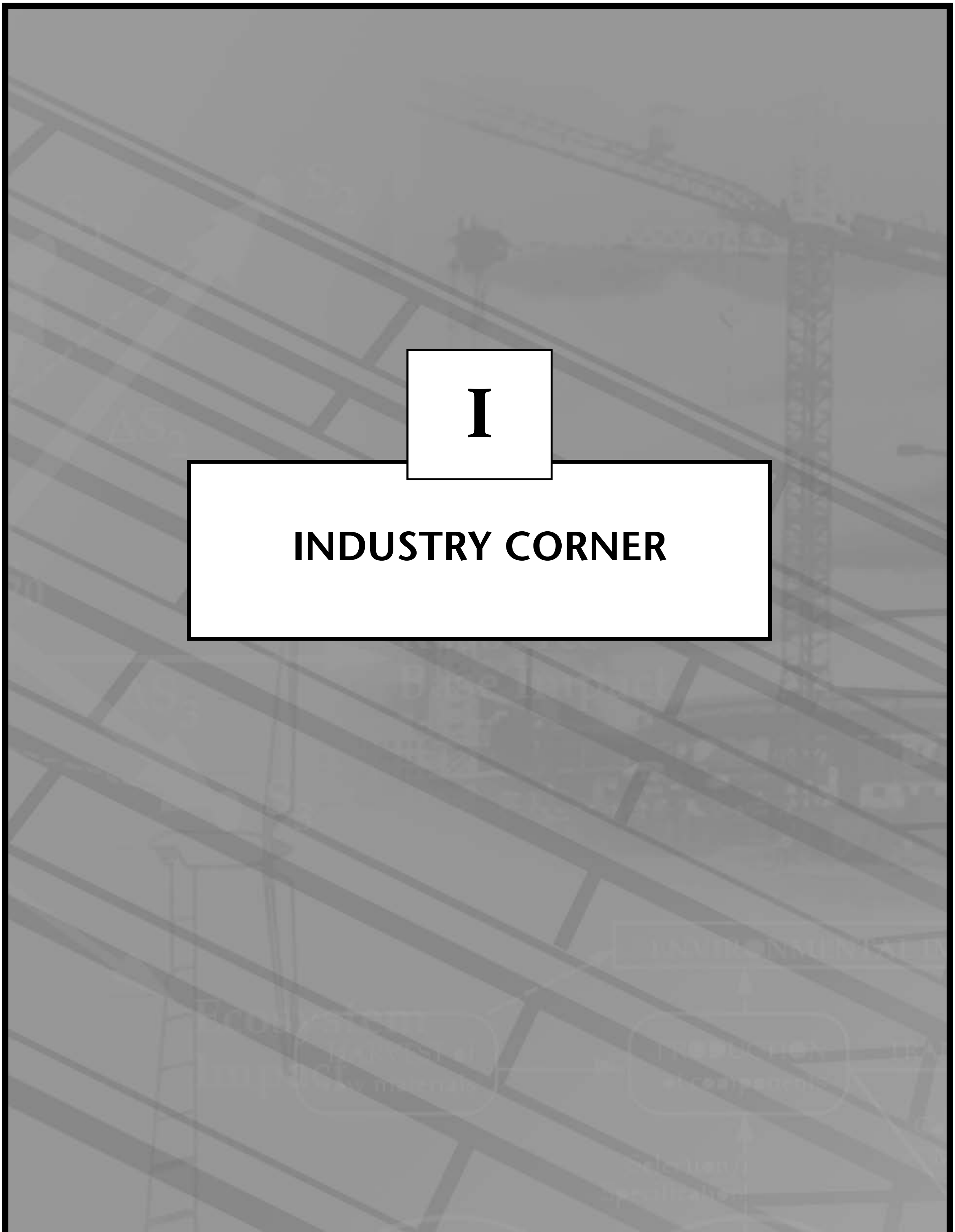

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INDUSTRY CORNER

GOING GREEN: STRATEGIES FOR ANY PROJECT

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INTRODUCTION

Green design is gaining acceptance. Some aspects of green design might even be said to be entering both mainstream practice and the wider public consciousness. There is an NAAB accreditation criteria focused on sustainability, and the actor Brad Pitt is a talking head for green building.[1] The language of the various LEED rating systems has seeped into the vocabulary of most designers, and uncertain energy prices have given environmental concerns economic cachet. Even some of the more progressive planks of the green building platform are receiving significant support (though if only in principle so far) with both the National Association of Counties and the United States Conference of Mayors endorsing the greenhouse gas reduction goals of the 2030 Challenge.[2]

