Green Building and Development

Creating Sustainable Spaces

What's the Problem?

The built environment is an essential part of our lives, necessary to provide spaces to live, work, play, shop and learn. However, the design, construction, maintenance and operation of our built environment have a tremendous impact on the natural environment and resource base. Already there are more than 76 million residential buildings and 5 million commercial buildings in the U.S. and 38 million more will likely be constructed by the year 2010.

Traditional building practices often overlook the interrelationships between building and the environment. A standard wood-framed home consumes over one acre of forest and the global building industry accounts for almost one half of the world's demand for wood. Run-off from roads and built landscapes is a major source of water pollution. Heating, cooling and providing electricity to buildings contributes significantly to air pollution and accounts for more than one third of the world's energy consumption. Buildings account for 40% of our consumption of raw materials like copper, steel and plastics. The standard wood-framed house creates an average of 3-7 tons of waste created during construction. Homes, roads, office complexes, shopping malls and parking lots are creeping across the landscape at ever-increasing rates, consuming land that was previously farm, forest or open space.

"Green Building" as a Solution.

The good news is that a range of new solutions and techniques are being developed which lessen environmental impacts of building and development. These techniques come under a wide umbrella often termed "Green Building Practices". They encompass strategies that:

- improve energy efficiency in homes,
- reduce consumption of raw materials,
- better manage water resources,
- better preserve open spaces,
- minimize production of waste from construction,
- make buildings which work with the natural elements of their immediate environment.

Examples include: Taking maximum advantage of sunlight to heat and light homes, reducing unnecessary land disturbance, working with the landscape to minimize threats to soil and water quality and protecting ecological diversity.

According to Roodman and Lessen of the World Watch Institute, sensitive design using available technologies in the US could cut total energy use by 60% percent in commercial buildings. Paul Hawken, in "The Ecology of Commerce", states that residential energy conservation with ceiling insulation and double-glazed windows can produce more oil than the Arctic National Wildlife Refuge at its most optimistic projections, at about 5% of the cost, simply through cutting down on wasted energy.

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Basic Principles of Green Building:

It is important to recognize that there is no universal formula for building green. What can be considered “green” depends heavily on climate, vegetation, availability of local materials, relative costs and an array of other factors.

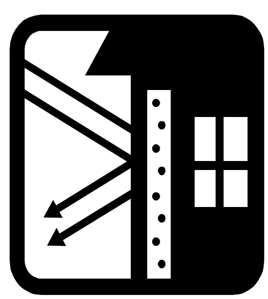
There is often debate about which building practices are in fact “more green”. Is it more ecologically sound to use a recycled plastic carpet, which is produced from waste but must be land filled eventually, or to use wood floors, which can be expected to last longer and come from a renewable resource, but require cutting down trees? The answer is not always clear.

Although techniques may differ, there is a general agreement about the goals of building green. The goals of green building are to increase the overall efficiency, energy and otherwise, of buildings, cut down on the consumption of raw materials, use land, soil and water resources sparingly and efficiently and minimize the creation of waste from construction. All of these factors combine to lessen the “ecological footprint” that built spaces create.

Achieving the Goals:

The following are green building techniques often put into practice to meet the overall goals.

- **Maximize Energy Efficiency**
  - Design buildings from the outset to maximize energy efficiency, especially in heating and cooling, rather than trying to make a structure energy efficient after it is built.
  - Build a “tight“ house that has few if any air leaks and provide for a mechanized ventilation system to allow for adequate air circulation.
  - Use energy efficient appliances such as those certified as “energy star” by the US Department of Energy.
  - Consider use of alternative heating/cooling such as geothermal (ground based) systems or radiant floor heating.
  - Use well-sealed, energy efficient windows and insulated doors.
  - Orient and construct buildings to take advantage of natural lighting and passive solar heat gain in winter.
  - Use vegetation to provide shade and cooling in summer.
  - Build close to work, shopping and other activities to minimize driving and therefore gasoline consumption.



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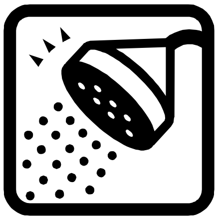
- **Use land resources efficiently and ecologically.**
  - Avoid sprawl in designing building sites. Cluster buildings or build “up” instead of “out” to preserve open spaces.
  - Build in areas that are already impacted by development, filling in vacant spaces where possible, tearing down deteriorating buildings and replacing them with new ones or renovating older buildings that are still structurally sound.
  - Revitalize abandoned areas or “brownfields” such as warehouse districts, old industrial centers, abandoned lots etc. with new building that makes the area functional once again.
  - When building on a previously undeveloped site, identify and protect natural amenities such as wetlands, streams, forested areas and zones of ecological diversity.
  - Protect the soil when building by avoiding steep slopes, providing ground cover, preserving and replacing topsoil when grading.

