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The High Line: Reclaiming Urban Assets | A Call for Resourceful Architecture
(Re)Designing Education | 9 Things to Know About Pro Bono | Eco Web 2.0

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A Call for Resourceful Architecture

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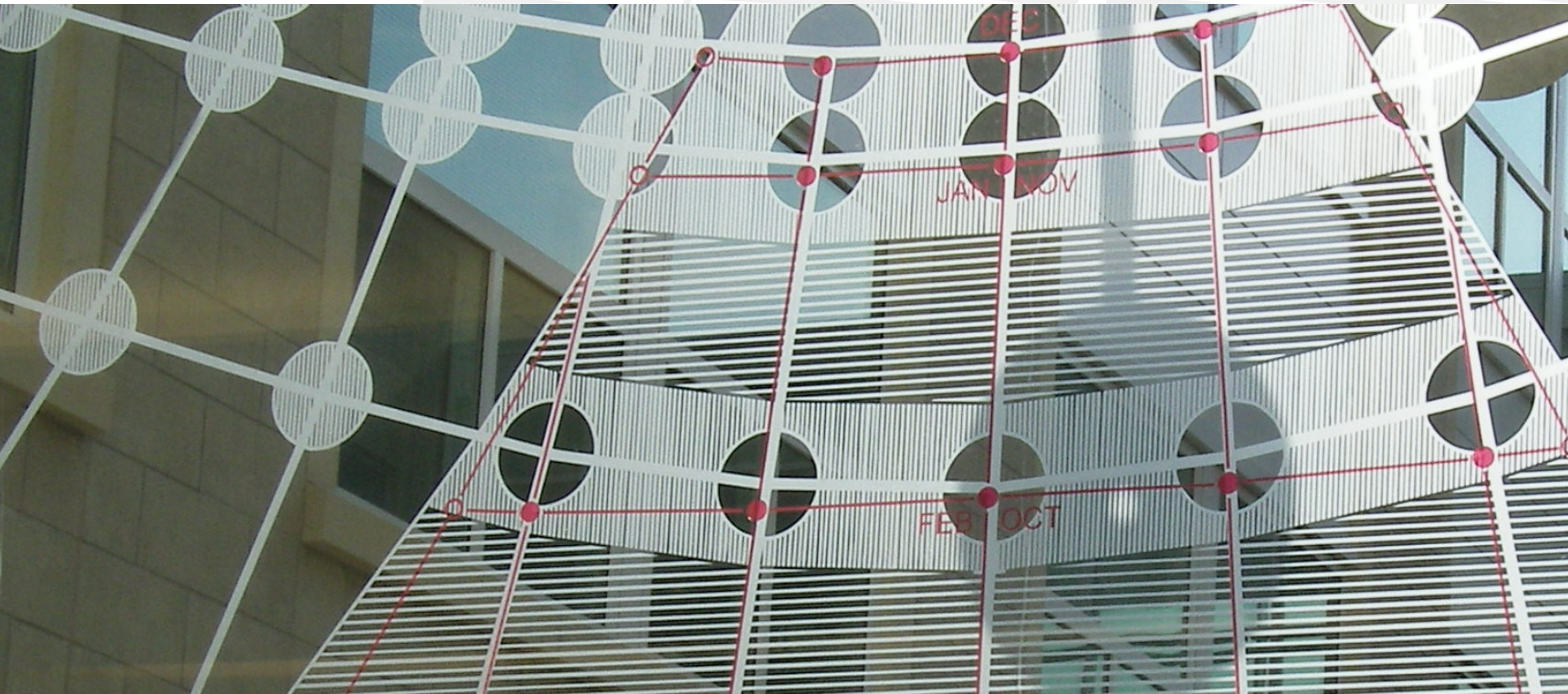
A founder of sustainable and `green' architecture in America and recipient of the USGBC's National Leadership Award in 2005 and 2008, Mr. Croxton has led his firm in their receipt of the profession's highest award for sustainable design, the National AIA COTE `Top Ten' Award in three consecutive years: 2005, 2006 and 2007. Having authored the first sustainable design green guidelines in 1994 (preceding LEED 1.0 by four years) and more recently the precedent-setting World Trade Center Sustainable Design Guidelines issued in 2003, Mr. Croxton brings a unique perspective to the challenges and opportunities of building in the post 2008/2009 Economic Meltdown Era, moving beyond conspicuous consumption to a more durable and sustainable prosperity.

