



HUMAN-CENTRIC LIGHTING

Lighting Integration Options for Metal Ceilings



Network
Architectural

Introduction

When it comes to modern design, artificial lighting is frequently considered primarily for its impact on the aesthetic and functional aspects of a space. However, artificial lighting has a profound impact on the human body and wellbeing too, particularly on the human circadian rhythm.

By aligning artificial lighting with the natural patterns of the human body, lighting integration supports the body's innate biological processes, promoting better sleep quality, mood regulation, and overall physiological health.

With the emergence of controllable lighting technologies aimed at reinforcing circadian rhythms, designers need to consider lighting integration as early as possible in the design process to create solutions that are optimised based on user preferences and environmental conditions.

In this whitepaper, we illuminate the often-neglected physiological and psychological effects of lighting. Central to this exploration is the concept of Human-Centric Lighting (HCL), a design philosophy that acknowledges the intricate interplay between light and human health. In this context, we look at how HCL systems can be seamlessly integrated into metal ceiling structures without compromising on design.





Terminal 1

Terminal 2

Terminal 3

Arrivals

Flight	From	Time	Gate
QF 123	Sydney	10:00	10
QF 124	Melbourne	10:30	11
QF 125	Brisbane	11:00	12
QF 126	Perth	11:30	13
QF 127	Auckland	12:00	14
QF 128	Wellington	12:30	15
QF 129	Christchurch	13:00	16
QF 130	Dunedin	13:30	17
QF 131	Queenstown	14:00	18
QF 132	Invercargill	14:30	19
QF 133	Wellington	15:00	20
QF 134	Christchurch	15:30	21
QF 135	Dunedin	16:00	22
QF 136	Queenstown	16:30	23
QF 137	Invercargill	17:00	24
QF 138	Wellington	17:30	25
QF 139	Christchurch	18:00	26
QF 140	Dunedin	18:30	27
QF 141	Queenstown	19:00	28
QF 142	Invercargill	19:30	29
QF 143	Wellington	20:00	30
QF 144	Christchurch	20:30	31
QF 145	Dunedin	21:00	32
QF 146	Queenstown	21:30	33
QF 147	Invercargill	22:00	34
QF 148	Wellington	22:30	35
QF 149	Christchurch	23:00	36
QF 150	Dunedin	23:30	37



Arrival

RECOVER

13

Lighting and circadian rhythms

Our circadian rhythm is our natural body clock that dictates periods of wakefulness, alertness, relaxation, and tiredness. It also influences our productivity, performance, stress levels, blood pressure, and body temperature, all depending on how our bodies react to the quantity and colour temperature of the light surrounding us.

Lighting conditions have a significant impact on our circadian rhythm and biological processes.¹ Light enters the eye and is detected by a special collection of cells called the retina. This information is then sent to the brain, where it is processed to control organs and other systems in relation to the time of day.²

Although it is common sense for most people that it is easier to sleep when it is dark, there is more to the relationship between light and the human body than meets the eye. Light helps regulate the nervous and endocrine systems as well as the secretion of hormones such as melatonin. In line with normal sleep-wake cycles, the hormone is at its highest level at night to promote

healthy sleep and at its lowest in the light of day to promote alertness.

Improper lighting conditions, such as exposure to strong lights during the night, causes these rhythms to be disturbed, leading to sleep problems, mood disturbances, and an increased risk of depression.³ Those who are prone to having disrupted circadian rhythms are often those who spend prolonged periods indoors under low lighting conditions. This situation is typical for office workers who spend long hours in the workplace without exposure to natural daylight.

