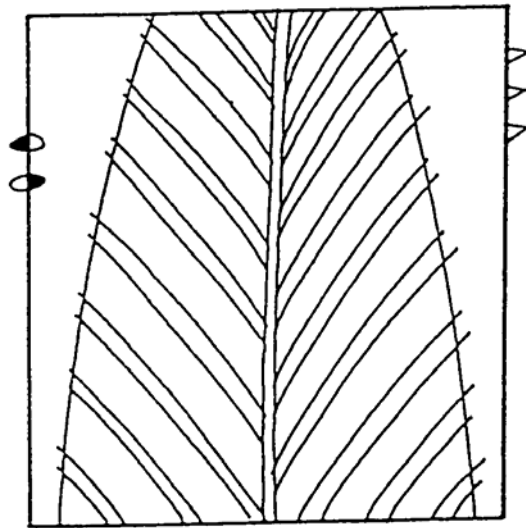


LIGHT & LIGHTING



Waitakere City Council
Te Taiāo o Waitakere

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This chapter is part of the Waitakere City Council's Sustainable Home Guidelines. The complete set can be obtained through most libraries or from the Waitakere City Council, Private Bag 93109, Henderson, Waitakere City 0650, New Zealand, phone (09) 839 0400, email: info@waitakere.govt.nz.

The guidelines are also available on the council's web site: <http://www.waitakere.govt.nz>



Light for comfort and health

Why do we need light?

Besides being essential for vision, light affects human performance, alertness and mood. It influences body rhythms such as sleep patterns, ovulation and hormone secretion. The absorption of sunlight by our skin is also a necessary part of our body's chemistry. Without sunlight there would be no life. Insufficient sunlight may cause depression and lethargy.

How much light do we need?

In order to see properly without eye strain we need a minimum light quantity or intensity. The light output onto a surface is measured in lux.

lux = the number of lumens per square metre of surface:

In offices a minimum of 500 lux

In schools a minimum of 300 lux

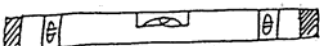
In homes a minimum of 200 lux.

What kind of light do we want?

The quality of the light is important too: the more natural light available, the better. Natural light offers us a balanced light spectrum with a full range of different wavelengths. The different wavelengths and corresponding colours stimulate different aspects of our physiology.

Incandescent lighting emits most wavelengths close to the infra red, while most fluorescent lights emit more in the yellow, green and ultraviolet range. Cool white fluorescent particularly creates an unbalanced light, which may cause fatigue or increased hyperactivity.

Ultraviolet (UV) light from the sun can be divided by wavelengths into UVA, UVB, and UVC. Nearly all the UVC and most of the UVB is blocked (absorbed) by the atmosphere. UVB is blocked by normal window glass but some UVA passes through it. While too much UV is harmful, we need small amounts of UVB to generate Vitamin D in the skin, so we need regular exposure to the full spectrum of natural sunlight. Dawn and dusk in particular expose our skin to beneficial levels of UVA, while midday sun has a higher proportion of the harmful UVB. The most important guidelines are balance and moderation.



Glazing for natural daylight

The *Design for the Sun* chapter discusses the functions of windows in transmitting and retaining heat energy in our home, but glazing also affects vision and the quality of light we receive.

Normal 6 mm clear glazing (**float** glass) allows most of the visible light (87%) to pass through, along with some of the radiant heat. It keeps much of the ultraviolet light out, though not enough to prevent fading of carpets and furnishings over time.

Both light and radiant heat transmission will be decreased by **tinted** glass. However, long-term work behind tinted glass is probably a factor in “Sick Building Syndrome.” It may cause depression, a measurable loss of muscle strength, lowered resistance to colds and flu, and disturbance of physiological equilibrium.

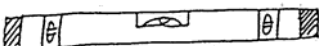
Where excessive light or glare is a problem, vertical **blinds** in conjunction with clear glass are more cost effective than tinted glass and more controllable by individuals.

Toughened glass will provide security where required. **Laminated glazing** will increase security and noise reduction and will also allow for different glazing layers to further reduce both light transmission (as low as 7%) and radiant heat transmission (down to 18%).

Low-e glass has a coating on one side which reduces heat transmission. It can significantly alter the thermal performance of a window. Because the coating is fragile it's usually used on an inside face of a double-glazed unit.

Double and **triple** glazing allow good light transmission while dealing with conductive heat loss through a window, by insulating with layers of air. With the introduction of the new H1 Energy Efficiency requirements in the Building Code, it is now trickier to build new without installing double glazing. The benefits of this include: better comfort, noise reduction, and the avoidance of condensation on the interior face of windows.