The solar clock/ calendar at Johnson Hall of Science measures hours, days and months via the daily traversing point of sunlight.



First things First

New York City has evolved a dense, inherently efficient urban order supported by an exemplary mass transit system. More recently, Mayor Bloomberg has initiated a well-publicized sustainability initiative and we see heavily marketed 'green' buildings popping up on a regular basis. Given these very positive developments, one could easily conclude that the City is well on the way to a sustainable transformation and that 'carbon neutral' or 'energy neutral' buildings are just around the corner. However, much like the futuristic predictions of the 1950s and 1960s which envisioned fleets of personal helicopters as the solution to traffic jams in the New York of 2000, these expectations will first have to be tested against the realities of economics, demographics and the laws of physics. In truth, we have a long way to go.

Our current "Green Building" models, even the best of them such as the US Green Building Council's LEED Rating System, are still awarding buildings with little or no improvement in energy efficiency. Projects registered prior to June 26, 2007, have no minimum energy performance required beyond the ASHRAE 90.1 code while those after that date must achieve energy savings of 14%. In 2008 approximately 10% of the LEED projects awarded had no energy points.[1] More importantly, the measures of success continue to reward a "finish line" building. That is, you get your Silver or Gold or Platinum award based on compliance with a checklist of universal, pre-set performance objectives at the time of initial occupancy.

If we are to move to the next level of sustainable performance in architecture (i.e. as described by objectives of Architecture 2030[2] and other pathways to carbon neutrality) we must break this 'finish line' mentality and begin to create 'future-directed' buildings. By this I mean a more open-ended architecture that is a facilitator of business/technology flexibility and evolution of mission over time. Among the strategic advantages of such a building:

Maintainability

You can't begin to address sustainability until you have solved maintainability. The value of a building over time depends on design for fully enhanced ease of access to all systems for repair, maintenance and replacement.

Continuity of Operations/Mission

This fundamental design attribute creates 'access mapping,'© a protocol which enables retrofit and maintenance without interruption of ongoing functions.

Benign Renovation

Avoidance of Destructive Demolition:
Interior design/detailing for 'facilitated disassembly'©; massive reduction in toxins and particulates = reduced health risk/liability.

Sustainable Transition Planning

The key strategic attribute of a building's design in the 21st century is the anticipation of sustainable upgrades over time. Maximum solar harvest and next generation renewable upgrades need to be quantified and anticipated in the 'opening day' design.

These four strategic advantages are not embodied in our current green models. More importantly, our most publicized exemplars of sustainable design tend to carry a very high price tag. As a result, 'green' buildings remain marginalized, representing less than 10% of new construction. No matter how many studies are developed to show that the additional cost of 'green' buildings is only 5% or 3% or 2% or less, the impression is left that they cannot be achieved within market rate constraints of schedule and budget.

An unfortunate contributor to this pattern is that many architects view the sustainable or 'green' dimensions as add-ons to their building as usual. This attitude results in highly visible added costs that are often eliminated during the value-engineering process or give birth to yet another more costly 'green' building.

The Johnson Hall of Science was awarded New York's first **LEED Gold** certification for a university while keeping construction costs **25% below** the regional benchmark.

In the early days we envisioned that the LEED framework would not only provide third party affirmation and industry consensus, but would also act as "training wheels" to bring the practitioner's attention to the vast array of value-enhancing design strategies that are inherent in sustainability and its 'triple bottom line' approach (more about that later). Once these potentials were identified, we felt that architects would naturally move on to higher levels of sustainable performance in buildings. Unfortunately, in practice the LEED guidelines, like many a code reference before, have all too often become a stopping point. Having taught a course, 'Architecture and Sustainability'[4] to architects over the last fourteen years, I have often heard the lament that the client does not want to spend a penny more than what is absolutely required to achieve a given LEED point. My own experience is that the owner has no objections to these added values if they are achieved within the project budget.

