Balancing Nostalgia with Efficiency

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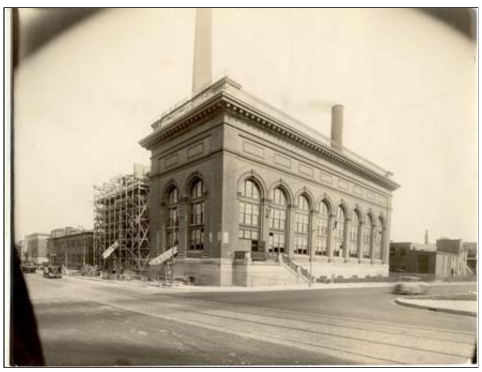


Historical photo of 46 Blackstone Street when it was functioning as a coal switching house. **(Harvard University Operations Services)**

Retrofitting historical buildings for greater energy efficiency is no easy task for those also interested in faithfully preserving an aged structure. This was certainly true for the team involved in the sustainable renovation of the **46 Blackstone Street** complex, now used as a Harvard University Operations Services (HUOS) facility.

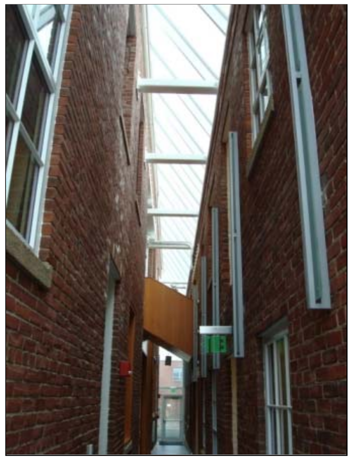
From the get-go, HUOS set high green goals for the 40,000 square foot brownfield reclamation project that combined three adjacent structures built between 1889 and 1926, one of which had functioned as a Cambridge Electric Light Company coal switching house.

The biggest challenge was improving the energy efficiency of the draft-prone nature of the building's heavy masonry structure, a common hurdle for buildings of this age. Heating typically accounts for a much larger energy investment than cooling, and this is certainly true for buildings like the Blackstone in cooler areas of the country. However, since Harvard is able to produce and distribute their own cheap steam heat (powered by oil and natural gas and distributed through underground tunnels), the team would focus on overall building efficiency and low-energy cooling and air circulation requirements.

Brickwork is notorious for its tendency to allow heat to pass through it freely. But as one of the building's most attractive qualities, the designers were hesitant to cover it over altogether. Working closely with the **Cambridge Historical Commission**, the team eventually came to a compromise. Most of the interior brickwork would be finished with **Icynene** spray foam insulation and then finished with sheetrock. The insulation is an open cell foam tested to allow the free-flow of water vapor while blocking the passage of air and liquid water. This is important since, were the insulation to trap moisture against winter-cooled brickwork, the moisture would freeze, tearing the brick apart.

"It's a really delicate matter," according to Henry Moss, one of three **Bruner/Cott** principals on the design team. "In a way it's all very low-tech, but people have been unable to do this in the past."

While essentially an irreversible modification, portions of the historical brickwork were maintained by adding a unique feature: a Light Slot connecting two of the adjacent buildings. By covering over a space that was otherwise a runway for rats, "we now have two huge walls which used to be external that are now internal, but we no longer have heat loss and gain through them," comments Moss. This freed the team to leave the interior brick along these expanses exposed, while also creating a covered passage for getting from one building to the other.



The unused expanse between buildings A and B was turned into a lightslot, reducing heat loss. **(Harvard University Operations Services)**

Once the air leaks were addressed, it was time to think about how to cool the space. Two standing column geothermal wells remove heat from the building through a heat rejection process. Generally much deeper than closed loop wells, in this case 1,500 feet deep each, the vertical installation of standing column wells (SCW) makes them ideally suited for areas where land is at a premium. Their installation is also cheaper than closed loop systems.

SCWs remove heat by pumping cool water from the bottom of the well and re-injecting warm water at the top. At the Blackstone building, hydronic valance units installed near the ceiling circulate the cool well water. As the room temperature raises the temperature of the water, it circulates back to the wells to be cooled again. This system, which requires less energy than using electricity to run an air conditioner, has a significant positive effect on the building's carbon dioxide emissions. **Eastern Connecticut State University** installed a similar system in their high-rise residence hall that cuts heating and cooling costs **by 80 percent** and provides domestic hot water, too.

Further savings for both the heating and cooling systems are obtained through a zero-energy air circulation system. Forcing air through a building via fans and pumps often accounts for 20 percent of the total electricity use. The Blackstone system relies instead on free, clean, natural convection: a **hydronic valance system** has the added benefit of fewer visible ducts and less rooftop and ground-level equipment, which are easier to coordinate with the look of exposed beams and ceiling decks in historic industrial space. A hydronic heating system can also be found on the **California College of the Arts** (San Francisco) campus in a retrofitted **1950s Greyhound Bus building**.

To complete the picture, the building was installed with operable, low-e glass, double-hung, argon-filled aluminum windows that preserve the look of the building in their old-world design and act as an ultra-efficient and functional "first line" of cooling. Working from two originals, the team matched the profiles, then designed the easy-to-operate awning window to look like a double-hung sliding sash.

This old building appears to have attained a significant energy-saving boost through the retrofitting project, but there have been a few hiccups along the way, and efficiencies are likely to be less than those achieved by building new, even with embodied energy taken into consideration.

"I think it is harder to reach the same performance levels as new construction when we adapt historic structures," suggests Moss. "It is generally much more difficult to integrate new building systems into historic interiors in a visually satisfactory way, but

Not Just About Energy:

Known by the community for over 100 years as a coal switching house, the project had some serious soil contamination challenges. Moving the soil proved too expensive, but none of the neighbors wanted toxins leeching into the nearby the Charles River.

The team therefore mounted a complex excavation project, their operation can still be quite sophisticated."

Buildings similar to the Blackstone typically have heating and cooling ratios around 70-30, and although data on Blackstone's performance has not yet been published, the team anticipates the building's envelope and systems designs to result in a 40 percent decrease in overall energy consumption.

carefully mounding the soil where it wouldn't cause problems, covering it with soil and plants. A bioswale was also created to filter storm water entering the river.

Yet sometimes systems don't perform as well as expected. The efficacy of the geothermal system, for instance, was less than anticipated due to the narrow temperature differential between warmed water from the valance system and cooler groundwater as temperatures increase during summer. Combined with the comparable operating costs between this system and conventional cooling towers or split-system air conditioners, some might view the zero-carbon cooling system's price too high.

Was it worth it? According to Moss, if you're not in it for the long haul, it may not be. "The paybacks are not short term. That is why this kind of building makes so much sense for institutions that will continue to own, maintain, and operate their buildings.

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