2. Exemplary High-Performance Reconstruction Projects

By Barbara Horwitz-Bennett, Contributing Editor

From the transformation of a vacant army warehouse into a high-performance government office building, to the incorporation of a prominent exhibit hall inside a historic library building, progressive Building Teams are proving that it is possible to renovate existing structures into remarkably high-performing buildings.

"There is a common belief that existing buildings can't be renovated to 'deep energy retrofit,'" meaning 30% energy reduction or more, says William T. Maclay, AIA, LEED AP, founding principal of Maclay Architects, Waitsfield, Vt. (www.maclayarchitects.com). While Maclay acknowledges that "there are very few examples of this being done, especially in larger buildings," his firm recently completed two such projects. "The greatest thing that we learned is that existing buildings can be taken to the same standards, in terms of energy, as new buildings."

High performance in the Green Mountain State. Through the use of a new high-performance building enclosure, wastewater treatment system, green roof, and off-site solar photovoltaics, Maclay's team took an early 1980s building at the University of Vermont—the George D. Aiken Center, in Burlington—and reduced its energy usage from 89 kBtu/sf/year to 25 kBtu/sf/year. The 40,000-sf building, which now houses the Rubenstein School of Environment and Natural Resources, was completed earlier this year, and is expecting LEED Platinum certification.[1] University officials estimated that building new would have cost $5-7 million more than the $13 million for reconstructing the Aiken Center.[2]

Meanwhile, with the specification of a geothermal heating system, air-source heat pumps, high-performance windows, and significantly increased insulation values, Maclay and RicciGreene Associates are transforming an old Vermont state office building, operating at 110 kBtu/sf/year, into the new Bennington Courthouse and state offices, modeled at just 23 kBtu/sf/year.

One unconventional design decision that helped the Maclay team achieve such low energy levels on both projects was insulating the exterior of the building envelope, which was determined after a careful cost analysis of four different options.

Making water do double duty in Iowa. In the case of the historic public library in Des Moines, Iowa, a new drainage system collects rainwater from the roof, stores it in an 8,000-gallon tank under a reconstructed exterior stair, then uses the graywater for flushing toilets and urinals and irrigating the garden, explains Scott C. Allen, AIA, a partner in the firm RDG Planning & Design (www.rdgusa.com), Des Moines, which teamed up with the Weidt Group (twgi.com), Minnetonka, Minn., on the Old Des Moines Library project. "This cistern becomes a tool for the docents of the building to teach the value of water usage, as this building is also along a river that has flooded portions of our city in the past."

The $29.8 million renovation, which also incorporates a ground-source heat pump system and PV rooftop panels to support the new Dr. Norman E. Borlaug Hall of Laureates inside the library, is anticipated to reduce energy costs by 63% in this century-old structure.[3]

"We created a vault outside the building to manage the large number of pipes drilled through an existing foundation wall. Whereas newer buildings are able to adjust the building shell in small degrees to work with such systems, older buildings, built before the systems were invented, require such creative measures to integrate new systems," notes Allen.

SALLY MACAY

Triple-pane windows provide natural light to significantly reduce electricity use at the renovated George D. Aiken Center at the University of Vermont, now home to UVM's Rubenstein School of Environment and Natural Resources.

1. See "Green Renovated Aiken Center," at: http://www.uvm.edu/rsenr/greening-aiken.

2. "Reborn Aiken Center an Energy Star; Serves as National Model for Green Renovations," at: http://www.uvm.edu/~uvmpr/?Page=news&storyID=13046.

3. The building honors the late Norman E. Borlaug, the plant scientist credited with developing the Green Revolution, for which he won the Nobel Peace Prize, in 1970.

4. See "Zero and Net-Zero Energy Buildings + Homes" for a review of NZEBs, at: www.BDCnetwork.com/whitepaper/2011.

WHAT BUILDING TEAMS LEARNED FROM EXEMPLARY RECONSTRUCTION PROJECTS

The Building Teams involved in these case studies derived some valuable lessons from navigating through these complex projects.