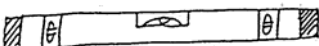
The Window Association has a chart, the Window Efficiency Rating System, which allows you to decide between different types of glazing systems according to their winter heat-loss, summer heat-gain, condensation, and fading characteristics.



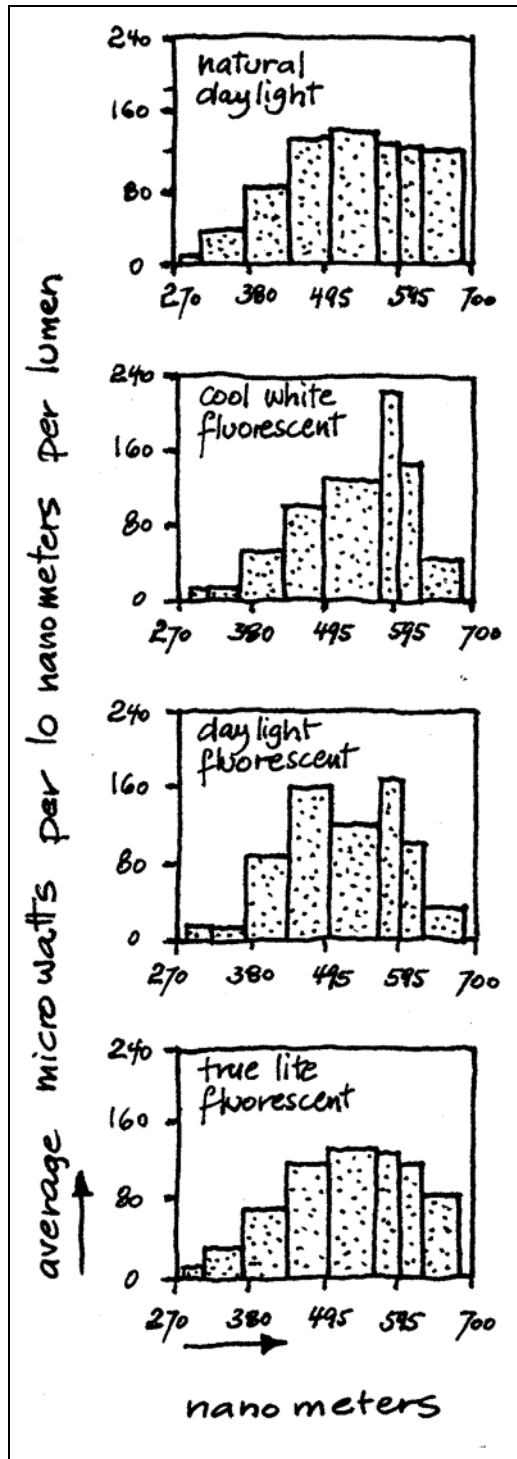
Energy-efficient lighting

The first principle of energy-efficient lighting is to ensure there are enough windows to give a good level of natural daylight inside. You shouldn't need to use lights during the day. After that there is plenty of scope for making significant savings on the cost of your night lighting. Efficiency varies enormously between different types of luminaires, and because we have many lights and they tend to be on for a long time, they contribute significantly to our energy costs (about 13% of total energy use).

- Use energy saving light bulbs and tubes.
- Fluorescent lights are five times more energy efficient than incandescent lamps (including halogens), which are really just small heaters that emit a tiny percentage of light.
- LED (light-emitting diode) lighting technology is rapidly developing, with their efficiencies surpassing that of fluorescent technology. They also have very long lives – however, their application is still limited due to their cost and characteristics.
- Use the lowest wattage bulb or tube that will meet a particular lighting requirement.
- Turn off lights when not required. Although fluorescent lights need a burst of energy at startup, the breakeven point is passed after ten minutes.
- Maintain lights regularly. Dust bulbs, tubes, reflectors and shades to increase the light output and to reduce pollution from scorched dust particles.
- Choose the appropriate light fitting for the intended use. Avoid spotlights where general lighting is required, but use task lighting where general lighting is inefficient.
- Place lighting where it is most appropriate for functional requirements. A lower-wattage lamp close by may be more efficient than a more powerful lamp further away.
- Install high-efficiency light reflectors, which may increase efficiency by 40%.
- Use timers or occupancy sensors to control lights in transient areas.
- Modern lighting technology is generally more energy efficient. Replace old and inefficient lamps.



