

The Benefits of Daylighting in Architectural Design



Contents

Option 1

	Page No.
Introduction	2
Part 1	4
Daylighting strategies	
Chapter	
01 Daylighting strategies - Factors affecting daylight design	6
02 Daylighting strategies - Electric vs artificial light	10
03 Daylighting strategies - Rooftop optimization	14
04 Daylighting strategies - Managing glare and heat gain	18
05 Daylighting strategies - Digital tools (waiting for design file)	24
Part 2	30
Daylighting and energy efficient, sustainable buildings	
Chapter	
06 Sustainable - Net zero	32
07 Sustainable - Net zero case studies	38
08 Sustainable - Daylighting in LEED and BREEAM	42
09 Sustainable - Daylighting in WELL	48
10 Sustainable - Retrofit	55
11 Sustainable - Retrofit case studies	56
Part 3	62
The human benefits of daylighting	
Chapter	
12 Benefits - Modern design	64
13 Benefits - Health & wellbeing	68
14 Benefits - Daylighting in education and sports	72
15 Benefits - Why daylighting is a wise investment for business	78
16 Benefits - Daylighting in retail	82
Conclusion	88
Index	90
Glossary of Daylighting Terms and Acronyms	92
Architectural Solutions and Design Support	100

Naturally
Enhanced
Environments

Introduction

Daylighting—the deliberate incorporation of natural light into building design—is one of the most important means through which architects can find harmony between the functionality and the beauty of buildings. The human instinct towards sunlight has defined how and where we have built our internal environments for millennia, from the positioning of the Great Pyramids to the soaring windows that define Gothic architecture. Today, daylighting has taken on increased significance, as scientific research has revealed its fundamental role in human health and wellbeing, as well as the role it plays in creating a more sustainable future.

In the chapters ahead, we explore how thoughtful integration of natural light can elevate architecture from functional to exceptional, examining not only its technical principles and practical applications, but also the profound impact it has on human well-being, spatial experience, and environmental performance.



THE BENEFITS OF DAYLIGHTING IN ARCHITECTURAL DESIGN

PART 1

Daylighting strategies

Light is a powerful design tool that shapes perception, guides movement, and enhances the character of a space. Through strategic daylighting applications that consider both the space it is serving and the balance between electric and natural light, architects can highlight materials, emphasize details, and create environments that feel open, inviting, and efficient.



Chapter 1

Key Factors to Consider in Daylight Design for Buildings

Natural daylight matters on several levels – it enhances the well-being of occupants, reduces energy consumption, and provides biologically – and psychologically meaningful variation to architectural spaces. It follows that daylighting design should sit at the heart of architectural and interior design, helping to shape functional and inspiring spaces. However, achieving effective daylighting in buildings is more complex than 'just adding windows.' Architects and designers must carefully balance internal, external, and product considerations to craft spaces that optimize daylight performance.

When referring to daylight and daylighting, it is important to understand the difference between the two terms as it affects how solutions are developed and applied to real world buildings:

Daylight: the lighting resource provided by light from

1. The solar disk (the sun/sunlight) and/or light from
2. The diffuse sky vault.

Daylighting: the artful application of the daylight resource (sky + sun) and architecture/products to achieve interior lighting objectives (task illuminance for visibility and/or illumination for visual effect).

In this article, we explore the critical factors that influence daylighting design and offer strategies for creating luminous, sustainable spaces.



“We only know the world as it is evoked by light.”



Benefits of Daylighting in Architectural Design

External Considerations

As a starting point, we need to determine how the structure's location will affect its daylighting solution – its surrounding environment will have a significant impact on deciding which daylighting strategies will work best. Designers must evaluate site-specific factors that determine how light enters a building, which will include:

1. Building Orientation

The orientation of a building dictates the directionality and quantity of sunlight different façades receive throughout the day and year. South-facing orientations, for instance, maximize sunlight in the northern hemisphere, while east and west-facing façades introduce challenges such as glare during mornings and evenings.

2. Surrounding Structures

Adjacent buildings, trees, and topography can block or reflect light. Conducting a shading analysis helps identify potential obstructions and opportunities for light redirection.

3. Climate and Weather Patterns

The intensity and angle of sunlight vary by geographic location and climate. In regions with frequently overcast skies, strategies should prioritize diffuse light, while in sunny climates, daylighting design needs to consider shading devices and glare control.

4. Urban and Environmental Context

Urban areas with dense development demand careful planning to balance daylight access and privacy. Environmental factors – for example, pollution or dust – may also reduce light penetration and will need to be addressed during the design phase.

Internal Considerations

Once light enters a building, its journey's shaped by interior design choices. These factors ensure daylight is effectively distributed and enhances the space. In daylighting design, the building's architecture (the location and finish of architectural surfaces) serves as the "light source" or "luminaire" and the building's interior becomes the "light fixture".

1. Space Layout

Open floor plans and strategic placement of partitions mean that light can travel deeper into the building's core. Using atriums, light wells, or clerestory windows can also bring daylight to lower levels.

2. Surface Reflectance

Interior surfaces play a vital role in bouncing light through space. Light-colored walls, ceilings, and floors reflect more daylight, reducing the need for artificial lighting. Additionally, the color of those surfaces can play a key role in how the reflected light is perceived. Surfaces with a warm tone (think white paints with a slight wheat-colored cast) will allow interiors to feel 'warm and inviting' on heavily overcast days. Conversely, the interior finishes with cool blue/grey undertones will result in a space feeling cold and clinical on highly overcast days.

“The choice of materials, glazing, and daylighting technologies can make or break a daylighting design strategy.”

3. Room Depth and Window Placement

Rooms that are too deep relative to window size can leave areas underlit. Ensuring an optimal ratio between window height and room depth helps achieve uniform light distribution. Additionally, toplighting daylighting technologies, such as tubular daylighting devices (TDDs) and architectural skylights, can be used to provide robust and controlled daylight to illuminate interior occupied zones and architectural surfaces.

4. Control of Glare and Heat

Glare from uncontrolled sunlight can make spaces uncomfortable. Designers should consider using translucent glazing materials, tubular daylighting devices, shading devices or adjustable louvers to maintain comfort without sacrificing light quality.

5. Building Function

Who will use the building or space, and why, will dictate how much light is necessary. Here, regulations come into play, with different guidance for different space uses and/or building types. Around 300 lux is the norm for most space types, with a higher requirement of around 500 lux in workspaces.

While task illuminance requirements do vary due to a number of factors, The Illuminating Engineering Society (IES) currently standardizes on approximately 300 lux (30 footcandles) for most commercial and institutional spaces (offices and classrooms), with 500 lux (50 footcandles) or more being reserved for spaces with more critical visual tasks such as manufacturing and other critically-important visual tasks. These more-moderate illuminance requirements are also deemed to be more conducive to the art of daylighting.

Beyond official guidelines, desirable building standards have their own requirements. For

instance, the U.S. Green Building Council (USGBC)'s [Daylight Standard](#) states that a minimum 75% of regularly occupied areas should have a daylight factor (DF) of at least 2% in all spaces used for critical visual tasks. This equates to around 300 lux under overcast sky conditions.

Additionally, in North America, modern design standards such as LEED and WELL now incorporate metrics like Spatial Daylight Autonomy (sDA) and Annual Sunlight Exposure (ASE) as preferred assessments of annual daylighting sufficiency, complementing traditional measures like the Daylight Factor.

6. Accessibility and Inclusivity

Daylighting design should consider the needs of people with disabilities, ensuring that spaces are comfortable and functional for all occupants. For example, individuals with visual impairments may benefit from enhanced lighting in critical areas, such as entrances, hallways, or workspaces. Thoughtful daylighting can make spaces more inclusive and supportive of diverse occupant needs.

Product Considerations

The choice of materials, glazing, and daylighting technologies can make or break a daylighting design strategy. So, what product factors should you bear in mind?

1. Glazing Types

High-performance glazing can enhance daylight penetration while managing solar heat gain. Incorporating options that can provide daylight while controlling glare and solar heat gain including translucent polycarbonate or FRP panel glazing, low-emissivity (low-E) glass, tinted glass, or tubular daylighting devices that can provide daylight while controlling glare and solar heat gain.



Chapter 2

Daylighting Strategies: Balancing Natural and Electric Lighting For Healthy, Energy-Efficient Buildings

Architects and designers often face the challenge of creating spaces that not only look stunning but also foster health, comfort, and sustainability. Daylighting plays a pivotal role in this process. But what exactly is the difference between daylight and electric lighting, and why is it essential to consider both in building design? In this knowledge article, we explore the nuances of natural daylight and electric light from a scientific perspective and examine how a thoughtful blend of both can create healthier, more energy-efficient environments.

The Science of Daylighting

From dawn till dusk, daylight is dynamic and changes in intensity and color temperature. This variability profoundly impacts human well-being and building performance, so understanding the science behind these differences is key to optimizing daylighting design.

Natural Daylight: A Dynamic Spectrum

Natural daylight — primarily delivered through windows, skylights, and glazed façades — is a full-spectrum light source derived from the sun. The standard measurement unit for color temperature is Kelvin (K) — in the context of daylight, Kelvin measures the hue of light along a spectrum ranging from warm (reddish) to cool (bluish). Color temperature plays a significant role in how we perceive and interact with light during the day.



“Architects and specifiers can harness the benefits of both creating well-lit, energy efficient, and human-centric spaces.”



Natural daylight’s characteristics on a typical sunny day include:

Intensity Variability

- Morning light is soft and warm, with a low intensity and color temperature of around 2000–3000K.
- Midday light is intense and cooler — its higher intensity and color temperature are around 5000–6500K.
- Late afternoon and early evening light transitions back to a warmer hue, similar to the sunrise.

Circadian Rhythm Regulation

- Exposure to bright, cool (blue-rich) light in the morning and midday supports our internal biological clocks, enhancing alertness and improving mood.
- Warmer (red-rich) evening light tells the body to wind down, promoting restful sleep.

Spectral Completeness

- Daylight includes all visible wavelengths, ranging between ultraviolet to infrared, facilitating natural color rendering and a psychological and physiological connection to the outdoors.

Electric Lighting: Controlled Consistency

Electric lighting — achieved through LEDs, fluorescents, or other technologies — is engineered to supplement or mimic natural light. Its key benefits include consistency, customizability, and energy efficiency:

Consistency

- Unlike natural daylight, electric light offers fixed intensity and color temperature, making it a predictable and reliable source when natural light is unavailable.

Customisability

- Modern lighting systems allow the precise tuning of brightness and color temperature. Some advanced LEDs offer dynamic spectral changes to align with circadian rhythms.

Energy Efficiency

- LED lighting has made electric lighting significantly more energy-efficient, with technologies like daylight sensors and dimmers optimizing energy use in response to changing daytime daylight illumination.

Why Both Natural Daylighting and Electric Lighting Matter

Relying solely on one type of lighting can result in suboptimal building performance. By combining natural daylighting and responsive supplemental electric lighting, architects and specifiers can harness the benefits of both creating well-lit, energy-efficient, and human-centric spaces.

The Benefits of Natural Daylight

1. Health and Well-Being

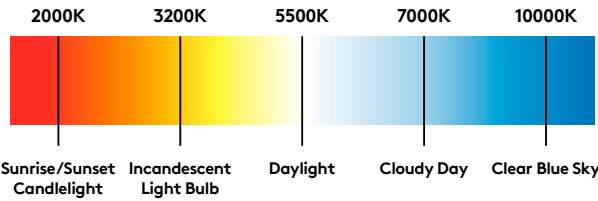
Access to natural light has been shown to reduce stress, enhance mood, and improve productivity. Studies have demonstrated that workers in offices with ample daylight report higher job satisfaction and fewer health complaints.*

2. Energy Savings

Strategically placed skylights, tubular daylighting devices, glazed wall systems and windows can reduce the need for electric lighting during daytime hours, significantly lowering energy costs while increasing the building’s sustainability.

3. Aesthetic Appeal

Daylight enhances architectural features, creating visually dynamic spaces that change with the time of day.



*Impact of Daylight Exposure on Health, Well-Being and Sleep of Office Workers Based on Actigraphy, Surveys, and Computer Simulation. Journal of Green Building, 2020. Available at: meridian.allenpress.com/jgb/article/15/4/19/449481/IMPACT-OF-DAYLIGHT-EXPOSURE-ON-HEALTH-WELL-BEING. Results indicate that working in daylight office spaces leads to higher sleep quality and higher scores of the health and well-being scales compared to non-daylit conditions.

“By harnessing and optimizing natural daylight, these technologies help maximize its benefits while minimizing its limitations.”

The Limitations of Natural Daylight

Alongside the health and energy benefits of natural daylight, some obvious challenges restrict its usefulness in buildings. Dependence on weather and time of day, the potential for glare or uneven light distribution, and heat gain or loss through large, glazed areas can cause issues which electric daylighting is indispensable in addressing.

To mitigate these challenges, translucent systems, and tubular daylight devices (TDDs) offer innovative solutions. Translucent systems, such as frosted glass, fiberglass reinforced polymer (FRP) panels or polycarbonate glazing, diffuse sunlight to reduce glare and provide more even light distribution. These systems can be strategically placed to enhance the quality of natural daylight without the associated heat gain or loss.

Tubular daylight devices, also known as tubular skylights, capture sunlight on the roof and channel it through highly reflective tubes into interior spaces. TDDs are effective in bringing natural light into areas that are otherwise difficult to illuminate, such as basements or interior rooms, without the need for additional electrical lighting. By harnessing and optimizing natural daylight, these technologies help maximize its benefits while minimizing its limitations.

The Benefits of Electric Lighting

1. Reliability

Electric lighting ensures consistent illumination, which is crucial in spaces with limited access to natural daylight, such as basements or interiors of large buildings.

2. Extended Usability

It supports activities outside daylight hours, ensuring that buildings remain functional and inviting.

3. Flexibility and Control

With smart lighting systems, electric light can complement natural daylight seamlessly, adapting to the time of day and user needs.

The Limitations of Electric Light

Despite its reliability and adaptability, electric lighting has several limitations that impact both human well-being and energy efficiency. Unlike natural daylight, artificial lighting often lacks the full spectrum of light needed to support circadian rhythms, potentially affecting mood and productivity and leading to eye strain, fatigue and sleep disturbances. In addition, reliance on electric lighting can lead to increased energy consumption and associated costs. Prolonged exposure to certain artificial light sources, particularly those with excessive blue light, can contribute to digital eye strain and disrupt melatonin production. While advances in LED technology have improved efficiency, electric lighting still contributes to operating costs and environmental impact. Additionally, electric lighting can sometimes create harsh shadows or insufficient brightness in certain areas, requiring careful design to achieve even distribution.

Getting the Right Balance

To fully leverage both natural daylight and electric lighting, design strategies must integrate their strengths while mitigating their weaknesses. Here is how:

Strategic Placement and Choice of Natural Daylight Sources:

- Use tubular daylighting devices (TDD), skylights, clerestories, and translucent wall panels made from polycarbonate, fiberglass reinforced polymer (FRP) or translucent glass designed to increase diffusion, allowing even light distribution while minimizing glare and heat gains.
- Utilize Tubular Daylighting Devices to bring daylight into difficult to reach areas and illuminate interior surfaces while minimizing shifting patterns of light.
- Incorporate glazed façades with advanced coatings to reduce heat gain and improve energy efficiency.
- Utilize skylights with transparent glass in transient areas or where views and a connection to the sky are a key design goal.

Optimized Electric Lighting Design:

- Select LED systems with tunable white technology to mimic natural daylight's spectrum and intensity changes.
- Pair electric lighting with daylight sensors to maintain consistent light levels while conserving energy.

Synergistic Integration:

- Combine natural daylight and electric lighting in layered systems. For instance, a well-placed skylight or TDD can provide daylight during the day, while strategically positioned LEDs enhance interior surface brightness on overcast days or at night.

Energy Modelling and Simulation:

- Leverage simulation tools to predict daylight performance and energy consumption. These tools help architects refine designs for optimal balance.

Integrating Daylight into Architectural Plans

Building codes and standards establish the minimum requirements for natural daylight in terms of occupant wellbeing. While these vary by jurisdiction, they often reference the [International Building Code \(IBC\)](#), which specifies a minimum glazed area not less than 8% of the floor area of the room, and the [International Residential Code \(IRC\)](#). Beyond building codes, energy standards such as [ASHRAE 90.1](#) and the [International Energy Conservation Code \(IECC\)](#) address the use of daylighting solutions to enhance energy efficiency.

When considering fenestration, in addition to windows, skylights, TDDs, and glazed façades are instrumental in achieving a harmonious blend of natural daylight and electric lighting. For example, designers can exploit the advantages of:

Skylights and Tubular Daylighting Devices:

- Lightweight, durable, and highly customizable, translucent panel skylights and TDDs allow diffuse and controlled daylight to penetrate deeply into spaces, reducing glare and maximizing comfort.
- Glass glazed skylights can be configured to let the maximum amount of light into a space or can be configured with glass featuring translucent interlayers for light control.
- Skylights and TDDs can be paired with smart shading systems to modulate light levels dynamically.

Façades:

- Translucent panel systems can be integrated with vision glass to provide enhanced thermal performance while enabling expansive views and daylight penetration.

- Glazed façades integrate seamlessly with electric lighting systems to maintain consistent lighting levels.

In summary, far from being competitors, daylight and electric lighting are partners in creating healthier, more energy-efficient buildings. By understanding their scientific differences and integrating them thoughtfully, architects and specifiers can design spaces that enhance human well-being, reduce energy consumption, and elevate architectural aesthetics.

As a manufacturer of TDDs (Tubular Daylighting Devices), polycarbonate and FRP (Fiberglass Reinforced Panels) glazing solutions, and innovative glass skylight systems, we can help you achieve the right balance between natural daylight and electric lighting.



Chapter 3

Maximizing Rooftop Potential

Harmonizing Daylight and Equipment Integration

Maximizing rooftop potential is a crucial strategy in sustainable, low carbon building design, where the integration of energy generation and natural daylighting plays a key role in enhancing efficiency and occupant well-being. A well-balanced approach that incorporates photovoltaic (PV) panels, skylights, and tubular daylighting systems allows for the simultaneous optimization of solar energy capture and daylight distribution.

PV panels can be strategically placed to generate renewable energy without compromising the effectiveness of daylighting elements, ensuring that skylights and tubular daylight devices capture and distribute sunlight efficiently within interior spaces. This harmonized approach reduces reliance on electric lighting, lowers energy costs, and improves occupant comfort. By carefully planning the layout and interaction of these systems, rooftops can become multifunctional assets that contribute to both energy efficiency and architectural aesthetics.

Harmonizing Daylight and Equipment Integration

Achieving an effective balance between daylighting and PV energy generation requires careful planning and innovative design strategies. The challenge lies in allocating sufficient space for both systems while maximizing their individual and combined efficiency.

