

A Brick Rehab Meets LEED's Highest Standards

Solar panels aside, you can't see the upgrades that make this downtown remodel so energy efficient

BY RICHARD RENNER

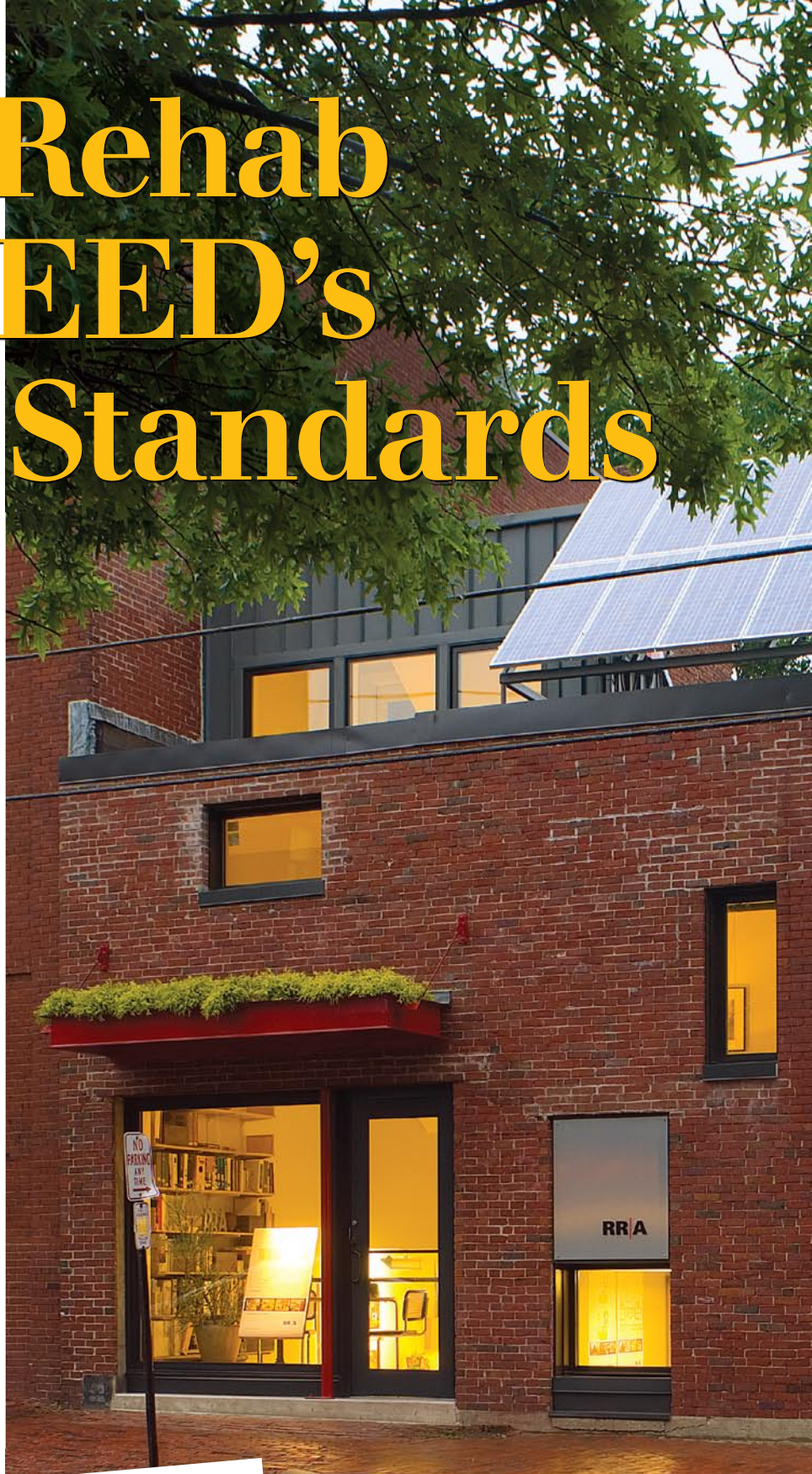
When a building that housed an old clothing store and apartment went up for sale near my architecture firm's office in downtown Portland, Maine, I jumped at the opportunity to buy it. As principal of a firm specializing in green design, I believed that it was time for me to start living the talk. Also, my wife, Janet Friskey, and I wanted a home and office in one location.

After a perhaps too-quick budget analysis, we purchased the building and began to formulate a comprehensive design program. The goals were to have an efficient building envelope for our apartment and for my firm's office, to introduce more daylight to the interior, and to create open plans so that the spaces seemed generous. Because our firm had just completed a new home that was certified LEED Platinum, I hoped to achieve that level with this project.

