

3. How Building Technologies Contribute to Reconstruction Advances

By C.C. Sullivan, Contributing Editor

Experience has shown that Building Teams need to consider a number of building technologies—some long-established, others newly emerging—for almost every reconstruction project.

From enclosure retrofits for improved roofing, to thermal insulation and air/moisture protection, and on to MEP upgrades for efficient lighting, high-efficiency, low-flow plumbing fixtures, and enhanced building automation systems, these components and systems are mainstays of effective reconstruction. Others include categories developed largely for recurring reconstruction needs: replacement windows, overcladding, and low-voltage controls, among others.

These are the so-called “low-hanging fruit” of reconstruction projects, and the rationale for their use is just as easy to grasp. According to a recent report by the Preservation Green Lab of the National Trust for Historic Preservation (NTHP), “when comparing buildings of equivalent size and function, building reuse almost always offers environmental savings over demolition and new construction”—a fact not limited to reconstructing historic structures. The report shows that it requires “up to 80 years for a new energy-efficient building to overcome, through efficient operations, the climate change impacts created by its construction.”

Further, the NTHP report demonstrates that most buildings take only about two to three decades to compensate for their initial, construction-related carbon impacts. Yet the savings offered by proper application of reconstruction technology is significant. NTHP calculates that Portland, Ore., could achieve 15% of its total CO₂ reduction targets for the next 10 years by retrofitting just 1% of the city’s office buildings and single-family homes. Rehabilitation work may even be better for the economy, creating 50% more jobs—jobs that can’t be outsourced overseas—than new construction, according to the NTHP study.¹

Building owners and financial institutions are “slowly turning ... attention to the existing building stock as a massive opportunity to cut energy consumption and greenhouse gas emissions,” according to the 2010 analysis EnOcean Technology and LEED Enabling Sustainability (at: http://www.enocean-alliance.org/en/white_papers/). Further, the paper, authored by the EnOcean Alliance, asserts that the “existing building

stock presents a corresponding massive opportunity to apply technology as a means to those ends.” The group represents a range of self-powered, wireless reconstruction technologies, including lighting, building automation systems, and electrical controls.

According to the NTHP study, reconstruction projects can still shoot themselves in the foot. If many new materials are required, says the group, the benefits of reuse may be totally negated. “By minimizing the input of new construction materials,” the group sums up, “the environmental benefits of reuse are maximized.”

HOW RECONSTRUCTION TECHNOLOGY IS BENEFITING FROM AN EVOLVING MINDSET

Energy codes and, to some extent, sustainability standards are shaping how building reconstruction projects trend in terms of deploying technology. Some practitioners, like historic preservation expert Jean Carroon, FAIA, LEED AP, of Boston architecture firm Goody Clancy, see energy codes as “a short-term awareness issue” that may require a decade or so of adjustment before they have nationwide acceptance and impact. In jurisdictions such as Seattle, where “outcome-based codes” are emerging, new performance-based regulations allow Building Teams to meet energy-use guidelines however they see fit, as long as they meet the criteria.

Embedded in these codes are certain ideas or principles related to the opportunities presented by building reuse. For example, different building systems require different levels of service: the structure and shell must last for 100 years, but interior finishes may have a much shorter lifetime. For systems that are expected to be switched out every 30 years or less—due to technological change, use needs, and the like—Building Teams should make them easier to work with, replace, and retrofit.

Along with the new codes regime, the industry is seeing shifting attitudes toward older existing buildings that actually increase the viability of today’s reconstruction technologies, says Michael D. Binette, AIA, vice president and principal of the Architectural Team (www.architecturalteam.com), Chelsea, Mass.

On one front, this is increasing the pace of historic building reconstruction. Instead of preventing historic buildings from being torn down or changed significantly—keeping them “frozen in time,” as critics would

¹ *The Greenest Building: Quantifying the Environmental Value of Building Reuse* (www.preservationnation.org/issues/sustainability/green-lab/lca/The_Greenest_Building_lowres.pdf).

