Pushing the Envelope

Colorado Architects and Engineers Expand the Realm of Possibilities in Building Skin Design

by Sarah Goldblatt, AIA

The convergence of science and technology is fueling an explosion of new building materials and designs that offer striking visual effects while providing innovative strategies related to energy conservation and material optimization. It is hard not to notice that much of the application of these materials is occurring outside of the United States or is limited to the palettes of high-profile architects and their clients. There are, however, architects and engineers in Colorado who are engaged in the research, development and application of both new materials and the transformation of conventional ones.

Architect Colorado had a conversation with a few of these architects and engineers, including: Chris O'Hara, AIA Colorado professional affiliate, P.E., principal, Studio NYL; Gerardo Salinas, AIA, LEED AP, partner, Rojkind Arquitectos; Fred Andreas, AIA, LEED AP BD+C, principal, Unit Design Studio; and Ben de Rubertis, AIA, LEED AP BD+C, principal, NAC|Architecture.

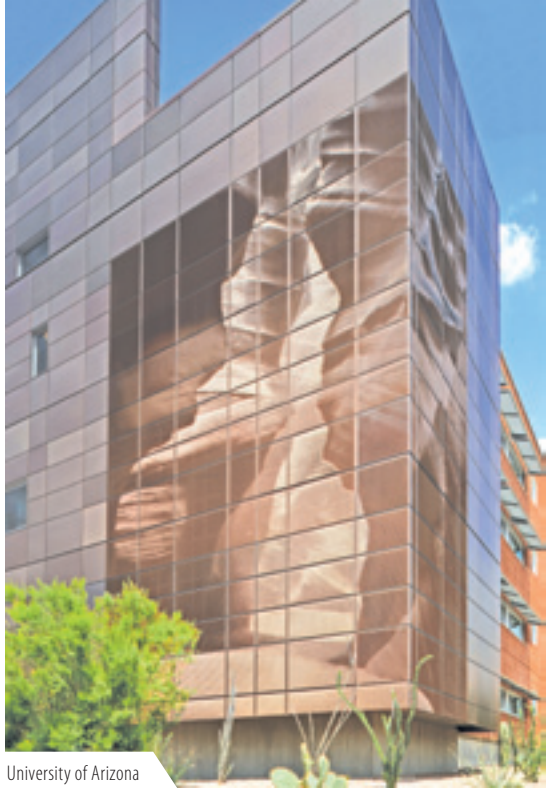

Photo Credit: Dri-Design with Ombrae™

University of Arizona

Chris O'Hara, P.E., Studio NYL

In 2004, Chris O'Hara and Julian Lineham founded Studio NYL Structural Engineers in Boulder, Colo., with an emphasis on the holistic design of building structures, which is supplemented with a specialization in façade design. Notable façade projects include the Lindsey-Flanigan Courthouse with klipp *Architecture Planning Interiors; the Ralph Carr Justice Center with Fentress Architects; and projects around the world with Rojkind Arquitectos, Bohlin Cywinski Jackson, Neil Denari and Renzo Piano Building Workshop.*

What is happening worldwide with building skin innovation?

Lots. Let's start with concrete. Photocatalytic concrete is basically the smog-buster that Richard Meier used on the Jubilee Church in Rome. It creates a chemical reaction with sunlight, dirt and pollutants and breaks them down into water and gas. As a result, it takes the smog and dirt out of the air while keeping the building façade perfectly clean throughout its life. It's available in the States now, mostly on the coasts.

The other concrete product that is also just reaching the United States is a product called Ductal®, made by Lafarge. For a while in the U.S., it couldn't be classified as concrete, because it can be cast so thin. It's like a fiber-mesh concrete, except the fibers are steel, so it's highly corrosive-resistant and roughly three times as strong as conventional concrete and doesn't require reinforcement. It's generally used as a precast element.

A good example of this application is the RATP Bus Centre designed by ECDM Architects in France.

Ductal® is phenomenally, outrageously rigid and thin. It's like putting up any other precast system, except you're saving weight, which makes your beams smaller, columns smaller, foundations smaller, and you aren't losing all that floor area with a thick skin element. It's here, just not in Colorado yet. Eventually, standard precast skins will go away, and this will take over. There is also a radiant skin system that was recently featured in *Architectural Record* called Liquid Wall™, which uses Ductal® in conjunction with a radiant heating/cooling system.

How about innovation in glass?

The real jump in glazing technology is in performance rather than structure. The technology has changed with light transmittance, reflectivity and energy performance — whether it's through insulated units or different coatings. Structurally, the big change can be seen in the Apple Stores. Many of those details and concepts are patented, but all that testing and technology is now available. We can take this data and extrapolate from it and do more inventive things that we couldn't do previously, primarily because no one could afford to do the testing that Apple does.

Describe the metal skin you are working on with Rojkind Architectos in Mexico City.