Yet, it still seems that a surprising number of clients remain unconvinced as to whether they should pursue green strategies in their buildings. Likewise, there remain many design professionals waiting for the "right" project with which to begin greening their practice. Both of these stances fundamentally misunderstand the place and scope of sustainability within the design disciplines. The call for designers to create environmentally progressive products, buildings, or cities is not a call for an applied style or set of technologies. Rather, it is a call for the application of an ethic that is integral to the process of design no matter the project, the style, or the client. It is an expanded understanding of context. Every project must now answer for its impacts on not only its immediate surroundings but also on the broader planet. We have passed the point when architects and designers can plausibly claim ignorance of these issues. To design in today's world and give no consideration to environmental issues is to act irresponsibly, and results in the creation of buildings that are obsolete before their time.

So how does one begin? The issue of sustainability in design is certainly a vast and nuanced topic with each breakthrough in understanding seemingly leading to many new unanswered questions. A designer beginning on the road to a more sustainable practice will not address all relevant issues on his or her first attempts. Many pieces of the green puzzle are currently beyond the reach of everyday practice. It remains impractical for the average practitioner to develop a comprehensive understanding of the embodied impacts of all of the materials she or he uses, and renewable energy sources are far from being a choice that is easily justified on the typical project. In time, with advancing knowledge and technology, such strategies will become common practice. However, there are steps that any designer can take on any project to make it significantly greener. What follows is an overview of some strategies that are available to designers whether or not one's client is calling for a green solution.

INSULATION AND AIR-TIGHTNESS

Over the lifetime of a typical building the energy used to heat, cool, and condition its interior environment will dwarf the energy used in its construction. With such a large percentage of this energy typically coming from fossil fuels, there are tremendous negative consequences associated with this demand. These include greenhouse gas production, the associated acceleration of climate change, and the despoliation of natural habitat during resource extraction. When searching for a place to make a sizable environmental impact, architects and designers need look no further. It was recently noted that, "U.S. buildings account for nearly the same amount of carbon emissions as the economies of Japan, France, and the United Kingdom combined." (American Institute of Architects, 2007.)

With proper insulating and sealing architects and designers can address these serious environmental impacts directly. Insulation offers an inexpensive,

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cost-effective path to a greener building, though it begins to have diminishing incremental effectiveness when buildings become highly insulated. When designing a well-insulated building, detailing for air tightness should not be neglected. Even a small opening in the building envelope can significantly reduce its insulating effectiveness.

A later section of this article explores the importance of being able to open a building up to the outdoors for natural comfort. In addition, there are concerns associated with inadequately ventilating a tightly sealed building. Addressing these concerns requires the introduction of outside air into the building. Sealing the envelope doesn't imply that outside air is totally excluded from the building. It simply allows for that air to be introduced, whether through a ventilation system or through an open window, in the most advantageous manner rather than through an unseen gap.

With growing awareness of this issue, the marketplace for insulating and sealing materials is expanding—blown insulation and foaming sealers are becoming more commonplace, and several manufacturers now carry items such as sill seal gaskets. With widening options, the strategy of designing well insulated, airtight buildings should remain an inexpensive and effective option for creating greener designs. As a starting point, the latest version of the International Energy Conservation Code and International Residential Code offer good climate-specific recommendations for insulating values.

FIGURE 1. The Cantilever House in Granite Falls, Washington, by Anderson Anderson Architecture, uses structural insulated panels (SIPS) for the walls, floors, and roofs providing a well insulated envelope and greatly reducing the number of joints to seal (Wagner 2005).

