Less light for more effect

Malcolm Innes, Edinburgh Napier University

Where do standards come from?

There are two ways to look at lighting standards and codes of practice. One view is that the standard is a quantification of what is actually required for optimal vision. The other way is to see a standard as a description of what is normally done by others. They two descriptions are definitely not the same.

We all tend to view standards as some kind of scientific quantification of what is essential, when sometimes, the standard is simply a reflection of common practice. I know, because I have written standards like that. When working for Spiers + Major on the Terminal 5 project at Heathrow Airport, we were tasked with drafting new lighting standards for the airport's rail stations. This had to encompass all the existing standards that each of the train operators (London Underground, British Rail, Heathrow Express, CrossRail and Heathrow's own Tracked Transit System) used at the time. At some point in the past, some of these documents may have been based on scientific research about what was necessary for lighting, but they were mostly just descriptions of how the different companies normally did things. The resulting T5 Rail Lighting Standard was therefore a compromise between what we as designers believed would create good lighting and what the multiple existing standards demanded.

All around the world there are temporary light art events that take audiences into dark forests and landscapes that are brought alive by colourful lighting. There is no lighting standard for these events, but if one did exist, it would most likely be built upon common practice. Most of these light art events are actually delivered by production companies with a background in theatre and live events. Being temporary installations, the normal approach is to use equipment from hire stock. Traditionally, this meant lighting up the forest with 1kW tungsten halogen PAR cans, coloured with theatrical gels (fig 1). Even where annual events now mostly use LED luminaires, they are using equipment designed to mimic the output of PAR lamps. The results can be spectacular, and spectacularly over-lit.

Audiences love these events and they are always very popular. Partly because people see this as a safe way to explore the forest at night - we want to experience the rural darkness that is missing from urban life.

When I was asked, as an artist, to create a month long night trail through a

Fig.1 The standard approach for lighting temporary night time events in woodlands is to use theatrical equipment such as these 1kW Par cans uplighting pine trees. Why is so much light required?

remote valley in the Cairngorm Mountains in Scotland, I decided to ignore the 'standard' PAR can and theatrical hire equipment approach and, instead create a design that was based on giving the audience a real feeling of darkness and providing the minimum amount of light required to illuminate the features of the trail. The specification and design was decided, not by doing what others normally did, but by a process of actively testing on site.

The approach I took was to try and ensure maximum visual adaptation to darkness. I knew myself, that it was possible to walk the path safely at night with nothing more than the very dim glow of the night sky (starlight or clouds very faintly glowing from the nearest urban areas - 80-100km away). To identify which trees would be lit, I used a 1w LED torch for testing. Against such low levels of ambient light, this was enough to illuminate the whole tree. In the end, where the normal approach would have used a 1kw PAR can, our project mostly used 3w white LED sources to uplight fully grown pine trees.

We were so successful at illuminating the 3km trail with low output sources, that we actually caused a problem for the power supply. The power requirements were so small that the generator sets believed there was no load attached and tried to shut themselves down. Ironically, the solution from the installation company was to hang a dummy load of a single blacked out PAR lamp onto the circuit so that the generators did not shut down.

Because darkness was an integral part of the design for the project, what seems on paper as tiny quantities of light were all that was required to create the lit effect. It did not look under-lit, but it did allow subtle modulation between the lit and unlit areas. It allowed the maintenance of a level of vision adapted to the ambient conditions. None of the 3,000 visitors said that it was too dark.

While the essential lighting 'task' for the Between Two Worlds event was quite simple, being able to safely walk along a path, a lot can be learned from the experience of working with such low levels of light. The principal lesson is for us to remember how adaptable the human visual system actually is. If you only read lighting standards for interior

Fig.2 Between Two Worlds, Glenmore Forest, Scotland. Light Artist, Malcolm Innes.

Where the designer has complete control over ambient light, even tall trees can be effectively illuminated with seemingly tiny quantities of light. Each full size tree trunk is illuminated with a single 3w LED uplight.

spaces, you might believe that our visual system works over a maximum range of around 10:1 (the difference between corridor lighting and drawing office lighting) and that vision will become seriously impaired if there is more than a 2:1 difference in light levels across a task area. However, the self referential nature of standards and codes of practice tend to forget the reality of natural light - the light for which our visual system is best adapted. Between a patch of direct sunlight and the dappled shadow cast by leaves, there can easily be in excess of a 7:1 difference. We do not tend to trip over because we walked into the shade of a tree. Even on an overcast day, a modest sized interior space, such as a classroom, with a wall full of windows can experience a variation of natural light greater than 10:1 over the depth of the room. Again, we accept this visually because it is natural, but our lighting standards would not accept this for electric light - why not?

When standards fail

Although it is rarely the intention of codes of practice and standards to quash creative solutions, by their very nature, lighting standards tend to lead to standardised solutions. In any field of design there are those who want or need a quick fix, standardised lighting solutions are often seen as a short-hand to compliance. The rationale being that, if it has been done before, it must be the right way to do it. However, standardised solutions, when repeated over and over, tend to reveal design shortcomings that were not envisaged at the time of writing the lighting standards.