Be aware that timing is everything. It's crucial to approach the community affected by the proposed project—neighborhood groups, end-users, public officials, etc.—at the right time before you begin the more intensive dialogue. "You want to have the vision in place, but not have so much resolved that people feel left out of the process, which is where trouble can set in," warns EHDD's Marc L'Italien.

Get early buy-in from clients. "Get the clients to buy in as early as possible during the design concept and development stage, lock in the floor plate, then allow the shell or base building to be completed while the client selects finishes," suggests the GSA's Dean Smith.

Focus on heating and cooling load reduction first and foremost. Only after your team has reduced energy use to the fullest possible extent should you consider advanced technologies and on-site renewables, according to the GSA's Jason Sielcken. Once you've reached that stage, however, get creative. "One thing we would have pursued is to bring in more innovative ideas through solicitations for new technologies for renewable resources as an option during the bid review process," says the GSA's Smith.

Fully exploit your trust relationship with building owner or developer. For the Oregon Department of Transportation to give the green light on a hydronic radiant system, when only a couple of such systems were operational in the entire U.S., required a great deal of trust on ODOT's part. "The client needs to be comfortable with the technical prowess of the design team to be able to deliver more progressive technologies," says SERA Architects' Stuart Colby.

Think beyond "been there, done that" solutions. "Establish your essential goals and ask yourself the tough questions at each step along the way: Are we achieving the goals? Are we creating a great environment for the users? Are we using resources wisely?" suggests Lake|Flato's Robert Harris.

Have faith that existing buildings can be taken to the same energy use standards as new buildings. "We began both of these projects believing this was possible, but we were having a hard time of convincing anyone else, because this was not the conventional wisdom, even in the architectural world," says William Maclay. He says his firm's two projects in Vermont "prove that this is possible."

GSA / WESTLAKE REED LESKOSKY / THE BECK GROUP

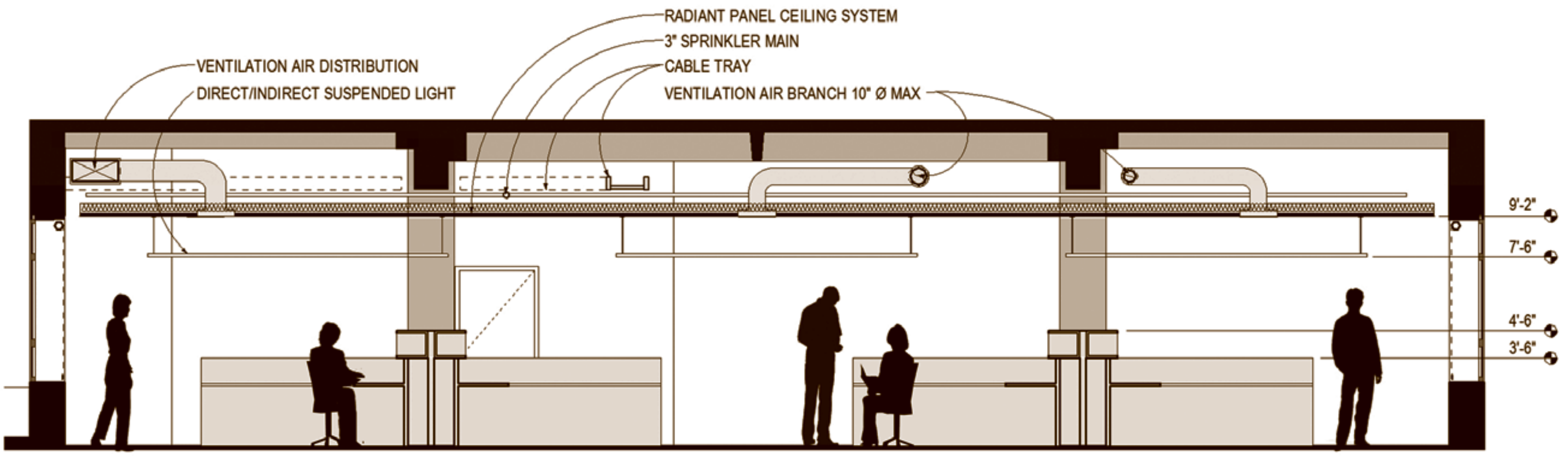
Just beginning reconstruction, this 1918 government building (top) will be converted into the new Wayne N. Aspinall Federal Building and U.S. Courthouse in Grand Junction, Colo. The reconstructed 41,562-sf courthouse will feature a 115 kW roof and canopy-mounted PV array and a geo-exchange system. The Building Team is headed by architecture firm Westlake Reed Leskosky and design-build firm The Beck Group.

