From the street, the remodeled building looks much like it did in 1842 (inset), but it's a lot more comfortable to work in and easier to maintain.

A Historic Building Gets an Energy Upgrade

Satisfying the commissions while bringing an 1840s building up to 21st-century energy-efficiency standards presented a challenge

by Andrew Borgese

Back in 1842, when Captain Thomas Davis built a classic Greek Revival house in the seaport of Woods Hole, Mass., homes were heated with wood or coal, and whale-oil lamps lit the inside spaces. Insulation was rarely considered a building component. Fast-forward a century and a half. Davis' former residence still sits prominently on a hill overlooking Vineyard Sound and historic Woods Hole, but over the years its many owners have used it for many different purposes. Most recently, NPR station WGBH purchased the building as a home for local affiliate WCAI.

Compromise, Not Conflict

When WGBH took over the building in 2009, it was clad with asbestos shingles (**see Figure 1**) and the asphalt roof was failing. The walls and roof had little or no insulation, most of the exterior trim needed replacing, the two brick chimneys were crumbling, and the original double-hung windows were in poor condition. In short, the building had serious structural and energy-efficiency problems, as well as a lack of wheelchair accessibility. But its location within a historic district meant that any work done to the exterior of the building had to be approved by the local Historic Districts Commission.

Historic-preservation and energy-efficiency advocates often find themselves in conflict when it comes to renovation issues. On one side are purists who believe that altering any part of a historic building is sacrilegious; on the other, energy conservationists who believe that reducing energy use should take precedence over all else. However, as the designers for this project, we were able to find common ground between the two camps — the desire to extend the useful life of existing buildings for as long as possible — and that became our starting point.

We began by researching the building's history. The Woods Hole Historical Collection and Museum shared several archival photos of the original structure, giving us glimpses of details that had been lost over time, including a front porch with an ornate entry door. These photos also confirmed the original exterior trim details. We prepared a plan that honored these historic elements while incorporating features that would improve the home's longevity, ease of maintenance, and operating efficiency.

Figure 1. Before the renovation, the building was essentially sound, but the years had not been kind to it. Asbestos shingles covered the walls (left), and much of the trim had deteriorated beyond saving. As the exterior layers were peeled back, any of the original cyprus trim that still had life was set aside to be reinstalled later (above).

We presented our plan to two different commissions: the Historic Commission, which had to approve the work done to the exterior of the building, and the Community Preservation Commission, which was helping to fund the renovation. Altogether we attended a half-dozen meetings. To qualify for funding, the work also had to be done within the Secretary of the Interior's Standards for Rehabilitation (cr.nps.gov).

A New Old-Looking Exterior

Both commissions were primarily concerned with the outside of the building — how it would look and what materials would be used to make it look that way. The outer shell was also where we would have the greatest impact on raising energy efficiency.

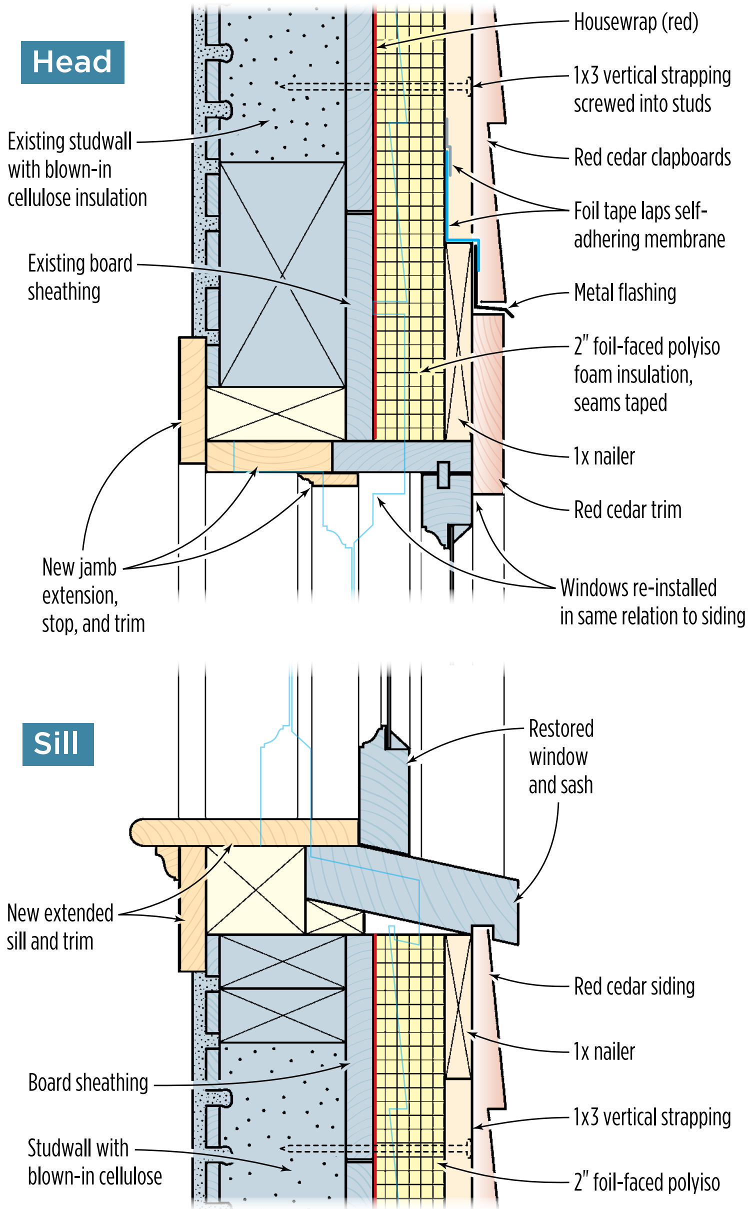
The Standards for Rehabilitation require that materials be repaired and reused wherever possible, so as the outer layers of the building were peeled back, we set aside any such material. Once the original board sheathing was exposed, we were able to fill the empty stud cavities and rafter bays with dense-packed cellulose insulation from the outside. Next we wrapped the walls and roof with a layer of 2-inch foil-faced polyisocyanurate foam insulation, taping the seams to complete the air and moisture barrier and provide a thermal boundary (**Figure 2**).

