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The Greenest Building Is the One that Doesn't Need Rebuilding

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Embodied energy encompasses all of the materials, transportation, and labor required to construct a building. Attention to detail conserves this energy by promoting longevity.

With the news media and the profession in a frenzy over "green building" and "sustainable design," public perception plays a greater role in defining environmentally conscious architecture than does responsible building practice. New certification programs, such as the US Green Building Council's Leadership in Energy and Environmental Design (LEED) Green Building Rating System, attempt to quantify building performance in terms of environmental impact, yet the criteria used for awarding accreditation tend to be skewed in favor of popularly identifiable "green" strategies, such as verdant roofs or light-responsive louvers.

While it is important to place value on recycling waste water or incorporating natural lighting and ventilation into building spaces, neglecting less sound bite-savvy basics, such as proper waterproofing and appropriate installation, can have catastrophic environmental consequences. No matter how energy efficient a green roof might seem to be, tearing the entire assembly off and dumping it in the landfill in a few short years because the underlying waterproofing membrane fails has a more detrimental impact on the planet than would a traditional roof, designed and installed properly, that lasts its full twenty-year-plus lifespan.

Embodied Energy

Each time a building is constructed, energy is consumed. In addition to the usage of raw materials, energy is expended at each step in the process:

- Manufacture/extraction of materials
- Transportation to site (both of materials and of labor)
- Construction
- Demolition
- Reconstruction

The energy required to construct a building can be considered "embodied energy," stored within the structure. When a building or a portion of a building is demolished, this energy is lost.

In a recent project, Hoffmann Architects was asked to evaluate and rehabilitate the concrete block walls of a prison facility. The structure had been built a scant five years earlier, and would have scored a number of points on the LEED rating system: the walls contained an energy-efficient six inches of insulation, well above the standard. Because a prison's requirements differ from those of other structures, the design needed to be especially sturdy and resistant

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Hoffmann Architects is a member of the US Green Building Council.

to damage, as well as long-lasting with minimal maintenance requirements, since, with prison overcrowding, cell blocks cannot go unused for long periods while upkeep repairs are performed.

What the design overlooked were the details. Poor design and construction methods permitted extensive water entry into the wall cavity. Due to the constant presence of moisture, mold spores developed and proliferated, creating a health hazard for staff and inmates. Ultimately, the decision was made to completely rebuild all of the exterior walls; the mold, an environmental toxin, would then require expert remediation. Meanwhile, additional energy (and taxpayer dollars) would need to be expended on specialized construction methods and added security for the duration of the project.

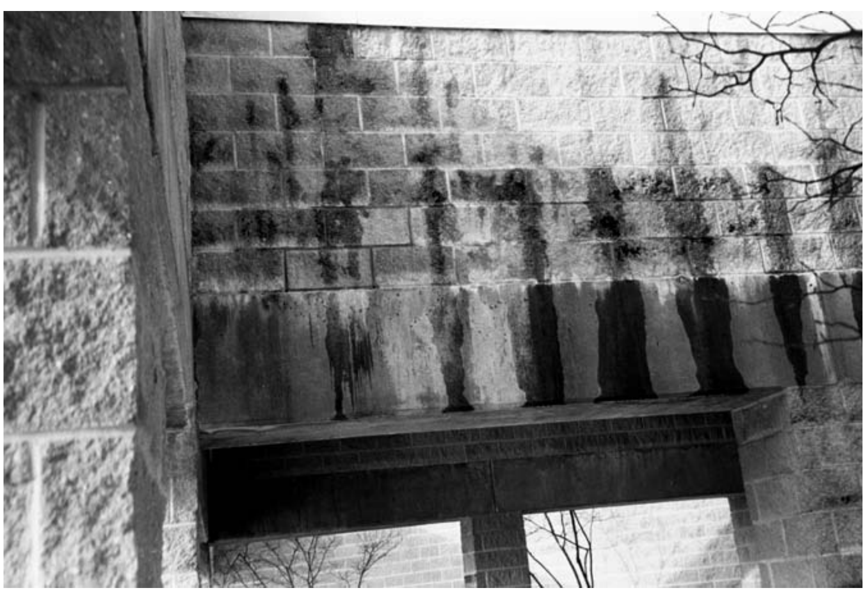
Losing the embodied energy of such a substantial structure after only a few years of service could have been avoided quite simply with proper attention to details and construction. While decidedly unglamorous concrete block detailing might not fall under the common parlance of "green building," the environmental impact of neglecting such details can be significant.

