

Naturally
Enhanced
Environments



THE BENEFITS OF DAYLIGHTING IN ARCHITECTURAL DESIGN

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

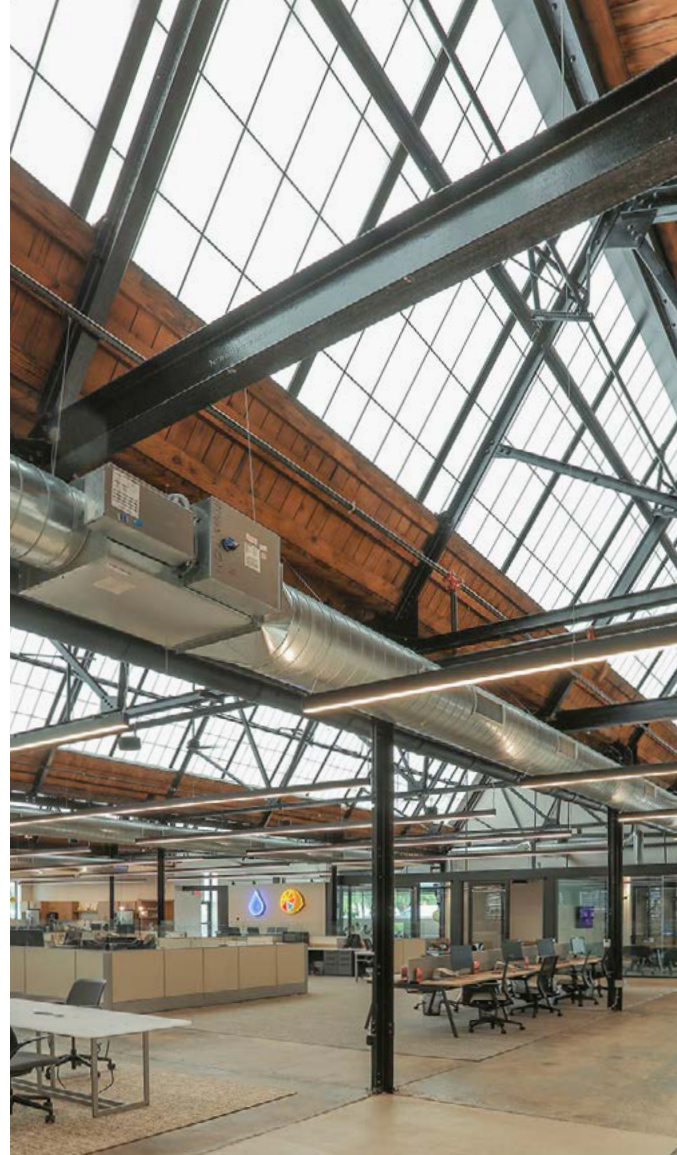
Beyond functional impacts, glare also affects how spaces look and feel. Overly bright areas and stark luminance contrasts can create visually chaotic environments. Thoughtful glare control, on the other hand, allows daylight to highlight materials, surfaces, and forms in ways that enhance spatial quality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



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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.

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