Mind and Matter

By turning materials research into a sideline business, one firm is reinventing its practice.

BY RAUL A. BARRANECE

> PRACTICE > Architects are no strangers to working beyond the confines of traditional practice. Designers from Mies to Michael Graves have tried their hand at shaping everything from "the spoon to the city." But these architects, no matter how successful at cutlery design or urban planning, have yet to move beyond a fixed model for creating products—whether buildings or teapots or city plans—and selling the professional services that go with them. And few, if any, have attempted to work with industry to relashion the very materials with which they and other architects build.

Boston architects Sheila Kennedy and Franco Violich are poised to break that impasse, and to redefine the way clients view an architect's skills. In their firm, Kennedy + Violich Architecture (KVA), the pair have been exploring inventive and unorthodox applications of materials for years, whether developing solutions for specific projects, teaching investigative design studios sponsored by manufacturers, or piggybacking architecture onto more pragmatic infrastructure projects. The partners share a longtime fascination with expanding applications for existing materials—what Kennedy calls "material misuse"—and they have pursued the subject in essays, lectures, and design studios at Harvard and SCI-Arc. Earlier this year, the two decided to make their interest into a new business by launching MATx (an abbreviation for "materials"), a materials-research-and-development operation within their existing studio.

MATx was born through a slip of the tongue. At an academic conference last year, Kennedy was lecturing about KVA's investigations into materials. Suddenly—much to her partner's surprise—she told the audience that the firm had launched a research division. "I suddenly heard myself saying it, and it clicked with what we had been thinking and doing in our studio," recalls Kennedy.

KVA has since discovered that launching a new business arm can be a matter of simply putting a brand name on a body of knowledge. "MATx is an affiliated business within KVA, though we prefer to call it a research unit," Kennedy explains. For the moment, operat-
ments accustomed to working directly with architects.

"Manufacturers usually see architects in traditional roles, not as people who have the training and imagination to invent new applications for technologies in architecture," says Kennedy. The MATx entity helps counter that shortsightedness.

In practice, the boundaries between the two businesses are deliberately blurry, Kennedy reports. Nearly all of KVA's 14 employees have worked on MATx research projects—an efficient and profitable use of resources. The mechanics of billing for MATx work hasn't yet been standardized. Sometimes Kennedy and Violich separate billable hours between MATx and KVA projects; sometimes they don't. The accounting issue could become even murkier, as Kennedy and Violich are examining ways of adding material-development phases to both schematic design and also to the end of design development. Weaving material R&D services into architectural contracts is also a way to squeeze materials research into a commission, without undertaking an entirely new project and scaring off the client.

KVA's architectural projects are often the source of innovative material studies and applications carried out under the MATx name. For instance, in their 1999 design of a Massachusetts house addition, KVA developed a ramping, 3-inch-deep structural plywood floor that splits into a floor and work desk. The desk becomes the basis of a MATx project, dubbed the EL (or Electro-Luminescent) Desk. In order to do away with messy cabling and wiring, KVA embedded ultra-thin polymer films into the plywood work surface—allowing the wood to carry both electricity and data. The electroluminescent film between the wood and the veneer generates light, and handheld PDAs can be plugged into discrete data ports embedded within the desk. (A new prototype of the EL Desk is on view at the Cooper-Hewitt Museum in New York City through mid-September.)

In other cases, Kennedy and Violich look for suitable applications for new MATx-generated materials in their architectural commissions. MATx developed a light-emitting "give-back curtain" prototype for the Opto-Semiconductors division of lighting manufacturer Osram. By dyeing the synthetic and cotton fabric of the curtain with phosphors that absorb low-spectrum waves from artificial and natural light, the curtain releases the waves as visible light; a larger, more sophisticated version of the technology used in glow-in-the-dark wristwatches. The curtain then found a perfect application in the Boston offices of German street-furniture manufacturer Wall International. KVA used the luminous curtain to form mutable enclosures for small meeting spaces within the lobby interior.

Whereas an architectural practice tends to afford only a one-time payoff, materials research conti-
For its Boston Theater District project (right), KVA created a system of glowing markers to orient visitors to the streetscape. The markers, like this luminous manhole cover (left), are now standalone objects, ready for production.