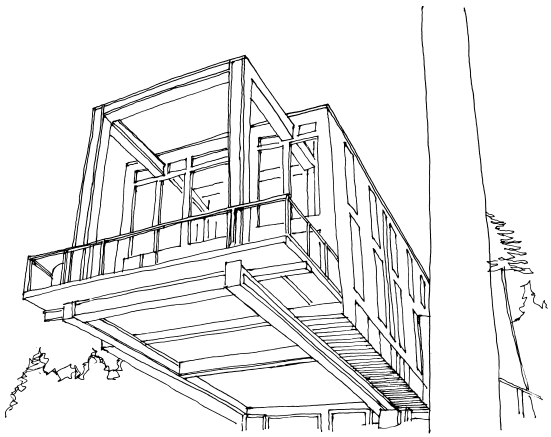
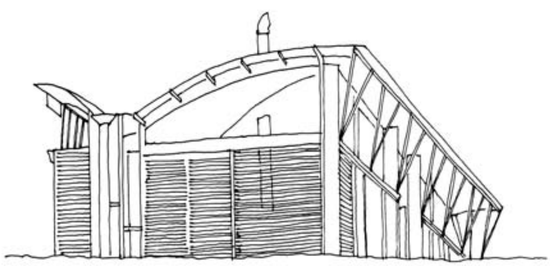


FIGURE 2. Several of Glenn Murcutt's projects, such as the Magney House, use an elongated plan oriented with the long edge facing the low winter sun (north in the case of Australia). Depending on the shape and topography of the site, advantageous building orientation can cost little or nothing, providing designers with a powerful strategy for reducing the energy impacts of their projects.



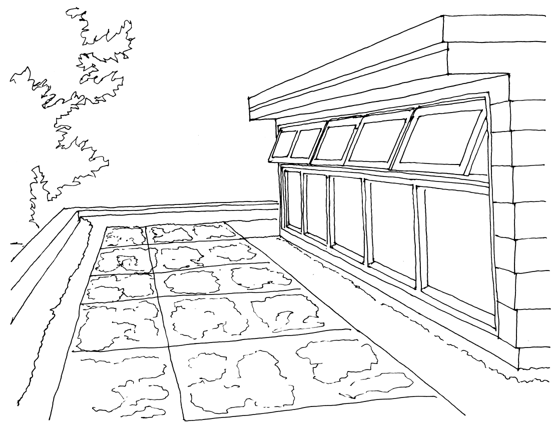
ORIENTATION AND CONFIGURATION

The strategy of correctly orienting and configuring a building goes hand in hand with the strategy of insulation. Where insulating uses the material properties of the building envelope to minimize the exchange of energy with the exterior environment, orientation uses the building's shape to maximize positive solar impacts and minimize negative ones. This strategy takes different forms at different latitudes. In the tropics the high overhead sun and mild temperatures experienced throughout the year make it largely unnecessary to configure buildings to receive solar gain even during the "winter" months. Shading becomes much more of a concern in these areas. Whereas in the extreme latitudes closest to the poles, the available useful gains are so meager that losing heat through the building's walls becomes the overriding concern and compact configurations are required.

In the broad middle latitudes, however, the seasonal variation in the position of the sun in the sky provides opportunity for designers to use the configuration to create various passive advantages as conditions change. In these regions, a building elongated in the east-west axis becomes the preferred form, requiring significantly less energy to heat and cool than an identically sized building in a square configuration. This phenomenon is driven by the solar impacts on the building. During the winter the sun is low in the half of the sky that faces the equator (south in the northern hemisphere, north in the southern). During these months, the maximized southern or northern elevation of the building receives useful solar gain from the low sun. Conversely, in the summer when these gains are unwanted, these facades are easily shaded from the high overhead radiation of the midday sun. (See *Window Design for Solar Gain* below.) Meanwhile, the minimized eastern and western elevations of the building help to limit the harmful impacts of the morning and late afternoon sun during the long summer days.