“Rooftops can become multifunctional assets that contribute to both energy efficiency and architectural aesthetics.”



Skylights and tubular daylighting devices (TDDs) each offer unique benefits based on roof size and project needs. Skylights provide widespread daylight distribution, and when glazed smoke vents are used, they serve a dual purpose of providing daylight and offering code-compliant smoke venting. In contrast, TDDs focus light on the work plane using compact, optically enhanced roof domes and highly reflective tubes to channel daylight deep into interior spaces. Their design minimizes rooftop penetration while offering flexibility in dome placement, making room for more extensive PV panel installations.

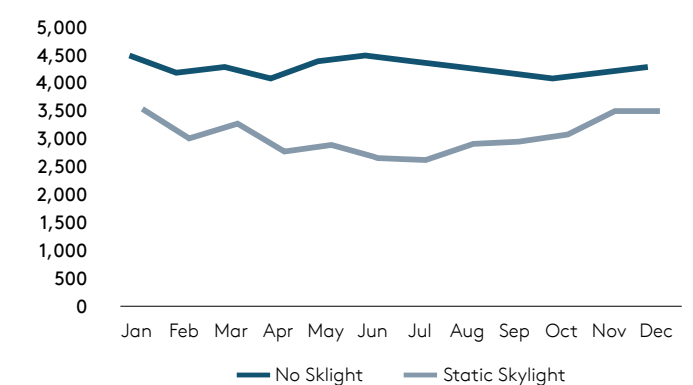
The significant energy savings provided by skylights and tubular daylighting devices (TDDs) reduce a building's overall electricity demand, which in turn reduces the size of the PV system required to meet a building's low energy goals. Skylights provide broad daylight coverage, enhancing natural light and aesthetics over larger areas, while TDDs efficiently direct daylight into interior spaces, reducing reliance on electric lighting during the day. Both solutions help optimize energy efficiency, which means fewer PV panels may be required to meet the building's power needs.

This reduction in PV system size not only saves on installation costs but also allows for more flexible roof space utilization, further enhancing the synergy between daylighting and solar power generation.

Proper orientation and placement of PV panels and the strategic integration of daylighting devices further enhance both systems' performance. For example, PV panels are often positioned to face south or west for optimal solar energy capture, while daylighting solutions are strategically located to provide uniform daylight distribution throughout the building. In some cases, bifacial solar panels, which can generate electricity from both direct sunlight and reflected light, can be combined with daylighting systems to maximize efficiency.

Additionally, advanced controls and automation technologies, such as daylight sensors and integrated dimmable LED fixtures, can further optimize energy use by seamlessly integrating responsive electric lighting with available daylight.

Monthly lighting energy consumption of a small office*





CASE STUDY 01 SICON Group Headquarters Gescher/Münsterland, Germany

The SICON Group's new headquarters in Gescher/Münsterland, Germany, exemplifies the innovative use of roof space by integrating photovoltaic (PV) systems with skylights. This design not only harnesses solar energy to generate electricity, reducing reliance on the grid, but also enhances the natural lighting provided by the skylights.

A prominent feature of the project is a 60 x 4.50 m (approximately 197 x 15 ft) flat curved continuous skylight that illuminates the 4,000 m² (43,056 square feet) factory roof with uniform, glare-free light. The skylight uses energy-efficient plastic glazing with a U(g) value of 1.80 W/m²K (approximately 0.317 BTU/(hr-ft²-°F)), ensuring optimal energy efficiency.

Safety is a key consideration in the design, with advanced features to mitigate roof access risks. The ID 1200 plus integrated fall-through protection system, installed below the PVC-U glazing, provides comprehensive fall protection, and ensures that open vents do not pose a hazard.

This integrated approach improves the building's performance and promotes a safer working environment.

CASE STUDY 02 Solatube International Headquarters Vista, California

Solatube International, Inc., headquartered in Vista, California, is the global leader in tubular daylighting technology, specializing in innovative daylighting and ventilation solutions. The company operates from two primary buildings spanning over 103,000 square feet, supporting the company's mission to provide energy-efficient, high-performance daylighting and ventilation systems to its customers worldwide.

As a subsidiary of Kingspan Light + Air, Solatube International is deeply committed to Kingspan Group's Planet Passionate initiative—a company-wide sustainability program designed to address three critical global challenges: climate change, circularity, and the protection of our natural world. Through Planet Passionate, Kingspan is taking significant steps to decarbonize the manufacturing process, aiming for Net-Zero emission by 2030, while also working to reduce the carbon intensity of its primary supply chain.

A key milestone in the sustainability journey is the recent installation of photovoltaic (PV) systems at Solatube International's facilities campus. This investment highlights Solatube's commitment to reducing its carbon footprint and enhancing energy efficiency by harnessing Southern California's abundant sunshine to power operations and fully daylight its facilities.

Optimizing Roof Space for Maximum Energy Efficiency

Solatube International employs 224 Solatube tubular daylighting devices (TDDs) at its Oak Ridge facility and 111 at its Cousteau Court facility to displace the need for electric lighting across 94% of the campus' interior floor space during the day. In these daylit spaces, electric lighting is used for only 3% of the occupied year. Additionally, by using TDDs rather than traditional skylights, more roof space can be allocated to PV panels, significantly increasing photovoltaic energy production to address the manufacturing energy requirements.

Unlike skylights, which must be positioned directly above the areas they illuminate, tubular daylighting devices (TDDs) offer greater flexibility in placement. TDDs use highly reflective tubing to transport daylight from compact optically enhanced rooftop domes to interior spaces, allowing them to be installed at various angles and distances from their targeted illumination areas. This design enables buildings to optimize roof space by positioning TDDs strategically around obstructions, such as HVAC units or PV panels, while still delivering ample daylight to desired locations. By contrast, skylights require dedicated overhead space, which can limit roof utilization and reduce the available area for solar panels. The adaptability of TDDs allows for a more efficient integration of daylighting and solar energy systems, maximizing both natural daylight distribution and renewable energy generation.

System Specifications

At the Oak Ridge facility, the PV system has a total power output capacity of 332.17 kW direct current (DC), representing the maximum energy it can generate under optimal conditions. It consists of 563 panels, each with a power output of 590 watts (W), efficiently converting sunlight into electricity. Over the course of a year, this system is expected to generate 546,900 kWh of electricity, significantly reducing energy costs and reliance on traditional power sources.

Meanwhile, Cousteau Court has an even larger capacity, with a total output of 489.11 kW DC, allowing for greater energy generation. This system includes 829 panels, each rated at 590W, ensuring maximum solar energy capture. The expected annual energy production reaches 776,100 kWh of electricity.

Real Energy Impact

Both facilities are now net-zero energy buildings, and with a combined annual energy production of 1,323,000 kWh Solatube International's PV installation is the highest energy-generating system in the entire Kingspan Light, Air + Water division. This clean energy output is enough to power approximately 123 U.S. homes for a year, based on the average household consumption of 10,791 kWh annually. These facilities demonstrate the power of renewable energy to reduce reliance on traditional energy sources while advancing sustainability efforts.

Conclusion

The integration of daylighting and PV energy generation presents a powerful opportunity for buildings to enhance sustainability while optimizing energy efficiency. By utilizing compact, high-performance daylighting systems such as Solatube TDDs, buildings can maximize roof space for photovoltaic solar panels, significantly increasing energy production while maintaining optimal indoor daylighting conditions. This synergy not only reduces operational costs and environmental impact but also enhances occupant well-being by providing natural daylight throughout the day. As businesses and institutions worldwide seek to implement greener building solutions, harmonizing daylighting solutions with solar energy generation will continue to be a key strategy in the transition to net-zero energy buildings.



*Cochran, E., Pei, Z., Marion, F., Kolosky, A., Loftness, V., & Aziz, A. (2014). Integrated Dynamic Skylight Solutions to Reduce Energy Consumption and Improve Indoor Lighting Quality in US Buildings. Conference Paper. Carnegie Mellon University. Retrieved from researchgate.net/publication/3358280051

Chapter 4

Managing Glare and Heat: Critical Considerations for Daylighting Design

Natural daylight can create dynamic architectural spaces that enhance occupant well-being and reduce energy consumption. While the benefits of daylighting are substantial, without careful planning, two significant challenges can arise: **solar heat gain** and **glare**.

These factors can undermine daylighting advantages by causing visual discomfort, productivity loss, and increased cooling loads. For architects and designers, mastering the balance between maximizing daylight and minimizing its side effects is essential for occupant comfort, energy efficiency, and overall building performance.

In this knowledge article, we explore why controlling heat and glare is critical when specifying daylighting materials and strategies, and how thoughtful design can turn potential liabilities into strengths.



The pros and cons of natural daylight

As we have explored in previous knowledge articles, using daylighting in buildings as the primary light source reduces the need for [electric lighting](#) and supports [occupant health](#). However, sunlight also carries thermal energy and high luminance levels.

Without thoughtful control, this can cause visual discomfort, localized overheating, and increased reliance on mechanical cooling systems.

- **Solar heat gain** refers to the rise in interior temperature as spaces absorb solar radiation.
- **Glare** results from excessive brightness or strong contrast within the visual field, making it difficult for occupants to see or focus comfortably.

Effective daylighting design must mitigate these risks while preserving the many benefits of natural daylight.

To bring more daylighting into the deep footprint, architects at CO-OP Architecture exposed the building's original sawtooth roof structure and restored its industrial character, while integrating modern daylighting solutions in the form of the Kingspan GridSpan™ system into the vertical slopes.

Why solar heat gain matters

Energy efficiency and HVAC impacts

When sunlight enters a building, its infrared radiation converts to thermal energy, warming the interior spaces. While passive solar heating can be beneficial in cold climates or during winter, unmanaged solar gain during summer or in warm regions increases air conditioning loads, driving up operational costs and carbon emissions.

Uncontrolled solar heat gain can offset the energy savings achieved through reduced electric lighting. In fact, [windows can account for up to 40% of a building's total heating and cooling energy](#), making solar control essential for achieving energy standards and sustainability goals.

Comfort and space usability

Thermal comfort plays a critical role in space utilization, as excessive heat can render areas near glazing unusable during certain times of day or seasons. Spaces that overheat frequently generate occupant complaints, leading to costly retrofits or shading system installations after project completion.

By addressing solar heat gain early in the design process, architects and specifiers can create consistently comfortable environments year-round.



The impact of glare

Visual comfort and productivity

Glare overwhelms the eye's ability to adapt between bright and dark areas, compromising comfort and visual performance. It falls into two categories:

- **Disabling glare:** excessive brightness that physically impairs vision
- **Discomfort glare:** brightness causing psychological discomfort without impairing vision

In work environments, glare can reduce concentration, impair task performance, and contribute to eye strain and headaches. For example, direct sunlight on computer screens can disrupt workflow and necessitate constant furniture adjustments, leading to decreased productivity and a general sense of dissatisfaction.

Aesthetics and user experience

Beyond functional impacts, glare also affects how spaces look and feel. Overly bright areas and stark luminance contrasts can create visually chaotic environments. Thoughtful glare control, on the other hand, allows daylight to highlight materials, surfaces, and forms in ways that enhance spatial quality and create welcoming, harmonious interiors.

Strategies for managing heat and glare in daylighting design

The most effective daylighting decisions happen during early design phases, where they can be integrated holistically into building orientation, massing, and material selection.

Design with orientation and form in mind

Architectural strategies such as window placement, building orientation, and facade articulation play a significant role in controlling heat and glare. In addition, using Climate-Based Daylight Modeling (CBDM) can help to understand the sun's path throughout the year and optimize interior daylight placement and coverage, allowing designers to leverage daylight effectively.



While passive solar heating can be beneficial in cold climates or during winter, unmanaged solar gain during summer or in warm regions increases air conditioning loads, driving up operational costs and carbon emissions.

Dynamic shading systems offer flexibility to accommodate seasonal shifts.



Approaches to consider include:

- **Minimize east/west exposures** to reduce challenging low-angle sun penetration
- **Use horizontal overhangs** on south facades to block high summer sun while admitting lower winter sun
- **Strategic space planning** positions sensitive programs (e.g. workspaces) away from problematic solar exposures
- **Higher ceilings** allow deeper daylight penetration while reducing direct glare
- **Skylights and tubular daylighting devices** bring controlled daylight deep into building cores and to effectively daylight interior walls and architectural surfaces, thereby reducing the potential for the occurrence of perceived glare from view windows
- **Translucent wall systems** for exterior walls and interior partitions provide soft, controlled daylight to interior spaces while achieving good thermal and acoustical performance

Material selection and specification

Intelligent material choices are critical to daylighting success. Advanced glazing technologies help optimize visible light transmission while managing unwanted infrared and ultraviolet radiation.

Key performance factors include:

- **Visible Light Transmittance (VLT):** the percentage of visible light passing through glazing
- **Diffusion:** how the glazing material spreads/distributes the incoming beam daylight
- **Solar Heat Gain Coefficient (SHGC):** how well glazing blocks solar heat
- **Light-to-Solar Gain Ratio (LSG):** the efficiency of transmitting light relative to heat

Dynamic shading and smart glazing systems

Automated shading devices – including dynamic interior blinds (adjustable slats), exterior louvers, and responsive glazing – adjust throughout the day to optimize daylight access while limiting solar gain and glare. Dynamic shading systems offer flexibility to accommodate seasonal shifts, occupant preferences, and varying daylight conditions.

Static external shading systems

External shading devices block solar radiation before it reaches glazing, providing superior thermal control compared to internal solutions.

Options for external shading include:

- **Horizontal overhangs** (ideal for southern exposures)
- **Vertical fins** (best for east and west exposures)
- **Egg-crate systems** (combining horizontal and vertical elements)
- **Movable external louvers or screens** that adjust seasonally or throughout the day

Properly designed external shading can reduce cooling loads by 15-30% compared to unshaded glazing, with [one study showing that even a 35% reduction in cooling loads is achievable](#).



By proactively addressing solar heat gain and glare through orientation, materials, shading systems, and emerging technologies, architects and designers can create spaces that maximize the benefits of natural light.

Internal shading for glare management

While less effective for thermal control, internal shading solutions are vital for managing glare:

- **Diffusing materials:** translucent panels, specialized fabrics, or fritted glazing scatter sunlight evenly across spaces to minimize harsh contrasts and hot spots
- **Blinds (adjustable slats) and shades (fabric panels):** provide occupant-adjustable control over brightness and views
- **Light shelves:** reflect daylight deeper into interiors while blocking direct sun
- **Microlouvers:** fine-scale slat systems embedded into window films or shades that selectively block direct solar glare while preserving outward views and maintaining diffuse daylight

Advanced daylighting technologies

Emerging technologies are expanding daylighting possibilities:

- **Prismatic layers:** redirect light to target areas while reducing glare
- **Holographic optical elements:** diffract and redirect selected wavelengths
- **Tubular daylighting devices:** advanced optical technologies and systems block unwanted UV and Infrared wavelengths from entering the building and transport beneficial, precisely controlled daylight into deep interior zones and redirected to artfully illuminate interior surfaces and visual task planes
- **Daylight-responsive lighting controls:** adjust electric lighting automatically based on available natural light

Prioritize integrated design

Successful daylighting design requires an integrated approach that balances aesthetics, performance, and occupant comfort from the earliest stages of a project. By proactively addressing solar heat gain and glare through orientation, materials, shading systems, and emerging technologies, architects and designers can create spaces that maximize the benefits of natural light while avoiding its potential drawbacks. The result: buildings that are not only more sustainable and energy-efficient, but healthier, more productive, and better attuned to human needs.



Glossary of Key Daylighting Terms

Blinds – Interior window coverings made of adjustable slats, allowing occupants to control light levels and privacy.

Glare – Visual discomfort caused by excessive brightness or stark contrasts between light and dark areas:

- Disability glare impairs vision
- Discomfort glare causes psychological discomfort without impairing vision

Light-to-Solar Gain Ratio (LSG) – The ratio of visible light transmittance (VLT) to solar heat gain coefficient (SHGC). A higher LSG value indicates better daylight admission relative to solar heat gain control.

Louvers – Architectural shading devices composed of angled slats, typically exterior, designed to control sunlight penetration and reduce solar heat gain.

Microlouvers – Fine-scale fixed-angle slats embedded in films or fabrics that selectively block high-angle direct sunlight while maintaining views and admitting diffuse daylight.

Shades – Interior fabric coverings (such as roller or Roman shades) that roll, fold, or stack to block or filter sunlight.

Solar Heat Gain Coefficient (SHGC) – The fraction of solar radiation admitted through a window, both directly transmitted and absorbed, then released as heat inside a building. Lower SHGC values indicate better solar heat control.

Visible Light Transmittance (VLT) – The percentage of visible light that passes through glazing. Higher VLT values mean more daylight is admitted into the space.

Chapter 5

How Digital Tools are Transforming Daylight Design in Architecture

Daylighting is a powerful design tool, combining the natural illuminance of the sun and sky with architectural principles and building products to deliver spaces which are invigorating to be in, efficient to run and truly beneficial for their occupiers.

To design effectively, architects must consider the local climate, building orientation, fenestration layout, and daylight performance objectives for occupants. In the past, this would have been a cumbersome process, involving extensive inputs and significant technical expertise. However, the rise of Climate-Based Daylight Modelling (CBDM) software has made accurate analysis more accessible, intuitive and project specific, enabling this essential approach to become part of every architect's toolkit.



What is Climate-Based Daylight Modelling?

Climate-Based Daylight Modelling (CBDM) is a means of assessing the quality and quantity of natural daylight and sunlight that the rooms within a building will receive. It employs location-specific annual weather data pertaining to time-varying sky and sun conditions and predicts hourly levels of absolute daylight illuminance. This dynamic and data-rich method differs greatly from the traditional daylight factor approach—which uses single “point-in-time” illuminance calculations to determine interior light levels at a specific time and date under an overcast sky condition.

There are three main criteria in CBDM for assessing whether a room will be sufficiently daylit or not:

1. Useful Daylight Illuminance (UDI)

Useful Daylight Illuminance (UDI) [approaches daylighting data from a human factors perspective](#). The location-specific data is used to determine “useful” light levels across the work-plane of a particular space. This is generally between 100 to 3,000 lux, with the range then subdivided further:

- **UDI-s** (100 to 300 lux) indicates where the light would be considered insufficient without electric lighting.
- **UDI-a** (300 to 3,000 lux) shows where electric lighting is acceptable but wouldn't be needed for the majority of the day. Achieving a high UDI-a percentage indicates that the space is predominantly daylit throughout and glare is controlled.
- **UDI-e** (above 3000 lux) demonstrates where light levels would be considered excessive and a source of glare, where blinds would need to be closed.
- These three subcategories—UDI-s, UDI-a, and UDI-e—represent insufficient, optimal, and excessive daylight conditions, respectively.