The architects also earmark certain projects for MATx when looking for solutions for their building commissions. If they haven’t already built a body of knowledge on a particular material, KVA will turn to MATx and begin a new research project. In designing a renovation for the Art Institute of Chicago, KVA was looking for new ways to integrate donor’s names into the walls of exhibition areas, auditoriums, and lobbies—a handsome alternative to engraved plaques or slide-in nameplates. From MATx came the idea of walls made of inexpensive “junk wood” (scraps of glue-laminated beams) imbedded with solid-state active-matrix displays (more commonly seen in handheld PDAs and cell phones). The displays can show text or even streaming video.

Often, manufacturers call on MATx’s services to work on a product prototype. But industrial clients also pay them for problem-solving skills: conceptual brainstorming about a material, or

Water changes color. From crystal clear. To earthy browns. To brilliant greens.

Water constantly remeets itself.

finding potential architectural or landscape applications for an existing product. Companies have called on MATx to work with them on products they are looking to launch three or five years down the line, products as vague as "large bendable surfaces" or as specific as "smart windows." This intellectual-property work is where the MATx business model makes good sense: By offering itself as a research lab, the firm can tap its existing human resources to sell a valuable service—knowledge and expertise—hopefully at a healthy profit.

"We have to be very careful not to propose competing ideas to different manufacturers; each has to get its own concept," explains Violich. For certain projects, employees and outside collaborators must sign confidentiality or nondisclosure agreements. "It can be very James Bond," he says. If MATx’s scope of work includes the development of an actual product, they negotiate royalty agreements with the manufacturer.

Naturally, the process of developing new materials involves creating mock-ups of the products. In the absence of a vast R&D facility, most of those mock-ups and prototypes are built right in the KWA/MATx studio. For the sake of confidentiality, Kennedy and Violich keep those individual projects out of view in separate workrooms down the hall from the main studio, often at a client’s request. If possible, the final products are also manufactured in the studio. For instance, Indian-born, RISD-trained weaver Sheetal Khanna set up a loom in the studio and spent two weeks weaving the "give-back curtain" for the Wall International project. The yarn from which the curtain was woven was also impregnated with phosphors in the studio. If a project is too large to be produced in-house or requires, say, large computer-numerically controlled milling or plastic-forming equipment, it gets outsourced to trusted partners.

Kennedy and Violich’s strategy makes good business sense for their firm. But it is also important as a new benchmark in interdisciplinary collaboration among designers, manufacturers, and even government. The work goes a long way toward proving how research can inform architecture, and vice versa, like a feedback loop. And the DOE’s interest in the give-back curtain demonstrates how architectural innovations can have a broad interest and applicability beyond architecture and interiors—as a renewable, recyclable source of light, for instance. In that sense, KWA’s endeavor really isn’t an expansion of the architect’s traditional role, but a more accurate representation of the architect’s valuable skills.


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ARCHITECTURE HAS EVOLVED, JUDGING FROM THE
WINNERS OF OUR SECOND ANNUAL R+D AWARDS. WITNESS A FAÇADE
THAT BREATHE(S, A RECYCLING NETWORK BASED ON THE HUMAN INTESTINAL TRACT,
an exterior lighting system inspired by photosynthesis, and other such wonders. If industry drove the
architectural technology of the late 19th and 20th centuries, biomimetics seems the order of this day and age.

The jurors began the selection process with a discussion of what the criteria should be. They decided that the ideal entry should offer both a compelling hypothesis and research that led to an equally compelling answer. Sounds simple, and suitably scientific. But so many of the entries asked such provocative questions, and provided such provocative answers, that, in the fever of discussion, some of the jury members nearly missed their flights home. At the end of the day, five entries emerged as award-winners and four projects as citation-winners. All nine demonstrate that architectural technology is alive and well—and evolving in remarkable ways.
JURY

Chris Genik A co-founder of Daly Genik Architects in Santa Monica, Calif., Genik has taught at institutions including the Art Center College of Design and the Southern California Institute of Architecture, where he is undergraduate program director.