Space allocation follows the light

We began by assessing what the building's basic elements offered. My wife, who is a graphic designer, and I worked

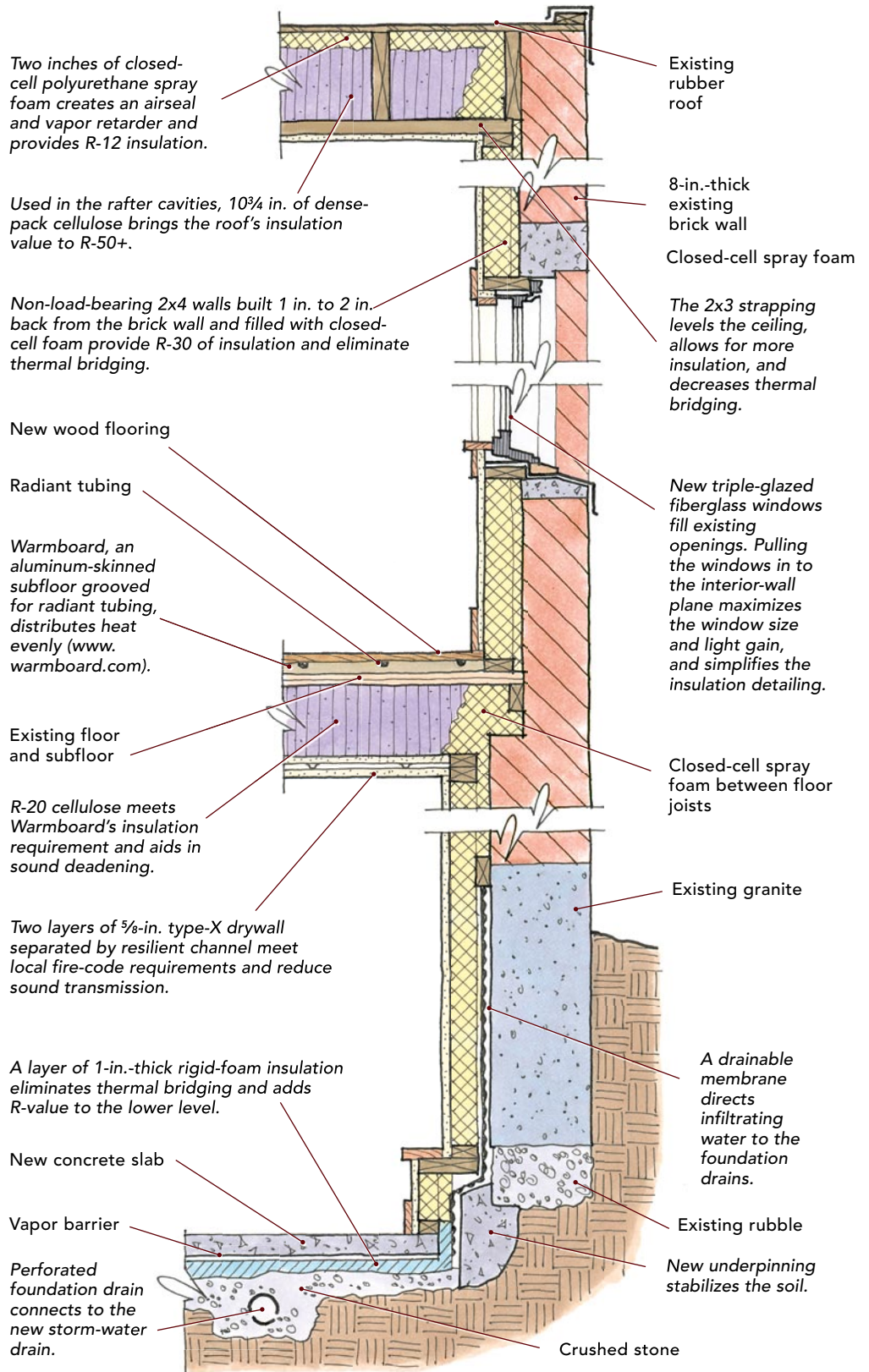
A commute that leaves no carbon footprint. Despite the lack of insulation and unappealing facade, the original building had green appeal: an urban setting zoned for mixed use. So along with a face-lift and energy-efficient makeover, the author made the first level his firm's offices and the second his residence.





A THERMAL ENVELOPE HIDES THE BRICK

As nice as they are to look at, old brick buildings are not energy efficient. An 8-in.-thick brick wall like the one in this project has an R-value of about 1.6. To create a tight thermal envelope without affecting the exterior, insulation and drainage systems were added to the brick walls from the inside. The result is a comfortable, healthful building that achieved a HERS rating of 43 (for more on HERS, see p. 18), exceeding even the most aggressive energy standards today.



