Daylight

To increase occupant comfort and well-being with reduced energy demand

What's included in this fact sheet:

This fact sheet will help you understand the importance of internal daylight and how to make the right design decisions to optimise daylight performance. It will provide tangible examples of the most common design parameters and demonstrate how these can increase or decrease the daylight amenity of a space.

Why is designing for good internal daylight levels so important?

Good access to natural light is essential to your wellbeing at home and at work. Daylight is vital for body functions, gives us a sense of time and place assisting with the regulation of the body's natural rhythm. Known as circadian rhythm, it is an internal process that regulates the sleep-wake cycle and repeats roughly every 24 hours, connecting us to our environment. Studies have also shown that light exposure has an impact on mood and reduces symptoms of depression in individuals. Additionally, exposure to light has been directly linked with health and can affect how we recover and heal.

There is no question that daylight has a positive impact on humans. But indirectly, it also impacts on our environment. Rooms that have little access to daylight depend on artificial lighting throughout the day. Unfortunately, artificial lighting not only uses energy, but also radiates heat into the room. During summer months this additional heat then has to be compensated by an increase in air-conditioning usage, which requires even more energy.

It is clear that daylight is not only a matter of internal amenity, energy efficiency, health and wellbeing, but also of long-term energy and cost savings. As the density and scale of buildings and localities increase, access to daylight and winter sun typically decreases. Developments therefore must be sited and designed to optimise solar and daylight access for dwellings and open spaces, considering climatic conditions, both within the development and for adjoining properties and urban spaces.

What is daylight?

Designing for daylight considers subjective qualities, such as privacy and views to the outside, as well as objective and measurable qualities, such as energy use for artificial light and the intensity of natural daylight. When considering visual comfort, take into account factors such as illumination levels, daylight distribution, and protection against direct sunlight and glare.

When designing for good daylight it is important to consider the different definitions of daylight and how they are utilised for good design outcomes.

Solar access is the ability of a building to receive direct sunlight without obstruction from other buildings or impediments, not including trees.

Sunlight is direct beam radiation from the sun.

Daylight consists of sunlight and diffuse (indirect) light from the sky. Daylight changes with the time of day, season and weather conditions.

How do we measure internal daylight levels?

Internal natural daylight is measured as a daylight factor. The daylight factor represents the proportion of the external daylight that reaches an internal space. It is simply how much of the outside light reaches a spot inside a room, measured as a percentage.

For instance, at a position with a 1% daylight factor, where the external overcast sky provides 10,000 lux, that position receives 1% x 10,000 lux = 100 lux of daylight illumination.

A common assumption is that north facing rooms have a greater daylight factor than those facing south. While the internal illuminance in a north facing room will likely be greater for much of the year, the daylight factor is actually the same.

This is because the daylight factor is simply how much of the outside light reaches inside. North facing rooms will usually have more light outside them, compared to a south facing room. Daylight factor is commonly calculated with a "worst-case" scenario assumption of a uniform overcast gloomy sky.

In Victoria, a design value of 10,000 lux is used for the outside (external) illuminance. A daylight factor of 0.5% translates to an illuminance of 50 lux. Typical best practice lighting levels for an office workspace is 320 lux and can be made up of both natural and artificial lighting.

Daylight autonomy is another measure used to determine the daylight amenity to a space, different to the daylight factor, daylight autonomy describes the percentage of floor area that receives a certain daylight illuminance across the nominated area.

There are a number of free alternative methods for calculating the daylight amenity that is being achieved. The VELUX Daylight Visualizer is a professional lighting simulation tool for the analysis of daylight conditions in buildings and is available for free download.