² At: <http://www.nps.gov/tps/standards/rehabilitation/sustainability-guidelines.pdf>.

³ See Figure 6.3, *McKinsey Cost Curve for GHG Reduction* (page 52), in *BD+C 2008 White Paper, “Green Buildings + Climate Change,”* at: <http://www.bdcnetwork.com/whitepapers>.

charge—green building technologies and new, energy-saving reconstruction systems are more often seen as consistent with long-term preservation and sustainability goals. “Organizations that champion historic preservation and those that champion green building now largely embrace each other’s missions,” says Binette, whose work on LEED-rated historic adaptive reuse projects includes the Bourne Mill Apartments, Tiverton, R.I. “It’s widely accepted that historic buildings are inherently sustainable, and that embodied energy is an important calculation used alongside evaluations of energy efficiency to determine overall environmental impact and carbon footprint.”

Recently published National Park Service guidelines² for buildings on the National Register of Historic Places allow flexibility in how the unique conditions of individual buildings can be addressed so that preservation efforts can be aligned with today’s energy codes and standards, according to Binette. The guidelines also recommend certain paths to maintaining a building’s historical status and significance and dissuade the use of others. Following the guidelines can help the project benefit from the Federal Historic Preservation Tax Incentives program, a 20% tax credit for qualified projects. Some states offer similar incentives, adding 10% to the tax breaks.

WHY RECONSTRUCTION IS UNLIKE NEW CONSTRUCTION

Whether for adaptive reuse, commercial renovation, or reconstruction in general, technology choices reflect the key differences between reconstruction projects and new construction. New building projects allow wide latitude in design, while reconstruction requires an organized assessment of the existing structure, systems, and materials. Furthermore, building conditions discovered during reconstruction must be overlaid with programming needs for new uses. In the process of creating the resulting matrix, several key building aspects must be analyzed:

- Structural integrity, including an analysis for uses intended as well as life cycle assessment
 - Accessibility and accommodations, especially for ADA compliance
 - Fire protection and life safety, notably fire alarm and emergency systems, as well as security infrastructure
 - Potential for hazardous materials, including asbestos, lead, PCBs, etc.
 - Indoor environmental quality
 - Electrical systems, including distribution systems, especially considering that systems in place for 15 years or more may be insufficient or dangerous for current technology needs
- The reconstruction technologies that

are easy to implement and indispensable for successful projects start with energy-related upgrades, notably thermal insulation.

Insulating the building envelope. Study after study has shown that, properly engineered, an insulation upgrade is the single most effective and least expensive way to improve energy efficiency in reconstruction projects.³

A variety of insulating materials and systems are seen as effective for reconstruction projects, including fiberglass, rock wool and slag wool materials. Using both common blankets and loose-fill or blown-in forms, the relatively inexpensive, mineral-based products are effective as an added layer of insulation or as a fill material to boost assembly R-values, according to the North American Insulation Manufacturers Association. (Note: NAIMA is a sponsor of this report.) Faced batts, with their paper or foil facers, add the integrity of a vapor barrier across a surface up to 70 feet or more in length. The loose-fill formats are seen as especially appropriate for enclosed building cavities and other areas that are hard to reach without added deconstruction or demolition.

The recent trend toward the use of continuous insulation, or “ci”—a blanket of uninterrupted thermal insulation installed outboard of the building structure—has increased the use of rock wool and rigid expanded-polystyrene boards in enclosure retrofits. For overcladding or other situations where the wall rebuild strategy allows for it, adding continuous insulation can offer significant reconstruction benefits. Continuous insulation, typically of R-7.5, is required in six of eight U.S. climate zones as defined in ASHRAE 90.1-2007.

