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JUNE 2010

Good, Better, BEST

Conference Sessions Focus on Designing Energy-Efficient Building Envelopes

by Ellen Rogers

The Department of Energy (DOE) has set a goal to achieving net-zero energy commercial buildings by 2025. With this in mind, building structures with greater and greater levels of energy performance and efficiencies has become top priority for many architects and specifiers. Luckily, glass and glazing systems, including windows and curtainwall systems, can help buildings meet these energy goals.

"We can reduce indoor lighting significantly. If you want to get to net-zero, one of the first things you need to do is stop turning the lights on during the day."

—James Benya, Benya Lighting Design

The second Building Envelope Science and Technology conference (BEST 2), which took place April 12-14 in Portland, Ore., focused on specific aspects of building systems performance, particularly energy efficiency, good indoor climate and long-term performance. The event was sponsored by the National Institute of Building Sciences, along with the Building Enclosure Technology and Environmental Council, National Building Enclosure Council, Portland Building Enclosure Council, American Institute of Architects, DOE, Oak Ridge National Laboratory and Construction Specifications Institute.

A number of sessions focused on curtainwall and windows.

"From an energy efficiency perspective, fenestration products are seen as the aesthetic component of the building whose popularity amongst designers and architects has come at a sacrifice to energy efficiency," said Stanley Yee with the Façade Group, who served as the chair of the conference's fenestration track. "BEST 2 demonstrated that the issue of energy conservation is more complex than simply comparing net U-values between opaque walls and glazing components, but rather only a piece of a larger puzzle: the built environment."

Curtainwall Design Challenges, Problems and Solutions

"Curtainwalls are essentially an exciting subject," said Karol Kazmierczak, senior building science architect with Morrison Hershfield Corp. in Miami, during his presentation, "but only with construction professionals familiar with them."

Kazmierczak reviewed fundamental classification and challenges associated with the design and construction of curtainwall and provided a "balanced, holistic approach" to their construction.

"Curtainwalls have been around for over a century; however, they still present a challenge for building designers, curtainwall manufacturers and installers," Kazmierczak explained. "Typical sources of confusion are structural tectonics, façade control functions and division of responsibility."

One of the challenges posed by curtainwalls, he explained, is the fact that there is no "rigid" classification system, given that they come in a variety of materials and forms. However, he pointed out that the name "curtainwall" has become associated "with a light, secondary rigid framing system filled or

Additional Information

The next Building Envelope Science and Technology (BEST) conference is scheduled to take place April 2-4, 2012 in Atlanta. Stanley Yee with the Façade Group, says he hopes the third event will provide an outlet for serious conversation about the energy efficiency contribution of building enclosure components—particularly when they are integrated with other building system.

"The focus should be on new and forward-looking applications and synergies. Regardless of the perceived level of success of these attempts, we can use BEST 3 as a discussion and learning forum. We simply need more than conversations; we need to act and we need to share our experiences in those attempts."

You can learn more about the BEST conference online at www.thebestconference.org.

Wagdy Anis, a partner with Wiss, Janey, Elstner Associates, stressed the importance of designing building envelopes with a proper understanding of how to prevent condensation.

covered with a lightweight cladding." This group can be classified by a number of characteristics: by place of assembly (stick systems, unitized, etc.); by function (fire-rated, acoustic, blast-resistant, etc.); by mullion materials (wood, steel, aluminum, composite, glass, etc.); by mullion type (tubular, truss, cable, structural glass, etc.); by glass type (reflective, low-iron, anti-reflective, etc.); as well as several others.

He also discussed three primary challenges of curtainwall: joinery, scope of responsibility and façade functions.

"Curtainwalls are famous for complicated joinery, movement from the exterior and movement from the curtainwall itself," he said, explaining that in the past joinery transferred the entire load to the building so there was not much differential movement.

"Now, the livelihood of deflection [is] accommodating of the building movement," he said, and added, "Architects tend to stretch the structural span as far as possible."

During the design phase there can also be confusion over scope of responsibility. Kazmierczak said there are often gaps in communication and misunderstood delegation of responsibilities on these projects.

The third area of confusion involves the façade function.

"Facades have never before been so complex. Their primary function is to provide shelter for the occupants; this has become somewhat forgotten," he said, explaining that sometimes the architectural community is more focused on the aesthetics than the function. He explained that the façade functions need to be considered in conjunction with each other because they overlap.

Shedding Some Light on Daylighting

Daylighting designs have seen increasing interest in recent years. Several presenters during the BEST 2 conference talked about different aspects of daylighting design.

Taking a look at the daylighting design process, Keith Yancey with Lam Partners in Cambridge, Mass., pointed out, "It's just that: a process; one that's sometimes not quite as linear as others, but a process, nonetheless."

Yancey's presentation covered some of the daylighting tools and techniques commonly used during the design process.

"It wasn't that long ago that sunlight and daylight were the primary sources of light in architecture," Yancey said. "[Light] was carefully introduced into the design." He added that the way the light was introduced provided more than just useful light for performing tasks; it also made for a comfortable place to be.

"Why are we providing light in the first place?" he asked. "The buildings don't need it. We need it as human beings."

Yancey explained that what differentiates daylight architecture from just another building with windows is that the daylight building is designed to manipulate space, reduce energy consumption, enhance visual and spatial

Dana Smith, executive director of the buildingSMART alliance, says that building information modeling soon will be used throughout the life cycle of a building.

