A GreenSource BOOK

# Green Building Through Integrated Design

Jerry Yudelson
Foreword by Leith Sharp, Harvard University

ICC INTERNATIONAL

# GREEN BUILDING THROUGH INTEGRATED DESIGN

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# GREEN BUILDING THROUGH INTEGRATED DESIGN

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# About the Author

**Jerry Yudelson, PE, MS, MBA, LEED AP,** is the Principal of Yudelson Associates, a green building consultancy based in Tucson, Arizona. He holds engineering degrees from the California Institute of Technology and Harvard University, as well as an MBA (with highest honors) from the University of Oregon, and he is a licensed professional engineer (Oregon). Mr. Yudelson has spent his professional career engaged with energy and environmental issues, and has been involved on a daily basis with the design, construction, and operation of residential and commercial green buildings. He works for architects, developers, builders, and manufacturers to develop sustainable design solutions. His work on design projects involves early-stage consultation, eco-charrette facilitation, and providing LEED expertise and coaching for design teams. He works with developers and building teams to create effective programs for large-scale green projects, as well as with product manufacturers to guide them toward sustainable product marketing and investment opportunities. In addition to this general business and professional background, Mr. Yudelson serves as a LEED national faculty member for the U.S. Green Building Council (USGBC). Since 2001, he has trained more than 3500 building industry professionals in the LEED rating system. He has served on the USGBC's national board of directors and, since 2004, he has chaired the steering committee for the USGBC's annual conference, *Greenbuild*—the largest green building conference in the world. He is the author of *Green Building A to Z: Understanding the Language of Green Building; The Green Building Revolution; Choosing Green: The Homebuyer's Guide to Good Green Homes;* and *Marketing Green Building Services: Strategies for Success.*

# FOREWORD

In the year 2000 when I first began working to introduce green building at Harvard, the most common perception I encountered was that green building was too expensive and that LEED was a costly point-chasing exercise with no value. Things reached their lowest point in 2001 when at one design team meeting, a faculty member acting as the project's client representative likened the belief that green building design could be cost effective to believing that there were elephants in the hallway.

To help transcend these attitudinal barriers, in 2001 I found three building project partners who agreed to pilot LEED at Harvard University. By studying these projects, I was able to trace almost all of the criticisms leveled at LEED to *a range of failures in the design process itself rather than failures intrinsic to LEED.*

For example, the complaint that LEED certification was too expensive turned out to be the result of architects overcharging because they had little experience and were trying to cover their own learning costs and perceived risks. The complaint that there were too many unexpected costs turned out to be the result of change orders that were in turn a result of poor integration of LEED requirements into the building construction documents. The accusation that LEED was a point-chasing exercise turned out to be the result of flawed sequencing of tasks such as the engineer doing the energy modeling after the design was already complete in order to satisfy the LEED documentation requirement, instead of doing it early enough to inform the design.

These pilot projects provided the necessary experiential evidence to prove that green building and the LEED framework in particular did have enormous value if utilized properly. Perhaps most importantly these projects proved to me that cost impact was largely subject to our own ability to properly manage the design process itself and that we needed to stop trying to answer the question "How much will green building and LEED cost us?" and start answering the question "How do we improve the design process to minimize or avoid additional costs for green building and LEED?"

By successfully working to answer this question at Harvard, my team and I have now [Summer 2008] engaged the Harvard community in over 50 LEED projects, most now striving for LEED Gold certification. Utilizing this momentum we were able to work with the extremely decentralized Harvard community to define and adopt a set of comprehensive green building guidelines that includes many key design process requirements, along with a minimum LEED Silver requirement. At the same time I have been working to foster the capacities of both the Harvard community and the building profession that serves it by leading an effort to get everything that we have been learning about the process of green building into a publicly available web resource.*

*See www.greencampus.harvard.edu/theresource, accessed July 31, 2008.

Which brings me to why I am so enthusiastic about this book. It is an important resource for anyone who wants to leapfrog years of experiential learning and get right to the heart of effective design process management for green building design. To date very few publications and resources have been focused on the design process and yet in many regards good process management is always the foundation for sustained and successful innovation.