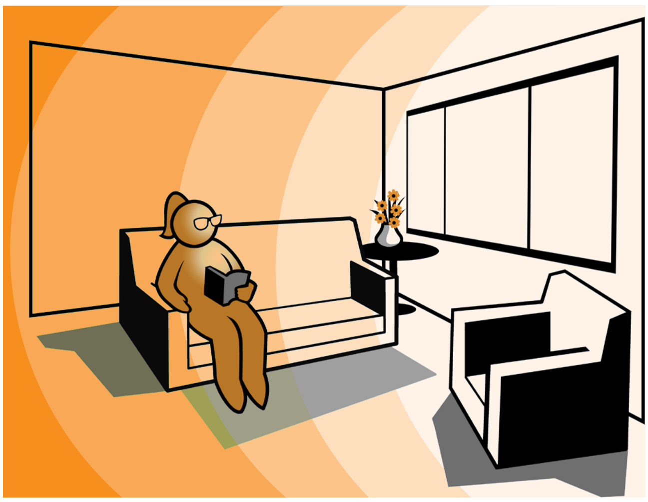
Alternatively, the Green Building Council of Australia Daylight and Views Hand Calculation guide methodology can be used to identify areas within a development with high levels of daylight access, or problematic areas with low daylight amenity. The guide is also free to access for all users. To find out more, refer to the Where Can I Find Out More Section at the end of this fact sheet.

Other design issues

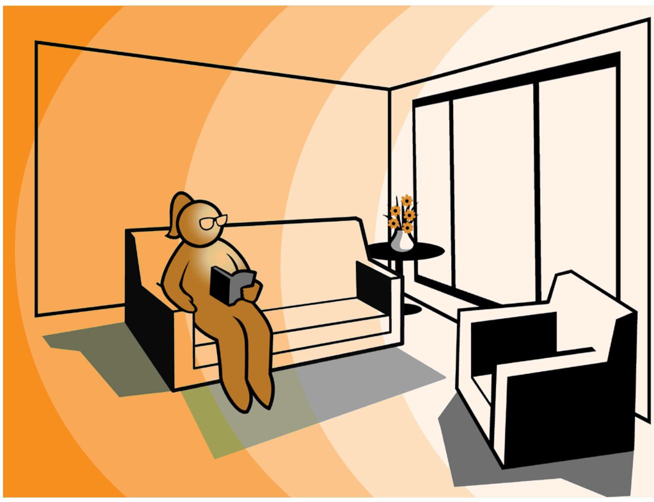
When designing for daylight care should be taken to avoid too much glare, particularly for offices and other workplaces. Careful sizing and placement of windows can assist to manage glare, as can external shading devices such as louvers and fins that can control glare without reducing daylight levels.

Protection of privacy is another important design consideration that can lead to poor internal daylight. If privacy screening is deemed necessary to protect privacy, consider the use of opaque glazing or carefully spaced external fixed louvers that do not block access to daylight.

“A common assumption is that north facing rooms have a greater daylight factor than those facing south... the daylight factor is actually the same.”



50% window to wall ratio



90% window to wall ratio

Best practice design for optimizing daylight

How early design decisions influence access to daylight?

The daylight factor is influenced by many early design decisions. The following sections will help you visualise how the daylight factor increases or decreases through:

- A window's size and location
- Orientation
- Building separation
- Glazing selection
- The design of balconies
- Battle axe rooms
- Light wells.

Daylight factor is not only impacted by a window's size, but also by its location. The daylight factor increases dramatically with an increase in the window size from 30% of a wall's size to 50% and 70% of the wall area. It is interesting to note, however, that no great improvement is achieved with a fully glazed facade. This is because light that enters on the lower levels of a room, does not reach far into a room's depth. It is therefore recommended to locate windows as high as possible and to avoid fully glazed facades due to unnecessary heat gains during summer and heat losses during winter. Ideally an optimal window size balances access to daylight with these heat gains and losses. A good 'rule of thumb' is to design window area (m^2) to be approximately 20% of the room's floor area.

Windows are complex and interesting elements in the fabric of a home or office. They let in daylight and fresh air and offer views that connect interior living spaces with the outdoors.