Healthy lighting

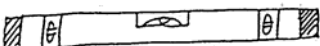


As well as energy efficiency you want lighting that contributes to your comfort, health and safety:

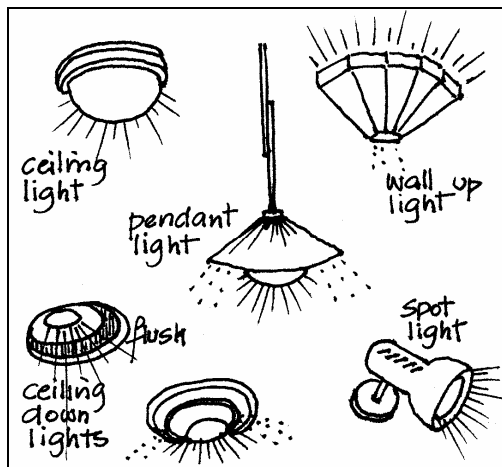
- Avoid overheating, which can cause outgassing of plastic fittings or even fire. Don't put a 100W bulb in a 60W fitting.
- Ensure fittings are well ventilated, especially flush-mounted ceiling lights with incandescent (including halogen) bulbs.
- Particularly with fluorescent and LED lights, choose fittings that emit a full spectrum of wavelengths, comparable to daylight (see diagrams at left).
- Check old fluorescent lights for rapid-start ballasts, which can leak PCBs.
- Reduce the flicker of fluorescent light with high-frequency electronic ballast.
- Make sure lighting is varied but free of glare and extreme contrasts.
- If you are concerned about electromagnetic fields keep at least a metre separation between light fittings and where your head will be – especially with fluorescent and halogen lights.

“Smart wiring” systems, which use low-voltage electronic signals from switches to a central computerised controller, are now available. Benefits include:

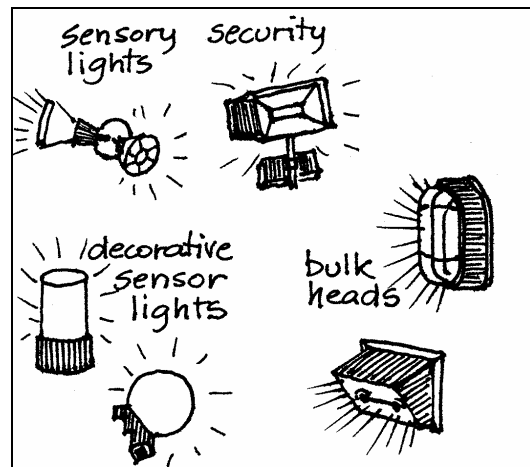
- more sophisticated control and automation of lighting, heating, appliances, smoke detection and security;
- control by sensors, cellphone or computer;
- reduction of EMF (electro magnetic field) exposure;
- graduated switch-on, reducing the thermal shock on an incandescent bulb's filament, and increasing expected operating life by up to four times.



Lights and lamps



Interior lights



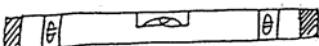
Exterior lights

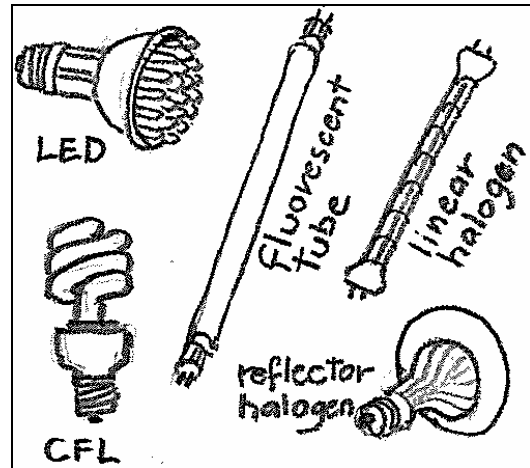
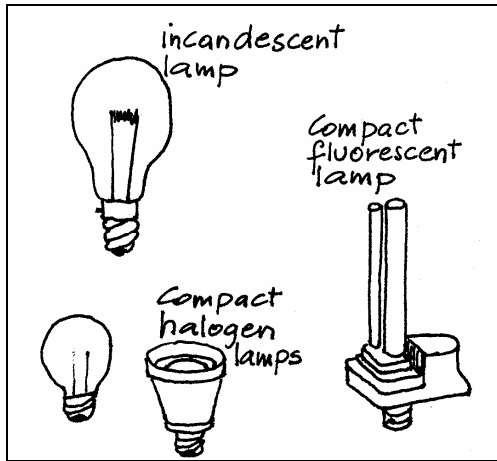
Incandescent lamps are cheap to buy but run at high energy costs, with an operating life of only about 1000 hours. They are suitable for table lamps, down lights, desk and wall lights. With a built-in **reflector** an incandescent lamp gives a bright and focused beam suitable for downlights and spotlights.

Halogen lamps give sparkling white light, last approximately 2000 - 4000 hours, and run at high temperatures. They are suitable for spot and downlights and table lamps. As a **linear tube** they give crisp white light, run at moderate energy costs, and are suitable for floor and ceiling lights. More efficient halogens are now available.

