Shades of Green

A Green Building Guide for YouthBuild Affiliates

Conceived and developed by Eva E. Blake
Director, YouthBuild USA Green Building Initiative

AUGUST 2007

YouthBuild U.S.A.

YouthBuild Green Building Initiative

THE HOME DEPOT FOUNDATION
Building Affordable Healthy Homes

YouthBuild USA thanks The Home Depot Foundation for providing a grant to support YouthBuild USA's Green Building Initiative, which is dedicated to creating healthy, livable communities through the integration of affordable housing built responsibly and the preservation and restoration of community trees. This grant funded the production of this guide.

About YouthBuild

In local YouthBuild programs, low-income young people ages 16–24 work toward their GED or high school diploma while learning job skills by building affordable housing for homeless and low-income people. Today, there are 226 YouthBuild programs in 42 states, Washington, D.C., Puerto Rico, and the Virgin Islands, engaging approximately 8,000 young adults per year.

Because a comprehensive approach is called for, the YouthBuild program has gradually and inevitably become a number of things at once:

Alternative school, in which young people attend a YouthBuild school full-time on alternate weeks, studying for their GEDs or high school diplomas. Classes are small, allowing one-on-one attention to students.

Job training and pre-apprenticeship program, in which young people get close supervision and training in construction skills full-time on alternate weeks from qualified instructors.

Community service program, in which young people build housing for homeless and other low-income people, providing a valuable and visible commodity for their hard-pressed communities.

Leadership development and civic engagement program, in which young people share in the governance of their own program through an elected policy committee and participate actively in community affairs, learning the values and the life-long commitment needed to be effective and ethical community leaders.

Youth development program, in which young people participate in personal counseling, peer support groups, and life planning processes that assist them in healing from past hurts, overcoming negative habits and attitudes, and achieving goals that will establish a productive life.

Long-term mini-community, in which young people make new friends committed to a positive lifestyle, pursue cultural and recreational activities together, and can continue to participate for years through the YouthBuild alumni association.

Community development program, in which community-based organizations obtain the resources to tackle several key community issues at once, strengthening their capacity to build and manage housing for their residents, educate and inspire their youth, create leadership for the future, and generally take responsibility for their neighborhoods.

Since 1994, more than 68,000 YouthBuild students have produced 16,000 units of affordable housing.

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CONTENTS

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FOUNDATION
Building Affordable Healthy Homes

INTRODUCTION

Welcome to *Shades of Green*, a green-building guide for YouthBuild programs written by YouthBuild USA with the help of several YouthBuild programs experienced in green building.

Shades of Green is intended to guide readers through a wide variety of green building practices that can be integrated into a YouthBuild program's construction and rehabilitation of affordable housing. Recognizing that YouthBuild programs are unique in their approach to construction, *Shades of Green* offers the following:

- **Sequential organization.** This guide is organized in the sequence that most of you build your homes, from the foundation to finish-out and final landscaping, with the least emphasis on phases that most YouthBuild programs contract out.
- **Detailed table of contents.** The detailed listing allows you to easily find the specific section for the phase of building for which you are currently planning.
- **Short and clear explanations.** The text is brief, with lots of references for further study. Wherever possible, the jargon has been eliminated and most of the content has been selected for its relevance to your world—affordable low-income housing built partially or entirely by youth on a shoestring budget.

We offer a few suggestions on using this material and in starting up green efforts:

- Quickly scan the whole text or the table of contents. If your program does not participate in the building design, lot selection, or development, then skip over these sections, and revisit them when they are most useful such as when you hire subcontractors and want to specify techniques or materials you'd like them to use.
- Recognize that rehabilitation and remodeling in and of themselves receive points in many green building checklists and rating systems. YouthBuild's original building in Harlem was a rehab that not only reused existing structural components that were still solid, but converted abandoned and dangerous property into affordable housing—talk about recycling and reusing!
- Focus on the items that work for you. Some items will apply to all climates and are easy and inexpensive such as good building orientation, programmable thermostats, compact fluorescent light bulbs, and caulking. Others will be difficult or expensive; not relevant to your situation, budget, or climate; or not possible within your local building codes. Items that are easy and inexpensive are indicated with the icon shown in the table of contents.
- Locate the nearest council or organization that has a green builder's checklist and use the checklist to determine ways that some of your current practices may

already be green, for example, if you rehab, reuse donated materials, or have superior insulation techniques. Most programs are amazed by what few simple changes could make them much greener. These green building organizations and their checklists represent the best thinking and adaptation for your area and will likely be updated as the various national rating systems are formalized.

- Start your green building process from where you are, with a few carefully selected items that you like and that have buy-in from everyone (students, construction staff, funders, parent agencies and inspectors) and are most likely to succeed.
- The curriculum and teaching point exercises referenced in Appendix C are a great way to involve and familiarize your students with green practices, even if the techniques are not implemented on the construction site.
- If you don't already have it, request a copy of the *YouthBuild Green Pages*, a green building resource manual with lots of sources for information, technical assistance, and funding.

Green building is entering an exciting phase; the benefits and necessity of energy and material efficiency alone are rapidly becoming well publicized. Green building creates lots of savings for homeowners, helps protect the environment, and ensures a healthy indoor environment in the interest of human health.

More and more states, cities and funding agencies are moving toward requiring some level of green compliance. Rapidly moving into the mainstream practice, green building has a growing number of standards and rating systems with both national and local specifications and checklists.

You and your work are integral to forwarding the affordable green building movement. In my 10 years of experience building green homes with my YouthBuild program I have discovered it to be very exciting to my youth, our board, the community of Austin, and our funders. Good luck. We hope this guide will help you on your way to accumulating similar benefits by embracing healthy and environmentally responsible construction.

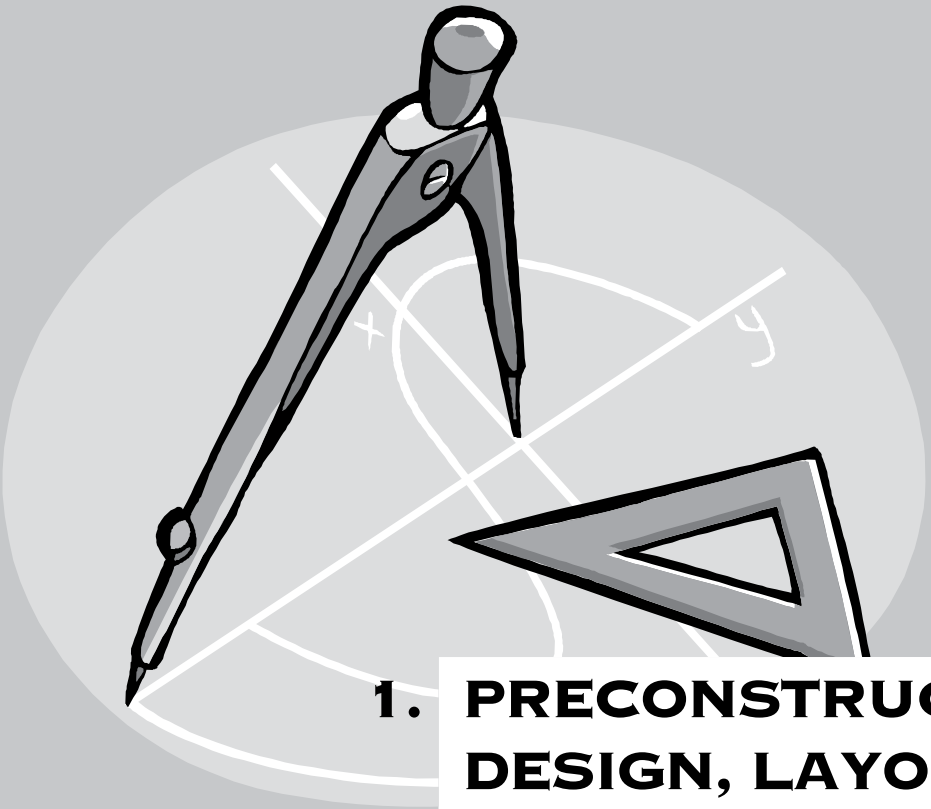
Dick Pierce
Senior Program Officer
American YouthWorks' Casa Verde Builders YouthBuild
January 2007

Explanation of Icons

This picture indicates text describing the monetary costs of the technique or material being discussed.

This picture indicates features that cost nothing to implement, or have the potential to pay for themselves over time.

This picture indicates teaching opportunities for green building practices. All references to exercises and lesson plans are located in Appendix C.



1. PRECONSTRUCTION DESIGN, LAYOUT, AND INFRASTRUCTURE

GREEN DESIGN TEAMS AND THE INTEGRATED DESIGN PROCESS

Old Colony YMCA YouthBuild Brockton's Green Innovation Team

Integrated design is a process in which the developer or contractor commits to green building or a specific standard of construction and ensures that each team member, beginning in the earliest stages of the design process, recognizes these commitments. The process aims to bring together all people with a stake in the building—such as financers, designers, occupants, developers, and subcontractors—to design a building with consideration of how each component will affect others when functioning as a whole system.

By coordinating plans preconstruction, members of a Green Design Team can come up with creative ways to maximize efficiency and use low-cost green techniques. For example, if the ductwork is not done by the same people planning the wall systems, and the two parties do not coordinate with one another, it is likely that the ductwork will not be installed in the conditioned space of the house (such as the ceiling above hallways) to save energy.

The integrated design process can be applied to both rehabilitation and new construction. With rehabilitation, existing structures may restrict the amount of choices available to a Green Team, but there are still plenty of options to consider when planning even the most basic remodeling. By considering all of your options with all stakeholders before construction starts, you will be able to incorporate green techniques into construction in an efficient and cost-effective manner.

Implementing Integrated Design

The integrated design process includes the early definition of specific building performance objectives, perhaps in a project vision statement, and should clearly incorporate these objectives into programming efforts. These objectives should also be integrated into all project narrative documents, building specs and contracts. Establishing specific levels of annual energy and water use is just one example of a building performance objective.

- Designate a coordinator of the integrated design process. This person will probably be the YouthBuild director or construction manager and will be the scheduler and facilitator of meetings and of communication between subcontractors, developers, and community members. The coordinator will also ensure that youth are included in the design process.
- Allow for additional costs, including the time necessary for team meetings or the hiring of a professional consultant to provide education and assistance.

- Choose members of local or national green building organizations (see the *YouthBuild Green Pages* for listings) when selecting architects, designers, and developers.
- Establish a performance-based fee structure to reward team members (engineers, plumbers, interior designers, electricians, etc.) for the extra effort involved and to encourage team cooperation and innovation, particularly with larger developments.
- Choose the rating system you are going to use (such as Energy Star, LEED for Homes, or one designed for your local climate by your local green building program) to help decide on a course of action and receive verifiable recognition of your green home by a professional organization.
- Simulate interactions among building systems; use computer modeling tools, particularly with larger developments.
- Include a life-cycle cost analysis (calculating the cost of a system or product over its entire life span) of options in your planning. These analyses serve as good research projects for team members. Refer to the resources section of this chapter for more information.
- Give awards and accolades at key points in the project and celebrate its conclusion with press coverage.

Organizing a Green Design Team

A Green Design Team gathering can wait until the construction manager has a set of designs to implement. It can also be done to introduce YouthBuild students to the concepts and applications of green building by designing a hypothetically ideal home if the program is not ready to implement the design into their actual construction practice.

Key Steps to Team Building

- Set the project's goals early in the design process with the input of all team members, and distribute a written statement of those goals once they are identified. Require personal signatures from team members to commit them to these goals.
- Establish a pattern of meetings for members of the integrated project team throughout the various design phases and during construction to do real work or make specific decisions. Waive the meeting if there is no business at hand. The frequency of these meetings should not interfere with the team's ability to get things done. Try to identify concrete tasks that the group can accomplish beyond simply "checking in."

Charrette

A collaborative planning process that harnesses the talents and energies of all interested parties to create and support a feasible plan.

A Charrette Is Usually:

- At least four consecutive days
- An open process that includes all interested parties
- A collaborative process involving all disciplines in a series of short feedback loops
- A process that produces a feasible plan
- A generalist, holistic approach

A Formal Charrette Is Not:

- A one-day workshop
- A multiday marathon meeting involving everyone all the time
- A plan authored by a select few that will affect many
- A "visioning session" that stops short of implementation

Above: Cobb County YouthBuild's Green Design Team

- Utilize a whole-system (whole-building) analysis, considering interactions among systems. The entire house should be evaluated as a system. If you choose to evaluate individual systems, ventilation should always be evaluated with windows, envelope, and the mechanical system.
- Systems that should be analyzed together include:
  - windows and envelope systems with mechanical systems,
  - gutters, drainage, foundations, flatwork and landscape,
  - framing and mechanical systems, and
  - windows, ventilation, and lighting (electrical and mechanical).
- Involve contractors, subcontractors, architects, engineers, inspectors, your executive director, customers or buyers, and other stakeholders.
- Clearly communicate to all subcontractors that the building process requires teamwork and working with youth; include this requirement in all conversations and in contracts. Team members should have a common interpretation of what constitutes improving performance.
- Host a design charrette, a form of brainstorming that creatively engages all stakeholders. If time is not available for a four-day charrette, shorter processes or variations can be used, such as focused project team meetings, brainstorming sessions such as community visioning events, and intensive workshops in which specific community members and experts are brought together to design the home(s) or the neighborhood.

Benefits of Integrated Design

- Including team members from the beginning allows them to feel more invested in the building process.
- Coordination fosters a closer working relationship between stakeholders (agency, funder, architect, developer, managers, staff, students, community, and homeowner) that will strengthen the critical partnerships you worked hard to secure.
- By taking the time to design a building from a whole-system approach at the beginning of the project, green improvements are likely to be less expensive and more effective.
- Investing time for this up front makes many more things affordable and easier as you go forward. It takes extra time and energy, but it will pay off in the end.

CHALLENGES OF INTEGRATED DESIGN

- Coordinating multiple schedules and changing traditional work patterns can be difficult.
- YouthBuild programs may not have much control over their construction projects, such as where there are partnerships with Habitat for Humanity or a housing suthority, or other projects where YouthBuild is not the owner or developer.

SOURCES

RSMeans, Green Building: Project Planning & Cost Estimating, (Contributing Authors, 2002)

Better Bricks: http://www.betterbricks.com and click on "Energy Effective Design"

Maryland Department of Housing & Community Development:

www.dhcd.state.md.us/Website/housingconf/document/Presentations/rose.pps

National Charrette Institute: www.charretteinstitute.org

Eric R. Shamp, *Basic, No Cost Green Building Strategies,* American Institute of Architects (AIA) www.aia.org/SiteObjects/files/18-11-03.pdf

Charrette in Atlanta Gives Opportunity for Learning and Collaboration

The Cobb County YouthBuild collaborative design charrette is an example of how to provide YouthBuild participants with hands-on opportunities to learn about sustainable building practices. With a small budget surplus, the Atlanta office of the American Institute of Architects' (AIA) Committee on the Environment (COTE) sponsored a community charrette in partnership with the YouthBuild at Cobb County Housing, the Southface Energy Institute, and the Community Housing Resource Center. The result was a four-day program: a two-day interactive workshop with the purpose of exposing YouthBuild students to sustainable building practices, and a two-day charrette with the students assuming the role of architects designing a house for a future YouthBuild construction site. Because of the charrette's success, Atlanta AIA decided to fund an annual charrette with Cobb County YouthBuild.

Day One: YouthBuild Cobb County students toured the facilities at the Southface Energy Institute. Students toured the Earth Craft House, a building that highlights a broad range of sustainable design and building practices. Two professionals spoke to the students. Jeff Christian, from the Oak Ridge National Laboratory, informed the group about the concept of zero energy and its integration into Habitat for Humanity homes across the country. Zero energy reduces utility costs for Habitat owners by utilizing solar energy and energy-efficient building materials. Joe Martin from AIA-COTE spoke to the students about The Rural Studio, an architectural training program out of Auburn University where architectural students design and build structures alongside residents in rural Alabama. Including this material was a way of introducing the broader issue of sustainable development and showing YouthBuild Cobb County students the kind of work that student architects do while learning their profession.

Day Two: After an overview of the charrette process, students were divided into four teams of eight students; each team worked with two architects. The teams were asked to come up with a design for one of four possible housing models. One group was assigned to work on a single-family home. The second group was asked to design a loft-style condominium arrangement. A third was given the task of working on an attached multifamily unit. The fourth group designed a hybrid unit, combining characteristics of single family, loft, and multifamily.

Day Three: The student teams went to an empty lot where Cobb Housing was going to build. Asked to envision what the building might look like, each team took photographs of the site, posted this information and reviewed the concepts of passive solar heating and cooling in sustainable design.

Day Four: The students developed models and scaled drawings and presented their completed designs to each other. While no new buildings were constructed as a result of the charrette, students incorporated sustainable materials and building practices into their design ideas and gave each other constructive feedback.

Several students left encouraged and excited about pursuing careers in architecture and design. "We also changed the way Cobb County Housing handled debris at construction sites. We initially had many locations for debris. We found that it was more sustainable to consolidate these into one location for debris. We have since adopted this practice," says Lance Wise, Executive Director at Cobb County YouthBuild.

To get more information about design charrettes and partnerships, contact Lance Wise at (770) 429-4400 or lwise@cobbhousinginc.org.

B. CONSTRUCTION PLANS AND SPECIFICATIONS

Nueva Esperanza YouthBuild Holyoke's Green Design Team

As you read through this manual you will notice that many items require preconstruction planning. The Green Design Team exists for this purpose, as it deliberately gathers everyone involved and schedules time to integrate new designs, technologies, or techniques into your practice.

The Green Design Team should review the entire portfolio of green building options for each building phase. Use this guide and other resources to decide each course of action, paying attention to how systems will interact. After making these preconstruction decisions, the team will be ready to draw up formal construction plans and specifications with subcontractors who are ideally already members of the Green Design Team.

Plans and specifications should include:

- A detailed mechanical plan (see the Plumbing, Electrical, and Mechanical section for details)
- A landscaping plan for protecting and restoring existing native plants and the site's wildlife habitats (see the Landscaping section for details), and
- Flashing for windows, doors, roof, deck, and chimney.

General Design Principles and Considerations

Below are a few general design considerations and techniques that go a long way to save on energy for heating and cooling. Several of the following points are explained in more detail elsewhere in this guide:

- If possible, orient the longest side facing south, to maximize natural heating, lighting, and cooling (see the Building Design section for details).
- Two bedroom homes must be a maximum of 1,250 sq. ft., with a maximum 250 sq. ft. for each additional bedroom.
- Use material dimensions when determining building dimensions to reduce material cuts and the resulting waste.
- Choose building materials that require no additional finishing.
- Choose building materials that are precut, preassembled or panelized—such as walls, roofs, or even entire home systems.
- Design a covered or shaded outdoor area or porch to be 100 sq. ft. minimum.

- Design a covered entry—such as an awning or porch—to prevent water intrusion.

- Prepare and protect existing trees for construction and avoid the trees' root systems.
- Design shared driveways and parking, and use shared trenches and tunnels for utilities.

- Ensure that the home meets American with Disabilities Act (ADA) standards for accessibility.
- Design a space for household recycling and equip new owners with recycling bins and instructions.
- Space and water heating equipment should go in a separate closet with an outside air source.
- Choose direct-vent, sealed-combustion fireplaces or include no fireplaces at all.

SOURCE

Member Manual: Version 1.5; Teacher Addition; Casa Verde Builders, American YouthWorks; 2003

C. BUILDING DESIGN

Good passive design uses natural heat from the sun and natural nighttime cooling to keep the home at a comfortable temperature year-round.

Passive designs can be implemented with little or no extra cost. Even basic measures can significantly reduce the need for expensive mechanical heating and cooling. Your first goal should be to lower energy bills. However, know that with a much larger investment, it is possible to build *zero energy* homes—homes designed to use zero net energy from the utility grid—in every climate that require no mechanical heating and cooling as a result of good siting, excellent design, renewable energy use, and superb insulation.

Passive solar design integrates a combination of building features to reduce or even eliminate the need for mechanical cooling and heating and daytime artificial lighting. *Passive* refers to the fact that there are no mechanical parts associated with any of these techniques.

TRUE SOUTH is not the same as magnetic south at most locations. Because of the earth's magnetic field, a compass reading of south varies as much as 22° in some parts of the country. This difference is called magnetic declination, and is measured in degrees. You can find True South with a compass if you know your local declination, or by the solar noon or north star method.

It is important to find out the hours and *direction* from which the building will receive unobstructed sunshine and wind throughout the year. The position of the sun, and therefore the amount and direction of sunlight, can be determined once you find true south on your building site. It is also important to understand the climate of your building site, specifically the number of days above and below 65°F during an average year. This information will help determine the building's heating and cooling needs—passive or mechanical.

The orientation of the building with respect to solar and wind patterns, nearby buildings and other things blocking the sun, and vegetation must be carefully planned to maximize and manage southern exposure for natural heating, lighting, and cooling to work well. The following sections describe window selection, natural heating, cooling, and lighting design.

Windows

The placement, size, and specifications of windows greatly influence the energy efficiency of a building. New window technologies such as selective coatings can make it easier to balance windows' heat gain and heat loss properties without overheating the space. This balance is very specific to your local climate and site characteristics.

In hot climates, the strategy for windows is to admit light while rejecting heat. Design large north windows to take in cooler, diffuse north light. Minimize window height on the south side (strip windows work well),

and shade the windows from direct sunlight when the sun is high in the south sky.

SOLAR GAIN is a measure of heat from the sun; the amount of heat produced in a building by solar radiation, e.g., through windows or transparent walls.

In cooler climates, effective strategies include installing smaller windows on the north side and large windows on the south side to maximize solar gain during the winter. South-facing windows will also require shading in the summer to block direct solar gain.

When selecting windows, start by looking at two important specifications: the U-value and the solar heat gain coefficient. U-value is the rate of heat transmission (lower is better). The Solar Heat Gain Coefficient (SHGC) measures how well a window blocks heat from sunlight. The SHGC is the fraction of the heat from the sun that enters through a window. SHGC is expressed as a number between 0 and 1. The lower a window's SHGC, the less solar heat it transmits. Also consider visible light transmittance (higher is better). Low-E windows use technology that reduces the amount of energy loss through windows by inhibiting the transmission of radiant heat while allowing sufficient light to pass through.

LOW-E (the 'E' stands for emissivity) is a new window technology that lowers the amount of energy loss through windows by inhibiting the transmission of radiant heat while still allowing sufficient light to pass through.

www.teachmefinance.com/Scientific_Terms/Low_Emissivity_low-E_Windows.html

Most window manufacturers offer an array of optional heat-reflecting coatings that block heat gain but allow penetration of natural light. Windows that receive large amounts of direct or reflected sunlight are good candidates for window coatings. This is a great choice for west-facing windows.

IMPLEMENTATION OF WINDOW SELECTION AND PLACEMENT

- A general rule of thumb is to minimize windows on the west and east sides to avoid the glare of morning and afternoon sun.
- Use double-glazed windows and avoid metal frames, regardless of climate. Single-paned windows lose up to 25 percent of the energy used to heat and cool a home because they are not insulated.
- If building in consistently hot climates, use glass with a moderate solar heat gain coefficient. Be sure to shade south-facing windows from summer sun (see Shading).
- For climates with both heating and cooling concerns, use glass with a moderate solar heat gain coefficient. Design for heat in summer with plenty of shading. Plants and trees that shade in the summer and not in the winter (such as deciduous trees and trellises) are a good choice.
- If building in consistently cold climates, use glass with low U-value and high solar heat gain coefficient.
- Use Energy Star-rated windows for your local climate or for a climate-specific window property recommendation and pricing tools, contact the Efficient Windows Collaborative:

FAST FACT

75 percent of YouthBuild programs surveyed in 2005 use Energy Star-rated windows.

EWC/Alliance to Save Energy
1200 18th Street NW, Suite 900
Washington, D.C. 20036
(202) 857-0666
www.ase.org
www.efficientwindows.org

- Use a computer simulation tool such as RESFEN (http://windows.lbl.gov/software/resfen/resfren.html) to compare window options by customizing calculations with heating and cooling costs for your area, utility costs, and housing design.

Low-E windows could cost 10-15 percent more than other windows, but will reduce heating costs by up to 50 percent. Many manufacturers are beginning to include Low-E as their standard at no extra cost.

BENEFITS OF WINDOW SELECTION AND PLACEMENT

- From an energy standpoint, a window is basically a hole in the wall. Choosing insulating, reflective windows (double glazed, reflective film, solar screens), and good caulking can help "close the hole."
- Avoiding windows on the east and west, where there will be direct sunlight, and carefully placing windows relative to overhang (shade in summer, sunlight in winter; see box to the right) will help dramatically.

CHALLENGES OF WINDOW SELECTION AND PLACEMENT

- If you are using a wooden frame for your window, a moderate insulator (R1 per inch), requires some maintenance (stain or paint) to prevent rot from moisture build-up.
- Over the course of many years aluminum will oxidize leaving a dull-pitted appearance. If not well insulated with a thermal break, it is very cold to the touch in winter and hot in summer.
- Low-E windows are a more cost-effective strategy in colder climates.

Natural Cooling

The use of outdoor air to cool a home without the need for mechanical cooling is especially effective when used in combination with shading, operable windows, and proper insulation. Cross ventilation captures breezes and directs them through the home, while upper-story windows allow naturally rising warm air to escape. Open layouts allow unrestricted air flow.

Common shading techniques include using trees and shrubs, trellises, overhangs, awnings, shade screens, window coatings, and interior shades.

