Gridlo

Glass Can be the Key to Exceeding High-Performance Building Expectations; But How?

by Ellen Rogers

New York City's skyline is one of the most iconic and recognized in the world. From the shimmering 1 World Trade to the newly completed towers at Hudson Yards to the soon-to-be-complete super-thin-super-tall tower located at 111 West 57th St., the city wouldn't be the same without glass. And now New York Mayor Bill de Blasio has suggested "banning" the use of glass that doesn't meet strict performance guidelines *(see sidebar on page 63)*. Is this another battle for the wall?

Armed with an arsenal of benefits, the architectural glass industry has successfully defended the use of high-performance glass in building façades for more than a decade: glass provides natural light; glass provides and improves occupant comfort and well-being; glass aids in reducing and controlling heating and cooling costs. Aesthetically speaking, architects like glass—and there are thousands and thousands of architects in New York City. Imagine if they could no longer design buildings with glass …

Constructing a high-performance, all-glass building that can exceed the baseline energy code is not unheard of. It's already been done. The Tower at PNC Plaza in Pittsburgh, which has more than 400,000 square feet of glass, is such an example. These projects take a carefully detailed and focused design. They require commitment from everyone involved, including the owner and developer. The options are there: double skin façades, triple glazing, and vacuum insulating glass, just to start.

The Spanish headquarters of the real estate company, Lubasa, at Castellón, incorporates the Pellini ScreenLine system of blinds inside the double-glazing unit, which are moved by magnetic controls.

Photos: Pellini SpA

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Photo: Jomar Bragança and Pellini SpA

The Tancredo Neves Administrative City, government headquarters of the Brazilian state of Minas Gerais, used Pellini's ScreenLine Venetian blinds integrated in double-glazing to maximize sun-screening of the windows and bring light comfortably into workspaces.

Adaptive façades, which are designed to respond to their own unique environmental conditions, are another possibility. While still a relatively new concept, adaptive façades are seeing increasing interest. These technologies involve tuning all components of the façade to control daylight and glare, temperature-driven heat flow and ventilation. The use of these systems can also generate significant performance improvements and added functionality compared to static building envelope systems.

"The downside is, it's a system that's complicated to design, it's more costly to spec and install and it's complex to operate," says Steve Selkowitz, an affiliate with the Lawrence Berkeley National Laboratory, Building Technology and Urban Systems Division. "Unfortunately, the architecture, engineering and construction industry hasn't done a particularly good job of making all of the pieces and parts work."

The 2012 Commercial Building Energy Consumption Survey (CBECS) published by the U.S. Energy Information Administration reports that electricity accounts for 60% of the energy consumed in commercial buildings. The survey also notes there's an estimated 5.6 million commercial buildings in the U.S., though many were built prior to 1980, before the high-performance glass technologies we have today, such as low-E glass and insulating glass units (IGUs), were commonly used.

"If building owners invest in high-performance façades they won't have to pay as much for the smaller heating/cooling systems that are required for comfort," says Selkowitz.

Today's commercial construction industry is challenged to find ways to reduce buildings' energy consumption—without sacrificing aesthetics. Adaptive façades, among today's other high-performance glass technologies, represent an opportunity that could provide the solution.

What is an Adaptive Façade?

Traditional buildings are designed as static structures, surrounded by an ever-changing environment. Adaptive façades are designed to respond to those conditions. Selkowitz says if the building design begins with the envi-

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Photos: Daniele Domenicali and Pellini

The glazed envelope of the Parallelo business center in Milan, Italy, was designed to optimize the energy required by using different concepts for the varying façades, including the ScreenLine blind system. The blinds can be rotated to ensure optimal protection from the sun, while also allowing exterior views.

ronment in mind, it's clear that a single set of parameters is not ideal.

"The logical outcome is that the façade needs to be able to adapt to its changing occupant needs and varying outdoor climatic conditions," he says, explaining he sees three drivers for the development of adaptive façades.

"The first is people. In the end, buildings are for people," he says. "Thermal and visual comfort, views, health and productivity, all are impacted one way or another by the façade. We want to have a façade that reliably provides the controls needed by people to provide this comfort."

This could be for example, having an automated means to manage the position of a solar shade, rather than relying on manual adjustment.

"Second, the building energy management piece is important. That involves minimizing annual energy use and peak heating/cooling loads. The largest load is usually driven by solar gain coming into windows. So our strategy is to invest more in the high performance façade and less in heating/cooling equipment, ideally for an overall cost savings," he says.