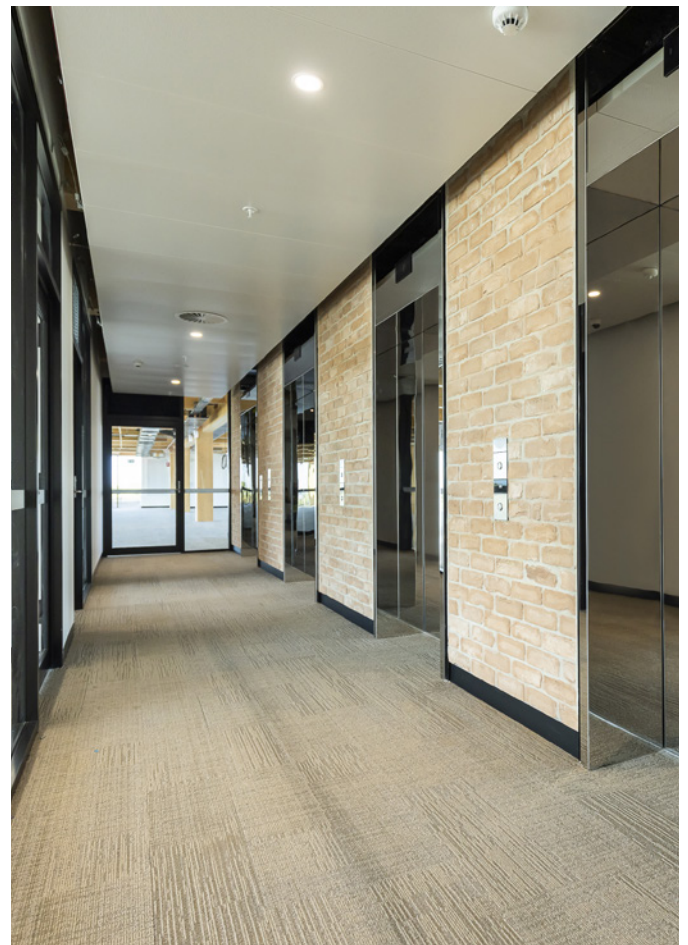
Exposure to light at inappropriate times can disturb our natural body clocks and sleep patterns but controlled exposure to light has been shown to have a therapeutic effect in the right circumstances. Light therapy is a well-known practice targeted at improving sleep, mood and general wellbeing.⁴ It has, for instance, been demonstrated to be effective in reducing the symptoms of depression, including seasonal affective disorder.⁵

Effects of poor lighting

Static light intensity and colour, regardless of time of day or night, is a problem. For example, intense white light in the evening and at night can disrupt the circadian rhythm. Poor lighting is also characterised by other factors, including uneven light distribution, excessive shadows and glare, all of which can have adverse physical and mental health effects on occupants.

In a workplace setting, too much light can contribute to glare-induced headaches and stress, while too little light can contribute to eye strain, mistakes at work and low productivity. These outcomes contribute to reduced employee satisfaction. For example, in one United Kingdom study, 83% of office workers reported frustration with the quality of workplace lighting, while 80% experienced negative symptoms due to poor lighting.⁶

In a 2018 survey conducted by UK company Staples, 80% of office workers emphasised the importance of having adequate lighting in their workplace. A concerning statistic revealed that two out of every five individuals (40%) contend with uncomfortable lighting conditions on a daily basis.⁷ Additionally, a significant portion of respondents (32%) expressed that improved lighting would contribute to their overall happiness and satisfaction in the workplace.⁸





The key characteristic of Human-Centric Lighting is that it aims to mimic the dynamic properties of natural light, which fluctuates in both colour temperature and intensity throughout the day and across different seasons.

What is Human-Centric Lighting?

Our blood pressure, body temperature, and hormone levels undergo fluctuations within a 24-hour cycle, partly influenced by the varying signals we receive from light throughout the day and night. Consequently, a static light source that remains constant throughout the day is incompatible with how the human body functions on a day-to-day basis.

Human-Centric Lighting (HCL) arose as a solution to address this dilemma, providing lighting environments that synchronise with the body's natural circadian rhythms. The key characteristic of HCL is that it aims to mimic the dynamic properties of natural light, which fluctuates in both colour temperature and intensity throughout the day and across different seasons.

To achieve this, HCL utilises a combination of warm white and cool white LED light sources, whose intensities are adjusted to create a tunable white lighting solution. These

luminaires are managed by an intelligent control system that employs suitable light profiles to replicate the nuanced qualities of natural daylight, depending on the time of day.

For example, cool white light containing wavelengths from the blue spectrum can invigorate the body during the morning hours or when heightened concentration and alertness are required. At the end of the day, lighting decreases to help the body unwind; at this time, HCL can provide warm white light that will have a relaxing effect.