However, windows can be a major source of unwanted heat gain in summer and significant heat loss in winter, particularly in Victoria's often changing weather patterns.

While a near fully glazed facade provides optimal daylight levels, it also attracts those unwanted heat gains during summer. Therefore, tinted glazing should not be the answer to this problem. Instead, a flexible external shading system should be applied. This way, heat gains can be managed differently throughout the year and the daylight factor is not compromised when needed. For office buildings, external operable or fixed shading can control both the glare and heat during summer.

The three main principles of energy smart window design are listed below:

- Maximise winter heat gain by orienting windows to the north and sizing windows to suit the necessary heat gain during winter while also considering the unwanted heat gain during summer
- Minimise winter heat loss through appropriate window sizing, together with double glazing, high performing thermally broken frames and/or close-fitting internal coverings such as drapes with pelmets
- Minimise summer heat gain by protecting windows with external shading devices, specifying glazing with appropriate solar heat gain coefficient and the sizing and positioning of windows. Refer to Fact Sheet 2.1 Sun Shading for further information.

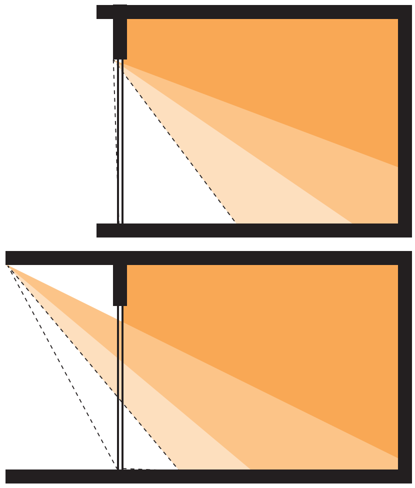
Design of balconies

The design of balconies and other obstructions impact on daylight access.

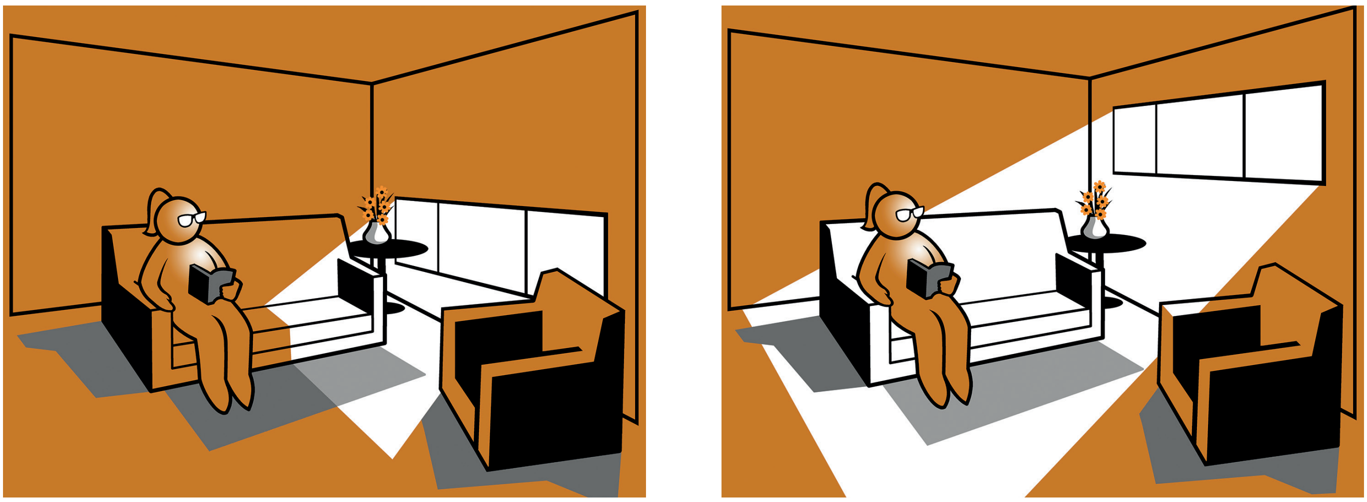
Windows without any obstructions, including balconies, winter gardens, fixed shading elements or design features achieve the best daylight factor.

