	2.1m	3.31
Bedroom 2	3.68m	3.17m	2.2m	2.83

6. CONCLUSIONS

Calculations have been conducted in accordance with the BRE guidelines to determine the extent to which the proposed redevelopment of 36a Courthope Road will retain good levels of daylighting in the basement area.

Calculations have shown that the Average Daylight Factor in both bedrooms within the basement meet the recommendations contained within the BRE Guidelines for bedrooms. Calculations also show that the room depths of these two rooms are adequate, such that the daylight within the room will be evenly distributed. Therefore, it is possible to conclude that the basement will be adequately daylit.

Appendix 1
The BRE Report

Appendix 1: The BRE Report

When considering daylight and sunlight assessments, reference is often made to the Building Research Establishment (BRE) report, *"Site layout planning for daylight and sunlight – a guide to good practice"* by PJ Littlefair.

The BRE report contains guidance on how to design developments, whilst minimising the impacts on existing buildings from overshadowing and reduced levels of daylight and sunlight. As well as advice, the report contains a methodology to assess levels of daylight/sunlight and contains criteria to determine the potential impact of a new development on surrounding buildings. However, the report does state that the guidelines are not mandatory, but should be considered a guide to help rather than constrain the designer.

A2.1 Daylight

Contained within the three relevant documents, there are three criteria and calculation procedures to determine levels of daylight. Each one has its limitations and are used in different circumstances. The criteria are:

- **The 25° Rule and the Vertical Sky Component**
- **Average Daylight Factor**
- **No-Sky Line and the Working Plane**

A2.1.1 The 25° Rule and Vertical Sky Component

The BRE report contains guidance on how to design developments, whilst minimising the impacts of existing buildings from overshadowing and reduced levels of daylight and sunlight, as well as ensuring developments are adequately daylit. The report suggests that in general, a building will have the potential for good interior diffuse daylighting providing that:

a) no obstruction, measured in a vertical section perpendicular to the main face, from a point 2m from the ground level, subtends an angle of more than 25° to the horizontal;

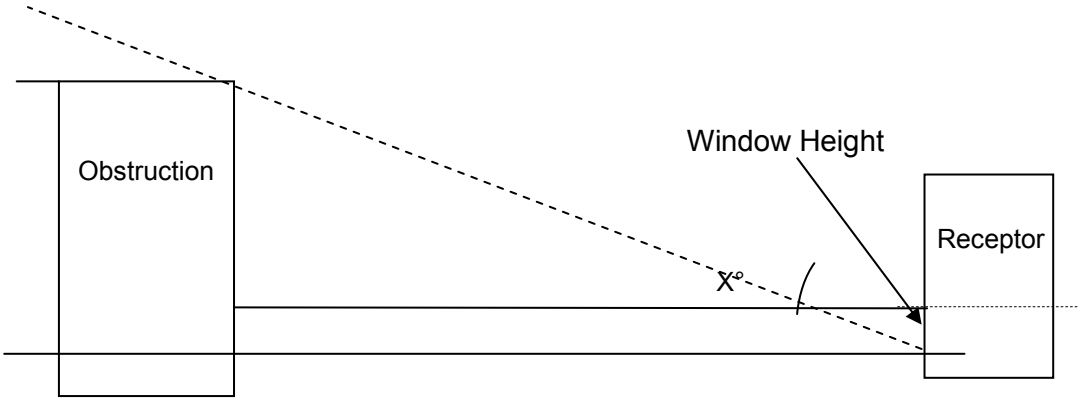
or

b) if a) is not satisfied, then all points on the main face on a line 2m above ground level are within 4m (measured sideways) of a point which has a Vertical Sky Component (VSC) of 27% or more.

The report contains a methodology for calculating the VSC, but also indicates that the methodology for calculating the levels of interior daylighting in BS 8206-2 should also be used where appropriate.