A classic example of this process was acted out in office lighting in the UK throughout the 1990s. The increasing reliance on computers in the workplace prompted a shift of emphasis in lighting practice. The principal manuals for compliance chasers were the Chartered Institute of Building Services Engineers (CIBSE) series of Lighting Guides. Although these documents were guides to good practice (the clue was in the title) and not a legally established standard,

many people treated these guides as if they were law. In an effort to reduce potential glare problems in workplaces full of computer monitors, LG3 recommended that light was focussed tightly downwards so that horizontal and low angle light did not reflect in display screens. Different kinds of display equipment uses were categorised as Cat1, 2 or 3 depending on the maximum luminance deemed acceptable at angles approaching horizontal viewing angles. The rush to compliance resulted in lighting manufacturers producing luminaires that were badged as being LG3 compliant and including Cat2 louvres (even though there was no official badging scheme). The high volume, low design installers saw the badged luminaires as a timesaving alternative to designing a lighting system. The result was a plague of speculative office spaces with high illuminances on the working plane but little or no light on the vertical surfaces and no direct light on the ceiling. The lit effect was commonly described as a cave and even though it complied with the office lighting guide, the lit effect was universally hated by users and linked to a wider 'sick-building syndrome' that was used to describe workplaces that were not fit for purpose.

The end result of so many installers following the letter of the guidance was the worst kind of lighting and, eventually, the wholesale scrapping of the guidance. The replacement lighting guides specified a minimum proportion of light on the vertical walls and on the ceiling plane - completely turning the whole basis of the previous guidance on its head.

As CIBSE themselves now say, "the term 'category 2' is no longer used by the CIBSE. It was used to describe a particular design of luminaire (light fitting) that could be employed to prevent reflections of the luminaire on the display screen. Unfortunately, in doing so, these luminaires can produce a gloomy environment if used on their own without consideration of surface reflectances. In most offices, particularly where modern computers with bright screens are used, such reflections are not

Fig. 3 Whilst the lighting for this office space may be designed to reduce potential glare on display screens, the lit effect in the room is very poorly considered. A very dark end wall and messy spill light of the side wall do nothing to inspire confidence that the installers cared about the end users of the room. As a student project, a similar space was dramatically improved by removing all the complicated optics from the fluorescent luminaire and adding a vaulted soffit of white card above the luminaires to capture and diffuse the uplight component.

likely to occur and therefore it is not necessary to specify this type of luminaire."[1] Nevertheless, it is still possible to buy Cat2 luminaires, even though their use will not satisfy the requirements of the revised office lighting guide.

Most lighting standards and codes of practice are created with the best intention, to ensure a minimum quality of lighting for the end user. However, the complexity of defining all the possible ways of producing good lighting means that standards tend to simplify solutions to make them more likely to be applied. However, as Albert Einstein said, "Things should be as simple as possible, but no simpler." Standardised lighting approaches in a world where there is no standard building or location is perhaps making things too simple and is no substitute for good design.

Perhaps, instead of standardised approaches, we need a rights and responsibilities model for lighting: the end user of the project has the right to good lighting, therefore the designer has the responsibility to deliver a lighting scheme that is fit for purpose, aesthetically enhances the architectural space in a way that is not detrimental to the user and does not waste energy.

To prove compliance, we usually calculate and measure illuminance (in lux or foot candles) within the lit space, even though we actually see luminance. In an attempt to be easily applicable by installers, do lighting standards and codes lead us to measure the wrong thing?

Designing light, or designing darkness

When commissioned in 1998 to carry out a lighting strategy to tackle some of the poorly lit streets and lanes in Cambridge, England, Speirs + Major surprised the client with their solution to some areas of perceived darkness -

Fig.4 Buchanan Street, Glasgow, UK. Lighting design by Speirs + Major.

Glasgow's principal shopping street was illuminated with blue tinted white metal halide sources in preference to the traditional, and supposedly ultra efficient, sodium sources. However, sodium sources are only highly efficient when measured relative to photopic vision. The relatively low illuminances of street lighting meant that the visual system would be in mesopic vision and would be far more sensitive to blue light than orange light. The design exploited this visual fact to increase apparent brightness for the end users. Even though common practice, lighting standards and traditional measurement and calculation methods did not represent the true visual experience of this kind of low light situation.

reduce the lighting elsewhere. Whilst the received wisdom would be to add luminaries in the 'dark' areas, a survey of the sites revealed that, of themselves, they were not too dark. However, the problem was that they adjoined very brightly lit main thoroughfares. Slightly reducing the illuminance near the junctions would reduce the contrast and make increase the perceived brightness of the lanes, without adding any more lighting equipment.

This approach to planning darkness as well as part of lighting design was embodied in subsequent master planning projects by Speirs + Major, such as the "Durham Light and Darkness Strategy". [2] Although lighting guides and standards are yet to catch up, darkness has now became an explicit weapon in the armoury of lighting designers.

Whatever the 'efficacy' of any new lighting technology, sometimes this kind of intelligent approach to design problems can achieve even more effective savings by not adding any lighting at all - surely the most sustainable solution.

The response to questions of lighting sustainability should be based on achieving efficiency through the application of good design principles in preference to simply ticking the box that says we have used 'efficient' sources, or adding lots of technology to improve lighting 'efficiency'. As eco architect Howard Liddell described it, "eco-minimalism is the antidote to eco-bling'[3].

References

[1] CIBSE. 2013. *Technical Resources: Frequently asked questions: Is 'category 2' lighting a legal requirement in offices?* [online] Available at: http://www.cibse.org/index.cfm?go=page.view&item=453#2 [accessed on 23/12/2013]

[2] Spiers + Major. 2006. *Durham Light and Darkness Strategy.* [online] Available at: http://www.speirsandmajor.com/work/strategy/durham_lighting_strategy/ [accessed on 23/12/2013]

[3] Liddell H. 2008. *Eco-minimalism*, London, RIBA Publishing