The mandatory requirement for ci covers about 90% of U.S. steel-framed walls above grade. It is required in the 2009 editions of the International Building Code (IBC) and the International Energy Conservation Code (IECC) to match the ASHRAE 90.1-2007 R-values. The new 2012 International Green Construction Code (IgCC) and ASHRAE’s standard 189.1 require the

Table 3.1
ROOFPOINT RATING SYSTEM
Section 1: Energy Management

Credit	Title	Primary Intent	Strategy
E1	High-R roof systems	Reduce energy and GHG emissions	Increase roof system R-value
E2	Best thermal practices	Reduce energy and GHG emissions	Reduce thermal discontinuities
E3	Cool roof surface	Reduce energy, GHG emissions, and heat islands	Install climate-appropriate roof surface
E4	Roof air barrier	Reduce energy and GHG emissions	Install air barrier
E5	Rooftop energy systems	Produce clean energy	Install solar and/or wind energy-producing materials
E6	Roof daylighting	Produce clean energy	Install daylighting systems

Source: Center for Environmental Innovation

Now in its pilot phase, the Center for Environmental Information’s RoofPoint rating system covers numerous energy management criteria that can impact reconstruction projects. Rating systems like RoofPoint can, when properly executed, provide a level playing field for the evaluation of building products.

highest ci performance—at least R-10.

Another thermal insulation product that is gaining attention, particularly for use in late 1960s-era institutional buildings with poorly insulated cavity wall construction and no continuous air or vapor barriers, is closed-cell spray polyurethane foam (ccSPF). “When the owner is investing in new high-performance windows and modern HVAC systems, it’s important to make the existing building envelope as tight and insulated as possible,” says Paul J. Arougheti, AIA, LEED AP BD+C, an associate with Philadelphia-based MGA Partners Architects (www.mgapartners.com). Arougheti says a single installation of ccSPF can provide an effective air and vapor barrier with an approximate insulating value of R-6 per inch. “Coating the foam with a spray-applied thermal barrier allows us to install the foam at the exterior wall above ceilings without the need for labor-intensive encapsulation with furring and drywall,” he notes.

Adding thermal insulation to the enclosure generally boosts the energy efficiency of reconstructed buildings. “But it also changes how a building responds to a host of internal and external environmental conditions, most notably moisture,” says the Architecture Group’s Mike Binette. For example, older masonry structures can, if not properly protected against moisture, suffer from mold, spalling bricks, and damaged façades. The key is to follow manufacturer instructions for insulating older building envelopes to avoid condensation or moisture.

Employing air barriers and moisture protection.

Along with insulation, air and water barriers are essential to envelope reconstruction. Energy codes increasingly call for barrier membranes and careful joint construction to preclude significant exfiltration and infiltration of air and moisture through the building envelope. The 2012 release of the International Building Code, the International Energy Conservation Code, and the International Green Construction Code—along with California’s CalGreen and other state green building and energy codes in Massachusetts, Wisconsin, Michigan, Rhode Island, Georgia, Minnesota, and Florida—call for sealed joints or continuous waterproof barriers with low or zero vapor permeability.

In addition, both ASHRAE 90.1 and ASHRAE 189.1 specifically call for air barriers that meet such rigorous criteria as ASTM E 2178 (a material standard) and ASTM E 2357 or E 1677 (for multi-component assemblies).

Air transports moisture and water vapor, meaning that barrier technologies such as spray-applied products, membrane sheets, building “wraps” and other air-stop materials help prevent moisture-related problems, too. According to Wagdy Anis, FAIA, LEED AP, a principal with Wiss, Janney, Elstner Associates (www.wje.com), Boston, condensation is mainly caused by air movement

into or through building assemblies. The air movement is due to one or more of the following effects:

- Convection looping into building assemblies
- Entraining water vapor to a surface that is colder than the dew point within the assembly
- Infiltration and exfiltration due to air pressure differentials cause by wind, stack effect, or HVAC pressurization

Active glazing offers new approach. A variety of novel glazing technologies has also expanded the horizons of building reconstruction. Examples include electrochromic materials, suspended-particle glazings, and liquid crystal devices.⁴

Among the most effective enabling technologies has been electrochromic glass, which can be engineered to modify light transmission properties in response to applied voltage. In this way, interior daylight levels and thermal gain can be determined and controlled on the fly, thereby controlling interior heat gain and glare. Some visibility and high levels of translucency through the glazing panels can be maintained even when the panels are charged and in their most opaque state.

