



AIA Best Practices: Five key steps to enhancing building daylighting

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Summary

Historically, daylighting design is based on fundamental principles of building orientation, perimeter window placement, and interior skylight opportunities. Today, daylighting requirements are more exacting because of energy code requirements, sustainable design objectives, and social mandates to enhance the occupant experience with natural light. This article identifies these requirements and provides a structured checklist to enhancing daylighting systems and the AIA 2030 Commitment.

Background

It is too late to find out that you don't meet the energy standards of the U.S. Energy Department COMcheck application when you are submitting for your building permit. It is also aggravating to find out that you are missing essential LEED daylighting points when starting the construction drawing phase of your project. The AIA 2030 Commitment challenges us to produce all buildings with carbon-neutral footprints. The enhanced use of daylighting is essential to meet this Commitment. Adherence to this challenge begins at the start of the project during programming and schematic design.

In 2019, the American Institute of Architects published the [Architect's Guide to Building Performance](#) to demonstrate the benefits of building performance simulations as an integral part of design practices. Daylight harvesting is a major factor in contributing to a high-performance building.

This article discusses five key steps to maximizing the benefits of innovative daylighting during the design process. Using the checklist that corresponds to these key steps will help you avoid surprises during the construction document and permit application stages of your project.

Steps to success

Identify enhanced daylighting strategies

Every successful project requires a carefully defined program and corresponding responsive design. Owner, architect, engineer, and cost advisor must work collaboratively and agree on the project goals and building systems. Several reference documents are available to assist in setting these goals. AIA E204-2017 Sustainable Projects Exhibit provides a comprehensive list of definitions, duties of various team members, and establishment of a Certification Authority. Another important document for daylight strategy determination is the utilization of the U.S. Green Building Council's LEED V4.1 checklist. For example,

credits 8.1 and 8.2 are rewarded for maximizing exterior views and using automatic shading devices. Identification and prioritization of the pertinent daylighting techniques form the foundation of a skillful project.

Evaluate top lighting vs. side lighting strategies

Windows are a common and cost effective method for bringing daylight into spaces, but the penetration of daylight into interior spaces is limited by a window's height and the sun's position in the sky. Windows at east, west, and south orientations need to be shaded using standard window coverings or operable blinds or light sensors. Other options to produce energy-efficient side lighting include building overhangs and high-performance glass. Interior light shelves and sloped ceilings will augment reflected side light so it penetrates deep into interior spaces.

It is also important to evaluate top lighting options in determining building energy performance. Skylights or tubular daylighting devices can be used where the light penetration by windows or clerestories is not sufficient to meet daylighting criteria.

The selected strategies are then developed into a schematic building envelope model to be subjected to energy performance analysis.

Utilize software programs to predict daylight levels

Computer programs such as Sefaira and LightStanza interface with various BIM programs to analyze and predict daylight levels and energy usage in buildings. Evaluate the schematic building envelope model in comparison with ASHRAE Energy Standards using one of these programs. Fine tune the building orientation to achieve maximum daylight into the building. Visualize the lighting results by changing the envelope configuration, increasing the window height, installing shading devices, or adding skylights or tubular daylighting devices. Integrate the various strategies with artificial lighting requirements to reduce the amount of energy usage by maximizing daylight harvesting.

To achieve a net-zero energy building, the amount of glass in the daylighting units needs to be balanced against energy loss in these systems. U.S. Department of Energy COMcheck software provides another tool that regulates the extents of glazing areas.

Finally, as with every step, input from the cost advisor is crucial to determine the strategies that are incorporated into the project.

Select the correct glazing for the application

The type of glass is critical for energy conservation and maintaining a high level of insulation in the building envelope. The insulated glass' U-value, solar heat gain coefficient (SHGC), and light-to-solar-gain ratio (LSG) are important variables for the mechanical engineers in the design of the HVAC system. The appearance of the glass (color and reflectivity) is equally important to the architect and owner. For example, does the glazing in the building want to impart an inviting appearance, or depict a highly reflective façade? Other important enhanced strategies to consider are frits that create bird-friendly glass patterns and various types of resilient glass that respond to climatic conditions.

Coordinate with mechanical, electrical, and structural systems

Coordination with these disciplines begins at the programming stage of the project but heightens in subsequent design phases as the HVAC and lighting designs are developed. Almost all daylighting strategies now interface with artificial lighting. For example, as the sun produces greater light levels in the space, artificial lighting can be automatically dimmed through integrated computer controls. Solar shades operate similarly; light levels are controlled by light and HVAC sensors of the building's energy management system. These require careful coordination with the project's mechanical and electrical engineers.