The Integrated Envelope

Building exterior systems are interdependent, and cannot be treated as isolated entities. In an effort to implement energy improvements in an existing structure, building owners sometimes fall into the trap of taking quick-fix measures to tighten their energy belts. At best, such solutions will probably not lead to significant energy savings; at worst, failure to consider the interrelatedness of building components can actually cause new problems, or exacerbate existing ones.

Single actions, such as adding insulation, replacing windows, or sealing cracks, can potentially lead to other problems if not considered in terms of the building enclosure as a whole. Should indiscriminate use of sealant, for instance, lead to trapped water inside a façade, then the potential environmental benefit of improved airtightness is negated by the energy and material expenditure of rehabilitating—or even replacing—the moisture-damaged wall.

Inappropriate "band-aid" repairs are not only unsightly, they create additional impact on the environment when they fail or, worse, damage surrounding building elements, which in turn require repair.



Failure to properly detail and build this concrete block wall left it open to water entry, which led to toxic mold growth. Exterior wythes must be demolished and rebuilt, wasting materials and energy.

The best bet, then, is an integrated approach, beginning with assessments of the building's condition, design, and construction. Improvements tailored to the specific needs of the structure can then be implemented holistically, with expert recommendations and construction oversight to see that the program of upgrades is well suited and carried out correctly. Thoughtful planning helps to insure that the financial and environmental benefit of such measures isn't lost to remediation of ill-conceived actions in the near future.

The Greenest Building Is…the One that Gets the Most Attention?

While it is true that incorporating green technologies into a structure can be an opportunity to call attention to a company's commitment to the environment, press coverage could turn negative should those modifications prove ineffective or, worse, detrimental. Ultimately, the real environmental value of building improvements can be assessed only by enhanced

Correct detailing of roof penetrations and building intersections can make the difference between a roof that must be thrown out and replaced in a few years, and one that's still going strong at twenty.

building performance, not by the public response to the upgrades.

Design details don't draw the kind of attention afforded the grander gestures of a living building face or system for reclaiming rainwater. But they are just as critical to minimizing ecological impact. As an example, for a building addition, it is not enough to draw a wall section only through the most common part of the structure. How that wall will meet existing construction, turn a corner, or open to penetrations are details that tend to be brushed aside, but these overlooked design elements are essential to building a watertight, long-lasting structure. By trusting the most complicated and difficult intersections to a contractor's imagination, designers shirk responsibility.

Unfortunately, precise architectural detailing rarely captures the attention of the news media. Motivation to articulate and oversee design details is therefore lower than is the drive to make bold and elegant environmental statements. Still, the embodied energy lost by demolishing and replacing poorly detailed portions of such a "green" structure would take decades to recover, even for the best-performing building.

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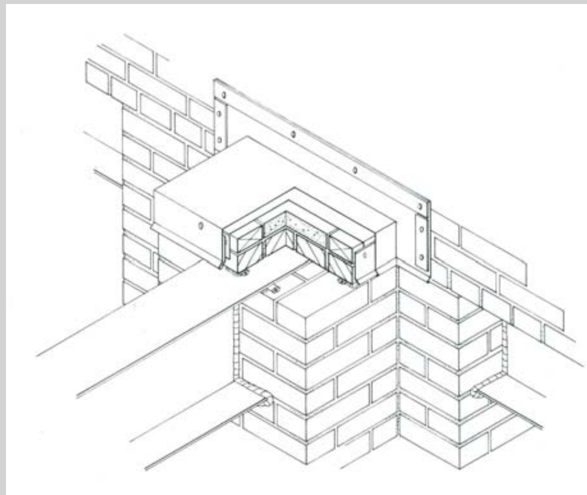
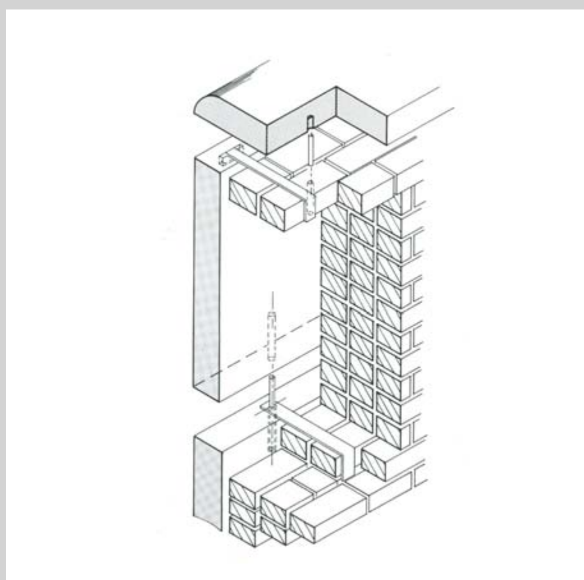
It's in the Details