In order to have national impact and to undertake the challenge presented by 'carbon-neutral' buildings we must first be able to demonstrate an overall 'resourceful architecture' which can be built at no net 'green premium.' That is to say, a rigorously efficient and economical building concept that is integrated into the design process

South Elevation

from day one and leaves the economic 'room' in the overall budget to deliver sustainable/environmental excellence at the benchmark (typical) costs for a building type in its region. This in no way precludes the client who wishes to provide a generous or experimental exemplar of sustainability at whatever budget they choose, but such projects are the exception to the rule and will not provide the basis for a consensus pathway forward.

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The new Johnson Hall of Science, which Croxton Collaborative Architects recently completed for St. Lawrence University in Canton, NY in collaboration with Stubbins Associates, is an example of this 'resourceful architecture' and achieved the highest statewide levels of environmental performance for its building type. There were no illusions of extra money for 'green'; on day one we were told that the University was interested in pursuing the project as LEED Certified (the lowest level of designation), "if we can afford it."

In March 2008, Johnson Hall of Science was awarded LEED Gold, the first university building in the State of New York to achieve a Gold or Platinum LEED designation. The construction cost for the building was $263/sq.ft. which is approximately 25% below the regional benchmark price for University Bio-Chemistry Teaching Labs.[5] The surrounding images convey the slender wings of the building (fully day lit) which form a large sheltered 'outdoor' room bounded on the south by a 2-story glass bridge. The entry lobby acts as a 'solar observatory' whose main feature is a full-height, full-width solar clock/calendar (dial plate) against which a point of light traces the solar time of day and seasonal change by month.

The exterior wall and glazing have been optimized for day lighting, glare control and thermal performance at this extreme north latitude; however, the composition and geometry are very straightforward and constructible. The economy that flows from the simplified exterior wall and relatively spartan interior materials palette is transferred over to the sophisticated full-range dimming/fully addressable lighting system as well as the project's incorporation of the highest performance glazing system then available and sloping ceilings that create a much larger space for the light-filled labs. Saint Lawrence University took delivery of the first commercial installation of the PPG Solarban 70XL glass which exemplifies the importance of the high-performance tracking process at Croxton Collaborative Architects that facilitated this strategic upgrade during the construction phase.

Beyond the LEED Guidelines and the economies of cost per square foot is the strategic significance of additional design performance resulting from the design team's commitment to a process of continuous improvement. Following is a list of five specific attributes not currently incorporated in LEED that serve to advance best sustainable practice.

Dramatically daylit labs feature transparent hoods, optimum ceiling shapes for 'deep daylighting' and continuously dimming ceiling fixtures that capture the economy of the natural light.

Life Safety, Daylit Spaces and Outdoor Rooms

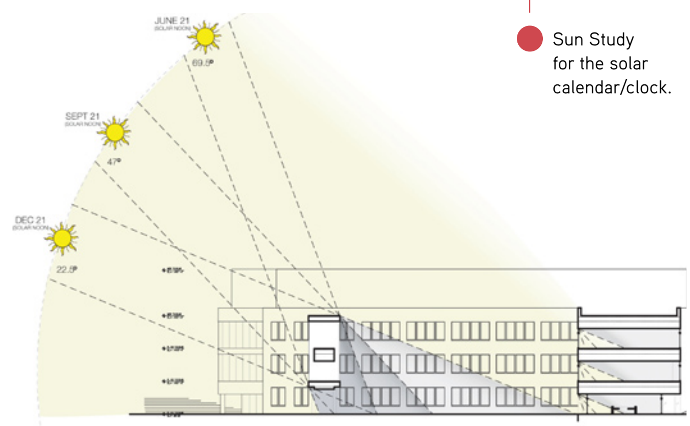
Going Beyond LEED and Current Practice, Johnson Hall not only achieves the Daylight and Views Credit, but also brings additional levels of borrowed light into all public corridors, assuring each occupant a visible pathway for egress even if all building systems fail. Breaking open the typical science building mass into slender parallel wings, orienting north/south and connecting the two upper floors on the south end of the building with glass bridges, has also created a sheltered wind break and solar 'catchment' for the limited winter solar loads at this northern setting. The indoor/outdoor connection is a constant reality to all building occupants; during daylight hours, all rooms receive 50% indirect light and 50% diffuse/controlled light as the sun crosses its path from the highest to lowest point.