- **Efficient and Innovative use of Materials**
  - Build small, using good design to maximize comfort and usefulness of spaces. Smaller buildings require less material to build (and heat!).
  - Use environmentally friendly materials such as recycled content decking, carpets, countertops, roofing tiles, certified sustainable lumber, cellulose insulation, engineered lumber, low VOC paints, etc.
  - Use good design to allow builders to do more with less material.
  - Use long lasting materials that are of high quality so that they will not have to be replaced or repaired often.
  - Design buildings to suit standard dimensions of common building materials so less waste is produced.
  - Use building materials that can be re-used or recycled after the end of the useful life of the building. These include metal roofs, good quality wood flooring, paving stones etc.

- **Minimize Impacts on Water Resources**
  - Install low-flow showerheads, faucets, toilets and other appliances in the home.
  - Use drought tolerant, low maintenance, low pesticide landscaping.
  - Decrease the amount of paved surfaces by cutting down on asphalt roads, driveways, parking lots etc.
  - Take advantage of natural rainfall by collecting roof runoff for yard and other outdoor applications.



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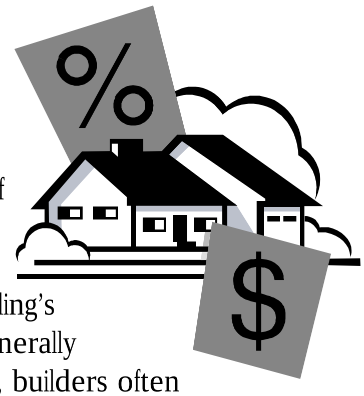
But What about Affordability?



Employing the elements listed above will lead to buildings that are much healthier for the environment. But can people afford to build and buy them? This is one of the biggest questions facing builders and buyers who would like to create buildings that are green. It has generally been considered true that building "green" will increase the initial costs of construction a minimum of 5 percent above the cost of conventional construction.

One factor that offsets increased initial costs is the savings a building's occupant will reap over time from decreased energy bills and generally lower costs of repair and maintenance. In spite of these savings, builders often feel that it is too risky to build houses that cost more than typically constructed ones when most of the improvements are hidden from the eye of the buyer. In addition, most homeowners move every 5-7 years making it difficult to recognize the full benefits of the green features. However, this can be offset by a higher market value when they decide to sell and tax incentives for green features given by local and state governments. For green buildings to truly achieve sustainability, they must also be considered affordable, or few people will buy them.

Some builders are beginning to find creative ways to meet this challenge. Gabriel Enterprises in Newport, Virginia has developed several affordable-home communities that feature their "Healthy-E" homes. These homes sell for the same price as conventional homes but are designed to use 50 percent less energy than conventional homes and meet indoor air quality standards set by the American Lung Association. They were able to keep costs down through careful planning and some give-and-take in design, according to company president Jay Epstein. For example, the dense cellulose insulation in the walls costs 30 percent more than conventional fiberglass insulation, but this was compensated for by design that allowed non-weight bearing walls to have studs that were 24 inches apart instead of 16 inches, requiring less wood.

Another example of affordable green building is the Erie-Ellington Homes of Boston Massachusetts. The homes were built in a run-down section of the city but feature state-of-the-art "EcoDynamic" energy and environmental technologies that were developed by the GreenVillage Company. These include energy-efficient panelized construction, a "tight" building envelope to promote comfort and durability, high quality materials such as energy-saving windows, EPA Energy Star rated appliances and natural linoleum floors. These measures are expected to save 50% annually on overall energy use as compared to standard homes, and 46% annually on total operating expenses for water, electricity, and heat. The builder managed to include these improvements and still keep building costs at $95 per square foot, which is standard for conventional homes.

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Conclusion

Creating and maintaining built spaces will always have some impact on our natural environment, but changes in the way these spaces are designed and built will allow for a softer “ecological footprint” which meets human needs while minimizing pollution and impacts on land, water and other natural resources. The sooner these changes become affordable and widely demanded, the greater the potential for sustainable outcomes in the United States and around the world.

HOME 1: Suburban Colonial

<u>FACTS AND FIGURES:</u>

Windows Standard double paned storm windows. Large picture window in family room facing north.

Siding Mix of PVC vinyl siding and brick foundation.

Roof Dark gray fiberglass shingles.

Paved Surfaces 15 foot wide asphalt drive way leading to three car garage.

Heating/Cooling System

Gas furnace, forced air heating and cooling system using duct work to distribute warm air through house. House is built with standard insulation package. No mechanical ventilation system is used since there is enough air exchanged through "natural" air leaks in structure.

Average Annual Energy Consumption

Average electricity and gas bills amount to about $180 per month. Fuel used in automobile commuting is high since little in the way of shopping, school, or work places are closer than a 10 minute drive.

Appliances Standard appliances installed.

Landscaping Majority of parcel is in lawn grass. Small stand of trees near fence line to east of home remain, and several saplings were planted in yard after construction to provide beauty and shade after they grow to maturity.