Three-dimensional cut-away views illustrate proper placement of each component, while assuring that the detailer has considered each intersection and termination. *Below:* Pilaster cap detail.



Exploded views, as supplements to numerous sections and details of components, help workers understand assembly sequences and procedures. *Below:* Limestone panel and coping resecurement to three-wythe brick back-up.



Note: Waterproofing under coping stone and between limestone panels is shown on other details.

Historic Applications

Preservationists have been touting the environmental benefits of rehabilitating and reusing older buildings for decades.

The National Trust for Historic Preservation reminds building industry professionals that regardless of how sustainably designed and constructed a structure may be, any new building creates a new impact on the environment. They note that rating systems like LEED were developed originally for new construction, and that the words "rehabilitation" or even "reuse" don't seem to factor much in sustainable building discussions.

Historic structures, remarks the National Trust, were often built to be more energy efficient than are today's structures, in that their thick walls, high ceilings, natural lighting and ventilation, long-lasting roofs, and siting for optimal weather exposure were designed to maximize available resources. Still, even a slate or metal roof with the potential to last over 100 years must be designed and installed correctly to reach its full lifespan, and it must be preserved over the years with appropriate upkeep and skilled repairs. If maintenance work is performed improperly, the resultant damage could potentially have a greater environmental (and financial) impact than if no work had been done at all.

A Case in Point

Hoffmann Architects was called in to evaluate a leaking flat-seam copper roof on a historic landmark structure. The recent roof replacement had used historic materials that should have had a century-long lifespan, but poor soldering at installation had led quickly to water infiltration.

Because the improper installation is not repairable, the copper roof would have to be completely removed and replaced once again. Although copper can be recycled, energy must be consumed in melting, re-forming, and re-installing it. Instead, the owner may have no choice but to place a 20-year rubber roof atop the 100-year copper one to waterproof it. Sustainability and historic integrity had both been compromised by an inattention to details.

Refurbishing, rather than replacing, older buildings saves energy and materials. Here, restoring steel windows preserved historic character while minimizing costs and ecological impact.

Real Green Buildings May Not Look Green

Even buildings built more recently, in the 1950s to 1980s, when energy supplies seemed endless and little effort was spent on efficiency, are best rehabilitated to meet current energy standards, rather than demolished and rebuilt. Because these structures are so abundant, the embodied energy wasted on abandoning them would be significant enough to take centuries to recover through any improved operating efficiency.

But as we rehabilitate these buildings, we need to eschew showy "green" improvements in favor of simple, well-designed performance upgrades, some of which may be credited only with a supporting role. ■

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Sometimes, the least expensive, least impressive solution also has the least environmental repercussions.

Designing for Durability

In a review of sustainable building rating systems, the American Institute of Architects (AIA) notes that LEED "does not require the generation of life cycle assessment data for a certified project." What this means, then, in terms of accreditation, is that the longevity of building components—the likelihood that they will fail and need rehabilitation or replacement—is not considered of much consequence to green design. Of course, the term "sustainable," that is used nearly interchangeably by the press with "green" to mean environmentally responsible, means "able to continue for a long time." In other words, it must possess the qualities of durability and longevity.

The ***life cycle*** of a product encompasses not only its extraction or manufacturing, transport, and distribution, but also the environmental burden of the material's use, maintenance, recycling, and final disposal. A ***life cycle assess-***

ment, then, attempts to identify and quantify the impact of energy consumed and wastes released during the lifespan of a particular material, system, or process, or of a building as a whole.