2. Spatial Daylight Autonomy (sDA)

sDA measures how much of a building's floor area receives sufficient daylight to support comfortable, energy-efficient working conditions without artificial lighting. As with UDI, it considers annual geographic, location-specific weather information to provide a measure of how often a minimum illuminance threshold can be maintained by daylight alone across the work-plane.

- sDA is defined as the percentage of the analyzed space receiving at least **300 lux** for **at least 50 percent of annual occupied hours from 8 AM to 6 PM**.
- sDA values range from zero to 100% of the floor area, with an **sDA value of 75%** indicating a space in which daylighting is “preferred” by occupants and sufficient that they can work comfortably without electric lights.

3. Annual Sunlight Exposure (ASE)

While natural daylight is essential for creating vibrant, healthy indoor environments, too much of it can lead to problems like glare and unwanted heat gain. These issues not only affect occupant comfort but can also reduce a building's energy efficiency.

To help designers strike the right balance, **Annual Sunlight Exposure (ASE)** is used alongside **sDA**. ASE specifically measures how much of a space receives excessive direct sunlight over the course of a year. The metric **ASE1000,250h** refers to the percentage of floor area that gets more than 1,000 lux of direct sunlight for at least 250 occupied hours annually. Like sDA, ASE values range from 0% to 100%. A high ASE value means a large portion of the space is overexposed to sunlight, increasing the risk of glare and thermal discomfort.

To mitigate these effects, designers typically aim for low ASE values using products designed to minimise glare and solar heat gain and shading techniques.



What are the benefits of using dynamic daylight modeling for architects?

The core benefit of using CBDM is the **accuracy it provides in visualizing real-life daylighting levels**. By drawing on data that accounts for building design, geographic location and weather down to hourly variances, it is possible to take a **responsive design approach** that can strategically shape daylighting within a space. This brings both practical and aesthetic rewards.

By using software which draws on real, project-specific data, architects can firstly **set daylighting targets that are relative to the end users' needs and occupancy schedules** for a specific building and allows products and solutions to be compared based upon real-world performance.

Effectively harnessing daylight can be a **highly cost-effective means of reducing a building's energy demand**. Careful consideration of size, form and positioning for glazed elements can ensure that light is dispersed usefully throughout the space and minimize the need for electric lighting. Meanwhile, strategic use of shading can help to mitigate heat spots and glare, supporting visual and thermal comfort and reducing reliance on mechanical cooling. It can also show the impact of various daylighting solutions and placement options, whether clerestories, punched wall openings, traditional skylights, or TDDs (**Tubular Daylighting Devices**, also called **tubular skylights** or **light tubes**) are to be used.

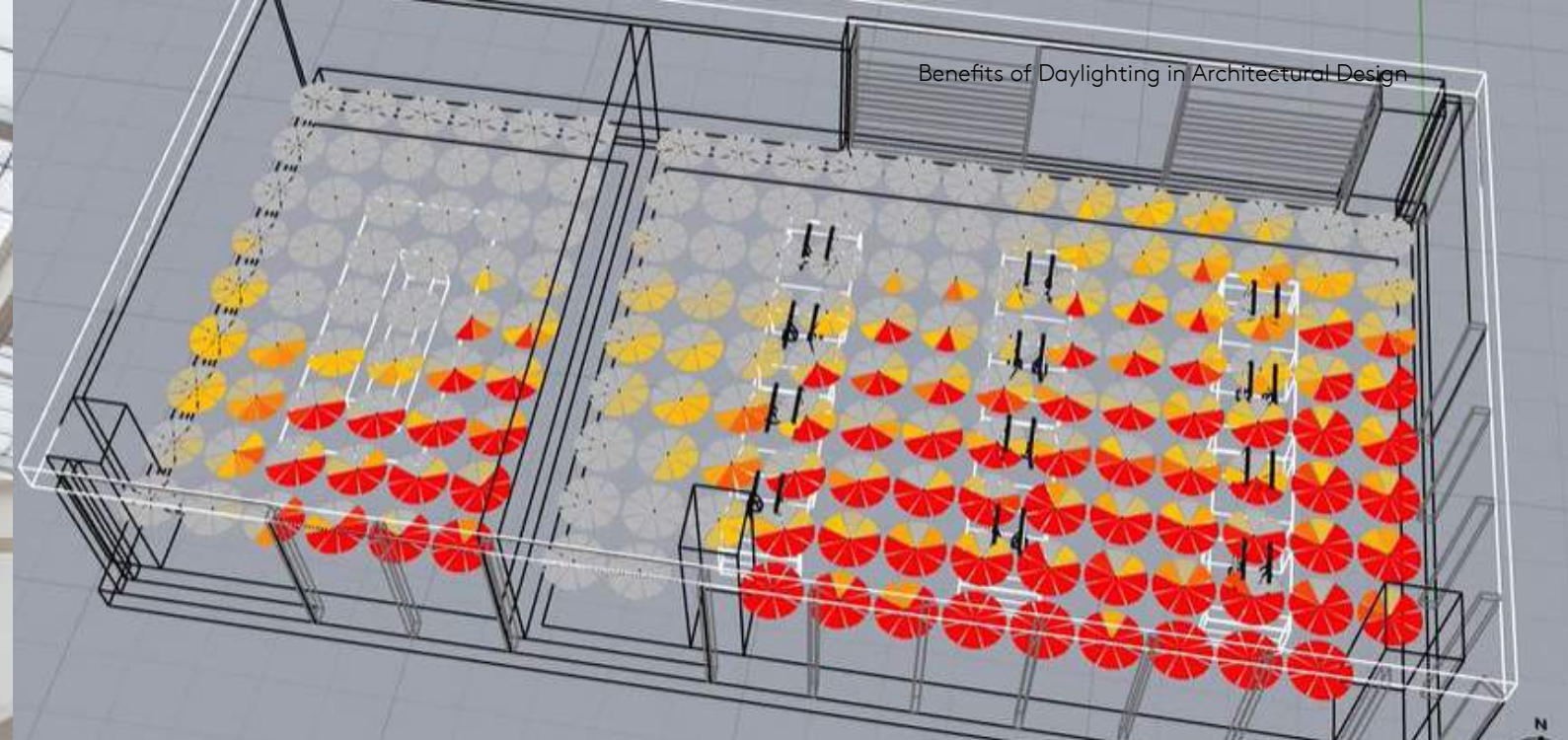
The software outputs also allow project teams to demonstrate compliance with regulatory requirements, as well as **document daylighting credits for sustainable building rating systems** such as LEED v4, LEED v4.1, WELL v2, and BREEAM.

In addition to the practical benefits of using CBDM to design effective daylighting schemes, the accuracy of this modelling allows architects to **interact with daylight at the design stage, molding it for purpose and aesthetic effect.**

Light fundamentally alters the look, feel and experience of a space. Through the integration of real-life daylighting data, it's possible to communicate what the experience of a space would feel like before it has even been created. In this way, light can be embraced and considered as if it were part of the building fabric and used to create better buildings for all.



Through the integration of real-life daylighting data, it's possible to communicate what the experience of a space would feel like before it has even been created.



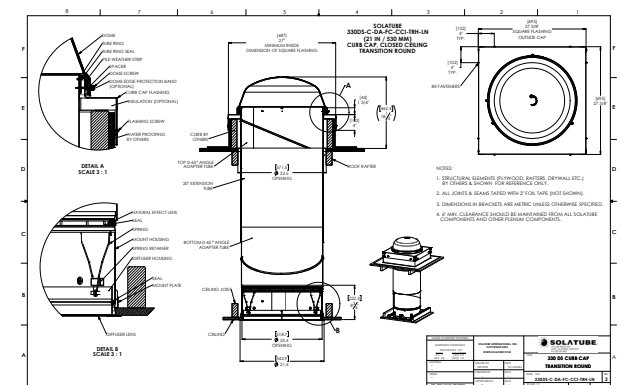
Daylighting design software and support

There are a number of software programs available to support architects with digital daylight design, such as ClimateStudio, and these often integrate with CAD, Revit and BIM to allow designers to design daylighting with the holistic building performance in mind. However, knowing how to get the most out of these can be a challenge. That's where our [Architectural Solutions and Design Services](#) come in.

Many of these daylight modeling tools are integrated within **Building Information Modeling (BIM)** platforms such as **Autodesk Revit**, allowing architects to analyze and visualize daylight performance within the broader digital building model. This integration supports seamless coordination between architectural design, energy modeling, and product specification, helping to optimize daylighting performance throughout the project lifecycle.

Daylighting specialists and design engineers at companies like Kingspan Light and Air and Solatube offer technical expertise in using digital daylighting tools. They often focus their work on achieving an appropriate balance between natural light availability, solar heat gain control, and thermal performance compliance.

Current design practices combine advanced digital modeling with evidence-based methods to develop standard and project-specific daylighting solutions. These configurations are tested to ensure they are suitable for each project's climatic and environmental conditions, which may require developing customized specifications or fully integrated daylighting systems.



Many daylight modeling tools are integrated into Building Information Modeling (BIM) platforms such as Autodesk Revit. This enables architects to analyze and visualize daylight performance within the broader digital building model. This integration facilitates coordination between architectural design, energy modeling, and product specification, optimizing daylighting performance throughout the project lifecycle.



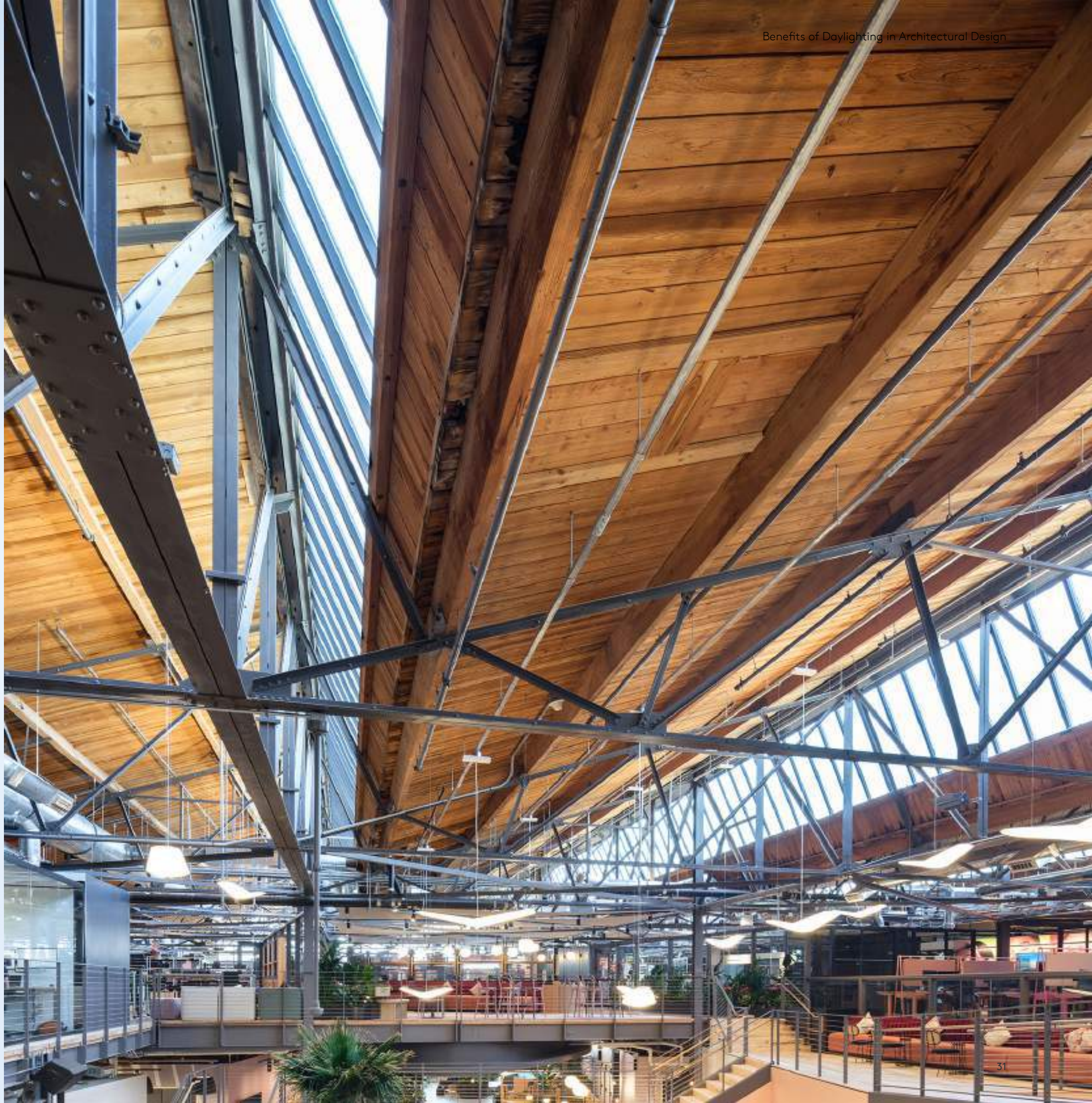
Naturally
Enhanced
Environments

THE BENEFITS OF DAYLIGHTING IN ARCHITECTURAL DESIGN

PART 2

Daylighting and energy efficient, sustainable buildings

Whether seeking to achieve sustainable building standards on a new development, or upgrading an existing building, thoughtfully applied daylighting is key to a more energy efficient and therefore lower carbon built environment, contributing to global efforts to address the climate crisis and reducing operational costs for building users.



Chapter 6

The Role of Daylighting in Achieving Net-Zero Energy and Carbon Goals for New and Modern Buildings

The construction industry faces mounting environmental regulations and the escalating urgency of climate change, giving architects and designers fresh impetus to revisit time-tested strategies that bring both immediate and long-term value. Daylighting – the intentional use of natural light to meet functional lighting requirements through architectural design – is a powerful and scalable solution that goes beyond reducing operational energy use to play a critical role in achieving net-zero energy and carbon-reduction goals across both new builds and modern retrofits.

The appeal of having a comprehensive daylighting strategy is clear, as it can influence not only energy performance but also spatial experience, façade articulation, and occupant well-being. New and modern buildings present a compelling opportunity for a structured approach and daylighting strategies can be integrated from the ground up to maximize daylight performance and energy savings.



Daylighting's impact on energy use

Daylighting directly reduces reliance on electric lighting (typically responsible for [15% – 20% of the world's electricity consumption in the building sector](#)¹, and around 20-30% of the total energy consumption in commercial buildings). Strategically placed façade glazing, skylights, and tubular daylight devices (TDDs) allow designers to significantly reduce lighting demand during daylight hours.

Integrative modern daylighting systems can also utilise smart technologies such as daylight level and occupancy sensors and automated shading to balance electric and natural light in real time. Such systems can lower lighting energy use by 40–80% compared to conventional buildings, contributing significantly to carbon and energy targets.

A recent literature review showed that [daylight integration can reduce lighting energy usage to just 5%](#)². Just as importantly, integrative systems allow architects to maintain their design intent while delivering high-performance, occupant-friendly environments.

¹Pompei, L, Blaso, L, Fumagalli, S, Bisegna, F, 'The impact of key parameters on the energy requirements for artificial lighting in Italian buildings based on standard EN 15193-1:2017,' *Energy and Buildings*, Volume 263, 2022, 112025, ISSN 0378-7788, <https://doi.org/10.1016/j.enbuild.2022.112025>.

²Taghizadeh, M, Gentile, N, Mattsson, P & M-C Dubois, 'Energy impact of integrative lighting: a systematic literature review,' *Energy and Buildings*, Volume 344, 2025, 115920, ISSN 0378-7788, <https://doi.org/10.1016/j.enbuild.2025.115920>.

Advanced daylighting systems: beyond glazing

Contemporary daylighting design goes well beyond traditional windows and skylights. New and modern buildings are increasingly incorporating sophisticated systems such as light shelves, prismatic glazing, solar tubes, and atria – all of which improve light penetration while mitigating unwanted heat gain.

These systems allow daylight to reach deeper into interiors, reducing the need for electric lighting even in spaces far from the envelope. In new build projects, such features can be embedded seamlessly into the architecture, free from the spatial or structural limitations of retrofitting.

Responsive technologies add another layer of performance. Motorized blinds and dynamic shading systems automatically adjust to daylight conditions, maintaining visual and thermal comfort while preserving views and daylight access. In smart buildings – increasingly common in modern developments – these systems are integrated into central control platforms that respond dynamically to occupancy, time of day, and weather patterns. These components, when designed thoughtfully, become integral to the architectural language of the building, supporting form, rhythm, and identity while serving energy and comfort functions.

When combined with other systems such as high-performance façades, efficient HVAC, and on-site renewable energy, daylighting forms a key pillar of whole-building sustainability. This synergy is far easier to achieve in new buildings, where holistic integration is possible from the earliest design phases. Advanced daylighting systems: beyond glazing.



Advanced daylighting systems: beyond glazing

Contemporary daylighting design goes well beyond traditional windows and skylights. New and modern buildings are increasingly incorporating sophisticated systems such as light shelves, prismatic glazing, solar tubes, and atria – all of which improve light penetration while mitigating unwanted heat gain.

These systems allow daylight to reach deeper into interiors, reducing the need for electric lighting even in spaces far from the envelope. In new build projects, such features can be embedded seamlessly into the architecture, free from the spatial or structural limitations of retrofitting.

Responsive technologies add another layer of performance. Motorized blinds and dynamic shading systems automatically adjust to daylight conditions, maintaining visual and thermal comfort while preserving views and daylight access. In smart buildings – increasingly common in modern developments – these systems are integrated into central control platforms that respond dynamically to occupancy, time of day, and weather patterns.

These components, when designed thoughtfully, become integral to the architectural language of the building, supporting form, rhythm, and identity while serving energy and comfort functions.

When combined with other systems such as high-performance façades, efficient HVAC, and on-site renewable energy, daylighting forms a key pillar of whole-building sustainability. This synergy is far easier to achieve in new buildings, where holistic integration is possible from the earliest design phases.

Embodied carbon: the other half of the equation

While operational energy often takes centre stage, embodied carbon – the emissions generated during material production and construction – plays an equally important role in a building's total carbon footprint.

Controlling embodied carbon is especially relevant in new buildings, where architects have greater freedom to specify materials with lower embodied carbon from the outset. Fortunately, newer alternatives such as polycarbonate are emerging as more sustainable options.



These systems allow daylight to reach deeper into interiors, reducing the need for electric lighting even in spaces far from the envelope.

