Green Building FOR A PROFIT

Green building doesn't have to be unusual — in fact, most elements of green building are invisible and cost no more than standard construction.

Thoughtful design and careful construction bring profit, satisfied customers, and sustainable development

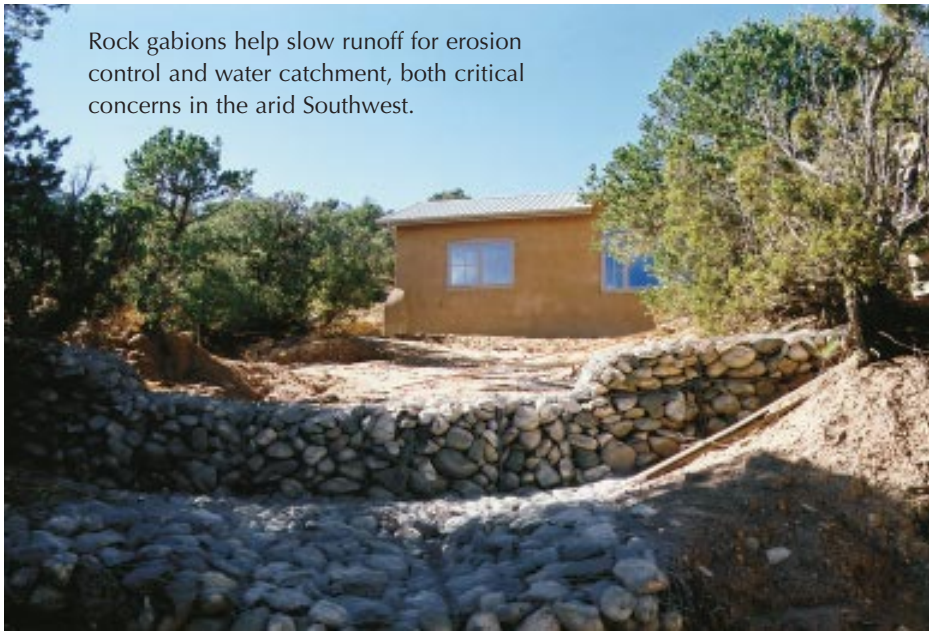
by Paula and Steve Hagar

A decade ago, we were building commercial high-rises in Dallas, and anything under ten stories was a small job. When our son was diagnosed with environmental illness in 1990, there weren't many doctors who had even heard of such a thing. It turned out that many of his debilitating allergic sensitivities were reactions to common building products, including solvents, adhesives, petrochemicals, and resins. We knew that we needed to make some changes, both personally and professionally, but we didn't know what they would be. This was all new territory and, as professional builders, we needed to remain economically viable.

Today, along with some partners, we specialize in designing and building ecologically responsible custom homes, commonly known as "green building." Learning how to do this successfully has been an

intensive learning process and a rewarding change in many ways.

Over the years, we have built or assisted with just about every type of alternative construction imaginable, but our mainstay has been perfectly average-looking houses. We recently won a local award for energy-efficient low-cost housing as well. Every one of these houses somehow fits into the "green" category.



Rock gabions help slow runoff for erosion control and water catchment, both critical concerns in the arid Southwest.

What's Green Building?

When people ask what makes a home "green," we have to answer, "It depends," because there's no one right answer. In the narrowest sense, green building is concerned with minimizing the environmental impact of construction from site development and procurement of materials all the way to the safe disposal of the building at the end of its useful life. In the widest sense, green building is about sustainability. Essentially, sustainability is the art and science of providing a healthy environment for ourselves and future generations while maintaining a viable economy in the process.

Regionally appropriate. A green house in the Northeast might not look like a green house in the Southwest, but similar principles will apply. Because green building strives to be a "whole-system" approach, the principles outlined below are interrelated. In fact, if you examine any one of them closely enough, you'll eventually get to all of them.