Going down to zero on government work. Another high-profile project currently under reconstruction is the Wayne N. Aspinall Federal Building and U.S. Courthouse (1918), in Grand Junction, Colo. This was not originally intended to be net-zero, but the GSA challenged the design-build firms competing for the project to see how far they could go on energy savings—within the budget.

The winning team of Westlake Reed Leskosky and the Beck Group came up with a highly energy-efficient design featuring a geo-exchange system tied to a variable refrigerant flow mechanical system, enhanced insulation, an advanced metering and monitoring system, a 115-kW roof and canopy-mounted PV array, and high-performance lighting systems.

GSA Project Manager Jason Sielcken notes that, thus far, most net-zero buildings have tended to be small in size with relatively few full-time occupants, with the exception of the Research Support Facility at the National Renewable Energy Lab, in Golden, Colo.[4] That's what makes the Aspinall project interesting. "At 42,000 square feet, there is truly no other project which is a blueprint for what we're trying to accomplish as we work to balance new technology, historic preservation, tenant needs, and agency requirements, essentially navigating new terrain," he says.

Heating and cooling hydronically. Yet another noteworthy reconstruction project is the 1950s-era Oregon Department of Transportation building on the Capitol Mall, in Salem. This 147,000-sf project will



The reconstructed Oregon Department of Transportation headquarters in Salem will feature one of the country's few hydronic radiant systems, in which a water-based heating and cooling system pipes water to radiant panels at the ceiling level.

Modernization highlights of the renovated ODOT headquarters include an expansive photovoltaic array, rainwater harvesting, wastewater treatment, ground-source heat exchange, radiant ceiling panels, and lighting controls.

COURTESY SERA ARCHITECTS

be among an elite few in the country with a hydronic radiant panel system. Designed by Stantec, with construction administration and design integration by PAE Engineers (www.pae-engineers.com) and SERA Architects (www.serapdx.com), this water-based heating and cooling system will pipe water to radiant panels at the ceiling level; 100% outdoor ventilation air will be supplied via small ducts, moving just one-tenth the air volume of a conventional system.

"We spent a tremendous amount of time programming the mechanical system, which will ultimately help the building perform 26% better than the Oregon Energy Code and 32% better than ASHRAE 90.1," says Clark Brockman, AIA, LEED AP BD+C, a principal and director of sustainability resources with SERA Architects.

BALANCING RECONSTRUCTION VS. TEARDOWN

The critical question facing Building Teams is how much of the existing structure to save and how much to tear down. Obviously, the answer has a lot to do with simple economics, which is the principle that the Building Team applied toward the adaptive reuse of a 1950s paper warehouse into the Livestrong Foundation, the new headquarters for Lance Armstrong's cancer support organization, in Austin, Texas.

"There was a lot of work to be done but the building was clean, the bones were solid, and we did not need to do much to gain a solid platform for reconstruction," says Robert Harris, FAIA, LEED AP, a partner with Lake|Flato Architects (www.lakeflato.com), San Antonio.

In this case, Lake|Flato was working with a primary structure and foundation, and, as Harris noted, had more or less a clean slate for such elements as the mechanical systems, interiors, and insulation. However, the enclosed warehouse shell made it difficult to create a pleasant, daylit interior environment. This was resolved by removing portions of the existing roof structure to make way for a north-facing saw-tooth clerestory, which opened up the interior to natural diffused light. The old wood structure was salvaged and reused to create the interior meeting and workspaces, according to Harris.