Polycarbonate offers some key environmental advantages for architects and designers:

- It can be recycled multiple times, maintaining its mechanical properties through multiple recycling cycles
- Can be produced using polycarbonate from all kinds of sources, including post-consumer waste
- Lightweight properties reduce transport emissions and simplify installation

In new construction, where lifecycle assessments can guide material selection, polycarbonate provides a low-carbon pathway for delivering effective, durable daylighting solutions.

Tracking performance and looking ahead

Measurement and performance tracking are vital to achieve the full benefits of daylighting. Today's analytics platforms monitor lighting energy use, daylight availability, and occupant comfort – all in real time. This data enables ongoing optimization and validates the return on investment (ROI) delivered by daylighting strategies.

In new buildings – [many of which now incorporate digital twin technologies](#)³

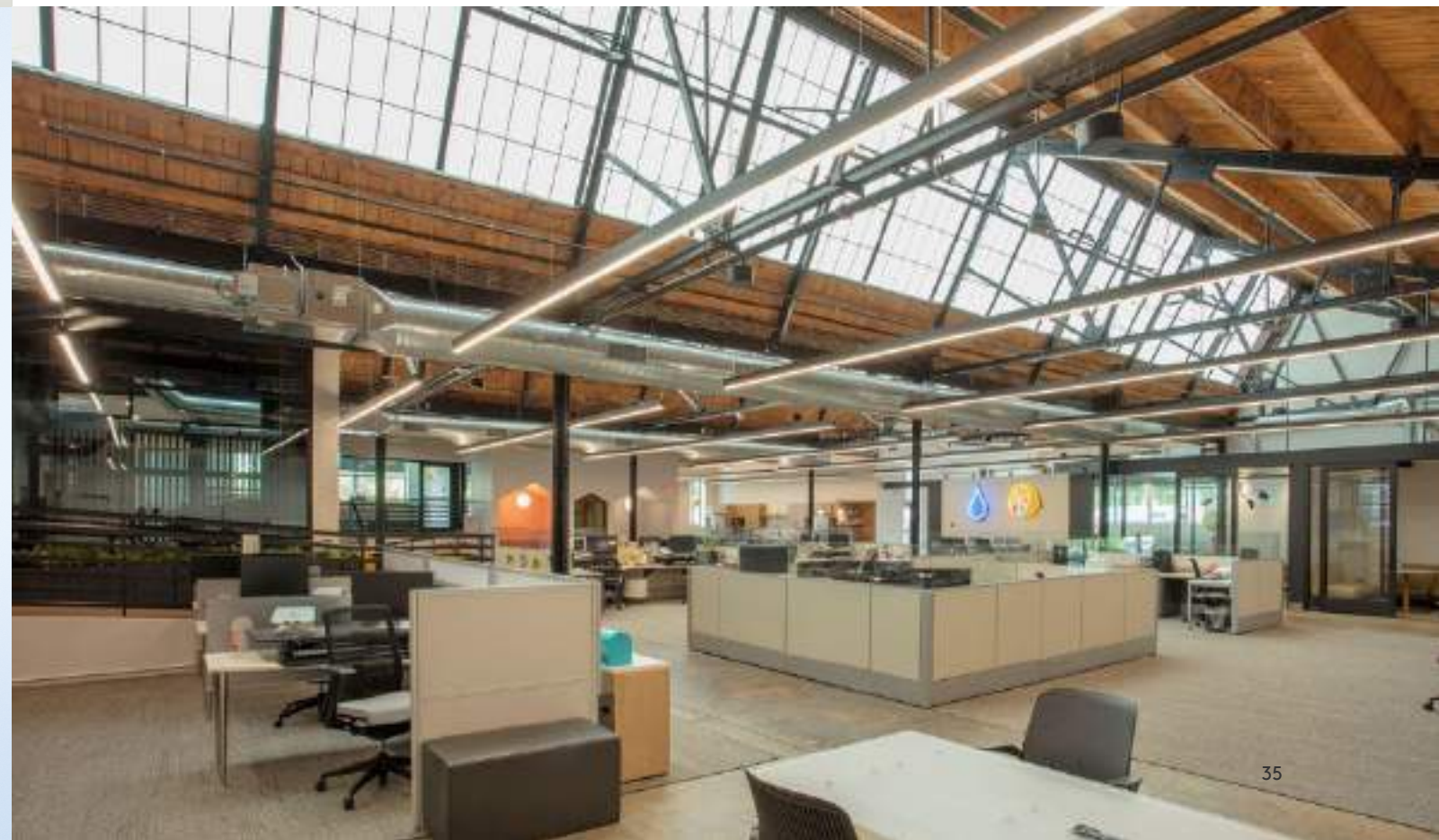
– daylighting systems can be simulated, monitored, and adjusted throughout the building's lifecycle. This ability supports predictive maintenance, performance-based design validation, and long-term energy savings.

Looking to the future, smart glazing, advanced light-redirecting materials, and building-integrated photovoltaic (BIPV) daylighting systems reveal even more potential. These innovations reduce lighting and cooling loads while contributing to on-site renewable generation through the building envelope itself.

Meanwhile, the regulatory landscape is evolving, although [there is still a gap between research and design practice](#)⁴. Updated energy codes and green building standards now increasingly include daylight autonomy metrics, glare control requirements, and automated lighting controls. This formal recognition – combined with growing awareness of the links between natural light, health, and productivity – reinforces daylighting's role in forward-thinking architectural practice.

³Seo, Hyuncheol & Woo-Seung Yun. 2022. 'Digital Twin-Based Assessment Framework for Energy Savings in University Classroom Lighting.' Buildings 12, no. 5: 544. <https://doi.org/10.3390/buildings12050544>

⁴Pinheiro, Amanda & Amorim, Cláudia. 2023. 'Daylight requirements: an overview of definitions, progress and gaps.' 10.25039/x50.2023.OP073.



Daylighting is more than a tool for compliance or efficiency – it's intrinsic to the creation of spaces that are naturally lit, contextually responsive.

Final thoughts

Daylighting is a proven yet continually evolving design strategy with the multiple benefits of reducing operational energy use, lowering embodied carbon, and elevating buildings' spatial quality. With options from passive techniques to responsive systems, supported by low-carbon materials such as recyclable polycarbonate, daylighting aligns environmental performance with architectural excellence.

In new and modern buildings, daylighting is more than a tool for compliance or efficiency – it's intrinsic to the creation of spaces that are naturally lit, contextually responsive, and fundamentally aligned with occupant comfort and ecological responsibility. As the built environment transitions toward carbon neutrality, daylighting offers a pragmatic, scalable, and inspiring path forward, supporting climate resilience while enriching the design process.



Chapter 7

Daylighting strategies to achieve net-zero carbon buildings – case studies

In our previous knowledge article, we explored how incorporating strategically placed daylighting can help achieve net-zero energy and lower carbon emissions in all kinds of buildings.

To illustrate this, let's look at three case studies of projects with varying energy loads and challenges, exploring how daylighting solutions have been used to achieve excellent levels of energy efficiency.



1. Humanscale Manufacturing Plant, New Jersey

Humanscale is the premier designer and manufacturer of ergonomic furniture that improves health and comfort at work. The New York City-based company takes sustainability seriously, summarizing its philosophy as "Everything we do has an impact. We're aiming to make it a good one."

The company's production facility in Piscataway, N.J., was undergoing a major energy-efficiency retrofit with the goal of a net zero carbon footprint. This included a new roofing system, with upgraded daylighting, and a solar PV array comprising over 2,585 panels. For the daylighting, 87 SkyVault Series units with Amplifiers were installed to focus daylight down to the production work cells. These large units having the ability to capture a large quantity of daylighting meant that a small number could deliver the required daylighting, helping to reduce roof penetrations and leaving more roof space for the solar PV panels.

As part of the integrated lighting plan, the Solatube Systems substantially reduced dependency on electric lighting during the day, moving Humanscale closer to their net zero goal.





Through Planet Passionate, Kingspan is taking significant steps to reduce absolute manufacturing carbon emissions, aiming for near-zero where technically feasible, while also working to reduce the carbon intensity of its primary supply chain.



Benefits of Daylighting in Architectural Design



2. Solatube International Headquarters and Manufacturing Facility, California

As a subsidiary of [Kingspan Light + Air](#), Solatube International is deeply committed to [Kingspan Group's Planet Passionate](#) initiative—our company-wide sustainability program. Through Planet Passionate, Kingspan is taking significant steps to reduce absolute manufacturing carbon emissions, aiming for near-zero where technically feasible, while also working to reduce the carbon intensity of its primary supply chain.

To reduce the carbon footprint and enhance the energy efficiency of our Oak Ridge headquarters and Cousteau Court manufacturing facility have recently been upgraded with a new solar PV array and upgraded daylighting— harnessing Southern California's abundant sunshine to power our operations and daylight our facilities.

224 of its own TDDs were used at its Oak Ridge facility and 111 at its Cousteau Court facility,

displacing the need for electric lighting across 94% of the campus' interior floor space during the day. Electric lighting is used for only 3% of the occupied year in these daylit spaces. Additionally, by using TDDs rather than traditional skylights, more roof space can be allocated to PV panels, significantly increasing energy production.

Both the Oak Ridge and Cousteau Court facilities are now net-zero buildings, and with a combined annual energy production of 1,323 MWh (1,323,000 kWh). This clean energy output is enough to power approximately 123 U.S. homes for a year, based on the average household consumption of [10,791 kWh annually](#).

This strategic use of rooftop real estate enhances sustainability efforts while driving long-term energy cost reductions—setting an example for businesses and institutions looking to improve their environmental footprint.

Chapter 8

Daylighting in LEED and BREEAM Standards

modern architecture, daylighting transcends basic illumination – it enhances energy efficiency, occupant well-being, and the creation of high-performance buildings. Certification systems such as **LEED** and **BREEAM** recognize the key role daylighting plays in allowing projects to reach their sustainability goals, although they approach it differently. In this article we'll explore how LEED addresses daylighting, compare it to BREEAM, and look at real-world case studies where daylighting systems have helped projects meet ambitious sustainability goals.

Daylighting in LEED:

Unlocking Indoor Environmental Quality

Introduced by the US Green Building Council (USGBC) in 1998, **LEED (Leadership in Energy and Environmental Design)** is the most widely used sustainability building rating system in the world, providing a framework for creating healthy, highly efficient, cost-saving buildings.



LEED v4.1: Precision in Daylight Performance
LEED v4.1 rating system for Building Design and Construction (BD+C) places a strong emphasis on daylighting in its Indoor Environmental Quality (IEQ) category under the 'EQ Credit: Daylight.'

Purpose of the Daylight Credit

LEED's daylight credit is designed to reduce dependence on artificial lighting, enhance occupant comfort and well-being, and support productivity and mood through natural lighting conditions. These three objectives align with LEED's mission to promote healthy, high-performance buildings.

Credit Requirements

Projects must demonstrate adequate daylight illuminance levels in regularly occupied spaces to earn the LEED daylight credit. There are three possible routes to compliance:

1. Dynamic Simulation – Spatial Daylight Autonomy (sDA 300/50): Recently updated in V4.1 Beta, projects must now achieve:

- At least 40% sDA (300 lux for 50% of the building's occupied hours) across 55% or more of the regularly occupied floor area to earn **1 point**.
- Higher thresholds than the previous 55% target, which now earns **2 points**, with **3 points** being awarded for 75% sDA.
- This provides a dynamic, year-round simulation of daylight availability and is considered the most rigorous and comprehensive method of measurement.

2. Simulation – Illuminance Modeling:

This is a more straightforward modeling approach using specific time and sky conditions (typically 9am and 3pm on the equinox). According to v4.1, illuminance levels must be:

- Between 300 and 3,000 lux for a minimum of 55% of regularly occupied space, lowered from the previous minimum of 75%, which now earns **2 points**.
- The latest update also means that areas with view-preserving automatic glare control devices need only comply with the minimum 300 lux level.

3. On-site Measurement:

For actual on-site measurements of daylight levels under clear sky conditions, readings for each regularly occupied space must fall within:

- The 300–3,000 lux range on a clear-sky day between 9am and 3pm.
- Glare-controlled spaces require only with view-preserving automatic glare.



LEED's daylight credit is designed to reduce dependence on artificial lighting, enhance occupant comfort and well-being, and support productivity and mood through natural lighting conditions.

LEED v5: Toward Near-Zero Carbon & Enhanced Well-Being
LEED v5 has been created to provide a comprehensive framework for the creation of near-zero carbon buildings. LEED v5’s revamped scoring system reflects its primary goals. Half of the available points in v5 will relate to climate action, while the other half are equally split between quality of life and ecological initiatives.

Key Updates:
Lighting Environment (Occupant Experience Credit). Improving occupant health, wellness, and overall quality of life is addressed through the Occupant Experience credit. As part of this, designers can achieve points by ensuring a healthy and productive Lighting Environment. This includes ensuring effective daylighting access by using daylight simulation analysis to **optimize visual comfort and reduce glare.**

Embodied Carbon Reduction. The focus on embodied carbon has increased significantly in LEED v5. It introduces a new credit concept focused explicitly on procuring low-carbon construction materials as part of the broader effort to reduce the embodied carbon footprint associated with building materials.

The new credit offers three options to earn points:

- **Option 1:**
Whole-building lifecycle assessment (LCA): This option requires a comprehensive assessment of the building’s lifecycle to identify and reduce embodied carbon.
- **Option 2:**
Low-carbon procurement: This simplified option focuses on procuring specific low-carbon materials. By reducing complexity and focusing on high-impact materials, it aims to be more accessible and straightforward than previous versions.
- **Option 3:**
Environmental Product Declarations (EPDs): This option involves using materials with verified EPDs, emphasizing transparency and environmental performance

This shift highlights the importance of considering the entire lifecycle of building materials — including those used for daylighting — through Whole-Building Life Cycle Assessment (LCA).

LEED v5’s incorporation of Whole-Building Life Cycle Assessment (LCA) and Life Cycle Thinking, as part of its comprehensive approach to sustainable building practices, involves evaluating a building’s environmental impact from construction and operation to final demolition or reuse, so that projects not only meet immediate environmental goals but also consider long-term ecological effects.

A Brief Look at BREEAM International BREEAM (Building Research Establishment Environmental Assessment Method) International New construction is the standard used for new developments in the USA.

Whilst the issues addressed are the same as the usual BREEAM standard, this international version provides ways to adapt section weightings to reflect the environmental conditions specific to the country of assessment. This regional approach is to make sure that any BREEAM certified project exceeds local regulations. The USA has been divided into 10 regions, based on climate, energy use, transport availability, population density, ecology and other factors. [You can learn more about the weightings here.](#)

BREEAM International New construction approaches daylighting through its [Hea 01 Visual Comfort](#) credit. This system generally uses daylight factor calculations, focusing on:

- Static illuminance levels under overcast sky conditions.
- Minimum daylight factor thresholds (eg. 2% for offices).
- Glare control and uniformity.
- Window and view considerations.

While BREEAM’s method can be considered more prescriptive than LEED’s dynamic and performance-based approach, both standards aim to ensure high-quality lighting environments. To illustrate this, we have created a table that sets the BREEAM requirements against that of LEED v4.1.

Category	LEED v4/v4.1 (EQ Credit: Daylight)	BREEAM (Hea 01 Visual Comfort)
Primary Objective	Ensure adequate natural lighting while supporting occupant comfort and reducing energy use.	Ensure sufficient daylight provision to improve occupant wellbeing and reduce artificial lighting demand.
Assessment Method	Dynamic simulation (sDA and ASE), illuminance simulations, or physical measurement.	Static daylight factor calculations under overcast sky conditions.
Key Metrics	● sDA 300/50 ≥ 40% of regularly occupied area (v4.1). ● Illuminance: 300–3,000 lux at 9am & 3pm (equinox). ● Measurement-based lux readings.	● Minimum Daylight Factor: typically 2% for offices, 1.5% for classrooms/ habitable rooms. ● Uniformity ratio requirements.
Glare Control Requirement	Required for all compliance paths (eg. blinds, dynamic glazing).	Must demonstrate glare is controlled (eg. shading, design strategies).
Occupant-Centric Approach	Yes – considers time of use, area, and daylight availability throughout the year.	No – evaluates a single point in time under overcast sky conditions.
Climate Consideration	Radiance, Climate Studio, Solatube Design Calculator, etc.	BRE Daylight and Sunlight guidance, simple simulation tools, BRE-recommended spreadsheets.
Compliance Tools	1–3 points depending on the level of daylight achieved.	1–2 credits depending on building type and performance.
Certification Influence	Yes, for exemplary performance or integration with other wellness strategies.	Possible if integrated into broader visual comfort or occupant health strategies.
Innovation Credit Eligibility	Yes, for exemplary performance or integration with other wellness strategies.	Possible if integrated into broader visual comfort or occupant health strategies.

Fig 1. Comparison of certifications/standards



Chapter 9

Designing for Wellness:

How Daylighting Drives WELL and Fitwel Certification

The strategic use of natural light within architectural spaces enhances aesthetics and supports occupant well-being and energy efficiency. Recognizing these benefits, building certification systems such as the [WELL Building Standard \(WELL\)](#) and [Fitwel](#) have integrated daylighting criteria into their guidelines.

While there are many nuances to each of these systems and what may apply, here is an overview of the latest daylighting requirements within these standards, offering architects and designers insights into creating healthier, more sustainable environments.

Unlike more traditional environmental building standards such as LEED and BREEAM, which focus on environmental sustainability, energy efficiency, water conservation, and resource management, the primary focus of WELL and Fitwell is human health, wellness, and occupant comfort – including daylighting, air quality, nutrition, and mental health.

Within this biological and psychological approach, WELL is performance-based and science-backed, with rigorous metrics for circadian lighting, acoustics, thermal comfort, and more.

For architects, this means prioritizing sDA300, 50% simulations and strategic glazing placement (e.g., 7% minimum glazing per floor area).¹



Key Comparison of Standards

Standard	Main Focus	Daylighting Focus	Origin
WELL	Human health and performance	Circadian health, visual comfort	US (IWBI – International WELL Building Institute)
Fitwel	Health and wellness access	Visual comfort, education, access	US (CDC – Centers for Disease Control/GSA – General Services Administration/Center for Active Design CfAD)
LEED	Environmental sustainability	Energy reduction, daylight modeling	US (USGBC – US Green Building Council)
BREEAM	Environmental and lifecycle	Daylight for occupant satisfaction and energy	UK (BRE – British Research Establishment)

Fig 1. Comparison of certifications/standards

One study cited in a [literature review](#) found that WELL-certified office spaces had the highest scores for overall satisfaction, workability, perceived productivity, and health, with the best-performing offices being those with active and biophilic designs to support work-related activities and ergonomics.