Green building is, at the core, a design challenge. There is no formula to determine what approach is most appropriate for any particular site, but you can always arrive at a suitable solution on the basis of these principles. And different clients will have different considerations they'll want to focus on. Ron Jones of Sierra Custom Builders summarized this well in a recent NAHB publication, saying, "No one builder can do everything, but everyone can do something. Recognize the opportunities and then customize your efforts to match your situation."

Make the least change for the greatest effect. For most buyers, budget considerations are a reality. Green building doesn't have to be more expensive — in fact, with careful planning, it can produce savings. Our estimator, Mike LeJeune, always explains to clients (and reminds us), "Green building isn't about possibilities, because the sky is the limit. It's about quantifying a specific benefit for a specific cost. Our job is to identify and prioritize these design changes to produce the greatest benefit for the greatest number of people."

Energy Efficiency

Energy efficiency is probably where green building receives the most attention, and it's a great place to start. It's the least controversial aspect, and the environmental benefits of reduced energy consumption are well publicized. Best practices for insulation, ventilation, and energy-efficient appliances have all been extensively researched and documented, and most builders already know something about the subject. Incorporating solar gain is often feasible and almost always cost-effective, although this is a feature that should be designed carefully.

Does it pay? Ecological concerns aside, it just makes sense to build a house that's inexpensive to heat and cool. Reduced operating and maintenance costs can generally offset the up-front expense of higher-efficiency appliances and improved thermal performance. Clearly, there is a point of diminishing return; in harsh climates super-insulation and heat-recovery systems may make sense; in temperate climates they may not.

For some clients, no increase in initial cost will be acceptable; others will see five years as a reasonable payback time, and for yet others, the extra 1% or 2% in the purchase price of the house is simply not a concern. What constitutes a reasonable return on the investment depends on many factors, including the client's preferences about indoor comfort.

Increased comfort. For example, radiant heat is a little more expensive to install than hydronic baseboard and a lot more expensive than forced-air, but we don't have any trouble selling it. Along with the increased efficiency, clients really appreciate the clean, quiet comfort.

While the individual energy savings of each family may not seem like much, the collective result can be enormous. Just remember that there is a balance between energy efficiency and comfort; a home isn't an engineering project — someone has to live there.

Resource Efficiency

The criteria for effective use of natural resources are hotly debated and will surely evolve as we learn more. Careful material selection is certainly a large part of resource efficiency; some widely

accepted starting points include using materials with recycled or recyclable content, minimizing the use of materials that demand high inputs of energy in the course of their production, and eliminating materials that create unacceptable levels of pollution during either their manufacture or disposal. Here in the Southwest, that means avoiding vinyl siding, fiberglass insulation, asphalt roofing, and carpet, and substituting stucco, adobe, straw, saltillo tile, and metal roofing. In other parts of the country, other materials will make more sense; for example, cedar siding or brick might be the best choice if it is locally produced. Recycled or reclaimed materials are also right at the top of the list, as are sustainably harvested lumber and materials that can be recycled or reused at the end of the building's useful life.

Materials that make efficient use of abundant and renewable resources are preferable, so we're great fans of engineered wood products. Wood I-joists, trusses, and a variety of engineered beams all provide a lot of design flexibility while minimizing the use of valuable or — in the case of old-growth forests — irreplaceable resources. As the glues and binders are improved for higher performance and lower toxicity, we'll like them even better.

Quality and durability are primary considerations for material selection. Using good materials properly isn't just good business, it's also part of green building.

Look at the true cost, not the price. Green building incorporates a wider view of the construction process, looking beyond the price tag and examining the hidden environmental costs of a material. For example, adobe and concrete might both be used for the construction of exterior walls, and the installed price per square foot for each material might be the same. But if you consider all of the natural resources used to produce and deliver each respective material to the site, there is a big difference. The relative amount of resources consumed to produce and deliver a particular product is referred to as the "embodied energy" of that material.

You'll often hear environmentalists tout the benefits of a particular material on the basis of low embodied energy, but don't be misled. For example, concrete is often criticized for having high embodied energy, but when you figure in the useful life of the material, it can come out as the best choice in certain applications. In every instance, green building is a design challenge in which decisions are made by looking at the larger picture.