With controllable lighting technologies now widely available, HCL is gaining a foothold across all sectors. In office and school settings, HCL systems can enhance learning, focus, and productivity while also boosting efficiency and accuracy. Additionally, HCL can enhance patient comfort in hospitals and aged care centres, as well as reduce the fatigue of hospital staff at night.



Integrated HCL solutions for metal ceilings

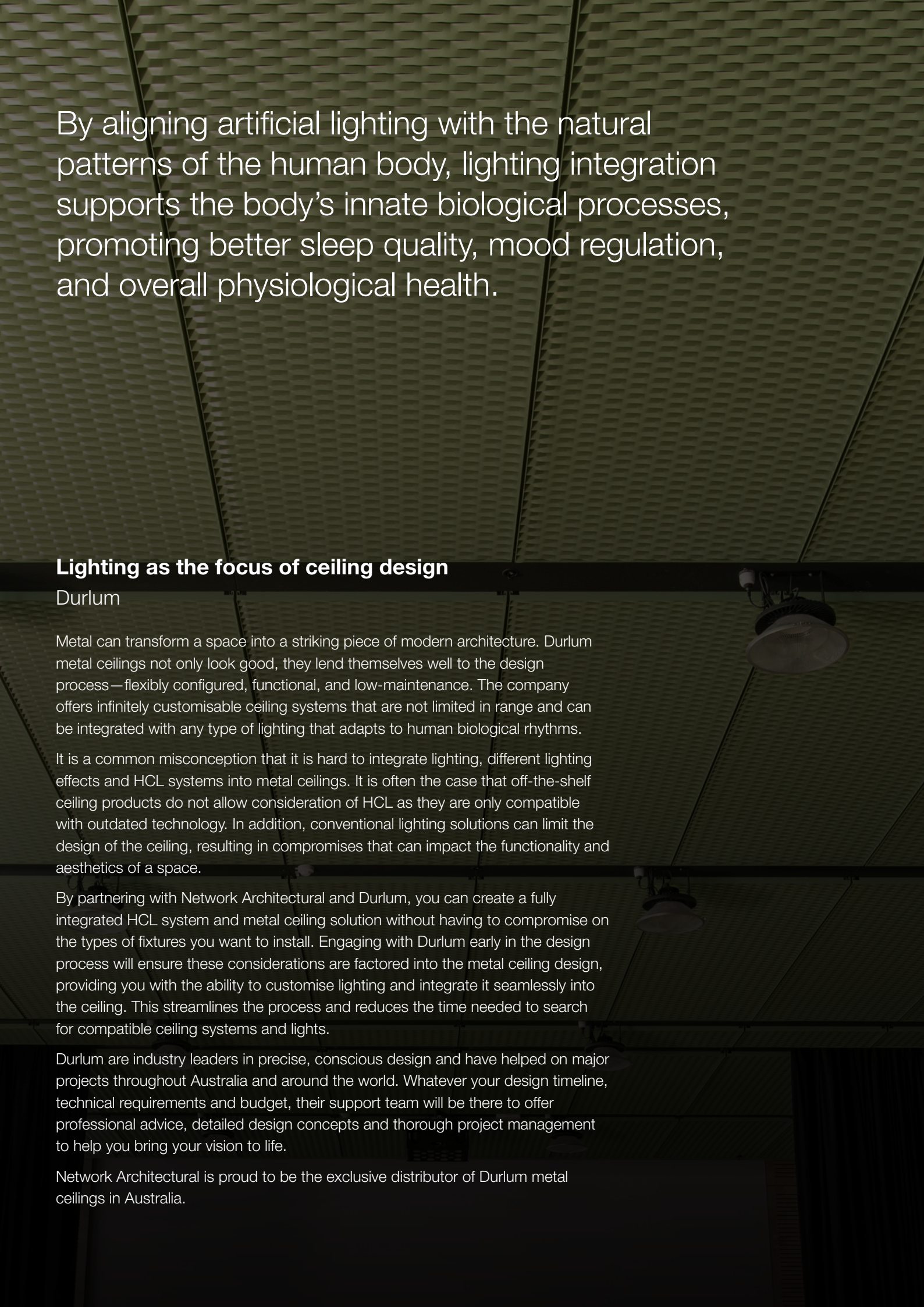
The first step in integrating HCL into a metal ceiling is selecting LED lighting fixtures specifically designed for HCL applications. Most standard LED or fluorescent lights can produce only a single colour temperature, while incandescent lighting can “warm” in colour when dimmed but is otherwise not tunable.

