BRIEFING NOTES:
DOMESTIC LIGHTING DESIGN CONSIDERATIONS

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Legislation concerning lighting has changed quite rapidly over recent years. The Building Regulations compliance guide currently stipulates that 75% of fixed light internal fittings in new domestic construction should use low energy lamps. The rule that "low energy light fittings" should have special lamp sockets that are unable to take conventional tungsten or halogen bulbs (see below) has been lifted, however, as these lamps have become less widely available. For the purposes of the Building Regulations, a "low energy" fitting is defined as one with an overall efficiency of at least 45 lumens/watt.

The requirements for fixed external lighting on new domestic construction are even stricter. All compliant installations must have a daylight detector to switch fittings off. Conventional (i.e. not low energy) lamps can only be used if they are under 100W and are also controlled by a PIR movement sensor.

It is perhaps worth noting here that what most people generally refer to as "lightbulbs" and "lights" are usually termed "lamps" and "fittings" respectively by the industry. To avoid confusion we will follow the industry terminology here. In the design of lighting these are two main considerations: the choice of lamp and the most appropriate location for the fitting.

LAMPS

Tungsten incandescent lamps, as mentioned above, have now largely been phased out from general domestic use. They have traditionally been the most common form of general lighting in domestic properties, usually with an output of 60W or 100W, and giving a warm yellowish light. The resistance to the phasing out of these lamps was mostly because their low initial purchase cost and the warm quality of light they produced. They have a limited life - traditionally they were given a life expectancy of 1000 hours or so.

Tungsten halogen (often referred to simply as "halogen") lights also produce a bright warm light, and are often used in recessed fittings. These are also very popular as they add a sparkle to a space. Although slightly more efficient than the traditional tungsten lamps, they do **not** qualify as low-energy light sources. Typical lamp life will be in the region of 2000 hours.

Low energy alternatives to these conventional lamps were initially unpopular; they were often bulky, slow to reach maximum brightness and produced a dull light. More efficient lamp technologies have matured hugely in the last three to five years, however, and now represent a real practical alternative. Higher initial purchase costs are outweighed in the long term by much lower running costs and longer lamp life, and the quality of light produced is now much better.

In domestic applications, there are three principal low-energy lamp technologies:

- The least common of these in domestic fittings are metal halide lamps, which are best suited for applications that need a high-intensity light source running for long periods of time (such as specialist external floodlighting and shop lighting). They produce a very bright white light source with a low wattage, and there are an increasing number of fittings on the market now for internal use. The smallest of these are rated at just 20W. Lamp life is very long (a typical rating is 6000-10000 hours) and colour rendition can be excellent. On the negative side, the lamps are quite expensive (£20 or more, depending on lamp type), and they require relatively lengthy warm-up and cool-down times - a fitting can typically take 5 minutes or so to reach operating temperature, and cannot be relit for 5 or 10 minutes after being switched

off. Light intensity is very high, and fittings are usually designed to screen the lamp from the viewer's eye.

- Compact fluorescent lamps are inevitably less efficient than straight fluorescent light sources, but they still qualify easily as low energy. They are generally readily available, inexpensive and have a long life - 5000-6000 hours is typical. Criticisms in the past have tended to be of light quality and colour (which have improved hugely), slow start-up (again, much better with modern lamps) and mercury content (inevitable with all fluorescents, but minimal in modern lamps).

- LED lamp technology is the field that has changed most dramatically over the last few years, and these lights are still improving from month to month. Early "white" LEDS suffered low light output, poor colour rendition and were not very efficient, but all these aspects have now been tackled. Light output and efficacy, in particular, have increased massively, while the traditional LED benefits of very low operating temperature and phenomenal lamp life remain. Lamp life of 20000-30000 hours is often quoted - equivalent to 20 years or more of typical use - and some fittings are designed never to be re-lamped.
By combining red, blue and green LEDs in a single fitting or lamp it is possible to achieve total colour adjustability. The only real remaining drawback of LED lamps is initial purchase cost. There are now some cheaper LED lamps available, but these do often seem to give lower output and lower light quality.

The following is a comparison of light source efficiency measured in terms of lumens per watt:

Candle	0.3
Tungsten incandescent(100W)	14
Tungsten halogen	19
White LED	70-100 (some prototypes are now achieving 200 lumens/watt)
Linear fluorescent (T12 tube)	60
Compact fluorescent	60 - 70
Metal halide	70 - 115
High pressure sodium	150

FITTINGS

Lighting design needs to be considered both in terms of the general level of illuminance required, and in terms of the relevant working plane. For example, compare an office where there is a uniform general level of illuminance, to a museum where everything is in darkness except the brilliantly lit display objects.

If the working plane is a kitchen worktop or a dining table, then a ceiling downlighter might be most appropriate. Task lighting is most effective when lighting the working plane and not the entire space, although some background lighting is advisable to avoid problems with glare.

General background lighting will illuminate the space by reflecting light off surfaces. The efficiency depends on the distance to the reflective plane and the degree of reflection. So recessed downlighters will have almost no impact in a high hall with a dark floor. However, in a bathroom with light glazed tiles, wall washers would bounce the light around the space brilliantly. Wall mounted uplighters can work well if the ceiling is the right height, but if the fitting is set too low the light is dispersed before it hits the reflective surface, and if set too

high it forms a bright patch directly above the fitting which is too small to effectively reflect sufficient light.

By far the most effective way to illuminate a space evenly is with a conventional pendant with the lamp centrally placed in the room, a shade diffusing the light from eye level, illuminating in all directions, and reflecting off all surfaces. Ceiling pendants have become less popular recently, but this is possibly changing as lighting efficiency becomes more of a concern.

Bear in mind that there are also hidden costs associated with recessed lights; the building regulations require that there is adequate fire separation between floors, and unless an intumescent cowl is fixed over the fitting then the fire separation will be broken. In lofts these fittings are also problematic, as the fitting can break both the insulation layer and the vapour barrier, introducing the risk of heat loss, air leakage and condensation around the light.

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