Waste from Construction

4.5 tons of construction waste produced in creation of this home. All waste was land filled.

HOME 2: State of the Art Townhome

FACTS AND FIGURES:

Windows
Energy efficient windows. More windows placed on south side to take advantage of passive solar heat gain in winter.

Siding
Brick and cementitious fiberboard (An alternative to wood and vinyl siding which, uses less wood, has a long life and requires minimum maintenance).

Roof Fiberglass shingles (30 year life)

Paved Surfaces Stone path from parking to front door, brick patio in back of home.

Heating/Cooling System
The house was designed with extra insulation – cellulose insulation from recycled materials instead of fiberglass, and "tight" construction that allows very little leakage of heat or air. A mechanical ventilation system was installed to ensure adequate air exchange for health without loss of heat. Heating and cooling provided by most efficient electric heat pump available.

Average Annual Energy Consumption
Average electric bills work out to about $55 per month. Automobile fuel consumption is typically minimal given proximity to public transportation and shopping near by.

Appliances Energy-star rated appliances installed. All showerheads are low-flow.

Landscaping Minimal landscaping due to small front yard and fenced-in back yard. Back yard vegetation is hardy and low maintenance.

Waste from Construction
Waste from construction was minimized by planning construction of many similar town-house units simultaneously. Design of homes took advantage of typical building material dimensions wherever possible.

HOME 3: Rural Retreat

FACTS AND FIGURES:

Windows

Energy efficient windows. Large ones on south side of home for passive solar heat gain, smaller ones on other sides of house.

Siding

Certified sustainable wood siding (Internal structure also made from certified sustainable lumber.)

Roof: Long lasting metal roof.

Paved Surfaces Parking area made from porous paving, gravel drive from main road.

Heating/Cooling System

Ground-based geothermal heating and cooling system. Natural cooling in summer from shade trees. Ceiling fans installed in several rooms. Solar cells provide water heating and generate part of the home's electricity.

Average Annual Energy Consumption

Monthly electric bills average $15/month. House is located a 15 minute drive from the nearest shopping area and a 45 minute commute to the nearest downtown area.

Appliances Appliances such as refrigerator, stove, lights and washers are all "Energy-star" rated as the highest energy efficiency levels. Low flow shower heads are installed as well as low-flow toilets and washing machine.

Landscaping Natural, low maintenance landscaping, drought tolerant plants, requiring minimum pesticide and herbicide usage. Trees planted to promote cooling of house in summer. Small wetlands preserved and enhanced on site.

Waste from Construction

By chipping and composting wood waste and through careful planning during construction, construction waste was reduced by 20% over typical levels.

Home Buyer Ranking Sheet

You are in the market for a new home. In each category rank the three homes featured on a scale of 1-5. Your final preference need not reflect the home that ranks the highest in total points. Instead it should reflect the home that you would be most likely to choose for the reasons that YOU consider most important.

RANKINGS

	Home 1: Suburban Colonial	Home 2: Town Home	Home 3: Rural Retreat
Aesthetics/ Attractiveness:			
Affordability:			
Energy Use:			
Land Use:			
Materials Use:			
Water Use:			
Preference:			
TOTAL			

1. What factors most influenced your home choice?

2. Which green elements, if any, exhibited in any of the featured homes or in the essay would you consider important in buying or building your own home? Why?

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How Much Do You Discount the Future....

Pay Now or Pay Later?

The following table illustrates the concept of discounting by representing tradeoffs between extra money spent on energy efficiency in a home's construction and savings in energy bills over time. Which of these scenarios would YOU choose if faced with these options?

Assume a base price of $100,000 for the home. The following figures represent additional up front expenditures to increase energy efficiency of the home and the correlated expenditures on energy bills over time.

Additional Investment in Home
Construction on
Energy Efficiency — Energy Bills Over Time:

Year: 1	2	3	4	5	6	7	8	9	10
A $0	$2,400	$2,400	$2,400	$2,400	$2,400	$2,400	$2,400	$2,400	$2,400
B $500	$2,300	$2,300	$2,300	$2,300	$2,300	$2,300	$2,300	$2,300	$2,300
C $2000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
D $6000	$1,200	$1,200	$1,200	$1,200	$1,200	$1,200	$1,200	$1,200	$1,200

Note that in reality several conditions presented in this table would not likely hold true:

1. Energy prices will tend to fluctuate over a ten year period – not remain constant as shown.
2. All dollars spent on increased energy efficiency are not created equal. Simply spending more money does not guarantee a certain decrease in energy bills over time. Some high-impact improvements may be low cost and some low-impact improvements may have a high cost.

1. How many years in each case does it take to "pay back" the initial investment through savings in energy bills?

2. How much money is saved in energy bills over 10 years in cases B, C and D?

3. Based upon how YOU value savings now vs. savings in the future, which scenario would you choose?