

Technical: Seeing the light – Building Design

Research has shown the effects that the brightness and colour of indoor lighting can have on personal wellbeing and performance, which could impact on the way interior architects are expected to approach new designs. Amanda Birch reports



Source: [Arup](#)

Architects know only too well the importance of designing buildings that make the most of natural light. Whatever the building's use, interiors that draw in daylight, are well-ventilated with access to views, and employ well-designed artificial lighting at appropriate light levels, will generally result in happier and healthier occupants.

However, there are still examples where these design features are largely ignored. Stephen Heppell, a professor at the Centre for Excellence in Media Practice at the University of Bournemouth, has studied the learning environment for many years and is still shocked by what he sees.

“I've visited 56 examination rooms in the last 10 months and I haven't found one that wasn't damaging the prospects of the children in them,” says Heppell. “The lights are too low, the CO2 levels too high and the vibrations from the fans are too fast, it's genuinely terrible. Children are stuck in rooms where they couldn't possibly learn, behave or remember.”

Through his research project, Learnometer, which combines hardware, software and analysed data, Heppell is helping schools to understand that by designing better classrooms, pupil's

achievement can be increased in measurable ways. One of the key factors for improvement are light levels.

“Almost all classrooms are under-lit,” says Heppell. “I was in an exam room recently where the lighting was 90 lux in the corner and there were children trying to do a test”.



Source: [Arup](#)

Given Heppell’s extensive experience with schools, he is now adept at spotting the warning signs. “I could go into a classroom and tell you where the children are going to yawn and which children will misbehave, just by going around the room and measuring a few things.”

Heppell says recent research confirms that good lighting significantly influences reading, vocabulary and science test scores. In classrooms, he recommends lux levels of above 250 lux for engaged conversation and above 450 lux for close work, like writing or computer use. He also suggests that immediate improvement can be achieved by simply painting classroom walls with highly reflective paint to lighten the space, removing paper from windows and putting in better lights.

But longer term, Heppell recommends that architecture courses should include a module on learning in schools and teacher education curriculum should incorporate a module on design. “Architects and teachers should have that conversation,” he argues.

Jonathan Rush, a partner at Hoare Lea who runs the practice’s lighting group agrees with Heppell that good lighting can make or break a space with a significant impact on the users’ wellbeing.

“The question of whether good lighting can increase people’s productivity goes back to how much light and the quality of light is needed in spaces, which was a determining factor for most of our standards,” says Rush. “There is a strong case now, which is backed up by the British Council of Offices guidance, that says offices need a background illumination level, but to light spaces for individual tasks and avoid a flat, generic across-the-board illumination level.”



Source: [Hoare Lea](#)

Rush argues that in office design there’s a lot of research on the importance of individual users control over their own environments.

“When we look at the future of office spaces we should be designing for individual control of every single product so that the lighting within your vicinity can be controlled via an app on your mobile phone or tablet. Also, each individual LED can be monitored in terms of its performance and efficiency,” says Rush.

Rush cites Hoare Lea’s own offices as an example of individuals being able to control everything, including dimming specific areas and monitoring their energy consumption. “It’s not about just lighting the whole space, it’s about the architect and lighting designer working with the users,” he says.

Rush recommends that when architects approach any new project they should always think of humans and how they will use that space. “Start any project thinking about daylight because moving forward that will be the biggest energy saver,” says Rush. “But also consider how do

you want the light and space to appear? And what atmosphere and emotion do you want to evoke?”

Francesco Anselmo, a lighting and interaction designer at Arup who has done a research project on circadian lighting, which considers the way light plays a role in the health and wellbeing of humans, agrees that daylight is key to any project.



Source: [Hoare Lea](#)

“Daylight is dynamic, it changes throughout the day, it changes in direction, it changes in brightness and it changes in spectrum, these are all aspects to which we have evolved, so it is a good idea to create an environment with some dynamism,” says Anselmo.

But when there is minimal daylight and a space is dependent on artificial lighting, Anselmo says the personalisation of lighting conditions is paramount and should be built into every design.

In a basement office project for Benjamin West in Shoreditch, Anselmo designed and specified a dynamic lighting system, which enabled the occupants to control the lighting located in the ceiling directly above their heads. Every two people could change the spectrum composition between a warm spectrum and a cool spectrum. They could also change the intensity of the light by using their mobile phones.

“Every day each person was changing the lighting slightly to suit themselves,” says Anselmo. “I’m pleased to say that those people said that the situation was similar to where they had worked previously, which was in daylight, because they now had control over their lighting.”

But how should lighting such as in hospitals be designed for nighttime use? Most LEDs are built out of blue components - think of a smart phone or tablet that contains blue LEDs in their screens. Blue or white light triggers a hormonal release or information to the brain that tells us it's time to wake up with an impact on our biological rhythm.



Source: [Atkins](#)

West Hall private care home, West Byfleet, Surrey

Anselmo suggests that perhaps LEDs that have less blue content should be specified. However, there's a conflict of interest here as bluer LEDs are considered to be more energy efficient.

Perhaps the answer lies in using amber LEDs, which are a different part of the spectrum and have no blue content. Caroline Paradise, head of design research at Atkins did a doctorate in the non-visual aspects of daylighting, and has also worked in the healthcare sector. Her work has highlighted the importance of lighting beyond just performing visual tasks – light has an implication for maintaining healthy biological processes.

“Patients are often observed overnight to monitor their condition and expose them to a consistent lighting environment irrespective of the time of day,” says Paradise. “The light levels received at night can have an impact on the messages to our brain and body which relate to our sleep and wake cycle”.

For example, says Paradise, research using amber LEDs in patient bedrooms was shown to be beneficial. Amber LEDs provide enough light to see by, but cause less disruption to the body's circadian rhythm due to the different wavelength or colour spectrum of light.

“In healthcare environments we're trying to maintain a high percentage of daylight to make sure there is a good, broad spectrum of light as well as providing a variation of light through the day,” says Paradise. “But unfortunately, healthcare environments have to rely on artificial light, which is very uniform and offers little or no variation throughout the day and night and affects the body's natural rhythms”.



Source: [Atkins](#)

Lime Tree primary academy

It's now commonly known that nurses and those who do shift work are vulnerable to the negative impact of receiving artificial light when the body should be asleep. Research suggests this affects hormone release increasing the potential for certain diseases, such as cancer.

“We haven't evolved as quickly as some of the environments that we live and work in,” says Paradise. “With the heightened use of mobile devices, people can work anywhere and at any time of day or night. We are therefore receiving more light than we might have done 100 years ago, which could have a long-term impact on our health that we don't yet know about”.

There are now signs though that the lighting industry is starting to acknowledge some of the findings. The importance of daylight for our biological wellbeing is now being incorporated

into lighting guidance, including in the Society of Light and Lighting's Code for Lighting. There are also products on the market that have the ability to provide dynamic internal lighting, as highlighted in Anselmo's office project.

"In the future we will see artificial light coming much closer to providing what natural light can," says Paradise. "The lighting industry is advancing all the time, with the continual development of LEDs, OLEDs, and now graphene LEDs, it's an exciting time".

Paradise agrees that designing lighting strategies for buildings has become more complex. She suggests that designers need to utilise ways of accurately modelling lighting environments and predicting daylight availability more effectively. She also recommends that designers should take on board the developing evidence from the biomedical community about the implications of lighting on our long-term health.

"The more we align ourselves with the research the health professionals are doing around the implications of the environment that we live and work in, the better the buildings we design will be," says Paradise.