Science Mission: First Translucent/Transparent Solar Calendar/Clock

Going beyond LEED and Current Practice, a defining artistic and analytical expression of solar traverse at Johnson Hall has been etched into the Main Entry Lobby glass wall facing directly south. A gnomon mounted on the Solar Court side of the glass casts a round shadow and center point of light that moves across the outer symbolic etched pattern (this pattern is the familiar sun angle pattern typically used for reference/analytical purposes). This same point of light passes through to the interior face of the glass which has a calibrated red grid which provides an observationally correct reading (by month, day, hour) of the moving point of light through the entire year with December (Winter Solstice) at the top and June (Summer Solstice) at the bottom.

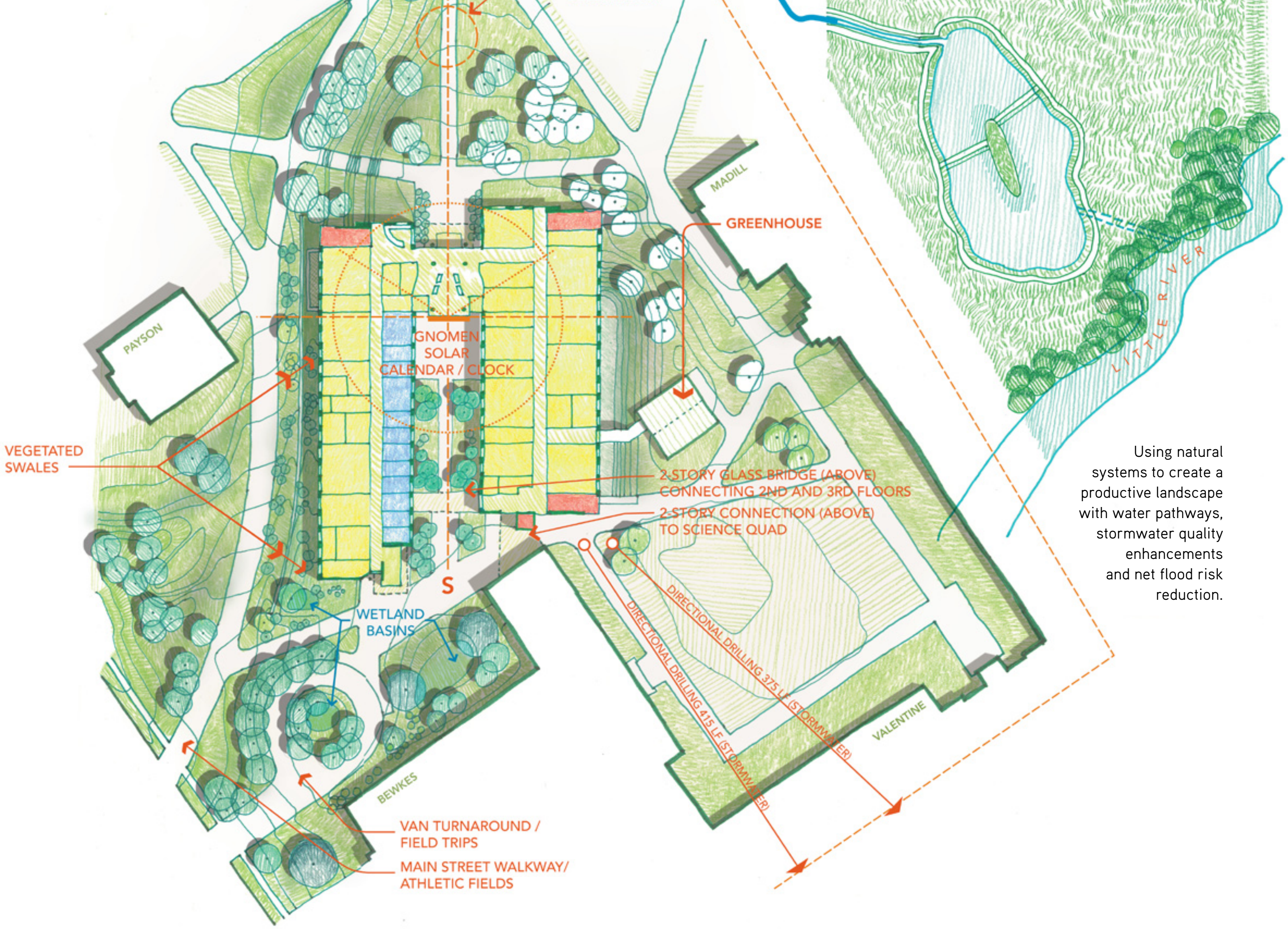
Resourcefulness: First Principles and Gravity Driven System