Also, structural engineers need to understand the placement of skylights, clerestories, glass curtain walls, and windows so their design can support these features. Key structural elements such as X-bracing and uninterrupted shear walls can also limit the placement of daylighting components. Skylight weights and reactive forces must be relayed to the engineers. Building information modeling and regular collaborative meetings with these disciplines are important to the final execution of the chosen enhanced daylight strategies.

Conclusion

Enhanced daylighting strategies are required to harvest more daylight and improve the health and productivity of building occupants. The use of building performance modeling is very helpful for making informed decisions on daylighting techniques that form the building envelope. As we approach the era of carbon-neutral buildings, systematic discovery, evaluation, and integration of these techniques into your design is essential to a successful project.

About the contributor

Mark E. Trier, AIA, LEED AP, is former president of JRA Architects, a 35-person firm in Kentucky. His company has successfully designed many award-winning projects that feature innovative daylighting techniques. Also, one of his firm's collaborative projects was featured as a case study in [The Architects Guide to Building Performance](#) referenced in this document. This study validates the benefits of building simulations to maximizing the use of proper daylighting.

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This article corresponds to:

Architect's Handbook of Professional Practice, 15th edition Unit 1 - The Profession

Chapter 12 – Quality Management

Section 03 – Checklists

Quality Management Checklist - Five Key Steps to Enhancing Building Daylighting

Project Name: _____ Date: _____
 Architectural Firm: _____ Project Number: _____
 Prepared by: _____

Identify Enhanced Daylighting Strategies

	Comments
Execute AIA E 204 - 2017 Sustainable Projects Exhibit	
Sustainability Review Meeting with Owner, Architect, Engineer, and Cost Advisor	
Define project's sustainability goals	
If project is to be LEED certified, determine targeted level & daylighting credits	
Is project designed to be carbon neutral?	
- define insulation and energy performance criteria	
What are the applicable building and energy codes?	
Does project include:	
- solar/PV panels?	
- passive daylighting techniques?	
What socioeconomic benefits are desired from natural light?	
Enhanced health	
Improved attendance	
Increased productivity	
What interior spaces are required to have daylighting?	
Are windows to have a coating that makes them bird-friendly?	
Are daylighting systems to be designed to be resilient in the case of natural disasters (high winds, etc.)?	

Evaluate Top Lighting vs. Side Lighting Strategies

Define window characteristics — punched, continuous, curtainwall, or clerestory	
Determine window shading devices	
- overhangs and solar screens	
- interior light shelves and sloped ceilings	
- motorized blinds linked to building energy performance system	
- cost-to-benefit ratio	
Define skylight characteristics	
sloped, punched, polygonal	
provided with shading devices	
effect of UV light on occupants/materials below	
tolerance for skylight assembly movement	
effect on structural grid	
effect on HVAC loads	

cost-to-benefit ratio	
Establish tubular daylighting device (TDD) options	
Limited placement at interior spaces? Or do they provide a major contribution to offsetting artificial lighting requirements?	
integration extents of TDDs with BMS	
usage of advanced models that augment daylight levels	
cost-to-benefit ratio	

Utilize Software Programs to Predict Daylight Levels

Designate daylight modeling supervisor	
Determine daylighting software to be utilized	
Input BIM model into software	
Examine building orientation for most energy-efficient position	
Determine optimum overhang depth	
Review energy saving options of skylights and TDDs	
Run initial COMcheck to affirm decided daylighting areas	
Integrate artificial light design with harvested natural daylight	

Select the Correct Glazing for the Application

Determine glazing aesthetic, energy, climatic, and bird-friendly goals	
List all of the glazing locations	
Select glass type based on goal and locations	
Run COMcheck based on glass type and HVAC criteria	
Re-select glass type if building falls short of energy goals	
Verify cost implications of selected glass	
Review selections with Owner for approval	

Coordinate with Mechanical, Electrical, and Structural Systems

Coordinate glass selections with HVAC Engineer	
Coordinate lighting levels with motorized window blinds	
Coordinate lighting levels with horizontal louvers at skylights	
Coordinate lighting levels with louvers at TDDs	
Optimize PV generation with building orientation	
Designate PV power generation with electrical engineer	
Review structural implications of skylight and clerestory concepts	
Coordinate geometry of skylight with structural opening	
Determine if skylight framing system or building framing system takes into account outward thrust forces of skylight	
Select sloped glazing skylight system with structural framing support or aluminum sloped glazing skylight with integral aluminum support	
Check interference of X-bracing and shear walls with daylighting features	