To help get you in the mindset for this process-rich publication, here are my Ten Commandments of Cost-Effective Green Building Design:

1. *Commitment.* The earlier the commitment is made, the better for everyone. This should be a formal, continuously improved, widely known, and detailed green building commitment for all building projects, integrated into capital project approval processes and related contracts.
2. *Leadership.* To minimize the risk of business as usual, the client and/or project manager must take an active and ongoing leadership role throughout the project, establishing project-specific environmental performance requirements in predesign (LEED is ideal for this), challenging, scrutinizing, and pushing the design team at every stage. The client and/or project manager should understand enough about LEED, integrated design, energy modeling, and life-cycle costing to ask the right questions at the right time, a subject this book goes into at length.
3. *Accountability.* To avoid lost opportunities and unnecessary costs, establish all roles and responsibilities, sequencing and tracking requirements for every environmental performance goal. LEED is ideal for this purpose. Use the LEED scorecard to empower the client to participate actively in holding the project team accountable. Utilize LEED's third-party verification process to keep the design team on track with documentation. Work to streamline LEED documentation procedures by paying attention to (and learning from) every project.
4. *Process Management.* The failure to properly manage tasks at each stage in the design process results in a wide range of missed opportunities and avoidable costs. Each green building performance goal requires a set of tasks to be identified, understood, allocated across the team, sequenced and integrated properly into the design team process. At every stage in the design process, from predesign through to construction and occupancy, there are stage-specific activities that must be completed to maximize innovation and minimize added costs.

   For example, many design teams don't include the building operators, or they fail to get any real value from the energy modeling process (because it is done too late to inform the design) or they fail to incorporate a life-cycle costing approach because cost estimations are either done too late and/or fail to include operating costs in the cost model.
5. *Integrated Design.* Effective integrated design can produce significant design innovations and cost savings. The client and project manager must commit to integrated design and apply constant pressure on the project team to comply. Commitment to the process must be included in all contracts, the selection process and any ongoing team performance evaluation and quality assurance processes.

The right people must be included at the right time (e.g., future building operations staff, the cost estimator, commissioning agent, and controls vendor), and the team must be managed using a collaborative approach to optimize whole building systems rather than isolated components. Well-facilitated design charrettes during conceptual design and schematic design phases are essential.

6 *Energy Modeling.* Energy modeling should go hand-in-hand with the integrated design process and life-cycle costing. Energy modeling must be used at the right phases in the design process, such as schematic design and design development, to evaluate significant design alternatives, inform efforts to optimize building systems, and generate helpful life-cycle-costing data.

7 *Commissioning Plus!* You should expect failures in both the installation and performance of new design strategies and technologies. Beyond making sure that the project team includes a commissioning agent by the end of schematic design, you should undertake an additional effort to test the entire building to ensure that it is performing according to specifications. Projects should include metering, monitoring, and control strategies to support building performance verification and ongoing commissioning for the life of the building. For complex buildings such as laboratories, include the controls vendor by the end of schematic design to integrate the logic of the operating systems into the design. Be sure to train, support, and effectively hand the building over to the operations staff.

8 *Contracts and Specifications.* All green-building-associated process and LEED requirements must be effectively integrated into the owner's project requirements, requests for proposals, all contracts, and all design and construction documents.

9 *Life-Cycle Costing.* The commitment to utilize a life-cycle-costing approach should be made by the client before the project even begins. This commitment should be integrated into all related contracts and specifications. The cost estimator should be brought on board early in the projects, so that costs can be continuously evaluated, including operating cost projections. Energy modeling should be productively utilized to inform operating cost projections, and building operations staff should be engaged to assist in considering operating-cost alternatives. Ensure that a life-cycle-cost perspective is utilized during any value engineering activities.

10 *Continuous Improvement.* For organizations that own more than one building, lessons from every green building project experience should be intensively mined to inform continuous improvement in the building design process and the ready adoption of proven design strategies and technologies. Utilize LEED documentation to support continuous improvement. Where possible, have someone from your organization act as the clearinghouse for project lessons. Invest in deliberate mechanisms to transfer experience from one project to the next. Invest in measurement and verification strategies to evaluate the actual performance of building features.

It is still a challenge to successfully integrate all Ten Commandments into our projects at Harvard, but with every experience we get closer. Harvard's Blackstone Office historic renovation (cover photo) has come the closest. As a direct result of

utilizing many of these strategies, the renovation achieved its LEED Platinum certification in 2007 at no added cost to the project. The 40,000-square-feet project was completed on time in 2006 and on budget with a hard cost for construction of $250 per square foot. The client (owner) team did invest a significant amount of their time reviewing and guiding the project, a real cost that was absorbed by non-project budgets. Interestingly, even this investment of additional client time has resulted in the client group developing a range of spin-off campus service offerings such as an owner's acceptance program now offered by the facilities group, which provides building owners at Harvard with additional building systems testing and better training and support for building operations staff.

Today, at Harvard and across the country, the challenge is less about convincing people to do green building, and more about keeping up with the enormous hunger for knowledge and guidance to help design teams achieve the greenest buildings with the least cost impact. To this end I hope you will find this book to be an extremely timely and highly informative resource for addressing critical aspects of the design process as you too strive to make your contribution to the green building movement.