Does size count? There are those who say a large luxury home can't fit the criteria of "green." We disagree. The fact is, the client is going to build the house anyway. We're here to help them get the very best house they can, with the greatest value, for the best price. We have shown clients how they could easily work with 7,000 square feet when they came to us with drawings for a home twice that size. On one such project, we designed the building so that, after two years, the owners have yet to pay an electric bill, pay nearly nothing for gas heat (in a 6,001-degree-day climate), and the only well water they use is for drinking — the rest comes from rainwater catchment, which is then reused for irrigation. Sure, it's a big house, but it was also built from sustainably produced materials, it's more energy- and resource-efficient than most tract homes, and it will last longer, too.

Minimize waste. We work hard to minimize waste — it's one of the most expensive costs on the job. You pay at least five times to create waste: Once to buy the material, once to turn it into scrap, once to clean it up, once to haul it, and once to landfill it. But some waste, like packaging, is unavoidable.

The most productive place to minimize waste is at the drawing board. Attention to detail during design saves costly mistakes. This is also the chance to take advantage of industrial production; if we're working with lumber and sheet goods, basing the design on a 4-foot module can save a lot of time and money, but if we're working with straw bales, we'd better be thinking in increments of 3 feet.

On each site, we set up recycling areas for construction waste. Trash is sorted into four bins: metals, plastics, and paper, which are all recyclable, and trash that must be landfilled. Next to that is the wood pile, which we try to reuse until it disappears. Whatever is left can be donated for firewood.

It doesn't cost a bit more to do this, and in fact we probably save money, given the cost of tipping fees. Employees are uniformly enthusiastic about this — it's a fun game to see how small the trash pile can be, and it's easier for everyone to do a better job next time when the mistakes don't just disappear into the dumpster. Subs get enrolled in the program fairly quickly, and if they don't, we remind them that it's in their scope of work.

Land use. Integration of a structure with its environs is a key component of green building. By situating a house thoughtfully, many benefits can be realized. Solar gain, reduced excavation with minimal disturbance to the site, and preservation of existing trees are all cost-effective advantages.

Regionally appropriate landscaping can be used to support existing wildlife with beautiful results and little additional expense. Through careful design and plant selection you can conserve water in almost any climate. Deciduous trees can help with shade in the summer while admitting sunlight for solar gain in the winter. Erosion control is required in many parts of the country; with a little extra effort this can be turned into landscape-enhancing water catchment (see photo, previous page).

Urban infill can combine the environmental benefit of efficient land use with economic opportunities by taking advantage of existing infrastructure, improving neighborhoods, and in some cases offering low-cost or subsidized housing to clients who might not otherwise be able to afford a home.

Healthy House

It has been suggested that the quality of the indoor environment is not a primary concern of green building, but we disagree. In our opinion, it's impossible to approach green building without

Green and Affordable: Casas de Don Juan

Both of these three-bedroom, two-bath, 1,384-square-foot homes were built in cooperation with the Santa Fe Community Housing Trust as part of an affordable housing program. The construction cost was low by local standards at $80 per square foot. The relatively small lots are best described as "infill" in an old neighborhood that is currently being revitalized. But low cost doesn't have to mean low quality — these houses were recently awarded the Parade of Homes Judge's Choice Award for Best Home under $250,000.

Despite the relatively low cost, the houses boast excellent interior and exterior finishes (tile interior throughout, acrylic-fortified stucco exterior). Natural lighting, good ventilation, and a thoughtful floor plan help to make the best use of space. Thermal performance was emphasized throughout design and construction, with a high-efficiency hot water heater and boiler, radiant heat, double-glazed windows, and careful attention to weather sealing. Fly-ash was incorporated into the concrete mix to reduce the Portland cement content in the slab, which also acts as thermal mass to retain and modulate solar gain. The 2x6 walls were insulated with wet-spray cellulose and R-5 foam sheathing. A blower-door test was conducted at the end of the job to evaluate the envelope and to determine ventilation requirements.

