INFORMATION SHEET
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Energy Design Assistance

ACHIEVING BUILDING ENERGY SAVINGS WITH DAYLIGHTING

People thrive in naturally lit environments. Studies have shown that in daylit buildings, students score better on tests, office workers are happier and more productive, and shoppers spend more money. In these spaces, the savvy designer will specify daylighting controls to dim and turn off the electric lights when they aren't needed. And, the bottom line can be a **significant reduction in electricity use and lighting energy costs**.

However other studies have shown that daylighting controls are often not saving as much energy as expected – or in some instances, not working at all. What is causing this? How can this be fixed in existing buildings, and how can it be prevented on future projects?

Successful daylight harvesting requires coordination during every phase of the project, from schematic design all the way through construction, occupancy, and especially continued maintenance. The following coordination "cheat sheet" targets the most common problems, and can be distributed to everyone involved on a project to ensure that the daylighting strategy is successful and sustainable. Assign a Daylighting Champion to refine this list for your specific project, ensure that everyone is aware of their roles, coordinate amongst team members, and verify that the tasks are completed. This "Steps to Daylighting Success" information sheet is not meant to be a resource for daylighting design; it is assumed that there is a daylighting expert on the team providing specific input to the design of the daylighting system.

FIVE STEPS TO DAYLIGHTING SUCCESS

1. *Define the Daylight*

   If a daylighting zone is sized incorrectly, the lights will rarely dim and potential energy savings will be lost.

2. *Design for Daylight*

   Daylighting strategy must consider the effects of furniture, partitions, self-shading, and shading from nearby buildings and landscape.

3. *Manage Glare*

   If there is discomfort due to glare, occupants will lower the blinds and disable the daylighting system.

4. *Controls Coordination*

   No energy savings can be realized without lighting controls. Daylighting sensors must be carefully specified, located, installed, and calibrated.

5. *Maintenance*

   Facility management and occupants are an integral part of the long term success of the daylighting system.

Following the 5 steps to success: Who needs to coordinate?	Responsible Team Members												
	Architect	Interior Designer	Energy Modeler	Daylighting Consultant	Electrical Engineer	General Contractor	Electrical Contractor	Ltg Controls Contractor	Commissioning Agent	Owner/ Owner's Rep.	Human Resources	Building Occupants	REFERENCES & LINKS
1. Define the daylight													
Daylight modeling. Hire a daylighting consultant early in design to coordinate with your daylighting champion. This analysis provides invaluable guidance to the design team, starting from massing and orientation, sizing openings, and evaluating shading.	✓		✓	✓						✓			1
Electric lighting. Use the daylighting analysis to coordinate the electric lighting layout. Be aware that any architectural and interior design changes will impact the daylighting system.	✓	✓		✓	✓								2
Don't over-generalize. Use caution when controlling many light fixtures or a large area from a single photocell. Even if the daylight levels may appear to be consistent, don't forget that occupant behavior (such as lowering blinds) and future interior layout changes can have a great effect on the uniformity of daylight levels across a space. Smaller/shallower daylighting control zoning has been found to have greater success (more frequent activation) and faster payback.			✓	✓	✓					✓			3
Design flexibility. For deep perimeter zones, layer multiple photocells and circuits to create deep daylighting areas. Carefully coordinate sensor layout and setpoints for each layer of control.			✓	✓	✓		✓	✓	✓				4
2. Design for daylight													
Coordinate interior layout, finishes, and ceiling elements with daylighting design. Partitions can significantly reduce daylight levels. Light finishes are a must to increase daylight inter-reflections and minimize contrast. Coordinate location and color of ceiling elements such as exposed structure and mechanical systems.	✓	✓		✓	✓					✓			5
Optimize windows for daylighting – size, location, visible transmittance, U-value, and solar heat gain. Minimize exposure on the east and west facades where daylight changes and glare is difficult to control.	✓		✓	✓									6
Exterior elements, including nearby buildings, landscaping, or self-shading elements can affect daylight levels. This may vary by orientation and building level. Coordinate with landscape designer to ensure that landscaping elements won't adversely shade daylighting elements.	✓		✓	✓						✓			
3. Manage glare													
Sunlight introduces heat and glare. Manage direct sunlight with architectural shading, both interior and exterior.	✓		✓	✓									7
Balance glazing with proper visual transmittance. "View" glazing (30" to 72") can be a much lower transmittance than "daylight" glazing (72" and higher). Glazing below desk height (30") does not contribute much to overall daylight levels, and increases HVAC loads. Minimize east/west glazing.	✓		✓	✓									8