WINDOW DESIGN FOR SOLAR GAIN

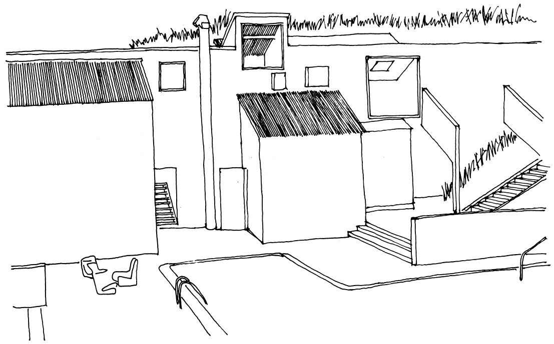
Passive solar design marries the strategies of orientation and configuration with thoughtful placement and selection of windows. Reacting to the same seasonal variations in the position of the sun outlined above, designing windows for solar gain seeks to selectively admit solar radiation into the building at advantageous times. (Again, like orientation and configuration strategies, this concept is generally most effective in the middle latitudes.) This strategy typically consists of concentrating windows on the side of the building that faces the equator while limiting and/or aggressively shading windows on the east and west sides of the building. To be most effective this strategy requires that the windows facing the equator be shaded during the summer months when gains are unwanted. This can be accomplished either with part of the building itself such as overhangs or louvers, or by external objects such as trees. (See *Landscaping for Microclimates* below.) Windows on the side of the building facing away from the equator have negligible opportunity for collecting useful gain and are therefore usually considered to be negative in terms of the thermal balance sheet due to the relatively low insulating value of windows in general. However, they can have significant benefit in relation to daylighting strategies. (See *Window Design for Daylighting* below.)



FIGURES 3 AND 4. In the design of the Factor 10 House, EHDD addresses a disadvantageously oriented site by using south facing clerestory windows. Protected from unwanted summer gains by a small overhang, the windows look onto an interior wall covered with water bottles that provide thermal storage capacity for the admitted radiation.

Along with manipulating the placement and shading of windows to admit solar radiation when it is desired and to reject it when it is not, designers can adjust the characteristics of the glazing itself to make the building perform better in this regard. Solar Heat Gain Coefficient (SHGC) is a measure of how easily solar radiation is transmitted through a given piece of glass. Designers should select glazing with higher SHGCs the farther their projects move from the equator. This allows for the low winter sun to more easily transmit solar radiation and its associated heat to the interior of the building in these relatively cold climates. As one moves closer to the equator and the rejection of heat becomes more important than its collection, a lower SHGC should be selected. While this decision has cost impacts for the building, even a small positive shift in the amount of radiation transmitted or reflected can have sizable impacts on the comfort that can be achieved passively and therefore on the amount of energy required to otherwise condition the building.

FIGURE 5. Sea Ranch Condominiums by Moore Lyndon Turnbull and Whitaker with landscape design by Lawrence Halprin, take advantage of the existing microclimates of the site and augment them to be of greater benefit to the project. Here, careful attention is paid to the placement of buildings in relation to existing topography and tree lines. Along with enlarging existing berms, this allows the buildings to tuck into the site in such a way as to both reduce their visual impact on the dramatic location and shelter them from the periodically harsh winds.



DESIGNING MICROCLIMATES

All of the strategies that have been discussed to this point provide ways of mitigating the harsher aspects of a building's climate. Another approach is to modify that climate locally. Considered siting and a purposeful landscape design can provide passive relief from some of these negative impacts. This strategy holds the possibility of mobilizing the entire site in the service of environmental goals and provides a powerful corollary to the building scale strategies outlined in this article. James Marston Fitch, in his seminal book *American Building: the Environmental Forces that Shape It,* identifies adjustments in the microclimate as one of a set of nested layers of environmental responses that precedes the building envelope or mechanical control (Fitch 1999).

This strategy can take one of two primary forms—either responding to the specifics of the microclimate as it is discovered on the site, or purposefully modifying it to better respond to the specifics of one's project. Nearly every project will have some amount of associated site modification. Nearly every site will exhibit some areas that are more climatically demanding than others. Even the fairly simple act of placing a building on the leeward side of a ridge or planting a deciduous tree on its equatorial (sunny in summer) side can not only make for a greener project, but also for more pleasant and enjoyable spaces.