The building registers an energy use intensity of 38.6 kBtu/sf. Eighty-eight percent of materials from the original warehouse were recycled or reused, with most of the concrete being repurposed for retaining walls, walkways, and fountain and garden elements. The project won a 2011 AIA/COTE award.

Making the most of existing materials. For the adaptive reuse of a 1940s Seattle army warehouse into Federal Center South, a new office space for the U.S. Army Corps of Engineers, much of the effort went toward reusing existing materials—notably salvaged structural timber—to the greatest extent possible. Duane Allen, GSA project manager based in Auburn, Wash., explains that the construction firm, Sellen (www.sellen.com), and architectural millwork firm GR Plume (www.grplume.com) determined that the original timbers in the building could not be sawed, because sawing the timbers into new sizes would result in cracked and unusable lumber. The design firm, ZGF Architects (www.zgf.com), committed to figuring out how to use the existing sizes as they designed and engineered the application of the timbers.

Before the timbers could be put in place, however, 190,000 board feet of timber and 150,000 board feet of 2x6 decking had to be carefully removed and shipped to GR Plume for reworking and recovery. "The modernized building at Federal Center South will end up using at least 140,000 board feet of timber that will be installed in the heart of the building," notes the GSA's Allen. "The reuse of the timbers is not only environmentally friendly, it also preserves a part of the history of the original warehouse."

Hitting the 95% mark for recycling. For the restoration of the 1922 Beardmore Block building in Priest River, Idaho, Seattle-based architect Brian Runberg, AIA, reused salvaged wood and just about anything else that was not damaged beyond use in reusing an impressive 95% of original building materials. Plaster was used as parking lot underlayment, water-damaged flooring was planed deep enough to reuse as wainscoting, and toilets were reconfigured and refinished. Even old boiler metal pieces were cut up and reformed into metal art sculptures and furniture.

Sometimes, however, it's just not physically possible for Building Teams to preserve as much as they would like to. For the Bennington (Vt.) Courthouse project, the team ultimately had to yield to mold and moisture conditions in much of the existing building material. Another difficult choice had to be made regarding a one-story section of the original building. In the end, it was torn down to make way for a better performing three-story section.

COURTESY ZGF ARCHITECTS

A 1940s warehouse building, originally constructed by the U.S. Army and subsequently owned by Boeing and the GSA, will soon become a high-performance office building for the U.S. Army Corps of Engineers in Seattle. It will be the first building in the Northwest region to combine geothermal with structural piles.

MYSTERIES AND SURPRISES BEHIND THE WALLS

In any form of reconstruction—gut rehab, renovation, adaptive reuse, historic preservation, interior fitout—Building Teams often find themselves having to rethink their strategies upon discovering unknowns behind the walls. "Existing buildings always have conditions that are surprises," says RDG's Scott Allen. "You're just not able to see through the walls and floors."

For instance, during construction inside the Old Des Moines Library, the contractor found that some of the structural bearing points were no longer supporting the floor or roof. In this case, all it took was a new structural bearing point for the steel members and the installation of an additional beam to support the load.

However, one of the exterior freestanding sandstone

This 1950s paper warehouse was adaptively converted into the new Livestrong Foundation headquarters for Lance Armstrong's cancer support nonprofit in Austin, Texas. The contractor, SpawMaxwell (a Balfour Beatty company), ran into a snag when the wood ran short. The Building Team found a match in a supply of wood salvaged from the bleachers of the famous Gilley's honky-tonk club in Pasadena, Texas.

COURTESY LAKE|FLATO ARCHITECTS

COURTESY PAUL HESTER/LAKE|FLATO ARCHITECTS

The Livestrong Foundation utilized 88% of recycled/reused materials, remilled salvaged roof decking, and repurposed concrete. It features an opened façade and roof with clerestories, an ultra-high-efficiency variable-volume-refrigerant mini-split system, and lighting controls.

columns supporting the roof over the entrance was found to have a crack. "We placed a monitor on the crack, while at the same time providing temporary shoring to take the load of the roof, while a solution to repair the column was found," says Allen. "The solution was to pin the column with stainless steel rods and repair the surface of the sandstone."