Careful construction, thoughtful design. Mature trees on site were protected carefully, and stone from a pre-existing rubble foundation was reused for the yard wall and landscaping. Water catchment was integrated into the grading and drainage plan in the form of a pond, which supports regionally appropriate landscaping and gives birds a place to get a drink (a rare treat in the desert). The architect, Greg Walke of WOA, Inc., made sensitive use of locally available materials to retain the regional character of Santa Fe without breaking the budget, and provided for shade, privacy, natural lighting, and optimal placement on the lot (see photo below). He also specified low-VOC finishes and polystyrene products that were manufactured without CFCs or HCFCs.

Mature trees on the small lot were carefully preserved, and rainwater is used to support landscaping and wildlife. Notice the shadow line under the portal, which has been carefully designed to admit daylight without overheating the interior.

This project worked out well for everyone — us, the city, the new homeowners, and their neighbors. By using the existing infrastructure, infill housing saves money, conserves resources, and can provide housing for those who might not otherwise be able to afford it. These houses were built within a block of each other in an older, traditional neighborhood. During construction, several of the residents stopped to thank us for helping to improve the neighborhood. It's hard to put a price on that.

— P.H. and S.H.

including the health of the occupants.

Modern materials along with tighter construction have resulted in legitimate concerns about indoor air quality. The need for effective ventilation is well documented and should never be neglected. Builders routinely subject new homeowners to a toxic "chemical soup" as carpets, paints, adhesives, and synthetic materials outgas into the indoor atmosphere. Anything you can do to improve the indoor air quality while maintaining thermal performance is good, including the use of nontoxic and low-VOC materials. If you have any doubts about the materials you use, read the *MSDS*.

Why Build Green?

We got into green building for personal reasons back before a lot of the recent technology was worked out, and we had a slow, expensive learning curve. But a lot has changed in ten years, and a tremendous body of knowledge is now available. New materials are being invented all the time, and the reasons to get involved are better than ever.

At the 1999 NAHB Green Building Conference, then-NAHB President Charlie Ruma declared, "The future of home building is green building." The demand is there, and so are the profits. Many major metropolitan areas, including Albuquerque, Atlanta, Austin, Boulder, Denver, Scottsdale, parts of California, western Washington, and northern Maryland, show enough interest in green building that HBAs are being formed specifically for green building, with state and local government agencies becoming involved, too.

We may have to, soon. As the population increases and resources become scarce, green building has taken on greater importance, and has become a matter of public policy in some parts of the country. Many cities and states are working on sustainable development plans, and some have active programs in place. For example, Austin Energy has created a Green Building Program in cooperation with the city of Austin and nearly 200 local architects, builders, contractors, designers, suppliers, and related tradespeople. This program has served as a model for many other programs nationwide.

As government officials at all levels realize the benefits, they are increasingly encouraging green builders, and in some parts of the country, incentives are available. Federal support in the form of information and research is coming from the U.S. Department of Energy, the EPA, HUD, and government/private-sector partnership initiatives such as PATH (Partnership for Advancing Technology in Housing; www.path.org). PATH is described as "a voluntary initiative that seeks to accelerate the creation and widespread use of advanced technologies to radically improve the quality, durability, environmental performance, energy efficiency, and affordability of our Nation's housing."

Benefits to the builder. Green building isn't altruistic, as there are definite advantages for the builder. Tom Estes of the California Integrated Waste Management Board states, "Building green can minimize the impacts of development on the environment and reduce the consumption of natural resources over the building's life. This benefits the contractor by differentiating him from the competition and providing more value for his customers and results in more demand for his product. Additionally, a builder with a reputation for being green will usually have a better image within the community."

Richard Dooley, environmental analyst with the NAHB Research Center, observes, "By incorporating environmental issues into the home building process — from site design to hand-off to the homeowner — builders and developers have found that they can build profitable homes that benefit the environment and the homeowners."