It is obvious, though worth pointing out, that the strategy of microclimatic modification can be effective for influencing some environmental impacts while being completely ineffective at addressing others. For instance, one can shade with a tree but cannot create more solar radiation when it is desired, one can temper cold winter winds with a berm but cannot induce wind, and one can humidify the air and create evaporative cooling by designing a pool of water but cannot modify the microclimate to effectively dehumidify the air.

WINDOW DESIGN FOR DAYLIGHTING

Windows are a sign of life, a sign of human habitation. With very few exceptions every project will include some windows. Using these windows to provide daylight for the building's inhabitants can not only reduce the energy demand of the project but provide a preferable interior atmosphere. As has already been noted, window design for daylighting is not directionally limited as is window design for solar gain. Effective levels of daylighting can be achieved with light from any directly available part of the sky. In fact, when daylight is provided from only the diffuse portion of the sky and not directly from the sun itself, it can be a rather cool source of light contributing less to the internal heat loads than equivalent illuminance from an electric fixture.

When designing windows for daylighting placement is crucial. Windows high in a space allow the admitted light to travel deeper into the building and strike work surfaces more directly rather than at a glancing angle. High windows are also less likely to be obscured by objects inside of the building. The reflectance of the interior surfaces impacts the efficacy of daylighting with more highly reflective materials (usually those that are a lighter color) bouncing more of the light deeper into the building, and less reflective ones absorbing more light and therefore not "passing it on." As with designing for solar gain, there is also a property of the glazing that is important to consider when designing for daylighting. The visible transmittance (VT) of glass is a measure of how much of the visible light spectrum (the portion of solar radiation humans can see) is transmitted or passed through the glass. The higher this number, the greater the amount of daylight that will be admitted for a given area and placement of window. While this may have cost implications for the project, they can be limited by selectively tuning windows for daylighting—for instance, specifying glazing with a higher visible transmittance for the clerestory windows that are contributing the most to the daylighting strategy.

WATER CONSERVATION

By most accounts, water scarcity is going to be an issue of increasing importance for the foreseeable future. Growing urban populations coupled with wasteful practices have placed pressure on water sources in many areas, often making it difficult to provide sufficient supplies for the human population while simultaneously leaving enough to recharge natural systems. Fortunately, making meaningful advances in water conservation is a fairly straightforward matter. The water efficiency credits found in the LEED™ NC rating system offer common-sense guidance on this issue. In summary, these credits call for: reducing the amount of water used by the building's various fixtures, reducing the amount of water put into the building's wastewater system, and reducing the amount of or eliminating altogether water used in the landscape.

With items such as dual flush toilets, waterless urinals, front loading washing machines (though these

FIGURE 6. At the headquarters of Heifer International, PSRCP uses a narrow floor plate, high windows, a sloping ceiling, and glazed interior partitions to distribute daylight evenly to all workers.

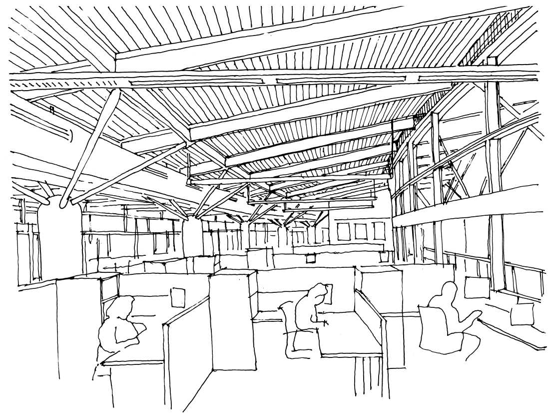
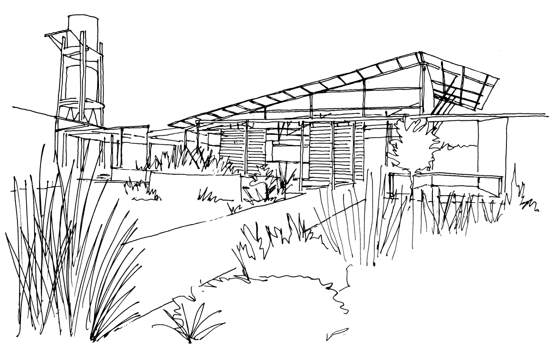