Most important, the materials are highly efficient, reducing cooling loads by as much as 20% and lighting energy costs by up to 60%. The U.S. Department of Energy’s National Renewable Energy Laboratory, where electrochromics were used in the construction of the net-zero Research Support Facility, estimates that electrochromic glazing could cut 5% of the nation’s total energy budget each year.

Multiple benefits from replacement windows.

Technical improvements have also contributed to window unit designs. “In recent years, windows have undergone a technological revolution,” says Southern California Edison’s Gregg D. Ander, FAIA, in the Whole Building Design Guide (wbdg.org). Replacement windows for reconstruction projects can reduce heat loss, air leakage, and the effects of cold interior window surfaces—another source of condensation as well as occupant discomfort. The fenestration systems include high-performance double or triple glazing, specialized transparent coatings, insulating gas sandwiched between panes, and improved frames. “All of these features reduce heat transfer, thereby cutting the energy lost through windows,” says Ander.

A few essential characteristics of replacement windows, storefronts, and curtain walls must be analyzed for an effective building, caution building envelope experts:

- Window U-value
- Solar heat-gain coefficient (SHGC)
- Shading coefficient (SC)
- Visible light transmittance (VLT) of the glass
- Glass tints and coatings

According to Ander, typical projects benefit from low

⁴ Another technology not directly related to reconstruction feasibility but helpful in reducing O&M labor is self-cleaning glass. These panels have a super-thin titanium dioxide coating that reacts with solar ultraviolet light to help break down organic compounds on exterior glass surfaces. A secondary hydrophilic effect attracts water to the glass surface so it sheets off, taking the organic materials with it.

⁵ For more on reroofing (and to earn 1.0 AIA CES Discovery learning units), see “Reroofing Primer: In-depth Advice from the Experts,” at: <http://www.bdcnetwork.com/aia-continuing-education-reroofing-primer-depth-advice-experts>.

U-factors (less than 0.40), but the entire window assembly U-value must be known, not just the glass value, which often may be higher.

In warm and humid climates where air-conditioning is needed most of the year, low solar heat-gain values (less than 0.40) usually are beneficial. In many projects where the intent is to maximize the benefits of daylighting, high visible light transmittance may be desirable (greater than 70%).

As with all envelope upgrades, condensation can occur if windows are specified incorrectly and the glass surface temperature falls below the dew point of interior ambient air. The Architecture Group's Binette adds that historic buildings may require special detailing to meet the criteria of the National Park Service or the various state preservation agencies.

Properly applied, however, high-performance windows can increase passive heating, slash HVAC costs, and improve mean radiant temperature (MRT) at the perimeter, which may preclude the need for perimeter heating. Adding low-e and spectrally selective coatings enhances efficiency and can even reduce ultraviolet damage of interior finishes and furnishings.

Reroofing and replacement roofing. It's hard to think of a major reconstruction project involving any building more than, say, 25 years old where replacing and stabilizing the roof should not be given serious consideration. Roofing systems generally account for about 10% of the total budget in major reconstruction, but their impact on energy performance—not to mention owner and occupant satisfaction—is significant, from the reflectivity and emissivity of the roof surface to the insulation below.

In many reconstruction projects, leaks or damage to the existing roof is so severe that a tear-off replacement is the best alternative. One benefit of a tear-off is that the Building Team can inspect the condition of the roof substrate, which is important when it comes to the warranty, says Shad Traylor, AIA, a LEED Accredited Professional with BRPH (www.brph.com), Melbourne, Fla. "If the load-bearing capacity of the roof substrate is in question, a tear-off also reduces the additional weight of a second roof." On the other hand, simple reroofing is usually faster and less expensive than a tear-off, and overlayment maintains the building's weather barrier, protecting building structure, systems, and equipment below.⁵ The choice of tear-off versus overlay is a project-by-project decision.