How we earned LEED's highest rating

Building a new space to LEED standards is relatively easy; rehabilitation is a challenge. I developed a draft of the LEED for Homes checklist to set goals and to guide our design process.

With the checklist in hand, we began working with Horizon Home Energy (www.horizon-res.com), which prepared the initial computer model, did progress inspections, and administered the final blower-door test (a measure of the efficiency of the home). Fore Solutions (www.fore-solutions.com) acted as the local LEED provider. As an agent of the U.S. Green Building Council (www.usgbc.org), they answered questions and helped us to adapt standards and requirements primarily intended for new homes to our renovation.

Our urban location gave us many site-location points, but it was not always clear

how points would be awarded by reusing an entire building. That fact became frustrating. For example, we were given points for use of an existing building, but did not receive points for repairing the roof instead of replacing it.

In most cases, we were going to use sustainable-design strategies anyway; we just needed to know where they belonged in the rating system. Completing a preliminary checklist early is essential; it helps to structure and guide the design and construction processes.

The only real challenge was adapting a standard that was written more for stand-alone new homes to an urban-rehab project. I think LEED for Homes could be refined to respond better to projects such as mine, but because we achieved a Platinum rating, the system can't be too wide of that mark.

together on the design of the residence, and my staff and I collaborated on the office.

In terms of overall design and structure, we knew we wanted the office on the lower level because the storefront would give us visibility and light. On the other hand, the upper level had high ceilings and lots of windows, so it was ideal for the residence. The upper level also had potential access to the roof, so we could install a deck and maintain a solar collector and vegetative roof. At the suggestion of Jim Robbins, the senior architect in my office, we raised part of the roof to create a study loft and a light monitor.

A demolition plan minimizes impact

Regardless of its complexity, a renovation project will run more smoothly and minimize its environmental impact by having a demolition plan. The plan details what elements will be removed and how they will be dealt with, whether reused, recycled, or treated as waste. Here in Portland, a demolition plan is required by code to control debris removal.

The first phase of our plan required gutting the interior. All finishes and non-load-bearing elements were removed because they were of poor quality, were in the wrong places for my ultimate design, or restricted access to the exterior walls for insulating.

In an effort to minimize the amount of waste that ended up in the landfill, our demo plan specified that demolished material be taken to a municipal facility that sorts, recycles, and reuses waste. Similarly, construction waste was sorted on site.

In hopes of saving the existing lower-level slab, we excavated carefully around the edges to install perimeter drains, but we found that there were no footings. After realizing how out of level the existing slab was and assessing how much of that slab had to be removed for underpinning and drain installation, I gave in to the realization that the slab had to go.

Lucky for us, removing the entire lower-level slab was the only unexpected demolition. Although removing the slab added an unplanned expense, it allowed us to add 11 in. to the height of the lower level, install a gravity drainage system, add insulation below the slab, and create a level finished floor.

The exterior needed less effort. We selectively repointed the brick and repaired the existing roof membrane. We also had a structural engineer analyze the roof. Because the building had never been properly insulated, snow accumulation had not been a problem. But with new insulation under the flat roof, we had to count on significant snow loads. Also, the



Monitoring sunlight and headroom. The roof monitor brings light to the second-story living space and creates headroom for a lofted study, which in turn creates necessary headroom for the first-floor office below. Perforated-steel panels hide the cluttered study but allow light to pass.





No load-bearing partitions here. Steel I-beams and sistered rafters reinforce the roof, leaving a wide-open floor plan. Placing the entry foyer where the loading dock was makes use of an existing opening. Maintaining the long view makes the narrow space feel much larger than it is. High-efficiency appliances, fluorescent fixtures, and ample daylighting help to keep utility bills low. FSC-certified flooring, trim, and framing lumber; bamboo plywood cabinets; recycled-content tile; and PaperStone counters add to the building's sustainable interior.

adjacent building is taller than ours, creating additional snow-drift loads. Further, we added a roof monitor as well as a vegetative roof, so the engineer had several elements to consider.

Not surprisingly, he determined that the roof structure had to be reinforced and recommended adding wide-flange steel beams to the main carrying beams. Interestingly, the steel reinforcement was just for bending, so the wide-flange sections welded under the existing beams stopped just short of the exterior walls and did not have to be pocketed into the brick. The flanges of the new beams were slightly wider than those on the existing beams so that once the new beams were placed tight to the bottom of the old, the connection was a simple fillet weld.