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Finishes matter. Use light, non-glossy finishes to minimize contrast, which will reduce eyestrain and make spaces feel brighter.	✓	✓		✓						✓			
Space planning. Avoid placing people directly next to windows as they will be more susceptible to glare; instead use this area for pathways. Orient occupants such that they are sitting with the window to their side (not facing directly towards or away from window).	✓	✓		✓						✓	✓	✓	9
Raise the blinds. Educate occupants about the effects of blinds on the daylighting system – putting them back up when they are no longer needed. For open office spaces where perimeter windows are not "owned" by specific occupants, consider specifying automatic blinds with sunlight sensors.	✓				✓	✓	✓	✓	✓	✓	✓	✓	10
4. Controls coordination													
Controls narrative. Engineers should provide this to coordinate the execution of the daylighting system installation, programming, and calibration. Often there is crossover of responsibilities between contractors. Who is responsible for which components? When in construction does it occur? Designer's specifications need to be very clear so that installers and programmers can schedule time and budget the manpower.	✓				✓	✓	✓	✓					11
Setting requirements. The engineer's lighting controls specifications and drawings should include vital device calibration and setpoint requirements, including footcandle setpoints, sensitivity settings, aiming, exact locations and layout, and any other specific operational requirements.					✓		✓	✓	✓				12
Compatibility. Ensure that the photocell is compatible with the light fixtures (ballast type, dimming/ switching/ stepped), and if applicable, the building control system.					✓		✓	✓	✓	✓			13
Locate photocells appropriately and exactly. If sensors are in the wrong place, they will not operate correctly, and can be an annoyance to occupants. Sensor location must be coordinated with the daylit zone (not too far away or close to windows) and interior layout (not over a desk or someone's head), and should be precisely dimensioned for the installer. Manufacturer's representatives can assist with this placement, or designers can use SPOT (Sensor Placement Optimization Tool, free software).		✓		✓	✓			✓	✓	✓			14
Timing of calibration is key. Calibration of daylighting systems must occur AFTER finishes, partitions, and all furniture is in place. This scheduling must be planned and budgeted for by installers and programmers. This requirement should also be included in the engineer's specifications.	✓	✓			✓	✓	✓	✓	✓	✓			15
Commission the system. Be sure that a Commissioning agent includes the daylighting controls system in their scope.							✓	✓	✓	✓			16

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5. Maintenance													
Facility management. Make the facility management team an integral part of the daylighting design process to ensure the long-term system success.				✓	✓		✓	✓		✓			17
Operational manual. Sensor calibration settings should be included in the facility manager's operational manual so that the system can be maintained. Any future adjustments required by the facility manager should be noted in the manual so that these setting can be maintained.					✓				✓	✓			
Resources. If a daylighting system operates poorly, oftentimes occupants will simply disable it out of annoyance. To prevent this, the building systems manual should include local and/or online resources for the facility manager to access should there ever be operational issues or concerns.					✓		✓	✓	✓	✓			18
Education. Occupants may not understand the role that a daylighting system plays in saving energy. Empower occupants as part of the facility's sustainability efforts by educating them about the daylighting control system. Require that tenants include a section on the lighting controls and blind operation in the employee handbook. Encourage occupant feedback to improve system performance as well as to ensure that energy savings are sustainable.									✓	✓	✓	✓	19

REFERENCES & LINKS

- **Xcel Energy's Daylighting Building Case Studies: www.xcelenergy.com/businessnewconstruction**
- **Xcel Energy's Energy Design Assistance (EDA) Program with Daylight Modeling Offering: www.xcelenergy.com/businessnewconstruction (EDA link)**

[1] Architectural Lighting Magazine: http://www.archlighting.com/industry-news.asp?articleID=454515&sectionID=1326
[2] Lawrence Berkeley Laboratories: http://windows.lbl.gov/daylighting/designguide/section7.pdf
[3] Lighting Controls Association: http://lightingcontrolsassociation.org/sidelighting-photocontrols-field-study-lessons-learned/
[4] Northwest Energy Efficiency Alliance: http://www.h-m-g.com/Projects/Photocontrols/Final%20Report%20Sidelit%20Photocontrols%20including%20Errata%20031406.pdf
[5] New Buildings Institute: http://www.advancedbuildings.net/files/advancebuildings/Daylighting_Guide_for_Interiors.pdf
[6] Lawrence Berkeley Laboratories: http://windows.lbl.gov/software/cfsworkshop/Presentation/LBNL_Windows_glazing_facade_pubs_052009.pdf
[7] Whole Building Design Guide: http://www.wbdg.org/resources/suncontrol.php
[8] Lighting Design Lab: http://www.lightingdesignlab.com/articles/glazing/glazing.pdf
[9] Lawrence Berkeley Laboratories: http://windows.lbl.gov/daylighting/designguide/section3.pdf
[10] Lighting Research Center: http://www.lrc.rpi.edu/programs/daylighting/pdf/ShadeControlRpt.pdf
[11] Lighting Controls Association: http://lightingcontrolsassociation.org/why-do-daylight-harvesting-projects-succeed-or-fail/
[12] Lighting Research Center: http://www.lrc.rpi.edu/programs/NLPIP/tutorials/photosensors/index.asp
[13] Lighting Controls Association: http://lightingcontrolsassociation.org/photosensors-technology-and-major-trends/
[14] Sensor Placement Optimization Tool: http://www.archenergy.com/SPOT/
[15] International Energy Agency: http://www.iea-shc.org/publications/downloads/task31-Commissioning_Guide.pdf
[16] Lawrence Berkeley Laboratories: http://windows.lbl.gov/daylighting/designguide/section9.pdf
[17] Today's Facility Manager: http://www.todaysfacilitymanager.com/fm-resources/archived-webinars/daylighting.php
[18] Lighting Research Center: http://www.lrc.rpi.edu/programs/daylighting/daylightingresources.asp
[19] U.S. Department of Energy: http://apps1.eere.energy.gov/buildings/publications/pdfs/commercial_initiative/sustainable_guide_ch10.pdf

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