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North American Insulation Manufacturers Association (NAIMA)

The way to help secure our energy future is to reduce energy use and demand through sound building practices like insulating. Fiber glass, rock wool, and slag wool insulations are highly versatile insulating products. They are specified in sustainable buildings for superior thermal performance, acoustical comfort, energy and environmental efficiency, fire protection, condensation and process control. The fibrous composition of these insulations allows them to be engineered into many shapes, sizes, thicknesses, and forms. Each provides unique insulating properties that make them the proven products of choice for a wide range of applications.

Insulating with fiber glass, rock wool, and slag wool provides many benefits. In fact, you will find these products insulating cavities, surfaces, or systems found on every floor of every building. They could be in the form of:

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- Insulation duct wraps and duct liners for the HVAC equipment and air duct systems
- Pipe insulations for the building's mechanical services

These fiber glass, rock wool, and slag wool insulation products have a dramatic impact on the energy efficiency and sustainability of today's buildings.

As an authoritative resource on energy efficiency, sustainable performance, and the application and safety of fiber glass, rock wool, and slag wool insulation products, NAIMA offers a wealth of information, guidance, and research to:

- Architects and Builders
- Design, Process, and Maintenance Engineers
- Contractors
- Code Groups and Standards Organizations
- Government Agencies
- Public Interest, Energy, and Environmental Groups
- Homeowners

For more information: www.naima.org.



Overcladding in an existing building (left) using an exterior insulation and finish system (EIFS), with the finished work (right). EIFS can be used as overcladding on a masonry wall as long as the masonry is sound, to stop water penetration and improve the insulation R-value of the wall. Insulated metal panels are another increasingly popular overcladding material.

COURTESY STO CORP.

The use of vegetated roofing and roofing-integrated photovoltaic systems is also on the rise. In North America, green roofs were at least 25% more likely for a reconstruction project, according to a 2011 survey by Green Roofs for Healthy Cities. Use of rooftop PV is also expanding, often in concert with planted surfaces where the weight of the PV array minimizes uplift and vegetation damage while the planted surfaces cool the PV modules, improving their efficiency.

Cool-roof materials also contribute to better roof reconstruction. Climate zones 4-7 on the U.S. Department of Energy climate map generally benefit more from a darker roof material to absorb heat. In other zones, the lighter, low-emissivity materials are more effective.

Overcladding and integrated aesthetic enhancements. As in the case of reroof overlayment, adding new envelope construction over existing masonry, concrete, brick, and other façade materials has become a desirable approach for rejuvenating building exteriors in reconstruction projects. The approach can add new aesthetic materials, new insulation, and even the air and moisture barriers required by owners or jurisdictional authorities.

Exterior insulation and finish system (EIFS) and insulated metal panels (IMPs) are two common ways to overclad, according to Gary Zwayer, RA, a principal with Wiss, Janney, Elstner, Northbrook, Ill. To make EIFS applications successful, says Zwayer, "As long as the masonry wall is sound, EIFS can certainly be used as an overclad to stop water penetration as well as to improve the R-value of the wall."

One city that is seeing a wave of interest in this technology is Toronto, where there is "a movement to facilitate the renewal of high-rise residential buildings, and overcladding is a major component," says Halsall Associates' Kevin Day, a local building science and cladding specialist. Whether it's insulated composite exterior metal panels or another rainscreen-type overcladding, the solution can, he says, "improve not only the performance of the building, but also the comfort of the occupants." The technique also allows Building Teams to update the look of load-bearing segments of concrete and masonry walls without having to undertake expensive reinforcing of structure or the addition of columns and beams or underpinning foundation.