Brick is out, foam is in

Exposed brick might look nice, but exterior brick walls offer little R-value and aren't airtight. Insulating our brick walls was a must. Our building's exterior is right on the property line, so adding insulation on the outside

was not an option. Also, I wanted to preserve the brick and maintain continuity with the aesthetics of the neighborhood. Our only option was to add insulation inside.

To create a continuous thermal envelope, we ran stud walls adjacent to the brick, holding them back at least an inch. We filled the 1-in. space and the stud bays with closed-cell spray-foam insulation to yield an R-value above 30 and reduce thermal bridging. The roof got 2 in. of closed-cell spray foam and at least 10 in. of cellulose, creating an R-value above 50.

Aside from its obvious thermal benefits, the foam creates an excellent air barrier. We also placed 1 in. of foam insulation below the slab, which is much less than I would have liked, but drain-pitch requirements limited slab height and ceiling height.

All existing single-glazed metal-sash windows were replaced with triple-glazed insulated fiberglass-



frame windows in line with the rest of the thermal envelope. The triple-glazing also reduces street noise. The storefront window is double-glazed because at this size, triple-glazed was cost prohibitive.

Separate spaces need separate systems

I approached the mechanical systems for the upstairs and downstairs a bit differently. The office has basic heating and essential cooling needs, so we outfitted it with a gas-fired furnace, an air-conditioning unit on the roof, a heat-recovery ventilation system, and on-demand hot water. The loft has an efficient gas-fired condensing boiler, radiant heating with two zones, a heat-recovery ventilation system that also filters air, a two-zone mini-split air-conditioning system for occasional cooling needs, and a 1-kw grid-tied solar panel.

Because the residence is so tight, there was no doubt that we needed mechanical ventilation. I opted for heat-recovery ventilators because they reduce the energy needed to condition the fresh outside air and filter it as well.

In addition to using Energy Star-rated appliances and fluorescent lighting, we tried to maximize daylighting as much as possible to reduce energy consumption. The bathroom in the upstairs residence is windowless, so we installed tubular skylights, which bring in plenty of daylight. Ironically, there is enough urban light pollution that we can often see sufficiently at night, eliminating the need for a night-light.

Payback is cumulative and relative

I installed the 1-kw grid-tied photovoltaic panel more for philosophical than financial reasons. But it is also an attractive architectural element outside that helps to advertise the firm's commitment to environmentally responsible design. For the spring and summer months, the panel has been supplying half or more of the total electrical demand for our residence. The total load is relatively small, though, so the payback is slow.

Even though it typically has a better payback, I decided against solar hot water because our personal use is not high, the office uses little hot water, and there isn't much room for storage. On-demand hot water has been perfectly adequate, and overall energy use remains low.

The building-envelope upgrades were the best investment. The premium windows and insulation we used cost about 20% more than what code required and pay off monthly. Other design elements probably yield cost savings as well. For example, when the windows in the apartment are all open, the air circulation allows us to turn off the air conditioning. Ten months of utility bills indicate that it cost less than \$400 to heat the apartment last winter. □

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A green roof installed by lunchtime

Roughly 460 sq. ft. of the roof is vegetative, planted with succulents. There are a number of benefits to this roof style. It lowers the temperature in the spaces below, creates a habitat for birds and insects, protects the roof membrane from UV-degradation, makes the roof attractive, and reduces storm-water runoff. We used a do-it-yourself system from GreenGrid (www.greengridroofs.com) that included plastic trays, bags of soil, and plant plugs. The cost of installation was \$4 to \$5 per sq. ft., not including the cost of reinforcing the roof.

Installation was simple. The 2-ft. by 2-ft. planter trays and individual bags of soil were delivered on a pallet. Two days before installation, UPS delivered the plants. I rented a ladder lift, and my wife, several hired workers, and I arranged the trays, dispersed the soil, and placed the plant plugs in the trays. The work went quickly; we started at 9 a.m. and finished around noon. The only glitch was that plastic pieces from the drainage-hole punch-outs were still in the trays. When I noticed that, I was afraid the sharp plastic would damage or puncture the roof, so we had to be extra careful not to allow them to fall onto the rubber membrane as we laid out the trays. The manufacturer corrected this issue so that future trays made would be free of them.



Rooftop succulents. Trays filled with soil and perennial plants help to manage storm-water runoff. The 2-ft.-sq. trays can be placed in any pattern, provided the roof's structure can handle the extra 15-lb.-per-sq.-ft. dead load.

FineHomebuilding.com

Look for the Magazine Extras section on our home page to see a video of this roof installation and to learn more about green roofs.