HCL utilises tunable white LED lighting setups comprising various LEDs, dimmable drivers, and controllers to regulate colour temperatures as the day progresses. Incorporating these solutions into building management systems provides greater control and customisation, enabling lighting that can be tailored to individual preferences and environmental conditions.

Cutting-edge LED lighting manufacturers are introducing dynamic spectrum lighting technology, enabling the adjustment of light across the entire visible colour spectrum. In addition, LED products equipped with advanced controls are increasingly accessible and cost-effective. Another recent innovation is sensor-based lighting controls that allow automatic lighting adjustments to align with the natural daylight curve.

Once HCL-compatible fixtures are selected, the next step is to determine the placement of lighting fixtures within the metal ceiling layout to achieve uniform illumination while avoiding glare and shadows. It is important to work closely with architects and engineers early in the design process so that the HCL fixtures can be integrated into the metal ceiling structure. This may involve coordinating with ceiling system manufacturers to design compatible mounting options or recessed compartments for the fixtures.

The control systems installed for the HCL solution should allow for precise control of light intensity and colour temperature adjustments to support HCL principles. An effective HCL system should be intuitive and simple to modify, accommodating diverse preferences and needs. Consider features such as pre-set programs and manual programming features tailored to different times of day, including evening and nighttime settings, and options for fully automated operation.



By aligning artificial lighting with the natural patterns of the human body, lighting integration supports the body's innate biological processes, promoting better sleep quality, mood regulation, and overall physiological health.

Lighting as the focus of ceiling design

Durlum

Metal can transform a space into a striking piece of modern architecture. Durlum metal ceilings not only look good, they lend themselves well to the design process—flexibly configured, functional, and low-maintenance. The company offers infinitely customisable ceiling systems that are not limited in range and can be integrated with any type of lighting that adapts to human biological rhythms.

It is a common misconception that it is hard to integrate lighting, different lighting effects and HCL systems into metal ceilings. It is often the case that off-the-shelf ceiling products do not allow consideration of HCL as they are only compatible with outdated technology. In addition, conventional lighting solutions can limit the design of the ceiling, resulting in compromises that can impact the functionality and aesthetics of a space.

By partnering with Network Architectural and Durlum, you can create a fully integrated HCL system and metal ceiling solution without having to compromise on the types of fixtures you want to install. Engaging with Durlum early in the design process will ensure these considerations are factored into the metal ceiling design, providing you with the ability to customise lighting and integrate it seamlessly into the ceiling. This streamlines the process and reduces the time needed to search for compatible ceiling systems and lights.

Durlum are industry leaders in precise, conscious design and have helped on major projects throughout Australia and around the world. Whatever your design timeline, technical requirements and budget, their support team will be there to offer professional advice, detailed design concepts and thorough project management to help you bring your vision to life.

Network Architectural is proud to be the exclusive distributor of Durlum metal ceilings in Australia.



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- ² Suni, Eric and Abhinav Singh. "Light and Sleep." Sleep Foundation." <https://www.sleepfoundation.org/bedroom-environment/light-and-sleep> (accessed 15 April 2024).
- ³ Osibona, Oluwapelumi, Bethlehem D. Solomon and Daniela Fecht. "Lighting in the Home and Health: A Systematic Review." *International Journal of Environmental Research and Public Health*, Vol. 18, No. 2 (2021): 609.
- ⁴ Above n 1.
- ⁵ Above n 3.
- ⁶ Bean, Sara. "Research into office lighting reveals negative impact of poorly-lit workplaces." *Insight*. <https://workplaceinsight.net/research-into-office-lighting-reveals-negative-impact-of-poorly-lit-workplaces> (accessed 15 April 2024).
- ⁷ Staples. "The Harsh Reality of UK Office Lightig." Staples. <http://staples.co.uk> (accessed 15 April 2024).
- ⁸ Ibid.

All information provided correct as of May 2024.