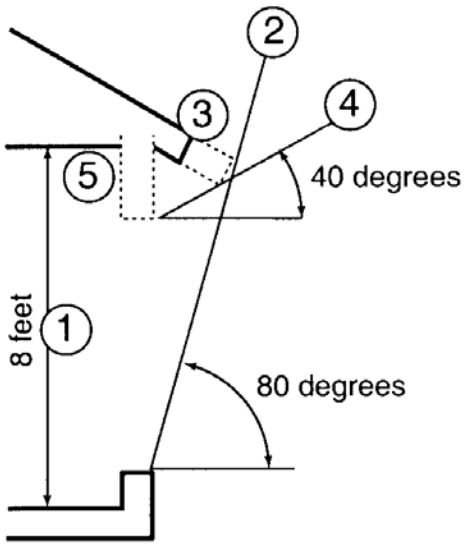
Window awnings and roof overhangs work like visors on baseball caps by blocking high-angle sunlight. On buildings, awnings can typically cover individual windows while overhangs cover sections of outside walls. Both sources of shade are most effective on the south side of the building. Some awnings stay in a fixed position, others can be rolled up in the winter to allow low-angle sun to enter the building.

Screens used for shading are often called sun screens, shade cloths, or solar screens. These screens are made from aluminum or plastic and are lightweight, durable, and easy to install. Unlike insect screens, shade screens are especially made to block a certain amount of the sun's energy, usually between 50 and 90 percent of the energy striking the outside of the window.

SIZE SOUTH-FACING OVERHANGS TO PROPERLY SHADE WINDOWS

- OVERHANG SIZING RULES:
  1. Draw the wall to be shaded to scale.
  2. Draw the summer sun angle upward from the bottom of the glazing.
  3. Draw the overhang until it intersects the summer sun angle line.
  4. Draw the line at the winter sun angle from the bottom edge of the overhang to the wall.
  5. Use a solid wall above the line where the winter sun hits. The portion of the wall below that line should be glazed.

Source: U.S. DOE Office of Building Technology



Interior window shades such as roller shades, blinds, and drapes can reduce heat gain. However, interior shades don't block sunlight as well as exterior shades or awnings. Interior shades work in three ways: 1) They reflect sunlight back out the window before it can significantly turn into room heat, 2) They block the movement of hot air from the area around the window into the room, 3) They insulate the room from the hot surfaces of the window glass and frame.

Living areas on the west and southwest walls can be buffered from hot or cold outside air by closets, a garage, and other non-living spaces, that is, rooms that are not heated or can get too hot or too cold without affecting occupant comfort. Do the same on the north walls in cold climates to buffer for winter winds. Place the highest priority on the surfaces that receive the most summer heat; that's usually the east and west sides of the building.

In many climates, the right combination of natural methods can lead to energy savings that range anywhere from 10 to 50 percent. At the very least, natural cooling allows you to install smaller cooling equipment that will run fewer hours and consume less energy.

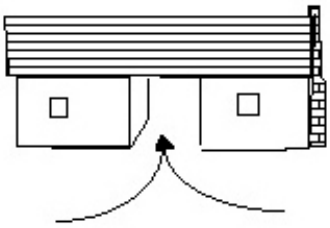
IMPLEMENTATION OF NATURAL COOLING

Ventilation

- Open floor plans with a center hall aligned with the direction of prevailing summer breezes with windows and doors with screens placed at either end will channel fresh, cool air through the building. In southern regions houses and porches face the prevailing breeze and have a center door or hallway. Air from the sides of the house is funneled through the house out the back door. This configuration can create a significant breeze.
- Install stack ventilation and, where possible, install an operable cupola, clerestory, or wind-chimney.

Trees and shrubs

- Your site plan should preserve as many existing trees as possible. Plan to plant new trees immediately after construction. Deciduous trees are best for south yards. The closer a tree is to the building, the more hours of shade it will give. Trees should be planted between 20 and 40 feet from the building to provide good shade and to prevent roots from damaging the foundation.
- Shrubs usually cost less, reach mature size more quickly, and require less space than sapling trees. Shrubs can also shade walls and windows without blocking roof-mounted solar panels as trees can do.



The classic Texas "dog trot" house was a good example of a no-cost cooling design. The large open breezeway separating the two main portions of the house channeled the prevailing winds to load cooling in the mornings and flushed heat in the evenings.

Source: Casa Verde YouthBuild

- In addition to the shading, trees provide a cooling bonus. To keep themselves cool, trees pump water from the ground into their leaves. As this water evaporates from the surface of the leaves, it cools the tree and its surrounding area.
- When their leaves fall in the winter, many deciduous trees allow solar heat to reach the building. Evergreens can work well for north and northwest yards, where you will want to block cold winter winds and won't have many windows to benefit from solar gain or daylighting.

Trellises

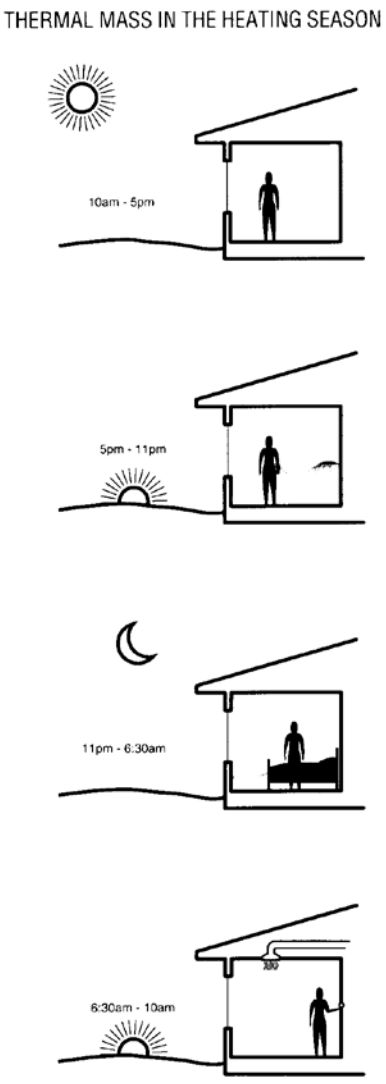
- Trellises are permanent structures that shade parts of the outside of a building. Clinging vines growing over the trellis add more shade and the cooling effect that comes from water evaporation. A special trellis to shade air conditioners and heat pumps improve the equipment's performance. Be sure not to restrict airflow to the equipment.
- Fast-growing vines create shade quickly. Deciduous vines, such as grape and wisteria, lose their leaves in winter, allowing the sun's heat to strike the building. Trellises and climbing plants are a design solution that is attractive and flexible.

Shade screens

- Put shade screens only on windows exposed to direct sunlight. The term "shading coefficient" listed on shade screens describes the amount of heat that penetrates the screen (lower numbers mean less heat gets through). While you can see through a shade screen, the view is somewhat obscured.

FAST FACT

There can be up to a 16-degree difference between the shaded and unshaded sides of a building.



Source: U.S. DOE Office of Building Technology

- To give you the most benefit, interior shades should have a light-colored surface on the side that faces the window, fit tightly to prevent air movement into the room, be made of an insulating material, and cover the whole window.

Natural Heating

Materials used to store heat can be installed on or in south-facing walls and rooms to collect the sun's heat during the day; the heat will then be radiated out into the living area at night. Such materials include concrete, masonry, wallboard, and water tanks. This technique is best suited for cooler climates or places where the temperature drops dramatically at night (at higher elevations, for example).

Sunrooms

South-facing sun rooms are often added on as a way to retrofit a home to take advantage of the sun's heat and light. It is also possible to use a sun-room to help ventilate the rest of the house. Lower vents connected from the sunroom to the interior rooms draw air through the living space; the air is then released through the upper vents along the top of the sunroom.

Trombe wall

A trombe wall consists of an 8- 16" thick masonry exterior wall coated with a dark, heat-absorbing material and covered by a single or double layer of glass placed from about 3/4" to 6" away. Heat from the sun is stored in the air space between the glass and dark material, and conducted slowly to the interior of the building through the masonry. Trombe walls may also sit deeper in the sunroom while still having the ability to receive direct sunlight.

Implementation of Natural Heating

- Use concrete, tile, brick, stone, or masonry floors—carpet or other floor coverings inhibit heat absorption and transfer.
- Use finished concrete or tiled floors.
- Apply durable insulated exterior finish systems to concrete or block walls that are exposed to the interior.
- Use double gypsum board throughout the building.
- Use water storage containers.

Natural Lighting

Also referred to as daylighting, natural lighting is achieved by sizing and placing windows and shading to provide just enough sunlight to reduce or eliminate the need for daytime electrical lights. Windows can be most effective and cooling if they allow daylight very high into a space.

As discussed earlier, the natural properties of glass allow sunlight in, yet also trap heat. If the building requires natural lighting and cool spaces, apply a coating that will screen out ultraviolet and infrared light. Pick glazing criteria carefully and design window size and location to efficiently light the room for the task. More window space does not necessarily mean more light. Too much window space can easily require more heating and cooling energy than the desired lighting energy savings. There is a subtle interplay of costs and benefits that must be calculated to get to the intended goals of energy savings and comfort.

There are a variety of windows and daylighting features available, such as standard vertical windows, clerestories, skylights, solar tubes, cupolas, and monitors.

Implementation of Natural Lighting

- Open floor plans allow more sun inside and light-colored wall and ceiling paint reflects the sunlight around the room, getting more use out of it.
- A day-lit room requires, as a general rule, at least five percent of the room floor area in glazing window area.
- Use a low-E coating to minimize glare while offering appropriate heat gain or loss.
- Skylights are usually trouble because of unwanted seasonal overheating, heat loss, and leaks. Try the newer light pipes if you can afford them.

Benefits of Natural Heating, Cooling, and Lighting

- Incorporating passive solar designs can reduce heating bills anywhere from 10 to 50 percent, a saving accrued from reduced HVAC unit sizes, installation, operation, and maintenance costs.
- Significantly improves comfort and well-being of the inhabitants.
- Reduces greenhouse gas emissions from mechanical heating, cooling, ventilation, and lighting.
- Buildings have brighter, inspiring interiors and are more in tune with local climate and nature.
- Circulating outside air using natural cooling techniques is healthier for occupants than mechanical cooling.

CHALLENGES OF NATURAL HEATING, COOLING, AND LIGHTING

- The cost of adding passive solar design to a home is highly variable depending on the site, size of house, and chosen techniques.
- The site may contain slopes and outcropping, or the orientation may need to conform to city or developer specifications.
- Solar access may be blocked by a nearby building or other obstruction.
- Additional planning is needed to implement and planning must start at the design phase.
- A limited number of choices are available to those doing rehab of existing structures.
- Natural cooling can be difficult in areas where outdoor humidity is high.

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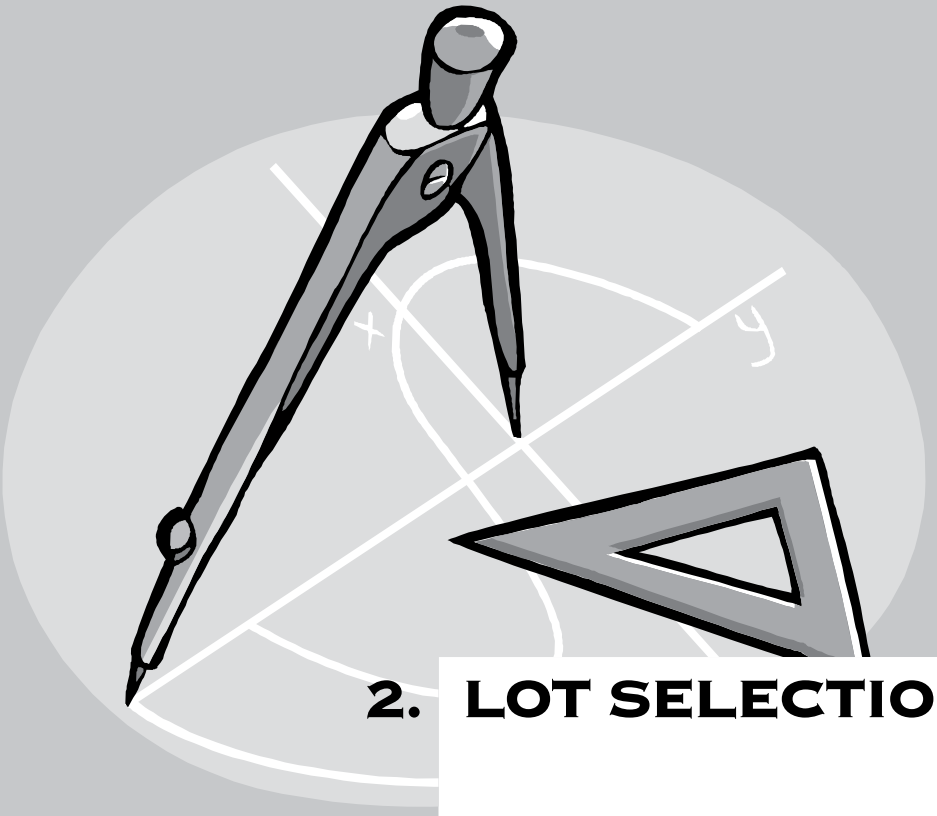

2. LOT SELECTION

LOT SELECTION

The first YouthBuild construction project in the nation was the rehabilitation of an abandoned four-story tenement in East Harlem. Rehabilitation qualifies builders for points towards green-building rating systems because of the resources conserved, waste avoided, and the reduced need for new materials.

Most YouthBuild programs cannot be picky when it comes to lot selection. However, if your program has the ability to choose the site, avoid overdeveloped sites and consider minimizing environmental impacts on the land.

By both choosing a smaller site and constructing a smaller home, you can minimize the amount (and cost) of building materials required for the project. Also important is maximizing the addition of patio and deck space, natural clearings, or other outdoor rooms (sunrooms). This can result in the need for less indoor square footage that needs to be constructed then heated and cooled. A prospective building site should be examined for existing tree groupings, landforms, or structures that will aid in creating pleasant, usable outdoor spaces.

Considerations include:

- Ability to renovate (reuse, recycle) abandoned buildings
- Avoiding ecologically sensitive areas (including wetlands or rare habitats) that have been identified as such through site footprinting or third-party assessment
- Choosing an infill site
- Choosing a brownfield recognized by the Environmental Protection Agency (EPA)
- Availability of a sufficient, rechargeable water source
- Choosing a lot size of less than 5,750 sq. ft.
- Accessibility to public transportation, bike paths, and businesses, preferably within walking distance
- Accessibility to renewable energy sources (solar, wind, geothermal, or biomass)
- Constructing more than one unit per lot (duplex, garage apartment, granny flat)

Brownfield Remediation

Brownfield remediation is also an option for YouthBuild programs, and has been done by them in the past. About 15 percent of the YouthBuild respondents surveyed confirmed that they have developed on brownfields or grayfields. You can find out the status of the land from any of the following:

1. Environmental Protection Agency records
2. Comprehensive plan (often conducted by a government planning department)
3. Previous owner records (such as insurance maps, and land surveys)
4. Utility records
5. Set of site plans

If you are given an opportunity to build on an EPA-recognized brownfield, you will need to clean it and rid it of any pollutants. A site remediation plan can include:

- Pump and treat
- Bioreactors
- Land farming
- In-situ remediation

Benefits of Reusing Lots

- Renovating a building can preserve the cultural heritage of community, limit urban sprawl, and yield lower infrastructure costs.
- Brownfield remediation significantly improves the health of the land, leaving it in better condition than before construction.
- Brownfield remediation can be supported by government grants.

Challenges of Reusing Lots

- Reusing lots is a great idea but it can be costly in time and funds. The best scenario would be to have the donor, public agency, or authority do any demolition and remediation or prep of the property. Many cities and codes require that the builder relocate any displaced tenants at their expense.
- It is important to receive an official or stamped set of environmental drawings on such a property, which gives the builder a clean bill of health for the lot.
- If you have to take down a building, consider deconstruction instead demolition and landfill.

FAST FACT

Several YouthBuild programs have experience redeveloping a greyfield or brownfield, namely:

- YouthBuild Louisville (Ky.)
- YouthBuild Holyoke (Mass.)
- HRDE-Mon YouthBuild (W. Va.)
- Housing Authority of the City of High Point (N.C.)
- Yuma Private Industry Council, Inc. (Ariz.)

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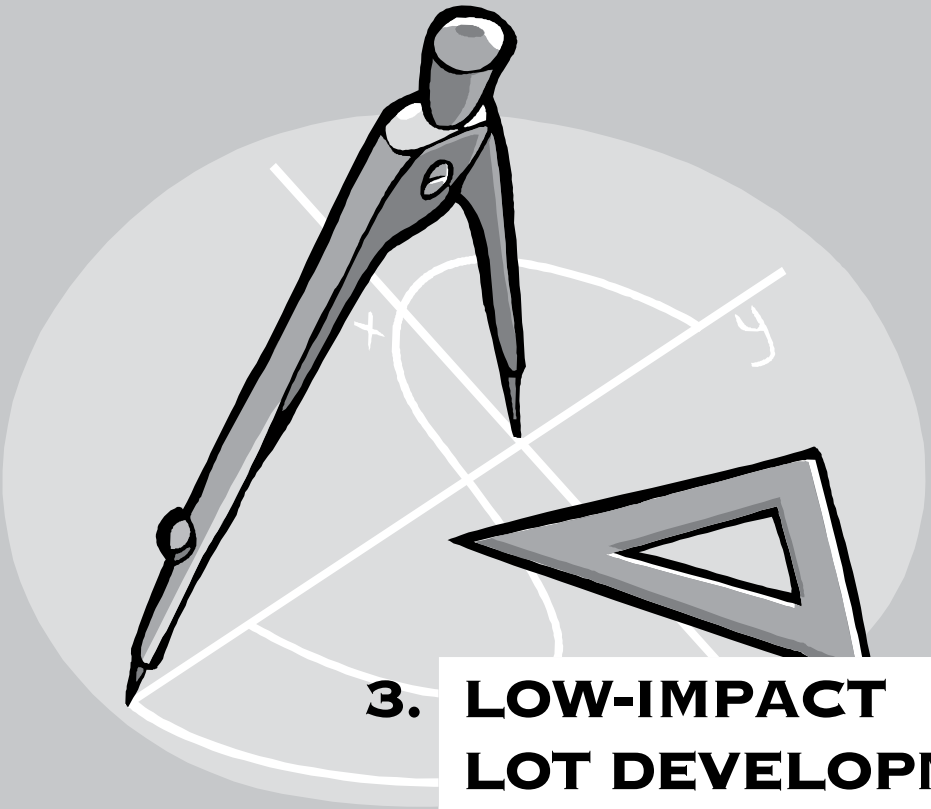


3. LOW-IMPACT LOT DEVELOPMENT

Low-impact lot development highlights the importance of protecting the natural environment in and around your lot—including wetlands, agricultural areas, rivers, and trees—by minimizing land disturbance, preserving open space, practicing erosion control, incorporating natural systems into design, and developing effective storm water maintenance systems. Low-impact lot development must minimize environmental intrusion during on-site construction as well as during occupancy.

The approaches to lot development in this chapter: storm water management; bioretention; habitat protection; and implementing a plan for reducing, reusing, and recycling can protect the environment and save you money.

A. STORM WATER MANAGEMENT

Using storm-water management in the construction of a home can cause less harm to streams, wildlife, and wetlands than traditional methods do. Rainwater can better infiltrate into the ground to recharge drinking water supplies, streams and wetlands. The site will be greener and more attractive with open spaces.

ASSESS AND UNDERSTAND THE SITE

Assess the site's topography, soils, vegetation, and natural drainages, then divide the site into protected and developable areas. Apply adequate buffers to protect these areas.

PROTECT NATIVE VEGETATION AND SOILS

Set aside a portion of the site's native vegetation and areas with soils that have high infiltration capacity. If left alone, these natural areas are excellent storm water management systems.

MINIMIZE AND MANAGE STORM WATER AT THE SOURCE

Minimize areas of impervious surfaces such as roads, rooftops, and parking areas by designing shorter, narrower roads; using various permeable pavements; and installing rainwater catchment systems (see Roof section). Manage remaining runoff by disconnecting the impervious surfaces from one another, and directing runoff to bioretention areas (or rain gardens), amended soils, native vegetation, or other types of infiltration areas. This can greatly reduce the need for pipes and other conveyance infrastructure. Implementing a storm-water management plan on a building site will also help protect the building from water damage and minimize maintainance associated with moisture issues.

B. BIORETENTION

Also known as a rain garden, a bioretention facility is a storm-water management approach that creates a natural water filtration and treatment area—a porous soil covered with a thin layer of mulch.

IMPLEMENTATION OF BIORETENTION

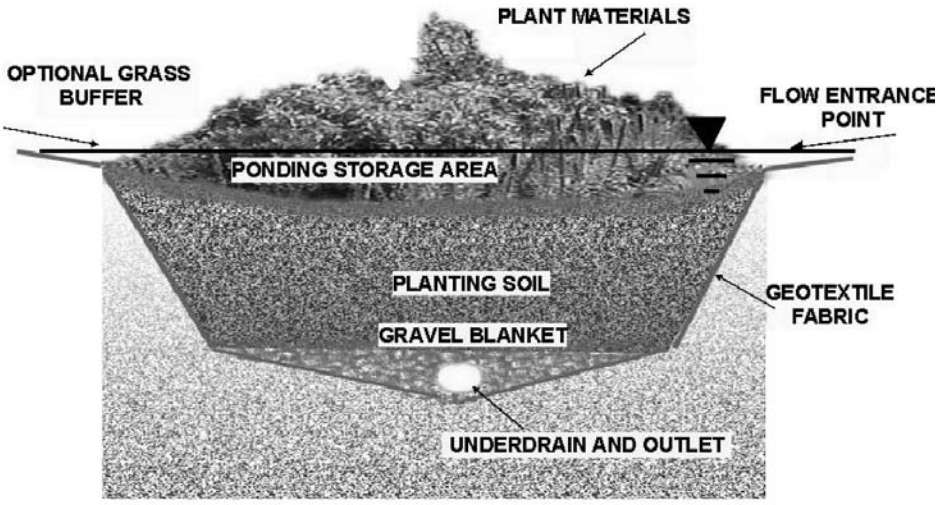
A stand of various grasses, shrubs, and small trees is established to promote evapotranspiration (loss of water from the soil both by evaporation and by transpiration from plants) maintain soil porosity, encourage biological activity, and promote uptake of some pollutants. Runoff from an impervious, nonabsorbent area is directed into the bioretention facility. The water infiltrates through the plant or mulch or soil environment providing the treatment.

BENEFITS OF BIORETENTION

- Bioretention areas remove pollutants through filtration, microbes, and uptake by plants.
- Contact with soil and roots provides water-quality treatment that is better than conventional infiltration structures.
- Bioretention areas increase groundwater recharge as compared to a conventional "pipe and pond" approach. They can help reduce stress in watersheds that experience severe low flows due to impervious coverage.
- Low-tech, decentralized bioretention areas are also less costly to design, install, and maintain than conventional stormwater technologies that treat runoff at the end of the pipe.
- Bioretention areas enhance the landscape in a variety of ways: they improve the appearance of developed sites, provide wind breaks, absorb noise, provide wildlife habitat, and reduce the urban heat island effect.
- Bioretntion areas can be very inexpensive and easy to create.

CHALLENGES OF BIORETENTION

- Requires land and space that may not be available, particularly in urban areas.



SOURCE: Prince George's County, Maryland, Dept. of Natural Resources

Bog Garden in the Pacific Northwest

A homeowner in the city of Shoreline installed a bog garden to direct storm water flows away from the foundation of his house. The bog garden uses wetland vegetation to collect roof runoff for a 1/4-acre residential property. The homeowner backfilled a lined retention pond (12' long by 8' wide by 3' deep) with three-way garden mix, coconut husk fiber, and peat moss. He then planted more than 30 species of native and nonnative (to the Pacific Northwest) wetland facultative plants. As the garden functions, there is no standing water, but the soils are saturated much of the time. Unlike many similar systems, this one promotes evaporation and transpiration; the impermeable liner allows excess water to flow into a constructed dry streambed.

RESULTS

The bog garden is an aesthetically pleasing, affordable garden that provides an effective visual barrier to the street. The installation reduced impermeable lawn surface while directing water away from the house foundation. Very little excess flow discharges from the bog garden, and what does flow out quickly infiltrates within a few feet of its point of discharge. The bog garden serves as a model for other residential homeowners.

SOURCE

www.ence.umd.edu/~apdavis/Bioret.htm

C. HABITAT PROTECTION

Steps you can take to protect a habitat include:

- Minimize slope disturbance by limiting or eliminating development on steep slopes (slopes greater than or equal to 25 percent).
- Align roads and paths along natural topography lines.
- Complete a natural resources inventory and include in site plan.
- Create construction "no disturbance" zones using fencing or flagging to protect vegetation and sensitive areas form construction vehicles, material storage, and washout.
- Maintain wildlife habitat.
- Protect aquatic ecosystems by washing forms and equipment in areas where runoff will not contaminate waterways.
- Reduce soil compaction from construction equipment by laying mulch, chipped wood, or plywood sheets.
- Avoid turf grass and use native grasses.
- Provide basic training in tree and other natural resource protection to the onsite supervisor.
- Improve the soil with organic amendments and mulch.
- Avoid the use of chemical fertilizers and pesticides.

D. REDUCE, REUSE, AND RECYCLE PLAN

A reduce, reuse, and recycle plan is much more than waste management. In addition to managing waste through responsible disposal and recycling when possible, such a plan includes reducing the amount of materials you use and choosing used or recycled-content materials. Demolition and construction should be carefully planned for waste reduction and reuse of materials that remain in good condition. Nearly half of waste sent to landfills is construction waste. Having a reuse and recycling plan from the beginning of the process can dramatically lower these numbers. Involve students in discussing the social and environmental value of recycling. Encourage them through math exercises and recycling contests.

FAST FACT

43 of the 60 YouthBuild programs surveyed in 2005 found reusing scrap building materials to be effective.

