

ROAD LIGHTING FOR PEDESTRIANS IN RESIDENTIAL AREAS: CHOOSING THE OPTIMUM LAMP COLOUR CHARACTERISTICS

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In the past few years a large amount of work has been devoted to investigating how light source spectral power distribution (SPD) affects vision at mesopic levels. This article considers lighting for pedestrians. Two primary factors to be considered when providing lighting for pedestrians are what do they need to see to enable them to safely complete a journey, and how does the lighting impact on their sense of safety. Safe movement is a performance based attribute. The lighting is required to reveal potential hazards such as irregular pavement surfaces and other objects, moving and stationary, to reduce the number of accidents, and also to reveal the faces of other people at sufficient distance to take avoiding action if necessary. Perceived safety is a perception based attribute. Lighting is required to create a bright and clear environment, which contributes to reducing the fear of crime, and to give the perception that the intentions of other people could be easily identified.

Recent experimental work has investigated how these requirements are affected by lamp SPD. There is some evidence that lamp SPD can affect spatial brightness at mesopic levels. Five previous studies have compared the brightness of spaces lit by HPS and MH lamps [Fotios & Cheal in progress, 2007; Rea, 1996; Rea, Bullough & Akashi, in press]; the results from these suggest an MH/HPS illuminance ratio in the range 0.68 to 0.79. That this has been found in tests using different levels of chromatic adaptation (mixed and complete), different procedures (matching and discrimination), different evaluation modes (simultaneous and sequential), in laboratory and outdoor environments and from different research groups, suggests the results are robust.

There is evidence that lamp SPD can affect the detection of pavement obstacles. A novel apparatus for testing SPD and luminance effects on obstacle detection was recently developed at Sheffield University [Fotios & Cheal, in press]. The interior of a booth is observed through an aperture which opens for 300ms, simulating the glance of a search task in peripheral vision: pavement obstacles in various locations across the floor are raised by incremental amounts to identify how the for 50% detection height is affected by SPD and illuminance. Pilot studies suggest significant effects of illuminance, and that effects of lamp type and observer age are significant at the lower of the three test illuminances (0.2, 2.0 and 20 lux). SPD effects on facial recognition have been explored in four studies. In two of these [Raynham & Saksvikrønning, 2003; Knight et al, 2007] it was reported that lamp SPD affected facial recognition whilst the other two studies [Boyce & Rea, 1990; Rea, Bullough & Akashi, in press] reported no significant effect. This disagreement may be due to experimental design.

This article discusses the findings of these studies, their integration into practical guidance for designers, and attempts to predict the relationship between lamp spectrum and illuminance for those tasks relevant for pedestrians.

In Europe, BS EN 13201-2:2003 specifies an average pavement illuminance in six classes (the S-series), ranging from 2.0 to 15.0 lux, and a minimum illuminance. These average

illuminances are higher than those for similar roads in Australia and New Zealand (0.5 to 7.0 lux) and Japan (3.0 to 5.0 lux): these countries also specify vertical illuminances as may be necessary to characterise facial recognition. For the UK, BS5489-1:2003 suggests choosing from this range according to the level of traffic flow, rate of crime, and type of environment, and as an approximate account for effects of lamp SPD BS5489 permits a reduction in average illuminance when using lamps of high colour rendering index ($Ra \geq 60$). Such a trade-off between lamp type and illuminance may be a step towards reducing over-lighting.

References

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