Going Beyond LEED and Current Practice, Johnson Hall of Science not only achieves the Storm Water + Sustainable Sites Credit, but also (in consultation with St Lawrence Faculty and students) incorporates a new constructed biofiltration wetland next to the Little River which treats both the project's storm water and, in addition, the previously untreated storm water from the grouping of adjoining buildings on an additional 6.7 acres of campus for a total of 11.2 acres. A key sustainable site attribute for this system design was the advantageous drop in grade down to the Little River. However, a combination of sub-grade obstructions to the east and the continuous line of classroom buildings to the south were forcing a conventional in-basement pumping system. Both the University and Design Team engineers supported this approach. However, the architectural design team was ultimately able to propose an improvised approach using an oil-exploration technology (very ironic) called slant drilling which allowed two 8-inch pipes to pass under the existing Valentine Hall. The new sewer and storm lines achieved 100% gravity feed to the treatment plant and constructed wetland.



Sun Study for the solar calendar/clock.

View of the transparent solar clock/calendar from the entry lobby. The 'outdoor room' beyond is formed by the parallel lab wings and two-story glass bridge.



Using natural systems to create a productive landscape with water pathways, stormwater quality enhancements and net flood risk reduction.

A detailed cost-benefit analysis demonstrated that although drilling costs exceeded $60,000, the equipment, construction, maintenance and energy costs for the four eliminated pumps were returned in two years of operational savings:

Cost savings of $6,627,500 over 100 year life cycle.

Avoided 778 tons of CO2 emissions.

Avoided 4.3 tons of acid rain impact.

Health and Well-Being: Optimized Building Flush-out

Going Beyond LEED and Current Best Sustainable Practice, the architectural design team independently placed temperature/humidity sensors (data loggers) around the building throughout the (current best practice) flush-out procedure to ensure that ideal conditions were met over time, rather than depending solely on the set points of the Building Management System (BMS). In reviewing this data, fluctuations in these temperature/humidity levels exposed the failure of one of the project's large fan motors which was replaced midway through the flush-out process. The total flush-out was allowed to run beyond what was required to provide a margin of safety for the flush-out effort.

Process Management: Early Integration and LEED Proficiency at Contractor

Going Beyond LEED and Current Best Sustainable Practice, the General Contractor was not only selected early (at Design Development) and integrated into the team, but a separate requirement in the contractor's documentation/invoicing process created a LEED/sustainability interface on the construction team side of the equation. The contractor's representative was required to pass the LEED accreditation exam and to vet all submissions for completeness before they left the contractor's office. Ultimately the contractor's own sustainable initiatives proved essential to our 'upgrading' over time from the initial goal of Certified to Silver and finally to LEED Gold.

So in the category of 'First Things First' we can see that there are immediate and urgent enhancements needed in our current 'green' buildings baseline. Our next challenge is to address the now-urgent challenges and opportunities presented by the more inclusive concepts of sustainability and the 'triple bottom line' approach.