IMPLEMENTATION OF REDUCING, REUSING AND RECYCLING

- Develop and implement a construction and demolition waste management plan and post it at the job site.
- Determine a plan for who will remove and obtain salvaged materials.
- Dedicate and provide onsite bins and space to facilitate the sorting and reuse of scrap building materials.
- Disassemble existing buildings instead of demolishing them.
- Reuse salvaged materials.
- Use precut or preassembled building systems or methods.
- Use locally available indigenous material.
- Use a life-cycle assessment tool to compare the environmental affects of reusing materials.
- Use recycled content building materials.
- Conduct onsite recycling effort, use grinder and apply materials onsite, thus reducing transportation-related costs.
- Return unused construction material to vendors for credit.
- Sell or deliver waste materials to recycling sites.
- Use building materials that require no additional finishing resources to complete application on-site.
- Design the building using increments of known material sizes to minimize cutting of plywood, lumber, and other materials.
- Research recycling guidelines and waste managers in your community and design an applicable recycling area for occupants.

COMMONLY AVAILABLE RECYCLED CONTENT MATERIALS

Rubble
Insulation
Rebar
Steel
Concrete
Pressed wood

BENEFITS OF LOW-IMPACT LOT DEVELOPMENT

- Communities designed to maximize open space and preserve mature vegetation are highly marketable and command higher lot prices.
- Reducing runoff from impervious surfaces such as blacktop and concrete can reduce or eliminate the need for storm water ponds in larger developments.
- Low-impact lot development can help save money on building supply purchases.

CHALLENGES OF LOW-IMPACT LOT DEVELOPMENT

- There are maintenance issues associated with stormwater management systems. A low-impact development system may have different types of maintenance requirements than a conventional system.
- Low-impact development can have higher upfront costs, such as engineering, but the long-term savings "outpace" the increased costs.

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ReCycle North: Integrating Green Building, Job Training, and Social Enterprise

ReCycle North of Burlington, Vermont, deconstructs old buildings; up to 80 percent of the resultant materials can be reused.

ReCycle North in Burlington, Vermont, started a **Building Material Reuse (BMR)** enterprise in 2001 after completing a reuse pilot project. The enterprise then expanded by salvaging old building waste and feeding it through a three-step cycle of programs—**Deconstruction Service**, **Building Material Center**, **and Waste Not Products**. In 2004, BMR integrated YouthBuild as a training component, complementing the cycle of deconstruction, recycling, and reuse with education and construction.

YouthBuild's Integration with ReCycle North

YouthBuild students are Partners of Recycle North and participate in eight months of intensive work with a paid stipend based on a performance measurement: the Performance Multiplier. Participating in all aspects of ReCycle gives Partners opportunities to shine in contexts such as office management, retail, maintenance, and construction.

BMR's Three-Step Cycle of Services

A **deconstruction service** gives homeowners and construction contractors an environmentally responsible alternative to traditional "crunch and dump" demolition. Buildings, rather than being demolished, are systematically taken apart through reverse construction. Up to 80 percent of the materials are salvaged for reuse. ReCycle North charges for this service but this cost is generally competitive with demolition. Customers also may deduct the value of the materials salvaged if they decide to donate these materials to ReCycle North. Partners working on the deconstruction crew can see what goes into building a house in a few days, something that normally takes months on a construction site. Three of the four full time staff for the deconstruction service are YouthBuild graduates.

Materials salvaged by the deconstruction crew are brought to ReCycle North's **Building Materials Center**. This store is open to the public, and low-income people and nonprofit organizations are able to get materials for free through ReCycle North's Essential Goods program. The Center is partly staffed by Partners who have completed their GED and wish to get internship experience.

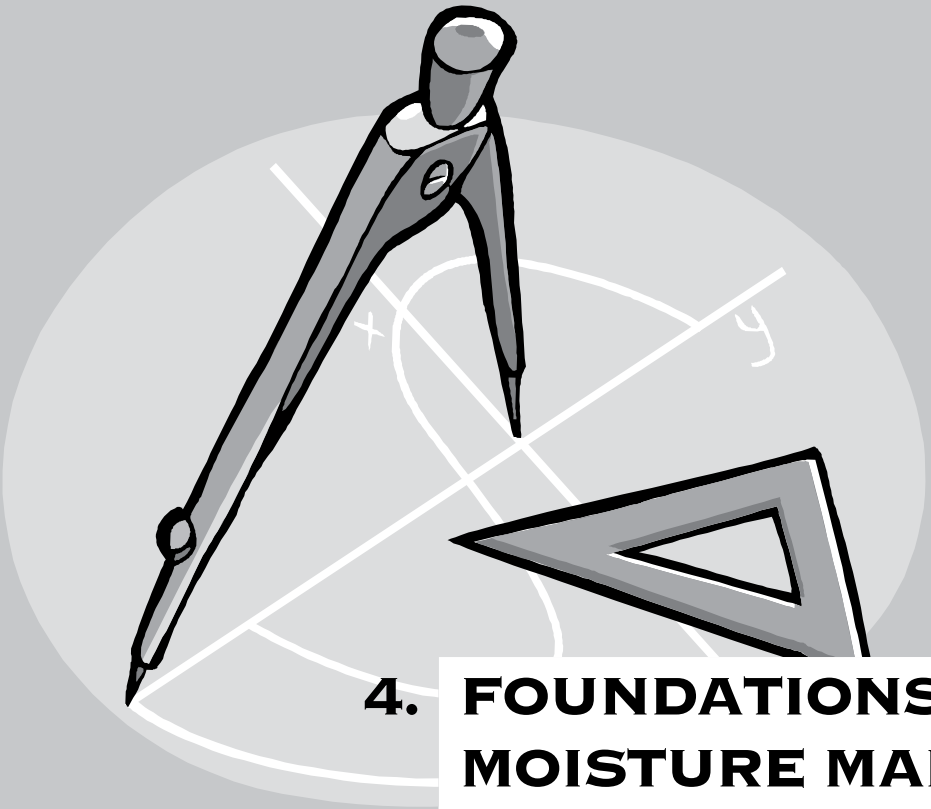
The most recent addition to the BMR enterprise is called **Waste Not Products**. Salvaged materials from the deconstruction site are converted to new products including garden sheds, picture frames, shelving, and bird houses. This enterprise reuses the otherwise land-filled material, provides valuable carpentry training opportunities, and generates revenue. Partners also compete for internships to create goods for Waste Not Products to sell.

ReCycle North's Building Materials Center

ReCycle North offers construction training, producing low-income housing in collaboration with Green Mountain Habitat for Humanity. Habitat acts as the developer and ReCycle North YouthBuild serves as the general contractor.

ReCycle North is continuing to fulfill its three-part mission of reuse, job training, and poverty relief. Says Tom Longstreth, executive director, "the BMR enterprise has allowed us to improve our training, create jobs for graduates, and increase the amount of reuse and poverty relief we accomplish. Reuse sales also fund parts of our training."

To learn more about developing a similar collaborative in your region, contact the Building Materials Reuse Association (BMRA), visit www.ubma.org, or contact Tom Longstreth at (802) 658-4143.



4. FOUNDATIONS AND MOISTURE MANAGEMENT

FOUNDATIONS AND MOISTURE MANAGEMENT

It can be argued that the most significant component of a building is the foundation. As a result, providing a quality foundation is often the most expensive consideration in constructing a new home.

Foundations are integral to helping the home withstand water, control dampness, reduce heat loss, and minimize unwanted air flow. Paying attention to details when constructing the foundation will help prevent damaging moisture buildup and make it easier to keep the floor dry.

MOISTURE MANAGEMENT

The following construction practices can help minimize water problems as well as curb environmental concerns:

- Use insulated shallow foundations in northern climates; consider pier and beam foundations instead of slabs on grade.
- Insulate foundation before backfill.
- Use a nonporous, low toxic sealant.
- Install enhanced foundation waterproofing.
- Use non-asphalt-based damp proofing.
- Reuse form boards.
- Use aluminum forms.
- Install proper vapor retardant under slab or in crawl space floor.
- Avoid using expansive soils and replace with a backfill material that does not expand when wet (for example, recycled aggregate in concrete).

PERIMETER FOOTING DRAIN

- Install perimeter or footing drain system of perforated pipe below the level of the basement slab on the inside and outside of foundation.
- Wrap pipe with filter fabric and surround with clean gravel or crushed stone.

DIRECT SURFACE WATER AWAY FROM HOUSE

To keep surface water from soaking in around the foundation, all roof runoff must be directed away from the house. This means putting effective gutters all around the building and sloping the final grade away from the foundation at least 5" in the first 10' (That's ½" per foot.) To protect the footing from subterranean water, it must bear on at least 4" of a nonfrost-susceptible material such as washed gravel or rock.

FRENCH DRAIN

A French drain is a drainage system that consists of a trench dug into the ground through and out of an area with poor drainage. The trench is filled with a porous material—usually gravel, crushed stone, or slag—along with a perforated PVC plastic pipe to collect and channel unwanted ground water. It is better to install the drain during construction, rather than later, to avoid problems digging around utilities, porches, and other obstacles. French drains will clog over time, so they need to be cleaned periodically.

The following options for foundation material are discussed in this chapter:

A. Poured Concrete

B. Preserved Wood

C. Insulated Concrete Forms (ICEs)

D. Insulated Concrete Forms

E. Frost Protected Shallow.

A. POURED CONCRETE

IMPLEMENTATION OF POURED CONCRETE

Selecting a poured concrete basement requires diverting surface water away from the house and limiting water seepage by installing a perimeter drain. This is especially important for all basement footings sloped to allow for daylighting, drywells, or sump pits.

- Carefully estimate the amount of concrete required to avoid waste.
- Use fly ash. Packaged in bulk or bags, fly ash cement is generally available in two standard colors; coloring agents can also be added at the job site. Fly ash can be used sparingly as an admixture or in large amounts to replace Portland cement. Casa Verde Builders in Austin, Texas, uses 40 percent content fly ash in all their concrete.
- Manufacturers are developing specialty cements, which should be widely available soon, that can be formulated to produce various set times, cold weather resistances, and strengths and strength gains, depending on the job.

FLY ASH is a fine, glass-like powder recovered from gases created by coal-fired electric power generation. U.S. power plants produce millions of tons of fly ash annually; this fly ash is sent to landfills.

Fly ash is an inexpensive replacement for cement used in concrete, for it improves the strength, segregation, and ease of pumping of the concrete. Fly ash is also used as an ingredient in brick, block, paving, and structural fills.

BENEFITS OF FLY ASH CONCRETE

- Some manufacturer's proprietary fly ash cement is considered a non-shrink material with advantages in workability, water retention, and strength.
- Because fly ash mixes with less water, it is less likely to crack.
- Fly ash has low embodied energy and is an industrial by-product.
- Fly ash concrete is currently cost-competitive with Portland cement concrete.
- The material is somewhat lighter than Portland cement.
- Because fly ash cement requires less water than Portland cement, it is easier to use in cold weather.
- Fly ash can be substituted for traditional raw materials such as shale, clay, or sand.

CHALLENGES OF FLY ASH CONCRETE

- Fly ash comes from various operations in different regions, so its mineral makeup may vary among manufacturers.
- Fly ash may not be available in your area.
- There are some concerns about freeze-thaw performance and a tendency of mixes made with fly ash to effloresce or leave a powdery substance on the surface. This efflorescence happens especially when used as a complete replacement for Portland cement.

B. PRESERVED WOOD FOUNDATION (PWF)

Preserved wood with batt insulation can be used to construct foundation walls. The preserved wood is soaked in a salt solution and pressure-treated, making it less vulnerable to water and more adaptable to outdoor usage. A vapor and water barrier must be installed at the interface between the soil and the wood because the wood will absorb water, which can cause mold and insect invasion. The R-value for a 4' preserved-wood wall is around R-19 if 2 x 4 construction is used with a full-depth fiberglass batt. The average cost is about $8 per square foot.

BENEFITS OF PRESERVED WOOD FOUNDATION

- PWFs are dry, comfortable, easy to finish, and more economical to convert to fully livable space than masonry foundations.
- PWFs are easily insulated and finished, which reduces foundation heat loss by up to 50 percent without the added expense of extra studding or furring.
- Unlike concrete or block, a PWF does not allow moisture or dampness to pass through the foundation walls, virtually eliminating the cold, damp, and musty basement feeling and maximizing comfortable living space.
- A PWF can easily be plumbed and wired just like the rest of a house.
- The PWF is approved by the Canadian Standards Association (CSA) and meets all building standards. It uses only treated lumber and plywood bearing the CSA stamp.
- When building a PWF, you can reduce building costs by as much as $10 per square foot.
- A preserved wood system would be a good choice for a house in a rural area because wood is lightweight and easier to transport, store, and use than ready-mix concrete.

CHALLENGES OF PRESERVED WOOD FOUNDATION

- In the event of a hurricane, a tornado, or flooding, a wood basement is unlikely to perform as well as concrete blocks or other foundations.
- The walls have little thermal mass, and since the exterior soil is often moist, the relative humidity near the wall will often be 100 percent, even if water is not present.

C. INSULATED CONCRETE FORMS (ICF)

Insulated Concrete Forms (ICF) are constructed from expanded polystyrene and stacked like building blocks to form the exterior walls of a home; the forms are reinforced with steel and filled with concrete. The forms interlock and fasten to each other to provide seamless "foundation to rafter" insulated, reinforced concrete walls. Window and door openings of any size are possible. ICFs provide a lasting building envelope, designed to withstand high wind, fire, the elements, and the test of time.

IMPLEMENTATION OF INSULATED CONCRETED FORMS

Basement waterproofing materials for windows and doors for an ICF basement need to be ordered with wider jamb extensions to accommodate the increased wall thickness. The level of manufacturer support, including training, on-site and technical support, and marketing materials will vary between manufacturers.

BENEFITS OF INSULATED CONCRETE FORMS

- ICF construction is compatible with all home designs.
- ICF walls benefit from concrete's inherent structural qualities, particularly important in regions affected by severe weather.
- The combination of a continuous concrete wall and the integral interior and exterior insulation provides superb energy efficiency and lower utility bills.
- ICFs energy efficiency translates into even, consistent temperatures throughout the home. Outdoor pollutants can be kept to a minimum.
- With several inches of concrete sandwiched by foam insulation, ICF homes are typically quieter than conventionally built homes.
- ICFs save money, conserve resources, and use recycled materials.
- ICFs are not subject to rot and result in a better insulated foundation.

CHALLENGES OF INSULATED CONCRETE FORMS

ICF homes may cost up to 10 percent more to build, depending on the manufacturer, shipping costs, and other factors impacting local building costs. Lower heating and cooling loads will offset the increased up-front construction costs with lowered requirements for HVAC equipment and long-term utility savings.

D. FROST-PROTECTED SHALLOW FOUNDATIONS (FPSF)

A Frost-Protected Shallow Foundation protects against frost damage without the need for excavating below the frost line. An FSPF has insulation placed strategically around the outside of a foundation to direct heat loss from the building toward the foundation, and to use the earth's natural geothermal energy.

IMPLEMENTATION OF FROST-PROTECTED SHALLOW FOUNDATION

- One layer of insulation covers the outside face of the foundation, while a second extends horizontally away from it.
- The rigid foam traps any heat that the ground absorbs from the building, keeping soil temperatures around the footing above freezing.
- The building's heating system can be safely turned off for up to three weeks in the winter because thermal lag in the concrete will maintain the soil temperature above freezing.

BENEFITS OF FROST-PROTECTED SHALLOW FOUNDATION

- Saves energy.
- Cuts construction costs.
- The insulated footings can keep the soil above freezing even in the coldest weather.

CHALLENGES OF FROST-PROTECTED SHALLOW FOUNDATION

- In some areas it may be difficult to acquire permit approval.
- An FPSF is only cost-effective if the frost line is 30" or deeper.
- If you have a walkout basement and the grade comes down the sides of the house, you have to be aware of where dampproofing is required.
- You will need to train subcontractors about the importance of frost-protected insulation.

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Green and Red Construction in Guadalupe, Arizona

YouthBuild Guadalupe has constructed 27 new, affordable homes over the last seven years. In the small town with a population of just over 5,000 people, this new construction has greatly contributed to improving the housing stock. YouthBuild Guadalupe's latest effort is their first energy-efficient home. In 2006 they began deconstruction of an existing building and aimed to complete construction in August 2006. With a membership of 50 percent Native American and 50 percent Hispanic, this project aimed to build an energy-efficient home that reflects the local cultures. The project is getting interest from groups seeking to replicate the model, such as Habitat for Humanity, the Yaqui tribe in Tucson, Arizona, and the Mexican American community. In a short amount of time, it has proven to be quite successful.

Red Construction— A Culturally Conscious Design

The new home was incorporated the input of citizens from three community forums. To reflect Southwestern culture, YouthBuild members skinned log trees (referred to as "Vegas") for the supportive roof structure. A courtyard area was designed to perform as a outdoor family gathering space. The community requested buildings that serve multiple generations, and the design responded by creating a casita for rental income or a mother-in-law apartment—a small house with its own bathroom and kitchenette. The larger house was also constructed to structurally withstand a second story for an additional two bedrooms, to accommodate a growing family. The design also includes cut-outs, or enclaves in the wall system, to place statues or other items.

Green Construction— An Environmentally Conscious Design

The house is designed as a passive solar building to maximize the benefits and reduce problems of desert climate in its orientation and layout. The courtyard, in addition to making sense culturally, was designed to help cool the rest of the house. The home wraps around the courtyard on three sides forming a C-shape. A fountain cools the space, which in turn, along with the shading of indigenous plants, cools the house. The courtyard also features an outdoor cooking area because traditional Native and Hispanic cooking is done outdoors to help keep the house cooler.

The roof is enclosed with a mirror seal—a nontoxic white, reflective, elastomeric flat roofing system in lieu of rubber or petroleum based products—produced in Tucson by Innovative Solutions. Most roofs are highly toxic, but the youth are able to build this one and they don't need to hire highly qualified roofers certified to work with toxic material, as is the case with other toxic roofing materials. The roof reflects the sun as well so that it keeps the house cooler, another solar energy-efficient design.

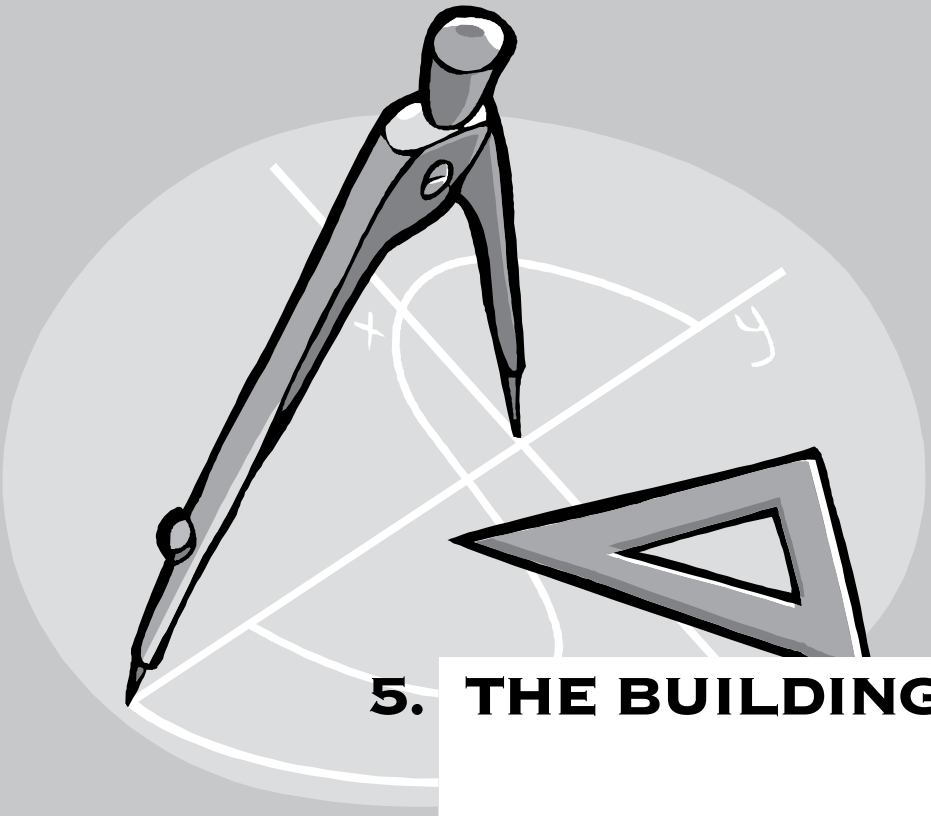
Another energy-efficient feature is the unique air-conditioning system produced by Alter-Air, of Phoenix. It's a water cooled air chiller that uses no Freon, so it helps prevent prevents ozone layer depletion. The exhaust air from the Alter-Air cooling system is cooler than Freon-based air conditioning methods: It's no hotter than 80° (Freon air conditioning exhaust is well over 100°) and as a result they funnel the exhaust into the courtyard to keep it even cooler.

For a watering system, three cistern water tanks will collect rainwater for landscaping, up to 4000 gallons a year of rain.

Another green element is a Flex-Crete block locally produced on the Navajo reservation in Page, Arizona. The Flex-Crete product is a fiber-reinforced aerated concrete product that uses high volumes of fly ash. Fly ash is abundant where coal is burned during strip mining. The ash is combined with concrete, fiber, and aluminum chloride. This particular block gives a high "R" value, which measures insulation quality. Traditional building insulation quality is measured at R-19, and the Flex-Crete product provides up to an R-40 value. It is soundproof, fireproof, and termite-resistant. For more information visit www.flex-crete.com.

The deconstruction material from the original home was reused; the original concrete foundation was used as pavers throughout the courtyard. They also used the old plywood from the old carport for the new carport.

Contact Gail Acosta for advice on green and culturally-conscious building designs: gacosta@guatlupeaz.org.



5. THE BUILDING ENVELOPE

THE BUILDING ENVELOPE

The building envelope comprises all heated parts of a building, including the walls, roof, and foundation. By properly insulating your building envelope, you can control the flow of air in and out of the home, which will have a tremendous impact on heat loss, cooling needs, moisture control, and air quality.

Insulation is an important factor in the success of a building envelope, but is not the controlling one. In a building envelope, there are several components that work together, and how they are assembled is the key to lowering energy use and maintaining healthy indoor air quality. The building envelope should be designed to manage the migration of three factors simultaneously—moisture, air, and temperature. Remember to consider the climate and location of the building as it relates to humidity and temperature.

General Implementation

- Install a good drainage plane on the exterior of the home, such as a building paper or house wrap in a lapped or shingle style to provide good drainage. This drainage plane must have an air space provided by furring strips or Home Slicker between it and the siding.
- The wall must include a very good air barrier. Neither fiberglass nor cellulose will stop air flow through the wall assembly, so all penetrations in the exterior sheathing—including joints in the sheets of sheathing—must be sealed with caulk or foam prior to installing insulation. An open-cell expanding foam such as Icynene provides the air barrier as well as good thermal resistance. (House wrap is not an air barrier, but a drainage plane).
- Use raised heel trusses "energy heels."
- Consider installing an insulated conditioned crawlspace as one strategy for control of temperature, moisture, and indoor air quality. (Not recommended if moisture is a problem in your area.)
- Use treated wood that does not contain chromium or arsenic.

Implementation of Insulation

No matter what construction technique you use, proper insulation is crucial. The insulation of your building envelope will help control the flow of heat from the home to outside. A more insulated envelope will be a more energy-efficient envelope, and therefore will use less energy. Remember to consider the climate and location of the building in order to ensure you use the correct amount of insulation.

COBB HOUSING YOUTHBUILD REDUCING MECHANICAL SYSTEM LOADS BY 50 PERCENT

Cobb Housing YouthBuild found that by properly and completely insulating a home with an open cell expanding foam such as Icynene, a home that would have required a 4-ton cooling system can now perform well with a 2-ton.

A cost-benefit analysis determined that the best insulation for a typical 1500 square foot home in Georgia using cellulose in the walls and an Icynene insulated roofline resulted in savings on a downsized cooling system for Cobb Housing, monthly savings to the homeowner, and reduced health hazards to the youth (fiberglass is very unhealthy to work with).

For a copy of this analysis contact Joseph Martin, Assoc. AIA, LEED AP: josephmartin@bellsouth.net

- Examine insulation materials for their affect on human health and the environment.
- Use total-fill insulation such as blown cellulose, BIBS, sprayed foam, or SIP panels that tend to provide better performance. With regard to spray foams, the open-cell foams are highly preferred to closed-cell polyurethane foams. Open-cell foams allow moisture to migrate through the wall as needed, but control air flow completely. The air-sealing step is eliminated.
- Icynene foam lends itself well to being installed along the attic roof line, as opposed to the ceiling. This provides an unvented, semiconditioned attic space, which is excellent for duct work and mechanical system performance.
- Utilize continuous insulation on exterior wall.
- Use total fill insulation such as blown cellulose, BIBS, and sprayed foam.
- Use sill sealer between foundations and sill plate.
- Caulk bottom plate of exterior walls.
- If building a basement, insulate between floor joists with unfaced batts supported by wire or metal rods.
- Fill insulation cavities entirely, leaving no gaps where convection currents can form.
- Install continuous insulation on exterior walls with cathedral ceilings.
- Use treated wood that does not contain chromium or arsenic.
- Seek an independent inspection of insulation.

LOOSE-FILL CELLULOSE INSULATION goes into finished walls and is blown into place. When used in walls, it is best when wet because the loose-fill wall insulation could settle. Wet-blown insulation offers great insulating qualities and can be trimmed by hand on walls before installing drywall. In attics, be sure to use baffles to keep the material away from soffit vents. Also, do not cover recessed light fixtures unless the fixtures are certified to accept insulation. Fiberglass, mineral wool (recycled steel slag), and newspaper are all different types of loose-fill cellulose insulation that are treated with boron-based chemicals to make it fire retardant. Cellulose-insulation has R-value of R-3.8 per inch.