*Leith Sharp*
*Director, Harvard Green Campus Initiative*
*Cambridge, Massachusetts*

# PREFACE

I started this book with one important question in mind: how can building teams design, build, and operate commercial and institutional projects that are "truly green"? In particular, how can we deliver buildings that will save at least 50 percent of energy use against standard buildings, that is, those built just to meet local building code and energy code requirements? In my experience, the building design and construction industry is not sufficiently equipped to achieve these goals in most projects. The disparate incentives and rewards, along with the industry's inherent conservatism, make achieving even minor decreases in energy consumption, measured against prevailing standards (currently the ASHRAE 90.1-2007 standard), difficult. The industry's intense focus on minimizing initial costs, coupled with a short-term mentality among building owners and developers, results in the development of many projects that do not make cost-effective investments in energy savings, even when justified using a 5-year or 10-year investment horizon.

Can we achieve these results with current industry approaches to design and construction? Based on personal and professional experience over the past 10 years, I have concluded that answer is a resounding "no." I decided to write this book with the following simple thesis: we must change the way we design and construct our buildings if we're going to have a chance to reduce overall carbon dioxide emissions below 1990 levels, the current Kyoto target. Otherwise, we may have to live with the consequences of a 37 percent increase in U.S. primary energy use between 2000 and 2020, as predicted by many experts. While a strong case can be made for putting energy conservation in existing buildings first, the fact is that most of today's new construction will still be with us 50 years from now, with energy use built into the building fabric and difficult to change. So, it's good to focus significant attention on new building design, construction, and operations.

Can we achieve these high-performance results with design and construction industry's current structure of incentives and methods? I have observed that the design and construction industry, for the most part, is stuck in a linear, risk-averse mode for delivering buildings, with multiple handoffs between the various parties, and many missed opportunities for doing a much better job. The result is buildings that cost more and perform worse than they need to. Conversely, I've observed a few projects that employed an integrated design process that produced buildings that performed better and cost the same as similar projects. After interviewing dozens of architects, engineers, builders, building owners, and developers, I've concluded that we can do a much better job, but we really need a fuller understanding of the integrated design process. This book is an attempt to answer that need.

The objective of all green building efforts is to build high-performance buildings at or close to conventional budgets. I have found that an integrated design process is the best way to realize this goal. There are good examples of LEED Platinum–certified buildings built for little or no additional capital cost, including the building described in the Foreword, Harvard's Blackstone renovation. Another LEED Platinum project, Oregon Health & Science University's Center for Health and Healing, currently the world's largest, was completed in 2006 at a 1 percent cost premium, net of incentives. Through following an integrated design process, Manitoba Hydro's new 690,000-square-foot headquarters in Winnipeg expects to exceed Canada's Model National Energy Code by 60 percent, in a climate with nearly 70°C (126°F) annual temperature swings. As a government building, the design focus was on long-term ownership economics, including enhancing the health and productivity of the workforce, and providing an exemplary sustainable building.

This book abounds with a number of such real-world examples. From them, I've extracted core principles and practices of integrated design, as practiced by leading architects, engineers, builders, developers, and owners. What I discovered is not a simple formula such as combine A and B, and you get C. It's a more complex management task, one that has to be thought about from the beginning of each project, even at project conception: why do we need this building and where are we going to locate it? To make the task more manageable, I've come up with nearly 400 important questions, largely based on the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) green building rating system, that you need to ask at each point in the sequence of planning-design-construction-operations.

*Green Building Through Integrated Design* was written with the commercial and institutional building designer, owner, and builder in mind. I have worked to, first, understand everything I could about green buildings, and, second, report back to important stakeholders on how to make sense out of a field that's growing 50 to 75 percent a year, a growth rate that results in a doubling in size every 12 to 18 months!

I hope that *Green Building Through Integrated Design* will be your guide to greening your next project. This is *not* a book about how to design a green building—there are many fine books on that subject by leading architects—but rather a book about the design and delivery process. I also show you one of the available project management software tools that will help cut the costs of green building projects, and I present the experiences gained by many fine architects and design teams in dozens of successful LEED Platinum projects.

So, grab a cup of shade-grown, organic, fair-trade coffee, put in a skinny squirt of nonfat milk and some natural organic sweetener, kick back, and let me help you find out from the experts how to design and deliver a high-performance building.

*Jerry Yudelson*

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Finally, many, many thanks to the thousands of passionate green building owners, designers, and builders who recognize the need for sustainable design solutions and work daily to implement them.

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