FIGURE 7. While the water cisterns used by Lake/Flato at the Government Canyon Visitors Center are not yet a common approach to reducing demands on potable water sources, this project is also a good example of the strategy of using native, drought-resistant species in the landscape design. The Texas Parks and Wildlife Department served as the landscape consultant on this project.



do not count as a fixture in the LEED™ NC rating system), and low-flow and motion-activated faucets becoming more prevalent, increased familiarity on the part of both designers and clients is making these technologies an easy sell on many new projects. Include the fact that several of these technologies have directly associated reductions in operating costs, and they become even more accessible. While not yet as widely accepted, the concept of designing landscapes that use only native plants (sometimes called xeriscaping) is growing in popularity. Plant species that are adapted to one's local climate and soils are better able to live solely on the area's typical rainfall requiring little or no additional irrigation.

MATERIALS

Selecting green materials for a project can be overwhelming simply because there are an overwhelming number of materials in the typical building. Additionally, detangling the many interrelated issues associated with the sustainability of a material is an activity that can get quite murky very quickly—how does or can one trade off habitat impacts with improved energy efficiency, for instance? With such a vast and complex web of issues, green materials research promises to be a fertile area of inquiry for some time to come, requiring the work of many dedicated manufacturers, designers, and researchers. However, there are sensible steps that can be taken immediately to begin greening one's material selections.

Look to the interior environment. Eliminating materials that off gas harmful compounds into the building and therefore directly impact human health by negatively affecting indoor air quality (IAQ) has direct benefit for the building's occupants. Materials of concern here include paints, adhesives, carpets, coatings, and sealants. Here designers might begin by asking how pervasively these materials need to be used. Might low-traffic or unseen areas simply go uncoated? Could carpet be limited to specific areas of the project? Alternately, the options continue to grow for more benign materials in this arena, such as paints and carpets with low emissions of volatile organic compounds (VOCs).

Use local materials. The energy required to transport raw materials for processing and finally move the completed component to the building site can be significant. By eliminating exotic materials and instead favoring local ones, this impact can be mitigated. This strategy requires knowledge of the local material base, but can often even produce costs savings for one's projects. In my area, for instance, certain colors of concrete can be created with locally available aggregates, while others require the importation of aggregates from quite a distance away, requiring both additional energy and cost. This simple piece of information might prompt me to adjust my palette to use the locally available material.

Choose durable materials. The concept of sustainability not only demands that buildings be responsible to people in other places, but also to people in other times. It requires that one accept a responsibility for the future. Though durable materials may have an immediate cost implication, for clients who are going to be long-term users, life cycle savings in maintenance and repairs can often help justify the initial expense. Specifying durable materials, especially for long-lived items such as structure and envelope, yields a robust building that will require fewer material resources over the course of its lifetime.

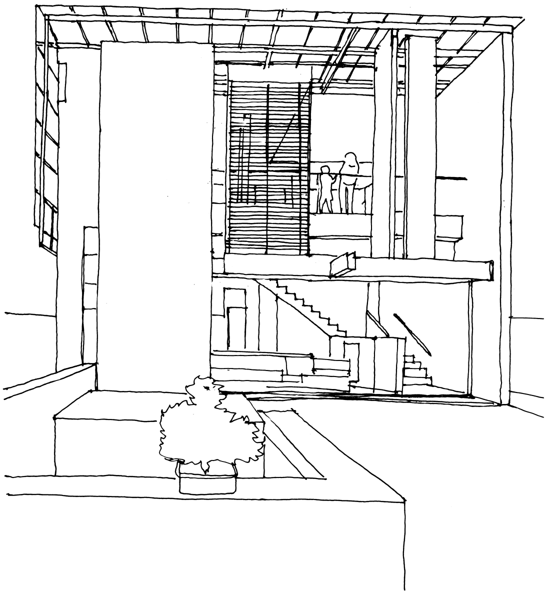
Go after the big items first. It seems obvious that one can have a much greater positive impact by specifying greener cladding or structural systems than by finding the perfect green choice for wall base trim. Yet, specifications deal with minutia and can easily distract designers from the big picture. When greening one's specifications it makes sense to prioritize.