Fitwel is more accessible and streamlined, offering flexible pathways to integrate wellness

into building design and operations without being overly prescriptive. Key for Fitwel v3 compliance: achieving a 35% window-to-wall ratio (WWR) and 40% VLT glazing—modular roof lights can supplement façade glazing to meet thresholds in deep-floor plans.²

Let's take a closer look at each in relation to daylighting...





WELL Building Standard: Emphasizing Light for Health

WELL is produced by the International WELL Building Institute (IWBI) to measure, certify, and monitor features of the built environment that impact human health and well-being. Its Light concept promotes exposure to natural light to support circadian health, enhance productivity, and improve visual comfort.

Feature L01: Light Exposure

WELL v2 [Feature L01: Light Exposure](#) emphasizes the importance of adequate daylight exposure through various design strategies:

- **Daylight Simulation**
Projects must demonstrate, via computer simulations, that a certain percentage of regularly occupied spaces receive sufficient daylight. Specifically, this means achieving a spatial daylight autonomy of sDA300,50% – in other words, at least 300 lux for 50% of operating hours for at least 30% of the space. (Tip: Modular skylights extend daylight penetration in core areas).
- **Interior Layout**
Design strategies should ensure that a significant portion of regularly occupied areas are near envelope glazing (windows or other transparent elements). For instance, placing at least 30% of such areas within a 20 ft horizontal distance from envelope glazing can contribute to meeting daylighting requirements.
- **Building Design**
The standard also considers the overall design, such as ensuring that the envelope glazing area $\geq 7\%$ of the regularly occupied floor area for each floor level.

Feature L05: Daylight Design Strategies

WELL's [Feature L05: Daylight Design Strategies](#) encourages the implementation of design strategies to enhance daylight exposure – this includes:

- **Daylight Planning**
Positioning workstations near windows within specific distances (e.g., within 7.5 meters) can earn points under this feature.
- **Solar Shading Integration**
Incorporating shading systems with manual or automated controls helps manage glare and heat gain, ensuring visual comfort while maximizing daylight benefits.

Feature L06: Daylight Simulation

[Feature L06: Daylight Simulation](#) requires projects to use daylight simulation tools to predict daylight levels within spaces.

Demonstrating that a certain percentage of regularly occupied spaces achieve specified sDA levels ensures that occupants receive adequate daylight exposure throughout the day.

Fitwel Standard: Integrating Daylight for Occupant Well-being

Fitwel v3 (launched in December 2024) introduces refined strategies to enhance daylight access:

- **Visible Light Transmittance (VLT)**
All windows in regularly occupied spaces must have a VLT exceeding 40%, ensuring that a significant amount of natural light penetrates indoor environments.
- **Window-to-Wall Ratio (WWR)**
A minimum WWR of 35% is mandated for each regularly occupied floor, balancing daylight access with energy efficiency and glare control considerations. (Tip: Combine vertical glazing with roof lights to meet WWR without compromising thermal efficiency.)
- **Educational Materials**
Fitwel states that providing occupants with information on strategies to maximize daylight access, such as positioning workspaces near windows and understanding the health benefits of daylight, is essential.

Daylight Simulations: Fitwel offers alternative compliance pathways through daylight simulations:

- **Spatial Daylight Autonomy (sDA):**
Projects can demonstrate that an average sDA300,50% is achieved for at least 60% of the floor area across all regularly occupied spaces, ensuring consistent daylight exposure.
- **Alternative Compliance**
Aligning with recognized standards such as LEED v4 BD+C: Daylight, Option 2, or Option 3, provides flexibility in meeting daylighting criteria.

Recent Updates

Both WELL and Fitwel continuously evolve to incorporate the latest research and industry practices. Recent developments include:

- **WELL Addenda:** the Q4 2024 addenda introduced updates aligning daylighting thresholds with the lighting industry's LM-83-23 standard, simplifying compliance calculations within modeling software.
- **Fitwel v3 Enhancements:** emphasize efficiency and scalability, offering tools that simplify certification and increase scorecard applicability while reducing user workload.



Maximizing natural light reduces reliance on artificial lighting, leading to energy savings.



Implications for Architects and Designers

Integrating daylighting strategies in line with WELL and Fitwel standards offers multiple benefits:

- **Enhanced ROI:** Wellness real estate purchases command higher sales premiums averaging 10 – 25% over traditional real estate. (Global Wellness Institute, 2024).^{3,4}
- **Enhanced occupant well-being:** adequate daylight exposure supports circadian rhythms, improves mood, and boosts productivity.
- **Energy efficiency:** maximizing natural light reduces reliance on artificial lighting, leading to energy savings.
- **Certification achievement:** adhering to these standards can highlight a commitment to health-centric and sustainable design.

Daylighting will remain a critical element of healthy building design. By aligning with the latest WELL and Fitwel requirements, architects and designers can create spaces that meet certification criteria while fostering occupant well-being and environmental sustainability.

Further reading:

- A broader comparison of WELL and Fitwel can be found on the SALUS healthy design knowledge community: <https://www.salus.global/article-show/well-and-fitwel-a-comparison-of-health-focused-rating-systems>
- For a commentary on the WELL v2 Building Standard, focusing on its methods, international applications, and the growing empirical evidence from research studies supporting its effectiveness, refer to Genell Wells Ebbini, Transforming health: The WELL Building Standard's role in sustainable development, Cell Reports Sustainability, Volume 1, Issue 5, 2024, 100100, ISSN 2949-7906, <https://doi.org/10.1016/j.crsus.2024.100100>. (<https://www.sciencedirect.com/science/article/pii/S2949790624001599>)
- You can find an overview of academic papers on WELL in: Kokatnur T, Faris F et al, The WELL Building Standard: A literature review and bibliometric analysis of a nascent field, Journal of Building Engineering, Volume 103, 2025, 112121, ISSN 2352-7102, <https://doi.org/10.1016/j.job.2025.112121>. (<https://www.sciencedirect.com/science/article/pii/S2352710225003572>)

L'Oréal USA's El Segundo, California Corporate Office Awarded LEED & WELL Certification

Certification:

LEED and WELL Platinum.

Daylighting Solution:

Translucent skylights, along with ample windows, maximize natural light.

Summary:

L'Oréal's El Segundo office achieved both LEED and WELL Platinum certification by implementing energy-efficient HVAC and lighting systems, a 330kW solar array, and extensive use of natural light. This sustainable design reduces energy consumption by 79% and enhances employee well-being through bright and inviting workspaces, setting a benchmark for sustainable and healthy office environments.

¹International WELL Building Institute (IWBI). (2021). Daylight modeling. In WELL Building Standard Version 2 (v2). Retrieved May 21, 2025, from <https://standard.wellcertified.com/v2/light/daylight-modeling>

²Center for Active Design (CfAD). Fitwel v3 Building Design Guidelines. New York: Center for Active Design, 2024. https://static1.squarespace.com/static/6294f761bc48c512bfad618b/t/665e273b2f2f61562f3958b6/1724120693463/Fitwel+v3+Building+Design+Guidelines_Site.pdf (accessed May 21, 2025).

³Paolo Volani, "Wellness Developments and Premiums," Paolo Volani (blog), accessed May 21, 2025, <https://paolovolani.com/wellness-developments-premiums/>

⁴Boston University. "A Guide to Developing Wellness Real Estate." Boston Hospitality Review, March 29, 2022. <https://www.bu.edu/bhr/2022/03/29/a-guide-to-developing-wellness-real-estate/>

Chapter 10

Bringing New Life to Old Spaces:

Critical Considerations for Daylighting Design

When extending the life of existing buildings, the thoughtful integration of natural light is arguably one of the most impactful interventions. For architects and designers, daylighting retrofit projects present a unique opportunity to enhance aesthetics, boost occupant well-being, and significantly reduce energy consumption—all while preserving a structure's character and history.

Benefits of daylight retrofits

Many older buildings suffer from outdated glazing systems, weathered skylights and inefficient facades, making them ripe for an upgrade. Whether it's as simple as replacing aging daylighting units or as complex as creating an entire daylighting strategy during a roof or facade renovation, daylighting retrofits bring several opportunities:

1. Dramatically reduce energy consumption

Buildings retrofitted with advanced daylighting systems [typically see annual lighting energy reductions between 30-60%](#). These savings derive from the obvious reduction in electric lighting needs during daylight hours, but also from the integration of daylight-responsive controls that automatically adjust electric lighting based on available natural daylight.

For commercial buildings, where lighting can typically account for [20-30%](#) of total annual energy consumption, these savings translate directly to operating cost reductions. When coupled with high-performance glazing units that minimize heat gain/loss, the energy benefits extend to HVAC systems as well, creating a compound effect on the building's overall efficiency profile.

2. Enhance occupant health and productivity

The intrinsic biophilic connection between humans and natural light is well-established—research consistently shows that exposure to daylight improves circadian rhythm regulation, mood, and general wellbeing. In commercial settings, [studies have documented productivity increases of 6-16% in spaces with optimized daylighting, alongside reduced absenteeism and improved cognitive function. Meanwhile, educational facilities with well-designed daylighting systems report improved student performance, with standardized test scores conservatively increasing by 7-18% compared to poorly daylit classrooms.](#)

3. Increase resilience and future-readiness

In an era of rising energy costs and climate uncertainty, buildings with optimized daylighting are inherently more resilient. By reducing reliance on electric lighting and enhancing passive thermal performance, they're better equipped to maintain functionality during grid disruptions or extreme weather events. For public buildings, workplaces, and housing, this kind of passive survivability is quickly becoming a critical design priority—and daylighting is central to that capability.

4. Extend building lifespan and value

A comprehensive daylighting retrofit is often a catalyst for broader building renewal. By upgrading the building envelope and fenestration, a retrofit can resolve long-standing issues—including water infiltration, thermal bridging, and material degradation—extending the structure's functional lifespan.

From a real estate perspective, buildings with optimized daylighting command premium values—typically 5-10% higher lease rates and increased property valuations—reflecting both the aesthetic enhancement and the reduced operating costs that accompany well-executed daylighting strategies.



Strategic approaches to daylighting retrofits

Thoughtful analysis and a strategic approach balancing multiple considerations are key to effective daylighting retrofit. Let's look at some proven strategies, ranging from modest interventions to comprehensive redevelopment:

Upgrading existing apertures

The simplest approach maximizes the performance of existing daylighting elements. Improvements might include:

- Replacing outdated, discolored, or degraded skylights with modern high-performance units featuring high-performance glazing that optimizes visible light transmission while minimizing solar heat gain
- Integrating automated shading systems that respond dynamically to changing light conditions
- Installing tubular daylighting systems to deliver natural daylight deeper into interior spaces
- Removing visual obstructions such as heavy window treatments or unnecessary interior partitions that block light penetration

These targeted interventions offer excellent return on investment, particularly in buildings where wholesale envelope replacement isn't feasible or necessary.

Strategic daylighting system expansion

When existing apertures prove insufficient, expanding the system can dramatically transform interior environments:

- Adding clerestory windows to introduce high-angle daylight that penetrates deep into floor plates
- Creating light wells or courtyards that bring natural light to previously windowless interior zones
- Installing tubular daylighting devices that can channel daylight through roofing systems with minimal structural disruption
- Introducing side lighting in strategic locations to balance lighting distribution and reduce contrast ratios

For buildings with historical or architectural significance, retrofits must be balanced against preservation objectives, often requiring creative solutions that respect original design intent while enhancing functionality.



Thoughtful analysis and a strategic approach balancing multiple considerations are key to effective daylighting retrofit.

Retrofitting daylighting systems is a chance to reimagine spaces with fresh vibrancy while respecting the structures' heritage.



Benefits of Daylighting in Architectural Design

Comprehensive envelope reconsideration

The most transformative daylighting retrofits often go hand-in-hand with holistic envelope renovations, providing an opportunity to fundamentally reconceive the building's relationship with natural light by:

- Integrating skylights into new roofing systems
- Replacing solid walls with translucent wall systems that maximize opaque while maintaining thermal performance

When coordinated with interior space planning, a comprehensive approach can turn even the most challenging existing building into luminous, energy-efficient environments.

Navigating regulatory requirements

It's important to note that daylighting retrofits often intersect with multiple regulatory frameworks:

- Energy codes may dictate minimum performance requirements for glazing and lighting controls
- Historic preservation ordinances may limit interventions on landmark structures
- Zoning regulations may restrict changes to building massing or envelope configuration
- Building codes may impose further structural requirements for new apertures

To navigate these requirements, successful projects engage early with regulatory authorities and employ creative design solutions that satisfy multiple objectives simultaneously.

Daylighting: a catalyst for transformation

Perhaps the most valuable aspect of daylighting retrofits is their capacity to kickstart broader building transformation. Reconnecting occupants with natural light cycles and views not only reduces operational costs and supports environmental goals but can fundamentally shift how they experience and value existing buildings. At its best, daylighting is transformative.

Retrofitting daylighting systems is a chance to reimagine spaces with fresh vibrancy while respecting the structures' heritage. Through daylighting, yesterday's buildings can become tomorrow's vibrant, sustainable spaces – full of light, life, and longevity.

Chapter 11

Daylight retrofit in action:

Five examples of successful integration of natural light into existing buildings

Incorporating natural light into existing buildings is more than just a design upgrade—it's a strategic move toward improved energy efficiency, better occupant wellbeing, and architectural distinction

In this knowledge article, we explore real-world examples of successful daylighting retrofit projects, each driven by unique challenges but united by a common goal: to create bright and inviting spaces for people to thrive in.



1. Replacing existing, low performing solutions with minimal disruption at Bloomingdales Beverly Center

Research has shown how daylighting can bring numerous benefits to retail spaces, including a more welcoming environment, the ability for consumers to see colors more accurately, and even increased sales.

The 30-year-old skylight at the [Beverly Center fashion mall](#) had reached the end of its lifespan and needed a replacement, and our [QuadSpan™](#) (formerly Quadwall®) system was the perfect solution for the mall.

Specified in ice white and white matte glazing, the new skylight was installed above the 41,000 ft². main floor in just seven days – to meet the store's unveiling deadline – all while it was fully occupied, thanks to its removable skin technology.

2. Enhancing existing architectural features at the Click Rain and Lemonly headquarters

Another case study that demonstrates the power of enhancing what already exists is the [upgrade of an old spark plug factory into a modern office space for two dynamic creative and digital agencies.](#)

Architects at CO-OP Architecture exposed the building's original sawtooth roof structure and restored its industrial character, while integrating modern daylighting solutions in the form of the Kingspan [GridSpan™](#) system into the vertical slopes.

The system minimizes glare and solar heat gain while preserving the building's open, factory-floor feel which was enhanced with key design details such as black-painted beams, restored concrete floors, and soda-blasted wood ceilings. This daylighting retrofit not only honors the building's history but also demonstrates how natural light can transform neglected spaces into dynamic, people-focused workplaces.

3. Reviving a historic bank lobby into a light-filled urban oasis

The Emery Hotel in downtown Minneapolis occupies the landmark Midland Bank building, which ownership envisioned as a vibrant “green oasis” filled with natural light and lush plant life.

The challenge was formidable: the lobby, surrounded by parking ramps and high-rises, received virtually no direct daylight. To solve this, the design team retrofitted the space with 14 Solatube SkyVault M74 DS units equipped with Collectors and Amplifiers, strategically capturing and redirecting sunlight deep into the grand historic lobby. Seamlessly integrated into the ceiling, the daylighting system highlighted the building’s marble and granite bones while nurturing thriving greenery.

The result transformed a dark, closed-off space into a biophilic, inviting environment that embodies both historic character and modern well-being.

Case study: [Emery-Hotel-Case-Study-Rev2.pdf](#)



4. Adding new bespoke functionality as part of historic building renovation in Madrid

[Palacio de Comunicaciones](#) is one of the most famous buildings in the center of Madrid. Originally designed by architect Antonio Palacios and built in 1909, it was first used as a post office. However, since 2007, it hosts the Mayor of Madrid’s headquarters. The building was renovated in 2009. Most striking is the transformation of the inner court called the Village Hall into a covered atrium.

Due to the constraints of working within an existing historical building and the courtyard’s irregular shape, a free-form glass roof with a triangular mesh was selected. As everything needed to be tailor made, [Kingspan worked closely with the architectural team at Arquimática to design, manufacture and supply 89 bespoke-sized triangular windows](#) to be used for daily ventilation and smoke extraction. Thanks to their slim profile and hidden controls, they fitted in with the roof scheme seamlessly and the result is a striking juxtaposition between historical and modern architecture.



Natural light can transform neglected spaces into dynamic, people-focused workplaces.

Reducing reliance on artificial lighting can help schools lower their energy bills, and ensure they’re better equipped to maintain functionality during grid disruptions or extreme weather events.



5. Improving the energy performance of Texas’ Allen High School

There is a wide body of research evidencing the profound impact that daylighting can have on pupil performance. Additionally, reducing reliance on artificial lighting can help schools lower their energy bills, and ensure they’re better equipped to maintain functionality during grid disruptions or extreme weather events. So, when [Allen High School in Texas](#) was renovated in 2015, improving the building’s daylighting was top of the agenda.

7,780 ft² of [QuadSpan™](#) (formerly Quadwall®) translucent skylight system was incorporated into the renovation design. Specified in ice white matte and ice white glazing, the system allows for an abundance of natural uniform daylighting to diffuse into the space below, while minimizing glare and heat gain within the building.



Naturally
Enhanced
Environments

THE BENEFITS OF DAYLIGHTING IN ARCHITECTURAL DESIGN

Part 3

The human benefits of daylighting

Notable modernist architect, Louis Khan, spoke of human's intrinsic ties to natural light when he stated "We are born of light. The seasons are felt through light. We only know the world as it is evoked by light." Daylighting can enhance not only the functionality of spaces, but the lives of the people who use them.



Chapter 12

Daylighting's Role in Modern Architectural Design:

Principles, Trends and Examples

Modern architectural design is rooted in a deep and holistic understanding of sustainability. It goes beyond minimizing environmental impact but also considers how our built environment affects human experience and ensuring spaces are functional, accessible, and enjoyable for as many people as possible. **Daylighting is fundamental to delivering on these aspects.** As we have explored in previous Knowledge Articles, [ensuring adequate access to natural daylight has a profound impact on human health and wellbeing](#), and it plays a vital role in [reducing reliance on electric powered lighting](#).

In this article, we will delve into some key emerging trends in architecture, exploring how strategic daylighting design can support best practices and help create contemporary spaces that work for both people and the planet.



1. Adaptive Reuse

'Sustainable design' is no longer a trend in architecture, but a fundamental part of the practice. As the American Institute of Architects (AIA) states: "[As authors of \[the built\] environment, architects, design professionals, and the entire AEC industry play a crucial role in addressing and mitigating the damage](#)" caused by human-driven climate change.