Still more surprises awaited the Old Des Moines Library team when they found large portions of damaged or missing clay flooring tile compromising the structural integrity of the historic structure's flooring system. By placing shoring under the floor—to support the clay while correcting the damaged tile—the contractor was able to insert a metal deck to span the beam spacing, and then poured new concrete to reconnect the floor to the original clay tiles, according to Allen.

One of the most significant federal reconstruction projects is 1800 F St., N.W., Washington, D.C. Designed by New York architect Charles Butler (1871-1953) and completed in 1917 for the Department of the Interior, the E-shaped Neo-Classical structure is on the National Register of Historic Places and has been the headquarters of the General Services Administration (and the Public Buildings Service) since 1949.

Phase I of the 724,000-sf, $200 million ARRA-financed project is being managed by a joint venture of Whiting-Turner and Walsh. Designed by the A/E team of Shalom Baranes, STUDIOS, and Syska Hennessy Group, it has employed heat-reducing glass on the infill, graywater management, and green roof technology. LEED Gold is anticipated.

"The hidden treasures found behind walls can reveal decaying or hazardous materials, unanticipated craftsmanship issues, or conditions different than the as-built drawings would indicate," says Dean Smith, GSA project executive on 1800 F Street. "We found undocumented abandoned fuel tanks, elements that needed to be brought up to current code, as-built conditions that were improperly documented, and material that had surpassed its usefulness. It's like the game 'Whack a Mole'—every time an issue pops up, you knock it out."

One problem that SERA Architects accidentally stumbled upon during the Oregon Department of Transportation project was interfacing with the city stormwater system. Even though the team had designed a rooftop rainwater harvesting system so that rainwater could be used to flush the facility's toilets—and keep it out of the city stormwater system—the team was forced to contend with a dilapidated city system well into the project.

In retrospect, Stuart Colby, NCARB, LEED AP, a SERA associate principal and the firm's government studio leader, says, "It's unclear that there are ever diminishing returns when it comes to due diligence, even given the challenges of doing so in an occupied, historic building. Once you have 100 to 200 workers on site, the cost of making changes is dramatic." For those reasons, he recommends doing extra investigation in the early stages of any reconstruction project.

Fortunately, thanks to building information modeling and a full laser scan completed just after demolition of the 1950 ODOT building, other potential surprises were largely obviated. "We worked with the laser scan and Navisworks to make sure the structure matched the historic building drawings, and it was almost spot on, with the exception of a couple of low areas where we had to reroute some electrical conduit," says Becky Epstein, LEED AP, a SERA project architect.

CODE CHECK: PUTTING UP ANOTHER HURDLE

Working on historic structures also presents the challenge of following preservation guidelines to maintain the project's historic integrity, which can sometimes conflict with the incorporation of modern technology, as was the case on the Aspinall project.

The design-build team's original proposal called for a prominent canopy to support a large PV array spanning the entire roof. "The reasoning which we felt met the intent of *The Secretary of the Interior Standards Guidelines for Historic Preservation* was that the canopy structure was not a permanent addition to the building and could be removed as PV technology improved and the original panels reached the end of their useful life," recalls the GSA's Jason Sielcken.

However, through the 106 review process—a reference to the section of the Advisory Council on Historic Preservation's Protection of Historic Properties standard, which requires federal agencies to follow certain guidelines when working on projects listed in the National Register of Historic Places—the decision was made to modify the canopy's size. By scaling back, the canopy's impact on the south façade's prominent site line was minimized; on the east and west façades, the canopy will not be visible from the building's edge.

The reduction in the canopy's size actually prompted the design team to reexamine ways to reduce the building's overall energy use now that the roof's capacity to support the PV load was being reduced. Ultimately, this led to a higher-performing building envelope, a geo-exchange system, and more elaborate metering and controls. "We were actually able to reduce the overall project cost and keep net-zero a realistic goal," says Sielcken.