While the commonly used rating systems do place some emphasis on the portion of a material's life cycle before it becomes part of a built structure, by awarding points, for example, for locally harvested or recycled materials, these criteria fail to consider the life cycle of materials *after* construction, particularly if the installation has been poorly conceived or executed. Use of locally sourced, reclaimed cedar for cladding is certainly environmentally preferable to virgin wood extracted thousands of miles from the site, but if construction failure necessitates replacing the cedar with fresh stock in a few years, any environmental benefit is negated. LEED's failure to consider detailing, durability, and appropriate installation in their rating program is an oversight with potentially great environmental repercussions. If a building system or assembly has a short lifespan, then, by definition, it is not sustainable.

Maintenance Considerations

Another element of sustainability involves the energy and material expenditures associated with maintenance. Materials and design strategies chosen for their longevity not only reduce the environmental ramifications of frequent replacements, potentially, they can minimize maintenance and repair efforts.

While LEED and other rating systems do offer points for sustainable improvements that lead to documented reductions in building operating budgets, they do not specifically reward facility management programs that plan for routine maintenance and timely repairs, two key elements in maximizing the longevity of building components. Indeed, such "green" building standards can be rather short-sighted about the functional demands of building envelope components. To prevent minor problems from becoming pervasive, major ones, the remediation of which demands extensive consumption of energy and materials, a facility manager must commit to a maintenance practice centered on thorough inspections and diligent upkeep.

> *"The environmental impact of neglecting details can be significant."*

Awarding twice the points for "green cleaning" approaches as for innovations in operations, of which maintenance programs are only one component, means that the chemical, material, and energy wastes associated with remedial construction are considered practically negligible in the sustainable building equation, as compared with the choice of plant- or petroleum-based floor polish. Opting to use environmentally friendly cleaning practices is clearly laudable, but the overall effect of such practices is ultimately not as great as is the impact of forgoing inspections and maintenance and permitting the growth of biohazardous mold.

The Sustainable Building Enclosure

Good building practice, including appropriate materials specification, detailed document preparation, adherence to details, and skilled installation, may not be the buzzwords of the green building initiative, but failure to keep proper detailing at the forefront of any construction project can take a substantial toll on the environment.

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What's wrong with this picture? Through-wall flashing is not turned up inside the wall, corner laps are insufficient, and reinforcing bars penetrate flashings. The result: multiple points for water entry.

Appropriate, timely maintenance and repairs are critical to sustaining building materials. Investigation into a problem's cause prevents the additional financial and environmental burden of duplicate repairs.

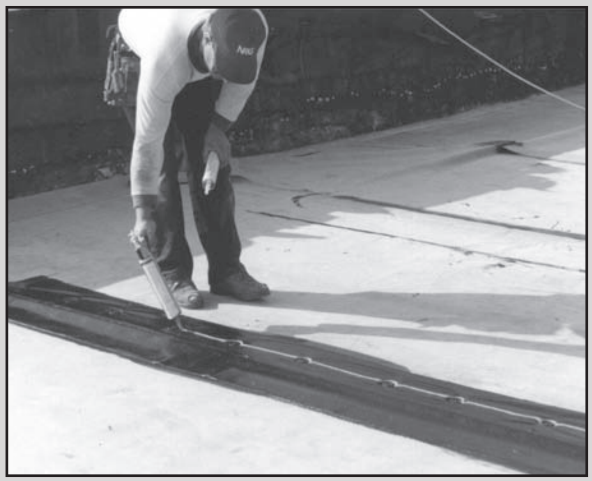
Design flaws permit water entry and lead to premature breakdown of components. After only a few years of use, this plaza must be ripped up and replaced, wasting energy and resources.

Learning the Lingo: Green Building Practice

Life Cycle Assessment: Evaluation of a product's or process' environmental impact by quantifying the energy and materials consumed and wastes released during its lifespan, encompassing extraction, processing, manufacture, transportation, use, re-use, maintenance, recycling, and disposal.

Embodied Energy: Quantity of energy required to manufacture/extract, transport, and install a material or product.

Sustainable Design: Arranging the built environment to integrate with, perpetuate, and preserve the natural world. In addition to ecological vitality, the design may also incorporate measures to encourage economic, social, or physical well-being.