Most of all—do something. The task of greening one's material specifications is going to require time and effort over the course of several projects. It can be so daunting as to breed inaction. However, positive steps taken on one's current project will likely accrue to future ones yielding material choices that are more comprehensive and informed. In this way, practitioners can progressively compile libraries of effective green materials.

CONNECTING TO THE OUTDOORS

In most any climate, there will be times throughout the year when it is pleasant to be outside or to open buildings so the exterior environment can be coaxed inside. While there have been great advances in the development of hybrid mechanical systems that take advantage of the ambient air to achieve increased effi-

FIGURE 8. Taking advantage of its mild climate, the Solar Umbrella House, by Pugh and Scarpa, expands living space by providing shaded and visually screened outdoor space that faces onto the back yard.



ciencies, connecting to the outdoors does not require complex or costly control systems. Often, all that is required are opportunities for a building's inhabitants to exercise choice in their daily routines. (A good deal of this article was written while sitting on a shaded back porch.) As communications technologies become more and more portable, perhaps architects and designers should respond to this phenomenon by providing more such outdoor rooms. Likewise, if provided with operable windows many people will take advantage of a cool breeze when it is available. The benefit of providing thermal comfort with such a passive method is obvious. Of course, care must be taken to assure that the building's mechanical plant does not drone on while the window is open. This can be accomplished with an automatic sensor or it can be achieved more economically (and perhaps more effectively) by an informed user. (See *Informing Your Clients* below.) When opportunity to modulate one's environment is linked to a deeper understanding of the building's overall control, turning off the air in order to open the windows can become as automatic an action as turning off the light when leaving the room. Aligning occupants' desires with design opportunities in this simple way can not only save energy, it can provide for a more gracious way of living.

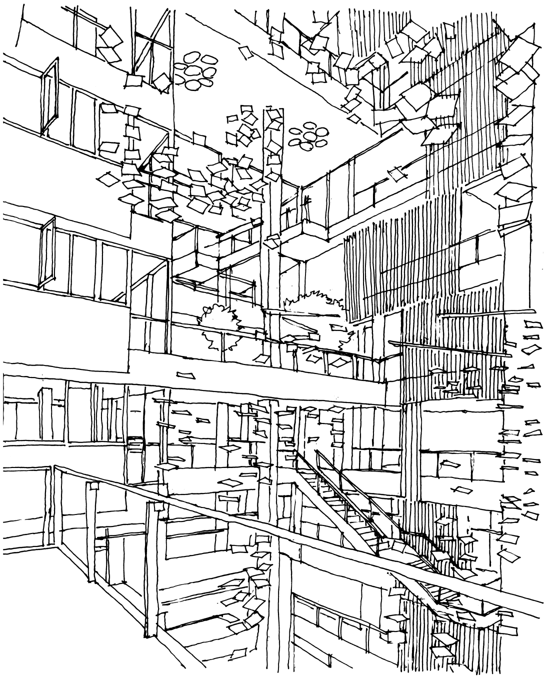
INFORMING OUR CLIENTS

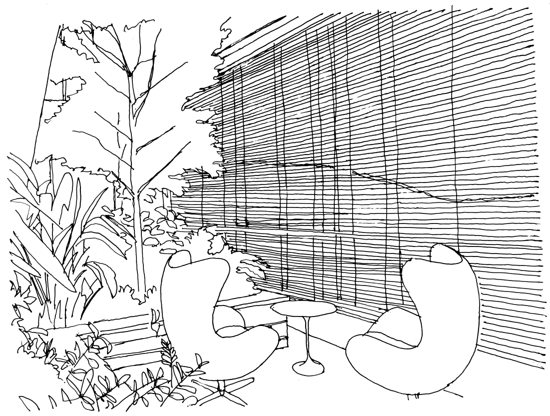
By suggesting that we as designers should inform our clients about green building, I do not mean to imply that we need to preach to them. There is a real danger of adopting an elitist tone that benefits nobody. However, as professionals dealing in the built environment, a certain leadership is required of us by virtue of our education, experience, and knowledge. As laypeople, our clients will never be able to make their best choices without the benefit of our council. As the world of modern construction and green building becomes more and more complex, this advice only becomes a more valuable ingredient in making a successful project. When advocating for fundamentally sound green design, one can speak with the confidence afforded by being on the right side of the issue without stooping to condescension.