Benefits to the buyer. By becoming a green builder, your clients can enjoy health benefits, more value for their money, reduced operating costs, a lower overall cost for their house over the life of the building, and in many cases, a higher level of perceived quality. Lenders are beginning to realize that energy efficiency and careful construction make good economic sense, and are beginning to factor those potential savings in as they qualify borrowers. For example, Paul McCutcheon of Old Kent Mortgage in Austin, Texas, says, "Whatever your budget, whatever your style, you can enjoy the benefits of a green home." Fannie Mae is working on its own Housing and Environment Initiative to develop mortgage products for energy- and resource-efficient housing. Fannie Mae offers several "green mortgages" that provide incentives for the design, construction, and purchase of homes that use resources more efficiently. These mortgages generally take the projected energy, water and resource savings that a green built home offers and add them to the home buyer's income for the purpose of qualifying for the home, giving the borrower greater buying power. Fannie Mae has also developed a consumer guide for buyers of green homes. (*Home Performance Power: Fannie Mae's Guide to Buying and Maintaining a Green Home* can be ordered by calling 800/471-5554 and asking for publication number HI274.)

Getting Started in Green Building

A lot of ink has been used trying to define what's green and what isn't. The "greener than thou" attitude helps nobody, and trying to force clients into anything is generally unproductive. We'd rather see builders start wherever they are, incorporate as many improvements as they can, and then continually educate themselves and their clients as time goes by.

If you can build a comfortable, attractive, energy-efficient home that fits your client's budget and outlasts the mortgage, you are more than halfway there. Then you can focus on nontoxic materials, sustainably produced or recycled materials, indoor air quality, waste reduction, embodied energy reduction, wildlife ecology and habitat preservation, water conservation, and lower building operation and maintenance costs. An alternative energy source (such as solar, wind, photovoltaic, or geothermal power) is often an option, especially

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Green Craftsmanship: Milburn House

Currently under construction, this 5,500-square-foot house is at the high end of green building, in terms of both size and cost. The finishes are remarkable, with extensive tile work (Figure A), carved wood doors, heavy timber, and hard-trowelled plaster throughout.

But beneath the appearance, the house is pure performance. It's built with Rastra (www.rastra.com), an ICF made from recycled, postconsumer plastics (such as expanded polystyrene) mixed with Portland cement. The combination of insulation and high thermal mass is ideally suited for passive solar applications in the Southwest; plus, you get the usual strength, durability, sound attenuation, and fire resistance (Figure B). Because of the surface texture of the material, you can also apply stucco and plaster directly without the use of lath. This results in lower material costs, faster production times, and easier management with fewer inspections and fewer steps on the project schedule.

Built to last. Durability is an important feature — rather than only looking at the up-front or initial costs, we also evaluate our buildings on the life-cycle cost. The reality is that someone will be paying for these homes, and there also will be a significant additional cost at whatever point the house needs to be renovated or demolished. Every time a house is taken to the landfill, the environmental impact is staggering. One of the very best things you can do is design a house for adaptive reuse and build it well enough that it lasts a long time. This house is designed and built to last, right down to the concrete countertops (Figure C).

Energy efficiency figures into this design as well, with high-efficiency boilers, radiant heat, passive solar gain, natural daylighting,

Figure A. Beauty and durability are combined in this tile ceiling.

Figure B. Rastra walls provide thermal mass and lasting strength. Much of the architectural woodwork, including these shutters, was reused from other buildings.

Figure C. Comfort and aesthetics are integrated with thrift and practicality in green building. Note the concrete countertop, good natural light, and the point-of-use hot water heater soon to be installed.

natural ventilation (no air conditioning required), and a point-of-use hot water heater in the kitchen.

The house was designed to fit the site, and accommodates the rugged terrain with minimal excavation and disturbance to the site. Erosion control has been accomplished with a series of rock gabions, which will support increased vegetation and wildlife habitat. Water catchment is accomplished with metal roofing, gutters, and underground plumbing for future use with a cistern. The landscaping incorporates reused flagstone and locally available river rock.