Buildings represent a huge investment, not only of time, effort and dollars but also carbon emissions generated during the manufacture of its materials and construction processes. To ensure this input is not wasted, there is an increasing trend for building owners and designers to **prioritize the reuse of existing buildings, rather than demolish and rebuild** — adapting them to meet the needs of modern building users both now and in the future.

A real-life example of this is [Click Rain and Lemonly's new headquarters set in an old and neglected spark plug factory](#). The manufacturing floor provided the perfect open-plan space to create an ideal collaborative layout for the creative and digital agencies, with modular structures added to create private meeting rooms and facilities.

To bring more daylighting into the deep footprint, architects at CO-OP Architecture exposed the building's original sawtooth roof structure and restored its industrial character, while integrating modern daylighting solutions in the form of the Kingspan GridSpan™ system into the vertical slopes.

Learn more about daylighting retrofits or explore more daylighting retrofit case studies.

There is also a clear opportunity when creating new buildings **to design with flexibility and high-performance standards in mind** to ensure a building can be continually optimized to remain useful throughout its lifetime, maximizing its commercial potential and offering longer-term return on investment. [Daylighting solutions such as tubular daylighting devices \(TDDs\)](#) can be easily adjusted to direct daylighting to different areas, allowing for future interior design layout flexibility. Fixtures can also be swapped out, and new effect lenses or lighting controls can be added or removed to adapt to evolving needs.



2. Human Centered Functionality and Biophilic Design

As US Visual Artist, Frank Chimero, put it: “people ignore design that ignores people.” To be successful, **buildings must be developed with the end users’ needs, wants, and potential barriers in mind.**

A key trend within human centered design is biophilia which recognizes that humans as a species have developed to respond to natural processes and therefore **should incorporate these elements into our modern built environments.** The concept is often characterized by the presence of natural materials, shapes, processes and forms. This includes **designing indoor daylighting strategies that mimic natural outdoor lighting patterns and cycles.** This helps to reinforce occupiers’ circadian rhythms – biological processes that follow a roughly 24-hour cycle—helping to improve energy regulation and enhance mood. It can also help to support plant life brought in by biophilic designers to improve air quality, enhance aesthetics and further contribute to the sense of positivity and wellbeing felt within the space.

A project that showcases the best of biophilic design is The Jewel, Changi International Airport in Singapore. Designed by globally renowned architect Moshe Safdie, the Jewel is inspired by Singapore’s vision of being a “city within a garden.” The complex harmoniously connects to the surrounding airport buildings with retail and leisure opportunities, whilst simultaneously presenting itself as a lush indoor garden, with full-size trees, plants, ponds, and walking trails. This mix of nature and commerce is housed under a distinctive glass and steel torus-shaped roof system, which opens at the center to allow for the iconic 130 ft rainwater cascade. As well as being a visual spectacle—particularly when illuminated at night — the indoor waterfall helps to provide both cooling and airflow within the garden environment.

The project team collaborated closely to find the best natural ventilation solution, settling on a specification of 105 bespoke-sized glass Lumera SHEV windows. Each unit opens automatically, helping to provide daylight and regulate internal temperatures for both occupiers and the plant life within. The product’s combination of natural ventilation and daylighting functions also contributed towards the project’s achievement of Singapore’s Green Mark Platinum status.



Daylight design can also play a key role in realizing contextual sensitivity, ensuring the building design respects and relates to the surrounding environment, culture, and history.



Source: www.kuwaitairport.gov.kw

3. Environmental Sensitivity and Place Making

Architectural tastes and trends are constantly changing. However, from the ornate grandeur of Gothic revival to the classically influenced clean lines of modernism, light is a fundamental design tool used to **enhance building forms, aid wayfinding and create a sense of place.**

This is exemplified at **Kuwait International Airport’s Terminal 2.** Designed by Foster and Partners, the design draws on the contrast between traditional stone architecture and the free, flowing nature of Kuwait’s traditional dhow sailing boats. It welcomes passengers into a flat, open trefoil terminal area illuminated with golden, natural daylight delivered via over 7,000 rooflights arranged in geometric clusters that align with the curved roof structure. To realize Foster’s vision for tubes which deliver beams of soft golden light into the depths of the building, our design team created an entirely new skylight product that comprises a glazed top, golden metal cladding on the inside and opening flaps to allow for smoke exhaust in the event of fire.

Daylight design can also play a key role in realizing **contextual sensitivity**, ensuring the building design respects and relates to the surrounding environment, culture, and history. This can be as simple as allowing views of significant landmarks, and as complex as creating bespoke solutions inspired by the location.

This idea was central to Tucker Sadler Architects’ design for the San Diego Symphony’s first and only permanent outdoor performance center — The Rady Shell at Jacobs Park. It was important to the project designers that concert goers felt the influence of the park’s natural surroundings.

They photographed the trees that needed to be removed from the site and— in collaboration with Kingspan Light + Air— transformed those photos into large graphics that were printed onto the ticket booth and concessions buildings’ translucent exteriors.

During the day, the trees appear like shadows, and at night, light from inside shines through the translucent panels to make it look as though there is moonlight gleaming through the trees.

Supporting Holistic Daylighting Design

As our collective understanding of the crucial role daylighting plays in successful buildings has grown, there has been a growing expectation for manufacturers to contribute their knowledge and expertise to the design process. As these case studies illustrate, **Kingspan has a long history of supporting architectural designers in creating bespoke daylighting strategies.** With a wide portfolio of solutions and access to daylighting experts across the globe, we can help designers find the right products and configurations to meet their specific design goals and priorities.

[Learn more.](#)

Chapter 13

The Impact of Effective Daylight Integration on Building Occupants' Health and Performance

Sustainable design and occupant well-being are increasingly intertwined in the built environment. Daylighting – the intentional integration of natural daylight into building interiors as the reliable primary daytime source of illumination – is a key design strategy to meet both requirements. More than just an aesthetic choice, access to daylight has profound implications for human health and performance, especially as most of us spend 80–90% of our lifetime indoors¹. Scientific research continues to uncover how the relationship between natural daylight and human physiology helps to improve mood, cognitive function, and overall well-being.

The Science Behind Daylighting

Human beings are evolutionarily adapted to the rhythms of natural daylight. Light exposure strongly influences our circadian rhythms – biological processes that follow a roughly 24-hour cycle – as natural daylight varies in intensity and spectral composition throughout the day. These variations play a critical role in instructing our bodies on how to regulate our sleep-wake cycle, hormone and neurotransmitter production, and even body temperature.

Research has shown that exposure to natural daylight in the morning helps reset the circadian clock for daytime physiological activity, enhancing alertness, and overall productivity and performance throughout the day². For example, a study published in [Building and Environment](#) showed that working in environments with abundant natural daylight not only improves occupant satisfaction but also helps cognitive function³.

Let's take a closer look at the ways in which daylight affects human health...



Health Benefits of Daylighting

1. Improved Sleep Quality and Circadian Regulation

As mentioned above, natural light is a powerful synchronizer of the body's internal clock. Access to daylight throughout the day can help to suppress melatonin production – the hormone that signals sleep onset – and stimulate the production of serotonin during daytime hours, leading to a more robust and natural sleep-wake cycle. A study by Figueiro et al. (2017) found that office workers with greater exposure to natural daylight during the day reported better sleep quality at night and lower levels of depression⁴. Further research conducted in the US and South Korea (2020) revealed that exposure to a large amount of daylight in a workspace increased sleep time and efficiency, as well as quality of life⁵.

What's more, in the healthcare sector, a study based on 15 years of medical data found that hospital patients with beds next to a window had shorter hospital stays than those with beds located by doors, potentially because they were sleeping better⁶.

Conversely, the lack of daylight experienced by shift workers has been shown to disrupt circadian rhythm and cause health problems, making thoughtful physiologically meaningful lighting design even more critical⁷. It's proven that by integrating daylight into the built environment, architects and designers can provide interior spaces that promote healthier sleep patterns and make a positive contribution to the physical wellbeing of building occupants in all types of buildings.

Effective daylighting design not only benefits physical health but plays a significant role in mental and emotional health.

2. Enhanced Mood and Reduced Stress

Effective Daylighting design has also been linked to improved mood and reduced levels of stress. Natural daylight has been shown to increase serotonin levels, contributing to improved mood and higher overall emotional well-being.

Since the COVID-19 pandemic and a rise in remote working, more and more people are spending much of their day at home. A study from 2022 demonstrated that the daylighting design of homes has a significant impact on subjective emotional wellbeing, with the most positive impact coming from maximizing the amount of daylight entering the home. It found that increased space between dwellings and larger, sun-facing windows also improved wellbeing.

The biggest beneficiaries of natural daylight conditions in the home were women and young people⁸.

According to a recent literature review, direct sunlight in the room, determined by the window's orientation, appears to be the most effective daylight-affecting factor for restorative effects. Sunnier and brighter environments appear to give the best results, followed by the proximity of the occupant to daylight or a sunny patch⁹. These findings suggest that effective daylighting design not only benefits physical health but plays a significant role in mental and emotional health.

3. Increased Productivity and Cognitive Performance

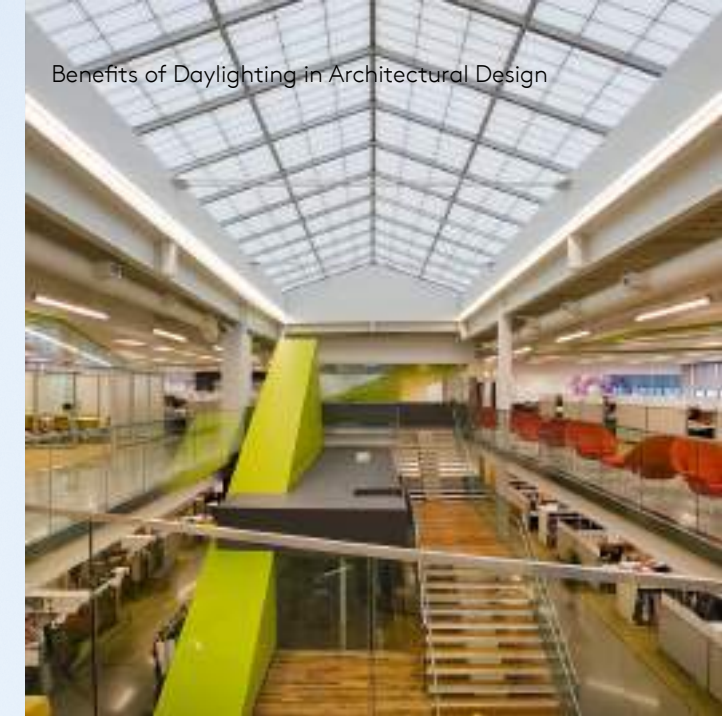
In environments such as offices and educational institutions, productivity and performance are key success metrics. Research has consistently found that natural daylight exposure, with its meaningfully dynamic nature, correlates with improved cognitive performance. A landmark study published in the *Journal of Clinical Sleep Medicine* showed that workers with access to natural daylight experienced a 10–15% increase in productivity, attributed to enhanced concentration and reduced fatigue¹⁰. Effective Daylighting design has also been associated with improved memory retention and faster reaction times, making it a factor in optimizing work and learning environments.

Challenges and Future Directions

While the benefits of effective daylighting design are clear, seasonal variations and geographic location can limit the availability of natural daylight, especially in regions with long winters or persistent cloud cover. Concerns about overheating and glare must also be addressed through smart, climate-responsive design and material innovations, such as the use of high diffusion glazing and spectrally selective coatings that minimize heat gain to the occupied spaces.

Our understanding of the relationship between natural daylight and human health is growing

Workers with access to natural daylight experienced a 10–15% increase in productivity.



thanks to emerging research examining how time-dependent exposure to different wavelengths of light affect mood and cognitive performance, as well as the potential benefits of personalized lighting systems that replicate natural daytime light patterns and spectral content throughout the day to alleviate seasonal deficiencies in meaningful daylight exposure.

As this knowledge evolves, so does the potential for designing spaces that conserve energy and promote occupants' health and well-being, making a compelling case for considering daylighting strategies from the earliest design stages to ensure brighter, healthier, more productive spaces aligned with our innate biological needs. Retrofitting existing spaces with daylighting strategies also presents a valuable opportunity to enhance occupant well-being in built environments.

Many existing structures can be improved to better integrate natural daylight, thereby reaping the benefits of improved health and productivity.

This approach not only maximizes the use of existing resources but also aligns with sustainable design principles by reducing the need for artificial lighting and energy consumption.



¹Kleppis N, Nelson W, Ott W. et al. The National Human Activity Pattern Survey (NHAPS): a resource for assessing exposure to environmental pollutants. *J Expo Sci Environ Epidemiol* 11, 231–252 (2001). <https://doi.org/10.1038/sj.jea.7500165>

²Blume C, Garbaza C, Spitschan M. Effects of light on human circadian rhythms, sleep and mood. *Somnologie (Berl)*. 2019;23(3): 147–156. <https://pubmed.ncbi.nlm.nih.gov/31534436/>

³Jamrozik A, Clements N, Hasan SS, Zhao J, Zhang R, Campanella C, Loftness V, Porter P, Ly S., Wang S, Bauer B. Access to daylight and view in an office improves cognitive performance and satisfaction and reduces eyestrain: A controlled crossover study. *Building and Environment*. 2019;165,106379. <https://doi.org/10.1016/j.buildenv.2019.106379>

⁴Figueira MG, Steverson B, Heerwagen J, et al. The impact of daytime light exposures on sleep and mood in office workers. *Sleep Health*. 2017;3(3):204–215. <https://pubmed.ncbi.nlm.nih.gov/28526259/>

⁵Lee J, Boubekri M. Impact of Daylight Exposure on Health, Well-being and Sleep of Office Workers Based on Actigraphy, Surveys, and Computer Simulation. *Journal of Green Building* 1 September 2020; 15 (4): 19–42. <https://doi.org/10.3992/jgb.15.4.19>

⁶Park MY, Chai CG, Lee HK, Moon H, Noh JS. The Effects of Natural Daylight on Length of Hospital Stay. *Environ Health Insights*. 2018;12:1178630218812817. Published 2018 Dec 3. <https://pubmed.ncbi.nlm.nih.gov/30546262/>

⁷Nie J, Zhou T, Chen Z. et al. The effects of dynamic daylight-like light on the rhythm, cognition, and mood of irregular shift workers in closed environment. *Sci Rep* 11, 13059 (2021). <https://doi.org/10.1038/s41598-021-92438-y>

⁸Morales-Bravo J, Navarrete-Hernandez P. Enlightening wellbeing in the home: The impact of natural light design on perceived happiness and sadness in residential spaces. *Building and Environment*. 2022;223 (109317). <https://doi.org/10.1016/j.buildenv.2022.109317>

⁹Karaman Madan O, Chamilothoni K, van Duijnhoven J, Aarts MPJ, de Kort AW. Restorative effects of daylight in indoor environments – A systematic literature review. *Journal of Environmental Psychology*. 2024;97(102323). <https://doi.org/10.1016/j.jenvp.2024.102323>

¹⁰Boubekri M, Cheung IN, Reid KJ, Wang CH, Zee PC. Impact of windows and daylight exposure on overall health and sleep quality of office workers: a case-control pilot study. *J Clin Sleep Med*. 2014;10(6):603–611. Published 2014 Jun 15. <https://pubmed.ncbi.nlm.nih.gov/24932139/>

Chapter 14

Daylighting in Education and Sports Facilities

There is a wide body of research evidencing the profound impact that daylighting can have on human performance. However, did you know that [children under 18 have a higher sensitivity to light than adults](#), and the lighting quality can have a notable effect on their learning rates, mood and activity levels in and out of school hours?

In this article, we'll explore why daylighting is so fundamental for effective education and sports facilities, the considerations that must be factored into specifications, and how some schools in the United States are creating inspiring facilities for their students.

Daylighting and Pupil Performance

In 1999, [Heschong Mahone Group released the results of its landmark study into the connection between daylighting levels in classrooms and academic achievement](#). It examined 21,000 school records from three school districts in three states and daylighting conditions in over 2,000 classrooms. It found that students who worked in spaces with high levels of daylight progressed 20% faster in math tests and 26% faster on reading tests than those working with the least amount.

From here, the body of studies into how exposure to natural light can positively influence student health, wellbeing and performance has grown, further compounded by research in other settings such as workplaces and healthcare facilities. For example, research has shown that students demonstrate [significantly higher oral reading fluency when exposed to high intensity light, with especially positive results for students that could be considered 'at risk.'](#)



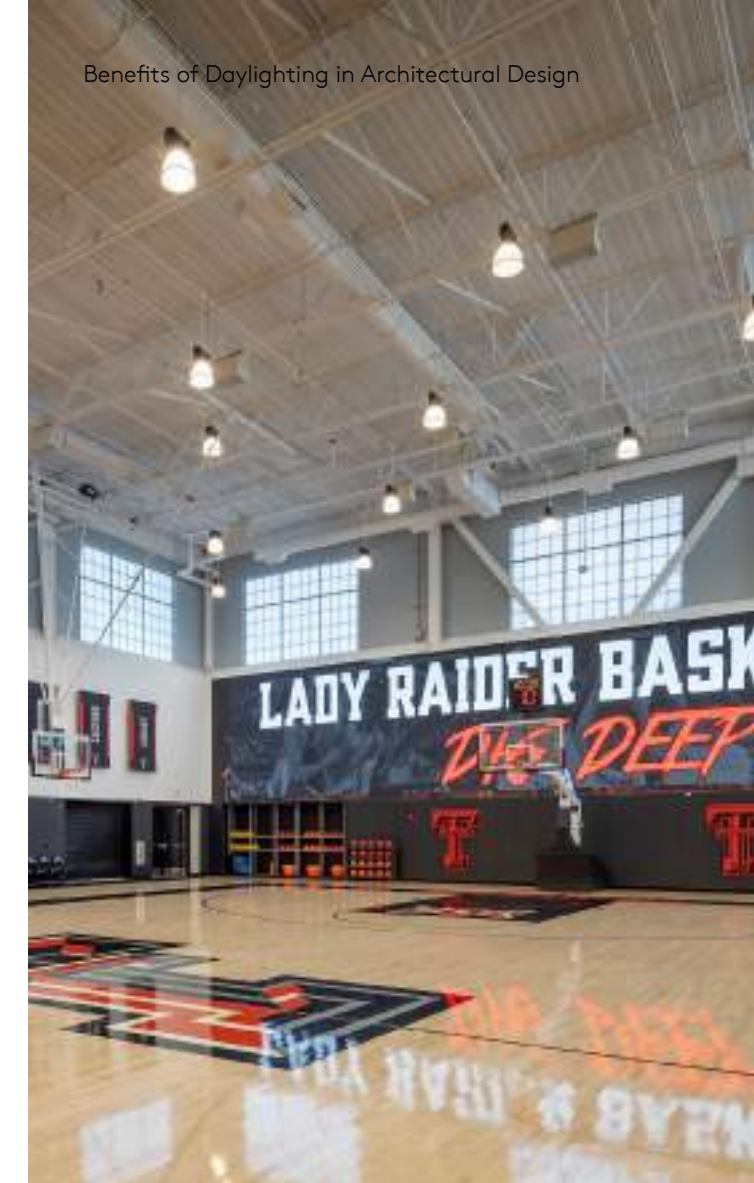
Students exposed to the natural colors and rhythms of daylight are also [less likely to make errors and show higher levels of concentration](#).