The report highlights a simplified procedure that can be used to screen new developments to determine whether a more detailed assessment is required. This screening method considers the extent to which the angle of view of the sky from the centre of the lowest window of the existing properties will be constrained by the new proposed buildings. If the new development subtends an angle of less than 25° to the horizontal from the lowest window of the existing property, then it is unlikely that the development will cause any substantive effects of the lighting of existing buildings; greater than 25° and further analysis will be required to determine the extent to which there will be a loss of daylight to the existing building. A schematic example of this calculation can be seen in **Figure A2.1**.

Figure A2.1: Schematic Example of Daylight Calculations



If the screening method determines that there may be an obstruction, the exact level of light can be calculated by determining the Vertical Sky Component (VSC). The BRE report highlights a number of ways to calculate the VSC, including the skylight indicator method and the Waldram Diagrams.

When undertaking a daylight assessment, the BRE report suggests a VSC of 27% or more should be achieved if a room is to be adequately day lit. It also suggests that when existing levels of daylight are below 27% VSC, a reduction of more than 20% from the existing level will be noticeable to the inhabitants, i.e. an impact will occur.

With regard to the surrounding properties, greater protection should be afforded to windows that serve habitable dwellings and, in particular, those serving living rooms and family kitchens. The tests can also be applied to non-domestic uses such as offices and workplaces where such uses will ordinarily have a reasonable expectation of daylight or sunlight. However, retail outlets such as shops and high street banks are not generally considered to have a reasonable expectation of daylight or sunlight. It is considered that retail outlets and point-of-sale displays do not rely on daylight or sunlight but on electric lighting. Assessment for daylight and sunlight is not therefore considered necessary in those instances.

The use of the VSC does have a number of limitations. For example, the calculation procedure only calculates the amount of light falling on the wall in question, it does not take into account the size of the windows or the size of the room that it is intending to light. Consequently, it is possible to design a room that would be adequately daylit through sensible room and window design (e.g. shallow rooms and large windows, or the use of roof lights), but the VSC will still show a low level of light falling on the wall. The VSC calculations do not take into account how designers may maximise the available light within a dwelling.

A2.2.2 Average Daylight Factor

The VSC only determines whether a room has the potential for good interior daylighting. The actual interior daylighting of the building can be checked by using the Average Daylight Factor (ADF) introduced in BS 8206: 2008.

The ADF is a very common and easy to understand measure for expressing the daylight availability in a room. It describes the ratio of outside illuminance over inside illuminance, expressed as a percentage. The higher the DF the more natural light is available in the room.

Rooms with an average DF of 2% give us a feeling of daylight. However, it is only when the ADF rises above 5% that we perceive it as well day lit. Different types of rooms have different minimum requirements for daylighting. **Table A2.1** details the acceptable criteria for average daylight factor for habitable rooms.

Table A2.1: Daylight Factor Criteria

Criteria	Minimum Daylight Factor
Predominantly daylight without the need for supplementary electric lighting	5%
With supplementary electric lighting: Suitable for kitchens Suitable for living rooms Suitable for bedrooms	 2% 1.5% 1%

A2.2.3 No-Sky Line and the Working Plane

Whilst the ADF and VSC determine the amount of daylight in a room, the no-sky line determines how well the daylight is distributed in the room. Areas beyond the no-sky line will generally look gloomy.