"And third is the increasing focus on the electrical grid and net zero energy buildings. First, you need to minimize energy use with an efficient façade. Then you can generate power at the building [i.e. building integrated photovoltaics], even in the glazing now, and offset those remaining needs. Buildings use more than 70% of all electricity, so they are an important part of the grid," he says. "The key is to intelligently use an adaptive façade to control the building's impact on the electrical grid. A smart façade can provide daylight to reduce electric lighting and can help you manage the HVAC system loads when the grid is overloaded. A smarter, adaptive façade that is 'grid responsive' can help in many ways in the future."

No Simple Task

But there are barriers to acceptance.

"The reaction to these integrated façade solutions is often that this is too complicated, it will never work, and it won't be installed and integrated properly at the jobsite … and that's too often correct because with the fragmented state of the industry today it's hard to do. But it doesn't need to be that way," says Selkowitz. "The technical understanding to make these solutions work reliably is there, but it's not yet to the point where it can be delivered on a routine basis on every project. It's not something any one company can pull off on its own. The façade industry needs to coordinate with the lighting and HVAC world, and within the fenestration industry across the key elements, including electrochromic companies, glass manufacturers, shading suppliers, curtainwall suppliers, etc. Some of those companies are working together more effectively on this challenge. It's happening, but it's a slow process and not delivering the results as rapidly as we need."

He gives low-E glass as an example of a successful large-scale change.

"This went from being a laboratory concept in the 1970s to now capturing 90% of the market," says Selkowitz. "In 20 years will we see that progress with adaptive façades? We need to re-think the whole design-build-operate process and how the supply chain interacts with all parties to make that kind of progress. I think it's an essential goal, but this won't evolve as rapidly."

What Are the Options?

Adaptive façades comprise a number of technologies. Some are common and readily available. Others are still emerging—at least in North America. Selkowitz addresses the options based on their

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Don't Call it a Ban

What New York City's Proposed Legislation Really Means

On Earth Day, New York City Mayor Bill de Blasio announced his plans for a Green New Deal that included legislation to "ban inefficient all-glass buildings." It sounds harsh—a city like New York without a glassy high-rise—but could this actually be a move in the right direction? *(See also page 6)*.

If the legislation passes, the city would allow all-glass façades in new construction only if they meet strict performance guidelines; this would also involve changing the city's energy codes. (At press time there were no details regarding the use of glass specifically.)

This doesn't mean an elimination of glassy construction, but it will require more effort on the part of the architectural design community to ensure the right glass products continue to be used. A change like this could, in fact, push the architecture and construction industry toward higher and higher building performance—while still using lots of glass.

European glass fabricator Interpane has been involved with a number of projects in the U.S., including many in New York. Yago Martinez, business development manager for North America, doesn't see the proposed Green New Deal as an attack on glass façades, but rather the way current energy codes allow them to be inefficient.

"Ever since I started working on U.S. projects I have been surprised at how low the performance requirements are, and how little effort is made to adopt technologies that not only make glass façades more efficient, but have also been on the market for many years and are well-known and proven in other countries," says Martinez. "Most of the glass we supply in Europe is triple-glazed, with high-performance coatings and Argon or Krypton filling; U-values of 0.18 btu/sqf*hr*F or lower are not hard to achieve.

"Glass is a great material for buildings … and it can also perform incredibly well when used right. Argon-filled triple glazed units should be the new standard, and more efforts should be put into enhancing even more façade systems like double-skin walls," he continues.

Organizations such as the American Architectural Manufacturers Association (AAMA) also support a push for more energy-efficient products and buildings, especially for existing buildings where energy efficiency upgrades would have a positive impact on the building's energy consumption and the comfort of occupants.

"Most new and existing products can be designed or retrofitted to meet even the strictest of current energy codes," says AAMA technical director Steven Saffell. "Existing technologies such as low-E glass, high-performance spacer systems, multi-pane insulating glass units and new emerging technologies can be employed to improve energy efficiency of not just the products, but also the entire building. Additionally, the positive impacts of windows, doors and skylights are immense. Fenestration connects us to our environment with views that improve attitudes, increase productivity, provide ventilation and more."

High-performance solutions include wide, complex, aluminum thermal breaks; double skins; multi-cavity insulating glass, high-performance warm-edge spacers and glass coatings; and dynamic shading or glazing.

"In the façade community, we know that highly glazed façades can already be designed to meet high energy performance levels. The technology is available, it just needs to be specified and building owners need to be willing to make the higher cost investment," says Helen Sanders, strategic business development at Technoform North America.

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energy management functions.