BLANKETS OR BATTS OF INSULATION are usually fiberglass, mineral wool, or recycled cotton. They can be fitted between studs in unfinished walls or between joists and beams and for all unfinished walls. Fiberglass insulation has R-values R-2.2 to 4.0 per inch.

RIGID BOARD INSULATION includes expanded polystyrene, extruded polystyrene, and polyisocyannurate and is useful for sheathing on homes. Polymer insulation has R-values typically R-6.0 to 7.4 per inch.

Be sure that the rigid board you choose does not have chlorofluorocarbons (CFCs). Expanded polystyrene usually does not have CFCs. Rigid board may require certified installers, depending upon your local jurisdiction.

BENEFITS OF HIGH PERFORMANCE BUILDING INSULATION

- Natural ventilation can be used for a greater number of hours.
- Smaller HVAC equipment can be purchased.
- Spaces are more comfortable.
- Homes can achieve up to 50 percent less energy for heating and cooling.
- Less emissions of greenhouse gases are produced.
- High-performance insulation lasts longer, is fire-resistant, and reduces maintenance costs
- By not using fiberglass, the health risks associated with inhaling fiberglass.

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Minnesota Office of Environmental Assistance: www.moea.state.mn.us/greenbuilding/products.cfm

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For definitions and considerations for insulation: www.greenbuilder.com/sourcebook/Insulation.HTML#CELLULOSE

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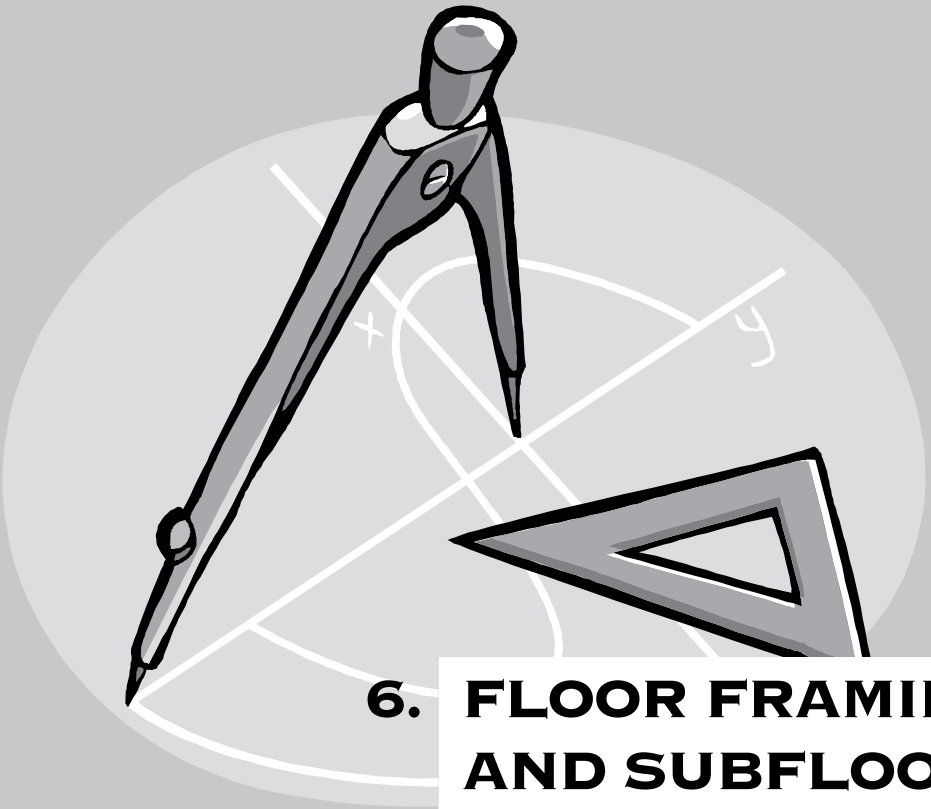

6. FLOOR FRAMING AND SUBFLOOR

FLOOR FRAMING AND SUBFLOOR

ORIENTED STRAND BOARDS (OSB), are panel products made by gluing and high-temperature pressing of layers of thin wood chips, with each layer oriented at a right angle to adjacent layers. When used as subfloors it is strong, rigid, and impact-resistant for underlayment, carpet, or tile. Traditional plywood uses prime, big logs from new growth as opposed to OSB that uses waste products.

Source: www.osbguide.com/hconstruction.html

When using a green approach to building a framing and subfloor system, the material choice is critical. There are several approaches that can ensure that the floor frame will be durable yet healthy for the environment and the occupants.

IMPLEMENTATION OF FLOOR FRAMING AND SUBFLOOR

- Avoid using dimensional lumber greater than 2" x 10" for floor framing.
- Use oriented strand board (OSB) for subfloor and sheathing.
- Use urea-formaldehyde–free material.
- Avoid use of underlayment.
- Substitute solid sawn lumber with engineered lumber.
- Use certified wood (Forest Stewardship Council (FSC) certified is commonly available and trustworthy) for framing.
- Use wood I-joists for floors and ceilings.
- Use finger-jointed, engineered, or steel studs for vertical applications.
- Use reclaimed lumber from demolition.
- Use web floor trusses.
- Design energy heels on roof trusses 6" or more.
- Use micro-lam beams and micro-lam I-beam floor joists.
- Ensure that all wood is at least 12" above soil.
- Use low-VOC finishes.

IMPLEMENTATION OF CONCRETE SLAB FLOORING

- Use a moisture barrier under slab.
- Consider using insulation under slab to provide thermal mass.
- Use a dark color to maximize solar gain.
- Be sure concrete contains recycled content material such as fly ash.

BENEFITS OF CONCRETE SLAB FLOORING

- Guarantees long-term availability of precious woods.
- Reduces pollutants in building materials.
- Concrete slab flooring will not twist, warp or split, is stronger and lighter than 2x10s or 2x12s, and can span greater distances.
- Reduces the need for large diameter old-growth trees, is as strong as plywood sheet material, and is less expensive.

LOW- VOC

VOC (volatile organic compounds) are airborne gases released when wall coatings dry.

The EPA's definition of "low" is based not on an indoor health standard but on an outdoor environmental standard. "Low-VOC" implies less than 250 grams of VOCs per liter for latex paint, and less than 380 grams per liter for oil-based. These levels are far higher than those recommended by many environmental and health experts.

To find a paint's VOC content, look at the label or the material safety data sheet.

Source: www.utne.com/pub/2006_136/promo/12178-1.html

- Reduces air leakage relative to frame construction, is energy-efficient, provides excellent soundproofing, is erected quickly, and saves wood by eliminating much of the conventional framing lumber.
- Uses recycled content materials, is straighter and stronger than solid sawn studs, and eliminates crooked walls, thereby reducing material waste.
- Increases the strength and durability of the concrete and reduces the amount of cement needed.

SOURCES

Green Remodeling Illustrations can be found in chapter 5 at www.stopwaste.org/docs/remodeler-c5.pdf

Green Building Guidelines for New Home Construction; chapter 6: Summary of Green Building Benefits: www.sfenvironment.com/aboutus/innovative/greenbldg/tools/newhome_8.pdf

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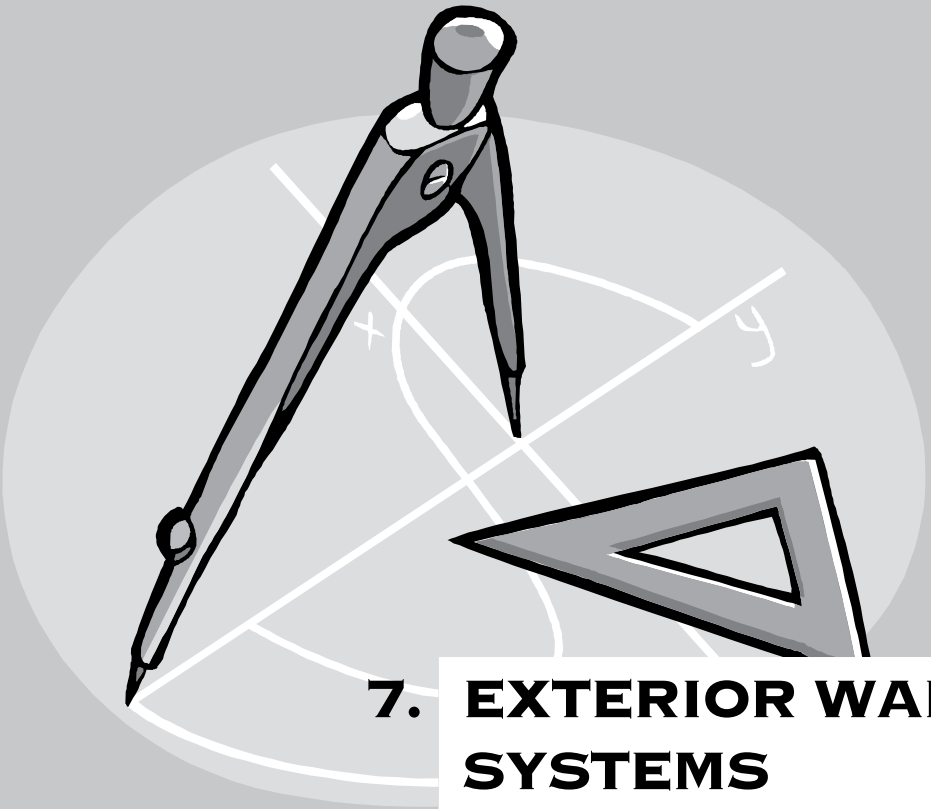

7. EXTERIOR WALL SYSTEMS

Building a green wall system is an opportunity to use resources efficiently while creating healthier buildings that improve human health and provide cost savings. There are many alternatives to traditional stick framing techniques; some are described in this chapter. This chapter will also cover an integrated approach to all components of a home's wall system.

A. ADVANCED FRAMING TECHNIQUES

Advanced framing, or optimal value engineering (OVE), refers to techniques that both reduce the amount of framing material used to build a home and meet model building code structural performance requirements. This is achieved by omitting the structural redundancies of conventional stick framing. In addition, omitting structural components leaves more room for insulation, thereby increasing the energy efficiency of the home.

Common techniques include utilizing two-stud corner framing with inexpensive drywall clips, increasing floor joists and rafter spacing to 24", eliminating headers in non-loadbearing walls, increasing stud spacing from 16" to 24", and using single top plates with in-line framing to transfer loads directly.

One commonly used and easy to implement advanced framing technique is to use 2 x 6" studs, 24" on center to frame the exterior walls, resulting in multiple benefits. Using fewer studs results in faster assembly and creates a better insulated wall because of less thermal bridging and more space for insulation in the cavity.

IMPLEMENTATION OF ADVANCED FRAMING TECHNIQUES

Check with local codes before implementing.

- Use FSC-certified wood
- Use dimensional lumber no larger than 2 x 6"
- 19.2" and 24" on-center framing, floor systems and bearing walls
- 24" on-center framing, roof systems
- 24" on-center interior partitions
- Single top plate walls
- Right-size headers or insulated (box) headers, where required
- Eliminate headers in non-bearing walls
- Doubling the rim joist in lieu of header (2 x 6" or deeper wall framing)
- Finger-jointed studs on 24" centers
- Ladders at perpendicular wall intersections
- Two-stud corner framing
- Use wood framing treated with Borate for a minimum of 3' above the foundation, or sand diatomaceous earth or mechanical termite barrier in known problem areas
- Check moisture content of wood before enclosing both sides

BENEFITS OF ADVANCED FRAMING TECHNIQUES

- Save lumber (25–30 percent).
- Reduce labor.
- Reduce scrap.
- Reduce drywall cracking and simplify air sealing.
- Adopt techniques incrementally.
- Improve energy efficiency (3–5 percent per year) by allowing better insulation and minimizing the thermal effect of studs, improve buildings thermal performance.

CHALLENGES OF ADVANCED FRAMING TECHNIQUES

- More up-front planning is needed to implement; planning must start at design.
- Framers may need training.
- May be difficult to get subcontractors on board.
- May be difficult to clear some techniques with local jurisdictions.

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Johnston, David and Kim Master, LEED AP. *Green Remodeling, Changing the World One Room at a Time*. New Society Publishers

B. STRUCTURAL INSULATED PANELS (SIP)

Structural Insulated Panels are a widely used alternative construction material for homes. SIPs are panels made from a thick layer of foam (polystyrene or polyurethane) sandwiched between two layers of oriented strand board (OSB), plywood, or fiber cement. As an alternative to the foam core, SIPs are available with a core of agricultural fibers (such as wheat straw) that provides similar thermal and structural performance. The result is an engineered panel that provides structural framing, insulation, and exterior sheathing in a solid, one-piece component.

Panel manufacturers now use continuous lamination machines, which automate forming and cutting according to dimensions downloaded from digital floor plans. The panels will arrive precut, and can be rapidly assembled by students without extensive training. Using SIPs will allow you to quickly construct an exterior building envelope that is strong, airtight, and energy efficient.

Some manufacturers now offer special variations in SIP products, such as a high-end panel made with an injected polyurethane core, and vertical joint connectors featuring eccentric cam locks that draw the panels tightly together and assure proper alignment. Manufacturers can also produce curved walls or other customized architectural features.

SIPs in Practice

For a 2,500 square foot home, one custom homebuilder in Arkansas (Stitt Energy Systems) estimates an additional $5,000 to $8,000 for materials. *Labor savings are substantial however, and can tip the economic scales in favor of SIPs.* For example, in areas of the country with high labor rates, installation costs for SIPs can be lower than conventional wall systems.

SIPs have:

- Manufactured wall panels 4' to 24' wide and 8' or 9' high, made in standard thicknesses of 4 ½" to 6 ½".
- Thicknesses of up to 12" for roof panels where greater R-value is needed.
- A core material of thicker panels usually corresponds to standard lumber dimensions, so board stock may be used for splines and plates. Panel lengths can vary to accommodate higher ceilings or roof spans up to 24'.

SIP MANUFACTURERS

To find SIP manufacturers in your area visit the Structural Insulated Panels Association Web site (www.sips.org) and click on the state in which you are located.

ThermaSave
info@thermasave.us
www.thermasave.us

Thermal Foams Inc
2101 Kenmore Avenue
Buffalo, NY 14207
www.thermalforms.com

Insulspan/PanelPros, Inc.
PO Box 1680
Keene, NY 03431
www.panelpros.com

IB Panels
PO Box 723
Jerome, ID 83338
www.ibpanels.com

IMPLEMENTATION OF STRUCTURAL INSULATED PANELS (SIPS)

- Send your plans to an SIP manufacturer so it can produce a customized panel layout and working drawings.
- Have a structural engineer certify the design.
- Have the foundation in place before panels are delivered.
- If possible, use a forklift or have at least four people on site to unload the truck.
- Assembly can usually be done in one to two days.
- Use aerosol foam, gaskets, or other caulking materials for sealing SIPs.
- Bond the foam core to the stiff outer skins to create a web-and-flange structural strength (along the same principal as an I-beam) across the length and breadth of the panel. Insulation capacity is another advantage of SIPs.
- The foam core is typically held back from the edge to allow the panel to accept 2 x 4 top and bottom plates. Alternatively, placing header sections between full-length wall panels may create rough openings for doors.
- Window openings can be made in a similar fashion with the addition of a base panel. Dimensional lumber usually frames out rough openings.

- For wider openings, headers with greater load bearing capacity may be needed. Insulated headers using sandwiched foam have been specially designed to work in conjunction with SIPs.
- Properly seal joints.
- Consult a structural engineer to specify required headers and connections.

BENEFITS OF STRUCTURAL INSULATED PANELS

- With the capacity to handle axial, bending, racking, and shear loads, properly designed and assembled SIPs not only replace conventional framing, but will withstand high wind and great seismic forces.
- SIPs provide better overall air tightness than conventionally framed walls.
- SIPs panel systems offer a dense, uniform, and continuous air barrier with few thermal bridges, and no opportunity for internal convection.
- SIPs generally have higher R-values than similarly sized framed walls, improving thermal performance.
- Operational energy costs are typically low.
- Labor time is reduced due to ease of installation.
- Uses at least 50 percent less framing lumber.
- Requires less room at building site (less site disturbance).
- SIPs contribute less construction waste to landfills due to their customized sizing.

CHALLENGES OF STRUCTURAL INSULATED PANELS

- If the inhabitants wish to remodel, they may have to hire a design professional.
- Producing and engineering the SIPs may increase initial costs.
- It is difficult to determine the exact increase in initial costs, but panels usually cost more than stick frames do.

SOURCES

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The Engineered Wood Association: www.apawood.org

Structural Insulated Panel Association: www.sips.org

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Path "Partnerships for Advancing Technology in Housing": www.toolbase.org/techinv/techspecs/sips.pdf

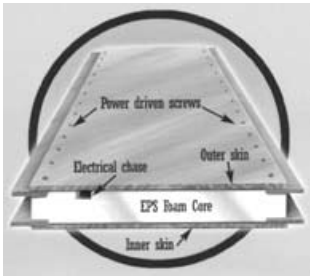
YouthBuild AmeriCorps Rebuilds Gulfport, Mississippi, with SIPs

In the fall of 2005, YouthBuild USA and the YouthBuild movement of hundreds of local programs across the nation pledged to build upon their experience, infrastructure, and dedication to help respond to the economic and social disaster wrought by Hurricane Katrina. Through this dedication and the support of The Home Depot and the Corporation for National and Community Service, the YouthBuild AmeriCorps Katrina Rebuilding Project was born.

This project has engaged 385 YouthBuild AmeriCorps graduates and students who have used the construction skills and community service they learned from their programs to build 140 units of housing in North Gulfport, Mississippi, a predominately low-income community that was destroyed by the hurricane. A special AmeriCorps program of 35 YouthBuild graduates has been in Gulfport for one year, dedicating their full time to restoring this devastated community; they have been joined by rotating crews of 35 to 45 current AmeriCorps members approximately every month from YouthBuild programs nationwide.

What makes this project an exciting step forward in the trend towards building green in YouthBuild is the opportunity it presents to not only offer affordable housing to the people of Gulfport, but also to offer environmentally conscious housing while educating YouthBuild graduates and students on green building applications and materials.

The use of the SIPs played a pivotal role in enabling the YouthBuild AmeriCorps Katrina Rebuilding Project to construct homes that were at once sound, affordable, and green. ThermaSAVE is a pre-assembled structural insulated panel made of expanded polystyrene and concrete, and eliminates the need for conventional wood framing and insulation. The environmental benefits are: it is nonhazardous (versus fiberglass insulation); it reduces construction waste (compared to traditional wood framed construction); it is a terrific insulator and substantially reduces energy consumption from heating and cooling; and it is highly resistant to mold, pests (such as termites), and fire and natural disasters—SIPs are structurally sound to survive severe storms, hurricanes, and earthquakes—and therefore minimizes additional resources needed for repair and reconstruction. SIPs can be used to construct foundation or basement wall, even below grade; floors spanning up to 16 feet between supports, load-bearing walls up to four stories. Lastly, many SIPs, such as ThermaSave, are certified by the International Code Council (ICC).



Basic SIP structure

To learn more about the YouthBuild AmeriCorps Katrina Rebuilding Project and its application of ThermaSAVE and other green building materials, contact Tony Frazier at tfrazier@youthbuild.org.

C. INSULATED CONCRETE FORMS (ICF)

Insulated concrete forms (ICF) are constructed from expanded polystyrene and stacked like building blocks to form the exterior walls. The forms are reinforced with steel and filled with concrete. The forms interlock and fasten one to the other to provide seamless "foundation to rafter" fully insulated, reinforced concrete walls. Window and door openings of any size are possible.

Insulated concrete forms provide a lasting building envelope, and are designed to withstand high wind, fire, the elements, and the test of time.

Basement waterproofing materials for an ICF basement may need to be different (i.e., petroleum-based tar would melt the exterior foam on the ICF form). Windows and doors would need to be ordered with wider jamb extensions to accommodate the increased wall thickness. Another major factor in the discussion to use ICFs is the level of manufacturer support available, including training, on-site and telephone technical support, and marketing materials.

BENEFITS OF INSULATED CONCRETE FORMS

- Some ICF systems boast up to 75 percent energy savings.
- ICF construction is compatible with all home designs.
- ICF walls benefit from concrete's inherent structural qualities, which is particularly important in regions affected by severe weather.
- The combination of a continuous concrete wall plus the integral interior and exterior insulation provides superb energy efficiency and lower utility bills.
- Outdoor pollutants can be kept to a minimum due to decreased air infiltration.
- With several inches of concrete sandwiched by foam insulation, ICF homes are typically quieter than neighboring homes built conventionally.

CHALLENGES OF INSULATED CONCRETE FORMS

ICF homes may cost up to 10 percent more to build, depending on the manufacturer, shipping costs, and other factors. However, lower utility bills will offset the increased up front construction costs.

SOURCE

BobVila.com: *The Energy Wise House: Building with Insulated Concrete Forms*

D. ADOBE

Adobe home built by Taos County YouthBuild, New Mexico

Adobe is a mixture of dirt that has been moistened with water, or sometimes with chopped straw or other fibers added for strength. The mixture is then left to dry in the desired shape. Adobe can be shaped into uniform blocks that can be stacked like bricks to form walls, but it can also be simply piled up over time to create a structure.

Those who build in wetter climates often choose either rammed earth or pressed block, which require little curing time. Today, techniques within adobe construction, such as adding cement stabilizers, keep moisture from affecting the earth walls. Adobe construction, in combination with good passive solar design, makes for an effective energy-saving solution in cold, wet, hot, and dry climates.

IMPLEMENTATION OF ADOBE

Building with adobe is a whole-building approach, so if your program is interested, there are several things to consider:

- Determining site logistics
- Identifying and preparing the soil, stabilization
- Identifying foundation and subfloor needs
- Choosing a wall system
- Identifying door and window bucks, attachments
- Designing electrical systems—bond beams and roofing systems

If your program is interested in integrating adobe into your construction, visit www2.itu.edu.tr/~isikb/Tech1.htm for a step-by-step approach, and contact your nearest green building organization for professional referrals.

BENEFITS OF ADOBE

- Indoor air quality in earthen construction is very healthy.
- Adobe is a good thermal mass material, holding in warm and cool air well.
- The mass of the adobe walls will absorb heat and radiate it back out into the house at night.
- When using high-mass walls, insulation, and a large south solar aperture, you can cut energy use in January by 60 percent or more.
- High-mass earth walls also cut cooling costs in hot desert locales.
- Earth walls allow you to buy smaller heating and cooling units.

CHALLENGES OF ADOBE

- Adobe construction is labor and detail intensive.
- When adobe is used as an exterior plaster it will need to be either stabilized or re-plastered on a regular basis.
- Adobe does not insulate very well, so walls made of adobe need some means of providing insulation to maintain comfort in the building.

- A custom-built adobe house will cost about $45–$65 and up per square foot.

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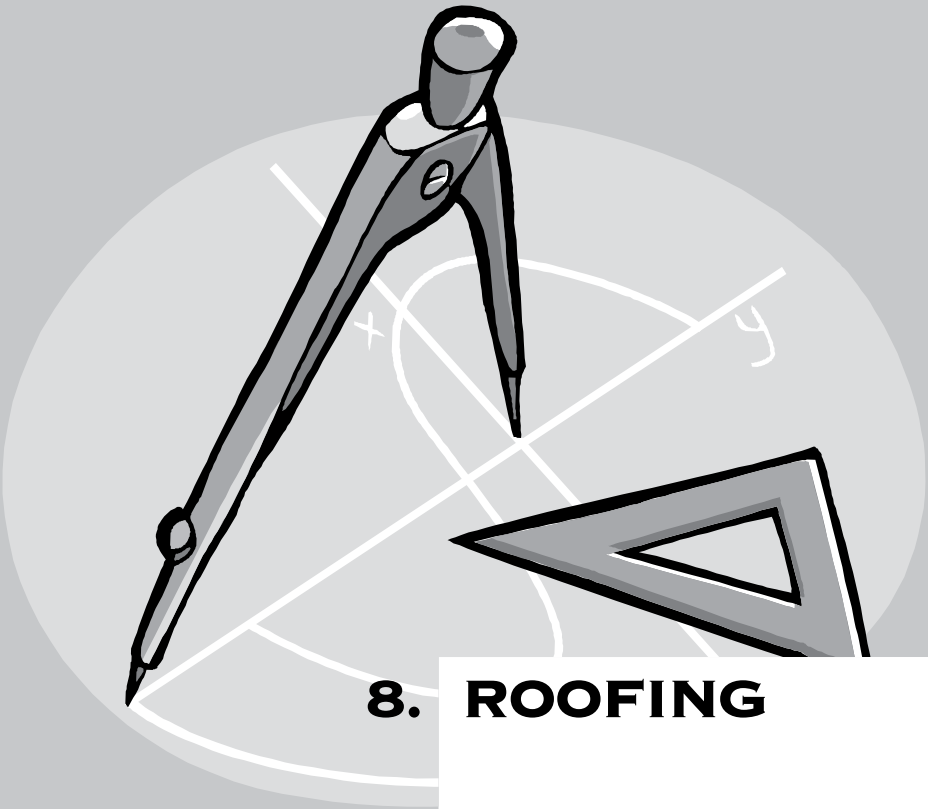

8. ROOFING

Green roof framing techniques are similar to those discussed in advanced framing, with more focus on reducing waste, reducing the amount of virgin wood used, and choosing wood products that have been certified for being sustainably harvested, such as FSC-certified products.

Remember that the roof system is also part of the building envelope. Proper insulation and control of air leakage is essential to meeting green-building goals. There are several approaches to include in your roofing system to ensure a durable, energy-efficient roof.

