EVALUATING DAYLIGHTING IN DESIGN

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How do you quantify daylighting in a building design? Is it the length of time an office space can go without supplemental artificial light? Or is it how far light penetrates into the interior of a room? Or, is it a space's ability to feel bright even on cloudy days?

All of these factors and more come into play when it comes time to quantify daylighting. And like any design decision, daylighting isn't plotted and planned in a vacuum. It's affected by site, massing, orientation, and more.

That's what makes the daylighting analysis in the Custom Plus track of the Commercial New Construction (CNC) Program so invaluable to the design process. The CNC program is funded through the energy efficiency programs of Alliant Energy, Black Hills Energy, and MidAmerican Energy Company and is available to utility customers. Daylighting analysis is a way for design professionals to quantify many intangibles, to help owners, architects, and designers put numbers to paper and make rational decisions that have concrete impact on a building's operation.

IT'S COMPLICATED

What one person defines as daylighting differs from another person—which is why energy modeling and analysis is important. "The most fundamental misunderstanding is that if you have windows, you have daylighting," says David Eijadi with The Weidt Group, a CNC program administrator.

In fact, says Eijadi, daylighting has several possible technical definitions. It is, of course, mixed up with the idea of a view, but is also thought of in terms of its environmental impact and the impact on people. "It's meaningful to have metrics and criteria to evaluate daylighting," he says.

During the daylighting analysis of the Custom Plus track, daylighting is generally considered whether or not a building meets a threshold for a specific level of illumination for a specific period of time under a specific set of conditions. The analysis also evaluates shading strategies "To be successful, daylight must also be present without glare," says Eijadi.

But how much glare is acceptable? What level of daylighting is best? "The definition of good daylight is somewhat subjective, because not everyone's eyes have the same sensitivity," says Eijadi. "There are also regional and cultural and age differences. A lot of people have been discussing daylighting criteria for a long time. What the Custom Plus track daylighting analysis provides is reasonably mainstream and uses judgments that participants feel comfortable with."

LIGHTEN UP

As much as daylight's impact on the experience of quality in spaces may reflect a personal preference, it's impact on energy use is reflected in measurable ways that are not always obvious to designers and owners. "When many people look at the results of the daylighting analysis, it's the first real objective information they get," says Eijadi. "They may, from experience, have formed an opinion on what is good, qualitative placement of windows. The CNC program is not trying to influence that. It's presenting information about energy impact, illumination distribution, and sun penetration."

One of the daylighting criteria and goals of the Custom Plus track daylighting analysis is to show uniformity and deepness of daylight. Uniformity is particularly impactful: The study will reveal glaring patches of sunlight on the floor, or a dark ceiling, and that daylight can be balanced with energy efficiency. "The question we try to answer is at what point in design do you get the most daylight with minimal glare through most of the work hours for the space but not so much that you have a heating or cooling penalty," says Eijadi. "It's an energy-centric view of good daylighting."

And there is a strong, simple case to be made for more consideration of the environmental impact of daylighting: Light from the sun is pure energy, and using light as light is about the most energy-efficient thing you can do. Making light, which can be thought of as densely packed short wavelengths of energy, from loosely packed long wavelengths of heat energy, is—well, to be blunt —really energy intensive.

"The alternative is to generate power in a power plant, send power to wires, where there are energy losses, then send it into a light fixture, where in the most common cases it is 20 percent efficient," says Eijadi. "With daylight we have a highly organized, literally focused form of energy, and we should use it that way. Everything you do with daylighting is probably the single biggest thing you can do to reduce a building's carbon footprint."

PROJECT:

Cedar Rapids Design Engineers Office

The earlier the better was the mantra for engineer-owner Design Engineers PC: The earlier they could analyze the decisions they were making for their new building, the better it would be for them for minimizing their carbon footprint. "We as a firm are committed to sustainable design and energy efficiency," says Dwight Schumm with Design Engineers. "Very high energy savings was a real priority for us. To invest in our own building, made a lot of sense and it's in line with what we try to do all day every day."

That meant enrolling in the Custom Plus track of the CNC program. "We were interested to look at some of the energy impacts of our real early design decisions, particularly things like the building size, shape, and orientation," says Schumm.

The firm was particularly interested in the impact of the width of the building as it relates to daylighting. "One of the things that gets decided really early on is how a building will fit on the site," says Schumm. "Custom Plus gave us the opportunity to test some of those ideas. We got some really good feedback from the program on that."