While good daylight is not the only design intention, it needs to be taken into consideration carefully.

Any obstruction, such as enclosed balconies or adjacent buildings, can significantly decrease daylight entering a room or an entire dwelling.



Daylight with and without balcony



Window location comparison (low level vs high level)

Best practice design for optimizing daylight

Orientation

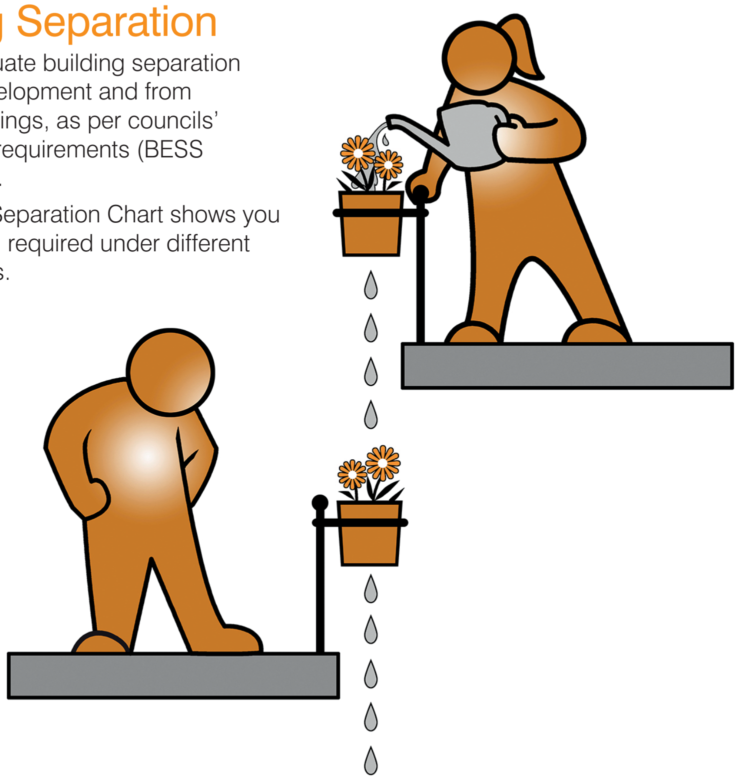
Follow these design guidelines to achieve a good design outcome when considering daylight:

- Orientate buildings to maximise north facing windows.
- Provide adequate building separation within the development and from adjacent buildings. Using dual aspect apartments when the long elevation of the building faces east and west.
- Use dual aspect apartments when the long elevation of the building faces east and west.
- Avoid single aspect apartments with a southern aspect.
- Consider the glazing performance to ensure good daylight amenity is achieved in the space and ensuring good daylight amenity is achieved in the space while considering the thermal performance.

Building Separation

Provide adequate building separation within the development and from adjacent buildings, as per councils' best practice requirements (BESS requirements).

The Building Separation Chart shows you the separation required under different circumstances.