Low-toxicity building products for IAQ. Another important trend in reconstruction projects has been the focus on air quality and human health issues, in particular the chemistry of building products and finishes. This goes beyond interior finishes with low-VOC and no-VOC finishes. "In renovations and restoration projects you often have neighbors and people sharing building spaces, and the careful review and selection of materials ensures there are no chemicals of concern for the occupants as well as neighbors," says Zinder, whose firm routinely specifies no-VOC paints and finishes for reconstruction projects. The next step in this product sector will be clear-finish products that are low in VOCs, followed perhaps by the introduction of clear coatings and sealants with zero VOCs.

Other finish approaches include powder-coating and

similar shop finishing techniques, which typically have no VOCs, according to Zinder. The technique melts the coating onto metal surfaces, providing a resilient and highly durable application for miscellaneous metal, built-in furnishings, and the like.

In many older buildings, toxic materials such as asbestos tile must be abated during reconstruction. In selecting replacement products, says MGA Partners' Arougheti, "It is important to select new finishes that are easy to install, require no initial finishing, and need minimal long-term maintenance."

OPTIMIZING BUILDING SYSTEMS IN RECONSTRUCTION PROJECTS

Reconstruction projects are benefiting from technological advances in efficient, integrated, and highly coordinated electromechanical schemes. The options and opportunities on the mechanical, electrical, and plumbing side and on the building automation horizon are quickly expanding. In particular, greater efficiencies have been achieved with retrofit-ready systems such as passive solar design, thermal energy storage, underfloor air distribution, and chilled beams. On the electrical side, energy-efficient

lighting and integrated controls, cogeneration, and power metering and monitoring are quickly becoming areas of focus in reconstruction.

High-efficiency plumbing—a must-do in reconstruction. The new codes and LEED credits, such as the pilot credit for cooling-tower water makeup—likely to be incorporated into LEED 2012 as its own credit, say experts—are driving a new generation of low-flow and reuse strategies in reconstruction projects. A 50% reduction in the generation of wastewater and potable water demand is the primary goal.

Many recent reconstruction projects are using rain-water harvesting and graywater as sources of free water, although the installed costs can be high for proper capture and storage of sinks and shower water as well as rainfall. Just as important are maintenance plans for filtering, disinfecting, and treating recaptured effluent. In some jurisdictions, local codes allow for a variety of uses, from irrigation to toilet flushing, once the proper systems are in place and pass inspection.

For low-flow fixtures, the bar to entry is low and the solutions are many. Yet recent thinking in plumbing fixture retrofits emphasizes user behavior over pure

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21st-century Skylight Preserves 19th-century Art Gallery

Built in 1871, the Athenaeum in St. Johnsbury, Vt., is the oldest art gallery in the country that still maintains its original design. One distinctive element of this elegant facility is its Victorian skylights, which flood the gallery's interiors with natural light and enhance the viewing experience of well-known masterpieces such as Albert Bierstadt's "Domes of Yosemite."

Unfortunately, natural light also poses a threat to the Athenaeum's extensive collection of artwork and furnishings. When the skylights deteriorated beyond repair, leadership at the Athenaeum recognized an opportunity to use 21st-century technology to preserve a 19th-century treasure. "It was critical that the skylight preserve the authentic atmosphere people experience when they visit the Athenaeum," said project architect John Mesick. "SageGlass allows us to do that."

The right solution. Replacing the skylights with traditional glass would have required the addition of mechanical shades or other sun controls that would severely compromise the appeal of the gallery and the visitor experience. For this reason, Mesick selected a SageGlass triple-pane glazing system for the skylights. SageGlass is electronically controlled dynamic glass that tints and clears on demand to allow optimal daylighting while preventing fading, glare, and heat gain.

The SageGlass-enabled framework replicates both the design and dimensions of four Victorian-era skylights, incorporating a layer of textured glass to match the look of the historic glass.