Orientation obviously also impacts daylighting, and Schumm and his team analyzed choices regarding higher floor-to-floor height, as well as the impact of higher window heads and more daylight penetration. "You have to look at the energy benefit but make value judgments based on the added cost," says Schumm.

Ultimately the firm ended up on good middle ground, with 10-foot ceilings. "It's great to have an additional piece of information on energy impact," says Schumm. "Energy numbers are a piece of information, and you have to look at if it will pay back from an energy standpoint and how long that payback will be. It helps if you look at the information and consider it with the aesthetic and financial benefits, too."

One of the paybacks for Design Engineers has been the LEED® Gold certification, with exemplary performance points for energy efficiency. "It was one of the things we were able to achieve by being proactive and planning from the beginning," says Schumm. "We focused on energy, but not to the exclusion of other things, and pushed it to its limit. We're proud of that."

PROJECT:

Wellmark Downtown Headquarters

In just a few short years, LEED certification has become a bellwether of sorts as a mark of energy efficiency for new buildings—and LEED Platinum is the pinnacle of that process. LEED certification is never easy, but probably even more so for very large structures with multiple demands and budgetary constraints. But even so, when Wellmark Blue Cross and Blue Shield decided to build a new headquarters in downtown Des Moines, the company set themselves the demanding goal of achieving LEED Gold.

Wellmark knew that working together and sharing insights during the design process would be key—and that included energy modeling through the CNC program. "It is a collaboration between MidAmerican Energy Company and the owner/developer of new facilities," says Matthew R. Brown, AIA, Vice President, Property Management with Wellmark Blue Cross and Blue Shield. "The models provided as part of the program were at no cost to Wellmark and offered valuable insight for strategies that result not only in a rebate of a portion of first costs for specific system strategies, but also ways to reduce the ongoing costs to operate our building.

During design, Wellmark integrated a number of strategies as part of the building's plan, including a primary/secondary chilled water system; a total heat recovery system to gather at least 90 percent of the building exhaust air volume; carbon dioxide control of minimum outside air; carbon monoxide control of garage exhaust fans; variable speed drives on chilled water pumps, cooling tower fans, and modular chillers; raised floor with under-floor air ventilation; and energy efficient lighting and envelope designs.

Those systems resulted in a very real impact on the Wellmark bottom line—projected yearly operational savings of $395,297, or a reduction in energy usage by 33.8 percent—as well as a LEED Platinum rating. In addition, says Brown, the company continues to modify its operations to capture additional savings—lower supply air and return air temperatures, 24-hour operation of air handlers, different service hot water loads, for example. "We continuously measure our building's performance and have since updated the energy model to reflect actual building operating parameters," says Brown.

Brown, who had previous experience with the CNC program, continues to point to its advantages—for all building owners, big and small. "The Commercial New Construction program is a great program that … creates building performance models that give the owner and design team valuable insight into how design and equipment strategies will impact the performance of the new facility," he says. "The program has been an all-around positive experience for me and my teams."

PROJECT:

City of Council Bluffs Operations Facility

Think of those buildings that naturally lend themselves to lots of daylight: offices, creative spaces, residential lofts. But when it comes to hardworking facilities such as vehicle storage, natural light isn't the first thing that comes to mind.

Fortunately for the City of Council Bluffs, a new office/vehicle storage facility ended up with plenty of old-fashioned sunshine, as well as lots of other energy saving and economical strategies. "They were consolidating four departments and five divisions in the city public works departments, and wanted to make it as sustainable as possible," says Dean Fajen, HGM Associates, Inc., architect on the project.

The architects and owners got affirmation of both their goals and design concepts after energy modeling with the CNC program. Strategies included ground source heat pumps, radiant heat, and natural light, both in the vehicle/truck bays and the office areas, courtesy of light tubes. Other practical strategies included lighting occupancy sensors and precast wall panels and masonry panels that are heavily insulated.

Those choices have definitely made a difference for the city employees at the facility. "We hardly have to use the lights—only when employees come in at night for things like snow removal," says Pat Miller with the City of Council Bluffs. "Even on a cloudy day, it's really bright, plus the in-floor heating really provides a comfortable environment."

Sometimes there's a disconnect between how a building is expected to operate and how it actually operates. But for both architect and owner, the CNC program helped mesh those two. "It was good because after the program recommendations, we realized we were considering many of them, so it turned out the way we expected it to," says Fajen. "The utilities helped the city with incentives, and as a result of the process, the city has lower utility costs, too."