Blaine Brownell A visiting professor in sustainable design at the University of Michigan, Brownell is also the founder of Transstudio, a firm devoted to materials research and awareness. He is the author of *Transmaterial* and *Transmaterial 2* (Princeton Architectural Press).

Andres Leopik Curator of contemporary architecture at New York’s Museum of Modern Art, Leopik has written and edited several books, including *Skyscrapers* (Prestel) and a monograph of Berlin-based Barkow Leibinger Architects (Hajie Curtz Verlag).
DRAPE WALL / CLOAK WALL

Two discrete wall systems based on the same concept of modularity, Drape Wall and Cloak Wall both provide alternatives to stick construction for single-family homes.

Drape Wall features a system of vacuum-formed plastic bricks that snap together on an aluminum frame to form a building’s exterior shell. Some bricks are opaque and others are perforated to serve as windows and to allow ventilation. On the interior, the exposed aluminum frame is covered with a quilt or drape that serves as insulation. The quilt incorporates a layer of waterproofing and a layer of insulation that also manages acoustics. Flaps can be opened and closed to expose the perforated bricks, allowing natural light and air to enter the space.

A newer exterior wall system, Cloak Wall, expands on the principles of Drape Wall. Instead of using framing for support, the bricks of Cloak Wall are held in place by compression forces from a system of tightened wires. When a structure is built using Cloak Wall, bricks can be set in place to permit larger or smaller window openings depending on the climate. Once the position is set, bricks are clamped to the foundation by a system of tension cables. The exterior is painted with automotive paint that shifts hue depending on the angle of the sun, regulating heat absorption and therefore interior temperature. In Cloak Wall, the waterproofing barrier is a separate layer of ETFE plastic that is installed between the bricks and the quilt. The quilt itself is expanded to integrate lighting fixtures and storage pockets.

The jury appreciated the comprehensiveness of the research, and the original approach of designers Marc Swackhamer and Blair Satterfield of HouMinn Practice. "I found it very fascinating," Andres Lepik said. "I like this idea of redefining a wall system—not just make it better, but rethink it completely." Blaine Brownell praised the integration of interior systems into the quilt. "It would be interesting to see in future iterations how it plays out with further integration of these layers," he said. "It seems fairly resource-intensive still, but I like the tactility."

PROJECT: Drape Wall/Cloak Wall
ARCHITECT: HouMinn Practice, Houston and Minneapolis—Marc Swackhamer, Blair Satterfield
PROJECT RESEARCH: University of Minnesota—Gary Meyer (associate professor, computer science and engineering), Seth Berrier (research assistant)
DESIGN CRITIQUE: Marius Martinez, Patrick McCloskey, Aidan Darling
Design—Adam Rouse, University of Cincinnati—Karl Wallick
PROTOTYPE PRODUCTION: University of Minnesota—Dave Hultman, Matthew Haller (research assistant), Terrance—Susanna Kohmann, Industrial Art and Design—Rob Tickie, Boston Scientific CRM—David Wulfman (principal engineer), Cranbrook Academy—Antonio Rodriguez, Loom Studio—Don Vu
SPONSORSHIP: Dayton Hudson Faculty Fellowship; Metropolitan Design Center, University of Minnesota; Weisman Art Museum; Digital Design Consortium, University of Minnesota; Goldstein Museum of Design; DuPont Performance Coatings
1. In the Drape Wall system, vacuum-formed plastic bricks snap together on an aluminum frame, creating the rainscreen exterior of this housing prototype.

2. Preliminary sketches document the initial attempts to turn the Drape Wall concept into a comprehensive design for a single-family house.

3. In the final Drape Wall system, some bricks are perforated, serving as windows. These perforated bricks allow controlled airflow into the space and views from the interior.

4. A felt "drape" layer lines the interior surface of the wall system. It is backed with a blue layer of waterproofing to weatherproof the house (the exterior bricks serve only as a rainscreen). Insulating felt forms storage pockets and can be pulled aside to allow access to the "windows"—perforations in some exterior bricks.
5. Drape Wall bricks are vacuum-molded over milled forms that correspond to every brick configuration available.

