PHOTOMETRIC EVALUATIONS FOR PEDESTRIAN ENVIRONMENTS WITH EMPHASIS ON LIGHT SPECTRUM AT MESOPIC LEVELS

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Given the demand to reduce greenhouse gas emissions and energy consumption, many city and university campuses are planing to convert most of their street and pathway lighting systems to LED or Induction light sources. This plan is principally based on manufacturer claims that these LED or Induction light sources have five times longer life as compared to traditional HID sources and can supply a higher lumen output with more desirable spectral quality while requiring only half as much energy. The light level regime of concern for these applications, referred to as Mesopia, ranges from 20/30 Lux of horizontal illuminance to factors of 10 to 100 lower. In mesopia and when the lighted space is large, i.e., the field of visual view is large, such as when viewing a large area or space, both rods and cones will contribute to the visual experience. Besides brightness perception in mesopia, both rods and cones will also contribute to the noticing of objects that are not in the line of sight (off-the-visual-axis detection).

Claims have been also made that at mesopic light levels LED and Induction lighting can be substituted for traditional HID lighting but operating at a lower photopic level because the LED or Induction spectrum is more efficient at producing rod responses. To apply this principle it is necessary to have knowledge of the adaptation luminance level of the eye for the conditions of the substitution. In real mesopic environments little is known about the actual values of luminances that a pedestrian encounters as these are widely varying and depend on many features such as source type, mounting height, aggregate reflectivities, and viewing direction.

This study examines the light level and spectral conditions that are experienced by the users of roads or pathways. At mesopic levels and especially for pedestrian applications the viewing directions plays a major role depending on whether the targets require off-axis, parafoveal and or foveal vision. To evaluate these factors, a field study was conducted employing sophisticated instrumentation to provide realistic photometrics for luminous pedestrian environments at mesopic light levels including the effect of light sources such as LED's, HID's, HPS and Induction lamps. The illuminances, luminances and spectral power distribution measurements are made for various typical viewing directions along selected pathways with standard layouts utilizing multiple light source types installed in identical fixtures.

For the various conditions the horizontal/vertical illuminances and luminances are measured with additional photometric tabulations made for the direction of gaze (DOG) illuminance obtained by computer simulation. The results show relationships between DOG illuminance and the average luminance for various viewing directions. Spectral power distributions under the different light sources are also provided for many viewing conditions thereby allowing calculation of various types of photometric quantities that are employed in models of mesopic vision. These measured and simulated results will further contribute to the understanding of the effect of light spectrum on the human eye for roadway and pathway applications regarding the choice of lighting systems with different spectral characteristics.