Key benefits. SageGlass blocks up to 98% of total solar radiation that causes fading and other harmful effects. Unlike conventional glass, it allows optimal amounts of natural light to enter without unwanted heat gain during warm seasons. The triple-pane glazing system not only provides excellent thermal efficiency during Vermont's cold winters, it

also addresses concerns about humidity levels in the gallery and condensation on the glass.

SageGlass also helps the Athenaeum improve overall energy efficiency. With a very low U-factor, SageGlass triple-pane glazings help reduce energy consumption 50% more

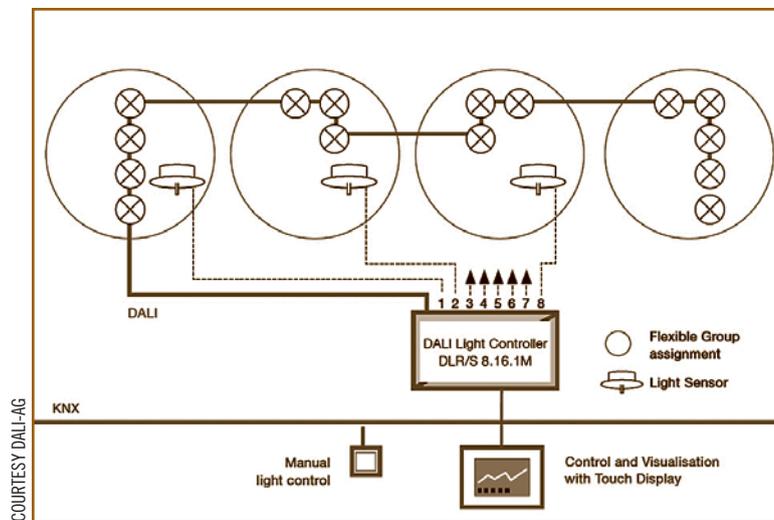
than single-pane glazings and 15% more than triple-pane glazings that use static glass. In a recent study, SageGlass triple-pane glazing achieved superior results over other glazing solutions, resulting in lower electricity costs, lower HVAC requirements, and a smaller carbon footprint.

"The Athenaeum was built by individuals in the 19th century who embraced and promoted innovative technologies and design," said Matthew Powers, the Athenaeum's Executive Director. "Today, we continue this tradition with the application of SageGlass in our art gallery. SageGlass will provide energy savings, protect our important collection from harmful UV solar radiation, and enhance our visitor experience."



Installation of the skylight at the Athenaeum in St. Johnsbury, Vt. The electronically controlled dynamic glass controls the amount of daylight entering the interior of the art gallery.

COURTESY SAGE ELECTROCHROMICS



Schematic of a DALI (Digital Addressable Lighting Interface) system. DALI permits interoperability and dimming capability of building's lighting system components. No hardware is needed to reconfigure the system.

technology. Some sensors and timer-based actuators have been shown to be ineffective, while some old-fashioned systems like aerators, laminar-flow fixtures, and pedal-operated faucets have been shown to save water use and maintenance costs. In a typical commercial restroom, a 0.5 gpm aerator can cut annual water draw by 20,000 gallons or more; the laminar-flow types save the same amount and are often preferred because of their sensory appeal. Pedal-operated fixtures are the real sleeper: They provide a touchless washroom but without the water loss or functionality problems sometimes associated with sensor-operated hardware.⁶

Novel systems light the way. DALI, the Digital Addressable Lighting Interface protocol (www.dali-ag.org), is based on the technical standard IEC 62386 and is used purely for lighting. DALI enables the networking of lighting systems in which all components are interoperable and that permit dimming throughout a facility. "The DALI lighting systems are more complex and sophisticated controls that really help provide a better use of daylighting," says Goody Clancy's Jean Carroon. DALI is ideal for reconstruction projects, say proponents, because wiring is only a simple two-wire cable; reconfiguring the system is accomplished by reprogramming—no hardware changes are needed.