6-7. The Drape Wall system is being continuously refined, and new brick prototypes are being manufactured for testing. One option (6) is engineered for greater flexibility in overall house design, using circular forms to allow bricks to interlock at 10, 45, and 90 degrees. Another prototype (7), based on research by mechanical engineering students, provides for flexible spacing of the bricks, permitting more or less ventilation as climate conditions in different areas dictate. This latter system is the driver for the design of a full-scale installation called the Drape House.

8. Preliminary sketches (left) for the felt drape system have been manufactured into large-scale mock-ups (right). There are voids in the felt to give access to the blue vapor barrier, and zippered pockets so that residents can actively use the surface for storage.
9. Created as part of the Goldstein Museum of Design’s Here by Design III exhibition, the Cloak Wall system includes several advancements over Drape Wall, including discrete window openings. The bricks are held together by compression as opposed to being locked to a separate aluminum frame.

10-11. The insulating felt quilt lining the interior surface of Cloak Wall has a separate ETFE plastic waterproofing barrier that is hung behind the felt.

12. In addition to storage pockets, the felt quilt in Cloak Wall incorporates systems such as LED lights and wires for radiant heating and cooling, making it a much more active part of the interior environment than previous iterations were.

13. Three main layers—performative bricks, ETFE waterproofing, and felt quilt—form the wall structure, but each can be tweaked to customize a home for a specific environment. For example, air pockets in the ETFE layer can be filled to increase or decrease insulation as ambient temperatures dictate.

14. Cloak Wall uses a high-performance automotive paint on the exterior, which gives the appearance of changing colors as light angles shift season to season. When the sun’s light is at a low angle or dim, the paint appears darker, soaking up and trapping more heat. During summer months when the sun is higher, the paint appears lighter, reflecting heat to keep the house cool.
A SURFACE
OF POINTS

In past projects, Eric Owen Moss has used fields of glass rods emerging from the ground as a means of organizing space and influencing pedestrian movement. These rods, when installed over a skylight, provided visual interest to the ceiling plane of subterranean spaces. Taking the concept a step further, the architect explored using the glass rods not just for their formal properties, but as structural components. The result is A Surface of Points, a system of deep cable trusses that incorporate glass tubes as compression members. The concept was proposed for the Smithsonian Institution Patent Office Building in Washington, D.C., and is appearing in two projects: the Nike Los Angeles offices at 3505 Hayden Avenue and 8511 Warner Drive, also in Los Angeles.

The system involves a base of steel truss frames within a boxlike enclosure. Steel cables are hung between the truss frames, approximating the surface plane of the ceiling. The cylinders, formed from ½-inch-thick laminated glass, are installed and threaded on the cables, forming the compression members of the deep cable trusses.

Depending on whether a skylight or an opaque ceiling is installed above the truss system, natural or artificial light can be constantly refracted through the glass rods. The tubes also have acoustical properties, which can be adapted by varying the length of the tubes in accordance with the natural acoustics of the room. Sound travels and diffuses in the spaces between and within the tubes, or can be reflected by the use of a plug in the bottom of the tube.

"I thought it was really interesting to invert the idea of a truss and make things that are fragile and brittle into things that are load-bearing and spanning," says Chris Genik. "The notion of a glass truss, in its capacity to be an acoustical environment and a light environment, reaches a higher plateau," he adds. "I think it's a really extraordinary project and a vision of how to coerce structure into something which is also producing something for the building as a shell, a kind of container."

PROJECT: A Surface of Points
ARCHITECT: Eric Owen Moss Architects, Culver City, Calif.—Eric Owen Moss, Dolan Daggert, Eric McNevin, Kyung Kim, Grit Lepert, Jose Herrasti, Tom Raymond, Scott Nakao, Andrew Wolff, Fausto Nunez, Vanessa Jauregui, Herbert Ng, Ren Huang (project team)
CONSULTANTS: Arup-NY—Neil McAllister (Smithsonian); Ingenieurbüro Structural Engineers—Bill Wallace (3505 Hayden Avenue Glass Courtyard)
1. A rendering of the courtyard at Nike's Los Angeles offices demonstrates how sunlight coming through a glass atrium and through the glass tubes will illuminate the enclosed space while adding a texturing shadow pattern to the environment.