On the walls, we installed vertical strapping over the foam and put 1-by nailers around the windows and doors to serve as backing for the trim and siding. We added a strip of Cor-A-Vent (coravent.com) along the bottom and top of each wall to create a vented air space behind the new red cedar beveled siding. To attach the new red cedar roof, we screwed 5⁄8-inch Zip System (zipsystem.com) roof sheathing over the foam according to the manufacturer's instructions, providing a continuous nail base for the shingles (**Figure 3, next page**).

The extra layers of foam and nailers

Figure 2. Before the nailing strips went on, cellulose insulation was blown into the walls; housewrap was attached to the original sheathing (above) to keep the cellulose from leaking out. Then the walls were wrapped with foil-faced foam and the seams taped. Vertical strapping was screwed through the foam and into the framing to attach the siding and trim (left). Extra stock was later added around window and door openings for nailers. Vent strips were installed at the top and bottom of each wall for drainage and to allow air to flow freely behind the clapboards (bottom).

Window Installation Details



added about 5½ inches to the overall width and length of the building and 2½ inches to the height, changes that both commissions found acceptable as long as we faithfully reproduced the eaves, rake, and return details (**Figure 4**). The original trim on the building was cyprus, and we repaired and reused what was salvageable. We used red cedar for any replacement trim, a choice that was cost-effective and met the commissions' requirements. (Neither synthetic trim nor non-wood siding was an acceptable option.)

One area where the commissions left no room for compromise was the windows. They insisted that we reuse every window deemed original. And they insisted that the windows be re-installed in the same relation to the siding as on the original building (see illustration, left). Therefore, all original windows were taken off site and painstakingly restored before being reinstalled. Non-original windows were replaced with new units that closely matched the originals. Though single-glazed, the restored windows were much more airtight than they had been previously, and interior storm panels improved their performance even more.

The only requirement the commissions had for inside the building was that we work within the Standards for Rehabilitation guidelines. We connected the three levels with a new code-compliant stairway and turned the walkout basement into usable space (see "Parking and Accessibility," facing page). We also reinforced the structure with metal connectors where they were needed and added beams in strategic places.

Reinstalling the windows. To match the original building façade, the restored windows were mounted flush with the furring strips. This required jamb extensions (top) and deeper sills (above) to accommodate the thicker wall.

Figure 3. Plywood sheathing, screwed through the foam insulation on the roof and into the rafters, provided continuous nailing for the red cedar roof shingles. The seams were taped per the manufacturer's instructions, and a mesh drainage layer went between the sheathing and the shingles.

Improved Performance

The new insulation raised the R-values in the walls and roof from practically nothing to over 30. More importantly, we created a much tighter envelope with almost no thermal bridging. Blower-door tests done before and after the renovation confirmed that air-infiltration levels were down to a third of what they had been. The budget did not allow for the entire mechanical system to be replaced, so we upgraded to much more efficient condensers on the hvac units. These improvements have translated into a significant reduction in utility costs — and have made the building much more comfortable to work in.

The last element of this project was reconstructing the porch and formal entry door that we'd discovered in the old photographs. Through the successful collaboration of historic and energy interests, the entire building today looks more like it did in 1842 than it has in generations, even as it exceeds the latest energy-code requirements.

Andrew Borgese *is founding principal of Integrata Architecture and Construction (integrata-ac.com) in Falmouth, Mass.*

Figure 4. When the trim went back on the building, original detailing was followed as closely as possible based on archival photos and the trim that was removed (above). Metal connectors and beams were added where the old structure needed strengthening (left).

Parking and Accessibility

Local zoning required minimum on-site parking, and code required that the newly renovated lower level be wheelchair-accessible. An inside elevator was not feasible, so a new exterior stairway was built from the parking area behind the building at the main level, with a ramp and an electronic chair lift that follows the site topography.