Even in mild climates the sun's heat can cause extreme temperatures and push heat into the building through the roof. Two approaches to reduce heat gain and its resulting energy use include adding insulation underneath the roof and installing a reflective roof such as aluminum or a roof radiant barrier to reflect heat. Installing a rainwater catchment system is another roofing technique that helps offset water use by collecting and using rainwater for landscaping, car washing, or other uses.

A. WOOD TRUSSES

Wood trusses are structural frames that rely on a triangular arrangement of webs and chords to transfer loads to reaction points. They have a high strength-to-weight ratio, and have longer life spans than conventional frames. Wood trusses also offer more flexibility in floor plan layouts and a broad range of shapes and sizes to choose from. The light frame wood trusses are prefabricated by pressing galvanized steel truss plates into wood members that are pre-cut and assembled in a jig.

IMPLEMENTATION OF WOOD ROOF FRAMING

- Use engineered roof trusses to save on dimensional lumber or use alternate roof structures with SIPs, steel, or laminated veneer lumber.
- Truss heels are necessary to avoid compressing or squishing the insulation, which reduces the insulation value. Truss heels are blocks built on the truss ends that raise the truss 4–8" above the top plate. Raised heel trusses or "energy heels" normally sit directly on a 2 x 4 or 2 x 6 top plate. This makes a little triangle in the attic at the eaves—when insulation is put in the attic, it needs to be pushed to the farthest extreme. The sides or house walls is where insulation is needed most.
- Avoid using dimensional lumber larger than 2 x 10".
- Insert continuous ridge and soffit vents.
- Insulate and weather strip attic access doors.

BENEFITS OF WOOD ROOF FRAMING

- Wood trusses provide an economical framing solution.
- Wood trusses enhance wood's environmental advantage by optimizing wood use for each application.
- The environmental impact of wood trusses is lower in regards to air and water toxicity, resource use, and embodied energy, compared to light-gauge steel and insulated concrete forms.

B. ALUMINUM OR GALVANIZED METAL ROOFS

Casa Verde Builders YouthBuild installing an aluminum roof

One roofing material, which is lightweight, rust and corrosion resistant, is aluminum. Aluminum roofs not only provide premium protection, they are also great for the environment.

The Casa Verde YouthBuild program uses galvanized metal roof systems. These roofs reflect heat and have less mass to store the heat they do collect. When combined with a ridge-and-soffit venting system, they reduce the attic temperature by 20–30 degrees on hot summer days. These roofs will last 30–40 years with little or no maintenance.

IMPLEMENTATION OF ALTERNATIVE ROOFING SYSTEMS

- Use metal material (aluminum or galvanized metal) for roof or alternative roof structure-SIPs (see SIP section under wall systems), steel, or laminated veneer lumber (LVL).
- Use photovoltaic-integrated roofing panels or photovoltaic shingles.
- Avoid black roofs, such as EPDM (rubber), asphalt, and modified bitumen.
- Use a non-petroleum, water-based reflective coating on your roof.
- Install ice flashing at roofs edge and a drip edge at eave and gable, if needed.

BENEFITS OF ALTERNATIVE ROOFING SYSTEMS

- Installation of reflective metal roofing can save the home up to 40 percent in summer cooling energy costs while *highly emissive* metal roofs can reduce urban air temperatures by as much as 12° F. Combined, these benefits mean less money, less dependence on energy resources and less general air pollution.

CHALLENGES OF ALTERNATIVE ROOFING SYSTEMS

- An aluminum or galvanized metal can initially cost more.
- The heat reflective (home cooling) benefit of aluminum roofs will diminish over time unless steps are taken to keep them shiny.

FAST FACT

Roofing Shingles

According to the Bureau of Cedar Shakes and Shingles, three full-grown trees are destroyed for the average shake roof. One study has shown that composition shingles buried in landfills will take over 300 years to decompose. But by using aluminum roofing shingles, your project can avoid contributing to the growing problem of landfills due to aluminum being completely recyclable and often having a high recycled content. Also, because aluminum is more malleable, it can be formed into more intricate and detailed product designs, which provide strength and beauty to a roof.

Source: www.zappone.com

C. RADIANT ROOF BARRIERS

Radiant roof barriers are made of a thin sheet or coating of highly reflective material applied to one or both sides of a number of substrate materials. Substrates include kraft paper, plastic films, cardboard, plywood sheathing, and air infiltration barrier material. Radiant barriers reduce heat transfer by thermal radiation across the air space between the roof deck and the attic floor.

IMPLEMENTATION OF RADIANT ROOF BARRIERS

There are several configurations possible:

- Install under tile roofing with shiny side up.
- Lay the radiant barrier directly on top of existing attic insulation, with shiny side up.
- Attach the radiant barrier to bottom surfaces of the attic truss chords or rafter framing.
- In homes roofed with wood shakes, drape the radiant barrier with shiny side down over the tops of rafters before the roof deck is applied.
- Attach the radiant barrier directly to the underside of the roof deck.
- For single-ply membrane roofs, separate the rigid insulation from the roofing membrane so that the insulation can be reused.

BENEFITS OF RADIANT ROOF BARRIERS.

- Radiant barriers can reduce cooling costs as much as 30 percent, reduce heat island affect, and prolong the life of the roof by lowering the roof temperature.
- White, reflective roofs with no barrier can reflect 80 percent of the heat.

CHALLENGES OF RADIANT ROOF BARRIERS.

- Without proper attic ventilation, radiant barriers can cause moisture-related problems, especially if used in combination with wood shakes or installed incorrectly.

D. RAINWATER CATCHMENT SYSTEMS

A rainwater catchment system, attached to the roof, can also help the homeowner utilize rainwater as a valuable water resource. Metal roofs, such as aluminum, lend themselves very well to this technique.

IMPLEMENTATION OF RAINWATER CATCHMENT SYSTEMS

Collection Area

This is generally the roof of the house. The roofing material should be one that does not leach heavy metals or petrochemicals.

Conveyance System

Add gutters or pipes that deliver rainwater falling on the rooftop to cisterns or other storage vessels. Construct drainpipes and roof surfaces with chemically inert materials such as wood, plastic, aluminum, or fiberglass.

Storage Facilities

A storage tank or cistern should be constructed of an inert material such as reinforced concrete, fiberglass, or stainless steel. The storage system can be built as part of the building or as a separate unit.

The catchments' surfaces should be made of a nontoxic material. If using paint then use nontoxic paint (no lead, chromium, or zinc-based paints).

BENEFITS OF RAINWATER CATCHMENT SYSTEMS

- Rainwater catchments are inexpensive and flexible systems that are easy to reconfigure, expand, or relocate.
- These systems will reduce the homeowner's water bill.
- Using less water will reduce the amount of energy used and the pollution caused by pumping water from its source to the house.

CHALLENGES OF RAINWATER CATCHMENT SYSTEMS

- Rainwater catchments may not meet local building code requirements for primary water source for new construction.
- Requires a good-sized roof.
- Gutters require constant maintenance and cleaning.

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Johnston, David and Kim Master, LEED AP. *Green Remodeling, Changing the World One Room at a Time*. New Society Publishers

Casa Verde Builders Design and Construct Green Homes Using Galvanized Steel Roofs

Casa Verde Builders is a program of American YouthWorks, a nonprofit corporation in Austin, Texas, that has been providing alternative educational services to young people for more than 25 years.

Since 1993, Casa Verde Builders has been building single-family, energy efficient sustainable houses in East Austin—providing homes for families who might otherwise never have the opportunity to own one. These homes are built by AmeriCorps Volunteers, young people between the ages of 17–25 who work for minimum wage and receive an educational award at the end of their year of service.

Green Building Collaboration

In 1992, the City of Austin's Green Building Program needed a builder to build a model energy- and resource- efficient home. After several months of discussions with various community groups, a partnership formed among the Green Building Program, Austin Habitat for Humanity, and American YouthWorks. The Green Building Program provided technical support for the project. Habitat for Humanity provided the lot for the project, sold the finished home to one of the families on its waiting list, and provided volunteer labor for some phases of the project. The American Institute for Learning set up the program with staff and students from their alternative school to build the home. Within a few months a floor plan was developed, funds and materials for construction promised, and two staff members and eight students selected for the project. Construction began on August 13, 1993. Since this auspicious but modest start, the young people and staff of Casa Verde Builders have built over 90 quality, energy-efficient, affordable homes for low-income families. Families have new homes; the neighborhood has dramatically lower crime with the increase in home owners; and hundreds of young people have pride in their accomplishments that will last a lifetime. In 2005 one of their homes won a national Gold Medal award from NAHB, the National Association of Home Builders.

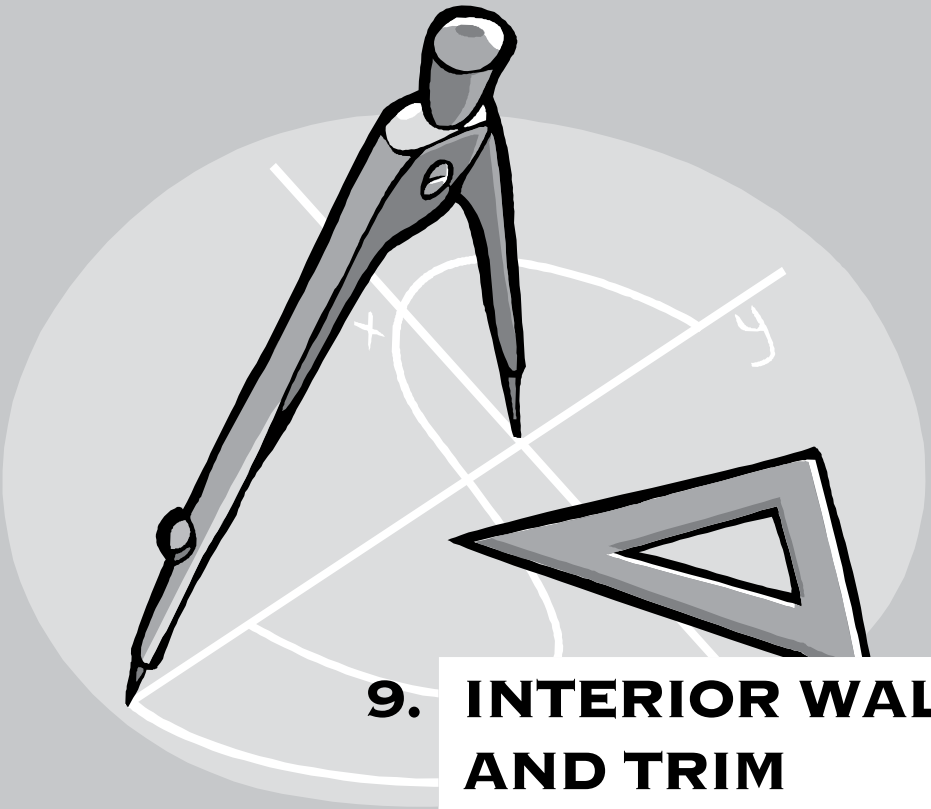
Reduced Energy Consumption

The City of Austin has been tracking utility costs for a sampling of the Casa Verde homes and comparing them with other comparable homes in Austin since 1994. Average electricity costs of a Casa Verde home are 30–50 percent lower than the control group and natural gas consumption reduced by 10 percent.

Roofing Design and Construction

The roofing design and construction of the home is particularly significant in green design. To avoid heat buildup in the attic, Casa Verde uses galvanized metal roofs. These roofs reflect heat and have less mass to store the heat they do collect. When combined with a ridge-and-soffit venting system, they reduce attic temperatures by 20–30 degrees on hot summer days. These roofs will last 30–40 years with little or no maintenance. To prevent the heat that does build up in the attics from penetrating into the conditioned spaces, Casa Verde installs an R-30, 10-inch layer of blown cellulose insulation above the ceiling. In addition to the thermal benefits that reduce the operating costs of the homes, these roofs are made of steel, the most recycled material commonly used in construction. The primary material in the cellulose insulation is recycled newsprint, again reducing the need to use virgin raw materials in the construction process. To complete the thermal package, Casa Verde installs a 14 SEER air-conditioning unit with a high-efficiency gas furnace. Casa Verde installs ceiling fans in all major rooms and a whole-house fan for use in mild weather. Finally, most of the rooms are designed to have windows on at least two walls to provide cross ventilation.

For more information, contact: Richard Halpin, founder and CEO, American YouthWorks:(512) 236-6100; rhalpin@americanyouthworks.org; www.americanyouthworks.org/cvb/greenconstruction/frontpage.htm



9. INTERIOR WALLS AND TRIM

INTERIOR WALLS AND TRIM

Interior wall systems can be made from agricultural waste such as straw. Some products contain as much as 100 percent agricultural waste product, are fire resistant, avoid toxic binders, and do not require structural studs.

If using gypsum board, attempt to find recycled content that is locally available. The gypsum board scraps should be separated on the job site and recycled as part of your recycling plan. If you do not recycle all of your gypsum board content, it can be ground up and used for soil amendment (as long as there are not toxic paints or wall coverings). Alternatives to gypsum board include straw bale, adobe, and cobb.

IMPLEMENTATION OF GREEN INTERIOR WALLS AND TRIM

- Install 24" off-center studs.
- Install finger-jointed studs or high recycled content metal studs.
- Use straw panel walls, such as strammit panels.
- Use certified wood trim.
- Use finger-jointed trim.
- Utilize a wood interior panel system.

A. WOOD INTERIOR PANEL SYSTEM

The wood paneling system is designed for interior finishes. Each panel has a hardwood veneer bonded to an engineered wood substrate such as medium-density fiberboard (MDF) or wheatstraw board.

Wood paneling can reduce the cost when compared to custom millwork by as much as two-thirds.

The paneling system is used exactly like any hardwood paneling in interior finish applications. It is a pre-cut system where pre-machined stiles, rails, and panel pieces are assembled and installed with minimal cutting and sanding. This allows the appearance of custom-built paneling at significantly lower cost of materials and labor. Panels and rails can be stacked to create full wall-paneling options.

MDF is made from highly refined wood fibers combined with a binding agent and pressed into a composite wood product that is uniform and dimensionally stable. Unfortunately, MDF has a high formaldehyde content, and you should therefore seal all edges and the material itself to minimize off-gassing.

Wheatboard is made with discarded wheat straw from farming operations. The straw material is processed into substrate panels that have excellent stability and strength.

Wheatboard panels usually cost $10–$35 per square foot.

BENEFITS OF WOOD INTERIOR PANEL SYSTEMS

- Wood interior panel systems help extend scarce hardwood resources and use recycled materials.
- Panel systems use less wood and recycled material, and *they cost much less* than a similar product using actual wood.
- These products are made of compressed straw and recycled manufactured wood products, and use significantly less wood than authentic wood wall décor.
- Wood panels hold up as long or longer than other actual wood decor due to their treatment and manufacture. They can usually be cleaned with conventional cleaning agents, and are rather strong for their cost as well.

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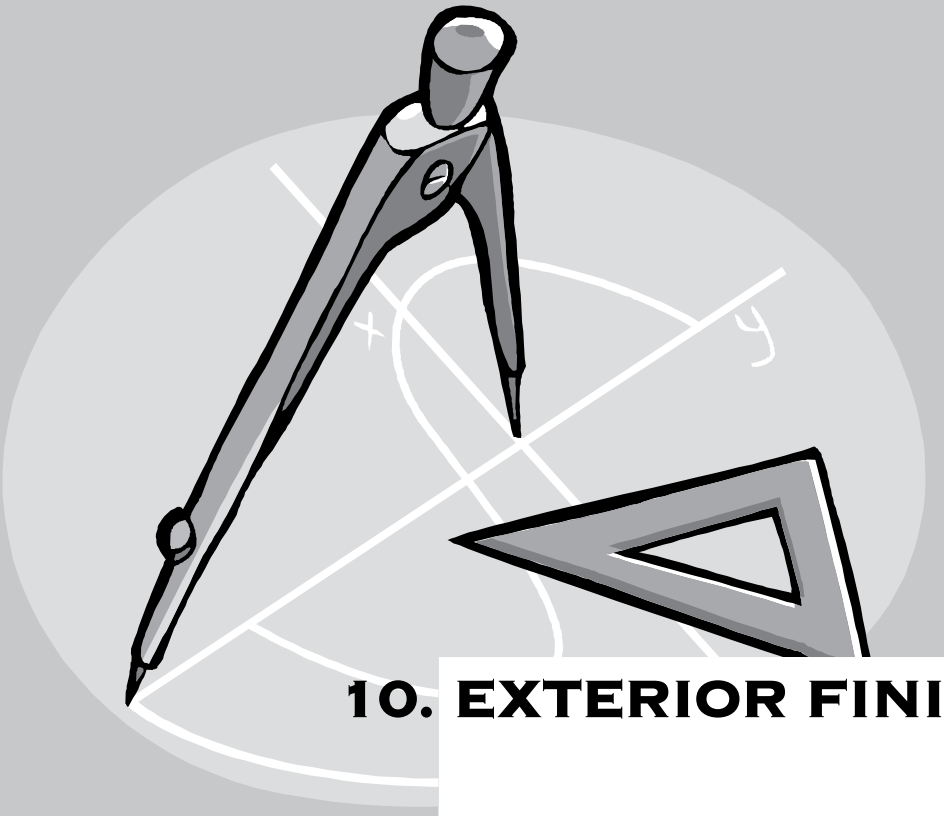

10. EXTERIOR FINISHES

EXTERIOR FINISHES

Protecting the home from the elements—whether it's extreme cold, heat, or moisture—is a vital part of visual appeal, environmental considerations, and energy savings.

Vinyl

Vinyl was once thought to be the best choice, but now there are differing opinions. Vinyl siding is a low-maintenance material, and some manufacturers may add a small amount of post-industrial scrap. However, vinyl siding is also made from polyvinyl chloride (PVC). Many environmental groups disapprove of the use of PVC because of the danger of its by-product dioxin which is created during the manufacture, use, and combustion of PVC. Dioxins include some of the most toxic chemicals known to science. (For more information about PVC, see the resources section.) Fiber cement and metal are usually better options for the environment and human health.

Solid-sawn Wood

Using solid-sawn wood with natural weather resistance (like cedar or redwood) puts some strain on harvested forests (true green building wouldn't use any cedar or redwood, unless it was reclaimed—most certification programs require no use). One way to compromise is to use these natural materials only on the front of the home, and side the rest with a man-made product that closely resembles the natural material, such as one that contains wood fibers, or virgin or recycled materials.

Plastic

There are currently over 20 products in the market consisting of plastic or plastic-wood composites. Plastic lumber is made from 100 percent recycled plastic, #2 HDPE and polyethylene plastic milk jugs and soap bottles. Plastic-wood composites are a combination of plastic and wood fibers or sawdust. These materials are a long-lasting exterior weather-, insect-, and chemical-resistant wood lumber replacement for nonstructural applications.

Alternatives

Alternative sidings include stucco, cement board, metal siding, recycled wood, styrofoam-concrete mixes, and other eco-friendly alternatives.

IMPLEMENTATION OF GREEN EXTERIOR FINISHES

- Use treated wood that does not contain chromium or arsenic for decking and sill plates.
- Use earth-based plaster.
- Use alternative siding materials such as:
  - Mineral or cement fiberboard (also referred to as fiber cement and cement board).
  - A recycled material or an environmentally friendly, engineered product.
  - Wood products such as sidewall shingles, or OSB siding. (Remember to utilize certified wood, low-VOC coatings, and non-exotic species. Avoid virgin, old-growth tree products.)
  - Hardboard like masonite or ABTco Stucco.
  - Fiber/cement composites like MaxiPlank® or James Hardie® products.
  - Polymer products like Nailite©, vinyl products like Wolverine®.
- Use locally produced block or brick.
- Use cement based integral colored stucco system.
- Design "moisture-forgiving" walls and roof details that repel rain and can dry out.
- Finish with light-color exterior finishes and high-reflecting roof covering.

BENEFITS OF GREEN EXTERIOR FINISHES

- Using recycled content materials is more durable and reduced demand for old-growth timbers.
- Using treated wood reduces exposure to chromium and arsenic.
- Cement-fiber will not burn, cup, swell, or shrink.
- Alternative siding will last longer, can be fire resistant, and can reduce maintenance costs.
- Choosing not to use vinyl siding means fewer toxins eventually being released into the environment, where they make their way into our bodies, causing health risks.
- Cedar shingles require less maintenance than wood clapboard.

CHALLENGES OF GREEN EXTERIOR FINISHES

- Cultured stone and brick can be extremely expensive, and other alternative materials can be more expensive than vinyl.
- Synthetic stucco will look authentic, but may not offer the same durability.

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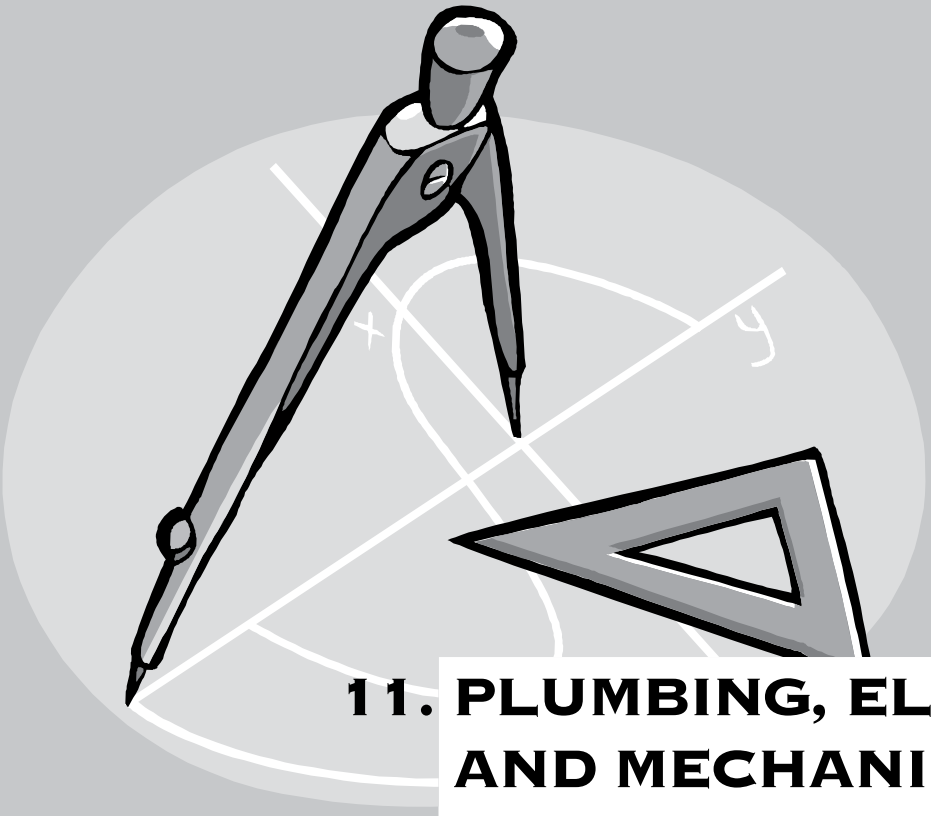


11. PLUMBING, ELECTRICAL, AND MECHANICAL

PLUMBING, ELECTRICAL AND MECHANICAL

The systems and appliances installed in a home can dramatically affect the amount of energy that the building will consume over its lifetime. There are several approaches and products that can be used to ensure the most energy efficient home. Energy efficiency standards for air conditioners, heat pumps, and residential unit packages have been raised in many locations, and many organizations have developed efficiency rating systems.

IMPLEMENTATION OF GREEN PLUMBING, ELECTRICAL, AND MECHANICAL PRACTICES

HVAC

- Start with easy tasks like installing ceiling fans, programable humidistats, and a high-efficiency particulate air (HEPA) filter.
- Choose a reputable HVAC installer that you trust; or consult with a green-building program near you (see the *YouthBuild Green Pages* for listings).
- Install 12 SEER or higher air-conditioning units over 1.5 tons with non-CFC/HCFC cooling refrigerant. This is now required by code in some states.
- Install outside air mechanical ventilation system or an energy-recovery ventilator.
- Be sure to get a system air-flow test and blower-door test to find any unwanted air leaks and to test caulking in walls, windows, and doors.

Plumbing

- Keep water supply lines out of exterior walls.
- Install anti-scald valves in showers and tubs.
- Use tankless (gas) hot water heater —whole house—DOE Std. 10CFR430.
- Install water heater within 20 feet of fixtures and appliances.
- Use an on-demand hot-water recirculation system—not one that is continuous or on a timer.
- Use hot water pipes with minimum of one inch of insulation.
- Cold water pipes should have a minimum of one-half inch of insulation in unconditioned space.
- Use a heat trap on cold and hot water lines to and from heater if not integral to heater.

Electrical

- Provide homeowner with information on "Green Choice" power options.
- Each ton of cooling from air-conditioning units should cover a minimum of 550–600 square foot of space. For more specific sizing, use Manual J or Manual ANSI/ACCA Manual D.

BENEFITS OF GREEN ELECTRICAL

- In many climates, air conditioning is the biggest item in the power bill. An oversized air-conditioning unit may cycle on and off every 15 minutes—this does not allow the unit to get to optimum efficiency (kind of like driving around in first or second gear!) and can cost a lot in electricity. Efficient air-conditioning units are designed to run from 30 minutes to several hours.

CHALLENGES OF GREEN ELECTRICAL

- Getting your HVAC contractor to believe in what was discussed above and specify the proper unit.
- Enlisting the help.

A. DUCTWORK

- Duct size, design, and installation should be done per ANSI/ACCA Manual D or local equivalent.
- The main HVAC trunk should be made of sheet metal and flex-duct take-offs should not be greater than 10 feet.
- Ninety-degree angles in ducts should have turning vanes.
- Duct connections should be sealed with mastic-hardcast or UL181 foil tape (not duct tape).
- Ducts, plenums, and trunks should be insulated if they cannot be installed in a conditioned space.
- Install air balancing dampers that are accessible.
- Ensure that pressure is balanced for all bedrooms.
- Eighty percent of ductwork should be located within thermal envelope and conditioned space, never in exterior walls.
- Use return ducts or transfer grilles in each room.
- Complete a direct duct-pressure test with an optimal leakage of less than 10 percent.
- Mask duct outlets during construction and vacuum before running to protect indoor air quality.