The heavy timber in the great room was reclaimed from an old railroad bridge (Figure D), and the exquisitely decorated beams in the kitchen and dining room were recycled from another building that had been demolished. The wooden doors and carved room dividers are also reused from previous buildings.

Indoor air quality has been addressed through the use of low-VOC paints and adhesives, the absence of carpeting anywhere in the building, formaldehyde-free cabinets, and adequate ventilation.

— P.H. and S.H.

Figure D. Heavy timber reclaimed from an old railroad bridge was used throughout the house, including the great room (top). Salvaged, decorated beams were used in the kitchen and dining room (above).

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in rural areas, and as the technology improves, the prices are coming down.

Savings by design. Your efforts as a green builder start with the design. At the 1997 Green Building Conference in Austin, Texas, architect Sym Van der Ryn said, "Every dollar you spend at the drawing board is worth ten dollars on site." In our experience, he was being a little conservative, but the point is well taken.

We try to design our buildings so that the client always receives the maximum benefit possible. For example, the roof can do more than keep the house dry. It can also be used for rainwater collection, and the roof overhang can work with the windows to optimize solar gain in the winter and shading in the summer. Windows can be used for view, natural lighting, ventilation, and solar gain. Carefully designed thermal mass in walls can help optimize a heating system while effectively attenuating noise from outside the building.

Mary McLeod, residential specialist with Austin Energy's Green Building Program, explains, "Green building has nothing to do with style and very little to do with money. It's hard to recognize, because it's hidden in the design process of building the right house for your site."

Profit from savings. Through careful design and by trying to make every component of the structure perform several functions, you can find unexpected savings. Those savings can be reinvested in the project, your employees, and your company. We try to work with dimensions appropriate to our materials to minimize waste. Establishing design clarity with the client early in the process saves mistakes, changes, and unnecessary costs. Cooperation with the subtrades during design is always a good idea; these guys are experts in their field, and they can often suggest materials, methods, and design modifications that benefit everyone.

Paula and Steve Hagar *work with Sustainable Building Systems, an alternative-construction technology and design corporation, and Living Structures, an environmentally oriented design/build cooperative in Santa Fe, N.M.*

For More Information

Austin Energy Green Building Program
P.O. Box 1088
Austin, TX 78767
512/505-3702
www.ci.austin.tx.us/greenbuilder
These folks are among the foremost authorities in green building, and a premier source of information. Their work has served as a model for others nationwide.

Built Green Colorado
c/o HBA of Metropolitan Denver
1400 S. Emerson St.
Denver, CO 80210
303/778-1400
www.builtgreen.org

California Integrated Waste Management Board
1001 I St.
Sacramento, CA 95812
916/341-6000
www.ciwmb.ca.gov/GreenBuilding
This first-rate website is a great place to start.

Maryland Department of Natural Resources
Education, Bay Policy, and Growth Management
Tawes State Office Building, E-2
580 Taylor Ave.
Annapolis, MD 21401
410/260-8710
www.dnr.state.md.us/programs/greenbuilding/

NAHB Research Center
400 Prince George's Blvd.
Upper Marlboro, MD 20774
800/638-8556
www.nahbrc.org

PATH: Partnership for Advancing Technology in Housing
470 L'Enfant Plaza S.W., Suite 7110
Washington, DC 20410
202/708-4277
www.pathnet.org

Other Websites of Interest

Energy Efficient Building Association
www.eeba.org

Environmental Building News
www.buildinggreen.com

Oak Ridge National Building Technology Center
www.ornl.gov/ORNL/BTC/

U.S. Department of Energy, Rebuild America Program
www.eren.doe.gov/buildings/rebuild

U.S. Environmental Protection Agency, Energy Star Homes Program
http://yosemite.epa.gov/appd/eshomes/eshomes.nsf

U.S. Green Building Council
www.usgbc.org