This responsibility to speak clearly about our intentions extends from pre-design through occupancy and beyond. A building's rate of resource usage is greatly influenced by the actions of its inhabitants. Often, green strategies rely on an informed user to achieve their full effectiveness. Designers would be well served to provide clients with a sort of user's manual for new buildings, clearly defining these strategies and outlining the user's part in making them work correctly.

Designing Great Spaces and Meeting Your Clients' Needs

No building, despite the considerations of its design team or the success of the strategies embedded within it, will be sustainable if it fails to provide comfortable, useful, and inspiring spaces for its users. As we strive to become better green designers we must always remember that first we are designers—addressing human needs while working within the context of and transmitting our culture. The green design revolution will not ultimately be a successful one if it produces ultra-efficient buildings that carry no meaning or fail to positively affect their user's lives.





FIGURES 9 AND 10. In addition to providing the efficient office space required by their corporate client, the Genzyme Center, by Behnisch Architects and Behnisch Architekten, supplies workers with airy, light- and plant-filled spaces that offer a comfortable setting for their daily routines. In a survey 72% of employees claimed to be more productive in this building than in the company's previous headquarters (Prospero 2007).

CONCLUSION

This outline of green strategies is neither comprehensive nor especially progressive. Many of the ideas presented here hearken back to fundamental design principles that we first learned in school. As such, this article is predicated on the proposition that many modest impacts can be more powerful than a few large ones. By focusing on issues that can be addressed in nearly any project—such as insulation, window placement, and configuration—it is my hope that this article can serve as a digest of sorts for designers who wish to green their practices and must do so without either a motivated client or a line item in their project budgets for green technologies. This may seem a small step. Yet, the widespread production of buildings that are well insulated, correctly oriented, and intimately connected to their environments would be a profound improvement over current practices, perhaps even more profound than the next crop of cutting edge environmentally progressive designs. Finally, beginning with the fundamentals not only provides practitioners with a solid first step on the path toward greener designs, it reinforces the important notion that sustainability cannot be applied; rather, it must be imbedded with an ethic that informs every design decision.

RESOURCES FOR FURTHER INVESTIGATION

American Institute of Architects Committee on the Environment Top Ten Green Projects. www.aiatopten.org. Detailed case studies of the winners of this national award for green design. Many of the projects used as examples in this article can be found on the site.

Architecture 2030. www.architecture2030.org. Details on the 2030 Challenge and a good overview of the relationship between climate change and the built environment.

Brown, G.Z. and Mark DeKay. 2000. *Sun Wind and Light, Architectural Design Strategies, 2nd Edition.* New York: Wiley. Provides information necessary for designers to implement a variety of green strategies during the schematic design phase.

Building Science Consulting. www.buildingscienceconsulting.com. Site includes many resources on fundamentally sound construction techniques made responsive to various climates.

Efficient Window Collaborative. www.efficientwindows.org. Information on selecting efficient windows including overviews of technical terminology.

The Pharos Project. www.pharosproject.net. An open source framework for evaluating the greenness of building materials in relation to various metrics. Beta version currently available.

Stein, Benjamin et al. 2005. *Mechanical and Electrical Equipment for Buildings, 10th Edition,* New York: Wiley. This old standby has been continually updated to include progressive green thinking on the mechanical and electrical servicing of buildings.

United States Department of Energy, Building Technologies Program. www.eere.energy.gov/buildings. Information on energy technologies in buildings along with numerous case studies.

United States Green Building Council. www.usgbc.org. Case studies of green building and information on the various LEED™ rating systems.

NOTES

1. National Architectural Accrediting Board, Inc.
2. For more information, see either www.architecture2030.org or www.aia.org/static/state_local_resources/adv_sustainability/.

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