FAST FACT

Approximately 70 percent of the 60 YouthBuild programs surveyed in 2005 found that avoiding installation of ductwork in exterior walls was effective.

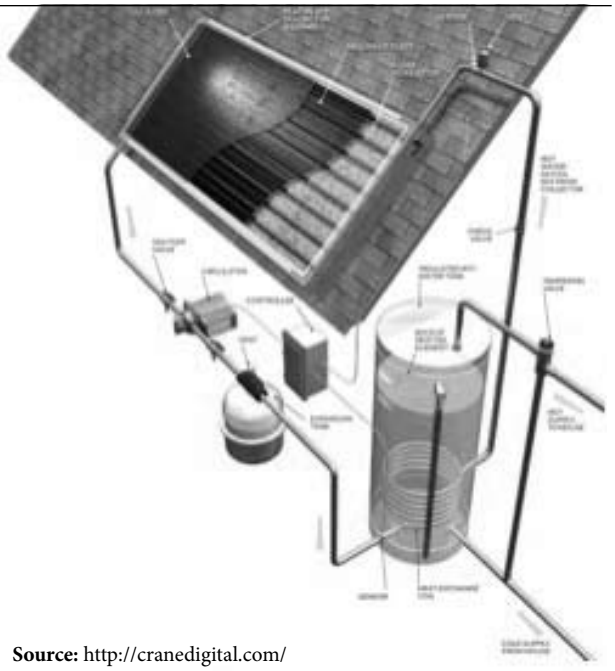
BENEFITS OF ENERGY-EFFICIENT DUCTWORK

- Reduces energy costs by 30–40 percent per year and improves comfort level.
- The most efficient systems on the market are up to 70 percent more efficient than the current average.
- Homeowners can qualify for a cash rebate from the local utility or be able to purchase a system with no payments or interest for up to one year in certain areas.
- Reduces dust circulating in the house after occupancy.
- Cleaning all ducts before occupancy increases comfort and reduces air-conditioner use.
- Installing an attic ventilation system reduces electricity usage and moves large volumes of air to achieve comfort at higher temperatures without air conditioning.
- Installing a greater efficiency gas furnace reduces air emissions, costs less to operate, and saves natural resources.

B. SOLAR HOT WATER HEATING SYSTEMS

Currently there are approximately 200,000 homes in the United States taking advantage of solar water heating systems. Solar water collectors can provide up to 80 percent of a house's hot water (and even more depending on the climate and location of the home), and save the United States millions of barrels of oil every year by reducing the need for conventional heating.

The basic technology of solar water heating is very simple. Sunlight strikes the roof system and heats an "absorber" surface within a "solar collector" or an actual storage tank. Either a heat-transfer fluid or the potable water (to be used) flows through tubes attached to the absorber and picks up its heat. Systems with a heat-transfer-fluid loop include a heat exchanger that then heats the potable water. The heated water is stored in a conventional water heater tank until needed or in a separate preheat tank. If additional heat is needed, it is provided by the conventional water heating system.



Source: http://cranedigital.com/

As for size and installation, there is no "one size fits all" solar water-heating system. The size of the collector will depend on where the house is built and how much hot water is required. It is possible to build a solar water heating system using an experienced installer or system supplier. Installing the system on a roof will require an analysis of the design load of the roof and the weight of the equipment. It is best to go with a solar heating system that carries an OG300 rating by the Solar Rating and Certification Corporation in order to qualify for available tax credits.

Types of Solar Heating Systems

Direct System. This system uses a pump to circulate potable water from the water storage tank through one or more collectors and back into the tank. The pump is regulated by an electronic controller or an appliance timer.

Indirect System. In this system, a heat exchanger heats a fluid that circulates in tubes through the water storage tank, transferring the heat from the fluid to the potable water.

Thermosiphon. A thermosiphon solar water-heating system has a tank mounted above the collector. As the collector heats the water, it rises to the storage tank, while heavier cold water sinks down to the collector.

Draindown System. In cold climates, this system prevents water from freezing in the collector by using electric valves that automatically drain the water from the collector when the temperature drops to freezing.

Solar Energy Collectors

There are three types of collectors useful for residential homes:

Flat Plate Collector. This popular collector uses a rectangular box with a transparent cover attached to the roof. There are small tubes in the box that have fluid (either water or an antifreeze solution) running through. The tubes are attached to a storage plate and as heat builds up in the collector, it goes through the tubes and as the fluid goes through tubes it is heated. The fluid is then stored in a storage tank.

Integral Collector-Storage System. Also known as ICS or batch system, this features one or more black tanks or tubes in an insulated, glazed box. Cold water first passes through the solar collector, which preheats the water. The water then continues on to the conventional backup water heater, providing a reliable source of hot water. They should be installed only in mild-freeze climates because the outdoor pipes could freeze in severe, cold weather.

Evacuated-tube Solar Collector. This features parallel rows of transparent glass tubes. Each tube contains a glass outer tube and metal absorber tube attached to a fin. The fin's coating absorbs solar energy but inhibits radiative heat loss. These collectors are used more frequently for U.S. commercial applications.

IMPLEMENTATION OF SOLAR HOT-WATER HEATING SYSTEMS

Review applicable building codes
Chapter 23 of the International Residential Code briefly covers solar systems. It states that solar systems and storage units must be listed with an approved testing agency, and heat transfer fluids cannot be flammable.

Eliminate unnecessary water heating loads
Maximize the home's energy efficiency and reduce water heating demand before implementing solar strategies by installing efficient shower heads, setting the water temperature lower, and other measures.

Take advantage of solar energy during the design process
Maximize a home's use of solar energy with good siting and architectural features, which add little or nothing to the cost of the house.

Contact an appropriate subcontractor to decide the appropriate solar water heating system for the site.

BENEFITS OF SOLAR HOT WATER HEATING SYSTEMS

- For the amount of money and energy saved, solar water heating doesn't involve a large investment for each household—from $3000 to $6000 is typical.
- The technology can cut the average family's energy costs to heat water by 20 to 40 percent (as much as 90 percent in some southwestern regions).

- For using a solar hot-water heating system, you could receive a rax credit of nearly 30 percent established in the Energy Policy Act of 2005 (EPA act of 2005).

CHALLENGES OF SOLAR HOT WATER HEATING SYSTEMS

- They can add additional construction cost and time.
- A third-party inspection may be required.
- They will require some attention and maintenance by the homeowner, and therefore require a degree of homeowner education.

C. GRID-TIED RENEWABLE ENERGY ELECTRIC SYSTEMS

A grid-connected power system allows a home to get part or all of its electric power from renewable sources, and reduces demand on existing coal, oil, gas, hydroelectric, and nuclear generating plants. New laws called "net metering" allow electricity consumers to connect battery-less PV energy systems to the utility grid. When a renewable energy system is generating more power than it is using, the excess feeds back into the grid, resulting in a reduction in the utility bill. The electric meter spins backward, "banking energy" as a credit for future use.

Renewable energy use for electrical generation is an area of construction that YouthBuild programs have typically avoided. The installation and maintenance of these systems is not especially difficult or complicated, but should be learned from a professional and installed by a commercial installer. A qualified installer will help design and build a system that not only meets the needs of the project, but meets the National Electrical Code and functions safely.

Renewable energy use should only be considered once a program has had success in building energy-efficient homes. When sizing a renewable energy system, even the smallest amount of wasted electricity can result in huge cost differences as solar electric panels are added to systems in series, meaning that depending upon the wiring, you may have to add two or more panels to the system even if your electric load would only require one additional panel. The high initial cost of renewable energy electric systems require a builder to reduce the electric loads as much as possible. The biggest electric loads in residential homes are refrigerators, washers and dryers, and appliances that produce heat such as irons and coffee pots.

IMPLEMENTATION OF GRID-TIED RENEWABLE ENERGY ELECTRIC SYSTEMS

- Contact the local utility company to see if they will allow a connection of a solar system to their electrical grid.
- If the utility company will allow the connection of a PV system to their grid, the next question to ask is if they will buy the energy back at the retail or wholesale rate.
- Identify a qualified renewable energy installer. You can find an installer in the Off-Grid Living Web site under the Resources section.

BENEFITS OF GRID-TIED RENEWABLE ENERGY ELECTRIC SYSTEMS

- Allow inhabitants to lower electric bills and have access to a very reliable source of power.
- Grid-tied renewable energy systems will lower electric bills, and, as electricity costs increase, the payback time for a system decreases.
- Renewable energy systems immediately contribute to a cleaner planet.
- Homeowners can access numerous rebates through the federal government and various state and local programs. (See the *YouthBuild Green Pages* for listings.)
- Builders can access numerous incentives through the federal government, various state and local programs, and private sources of funding.

CHALLENGES OF GRID-TIED RENEWABLE ENERGY ELECTRIC SYSTEMS

- Initial costs will vary greatly depending upon the size of the system and amount of labor costs.
- Homeowners need to learn proper maintenance of system, particularly if there is a battery bank.

SOURCES

Energy Services Office: www.cwlp.com/Energy_services/efficiency_ratings.htm

Saving Energy: Heating & Air Conditioning: www.powerhousetv.com/stellent2/groups/public/documents/pub/phtv_se_he_gs_000585.hcsp

(Seasonal Energy Efficiency Rating): www.furnacecompare.com/faq/definitions/seer.html

Lenox Home Systems Online: www.lennox.com/pdfs/wgya/PC40525%20Efficiency%20Standards.pdf

Green Building Guidelines for new home construction: "Chapter 6 Summary of Green Building Benefits": www.sfenvironment.com/aboutus/innovative/greenbldg/tools/newhome_8.pdf

Off Grid Living Online-this site lists renewable energy installers for different regions www.off-grid-living.com/

Positive Energy Solar: www.positivenergy.com/gisys.html

Bright Ideas in Renewable Energy; A guide for submitting a renewable energy proposal to Northwest Energy: www.northwesternenergy.com/documents/bright_ideas_in_renewable_energy.pdfM=2&I=348

Popular Mechanics Solar Water Heating Roundup: www.popularmechanics.com/home_improvement/smart_consumer/2270791.html?page=2&c=y

US Department of Energy Efficiency and Renewable Energy Website: www.eere.energy.gov/buildings/info/components/waterheating/solarhot.html

US Department of Energy Efficiency and Renewable Energy Website: www.eere.energy.gov/RE/solar_hotwater.html

Johnston, David and Kim Master, LEED AP. *Green Remodeling, Changing the World One Room at a Time*. New Society Publishers

YouthBuild Brockton uses Energy Star Ratings to Build Affordable and Sustainable Homes

Old Colony Y YouthBuild Brockton celebrates as a first-time homeowner is handed the keys to a four-star Energy Star-rated home built by the program

Since 2001, YouthBuild Brockton, Massachusetts, has built five Energy Star-rated homes and is currently working on one unit in partnership with Habitat for Humanity and a seventh unit in partnership with the Boston Housing Authority. John Bengel, executive director of the Brockton program, emphasizes that the importance of the Energy Star Program is two-fold: The program promotes energy-efficiency and environmental responsibility in construction, and it provides affordability for the homeowner.

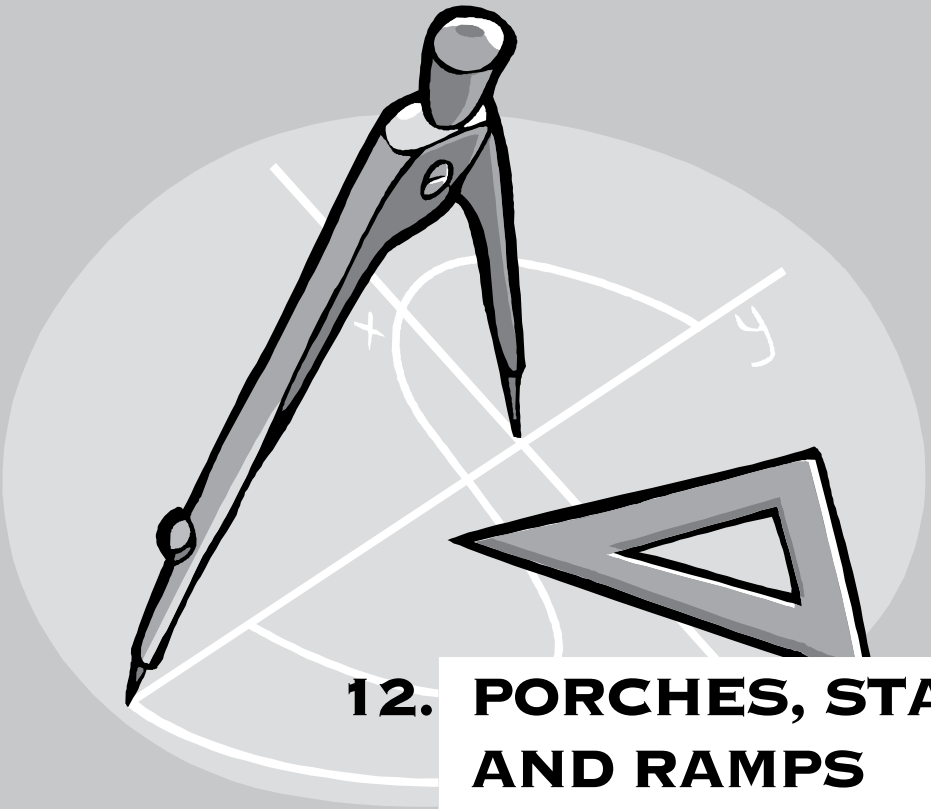
According to the U.S. Environmental Protection Agency Energy Star Web site, "homes that earn the Energy Star must meet guidelines for energy efficiency set by the U.S. Environmental Protection Agency. Energy Star-qualified homes are at least 15 percent more energy efficient than homes built to the 2006 International Energy Conservation Code (IECC)." The Environmental Protection Agency (EPA) reports building homes that use substantially less energy for heating, cooling, and water heating can reduce maintenance costs $200–400 annually. The Energy Star program measures efficiency for the entire home, not just retail appliances. Features that are also rated include increased insulation, tight building construction and ducts, and energy-efficient window and building envelope.

Bengel reports that using Energy Star-rated insulation and appliances increased construction costs only 2 to 4 percent. The Energy Star program does have an application fee that can be waived. After house plans and specifications are complete with Energy Star features, the EPA representatives evaluate the plans to assign an Energy Star rating and consult the construction team to implement improvements on the submitted plans. Bengel describes the application process as supportive and fairly easy to implement. Besides producing efficient, affordable homes, builders can apply for rebates based on their level of energy efficiency. Bengel says that, with a 92 percent rating for the YouthBuild constructed homes, the rebate program covered nearly half of the costs of the appliances by using efficient forced hot-air furnaces, more insulation, and installing Energy Star-rated appliances and lighting.

IN A RECENT SURVEY OF 60 YOUTHBUILD PROGRAMS ACROSS THE COUNTRY, ONLY TEN PROGRAMS HAVE HAD AN OUTSIDE AGENCY RATE THEIR HOUSES. ENERGY STAR IS THE SYSTEM MOST READILY USED AMONGST RESPONDENTS.

"The Energy Star program promotes homeownership by creating homes that are less expensive to operate," says John Bengel. To find out more about the Energy Star program and associated rebates within your state, visit www.energystar.gov/index.cfm?c=new_homes.hm_index

For more information, contact John Bengel, program director, YouthBuild Brockton, (508) 894-2816, jbengelyb@verizon.net.



12. PORCHES, STAIRS, AND RAMPS

PORCHES, STAIRS, AND RAMPS

Porches, stairs, and ramps should also use environmentally responsible products. There are several types of wood-polymer decking that can be used on the outside of the home. These products are made from wood waste and recycled plastic grocery bags, milk jugs, and other materials. Trex® is a well-known brand, but there are other brands on the market as well. Fiberon® is a product approved for use on wheelchair ramps due to the texture of its surface. Other quality brands include Timbertech® and Weyerhauser®. They rarely splinter or crack so they are very kid- and barefoot-friendly.

Implementation

- Locate the porch on the south side for maximum sunlight.
- Create a covered or shaded area or porch of a minimum of 100 square feet.
- Install covered entry-awning or porch-awing to prevent water intrusion.
- Use alternative materials such as wood polymer products, recycled plastic, masonry, concrete, or other recycled content composite materials such as Choice Dek® for porch, stairs, ramps, and patios.

BENEFITS OF USING ALTERNATIVE MATERIALS

- Wood polymer products require substantially less maintenance than wood products.
- Wood polymer products will not splinter, crack or warp.
- Constructed from reclaimed plastics and hardwoods, wood polymer products can be cut, fastened, sanded, and painted easily.
- They are naturally UV-resistant.
- They are slip-resistant, wet or dry.
- They remain undamaged by rot or termites.
- Wood polymer products are comparably priced with premium decking lumber but in the long run will save you money on maintenance, replacements and sealants.

CHALLENGES OF USING ALTERNATIVE MATERIALS

- Trex® can begin to look like wet newspaper after a few months.

Alternative Deck Supply Companies

ChoiceDek®

A composite of 50 percent waste cedar fibers and 50 percent recycled plastic.
Manufacturer: A.E.R.T., Junction, TX, (800) 951-5117, www.choicedek.com

Trex®

A composite of 50 percent waste wood and 50 percent recycled plastic.
Manufacturer: Trex, (800) BUY-TREX, www.trex.com

TriMax®

A structural, 100 percent recycled plastic lumber.
Manufacturer: U. S. Plastic Lumber, www.trimax-products.com/index2.html

Nexwood®

A composite of 50 percent waste wood, 20 percent sawdust, and 30 percent virgin polyethylene
Manufacturer: Nexwood, 888-7NEXWOOD, www.nexwood.com

TimberTech®

A composite of 50 percent waste wood, 20 percent sawdust, and 30 percent virgin polyethylene.
Tongue and groove, planks or "TimberTopper" deck covers available.
Manufacturer: Crane Plastics, (800) 307-7780, www.timbertech.com

SmartDeck®

Complete system with rails, trim, fascia, posts, stairs, etc.
Durawood PE is 100 percent recycled plastic and Durawood EX is 60 percent sawdust/ 40 percent recycled plastic.
Manufacturer: US Plastic Lumber, (888) 7DECKING, www.smartdeck.com

StranDek®

A composite of 50 percent waste wood/50 percent recycled plastic.
Manufacturer: StranDek, (208) 888-6798, www.strandek.com

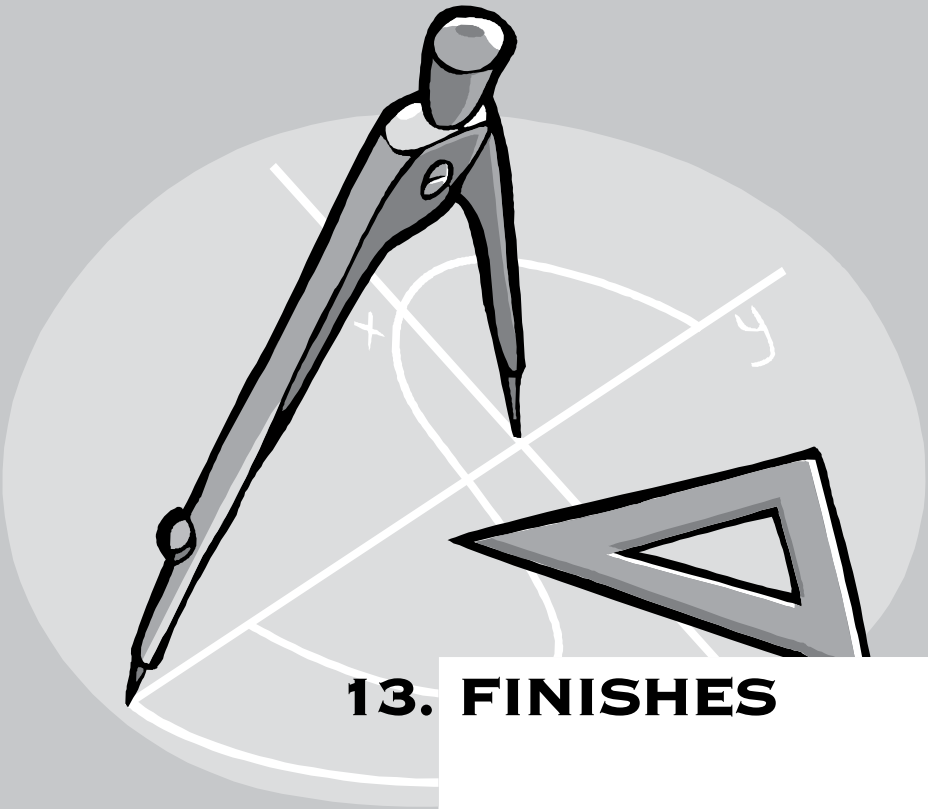
SOURCES

Building Technologies Program; Department of Energy
http://eere.energy.gov/buildings

The Green Good Life from The Independent Weekly, January 29, 2003:
www.indyweek.com/gyrobase/Content?oid=oid%3A18946

McGraw Hill Construction Network for Products Trex Company LLC:
http://products.construction.com/portal/server.pt?open=512&objID=204&PageID=249&cached=true&mode=2&src=C&companyId=NST50234

Deck Lumber Alternatives: A Factsheet from Austin Energy's Green Building Program



13. FINISHES

The finishes inside the home should have low toxicity to protect indoor air quality. Energy-efficient finish products are an important part of meeting green-building objectives and balancing integrated systems. Recycled products should be used whenever possible to conserve natural resources.

Installing energy-efficient appliances will increase the opportunity for the building to operate with reduced energy consumption. The sum of the purchase price and the energy cost of running appliances over its lifetime are called its lifetime cost. Lifetime costs of energy-efficient appliances are generally much lower than the cost of an average model.

A. ENERGY-EFFICIENT AND WATER-EFFICIENT APPLIANCES

There can be a significant difference in the energy consumption of appliances. EnergyGuide labels, found on all major appliances, can help you with your selection. The most efficient appliances are those that use the least amount of electricity and water to get a job done. Certain features of an appliance, such as the amount of flow allowed by a faucet or shower head, can also tell you a lot about its efficiency.

IMPLEMENTATION

Energy Star-qualified appliances use 10 to 50 percent less energy and water than standard models. The money saved on utility bills can more than make up for the cost of a more expensive but more efficient Energy Star model.

- Install ceiling fans in main rooms and bedrooms.
- Install front-loading clothes washers, which can bring a 50 percent savings in both energy and water use.
- Install fluorescent and compact fluorescent bulbs, or the Energy Star advanced lighting package.
- Install programmable thermostats.
- Install top-freezer model refrigerators, which outperform side-by-side models, or choose the most efficient partial automatic or manual defrost models.
- For outdoor lights, use photo cell, motion-detected, or solar-powered lighting; prevent up-lighting pollution; and use timed or automatic light switches.
- Install water-efficient shower heads, ideally those with a flow of less than 2.5 gallons per minute (gpm).
- Install faucets and aerators with flows less than 2.2 gpm.
- Install toilets with less than 1.6 gallons per flushes (gpf), or power-assist and dual-flush toilets.
- Install dishwashers that use less than 7 gallons of water per load.

B. PAINT

All oil- and many latex-based paints contain organic solvents that disperse and bind other paint components. These volatile organic compounds (VOC) are known to have bad effects on human health, and there is evidence that VOCs from paint contribute to ground-level smog. In response to such concerns, more governmental agencies are acting to limit the VOC levels in house paints and other common products.

Implementation

- Use low- or non-VOC paints and adhesives (do not exceed 100 grams per liter VOC).
- Avoid paints containing heavy metals and other health hazards.
- Use low-VOC wallpaper.
- Use recycled paint and paint primer with a minimum of 50% postconsumer content. There are two types of recycled-content paint: reprocessed and reblended.
- Provide good ventilation to ensure a minimum of exposed soft surfaces during installation.
- Take care to buy the right amount of paint in order to save money and prevent waste.

C. FLOOR FINISHES

Whether you are finishing floors with carpet, tile, wood, or other material, there are ways to lessen the environmental and human health impacts of the manufacture, installation, and use of floor finishes.

Implementation

- Design the building to use the structural floor as the finished floor to avoid the use of floor finishes altogether.
- Choose carpets that have high recycled content and are recyclable.
- Specify carpet tile instead of broadloom so that 100 percent of the carpet does not have to be removed when only 20 percent of it shows wear.
- Find carpet tile with low toxicity. For example, carpets made of recycled plastic.
- Use natural-fiber carpets such as sea grass carpet.
- Carpet underlayment should have recycled content and provide both insulation value (R-12) and sound barrier properties.
- Avoid solvent-based floor finishes that can cause air quality problems, and use alternatives such as water-based urethane finishes for wood floors.
- Choose durable flooring, avoid vinyl products, and choose alternatives such as cork, natural linoleum, recycled-content rubber, or chlorine-free polymer resin tile.
- With wood flooring, find locally or regionally grown and processed products if possible. Avoid endangered species of tropical woods. Alternatives such as bamboo (which is actually a grass) and cork are a strong and rapidly renewable substitute.
- When using ceramic tile, find products that have recycled content such as glass.
- Substitute particleboard with formaldehyde-free materials.
- Use exterior grade plywood for interior uses.
- Seal all exposed particleboard or medium-density fiberboard (MDF).
- Use no adhesives on finish flooring, or choose a non-VOC adhesive.

D. CABINETRY

Most conventional cabinets are made of hardwood, plywood, laminated or painted particle board, or medium-density fiberboard—all of which off-gas formaldehyde and other noxious or toxic gasses from the use of urea formaldehyde glue. Solvent-based adhesives used to attach a wood grain or veneer may also off-gas toxic fumes.