Lesson from the Global Roller Coaster

Beginning in September of 2008 and extending through early 2009, the global community has experienced a harrowing demonstration of our now near total interconnectivity with all other nations. In addition, the dramatic fluctuation of energy prices in 2008 was one example of hyper-competition among nations over a global resource. It signaled the rising pressure on markets in the face of unbridled patterns of consumption. In the late 1980s the Bruntland Commission, in an epic bit of foresight, put forward a re-conceptualization of the global economic framework under the name: Sustainability. First fully outlined in Agenda 21 at the 1992 UN Earth Summit, "sustainability" sought an approach to development that balanced the three E's, that is the interlinked goals of economy, environment and equity. In the ensuing 17 years this conceptual framework has gained enormous currency and consensus among nations and cultures. What we have apparently been missing was a crisis of the magnitude we now confront to appreciate the fundamental wisdom of sustainability and begin to act.

The built environment is the dominant physical form of economic development and the single greatest driver of the patterns of energy and resource consumption in the world. We used to think of design in a superficial way, as more a question of style or symbol (an adjunct to branding). More recently design has been characterized as a key driver of competitive advantage. At this point in time, we can state that sustainable design is the driver of global competitive advantage and, quite simply, all competition has become global.

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New York City is one of the nerve centers, if not *the* nerve center, of this dramatically demonstrated 'global village.' Our architectural firm, very small by New York standards, is not unusual in having completed projects in Saudi Arabia, Japan and (hopefully) India. It is hard to imagine any substantive business endeavor in the future that will not have to answer for the role they play in our global commons; and what net restorative or net destructive impacts are inherent in their realization of their mission.

Now we are in the early aftermath of the train wreck of conspicuous consumption, misplaced values and unsustainable leveraging of questionable assets. There has not been an equivalent time of crisis in the entire range of the natural and built environment since the UN Earth Summit of 1992 first articulated the global sustainable model. If this crisis point provides the shock to the system that is needed to get our house in order, it will have served an essential purpose.

Johnson Hall,
north elevation.

Looking forward

In closing, we can imagine a number of strategic concepts we will need to employ as we approach the carbon-neutral ideal. (Although not immediately evident, these basic strategies apply to all scales from single story to skyscraper.)

- The typical energy densities of our buildings and our rules of thumb will be replaced by ultra-low energy densities (70-80% reductions).
- The focus on passive forms of energy strategy will become essential (i.e. daylighting, all beneficial thermal exchanges, all solar thermal, all future photovoltaic potential, all bio-fuel flexibility and super self-aware buildings to harvest these assets).
- The innovative use of air, water and soil that interface to orchestrate optimum thermal assist will be essential in successful 'hybrid' systems.
- Cross-balancing energy uses between complementary building types and functions will be greatly expanded.
- Accommodating more and more programmatic uses in 'tempered' outdoor/indoor spaces and hybrid rooms that reverse roles during seasonal change will become common.
- Buildings will go beyond the BMS (Building Management System) reporting model to active levels of self-assessment and optimization of the varied array of passive strategies.

And what will the living experience in these new buildings be like? They will be user-centered, mission-supporting, stable, reliable, secure, adaptable and the product of a new 'resourceful architecture': inherently low-risk, high-value and humanistic.

References

1. Compiled from LEED project profiles posted online at www.usgbc.org

2. Architecture 2030 is a private initiative launched in 2003 by Ed Mazaria specifically addressing Climate Change and Buildings and setting a goal of 'carbon neutral' buildings by 2030.

3. © 2005 Croxton Collaborative Architects

4. Harvard Graduate School of Design: Executive Education Program, 1995-2009

5. Confirmed by 2008 R&D Magazine Annual Survey and zip-code specific adjustment for regional cost variance as confirmed by 2008 RS Means Construction Cost Data

Related Resources

The Philosophy of Sustainable Design by Jason F. McLennan

Rating system developed by Jason McClennon called the Living Building Challenge (LBC)

Catalyst Blog

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