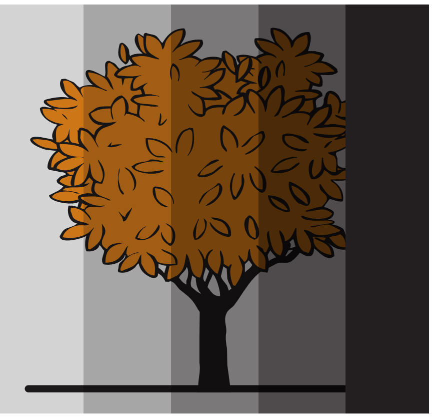
Building Separation Chart

Building Height	**Building Separation to Lane** (from lane centre line)	**Minimum Building Separation** (Measured from property boundary)	**Building Separation for Buildings Within Sites**
Up to 4 storeys/ 12 m		Main outlook: 6 m Bedroom outlook: 3 m	Main outlook to Main outlook: 12 m Main outlook to bedroom outlook: 9 m Bedroom outlook to bedroom outlook: 6 m Main outlook to no outlook: 6 m Bedroom outlook to no outlook: 3 m
5-8 storeys/up to 25 m	Main outlook: 6 m Bedroom outlook: 3 m	Main outlook to bedroom outlook: 9 m Bedroom outlook: 4.5 m	Main outlook to Main outlook: 18 m Main outlook to bedroom outlook: 13.5 m Bedroom outlook to bedroom outlook: 9 m Main outlook to no outlook: 9 m Bedroom outlook to no outlook: 4.5 m
9+ storeys/ over 25 m	Main outlook: 9 m Bedroom outlook: 6 m	Main outlook: 12 m Bedroom outlook: 6 m	Main outlook to Main outlook: 24 m Main outlook to bedroom outlook: 18 m Bedroom outlook to bedroom outlook: 12 m Main outlook to no outlook: 12 m Bedroom outlook to no outlook: 6 m

*Main outlook includes living rooms and main balconies

> "It's not easy getting the balance between daylight, ventilation, heat gains and losses right when designing facades and windows. It's however absolutely worth it finding the sweet spot between all considerations when aiming for high levels of occupancy comfort and energy efficiency."

Building design details can help maximise the amount of daylight that enters a room



Visual Light transmission

Glazing Selection

Many designers specify tinted glazing because of the need to reduce heat gains during summer in order to meet National Construction Code energy efficiency requirements.

Unfortunately, tinted glazing reduces the amount of daylight that enters the room.

Tinted glass can reduce heat in summer with a low solar heat gain coefficient (SHGC) but will also commonly have a low visible light transmission (VLT) as well. Visible light transmission is the percentage of light travelling through the glass.

As a rule of thumb, the lower the SHGC, the lower the VLT. Daylight levels significantly decrease with the use of glazing with a VLT of 40% (e.g. grey tinted glazing) over the use of clear glazing with a VLT of 80%.

Therefore, the implementation of external and flexible shading elements as an alternative, can result in the specification of glazing with a higher SHGC and VLT while still managing the heat gain through the façade. Refer to fact sheet 2.2 Building Envelope Performance for further information.

Battle axe rooms

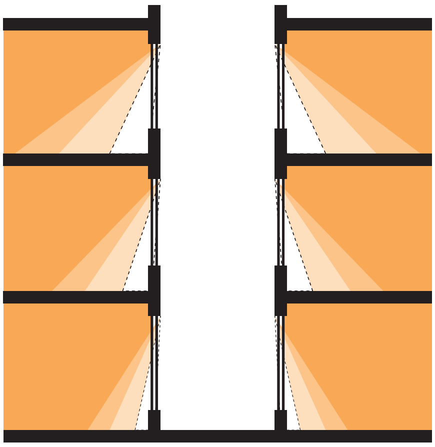
Battle axe rooms have greater access to daylight and natural ventilation than internal bedrooms.
Nevertheless, the daylight factor can remain low. Especially in the areas without direct visual connection to the window, artificial lighting is often required throughout the day.

Battle axe rooms should be avoided and only represent an exception in any development. If battle axe bedrooms are to be specified for a development, the maximum length of the battle axe bedroom handle should not exceed 1.5 times the width of the handle to achieve the minimum daylight standard to the bedroom as shown in the Battle axe room diagram.

Battle axe room with indicative daylight access shown

Light wells

While reliance on light wells can increase a property's usable floor space and financial yield, it can also decrease the internal amenity of rooms they serve. Common issues are ineffective natural ventilation, reduced privacy and significantly reduced daylight factors, especially when the light well is deep, reaching up to the sky through multiple levels of a building. The daylight factor is greatly impacted by the height and the width of a light well. For instance, lower level apartments have much lower levels of daylight than upper floor apartments.