Similarly, the Des Moines library project struggled with PV visibility issues as it related to preserving the building's historic character. "This was our 'difficult,' 'fun,' 'challenging' element of the project, walking the line between the energy efficiency and historic requirements

Reconstruction: Finding the Fun in the 'Unexpected Surprises'

Those involved in reconstruction and adaptive use agree that the fun and excitement of working on such projects ultimately outweighs the difficulties.

"It's always great to inherit structures from the past. They tell a story," says Marc L'Italien, FAIA, LEED AP, a design principal with EHDD, San Francisco. "I personally find dealing with old structures more interesting because it takes you in directions that are often out of your control. The challenge is to stay open-minded, as renovation projects bring unexpected surprises and you need to adapt to these unforeseen conditions."

William Maclay, AIA, LEED AP, a principal with Maclay Architects. Waitsfield, Vt., says, "The real excitement in working on reconstruction/renovation projects is the major impact we can make on U.S. energy usage."

The original Beardmore Block Building in Priest River, Idaho, designed by architect Brian Runberg's great-grandfather, Charles Beardmore. Runberg learned the history of the building through his grandmother and yearned to reconstruct it to current LEED standards.

Brian Runberg, AIA, a principal with Runberg Architecture Group, Seattle, says he enjoys the process of exploring the building's "bones" and projecting himself into the past to imagine how the building was used and how it functioned. "Every building has a past life, and there is a responsibility to honor, respect, and acknowledge that rich history."

This was especially true for Runberg during his restoration of the 1922 Beardmore Block Building in Priest River, Idaho, as it was his great-grandfather, Charles Beardmore, who built the original building. "This was particularly personal, having known the building as a child and learning its past through my grandmother," he says.

COURTESY RUNBERG ARCHITECTURE GROUP

The LEED Gold-certified Beardmore Block Building features high-efficiency HVAC with economizer controls, enhanced insulation, low-e insulated glazing, a roofing upgrade, and occupancy sensors. The project achieved a 32 kBtu/sf/year measured energy use, coming in at 66% below an average U.S. office, for an annual cost savings of $23,370.

for the many grants used to assist in funding the project," says Scott Allen.

Although the University of Vermont and Bennington Courthouse projects were not strictly historic preservation projects, Maclay Architects had to deal with another code issue: meeting current earthquake standards. Because the building envelope was such an essential component of both projects, and the code required the addition of a seismic joint connecting the old and new building sections, detailing was critical.

"This became an incredibly complex part of the design as the new codes required designing for quite a large amount of movement between the existing and new building sections," says Maclay.

WHAT RECONSTRUCTION TEAMS WOULD WISH FOR

Upon reflecting on these noteworthy high-performance reconstruction endeavors, project teams were invited to make a "magic wish" that would enable such projects to run more smoothly in the future.

A few designers lamented an overall lack of appreciation for the value of existing buildings. "The industry needs a way to talk about the value of existing buildings and why we should keep them," states SERA's Colby.

While the recent National Trust for Historic Preservation study, "The Greenest Building: Quantifying the Environmental Value of Building Reuse" (http://blog.preservationnation.org/2012/01/24/preservation-green-lab-releases-new-report-on-the-environmental-value-of-building-reuse), is a step in the right direction, Colby maintains that having a rigorous methodology to evaluate existing buildings—one that the real estate market can agree to and accept—is going to be critical in the future.

Harris says he wishes that the industry had the tools and data to readily understand the economic, environmental, and social value of revitalizing existing building stock. "With some 300 billion square feet of existing buildings in the U.S. alone, the implications for the future are immense," he states.

The GSA's Dean Smith would like to see an open database where "the wealth of knowledge in dealing with historic materials and solutions developed to integrate the old with the new" would be stored—perhaps under the National Building Museum, the National Science Foundation, or a similar agency or organization.

SERA Architects' Clark Brockman raises the perennial concern about building owners' shortsightedness when it comes to investing in improvements. "There is a massive disconnect between short-term investment and long-term building efficiency and operation," he says. "The value of designing well-built [reconstructed] buildings is simply not understood in the marketplace. We really need to expand the understanding of this point by the public and legislators to create a 'new normal' to really understand what the payback should look like in a 50- to 100-year building." +