All these things are easily transferrable to sports facilities, which require students to demonstrate considerable readiness to engage with their surroundings and peers. Incorporating natural daylighting strategies can also help to create bright, energetic spaces that set a positive tone for both the participants and spectators of all kinds of exciting indoor sports — from basketball to gymnastics.

There are several reasons why daylighting and education go hand in hand:

- Daylight from windows and skylights is more diffused than electric lighting, creating more even illumination of objects and people.
- Electric lights, particularly those containing fluorescent tubes, can also have a noticeable flicker that is distracting and can result in headaches and eye strain.
- As natural daylight contains all the color wavelengths visible to the human eye, it is the ideal lighting source for color rendition, helping students to better understand and engage with various educational resources.
- Humans are programmed to be more active and alert during daylight hours, tiring as it becomes darker. Therefore, access to high levels of natural light will reinforce children's natural circadian rhythms, making them feel more alert during the day and consequently sleep better at night.
- Exposure to natural light offers numerous other health benefits, including improved mood and reduced absenteeism. It helps eliminate certain viruses, supports vitamin D production, and alleviates symptoms of seasonal affective disorder (SAD)¹.

¹Mead, M. N. (2008). Benefits of sunlight: A bright spot for human health. *Environmental Health Perspectives*, 116(4), A160-A167.
Penckofer, S., Kouba, J., Byrn, M., & Estwing Ferrans, C. (2010). Vitamin D and depression: where is all the sunshine?. *Issues in Mental Health Nursing*, 31(6), 385-393.



Any daylighting solutions must also work with the overall design scheme for the buildings, enhancing their look and feel to create inspiring spaces for personal development.

Five Key Considerations for Daylighting Solutions in Education and Sports Facilities

1. Diffusion

Natural light is extremely variable and requires careful management. While artificial lighting can help to meet the demand in times of low light, excessive levels of sunlight can cause disruptive glare. In classrooms, this can result in teachers counteractively having to pull down the blinds and turn on the lights.

In sports facilities, this may render the space unsafe, especially where contact sports are being played. Daylight solutions can be specified with translucent glazing or blinds to provide glare-free and shadow-free illumination.

2. Solar Heat Gain Prevention (Solar Heat Gain Coefficient -SHGC)

Similarly, too much direct sunlight can cause 'hotspots' which can be uncomfortable and disrupt learning or play. For example, in a classroom setting, students may need to be moved around the space or the teacher may have to open windows, potentially causing further thermal or acoustic disruption.

Choosing skylights or tubular daylighting devices (TDDs) with glazing that can limit heat gains, or incorporating shading methods into the design of the building — either via dedicated solutions such as brise soleil or architectural or landscaping strategies — can help to prevent this issue.

3. Robustness

With their heavy usage, education and sports facilities have to work hard. It is also vital that they remain safe structures, protecting occupants

and contents from the elements or unauthorized individuals trying to enter the building. Therefore, any daylighting product specified must be robust enough to stand up to the local requirements.

Daylighting systems also need to stand up to everyday use and abuse from students, sporting activities and more. Whether you're looking to add daylight to a hallway, classroom, gymnasium or natatorium, be sure to consider both the glazing material used and system placement to ensure optimal performance.

4. Longevity

In addition to being structurally sound, it is also important that the chosen daylighting products can provide reliable high quality light transmission for their lifetime. As well as ensuring they are regularly cleaned and maintained, specifying solutions that are UV-resistant can help to maintain not only light transmission but the quality of light coming through the glazing, since studies have shown that how colors and shades are perceived can lead to reduced energy, negative moods and lower productivity in students.

5. Aesthetics

Any daylighting solutions must also work with the overall design scheme for the buildings, enhancing their look and feel to create inspiring spaces for personal development— whether that's in the classroom or on the courtyard. With a wide range of both wall light, skylight and tubular daylighting options, designers have the freedom to find the best options to fit within their project's aims, architectural context and desired aesthetic.



Case study: New London Educational Learning Center (ELC), Minnesota

The New London Educational Learning Center (ELC) was specifically designed to provide up to 50 students with additional learning and behavioral needs with a safe, functional, and aesthetically pleasing environment to learn and play.

Ensuring effective daylighting throughout the learning and sports facilities was central to this strategy. However, there were several challenges to overcome, such as how to bring in daylight to spaces where traditional windows or skylights were not viable and — most critically — how to illuminate the recreation area which also serves as the building's storm shelter.

The design team, led by Hay Dobbs Architects and BCI Construction, collaborated closely with Solatube distributor Daylight Specialists to integrate 12 Solatube SolaMaster 750 DS-O TDDs in the gym.

The 750 DS-O complies with Minnesota's strict building codes, meeting both ICC 500 and FEMA P-361 standards. This makes it the optimal choice for storm shelters, with no need for costly protective measures.

In addition to meeting the required structural standards, the Solatube TDDs allowed each space to be infused with diffused daylight, whilst blocking out UV-rays — a vital consideration for UV sensitive students.

[Explore the full case study here.](#)

I found myself looking for a light switch to turn off before realizing the brightness was simply natural daylight!"

BCI Construction's Project Manager, Jennifer Colton



By utilizing both translucent wall and skylight systems, the campus is illuminated with soft, diffused natural light.



Case study: Grover Cleveland Charter High School, Los Angeles

PBWS Architects created a comprehensive modernization of Grover Cleveland Senior High School, transforming the 1961 campus into a contemporary and light-filled 21st-century learning environment that pays homage to its mid-century heritage while improving campus life for both students and faculty through biophilic design—all while meeting the school district's stringent requirements for security, ease of maintenance and durability.

To assist in bringing natural light into the new spaces, as well as being true to the biophilic design goals, PBWS Architects used Kingspan Light + Air's UniQuad® wall systems, QuadSpan™ translucent skylights and Briteway® canopies alongside other materials. These modern systems helped create clean lines that complement the facility's external geometric design while providing effective daylighting throughout the campus. The design team also used UniQuad® wall systems around classrooms and seating areas where students will congregate to provide ample natural lighting without excessive glare.

Kingspan Light + Air products are engineered for long-term durability and can be custom designed to fit your project's needs, including easy maintenance. The translucent walls and skylights feature removable skin technology, which is particularly useful in situations where access to a system is limited or challenging. With removable skin technology, individual exterior or interior panels can be removed and replaced without disturbing the surrounding panels or structure—making maintenance and replacement easier.

By utilizing both translucent wall and skylight systems, the campus is illuminated with soft, diffused natural light, avoiding harsh glare or heat caused by direct sunlight. Additionally, the exterior canopy shields students, faculty and staff from the weather while creating a bright and welcoming multi-use space.

[Explore the full case study here.](#)

Chapter 15

Why Daylighting is a Wise Investment for Businesses

A Look at Different Workplaces

It's widely recognized that poorly lit buildings create a subpar work environment, making daylighting – the strategic use of natural daylight in buildings – a smart investment for businesses, with both aesthetic and environmental benefits. From corporate offices to industrial spaces and warehouses, maximizing daylight can enhance productivity, reduce energy costs, and improve employee well-being.

In this blog, we explore the advantages of daylighting for these workplaces and outline the design strategies that can facilitate daylighting.



The Business Case for Daylighting

So, why is daylighting such a worthwhile investment?

Of course, before the advent of electric lighting, businesses and industrial facilities relied almost entirely on natural daylight for interior illumination. Factory designs in the late 19th and early 20th centuries, influenced by the 'daylight factory' movement, featured large windows and [sawtooth roof designs](#) with clerestory windows to make the most of daylight.

Today, with increasing knowledge of the impact of biophilic design and a greater understanding of the scientific impact of lighting on occupants, architects have the opportunity to design for both health and productivity. By incorporating natural daylight into their buildings, businesses can expect to profit on several fronts:

- **Reduced energy costs:** lighting accounts for a significant portion of a building's energy use. Increasing natural daylight reduces electricity costs and lowers HVAC expenses by reducing heat emissions from electric lighting.
- **Increased productivity:** studies show that access to daylight improves concentration, reduces fatigue, and enhances overall work performance. Employees in well-daylit spaces tend to be more engaged and efficient.
- **Improved Well-being and Health Benefits:** natural daylight helps regulate circadian rhythms, improving sleep quality, mood, and overall health. These improvements support reduced absenteeism and higher job satisfaction. [The World Green Building Council \(WorldGBC\)](#) cites a study¹ that showed office workers who sat near a window with an outdoors view averaged an extra 46 minutes of sleep a night.
- **Enhanced sustainability:** with increasing environmental regulations and the push for greener buildings, daylighting can contribute to meeting sustainability goals and certifications such as [LEED](#) and [BREEAM](#). Additionally, when considering the many energy-efficiency measures that can be applied to today's building, the use of daylight is the one sustainable measure that occupants can actually see and appreciate.
- **Higher property value:** buildings with effective daylighting strategies are more attractive to tenants and buyers, resulting in higher rental and resale values.

¹Heschong Mahone Group (2003) Windows and Offices: a Study of Worker Performance and the Indoor Environment (Technical Report) for California Energy Commission, 2003, pp 2–4.



When considering the many energy-efficiency measures that can be applied to today's building, the use of daylight is the one sustainable measure that occupants can actually see and appreciate.

Daylighting in Office Spaces

Unsurprisingly, corporate offices are among the most studied environments for research into daylighting. Employees spend long hours indoors, often under electric lighting, which can cause negative effects such as eye strain, headaches, and decreased productivity. Daylighting supports:

- **Improved focus and performance:** natural daylight reduces drowsiness and enhances cognitive function.
- **Reduced sick days:** office employees with access to daylight have fewer health complaints such as stress and eye discomfort, leading to fewer sick days and lower healthcare costs.
- **Employee satisfaction and retention:** natural daylight is often cited as one of the most desirable workplace features. A well-lit environment can improve job satisfaction and help businesses retain top talent.

Daylighting Strategies for Offices

- Floor-to-ceiling windows maximize window surface area, especially on north – and south – facing facades, providing consistent light without excessive glare.
- Skylights and light shelves distribute natural daylight deeper into office interiors.
- Partitions and open layouts – using translucent or transparent partitions instead of solid walls allows light to penetrate deeper into the office space, benefiting more employees.
- Automated lighting controls will dim or turn off electric lights when sufficient daylight is available.

Daylighting in Industrial Spaces

Factories, manufacturing plants, and other industrial facilities traditionally rely heavily on electric lighting, which contributes to high energy costs and operational expenses. Incorporating daylighting can significantly improve efficiency and working conditions by providing through:

- **Lower energy costs:** strategically placed skylights and translucent panels can reduce electric lighting costs by as much as 50% during daylight hours.
- **Enhanced safety:** natural daylight improves visibility, reducing accidents and errors in high-risk environments such as assembly lines and machine shops.
- **Better worker morale:** industrial workers often operate in enclosed spaces for long shifts. Daylight can improve their mood, reducing stress and burnout.

Strategic window placement can overcome the fenestration limitations of warehouses. Well-placed clerestory windows or light wells maximize daylight entry without compromising security.



Daylighting Strategies for Warehouses

- High-efficiency skylights and TDDs, when large and evenly spaced, can provide uniform daylight across warehouse floors without creating excessive glare.
- Translucent roof panels – [polycarbonate](#) or fiberglass panels installed in roof sections – allow diffused daylight to penetrate deep into the space, reducing reliance on electric lighting.
- Strategic window placement can overcome the fenestration limitations of warehouses. Well-placed clerestory windows or light wells maximize daylight entry without compromising security.
- Daylight-responsive lighting controls using sensors that adjust electric lighting based on daylight availability bring optimal energy efficiency.

Whatever the workplace, the multitude of advantages brought by thoughtful daylighting strategies contribute to creating healthy buildings. Designers who successfully incorporate daylighting strategies help their clients to significantly cut operational costs and enjoy a safer, greener, more efficient and, ultimately, more valuable work environment that boosts employee well-being and satisfaction.



Chapter 16

Daylighting in Retail

Enhancing Shopper Experience, Staff Well- being, and Energy Efficiency

Retail environments are all about first impressions and customer experience, and daylighting is integral to creating the right ambience. Research has shown that natural daylight levels can significantly impact shopper behavior, employee productivity, and operational costs. This blog explores why daylighting should be a priority for retail design and how it can shape the future of commercial architecture.

How daylighting impacts retail

In retail, daylighting reduces reliance on electric lighting and influences consumer psychology and buyer behavior in several ways:

The shopper experience: engagement and sales

Natural daylight profoundly impacts human behavior – in retail environments, this affects shoppers' mood, perception, and purchasing decisions. [Research](#) shows daylighting enhances the in-store experience, making customers feel more comfortable and engaged. Specifically, the study suggested that the installation of skylights in non-skylit stores would result in a 40% improvement in sales, with a probable range of between 31% and 49%.



This translates into:

- **Increased time spent in store:** [Studies](#) show that shoppers tend to linger longer in well-lit stores with natural light, leading to a greater likelihood of purchase. Bright, naturally daylight spaces feel more inviting and reduce the feeling of being in a closed-off unnatural environment.
- **Enhanced product appeal:** Because daylight is a full-spectrum light source, [colors appear more vibrant](#) when viewed in daylight, making products look their best. Accurate color representation is significant in fashion, furniture, and lifestyle stores, as it can affect purchasing decisions.
- **Psychological well-being:** [Natural daylight affects mood and reduces stress, creating a more pleasant shopping experience that fosters brand loyalty and overall satisfaction.](#) Relaxed, comfortable customers are more likely to return – and spend.

Employee productivity and well-being

Retail employees spend long hours indoors, often under harsh electric lighting. Daylighting can improve their work environment for higher job satisfaction and productivity, evident through:

- **Better mood and focus:** Exposure to natural daylight regulates [circadian rhythms](#), improves alertness, and reduces fatigue. Employees working in naturally daylight spaces report fewer headaches, less eye strain, and overall better well-being.
- **Lower absenteeism:** Healthier, happier employees take fewer sick days. Access to daylight has been linked to [better sleep patterns](#) and [reduced seasonal affective disorder \(SAD\) symptoms](#), particularly in locations with long winters.
- **Better customer service:** When employees feel energized and engaged, their interactions with customers improve, leading to better service and a more positive in-store experience. A [literature review](#) of research on daylighting concluded that lighting conditions are a major factor in employees' satisfaction with their working environment.

Energy efficiency and sustainability

Daylighting in retail design positively impacts energy consumption, especially for large single-story facilities, which often require significant lighting. Integrating daylighting can lead to:



When considering the many energy-efficiency measures that can be applied to today's building, the use of daylight is the one sustainable measure that occupants can actually see and appreciate.

- **Lower electric lighting costs:** Maximizing daylight reduces electric lighting demand during peak business hours and reduces energy expenses. According to studies, well-designed daylighting systems can reduce electric lighting consumption significantly, potentially by as much as [50–80%](#).
- **Sustainability and green building certifications:** [New research](#) shows that 78% of consumers agree that sustainability is important. Unsurprisingly, many retailers are increasingly focusing on sustainability – according to the [2023 Deloitte CXO Sustainability Report](#), 62% of retail companies are increasing the efficiency of energy use. Incorporating daylighting helps meet LEED and WELL Building Standard requirements, reducing carbon footprints while appealing to eco-conscious consumers.

Design strategies for effective retail daylighting

For architects and designers, achieving the right balance of daylighting requires careful planning to incorporate strategies that optimize daylight in retail spaces. **Skylights and TDDs** can maximize overhead natural daylight, particularly useful for ‘big box’ single-story retail buildings. Skylights and TDDs introduce ample natural daylight without relying solely on vertical glazing. In large-format stores, **continuous skylights** are ideal for ensuring even light distribution.

In more complex designs, **modular skylights** bring flexibility, adapting to different retail layouts, and

tubular daylighting device solutions can direct daylight into deeper spaces where daylight from windows may not reach. **Clerestory windows** allow light penetration while minimizing glare and preserving privacy, ideal in mall-based stores or retail units with limited exterior walls.

Light shelves can help bounce daylight further into the store, reducing glare and ensuring more even illumination. Combined with light-colored **reflective flooring and walls**, this technique can amplify natural daylight penetration.

Smart glazing and automated controls

To optimize daylight without excessive heat gain, consider low-E Glass and tinted windows to control solar gain, used alongside automated shades and blinds that adjust based on daylight levels and time of day. Daylight sensors can be integrated with electric lighting systems for smooth transitions between natural daylight and electric light.

Daylighting is a strategic investment in customer experience, employee well-being, and energy efficiency, bringing sustainability and aesthetics together for visually appealing and functionally superior environments. By leveraging daylight effectively, retail spaces can drive higher foot traffic, improve operational efficiency, and contribute to a healthier, more enjoyable shopping environment.

Read on to find out about retail daylighting in action.



Case Study: Daylighting transformation at Ganahl Lumber, Pasadena, California

Ganahl Lumber, one of Southern California’s oldest building materials retailers, revitalized a historic General Motors dealership in Pasadena, transforming it into an inviting and energy-efficient retail space. The challenge was to balance adaptive reuse with modern retail needs while maintaining compliance with building preservation standards.

[Onyx Architects](#) implemented an innovative daylighting strategy to create a high-end shopping experience within a typically utilitarian setting. They installed 60 [Solatube](#) SolaMaster 330 DS-O Tubular Daylighting Devices (TDDs) to capture and distribute natural daylight throughout the store efficiently. Unlike traditional skylights, the TDDs integrate seamlessly with HVAC, lighting, and signage while reducing glare and energy consumption.

The results were dramatic – Ganahl Lumber exceeded revenue expectations, benefiting from the enhanced visual appeal and customer-friendly atmosphere created by natural daylight. Studies suggest daylighting in retail environments can boost sales by [over 40%](#), a trend reflected in the store’s success. The project was recognized with an AIA Pasadena & Foothill Chapter Honor Design Award for restoration and adaptive reuse, solidifying Ganahl Lumber as a standout retail destination.

This case study showcases the power of strategic daylighting in retail, illustrating how natural light can enhance both aesthetics and performance while driving business success.

[Explore the full case study here.](#)

Ganahl Lumber exceeded revenue expectations, benefiting from the enhanced visual appeal and customer-friendly atmosphere created by natural daylight.