Implementation

- Use water-based exterior coatings.
- Use interior cabinet materials that have no added formaldehydes, such as Medite II, medium-density fiberboard, solid wood, metal, wheatboard, or glass.

BENEFITS OF USING GREEN FINISHES

- Many states offer rebates for purchasing energy-efficient appliances.
- Many states offer income-tax credit or elimination of state sales tax for purchase of high-efficiency appliances.
- Since burning oil or gas in the furnace creates CO^2 directly, choosing a more efficient furnace will reduce this pollutant from the home by about one ton per year.
- New energy-efficient furnaces will save about 800 kWh per year.
- Inhabitants can save about $65 per year through reduced electric bills by using energy-efficient models.
- Zero- or low-VOC paints and adhesives improve indoor air quality, reduce smog, and are healthier for installers and occupants.
- Sealing particleboard assures the long-term availability of these precious woods while protecting ancient, old-growth forests.
- Using finger-jointed trim uses material more effectively, saves money and resources, and is straighter and more stable than conventional clear wood.

FORMALDEHYDE is a colorless strong-smelling gas widely used in the manufacture of building materials and household products. Its most common use is as a glue resin in pressed wood products. At high levels, formaldehyde can cause acute health effects: It has caused cancer in lab animals and may cause cancer in humans.

CHALLENGES OF USING GREEN FINISHES

- More efficient or less toxic products may be more expensive than conventional ones.

SOURCES

RSMeans, *Green Building: Project Planning & Cost Estimating* (Contributing Authors, 2002)

Energy Builder: www.energybuilder.com/greenhome-basics.htm

City of Austin: www.ci.austin.tx.us

Green Building Guidelines for New Home Construction: www.sfenvironment.com/aboutus/innovative/greenbldg/tools/newhome_8.pdf

Sustainable Building Products and Materials, Minnesota Office of Environmental Assistance: www.moea.state.mn.us/greenbuilding/products.cfm

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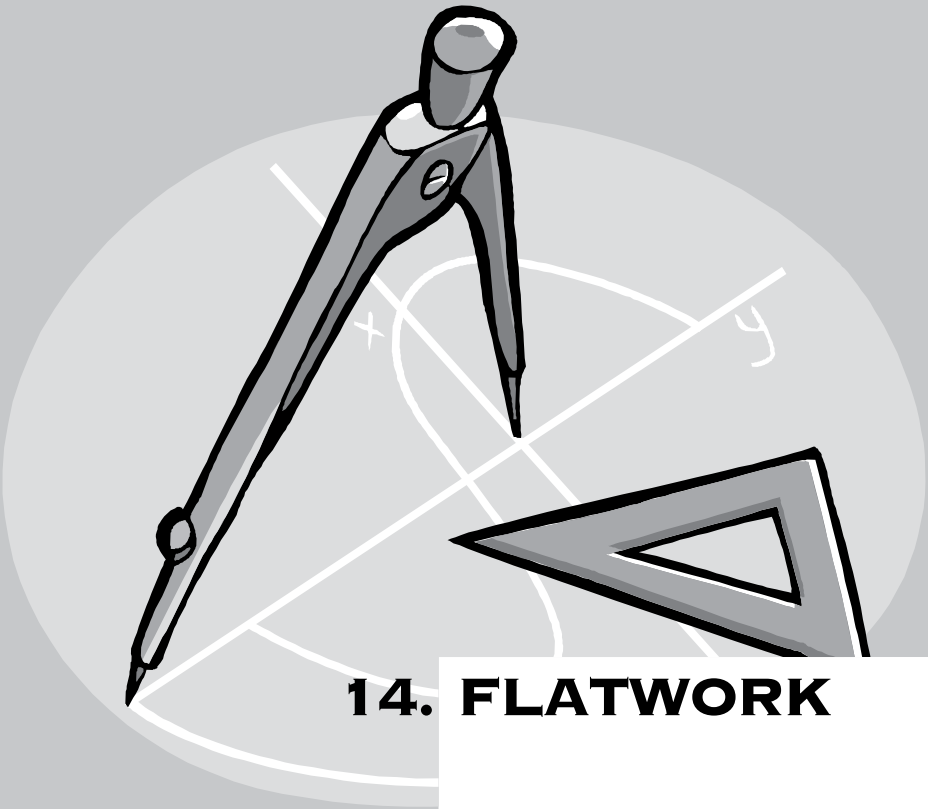
Energy Star: www.energystar.gov

Green California, Environmentally Preferable Purchasing *Best Practices Manual*: www.green.ca.gov/EPP/Introduction/default.htm

IAP Fact Sheet, *Formaldehyde*: www.nsc.org/ehc/indoor/formald.htm



14. FLATWORK

FLATWORK

Decorative concrete flatwork can be used as an affordable alternative to brick or flagstone and can be used for driveways, sidewalks and patios. Since concrete can be recycled, you will be able to find it locally.

Concrete's initial costs can be higher than other materials, but its lifecycle costs are much lower than competing materials due to maintenance costs. This means the inhabitants will save money down the road.

IMPLEMENTATION OF GREEN FLATWORK PRACTICES

- Add fly ash to concrete for a fly ash content of at least 40 percent.
- Use Eco-Crete, or other pervious concrete, for paths, sidewalks, and driveways.
- Use natural crushed stone, pervious pavers, or Eco-Crete in lieu of cement.
- Use local materials.
- Use light-colored or natural-colored materials.

BENEFITS OF GREEN FLATWORK PRACTICES

- Concrete stands up to natural disasters, wind-driven rain, moisture damage, and vermin. Less replacement means reduced resource requirements.
- Using light- or natural-colored material helps reduce the heat island affect.
- Concrete is commonly recycled in urban areas into fill and road base material at the end of service life. Materials are usually extracted and manufactured locally.

CHALLENGES OF GREEN FLATWORK PRACTICES

- Initial costs may be higher.

SOURCES

Portland Cement Association, *The Concrete Thinker*. www.concretethinker.com/Papers.aspx?DocId=249

15. SUSTAINABLE LANDSCAPING

SUSTAINABLE LANDSCAPING

The landscaping surrounding a home can protect and preserve ecosystems as well as add beauty and grace to the structure. Thinking about the natural community surrounding the construction site will enable you to integrate sustainable landscaping approaches throughout the construction process. Creating protection zones from the beginning phases of construction for large sections of plants, not just individual trees, will be beneficial. Natural areas can help capture storm water and prevent it from causing erosion during construction. Preventing soil compaction allows the soil to remain porous so it can absorb the storm water. This can be achieved by placing protection barriers beyond tree-drip lines and by not parking vehicles or equipment, or storing heavy materials, within the root zone of trees. All staging areas should be located away from trees.

Where you place trees is also important, as it can have a huge effect on energy efficiency. For instance, if evergreens are placed on the north side of a building and deciduous trees on the south side, the trees help to maximize the use of the sun's energy in winter and minimize the effects of heating in the summer while gaining a winter windbreak. In addition, a dense hedge or tree planted on the west side of a house can provide shade and deflect westerly winds in the winter. In contrast, a loose-foliage tree planted on the east side of a house allows some protection from the sun in summer but lets in winter sun.

IMPLEMENTATION OF SUSTAINABLE LANDSCAPING

- Create a plant protection zone.
- Protect trees by fencing during construction at the drip line.
- Shade west and east sides of house with trees or trellises on at least 50 percent of wall area.
- Trunks and stems of plants and trees should be a minimum of 36 inches from the foundation.
- Retain existing trees and vegetation (50 percent of vegetation retained in pervious area).
- Avoid trenching within the drip line of any mature tree.

- Move existing plants rather than cutting down existing plants. (This helps save money on plant purchases.)
- Use landscaping plants that are native (instead of ornamental turf grass), and from the city's approved list. These native plants (for example, native fescue grass) will often be less expensive and will require less or no watering.

- Use water-wise plants such as coreopsis, yarrow, verbena, ceanothus, buddleia, lavender, rosemary, and Russian sage, which need little supplemental water to survive.
- Use a low-volume irrigation system if necessary, such as a drip-soak system, not a spray one, and time it to come on at night, when less water will evaporate from the sun.
- Use edible plants in place of nonedible landscaping (for example, geographically appropriate fruit trees).
- Harvest plants by inviting plant-rescue groups to harvest plants prior to site clearing.
- Mulch all beds (all open soil) with a minimum of two inches of plant-based mulch.
- Planting beds should have at least 6 inches of good topsoil (a proper mix of sand, clay, organic material).

- Provide a backyard compost bin.
- Use terracing, retaining walls, and swales to reduce long-term erosion and allow more water to soak in.
- Minimize the amount of lawn needed, as lawns require extra maintenance and use unnecessary fossil fuel mowers. One to two thousand square feet of lawn, or less, is adequate.

BENEFITS OF SUSTAINABLE LANDSCAPING

- Replacing turf grass with native plants can save water, help avoid the need for fertilizer, and save money.
- Using native plants will reduce yard maintenance.
- Shade trees can reduce ambient air temperature by 15 degrees.
- Planting shade trees will cut down cooling costs.

CHALLENGES OF SUSTAINABLE LANDSCAPING

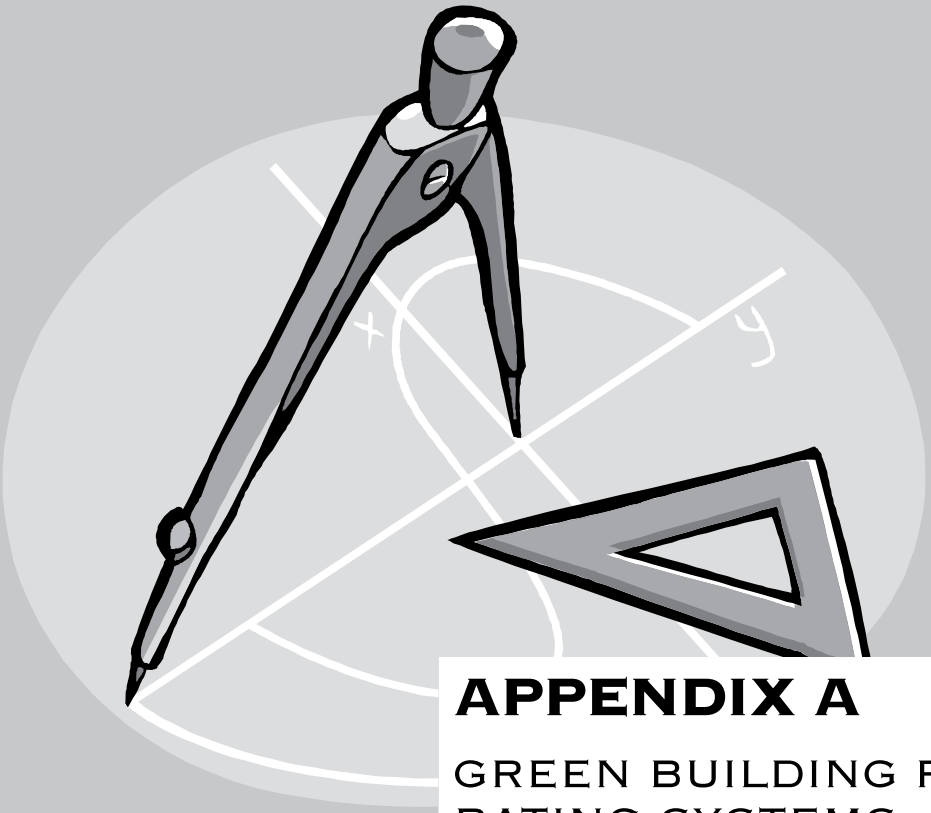
- Having an agreed-to plan before the final grading is done.
- Providing a modest amount in the budget for landscaping.

SOURCES

RSMeans, Green Building. *Project Planning and Cost Estimate* (Contributing Authors, 2002)

Recycle Works: A program of San Mateo County. http://recycleworks.dev.ikorb.com/greenbuilding/sus_plantings.html

Environmental Assistance, *Building an Eco-home*. www.recycleworks.org/greenbuilding/sus_landscape.html



APPENDIX A

GREEN BUILDING PROGRAMS AND RATING SYSTEMS

APPENDIX A
GREEN BUILDING PROGRAMS AND RATING SYSTEMS

In 1993, the U.S. Green Building Council (USGBC) developed the Leadership in Energy and Environmental Design (LEED) system, a voluntary consensus-based national rating system for developing high-performance, sustainable commercial buildings.

Today, over 80 municipal and state green-rating systems have been developed, and while there is a great deal of variation in the structure and administration of these programs, most of them focus on residential buildings, usually single-family homes.

In addition, the U.S. EPA and DOE's Energy Star Homes and the National Association of Homebuilders have both developed national standards by which greenness can be measured and compared.

This is a list of a few green-building programs that you can contact for assistance. Each has a point-based rating system for builders to plan and measure their green building achievements. In addition to these programs, there are many resources available for green guidelines, incentives programs, professionals, and products. Please refer to the *YouthBuild Green Pages* resource manual for a more comprehensive listing.

NATIONAL PROGRAMS

U.S. Green Building Council Leadership in Energy and Environmental Design (LEED) for Homes
www.usgbc.org/DisplayPage.aspx?CMSPageID=147
(202) 828-7422
leedinfo@usgbc.org

National Association of Home Builders (NAHB)
www.nahbrc.org
(301) 249-4000, (800) 638-8556

Enterprise Green Communities
www.greencommunitiesonline.org
(410) 715-7433
greencommunities@enterprisecommunity.org

REGIONAL PROGRAMS

California & Hawaii

Home Energy Rating System (HERS) Program
www.energy.ca.gov/HERS/index.html
(916) 654-5106
bpenning@energy.state.ca.us

Mid-Atlantic & Northeast Region

The Northeast Home Energy Rating System (NEHERS) Alliance
www.energyratings.org/default.htm
information@energyratings.org

Midwest Region

Green Built Home (Wisconsin)
www.greenbuilthome.org
(608) 280-0360
webmaster@greenbuilthome.org

Northwest Region

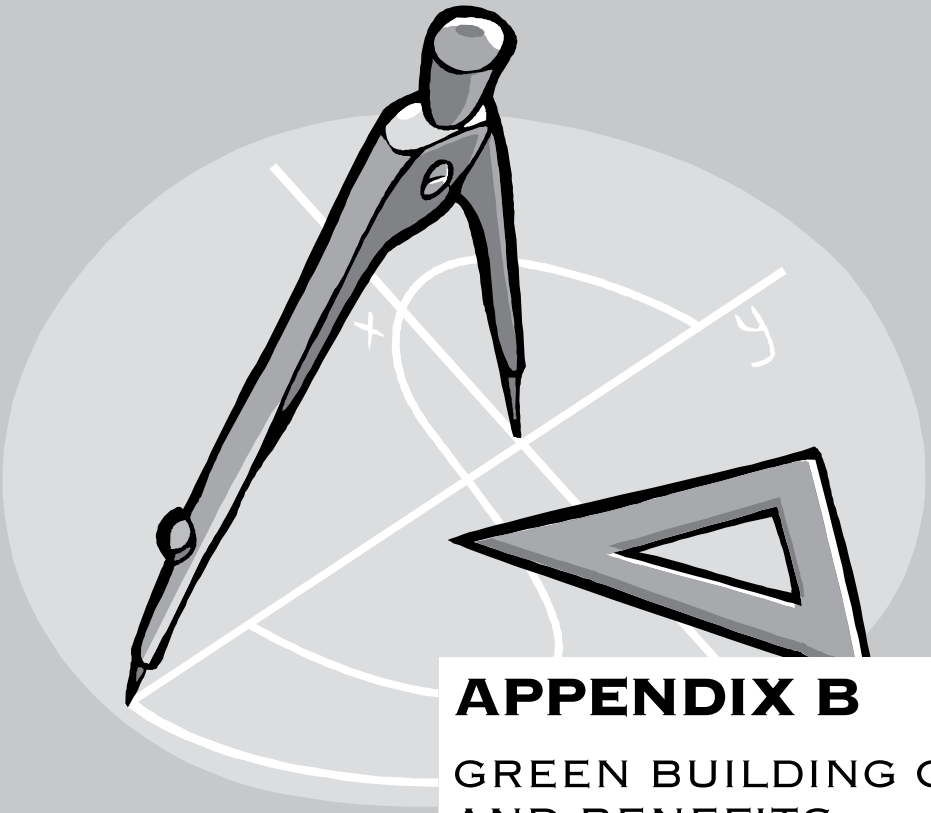
Office of Sustainable Development G/Rated Green Building Incentive Program (Portland, Oregon)
www.portlandonline.com/osd/index.cfm?c=41591

Southwest

Green Building Program (Austin, Texas)
www.austinenergy.com
(512) 482-530

Southeast

Southface Energy Institute (Atlanta, GA) EarthCraft Housing
www.southface.org
(404) 872-3549
info@southface.org



APPENDIX B

GREEN BUILDING COSTS AND BENEFITS

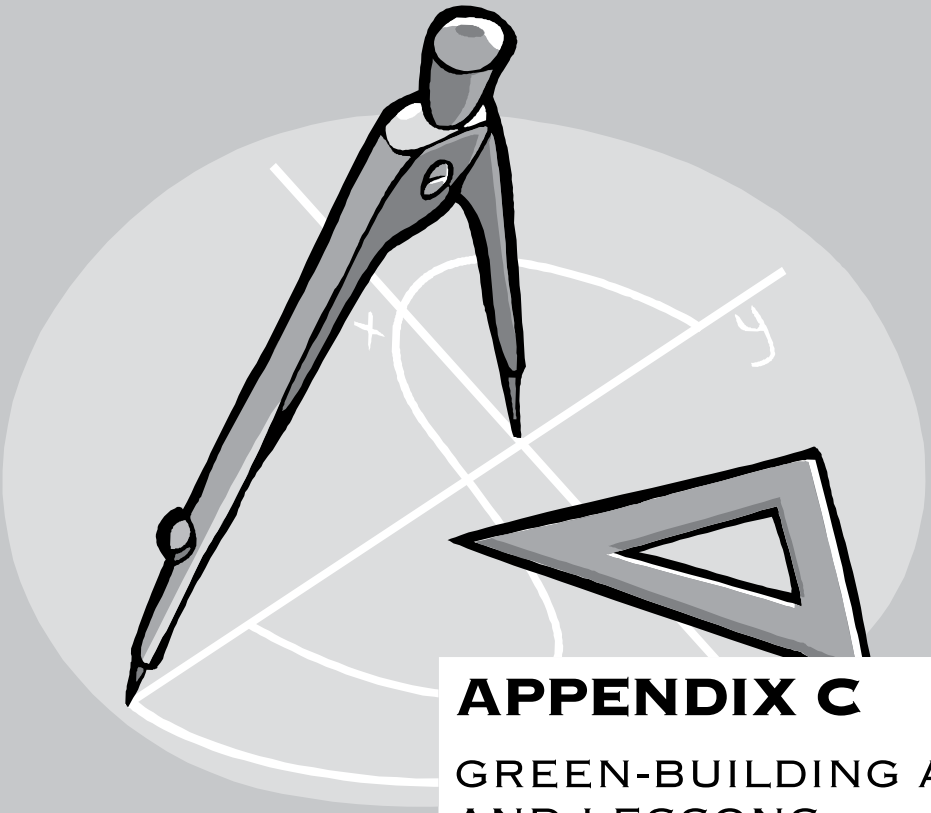
APPENDIX B
GREEN BUILDING COSTS AND BENEFITS

A common perception is that green costs more and is therefore not suitable for affordable housing. The good news is that this perception in not entirely true. Of course there are alternative materials and technologies that can add significant costs to a building, but there are also green-building techniques that cost nothing, or could save on construction costs. For example, advanced framing techniques can reduce the use of dimensional lumber and save a builder 20 to 32 percent in framing costs. Another example of a no-cost green-building technique is the installation of ductwork in the building's conditioned space. This simple low- to no-cost implementation can make a huge impact on energy savings.

Most recent studies of the costs and benefits of green building have been encouraging to skeptics. Specific to the affordable housing sector, New Ecology and The Green CDCs Initiative studies green affordable housing projects around the country and recently published a detailed case study analyses of the costs and benefits of sixteen such projects. Total development costs for the green projects reviewed in this report ranged from 18 percent below to 9 percent above the costs for comparable conventional affordable housing. The projects that were able to reduce their overall building costs by building green were mostly able to do so because green building and the use of renewable energy gave them access to rebates and other incentives. On average, the sixteen case studies show a small "green premium" of 2.42 percent in total development costs. These incremental costs are largely due to increased construction (as opposed to design) costs.

Further analysis of these case studies led to several key findings, including:

- Community development corporations (CDCs) and other mission-driven community-based organizations are natural leaders in the effort to build green affordable housing.
- The current overemphasis on the initial capital costs of green affordable housing is deeply flawed. Life-cycle costing, in which both capital and operating costs are considered over the expected life of a building, provides a fairer analysis of project economics.
- Using a life-cycle approach, green affordable housing is more cost-effective in net present value (NPV) terms than conventional affordable housing.
- The existing financing system for affordable housing is complex and rigid, and typically does not recognize the long-term value of green investments. This serves as an impediment to widespread development of green affordable housing.



APPENDIX C

GREEN-BUILDING ACTIVITIES AND LESSONS

APPENDIX C
GREEN-BUILDING ACTIVITIES AND LESSONS

Finding True South: Sea Education Association

www.sea.edu/academics/k12.asp?plan=truenorth

How to Map Shade Patterns: Eyes on The Sky, Feet on the Ground

http://hea-www.harvard.edu/ECT/the_book/Chap1/Chapter1.html#csdtd

Measuring Existing Trees'Sizes: Math Forum

http://mathforum.org/paths/measurement/tree.html

Testing Soil: Discovery Channel

http://school.discovery.com/lessonplans/programs/flood/

Forestry Supplier

www.forestry-suppliers.com/s01_pages/lessonplan_htmpages/58_soilph.asp

Measuring Roof Temperatures: Clean Air Campaign

www.cleanaircampaign.com/content/download/634/5281/file/cac_lesson_plan_8earth_Heat_Islands.pdf

Focusing on Math to Measure CO_2 Emissions

www.eduplace.com/activity/global_warming.html

Educating about and then determine ADA accessibility; Education World

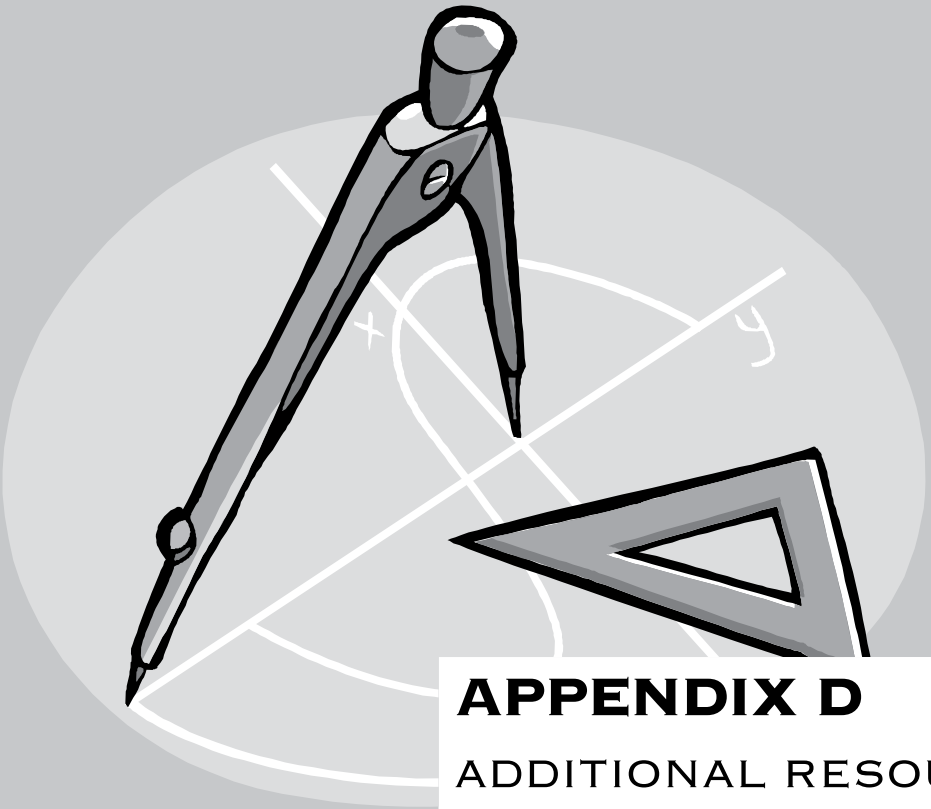
www.education-world.com/a_lesson/lesson115.shtml

Teaching about Composting & Compost Bin Design: The Green Team

www.thegreenteam.org/pdf/AdditionalLessonPlan-Compost.pdf

Window and Door Placement: What a view!

http://dnr.louisiana.gov/sec/execdiv/techasmt/ecep/constr/d/d.htm



APPENDIX D

ADDITIONAL RESOURCES

APPENDIX D
ADDITIONAL RESOURCES

Design, Layout, and Infrastructure

Design Charrette

The *YouthBuild Innovations* article "Cobb County YouthBuild design charrette sparks student creativity, increases knowledge of sustainable building practices" (issue 18, July 2005) describes a YouthBuild charrette run in partnership with the Atlanta chapter of the American Institute of Architects and Southface Institute.

The article is available online at www.youthbuild.org: Click on Knowledge Bank, then search for the phrase "issue 18" using the Exact Phrase option (but no quotation marks).

Building Material Reuse Enterprise

"ReCycle North integrates YouthBuild into social enterprise; promotes green building, sustainability, and job readiness." (*YouthBuild Innovations*, issue 23, February 2006)

The article is available online at www.youthbuild.org: Click on Knowledge Bank, then search for the phrase "issue 23" using the Exact Phrase option (but no quotation marks).