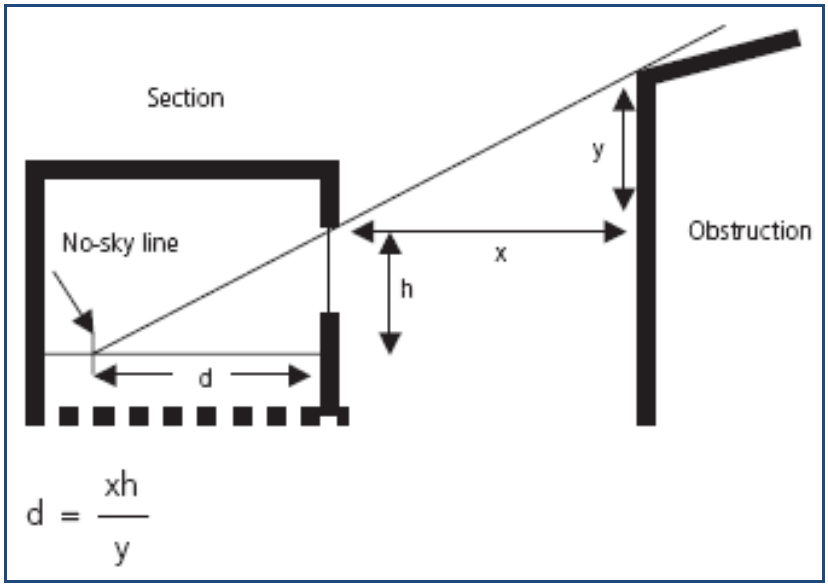
The working plane is a notional surface, typically at about desk or table height, at which the daylight factor or the 'no-sky line' is calculated or plotted. For calculations in dwellings, it is taken to be at a position 0.85 m above the floor.

The no-sky line divides those areas of the working plane which can receive direct skylight, from those which cannot. If the external obstructions already exist, it is possible to measure directly the position of the no-sky line in a room.

The assessment criteria for the working plane is detailed in the Communities & Local Government published report *Code for Sustainable Homes-Technical Guidance (2008)*. The minimum requirement stated by the guidance is 80% of the working plane in each kitchen, living room, dining room and study must receive direct light from the sky.

As an approximation, obstructions that are parallel to the window can be considered infinite. The no sky-line will then be parallel to the window at a distance 'd' from the window wall. **Figure A2.2** illustrates how the no-sky line can be calculated. If 'd' is greater than the room depth, then no part of the room lies beyond this *no-sky line*.

Figure A2.2: Pictorial calculation of the No-Sky Line



Where:

h = height of the window head above the working plane

y = height of the obstruction above the window head

x = distance from the window to the obstruction

A2.2 Sunlight

Whilst daylight is an essential element of all dwellings, sunlight is considered desirable rather than essential. The BRE report suggests that not all windows need to have access to direct sunlight and that direct sunlight is more desirable in living rooms and kitchens and less desirable in bedrooms.

When designing a new development or an extension to an existing building, the impact on the amount of sunlight received in the living areas of residential properties must be assessed, as residents are particularly likely to notice a loss of sunlight entering their homes.

Sunlight availability can be measured in Annual Probable Sunlit Hours (APSH). The APSH assessment determines the amount of probable sunlight that will shine on the window in a typical year.

The BRE report suggests that to ensure that a dwelling will appear reasonably sunlit, at least one main window wall should face within 90 º of due south and that the window receives at least 25% of the total APSH available during a given year, and at least 5% of the total APSH during the winter months. Consequently, not every window in a dwelling needs to achieve the minimum levels of sunlight, nor does every room in a dwelling.

When assessing the impact on sunlight from a new development on an existing development, if the levels with the development proposals include an APSH less than 0.8 times their former value, then the existing occupants will notice the loss in sunlight.

A2.3 Overshadowing of Gardens and Open Spaces

The effects of overshadowing and the loss of sunlight on open spaces and gardens should always be assessed as part of any sunlight or daylight assessment. Assessments should not restrict themselves to looking at just the effects on providing good natural lighting within buildings as sunlight in the spaces between buildings has an important impact on the overall appearance and ambience of a development.

The BRE guide recommends that no more than two-fifths (40%) and preferably no more than one quarter (25%) of any garden or other amenity area should be prevented from receiving any sunlight at all on 21st March. If, as a result of a new development, an existing garden or amenity area does not meet these guidelines, and the area which can receive some sun on the 21st March is less than 80% of its former value, the loss of sunlight is likely to be noticeable. The 21st of March is used as the assessment date as generally people only use outdoor amenity space during the summer months between 21st March and 21st September, and the 21st March is the date during the summer months when shadows are at their longest. Consequently, if the garden or outdoor amenity space is not significantly overshadowed on the 21st March, it will not be significantly overshadowed on other days between 21st March and 21st September.