The ice-white glazed QuadSpan™ panels not only enhanced the building's aesthetics, providing a modern, airy contrast to the solidity and complexity of the barn-like architecture. But the translucent glazing helped to illuminate the spaces with soft, diffused light.



Case Study: Creating a statement environment at Devon Yard, Pennsylvania

More than a conventional shopping mall, Devon Yard was retail brand Anthropologie's first ever "lifestyle center," built near its original 1992 retail store. In addition to the flagship store, it also features two fine eateries, a home/garden shop and other retail spaces which are all brought together around a central courtyard. To embody both the pastoral setting and the modern rustic characteristic of the iconic lifestyle brand, [NewStudio Architecture](#) was challenged to create a "light and airy greenhouse feel" for occupants while meeting strict local energy codes.

The final building used a mix of Pennsylvania field stone and reclaimed barnwood to create an exposed beam structure. This was then topped off with a roofing solution that combined a traditional-looking standing seam metal barn roof divided by modern glazed areas created from 2,680 sq ft of [QuadSpan™](#) skylight system.

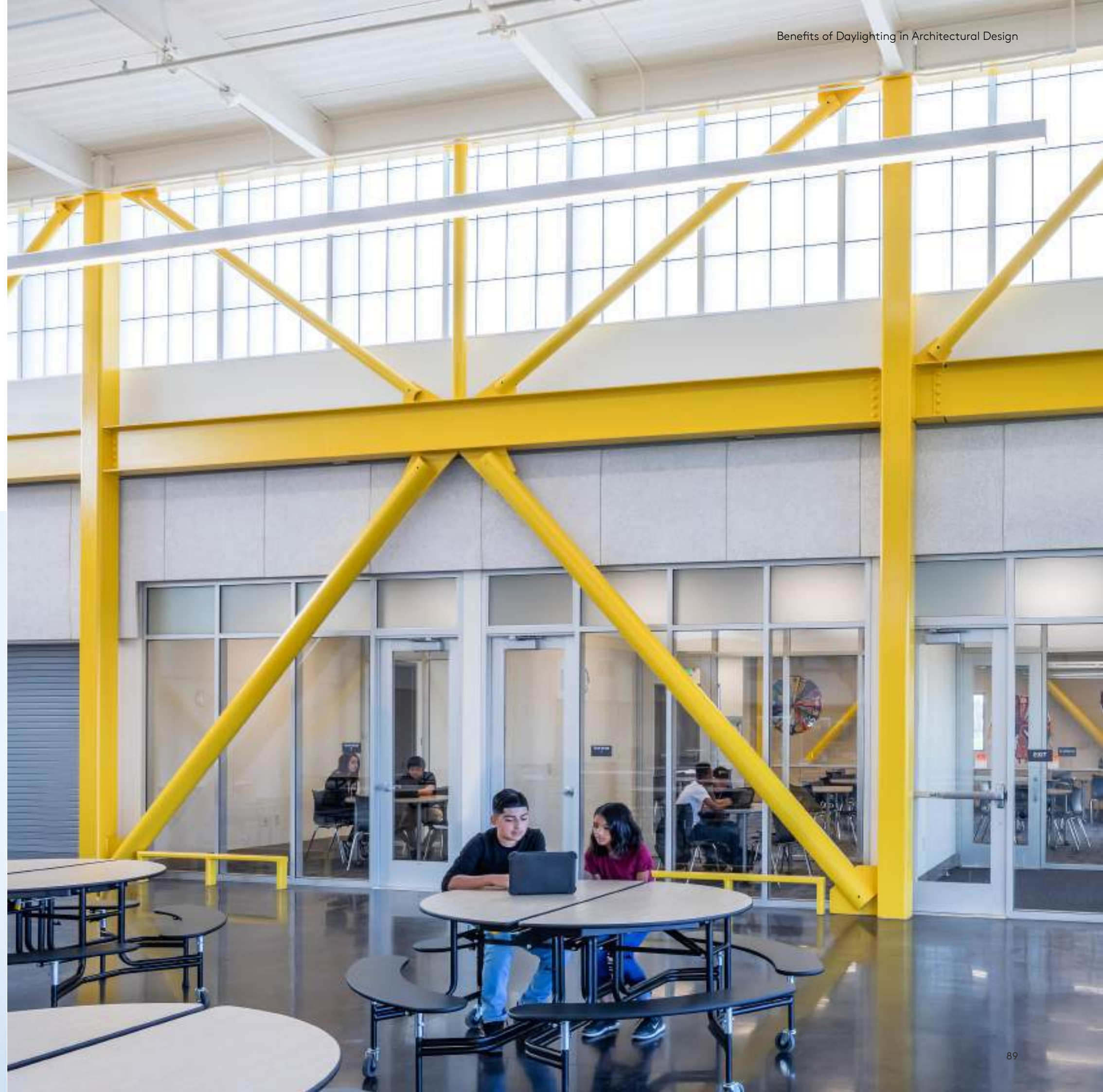
The ice-white glazed QuadSpan™ panels not only enhanced the building's aesthetics, providing a modern, airy contrast to the solidity and complexity of the barn-like architecture. But the translucent glazing helped to illuminate the spaces with soft, diffused light without risk of glare or added heat. This ensured a bright, inspiring space for shoppers, diners and workers alike.

[Explore the full case study here.](#)

Conclusion

Daylighting plays a multifaceted role in architecture, bridging aesthetics, performance, and human experience. For architects, it offers an opportunity to design with intention, balancing technical precision with creative vision for a holistic approach that considers energy efficiency, occupant comfort, and environmental responsibility.

Looking ahead, daylighting will remain central to architectural innovation. It is a design language that speaks to sustainability, human-centric design, and timeless beauty. By mastering its principles and applying them thoughtfully, architects can create buildings that are not only functional and efficient, but transformative, ensuring spaces that elevate everyday life and contribute to a healthier planet.



Index

Option 2

	Page No.
Part 1	4
Daylighting strategies	
Design principles and technical considerations for integrating natural light into buildings.	
Chapter	
01	Key Factors to Consider in Daylight Design for Buildings 6
02	Daylighting Strategies: Balancing Natural and Electric Lighting 10
03	Maximizing Rooftop Potential: Harmonizing Daylight and Equipment Integration 14
04	Managing Glare and Heat: Critical Considerations for Daylighting Design 18
05	How Digital Tools are Transforming Daylight Design in Architecture 24
Part 2	30
Daylighting and energy efficient, sustainable buildings	
The role of daylighting in reducing energy demand, supporting certification standards and enabling net-zero design.	
Chapter	
06	The Role of Daylighting in Achieving Net-Zero Energy 36
07	Case Studies - Daylighting Strategies to Achieve Net-Zero Carbon Buildings 38
08	Daylighting in LEED and BREEAM 42
09	Sustainable - Daylighting in WELL 48
10	Daylighting Retrofit Strategies for Existing Buildings 55
11	Case Studies - Daylighting Retrofits 56
Part 3	62
The human benefits of daylighting	
How natural light enhances wellbeing, productivity and user experience across different building types.	
Chapter	
12	Daylighting and Modern Architectural Design 64
13	Daylighting, Health and Wellbeing 68
14	Daylighting in Education and Sports Facilities 72
15	Why Daylighting is a Wise Investment for Business 78
16	Daylighting in Retail Environments 82

Glossary of Daylighting Terms and Acronyms

A

Annual Sunlight Exposure (ASE)

The fraction or percentage of the horizontal work plane that exceeds a specified direct sunlight illuminance level more than a specified number of hours per year over a specified daily schedule with all operable shading devices retracted. ASE helps identify risks of glare and overheating.

Source:

Illuminating Engineering Society (IES)

<https://ies.org/definitions/annual-sunlight-exposure-ase/>

Artificial Lighting

Light generated by electric or fuel-based sources such as LEDs, fluorescent, or incandescent lighting, used to supplement or replace natural daylight.

Atrium

A large internal open space, often with overhead glazing, designed to allow daylight to penetrate deeper into a building.

B

BIM (Building Information Modeling)

A digital process that integrates architectural, structural, and systems data into a coordinated 3D building model, often used for daylight analysis and performance simulation.

Source:

buildingSMART International

<https://www.buildingsmart.org>

BREEAM (Building Research Establishment Environmental Assessment Method)

An internationally recognised sustainability certification that evaluates building environmental performance, including daylight access and visual comfort.

Source:

buildingSMART International

<https://www.buildingsmart.org>

C

CBDM (Climate-Based Daylight Modelling)

Climate based daylight modelling (CBDM) is the dynamic analysis (over time) of daylight levels using a combination of sky types which are then modified by cloud cover or solar data from a selected simulation weather file. Climate based daylight modelling delivers predictions of illuminance or daylight factor over time which are dependent on the site location, building orientation, glazing and configuration.

Source:

IES LM-83-12 Spatial Daylight Autonomy and ASE Standard

[13. Climate Based Daylight Modelling \(CBDM\)](#)

Clerestory Windows

High-level windows positioned above eye level to introduce daylight deep into interior spaces.

Circadian Rhythm

The human body's internal biological clock, influenced by light exposure, regulating sleep cycles, alertness, and hormonal balance.

Source:

WELL Building Standard

<https://www.wellcertified.com>

D

Daylight

Direct, diffuse, and/or reflected light that originates at the sun.

Daylighting

The controlled architectural use of natural daylight to illuminate interior spaces while balancing comfort, energy efficiency, and visual performance.

Source:

Illuminating Engineering Society (IES)

<https://ies.org/definitions/daylight/>

Daylight Factor (DF)

The daylight factor is defined as the ratio of horizontal indoor to outdoor illumination by daylight under continuously overcast sky conditions, expressed as a percentage. As an example, for a mean outdoor illumination of 10,000 lux, a daylight factor of 5% results in an illuminance of 200 lux at a task height of 80 cm in the middle of the room. The advantage of daylight factors in building regulations is that they provide minimum daylighting standards.

Source:

ScienceDirect – Daylight Factor Overview

<https://www.sciencedirect.com/topics/engineering/daylight-factor>

Daylight Autonomy (DA)

A metric measuring how often a space meets a minimum illuminance level using daylight alone during occupied hours.

Source:

IES Virtual Environment (IESVE)

https://help.iesve.com/ve2021/2_2_4_3_spatial_daylight_autonomy_sda_.htm

Diffusion

The process of scattering incoming light to create even illumination and reduce glare.

E

Electric Lighting

Artificial lighting systems powered by electricity, typically used to supplement daylight during low-light conditions or night-time occupancy.

Embodied Carbon

Greenhouse gas emissions associated with building materials and construction processes throughout the lifecycle of a building, including material extraction, manufacturing, transport, installation, maintenance, and end-of-life disposal or recycling.

Source:

World Green Building Council

<https://worldgbc.org/climate-action/embodied-carbon/>

E

Fenestration

Any opening in a building envelope designed to admit light, such as windows, skylights, or glazed façades.

FRP (Fiberglass Reinforced Polymer)

A composite material often used in translucent daylighting panels that diffuses light while providing durability and insulation.

G

Glare

Condition of vision in which there is discomfort or a reduction in the ability to see details or objects, caused by an unsuitable distribution or range of luminance, or by extreme luminance contrasts.

Source:

International Commission on Illumination (CIE) – International Lighting Vocabulary

<https://cie.co.at/eilvterm/17-22-098>

H

HVAC (Heating, Ventilation and Air Conditioning)

Building systems used to control indoor environmental conditions, including temperature, humidity, ventilation, and air quality.

Daylighting strategies can influence HVAC energy demand by reducing heat gain, heat loss, and artificial lighting loads.

Source:

EPA US

[Heating, Ventilation and Air-Conditioning Systems, Part of Indoor Air Quality Design Tools for Schools | US EPA](#)

I

Illuminance

Illuminance is the amount of luminous flux (light) incident on a surface per unit area. It describes how much light reaches a surface and is typically measured in lux (lx) or footcandles (fc).

Source:

International Commission on Illumination (CIE) – International Lighting Vocabulary

<https://cie.co.at/eilvterm/17-22-098>

L

LEED (Leadership in Energy and Environmental Design)

A global green building certification system that evaluates sustainable building performance, including daylighting strategies.

Source:

U.S. Green Building Council (USGBC)

<https://www.usgbc.org/leed>

Light Shelf

A horizontal surface designed to reflect daylight deeper into a room while reducing glare near windows.

Light-to-Solar Gain Ratio (LSG)

Light-to-Solar Gain (LSG) is the ratio of visible transmittance (VT) to the solar heat gain coefficient (SHGC). It is used to evaluate the relative efficiency of glazing systems in transmitting daylight while limiting solar heat gain. Higher LSG values indicate that a glazing product allows more natural light to enter a space while admitting less unwanted heat.

Source:

U.S. Department of Energy (DOE). Energy Performance Ratings for Windows, Doors, and Skylights.

[Energy Performance Ratings for Windows, Doors, and Skylights | Department of Energy](#)

Lux (lx)

Lux (lx) is the International System of Units (SI) unit of illuminance. One lux is equal to one lumen of luminous flux distributed over an area of one square meter (1 lx = 1 lm/m²).

Source:

Illuminating Engineering Society (IES). Lux Definition.

<https://ies.org/definitions/lux/>

M

Micro louvers

Fine slat shading systems integrated into glazing or films to block direct sunlight while maintaining diffuse daylight and outward views.

N

Net-Zero Energy Building

A building that produces as much energy annually as it consumes through efficiency measures and renewable energy generation.

Source:

International Energy Agency (IEA)

<https://www.iea.org>

O

Occupancy Sensors

Automated lighting controls that adjust electric lighting based on space usage.

P

Photovoltaic (PV) Panels

Photovoltaic (PV) panels are electronic devices made up of solar cells that convert sunlight directly into electricity.

Source:

International Renewable Energy Agency (IRENA). Solar Energy.

<https://www.irena.org/Energy-Transition/Technology/Solar-energy>

Prismatic Glazing

Glazing materials designed to redirect incoming light to improve daylight distribution and reduce glare.

R

Reflectance

Reflectance is the ratio or proportion of light (or radiant energy) reflected from a surface compared to the amount of light incident upon that surface.

It influences interior lighting performance and daylight distribution because surfaces can reflect, absorb, or scatter light.

Source:

Illuminating Engineering Society (IES). Reflectance Definition.

<https://ies.org/definitions/reflectance-rho-of-a-surface-or-medium/>

S

Shading Devices

Architectural components such as louvers, blinds, or overhangs used to control sunlight penetration.

SHGC (Solar Heat Gain Coefficient)

Solar Heat Gain Coefficient (SHGC) is the fraction of solar radiation admitted through a window, door, or skylight, either directly transmitted or absorbed and released as heat indoors.

Source:

U.S. Department of Energy – Energy Performance Ratings for Windows, Doors, and Skylights.

[Energy Performance Ratings for Windows, Doors, and Skylights | Department of Energy](#)

Skylight

A roof-mounted glazing system designed to introduce daylight into interior spaces.

Spatial Daylight Autonomy (sDA)

A daylight metric measuring the percentage of floor area receiving adequate daylight levels for at least 50% of occupied hours.

Source:

Illuminating Engineering Society (IES LM-83-12)

<https://www.ies.org/standards/committee-reports/ies-lm-83-12/>

T

TDD (Tubular Daylighting Device)

A daylighting system that captures sunlight at the roof and transports it through reflective tubing into interior spaces. Also known as solar tubes or tubular skylights.

Translucent Glazing

Glazing that allows light transmission while diffusing visibility, reducing glare and improving uniform illumination.

U

UDI (Useful Daylight Illuminance)

A daylight performance metric categorising illuminance into three ranges:

- UDI-s – Insufficient daylight
- UDI-a – Acceptable daylight levels
- UDI-e – Excessive daylight causing glare risk

Source:

CIBSE Lighting Guide LG10

<https://www.cibse.org>

V

VLT (Visible Light Transmittance)

Is a fraction of the visible spectrum of sunlight, weighted by the sensitivity of the human eye, that is transmitted through the glazing material. A product with a higher VT transmits more visible light. VT is expressed as a number between 0 and 1.

Source:

U.S. Department of Energy (referencing NFRC rating metrics)

[Energy Performance Ratings for Windows, Doors, and Skylights | Department of Energy](#)

W

WELL Building Standard

A building certification programme focused on occupant health and wellbeing, including daylight access and visual comfort.

Source:

International WELL Building Institute

<https://www.wellcertified.com>

Definitions and referenced standards are provided for general guidance. Project requirements and regulatory criteria may vary by jurisdiction and building type.

Further Guidance and Design Support

~~Further Guidance and Design Support~~

Designing with daylight is a complex, project-specific process that involves balancing design intent, occupant comfort, regulatory requirements, and building performance. Specialist daylighting expertise, technical guidance, and digital design support tools are available to help architects, designers, and specifiers integrate effective daylighting solutions into their projects.

Explore the Daylighting Design Hub

The Daylighting Design Hub provides a central knowledge platform designed to support early concept development through to detailed specification. The hub includes:

- Daylighting design guidance and technical articles
- Performance data and product information
- Case studies across multiple building sectors
- Digital modelling and design support resources
- Certification and compliance guidance
- CPD and educational materials

Whether you are exploring daylighting strategies at concept stage or finalising technical specifications, the Daylighting Hub offers practical support and inspiration.

Visit the Daylighting Hub:

[Daylighting Design Hub | KLA NA](#)

Architectural Solutions and Design Support

Kingspan's Architectural Solutions and Design team works collaboratively with project teams to help optimise daylighting performance and integration within building designs.

If you would like to discuss a project, request technical guidance, or explore daylighting opportunities within your design, our specialists are available to assist.

Contact the Architectural Solutions Team:

[Architectural Solutions Team | KLA NA](#)

UK

Kingspan Light + Air

Mellyn Mair Business Centre

Lamby Industrial Park

Wentloog Avenue

Cardiff, CF5 2EX

T: +44 (0) 29 2077 6160

E: info@kingspanlightandair.com

www.kingspanlightandair.co.uk

Ireland

Kingspan Light + Air

Carrickmacross Road,

Kingscourt, Co. Cavan, A82 E89 7

T: +353 (0) 42 969 8500

F: +353 (0) 42 969 8572

E: info@kingspanlightandair.com

www.kingspanlightandair.ie

Join the conversation on our website and LinkedIn channel:

kingspan.com/us/en/business-groups/kingspan-light-air/

linkedin.com/company/kingspanlightair/

kingspan.com

Care has been taken to ensure that the contents of this publication are accurate, but Kingspan Limited and its subsidiary companies do not accept responsibility for errors or for information that is found to be misleading. Suggestions for, or description of, the end use or application of products or methods of working are for information only and Kingspan Limited and its subsidiaries accept no liability in respect thereof.



02/2026