According to Craig DiLouie, with the Lighting Controls Association (<http://lightingcontrolsassociation.org>), Rosslyn, Va., "DALI was introduced to the United States to provide assurance to both specifiers and owners that ballasts and controls from different manufacturers can function as a system." DALI-based control systems provide centralized control operating on a standard protocol. Such systems also provide daylighting and occupant control capabilities, application flexibility, and

significant energy savings, he adds. DiLouie cites a market study conducted by Ducker Research indicating that lighting automation is being used in about 65% of new construction and renovation projects in the office and school markets.⁷

DALI systems include self-contained "intelligent luminaires," according to DALI-AG (<http://www.dali-ag.org/index.php?n=wz1>), the European group that promotes the standard and related systems. The luminaires incorporate a ballast and multisensor to serve as constant light control, passive infrared (PIR) movement detection, and infrared (IR) remote operation. These and other components may be connected to create a fully functional single-channel system, using either the control panel or the IR remote control. The remote control (or Windows software) can be used to configure grouped loads, which can, for example, be individually addressed, if desired, for zoned, localized control of task lighting within a large open-plan office.

Finally, multiple DALI systems can be connected together utilizing gateways to building management systems. DALI can be expanded easily by adding new components anywhere without changing the wiring configuration. Software and controls allow for their use with scene-setting, timeclock, and partition control. Its simple wiring and programmable upgrades—with no hardware changes needed—make DALI a logical technology for many reconstruction projects.

"The greenest building is the one that's already built." So says the Architectural Team's Binette, citing the mantra of preservationists and others who see the value of adaptive reuse, renovation, and reconstruction in taking advantage of the embodied energy in existing buildings and reducing the possible environmental stressors associated with producing new materials for construction. By combining proven technologies like better insulation, high-performance replacement windows, and roofing improvements with newer technologies like DALI, Building Teams will be able to maximize the worth of the building stock that's already in the ground. +

⁶ For an extensive discussion of water-related sustainability, see "Green Buildings + Water Performance," at: <http://www.bdcnetwork.com/2009-white-paper-green-buildings-water-performance>

⁷ "Lighting Controls: Current Use, Major Trends and Future Direction Lighting Controls: Current Use, Major Trends and Future Direction," at: http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CCgQFjAA&url=http%3A%2F%2Fwww.archenergy.com%2Fflrp%2Farticles%2F-Lighting_Control_Study.pdf&ei=1WSET4f-ZIYXig-gT8bzXDA&usq=AFQjCNFL-NUnVYZozfRG-plW9POM7bevALaw



Although its significance is often overlooked in building design, the roofing system is among the most important construction considerations, in terms of watertight building integrity and positive energy performance.

“Cool roofing” is a term that has been well established for several years and has received a lot of press coverage. As architects, building owners, facility managers and other specifiers consider cool roofing alternatives, they should remember that reflectivity is only one of many important attributes to take into account, along with protection against leaks, building disruption, on-going maintenance, and warranty coverage. Minimizing these “costs” can help ensure that a roofing system remains a good investment over the expected life of the roof – up to 20 years, or more.

Since 1978, Duro-Last® Roofing, Inc. has manufactured a custom-prefabricated, reinforced, thermoplastic single-ply roofing system that is ideal for any flat or low-sloped application. Extremely durable and easily installed by authorized contractors without disruption to daily operations, the Duro-Last roofing system is also leak-proof, resistant to chemicals, fire and high winds, and virtually maintenance-free. Over a billion and a half square feet of Duro-Last membrane have been installed on all types of buildings throughout North America.

The Duro-Last Cool Zone® roofing system reflects up to 87% of the sun’s energy – delivering real cost savings for building owners and managers. The Cool Zone system can also help in obtaining credits toward LEED and LEED-EB certification. From reducing heat islands and optimizing energy performance, to resource reuse and thermal comfort, the Cool Zone roofing system can be a part of a comprehensive package for improving building performance.

A handwritten signature in black ink that reads "Thomas G. Hollingsworth".

Thomas G. Hollingsworth
President
Duro-Last Roofing, Inc.