2-3. With proper lighting from the interior, the proposed installation at the Smithsonian Institution Patent Office Building (which houses the National Portrait Gallery) would have created striking visual effects as the light went through each individual glass rod in the truss system. The Smithsonian competition was won by Norman Foster.
ARTIFICIAL LEAF

Set to be deployed as a nontraditional façade for the planned Hotel Forest in Barcelona, the Artificial Leaf is a draping system of light-emitting modules suspended on steel mesh. The scheme is based on the analogy that if a city is a forest, each building is a tree. Adding a net of individual modules is akin to putting leaves on the tree, and like an actual plant, these leaves both generate and expend energy by harnessing the energy of the sun.

Each module is a convex disk that is 12½ inches in diameter and just over 2 inches thick at the center. One side is made from translucent plastic and the other from clear glass. Contained in each disk is a small photovoltaic cell, a light sensor, a battery, and an RGB LED source. The modules are clipped to the steel mesh and are programmed in tandem to generate different color effects—mixing different intensities of red, green, and blue creates single- and multicolored lighting displays across the façade.

The jury was impressed by the goal of making a building's façade a dynamic part of the urban landscape, and in so doing engaging the public with the built environment. "It is a way of inducing a pretty boring building envelope to deliver something that was really spectacular for the city, in its capacity to react and respond to its urban context," said Chris Genik. "It seems like a layer of interaction that cities should become increasingly vested with."

The jury also saw the potential for other applications of the net, both as a renovation tool and as an energy-gathering device. "This is a fresh and potentially more playful way to clad buildings in adaptive reuse situations," said Blaine Brownell. "You're not constrained by the modules that currently exist or performance issues embedded within an existing skin. You can simply loosely drape something like fabric that not only performs for the building—or at least has that potential—but also can create this really interesting effect in public space." The hotel and its unconventional façade, both designed by Cloud 9, will open in 2010.
3-2. The pattern for the metal mesh net is tailored to fit the exact shape of the Hotel Forest in Barcelona, including terraces and outcroppings. The net has the appearance of being draped loosely, and extends farther out from the building as it nears street level, creating a canopy over pedestrians walking around the building’s base.

3. Individual leaf modules that contain PV cells to power LED sources are suspended on the net and glow at night. These modules can be programmed to emit different colors of light to create patterns on the surface. The result is a dynamic façade that engages the urban fabric surrounding it.
4. A surprising visual effect on the building itself, creating an interesting visual effect on the building itself, creating an interesting visual effect on the building itself, creating an interesting visual effect on the building itself, creating an interesting visual effect on the building itself.
1. The concept behind Living City is that a building—through a variety of sensors—can gather information about air quality, temperature, and other environmental factors, and then wirelessly share that information with other buildings on a dedicated network.

2-3. A lightweight, transparent building skin has gill-like openings that can close or open in response to the air quality of the surrounding environment, effectively allowing the building to breathe. A mockup (3) shows how the skin would appear in application, and contrasts alternating gilled panels with solid ones.

4. A control board was designed specifically to connect input data from the sensor network to the façade, and to control the pin mechanism that opens and closes the gills to permit or prevent airflow.

5. A sensor sits on the exterior window ledge gathering environmental air quality data while another sensor, uncovered, sits inside to monitor the interior air quality. The data are all routed to a software program that the team intends to publish so that others can create similar systems in other cities.

6. Depending on the location and planned duration of deployment, the input nodes or sensors have larger or smaller batteries and casings. This smaller version shows a sensor module connected to a radio module that transmits the collected data to computers and output nodes.
LIVING CITY

Living City explores the notion that building façades and access to fresh air are the frontiers of public space in urban areas—that in the future, façades will belong to and serve residents as streets and parks do today. To that end, architects David Benjamin and Soo-in Yang believe that façades should be active: gathering, transmitting, and reacting to data about the surrounding environment, and dialoguing with other buildings to create a network of information. The team designed a system of sensors that can be easily mounted on a building exterior to gather information about carbon monoxide and nitrogen content in the air.