In the project we are currently doing with Rojkind Architectos in Mexico City, we developed what I call a translation structure with idealized bearing locations for the exterior skin system. The exterior skin uses elements of Zahner's (metal skin fabricator) patented system, which support aluminum sheathing and stainless steel skin. By approaching the project this way, we were able to use more cost-effective local labor for the fabrication of the translation structure and erection of the skin's system.

Liverpool Insurgentes Department Store

Rendering: Rojkind Arquitectos

Is this groundbreaking for Mexico?

Yes. This is taking the form and the technology to a level that they previously didn't have the ability to do.

What about ETFE?

NASA invented ETFE. It's a thermoplastic version of Teflon®, so it's self-cleaning and can be transparent. It's one-one-hundredth the weight of glass. Cost and familiarity are holding back the product. It got its start with Grimshaw's Eden Project in Cornwall, England. The air inside the dome weighs more than the dome … that is how light the structure is. The same product was used on the Water Cube in Beijing.

A lot of these materials have high price tags. What's happening in terms of low-cost building skins?

We did a concept for a house that Libeskind designed. Basically, it is a form like the Denver Art Museum. It was a simple steel frame with SIPS clad on it. The parts and pieces that go together are very simple, normal part and pieces, arranged in a very complicated way.

We have also been going to the complete other end of the spectrum with rammed-earth technology and compressed-earth block. We have developed an insulated rammed-earth system that is appropriate to Colorado's climate.

Where do you think the future is going with building skins?

Fiber-reinforced polymers. Carbon fiber is light, five to six times as strong as steel — it's fantastic stuff, very elastic. Good for reinforcing and seismic upgrading. They make this like a SIP panel now. The Air Force developed the

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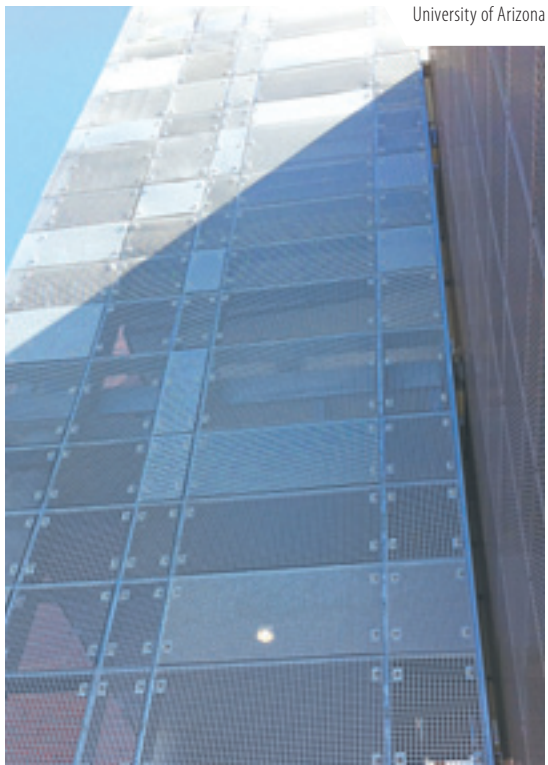

Photo Credit: Ben de Rubertis

carbon-fiber panel technology to use for temporary runways. They can also make similar system with polymers that are more similar to fiberglass and, therefore, less expensive than carbon. What makes it even more accessible is that it is made right here in Boulder.

What excites you about the future of architectural building skins?
I think ETFE is exciting. But the story hasn't been written on the carbon-fiber products. I am also interested in more low-tech systems. As much as we do the wild and crazy, we are starting a program with the Rob Pyatt and the University of Colorado called NASHI [Native American Sustainable Housing Initiative], and it is with the Lakota Indians, where we are designing sustainable houses — not just sustainable environmentally; I mean sustainable economically as well.

Gerardo Salinas, AIA, LEED AP, Partner, Rojkind Arquitectos

Gerardo Salinas spent 15 years working in the United States, including six for Anderson Mason Dale Architects in Colorado. In 2008, he was named Young Architect of the Year by The American Institute of Architects Denver Chapter. In 2010, he returned to his native Mexico to join Rojkind Arquitectos as partner.

How is Rojkind Arquitectos' commitment to building skin innovation impacting the fabric of Mexico City and design worldwide?
We tend to see the potential of our buildings in terms of improving the quality of the public space that can be generated by them. The building skin helps define the quality of these spaces or the way people react to them. In a country like ours, our buildings tend to have a bigger impact on the fabric of the city due to the lack of good urban planning.

How does the manipulation of the building skin on your projects respond to the demands of the site, including energy consumption, cultural context, identity, etc.?
Each project is heavily influenced by its unique relationship to its context. The skin becomes an integral part of the public realm and needs to address this condition and not only be an envelope for the building.

How do you approach the research and analysis of a new building skin that you are using?
There is a lot of exploration that is done at the forefront of each project with materials, including performance, costs and durability. Our focus then turns into how to take all of the digital explorations and turn them into a buildable solution using local materials and our available local fabricators.

