

## Lighting for health and productivity

In this detailed and analytical article *Ruth Kelly Waskett, Associate, Hoare Lea and President, Society of Light & Lighting*, explains why light is so important for health and wellbeing, and suggests that providing solutions is a lot more complex than just installing lighting that changes colour temperature.

At the turn of this century, scientists discovered that in addition to the rod and cone photoreceptors in our retinas that enable us to see, there is a third type of photoreceptor whose function is completely different. Commonly referred to as non-visual photoreceptors, they are essential for keeping our bodies in harmony with the 24-hour light-dark cycle of the earth. They regulate the production of key hormones such as melatonin and cortisol, which in turn determines when we feel alert, sleepy or hungry. The cycles of these hormones are often referred to as the body clock, or circadian rhythm.



Ruth Kelly Waskett, Associate, Hoare Lea and President, Society of Light & Lighting.



20 Old Bailey, London – Lighting design intent was based on providing light volume to make spaces feel light and airy, paying close attention to key art pieces and providing visual cohesion on both floors. © Hufton+Crow

Since their discovery, further studies have found that the non-visual photoreceptors are most sensitive to light in the blue part of the visible light spectrum. Unsurprisingly, daylight has all the qualities that make it the perfect light source to synchronise our body clocks, with a high amount of energy in the blue part of the spectrum earlier in the day, and less blue energy towards the evening.

### Lighting solutions

The discovery of non-visual photoreceptors, combined with the advent of LED lighting, has given rise to a number of innovations in lighting. These are primarily concerned with providing artificial light that can support our health, in a world where we spend most of our time inside buildings. It started with Human Centric Lighting, a term that soon fell out of favour as many objected to it on the grounds that all building lighting is designed for humans. More recently, the term Circadian

Lighting has been used to describe a lighting system that is designed to support the health of occupants. At the same time, the popularity of Tuneable White lighting has increased as people recognise the potential benefits of light sources that can change colour appearance throughout the day. So, what's the difference between Circadian Lighting and Tuneable White?

### Spectrum and colour temperature

To understand the difference between the two approaches, it's important to understand the key principles of light spectrum and light colour. Light colour is defined in terms of its correlated colour temperature (CCT) in degrees Kelvin (K), the equivalent temperature of a black body radiator. A low CCT, for example 2000K, will produce a "warm" white light with a yellow appearance, while a higher CCT, such as 6000K, is a "cool" white light with a blue-white appearance.

All light sources have a spectral power distribution or SPD. This is the amount of energy that is contained within each of the wavelengths of visible light.

Two light sources can have the same or similar CCT but very different SPDs. If the purpose of a lighting system is to elicit a circadian effect, it isn't the CCT that matters, it's the SPD content.

### Circadian Lighting and Tuneable White

Put simply, Circadian Lighting is lighting that is designed to deliver appropriate light at the eye throughout the day in order to support the human circadian system. This is achieved by using light sources that can produce a range of spectral compositions and resulting CCTs. These are combined with a dynamic control programme that delivers a sequence of light quantity and spectrum designed to mimic the natural light cycle. A typical sequence would involve delivering a high illuminance with a high blue-spectrum content in the morning, and a lower illuminance with a low blue-spectrum content in the afternoon.

Tuneable White lighting allows the user to select any correlated colour temperature (CCT) within a pre-defined range. In contrast to Circadian Lighting, Tuneable White doesn't promise any circadian benefits *per se*, because it is primarily concerned with the outward appearance of the lighting, not the spectral content. Tuneable White can be used for a specific purpose, such as to have dim-to-warm sources, or to have a range of settings that give different CCTs. Users can, in theory, have any control sequence to suit their preference.

The technology used to deliver the two different types of lighting can be the same: clusters of white LED chips of different CCTs. What's different is how that technology is employed, and ultimately what the objectives of the system are.



Beecroft Building, University of Oxford — Flooded with natural light, the building takes advantage of the unusually generous ceiling height and uses a minimum of general lighting. © Jack Hobhouse

### Is it worth it?

So, the real question is ... is it worth it? The answer, of course, is it depends. It depends on what you want to achieve with the system, and what your expectations are. The circadian benefits of these kinds of lighting systems are very difficult to measure directly in the field, so research evidence is thin on the ground. However, there are several studies indicating that people prefer

dynamic lighting over static lighting, whether it is changing the amount or the colour of the light. On that basis, it can be said that any well-designed dynamic lighting is almost certainly better for occupants' wellbeing.

A final point to consider is daylight. If occupants have been exposed to daylight during their journey to the building, and/or if they have good access to daylight during the day, the benefits of this daylight exposure will dwarf the effect of circadian lighting interventions. If a space is already well daylighted, then the value of introducing Tuneable White or Circadian Lighting is questionable.

### Conclusion

Let's take a step back and remind ourselves what we're trying to achieve with these kinds of lighting systems. We want to create buildings that support the health and wellbeing of people, and the solution to that is a lot broader than just installing lighting that changes colour temperature. Designing for daylight first, lighting the vertical surfaces, thinking about the needs of the occupants and having a lighting control system that is accessible for the users are all arguably more important. ■



Lighting in some of the meeting rooms at Investec, 55 Gresham Street, London. © Hufton+Crow