Scotopically enhanced lighting

Research has demonstrated that light sources that more effectively stimulate the rod photoreceptors of the eye improve visual acuity (Berman et al, 2006). This improvement is caused by the smaller pupil size produced and hence the improvement in retinal image quality. This finding suggests that light sources with a high scotopic/photopic ratio can be used at lower illuminance than those with a lower scotopic/photopic ratio to achieve equal visual performance. This is certainly true for tasks that are limited by visual acuity but not for tasks limited by other factors (Boyce et al, 2003b) or for applications where appearance is more important than visual performance. Nonetheless, this research has demonstrated that light spectrum has an impact on task performance beyond simply colour rendering.

Mesopic vision

Much exterior lighting provides conditions such that the visual system is in the mesopic state yet the measurements used to describe photometric conditions are all based on the photopic response. As a result, light sources that are calculated to be equal may be very different in reality. This is of particular concern for road lighting where interest is focused on the possibility that metal halide light sources may provide equal visibility at lower illuminances than the high pressure sodium light sources widely used at present (Fotios and Cheal, 2007a and b). Unfortunately, there is no internationally agreed system of mesopic photometry. Previous attempts to identify a standard observer for mesopic vision were based on the perception of brightness (CIE, 1989) but recently, alternative approaches based on reaction times (Rea et al, 2004) and performance measurements related to driving (Elohoma and Halonen, 2006) have been published. A comparison between these two systems suggests that there is little difference between them at the luminances typically produced by exterior lighting (Rea and Bullough, 2007). The CIE is attempting to develop a system for dealing with mesopic vision based on these findings. Once such a system has been developed, a major reassessment of exterior lighting practice is to be expected.

Replacement of the CIE general colour rendering index (CRI)

Although the CIE General CRI has been used to characterise light sources for many years it does have a number of limitations. First, just because two light sources have the same general CRI, it does not mean that they render colours the same way. The general CRI is an average and there are many combinations of special CRI values that give the same average. Second, different light sources are being compared with different reference light sources. This makes the meaning of comparisons between different light sources uncertain, yet comparing light sources is what the general CRI is most widely used to do. Third, there is considerable argument about the method used to correct for chromatic adaptation. What has made the search for a replacement urgent is the development of improved or new light sources with different colour properties but which the general CRI is unable to separate. It is likely that any replacement for the general CRI will involve abandoning the use of a single number to describe a phenomenon as complex as colour perception and the acceptance of something more sophisticated such as colour vector maps (van Kemenade and van der Burgt, 1988) or the colour gamut (see Section 1.4.5).

Replacement of daylight factor

Daylight factor has been used to quantify the proportion of daylight available in an interior for many years. Unfortunately, daylight factor suffers from a serious limitation, namely that it assumes a uniform overcast sky. This is a problem in that real skies vary greatly from day to day and from climate to climate. Thus, a realistic evaluation of the energy impact of any proposed daylighting scheme demands that account be taken of the typical climate in which the building is situated as well as the orientation of the building.