Fluorescent tubes offer different colour spectrums, last up to 8000 hours, and run at low heat and low energy costs. They are suitable for ceiling lights. **Compact fluorescents** come in different colour spectrums, can last 10,000 hours if they're not being switched on and off frequently, and are suitable for desk lamps, wall and ceiling lights.

LEDs, at the time of writing (2008), are in their infancy. Available for spot, task, and strip lighting, they are highly energy-efficient and very long-lived.





A lighting plan for your home

Traditionally we hung a single light fitting from the middle of the ceiling, then bunged a big enough light bulb in it to cast a fairly high level of light throughout the room. The result is bland, consumes unnecessary energy, and often fails to give satisfactory lighting for specific tasks. Desks and sink benches are usually positioned against a wall, so you would end up working in your own shadow.

It is more sensible to look at each room in turn, think of how you are likely to use it, and then design:

- **task** lighting for specific activities such as cooking, reading, sewing;
- **accent** lighting to create a mood or to highlight a feature;
- **general** lighting if necessary for background illumination of the room.

Living room:

This area of main activity requires a flexible combination of different lights to provide appropriate light for all the different activities, such as entertaining, relaxing, reading, studying, watching TV. Watching TV, for instance, requires dim lighting, placed to provide soft contrast and to avoid reflection in the screen.

Well spaced, recessed downlights will give good general background lighting. Wall lights can soften this effect as well as creating a feature. Spotlights can highlight paintings or plants. A floor lamp as task light for reading can also become a feature of the room.

A good quality dimmer will allow you to create different moods, but remember that not all types of lights can be dimmed (check with the supplier or electrician). Try to avoid over-lighting a living room.

Dining room:

In many homes the function of the dining room has extended beyond dining to parties, homework, games and other family activities, which require versatile lighting.

Correct lighting will increase the attraction of food. A ceiling-mounted pendant light can be lowered for intimate dining, or raised for larger parties or games. Uplights on the wall can add to the mood. Choose lighting to enhance colours and contrast.

Kitchen:

This area requires lighting to carry out tasks safely and practically. Downlights or spotlights give good visibility for task areas such as kitchen bench, stove and sink. A ceiling mounted light will give general lighting, while strip lighting in or under cupboards can offer indirect light. Lamps should provide true colour to judge food preparation and presentation.

Study:

This area has special demands as for reading and writing. Desk lamps must offer light to main working areas and not cast unwanted shadows or reflect glare which would cause eye strain. Recessed downlights can balance the tiring effect of a single pool of light. Choose good quality energy-efficient lamps.

Bedrooms:

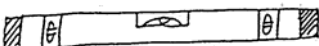
This area will require lights not to shine into eyes when lying in bed. Recessed soft-tone down lights will give general lighting without glare. In a child's bedroom, lamps with a low surface temperature, such as compact fluorescents or LEDs, are useful to avoid the risk of burns - or of fire if they are accidentally covered. Reading in bed, working at a desk, applying make-up, or selecting clothes all deserve consideration for lighting.

Bathroom:

This area, as for the kitchen, requires attention to specific tasks, such as being safe in contact with hot water, providing correct task light for shaving, toothbrushing and washing, and a soft light for a relaxing bath. Task lights should be placed beside the mirror to throw light into your face and not cast a shadow.

Outdoors:

This area may have lights for security and atmosphere. Sensor security lights (including PV-powered options) can be placed at eaves and traffic areas. Bulkhead lights must be water, dust and insect-proof. Floodlights will highlight trees, ponds or other garden features. Path edges can be marked with DIY low-voltage wired lights or with solar-powered LED lights, which require no wiring but need full light during the day to charge the battery.



Further information

Advice at the Waitakere City Council:

Phone the call centre (09) 839 0400

Ask for: Eco Design Advisor
 Cleaner Production

In print

Your Home Technical Manual, Australian Government. Comprehensive printed resource, much of it relevant to New Zealand.

On the web

www.energywise.org.nz, search keyword “Lighting”

www.smarterhomes.org.nz is a mine of up-to-date and independent information. Designed for the general public, it's easy to use, has case studies, and includes features such as Homesmarts, a calculator you can use to find information relevant to your needs or simply to run a home-health check.

If there are questions you can't find answers to on Smarterhomes, www.level.org.nz goes into more depth and is aimed at the design and building industries, with drawings and links to Building Code compliance documents.

Eco-building Products and Services Directory, Building Biology and Ecology Institute, phone Auckland (09) 376 6767, Wellington 0800 223 272. This is updated regularly and can be obtained from the website www.ecoprojects.co.nz.

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