Light well with indicative daylight access shown

Building material reflectance values in light wells

Another consideration to enhance the performance of light wells to enhance daylight amenity is the reflectance values of the walls and surfaces within the light well to ensure adequate daylight penetration to the lower levels. To enhance the daylight amenity into the rooms that rely on daylight penetration from the light wells the surfaces within the light well should have a reflectance value of greater than 0.6.

An easy way to ensure this is being met is to paint the surfaces of the light wells white.

The previous examples clearly show how sometimes even small and early design decision influence the quality of internal living spaces. Council therefore encourages applicants, designers and engineers to carefully think about daylight outcomes and meet our best practice standards.

Best practise standards and more information

Mandatory Requirements and Council's Best Practice Standards

Council's Best Practice Standards

You should aim to achieve a minimum daylight factor of 1% for 90% of the floor area in each living area including kitchens, and a minimum daylight factor of 0.5% for 90% of the floor area for each bedroom. A daylight modelling report for large scale developments may be required. Please refer to Daylight modelling for planning permit applications for further information.

For non-residential developments, you should aim to achieve a daylight factor of at least 2.0% for at least 30% of the floor area of regularly occupied primary spaces.

Modelling requirements

- Model adjacent buildings per their likely developed form based on current zoning (mirrored)
- Show full extent of internal room modelled

Use the following standard reflectance values:

- Ground plane: 0.1
- External walls and obstructions: 0.4
- Floor: 0.3
- Wall: 0.7
- Ceiling: 0.8

Others can be used but must be outlined and in accordance the proposed design.

Minimum light transmission values for proposed glazing must be outlined and in line with the proposed design. The grid contains evenly distributed grid points with a maximum distance of 0.5m.

Sky model

Assume a uniform design sky of 10,000 lux. External obstructions in the form of surrounding buildings, balconies, screening and large trees must be included.

Where can I find out more?

Green Building Council of Australia, Daylight and Views Hand Calculation Guide
https://bit.ly/3ac0WfH

Technical Manual Passive Design, Your Home
www.yourhome.gov.au

Lawrence Berkeley National Laboratory windows and daylight
windows.lbl.gov/research

Moreland Apartment Design Code
https://bit.ly/3tlr0fU

BESS Tool Notes Daylight
bess.net.au/tool-notes/

Better Apartment Design Standards
www.planning.vic.gov.au/policy-and-strategy/better-apartments/better-apartments-design-standards

Sustainability VIC, Energy Smart Housing Manual
https://bit.ly/3uYbxD3

Velux Daylight Visualiser:
velux.com/article/2016/daylight-visualizer

Green Building Council of Australia, Design and As-Built Submission Guidelines
new.gbca.org.au/

Other existing CASBE Sustainable Design Fact Sheets
https://www.casbe.org.au/what-we-do/sustainability-in-planning

Environment Design Guide papers
Lyons, P. 2004. Properties and rating systems for glazings, windows and skylights (including atria). Environment design guide, PRO 32. Australian Institute of Architects, Melbourne.

acumen.architecture.com.au/environment

Other Fact Sheets in this series are available to provide guidance on Indoor Environment Quality. Those Fact Sheets are entitled:

- 1.0 Indoor Environment Quality
- 1.2 Natural Ventilation
- 2.2 Building Envelope Performance
- 2.0 Energy Efficiency
- 2.1 Sun Shading

ACKNOWLEDGEMENT: The MAV acknowledges the five IMAP (Inner Melbourne Action Plan) councils – the Cities of Yarra, Port Phillip, Melbourne, Stonnington and Maribyrnong – for their leadership in producing this suite of Fact Sheets to enable a more liveable and sustainable built environment.