Prototype sensors were deployed on the Empire State Building and three other buildings in Manhattan to test their data-gathering and communication capacities. The next phase of the project involved getting the buildings to actually respond to the data. The team designed a prototype of façade louvers that can open or close depending on air quality readings, in effect allowing a building to breathe in reaction to environmental conditions.

The jury was taken by the project’s initial premise, that air is public space. "It’s the last public commodity that’s available for some kind of uploading of design capacity, a sort of engagement by the public realm,” Chris Genik said. "I thought that was insightful." Andres Lepik agreed: "I like the idea of buildings that communicate with each other. This is a stream of data and now these structures are starting to talk."

Genik thinks the idea should continue to be explored and developed. "The fact that it is open is what makes it a good kind of research,” he said. "Not all the questions are solved, but there’s a method in place. There’s a set of assumptions that are being investigated. It has that kind of generosity that research should bring with it—it’s not closing down opportunity.”

PROJECT: Living City
ARCHITECT: The Living, New York—David Benjamin, Soo-in Yang
SOFTWARE CONSULTANT: Jason Copriani
ELECTRICAL ENGINEERING CONSULTANT: Jesse Laskey, Todd Pijnenberg
WIRELESS COMMUNICATION CONSULTANT: Robert Tafudi
VIDEOMATION: Softlab—Mike Sevor, Jose Luis Gonzales

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In association with the Living Architecture Lab at Columbia University Graduate School of Architecture, Planning and Preservation
HOVER

Designed as a temporary canopy for the DesCours festival, an annual weeklong celebration of design sponsored by AIA New Orleans, Hover is a luminous canopy featuring both LEDs and photovoltaic cells that power them. Höweler + Yoon designed Hover—an entirely off-the-grid construction—as a kit of parts that is easily scaled up or down to adapt to a variety of venues and increase the potential for future installations. Coated nylon ripstop fabric is stretched and framed into a form derived from a cell in the human body. Each unit is rimmed at the top with flexible photovoltaic cells that generate enough energy to power a rope of LEDs placed in the fabric around the base. These fabric units were manufactured in several sizes, carefully measured to allow for replicable multicell groupings that can be rotated and fit together to form the layout of the complete installation. The installation reacts directly to the surrounding environment, emitting more light on sunny days and less on cloudy days, a direct effect of the amount of energy absorbed and generated by the PV cells.

The jury remarked on how the project’s formal and technical simplicity stimulates a larger dialogue about temporality and urban space. “It’s something that can be very quickly installed and make a significant sort of presence for itself,” Chris Genik said. “It’s not a very deep project, but it taps into a number of different ideas about temporary places.” Blaine Brownell, while concerned about the integration of the flexible PV cells with the fabric, appreciated the exploration of new material technologies. “I liked the fact that it attempted to be fairly hermetic in terms of supplying the solar cells using the latest technology and flexible films, as well as the lighting of the structure.”

PROJECT Hover, New Orleans
SITE OWNER Matt Kornhauser
CLIENT DesCours, New Orleans
SPONSOR AIA New Orleans—Melissa Urcan (executive director)
ARCHITECT Höweler + Yoon Architecture, Boston—Eric Höweler, J. Minjun Yoon (principals); Meredith Miller (project architect); Daniel Cho, Lucie Krasner, Gabe Blue Cira (project team)
ELECTRONICS ENGINEER Parallel Development—Will Pickering
STRUCTURES Paul Kassabian
1. Each cell is formed from coated nylon ripstop fabric rimmed with flexible PV cells at the larger, sky-oriented opening. A rope of LED lights is suspended in the fabric at the base, generating light that diffuses along the nylon, creating a luminous effect.

2. Each unit was constructed and installed by hand, and each has its own PV cells and power conversion system to generate energy for the LEDs. This allows every cell to operate independently in the system.

3-4. To create the different sizes and shapes of the cell units, a series of templates was devised as a finite number of options. These options can then be arranged into easily replicable building blocks to form larger installations.

5-6. The final installation is a luminous canopy that lends a sense of space to an outdoor environment. The system reacts to the climate as well, shining more brightly on sunny days, when more energy can be collected by the PV cells.