Green Building: Practice of increasing the efficiency of buildings and minimizing environmental and human impact through improved waste management, materials selection and usage, resource consumption, siting, design, and operation.

LEED Rating System: The Leadership in Energy and Environmental Design (LEED) Green Building Rating System was developed by the US Green Building Council (USGBC), a nonprofit building industry group advocating for sustainable building practice. LEED is a third-party certification program that establishes criteria for measuring building performance, environmental and human health impact, and sustainability.

Building Envelope: Exterior enclosure of a structure, including the façade, roof, foundation, and plazas/terraces over occupied space.

Construction Failure: Premature breakdown of building components due to substandard or improper construction, design defects, material failures, or poor workmanship.

Architectural Detail (also, Construction Detail): Large-scale drawing that provides focused attention to the design, location, composition, correlation, and intersection of components in a critical and/or standard building element, such as flashings, joints, closures, or penetrations.

Building Performance: Energy efficiency, economic viability, health quality, and environmental impact of a structure. High-Performance Buildings minimize resource consumption and waste production, while optimizing the well-being of occupants and of the surrounding community.

representative projects

Sustainable Solutions

Hoffmann Architects designs sustainable answers to building envelope problems not just because it's the catchword of the day. We've been creating innovative, long-lasting solutions to building distress and correcting the effects of construction failure for over three decades.

Our approach to challenging deterioration situations makes details a priority and considers building exterior components as a dynamic system, to develop integrated programs that are both cost-effective and environmentally sensitive. If a rehabilitation effort must be reconstructed due to poor design or construction, then the additional energy and materials expended creates a negative ecological impact, no matter how "green" the original design.

Improving building integrity and creating effective, lasting solutions to exterior envelope problems has been Hoffmann Architects' specialty since 1977. A few examples:

York Correctional Institution
Niantic, Connecticut
Building Envelope Integrity Remediation of 22 Buildings

GE Building
Rockefeller Center
New York, New York
Façade and Roof Rehabilitation, and Rainbow Room Window Replacement
National Trust for Historic Preservation Award

Radio City Music Hall, Rockefeller Center in New York, New York. *Landmark Façade and Roof Rehabilitation that received the National Trust for Historic Preservation Award*

Performing Arts Center and Campus-Center South
State University of New York (SUNY)
Purchase, New York
Roof Repair / Replacement and Plaza Rehabilitation

Renwick Gallery
Smithsonian Institution
Washington, District of Columbia
Water Infiltration Investigation and Façade Rehabilitation

Bureau of Engraving and Printing
U.S. Department of the Treasury
Washington, District of Columbia
Limestone Façade Investigation and Repairs

Gillette Castle
East Haddam, Connecticut
Roof Consultation and Building Envelope Investigation

Campus Tower Building
Montgomery College
Rockville, Maryland
Curtain Wall Replacement

National Air & Space Museum
Smithsonian Institution
Washington, District of Columbia
Water Infiltration Investigation and Terrace Rehabilitation

New York Stock Exchange
New York, New York
Façade Rehabilitation and Reroofing

United States Capitol Building in Washington, District of Columbia. *Water Penetration Study and Dome Restoration that received the AIA New England Regional Council Design Award*

Inappropriate materials selection can mean early replacement—and wasted resources. When wind pressures proved too great for the self-adhered insulation on this roof, the material pulled apart and shifted under the membrane.

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No matter how many points a project nets on LEED or another such rating system, construction failure can negate any potential benefit from green technologies in a couple of years—or fewer.

If the roof leaks or the walls crumble, it matters little that they were made of recycled denim or harbored a population of local plant species. The building exterior must still operate as a sound enclosure, one that protects from the elements and shelters occupants in comfort. When poor design or installation compromises these essential functions, the problems must be addressed, creating a new impact on the environment with each remedial project.

The movement to recognize sustainable building strategies is timely and important. But in our haste to jump on the environmental bandwagon, let's not neglect the basics of sound building design that have sustained our structures for centuries. ■

JOURNAL is a publication of Hoffmann Architects, Inc., specialists in the rehabilitation of building exteriors. The firm's work includes investigative and rehabilitative architecture and engineering services for the analysis and resolution of problems within roofs, facades, glazing, and structural systems of existing buildings, plazas, terraces and parking garages.

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