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environments and provide useful, comfortable illumination.

In addition, he also talked about some of the tools and technologies available that can be used in the daylighting design process. For example, sun-path diagrams can be used to allow a client to see where the sun will be in the building over the course of a year. Other programs can allow the designer to show a client whether a light shelf or overhang would be a cost-effective selection.

Models and animation also have seen advancements.

"These can show the client the dynamic qualities of the space … as well as other issues, such as shading," said Yancey. "Physical models are helpful for qualitative decisions."

He added, "[The design] is not only about daylighting and how it comes in, but also how you control it," said Yancey.

In addition to a focus on the daylighting design process, another presentation covered net-zero requirements and daylighting/efficient lighting design. James Benya with Benya Lighting Design told his audience that the real issue is no longer designing for sustainability; it's now about net-zero designs.

"We need to change our sources of energy," Benya said. With daylighting, "many climate change issues could be stabilized, if not improved."

He continued, "Those involved with lighting and daylighting realize there's been a promise of lighting: the sun is there all day and it's free; we just have to learn to use it properly."

When designing a net-zero building, one thing to take into consideration is that the amount of electric light used must be reduced. Realizing how, where and how much is being used is also important.

To create these structures, he advised becoming a daylight designer.

"Learn to make it part of the design process. Learn to design for dynamic light levels because light levels vary," said Benya.

Benya explained there are a number of ways to bring daylight into the structure. These can include skylights, linear skylights, clerestories, tubular daylighting devices and sidelites.

Likewise, he pointed out that building integrated photovoltaics are being used.

Benya added, "We can reduce indoor lighting significantly. If you want to get to net-zero, one of the first things you need to do is stop turning the lights on during the day."

And in terms of LEED, he said, "Daylighting is probably one of the most powerful tools we can use."

BIM Growth on the Horizon

Dana K. "Deke" Smith, executive director of the buildingSMART alliance, part of the National Institute of Building Sciences, expects that building information modeling (BIM) soon will become the information heart of a facility, from inception forward. Smith discussed some ongoing efforts by the buildingSMART alliance with regard to BIM and the development of an industry BIM standard.

One point Smith covered was finding a way to use information throughout the life cycle of the building.

"Collect the data once and use it from inception onward," said Smith. "Many times building information is entered over and over again and that creates waste."

Smith explained that with BIM the building can be built electronically first, before it's built physically. Some of the benefits of doing so can include the reduced risk of litigation; a reduced risk of requests for information and change orders; and providing a way to solve problems ahead of time.

In talking about the efforts of the buildingSMART alliance, he said a key element of the group has been to get various groups and projects going around the country. One significant effort has been the development of a BIM standard.

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"We're coming up with an open standard that everyone can use," said Smith.

He continued, "BIM ultimately changes everything; it changes the mindset and gets the designer thinking about what the contractor needs."

Smith also gave an example of a building project that was a collaboration of the buildingSMART alliance and the Open Geospatial Consortium.

"We manipulated the exterior skin of the building and at the same time could see what the impact would be on the energy usage of the building," said Smith, who said they are next planning to expand the project test to include geospatial aspects, to review solar heat gain, natural ventilation and other related aspects.

Causes for Building Envelope Condensation

Building enclosures often are designed without a proper understanding of the performance of the assembly when subjected to exterior weather and interior boundary conditions. This can result in condensation. That was the message Wagdy Anis, a partner with the Boston office of Wiss, Janey, Elstner Associates Inc., presented at BEST 2. According to Anis there are six common ways that condensation can occur in a building and several relate specifically to glass and window systems. The six ways are air leakage, diffusion, convection, thermal bridges, fenestration and ground contact.

Anis said air leakage has been called the biggest cause of condensation in buildings. He explained that moisture condensation in interstitial cavities from exfiltrating air in northern climates or from infiltrating hot humid air in southern climates, can cause problems such as mold growth.

Convection, said Anis, is the rotation of air into an assembly and then out again from the other side. He explained that cold air is heavier than hot air and sinks, pulling in warm, humid air replacing it and depositing moisture on the cold surface; this is especially true in vertical or sloping assemblies. Insulating glass, for example, can transfer energy through condensation, convection and radiation.

Speaking of fenestration, Anis joked that it is poorly designed windows that keep him in business.

"I see horribly designed windows all the time, mostly sliders and double hungs, because the manufacturers do not know where to put the thermal break," he said. He explained that fenestration with a good thermal break that minimizes the amount of exterior metal exposed to the cold usually perform best and, from a condensation resistance perspective, may out-perform non-metal units.

Other common problems with the fenestration system can include having the warm side of a thermally broken window frame exposed to cold temperatures; weepholes communicating between the indoor and outdoor environments, resulting in air leakage of cold air into the window frame; and air leakage at the interface of the window frame to the opaque wall's air barrier causing cooling of the warm side of a thermally broken window.

In an effort to avoid condensation, regardless of the cause, Anis advised keeping enclosure component temperatures above the dew point of the air coming in contact with it. "Controlling air movement, vapor pressures and thermal bridges in building enclosure assemblies is critical to avoiding condensation in/on building enclosures," he said. ■

the author

Ellen Rogers is a contributing editor of USGlass magazine.