"The first is reducing heat loss/gain. That means a more highly insulated façade to make heat transfer as small as possible, because then the responsibility (and cost) of the HVAC system is less," he says. "We still want views, so that's going to be some form of highly insulating glass. I expect to see a move from today's standard low-E double glazing to something that is at least twice as insulating. That could be triple glazing, which is only 1% of the U.S. market today, or vacuum glazing, which is an emerging product. Moving in that direction will be an enormous improvement and will require window and curtainwall framing to keep pace."

Solar control/daylighting and glare are also significant concerns that can be addressed through the use of adaptive façade products.

"You can control solar gain and glare with dynamic glass or with more traditional interior and exterior shading. We are excited about smart glass—electrochromic and thermochromic, with a preference for electrochromic because you have more control," says Selkowitz, explaining that's because electrochromic glass is controlled actively at any time, by pressing a button, flipping a switch, or via sensor-based building control, while thermochromic tints passively based on temperature.

"So it [thermochromic] doesn't always do the right thing when you need it. In general, it's better to have active rather than passive control, but all these products have their niches, especially if the cost of the passive systems can be much lower without the wiring controls."

There are some other barriers to the acceptance of dynamic. For example, he says architects don't always like the color it switches to, it takes time to change tints and it's costly.

"Those companies are all working on this challenge with a major new financial investment, and there are several new companies after 30 years of R&D. That type of competition is great, and we will see better products and lower costs," he adds.

Other options have been available for many years and are much more common in Europe. These include automatic shading and blinds incorporated into the building management system.

"Shading can be much more responsive and adaptive as well, and there are plenty of studies (simulations and measured data) that show if shades are left to be operated manually, people don't use them very effectively. So we want to motorize and automate them to improve their effectiveness," says Selkowitz. "Those costs are also coming down and the performance is getting better as more companies get involved, new research is completed, new ratings from the Attachment Energy Rating Council become available and some of the experiences from the

The southwest-facing façade of the Snow Hill station in downtown Birmingham, U.K., is fitted with motor-controlled blinds inserted inside the double glazed unit.

European markets filter into the U.S."

There's a variety of options for exterior, interior and even between the glass applications. Examples include roller shades, blinds that change as the sun changes, fins, etc.

Intigral Inc., based in Twinsburg, Ohio, is the only authorized U.S. manufacturer of ScreenLine, a blinds-between-the-glass system from the Italian company Pellini. According to marketing manager Jamie Runevitch, they are increasingly focusing on reaching the architectural market, as these products provide many benefits for commercial buildings.

"Automated blinds between the glass are becoming popular with the push for sustainable design. Architects are specifying between-the-glass options because they are able to see the long-term financial benefits and overall environmental improvements of the system," says Runevitch. "Low maintenance, virtually no cleaning and less-frequent replacement make this an attractive addition to building owners. Those reasons, paired with creating a cleaner, more controlled environment make blinds between the