Would you say that you are working more with new materials and technologies or standard materials used in new ways?
More than using new materials, it is the way these materials are assembled and finished using the local means available to us. We are not tied to a material palette and we are willing to explore what is best for each project.

Why, in your opinion, is there more innovation in architectural building skins in Mexico, Asia and Europe than in the United States?
Perhaps because we don't have such a litigious system as in the USA. We also are fortunate enough to have one of the best climates and very good local labor that allows us to experiment more without the added cost.

Fred Andreas, AIA, LEED AP BD+C, Principal, Unit Design Studio

Fred Andreas is the principal architect of Unit Design Studio, assistant adjunct professor of architecture at the College of Architecture at the University of Colorado Denver and assistant research professor at the College of Engineering and Applied Science at the University of Colorado Boulder. Through practice, teaching and research, he has been committed to the development of innovative sustainable and green design approaches. He is currently part of a National Science Foundation-funded project team researching the application of biomimetic design principles to develop an intelligent and integrated Living Building Wall system.

Describe the objectives and potential of your National Science Foundation (NSF) research on the Living Building Wall System.
The objective of the NSF Living Wall System research is to develop new cutting-edge technology for actual Zero Net Energy Buildings (ZNEB). Current LEED-based systems rely on typical, though highly efficient, HVAC

Liverpool Interlomas Department Store

Photo Credit: Rojkind Arquitectos

and lighting technologies. Our objective is to develop a comprehensive, completely passive commercial prototype with an energy reduction of between 80 [percent] and 90 percent over ASHRAE standards. This should revolutionize the conditioning of buildings with an entire paradigm shift in building design and technology.

How does the application of biomimetic design principles guide the advancement toward net-zero buildings?
The research follows the biomimic example of biologic skin that auto-regulates heating, cooling, moisture and vapor in any organism. Developing an effective auto-regulating hydrogel skin for buildings will revolutionize future building designs, allowing building's façades to react to environmental heating, cooling and lighting conditions on the exterior. Following biomimic examples, the Living Wall System integrated within a building's exterior skin and the centralized building automated systems (BAS) will allow building skins into collect, concentrate, store and transport energy from areas of high energy to areas of low energy.

How will buildings look and perform that employ the Living Building Wall System?
Buildings will largely look like modern commercial buildings do today, with curtainwall systems on the outboard side. The technology and systems will allow for modern designs with an expansive pallet of exterior skins showcasing integrated high-tech technologies. The exterior design concepts remain the same, placing a skin on the exterior of a building, except now the skin will react to the environmental energy and climate to capture and utilize that energy.

Benjamin de Rubertis, AIA, LEED AP BD+C, Principal, NAC|Architecture

Benjamin de Rubertis is a principal with NAC|Architecture in its Denver office. His award-winning work with the firm includes projects with a strong urban component and high-level sustainable design. For his recent resident hall projects at the University of Arizona, he explored old-world methods for climate control and translated them into a dynamic building skin that anchors the campus.

Describe your strategies for the building skin design for the University of Arizona residence halls.
In Tucson, thermal comfort is very difficult to achieve for spaces with any significant exposure to sunlight. We looked at technologies employed at similar latitudes: Marrakesh, Isfahan and Jaipur. These were old technologies — *jalis* windows, masonry *brise-soleil* and traditional sun awnings.

Photo Credit: Guido Torres

Tori Tori Restaurant

How does your design relate to the demands of the site and context?
At Likins Hall, we applied a brick pattern already in use throughout the neighborhood. At Arbol de la Vida, we have an old slab-style dormitory to one side and one of the four main campus corners on the other. At that corner, we worked with a company called Dri-Design that has developed a novel technology that allowed us to create a brise-soleil to protect a large window from solar gain and also reflect light off its surface to project the image of a slot canyon.

Describe your application of the Dri-Design with Ombrae™ imaging technology.
Each metal panel is fabricated with a unique image — accomplished by way of a proprietary technology. The metal panels perform as a rain screen — joints in the cladding are not sealed; rather, they allow the passage of air, vapor and moisture. The outside surface of the product is perforated in pixel fashion, such that the light reflects differently off of each individual pixel. The result is an almost holographic image. We suspended these panels in front of a large glass area so that the panels serve multiple functions — as a building cladding to control the elements, for shading to mitigate heat and as a work of art to establish a signature campus corner.

How did you translate old-world approaches to climate control into a modern building skin for the residence halls?
Masonry brise-soleil is a very common feature of older buildings in the Middle East and India. We did not do much to translate this technology; rather, we found a way to create a masonry brise-soleil using modern building codes. The Ombrae™ product is a true translation of older technology. At the Palace of the Winds in Jaipur, a perforated façade was created by craft traditions, whereas our metal slot canyon is part craft but also dependent on computer technology for creating the image. ●