

operation, tens of minutes may be necessary for adaptation to be completed. As for the direction of change, once the photochemical processes are involved, changes to a higher retinal illuminance can be achieved much more rapidly than changes to a lower retinal illuminance.

When the visual system is not completely adapted to the prevailing retinal illumination, its capabilities are limited. This state of changing adaptation is called transient adaptation. Transient adaptation is unlikely to be noticeable in interiors in normal conditions but can be significant where sudden changes from high to low retinal illumination occur, such as on entering a long road tunnel on a sunny day or in the event of a power failure in a windowless building.

2.2 Photopic, Scotopic and Mesopic Vision

This process of adaptation can change the spectral sensitivity of the visual system because at different retinal illuminances, different combinations of retinal photoreceptors are operating.

The three states of sensitivity are conventionally identified as follows:

2.2.1 Photopic Vision

This occurs at luminances higher than approximately 3 cd/m² (seeing colours will start at approx. 0.02 lux, depending on intensity of colour, age of viewer, and adaption stage of eye)*. For these luminances, the retinal response is dominated by the cone photoreceptors so both colour vision and fine resolution of detail are available.

2.2.2 Scotopic Vision

This occurs at luminances less than approximately 0.001 cd/m² (means approx. 0.02 lux)*. For these luminances only the rod photoreceptors respond to stimulation so colour is not perceived and the fovea of the retina is blind.

2.2.3 Mesopic Vision

This is intermediate between the photopic and scotopic states, i.e. between about 0.001 cd/m² and 3 cd/m² (means between approx. 0.02 lux and approx. 0.2 lux)*. In the mesopic state both cones and rod photoreceptors are active. As luminance declines through the mesopic region, the fovea, which contains only cone photoreceptors, slowly declines in absolute sensitivity without significant change in spectral sensitivity, until vision fails altogether as the scotopic state is reached. In the periphery, the rod photoreceptors gradually come to dominate the cone photoreceptors, resulting in gradual deterioration in colour vision and resolution and a shift in spectral sensitivity to shorter wavelengths. The relevance of the different types of vision for lighting practice varies. Scotopic vision is largely irrelevant. Any lighting installation worthy of the name provides enough light to at least move the visual system into the mesopic state. Most interior lighting ensures the visual system is operating in the photopic state. Current practice in exterior lighting ensures the visual system is often operating in the mesopic state.

All photometric quantities used by the lighting industry are based on the CIE Standard Photopic Obser-

* Conversion between cd/m² and Lux is indicative for understanding of the above Figures and based on typical experienced situations.