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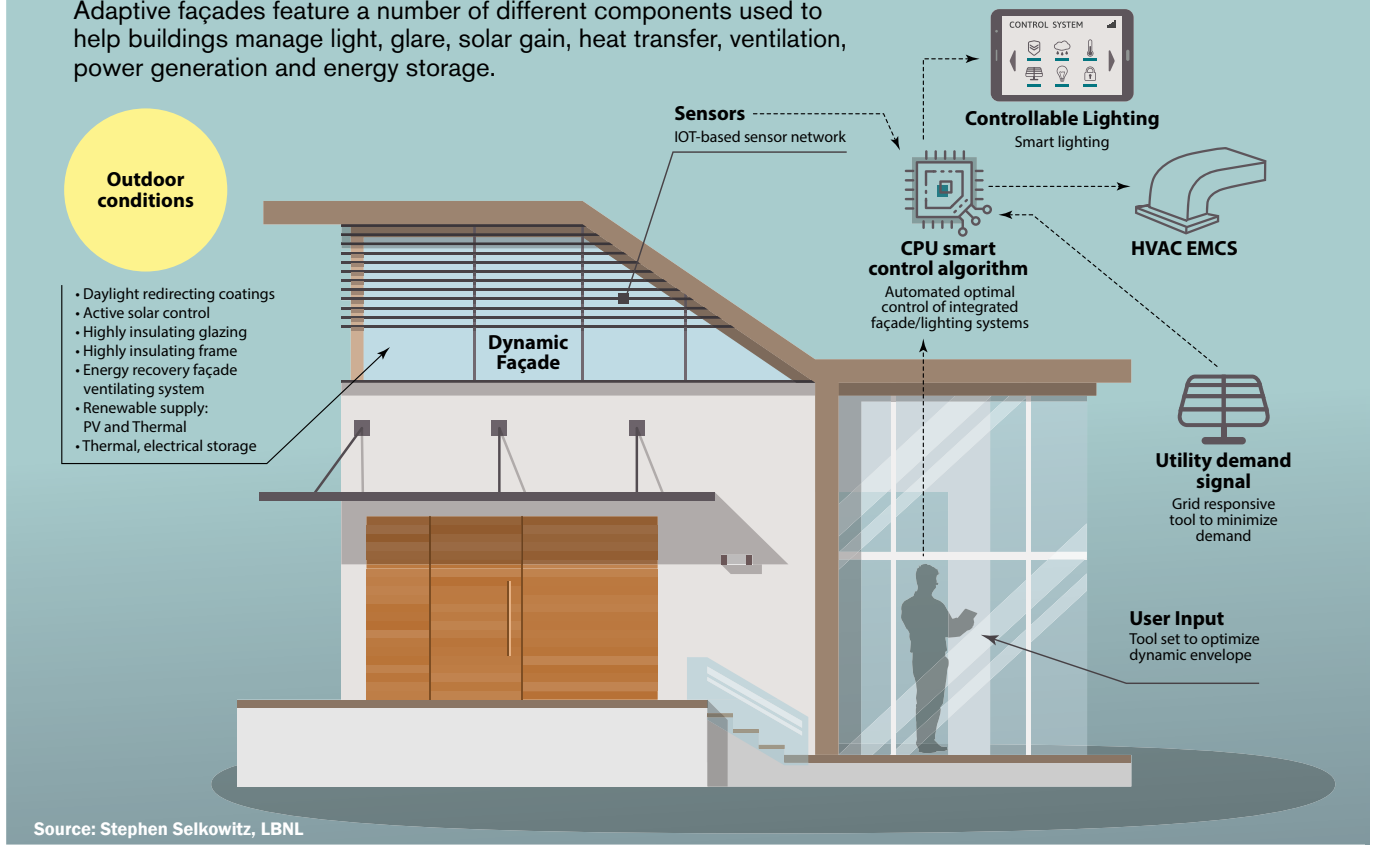
Adaptive Façades Are Intrinsically "Integrated Systems"

Adaptive façades feature a number of different components used to help buildings manage light, glare, solar gain, heat transfer, ventilation, power generation and energy storage.



Source: Stephen Selkowitz, LBNL

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glass a strategic choice for high-performance buildings."

Ventilation is also important. This can come from operable windows, which aren't common in U.S. commercial buildings, though frequently used in Europe. Double skin façades (DSF), which are also more common internationally, can also ensure proper ventilation.

Permasteelisa for example, has developed a moisture-free sustainable closed cavity façade called the mfree-SCCF. This is a DSF where the cavity between the inner and the outer skin is completely sealed and solar shading is integrated within the cavity. As far as the system's energy performance, the U-values are similar to those of a triple-glazed unit with extremely better SHGC performance *(see related article in the February 2017 **USG**lass, page 38)*.

Enclos is another façade contractor that's been involved with a number of DSF projects. According to Jeffrey Vaglio, vice president of the company's Advanced Technology Studio, all DSFs should have blinds or sunshades within the cavity.

"One of the greatest advantages of a DSF is using the outer skin to protect solar control devices (blinds/sunshades) that otherwise would have to be exposed to external winds on a single-skin façade," he says. "A DSF has the potential to improve thermal insulation with an air cavity, improve acoustics, and protect sunshades in the air cavity that mitigate solar heat gain when desired."

The Challenge

The U.S construction market, and glass industry in particular, is standing before a big opportunity. High-performance glazing products, when used as part of a properly designed and built façade can not only enhance, but improve the building's overall energy performance.

But it will take education, focus and commitment, as well as an understanding by the owners and developers that this isn't a cheap and easy quick fix.

But just as the CBECS noted, these buildings are built to last. From its first survey in 1979 to the most recent in 2012, the number of commercial buildings in the United States increased from 3.8 million to 5.6 million—many are still in existence.

"Given the challenge of carbon emissions and climate change, when you're putting up a building that will be there for 50-plus years … let's invest what we can in a high-performance façade as part of the solution to that challenge," says Selkowitz. "It will cost more and will be more complex, but we should do it for [the future built environment]. We are seeing growing interest in this now and I expect to see more in the long run." ■

the author

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