Green Building Guidelines: Meeting the Demand for Low-Energy, Resource-Efficient Homes

This is an easy-to read, builder-friendly text that is applicable to homebuilders across the nation. The manual is published by the Sustainable Buildings Industry Council and can be ordered online at www.sbicouncil.org/store/gbg.php

Life Cycle Cost Analysis Handbook

A PDF of this handbook is availabe at www.eed.state.ak.us/facilities.

Energy calculator

The calculator is on the home page of the Home Energy Saver program: http://hes.lbl.gov/

Building and Buying Green in Indian Country: A Practical Guide for California Tribes (May 2004)

The California Integrated Waste Management Board describes their guide as "a comprehensive guide providing tribal project decision makers and planners with an overview of green-building practices to help them evaluate and choose sustainable options as they develop projects with architects, contractors, suppliers, or other building professionals. The guide offers a range of ideas for any type of building project in any climate."

The guide is available free at www.ciwmb.ca.gov/Publications/default.asp?pubid=1069.

Lot Selection

Efficient Windows Collaborative

www.efficientwindows.org

San Antonio Business Journal In Depth: Engineering and Architecture (Aug. 27, 2004)

Discussion of site selection: www.buildsagreen.org/news/biz8-27-04.htm

Pollution Prevention Information Center

For further discussion of residential lot development and site selection techniques: http://peakstoprairies.org/topichub/subsection.cfm?hub=31&subsec=9&nav=9&CFID=2551920&CFTOKEN=78190766

Low-Impact Lot Development

Low Impact Development Center

www.lowimpactdevelopment.org

NAHB Research Center Toolbase Services

www.toolbase.org

U.S. Green Building Council LEED certification rating system

Version 2.0, June 2001

Funding for Brownfield Development

www.hsrc.org/hsrc/html/tosc/sswtosc/finance.html#funding

Reuse and recycling overview

www.ciwmb.ca.gov/Condemo/default.htm

Earth 911

Earth 911 lists local places to recycle various items, including construction and demolition waste.

www.earth911.org

Building Foundations

Fly ash concrete

www.toolbase.org/techinv/techDetails.aspx?technologyID=217

www.netl.doe.gov/publications/proceedings/03/ubc/ubc03.html

Raised floors

www.raisedfloorliving.com/footings.shtml

General foundation considerations

www.fsboadvertisingservice.com/home-inspector-4.htm

Glossary of building science terms

www.homes-across-america.org/PDF/HAAGlossary.pdf

The Natural Home Building Source

www.thenaturalhome.com/passivesolar.html

Home Plan Service Design Basics

www.designbasics.com/altcon/altcon-01.asp

Choosing a Basement Wall System
(*Home Energy Magazine Online*)

www.homeenergy.org/archive/hem.dis.anl.gov/eehem/99/990311.html

Floor Framing and Subfloor

Green Remodeling Illustrations

This chapter from *Home Remodeling: Green Building Guidelines* is available as a PDF from Almeda County's Stop The Waste Web site.

www.stopwaste.org/docs/remodeler-c5.pdf

Summary of Green Building Benefits

This chapter from *New Home Construction: Green Building Guidelines* is available as a PDF from the San Francisco Environment Web site.

www.sfenvironment.com/aboutus/innovative/greenbldg/tools/newhome_8.pdf

Forest Certification Resource Center, Comparison of Forest Certification Systems

www.certifiedwood.org

The Sustainable Forestry Initiative Program

www.sfiprogram.org

The American Tree Farm System

www.treefarmsystem.org

Forest Stewardship Council (FSC)

www.fsc.org

Program for the Endorsement of Forest Certification Systems (PEFC)

www.pefc.org/internet/html

Advanced Wall Framing

International Residential Code

According to ToolBase Services (toolbase.org), "the 2003 International Residential Code contains prescriptive methods for building wood panel box headers in section 602.7.1. Table 602.7.2 indicates that wood panel box headers that are 9 inches deep and sheathed on both faces can support a 28-foot roof truss and clear span a 5-foot opening. Several other depths, spans, and load conditions are laid out in the table."

International Code Conference, 2003 International Residential Code®, Panel Box Headers, Table R602.7.2, pg. 123, and Fig. R602.7.2, pg. 124

Building Science's Web Site

www.buildingscience.com/housesthatwork/advancedframing/default.htmp

www.buildingscience.com/resources/presentations/advanced_systems_engineering_hfh.pdf

ToolBase's Web Site

Search on Advanced Framing Technique to find a number of papers on OVE including assessments of techniques.

www.toolbase.org

Building Envelope

U.S. Department of Energy

www.eere.energy.gov/EE/buildings_envelope.html

Envelope Design Resources

www.energydesignresources.com/category/buildingenvelope

Minnesota Office of Environmental Assistance

www.moea.state.mn.us/greenbuilding/products.cfm

Green Building Program: Casa Verde Green building Case Study

www.americanyouthworks.org/cvb/greenconstruction/frontpage.htm

The Energy Wise House: Building with Insulated Concrete Forms

www.bobvila.com/HowTo_Library/EnergyWise_House_Building_with_Insulated_Concrete_Forms-New_Walls-A1627.html

Gypsum adobe construction technology

www2.itu.edu.tr/~isikb/Tech1.htm

Structural Insulated Panels

Examples of technologies in practice

www.toolbase.org for more

SIP construction training

www.sipschool.org

SIP construction steps (Flash presentation)

www.ibpanels.com/flashbuildit.php

Roofing

Guidelines for installing and bracing wood trusses

www.owtfa.com/installation_bracing.htm

Extensive resources on wood trusses

www.alpeng.com/wood_truss_info.html

Rainwater catchments systems

www.oas.org/dsd/publications/Unit/oea59e/ch10.htm

Benefits of wood framing

Several publications (PDFs) on wood framing are are offered by the Canadian Wood Council.

www.cwc.ca/Publications/PDF%20Publications/?Language=EN

Radiant barriers

www.ornl.gov/sci/roofs+walls/radiant/index.html

The best energy-saving metals in your area

www.metalroofing.com/v2/content/manufacturer/index.cfm

Exterior Finishes

The negative aspects of vinyl

www.watoxics.org/issues/vinyl-pvc

Plumbing, Electrical, and Mechanical

Partnership for Advancing Technology in Housing

www.pathnet.org

Gas Appliance Manufacturers Association

www.gamanet.org

U.S. Environmental Protection Agency's Energy Star program

www.energystar.gov

U.S. Department of Energy's Federal Energy Management Program

www.eere.energy.gov/femp

California Energy Commission's ~~High Performance Buildings Institute~~

www.energy.ca.gov

Air-Conditioning and Refrigeration Institute

www.ari.org

"Homemade Solar Water Heater"

Article from *Mother Earth News*

www.motherearthnews.com/library/1979_September_October/A_Homemade_Solar_Water_Heater

Solar radiation basics

www.toolbase.org/TechSets/solar-home

Interior Finishes

EBuild Energy Efficient Products

http://energy-efficient products.ebuild.com/guide/products/default.asp

Concrete Flatwork

Using recycled content

www.nahbrc.org/greenguidelines/userguide_resource_recycled.html

for information on resource efficiency throughout the building process.

www.nahbrc.org/greenguidelines/userguide_section2.pdf

Sustainable Landscaping

Software on regional water-wise plants

www.thewaterwisegarden.com

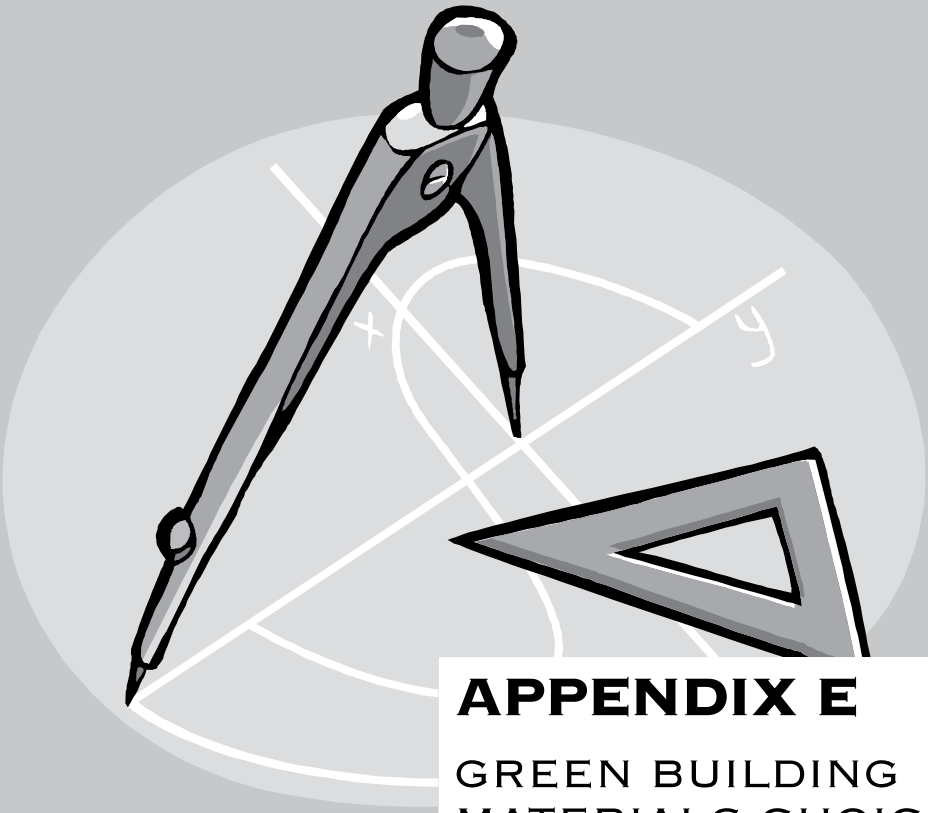
Sustainable landscaping standards and practices

www.owendell.com/standards.html

Composting and Compost Bin Design

The Green Team is an interactive educational program that empowers students and teachers to help the environment through waste reduction, reuse, recycling and composting. Check out their PDF guide on designing compost bins:

www.thegreenteam.org/pdf/AdditionalLessonPlan-Compost.pdf



APPENDIX E

GREEN BUILDING MATERIALS CHOICES

APPENDIX E
GREEN-BUILDING MATERIALS CHOICES*

*YouthBuild USA does not endorse any of the individual companies or services listed in this manual.

Ready-mix Concrete

Concrete mix design

Fly Ash Content: Minimum 25 percent of cementitious materials by weight. Slag content: Substitute 50 percent of Portland Cement

GranCem Cement
by Holcim-US
Dundee, Michigan
www.holcim.com
(800) 854-4656

Curing and protection agent

Low or non-VOC agents

SealTight Green Line
by W.R. Meadows
Hampshire, Illinois
www.wrmeadows.com
(800) 342-5976

MasterCure 100/200
by BASF
Shakopee, Minnesota
www.chemrex.com
(800) 433-9517

Cure and Seal
by Natural Soy
Watkins, Iowa
www.iasoybeans.com
(888) 655-0039

SoySolv concrete curing Ccompound
by SoySolv
Tiffin, Ohio
www.soysolv.com
(800) 231-4274

Expansion joint filler

Recycled filler material

Homex 300
by Homasote,
West Trenton, New Jersey
www.homasote.com
(800) 257-9491

Dimension Lumber

Forest Stewardship Council (FSC) "chain of custody" wood certification

FSC-US
www.fscus.org
(877) 372-5646
www.certifiedwood.org

Tembec Inc.
Témiscaming, Quebec, Canada
www.tembec.com
(819) 627-4741

Construction Panels

Forest Stewardship Council (FSC) "chain of custody" wood certification

FSC-US
www.fscus.org
877-372-5646
www.certifiedwood.org

Tuff Strand FSC-certified oriented strand board
by Roy O. Martin Lumber Management LLC
Alexandria, Louisiana
www.martco.com
(800) 299-5174

AdvanTech oriented strand board
by Huber Engineered Woods
Charlotte, North Carolina
www.huberwood.com
(800) 933-9220

Shiplap Sheathing Boards

Forest Stewardship Council (FSC) "chain of custody" wood certification.

by FSC-US
www.fscus.org
(877) 372-5646
www.certifiedwood.org

PRODUCT NAME?

by Menominee Tribal Enterprises
Neopit, Wisconsin
(715) 756-2311
www.mtewood.com

Factory Wood Treatment

ACQ or non-CCA arsenic-free pressure-treated wood

Preserve

by Viance
Charlotte, North Carolina
www.treatedwood.com
(800) 421-8661

Heavy Timber Structural Units

Laminated strand timber

Parallam PSL

by TrusJoist/Weyerhaeuser Heavy Timber

www.ilevel.com/walls/w_ParallamPSL_columns.aspx

(888) 453-8358

Fabrication equal to:

Product Name

by Pocoposon Timber Works
Pocopson, Pennsylvania
(800) 416-2818
www.timberworks.com

Product Name

by IWS Wood Products
Mindemoya, Ontario, Canada
(705) 377-5184

Glue-laminated Structural Units

Forest Stewardship Council (FSC) "chain of custody" wood certification.

by FSC-US
www.fscus.org
(877) 372-5646
www.certifiedwood.org

Weyerhauser Glu-Lam Division
704-357-3291

Fabrication equal to:

Standard Structures Inc.
Santa Rosa, California
www.standardstructures.com
800-862-4936

Panel And Sheet Materials

Wood-product sheet materials certified to be urea-formaldehyde free

Medite

by Sierra Pine
Roseville, California
www.sierrapine.com
(800) 676-3339

IsoBord Agri-board

by IsoBord Enterprises
Portland, Oregon
www.isoboard.com
(503) 242-7345

ResinCore phenolic particleboard

by Rodman Industries
Marinette, Wisconsin
www.rodmanindustries.com
262-569-5820

CollinsWood FSC-certified particleboard

by The Collins Comanies
Klamath Falls, Oregon
www.collinswood.com
800-547-1793

EPP panels

by Panel Source International
St. Albert, Alberta, Canada
(780) 458-1007
www.panelsource.net

Custom Cabinets

Forest Stewardship Council (FSC) "chain of custody" wood certification.

by FSC-US
www.fscus.org
(877) 372-5646
www.certifiedwood.org

LSI cabinets

by LSI Corporation of America
Minneapolis, Minnesota
(612) 559-4684
www.lsi-casework.com

Neil Kelly Cabinets Naturals Series

Neil Kelly Cabinets
Portland, Oregon
www.neilkellycabinets.com
(503) 335-9207

Countertop and Laminate Materials

Recycled countertop material

shetkaSTONE

by ShetkaWorks
LeCenter, Minnesota
(507) 357-4177
www.shetkastone.com

Roof Ice and Water Shield Underlayment

Recycled-content membrane

Drake's "Life Seal" peel-and-stick recycled rubber underlayment

by StrongSeal Rubberized Products
Winter Park, Florida
(407) 629-8282

Rigid Board Insulation

Extruded Polystyrene Board Insulation (XPS): ASTM C 578, type X

Styrofoam

by the Dow Chemical Company
www.dow.com/styrofoam/

Expanded Polystyrene Insulation (EPS)

Plymouth Foam

by Plymouth Foam
Plymouth, Wisconsin
(800) 669-1176
www.plymouthfoam.com

Blown Wall Insulation

Cellulose

ASTM C 739, modulated for pour and bulk pneumatic placement.

Wet-spray method application

Home insulation

Home Insulation Company of Wausau
Mosinee, Wisconsin
(715) 359-6505

Dense-pack method application

Dry Pac Wall System

by Par/PAC
South Bristol, Maine
(877) 937-3257
www.parpac.com

Fiberrific

A proprietary system of chopped fiberglass blowing insulation, adhesive, and containment netting

by Ark-Seal
Denver, Colorado
(800) 525-8992
www.fiberiffic.com

BIBS application

Renken Insulation
by Renken Insulation
Stevens Point, Wisconsin
(715) 345-0240
www.renkeninsulation.com

Blown Attic Insulation

Cellulose

ASTM C 739, modulated for pour and bulk pneumatic placement

Applegate Insulation
by Applegate Insulation
Webberville, MI
(800) 627-7536
www.applegateinsulation.com

Weather Blanket
by Champion
Fond du Lac, Wisconsin
(920) 322-8977

Batt Insulation

Fiberglass

Use only at the top of a wall-roof intersection in conjunction with insulation dam,or in limited areas where hand application is required around rough openings, etc.

Non-formaldehyde binder

Thermal-SHIELD Free
by Johns Manville
Denver, Colorado
(800) 654-3103
www.jm.com

GreenGuard
by Knauf Insulation
Shelbyville, Indiana
(800) 825-4434
www.knaufusa.com

Foam-in-place Insulation

HCFC-free open-cell polyurethane

For wall-spray applications.

Icynene Insulation System
by Icynene
Mississauga, Ontario, Canada
www.icynene.com
(800) 758-7325

Vapor Barrier/ Retarder

4-mil Tu-Tuf cross-laminated polyethylene

ShelterTuf
by Shelter Supply
Burnsville, Minnesota
(877) 207-7043
www.sheltersupply.com

Air Barrier Building Wrap

Tyvek HomeWrap
by DuPont
(800) 441-7515
http://www2.dupont.com

Airtight Electrical Box Enclosures

Lessco polyethylene vapor barrier box
from Shelter Supply
Burnsville, Minnesota
(877) 207-7043
www.sheltersupply.com

Seam Sealing Tape and Caulk

**3M 8086 (8087?)
Construction Seaming Tape**
by 3M
www.3m.com

Conserv Products' "Insul-Tape"
(see 01050 Suppliers)

Tremco nonhardening acoustical sealant
by Tremco Sealants
(800) 321-7906
www.tremcosealants.com

Air-Vent Insulation Baffles

Expanded Polystyrene EPS (non-XPS) recycled materials

Durovent and Provent
by ADO Products
Rogers, Minnesota
(866) 240-4933
www.adoproducts.com

Perma-Vent
by Cellofoam
Conyers, Georgia
(800) 241-3634
www.cellofoam.com

StyroVent
by Diversifoam Products
Rockford, Minnesota
(800) 669-0100
www.diversifoam.com

Vent-Rite attic vents
by Plymouth Foam
Plymouth, Wisconsin
(800) 669-1176
www.plymouthfoam.com

Recycled cardboard materials

Insul-Tray
by Insulation Solutions
East Peoria, Illinois
(866) 698-6562
www.insulationsolutions.com

Metal Roofing

Custom site-formed flat-panel standing seam, galvanized steel, galvalume, or painted steel.

Site fabrication & installation

John Golke Roofing
Waupaca, Wisconsin
(715) 258-8690

Golke Brothers Roofing
Waupaca, Wisconsin
(715) 258-4800

Stichert Roofing
Chile, Wisconsin
(715) 683-2490

Culpitt Roofing
West Salem, Wisconsin
(608) 786-0660

Preformed flat panel standing seam, galvanized steel, galvalume, or painted steel

PAC-CLAD
by Peterson Aluminum
Elk Grove Village, Illinois
(800) 722-2523
www.pac-clad.com

ATAS metal roof products
by ATAS
Allentown, Pennsylvania
(800) 468-1441
www.atas.com

AEP-SPAN metal roofing systems
by AEP-SPAN
Dallas, Texas
(800) 527-2503
www.aep-span.com

CENTRIA Galvalume
by Centria
Moon Township, Pennsylvania
(800) 759-7474
www.centria.com

Composite Roofing Shingle

100% recycled-content plastic

Majestic Slate
by EcoStar
Carlisle, Pennsylvania
www.premiumroofs.com
(800) 211-7170

EnviroShake
by Wellington Polymer Technology
Chatham, Ontario, Canada
(866) 423-3302
www.enviroshake.com

Progress Plastic Roofing Shingles
by Inteq
Eastlake, Ohio
(440) 953-0550

Authentic Roof 2000
by Crowe Building Products
Hamilton, Ontario, Canada
(905) 529-6818
www.authenticroof.com

Welsh Simulated Shake Shingles
by Welsh Mountain Slate
Campbellford, Ontario, Canada
www.welshmountainslate.com
(800) 865-8784

Fiber-Cement Siding, Fascia, and Trim

Non-Asbestos Fiber-Cement siding, ASTM C1186 Grade II

HardiePlank, HardiePanel, HardieTrim
by James Hardie Building Products
Mission Viejo, California
(866) 442-7343
www.jameshardie.com

Ridge Vents

External wind baffle with internal weather filter to deflect rain, snow, dust, or insects.

Air Vent ridge vents
(ShingleVent II, Multi-pitch FilterVent, Peak FilterVent, FlashVent)
by Air Vent
(800) 247-8368
www.airvent.com

At wall-roof intersections, such as clerestories, use HalfVent.

Caulk Joint Sealants

Low or non-VOC sealants

Quick Shield VOC-free sealant
by Geocel
Elkhart, Indiana
www.geocelusa.com
(800) 348-7615

Epoxy caulking compound #930
by Johnsonite
Chagrin Falls, Ohio
(800) 899-8916
www.johnsonite.com

Liquid Nails Super Caulk (LC-130)
Painters Caulk (LC-135)
by Maaco Adhesives
Cleveland, Ohio
(800) 634-0015
www.liquidnails.com

OSI Pro-Series Latex Caulk
(PC-158, SA-167)
by OSI Sealants
Mentor, Ohio
www.osisealants.com
(800) 624-7767

AC20 Acoustical and Insulation Sealant
Silicone Sealants 864, 890, & 895
Urexpan NR-200 & 201 Polyurethane Sealant Urethane
by Pecora
Harleysville, Pennsylvania
(800) 523-6688
www.pecora.com

Phenoseal Sealant

by Phenoseal
Franklin, Massachusetts
(800) 327-3339
www.phenoseal.com

TremFlex 834
Spectrem 1

by Tremco
Beachwood, Ohio
(866) 286-8273
www.tremcosealants.com

Foam Joint Sealants

Low or non-VOC and low-ozone depletion factor (ODF)

Touch 'n Foam

by Convenience Products,
Fenton, Missouri
(800) 325-6180
www.conveniencepproducts.com

CF 128 Insulation Foam

by Hilti
Tulsa, Oklahoma
(800) 879-7000
www.us.hilti.com

Universal Foam Sealant

by Tremco
(800) 321-5036
www.tremcosealants.com

Pur Fill 1G 600

by Todol Products
Natick, Massachusetts
(800) 252-3818
www.todol.com

Joint Sealant Gaskets

EPDM-shaped gaskets and gasket tapes

Sealant gaskets

by Resource Conservation Technology
Baltimore, Mayland
(410) 366-1146

Veneer Solid Core Doors

Forest Stewardship Council (FSC) "chain of custody" wood certification

FSC-US
www.fscus.org
(877) 372-5646
www.certifiedwood.org

Environmental Class Doors

by Marshfield Door Systems
Marshfield, Wisconsin
(800) 869-3667
www.marshfielddoors.com

Algoma Hardwoods

by Algoma Hardwoods
(800) 678-8910
www.algomahardwoods.com

Doors by Eggers

Eggers Industries
Two Rivers, Wisconsin
(920) 793-1351
www.eggersindustries.com

Door Frames

Solid hardwood

FSC-certified solid hardwood head, jambs, and stops

Veneer

FSC-certified veneer with non-urea formaldehyde composite base

Medite

by Sierra Pine
Roseville, California
www.sierrapine.com
(800) 676-3339

IsoBord Agri-board

by IsoBord Enterprises
Portland, Oregon
www.isoboard.com
(503) 242-7345

ResinCore phenolic particleboard

by Rodman Industries
Marinette, Wisconsin
www.rodmanindustries.com
262-569-5820

CollinsWood FSC-certified particleboard

by The Collins Comanies
Klamath Falls, Oregon
www.collinswood.com
800-547-1793

EPP panels

by Panel Source International
St. Albert, Alberta, Canada
(780) 458-1007
www.panelsource.net

Aluminum Clad Wood Windows

Forest Stewardship Council (FSC) "chain of custody" wood certification for frames and sash

FSC-US
(877) 372-5646
www.fscus.org
www.certifiedwood.org

FSC-certified

H-Window

by H-Window
Ashland, Wisconsin
(800) 843-4929
www.hwindow.com

NON-FSC-certified

Ultra Series

by Kolbe & Kolbe
Wausau, Wisconsin
(715) 842-5666
www.kolbe-kolbe.com

Hurd windows

by Hurd Windows and Doors
Medford, Wisconsin
(800) 433-4873
www.hurd.com

Marvin windows

by Marvin Windows and Doors
Warroad, Minnesota
(888) 537-7828
www.marvin.com

Weather Shield windows

by Weather Shield Manufacturing
Medford, Wisconsin
(800) 222-2995
www.weathershield.com

Pella windows

by Pella Corporation
Pella, Iowa
(800) 847-3552
www.pellacommercial.com

Gypsum Board

100% recycled content

Temple-Inland gypsum wallboard

by Temple-Inland
Diboll, Texas
(800) 231-6060
www.templeinland.com

USG gypsum products

by USG Corporation
Chicago, Illinois
(888) 874-2450
www.usg.com

National Gypsum products

by National Gypsum Company
Charlotte, North Carolina
(704) 365-7300
www.national-gypsum.com

Georgia-Pacific gypsum boards and drywall

by Georgia-Pacific Gypsum LLC
Atlanta, Georgia
(404) 652-4000
www.gp.com

Gypsum Board Joint Compound

Non-vinyl and low-VOC based joint compound

Murco M100 joint compound

by Murco Wall Products
Fort Worth, Texas
(800) 446-7124
www.murcowall.com

Ceramic Tile

Recycled content

Terra tiles
by Terra Ceramics Inc.
Richmond, Indiana
www.terragreenceramics.com

Recycled-glass Eco-Tile
by Quarry Tile Company
Spokane, Washington
(800) 423-2608

EcoCycle
by Crossville Inc.
(931) 484-2110
www.crossvilleinc.com

Daltile
by Daltile
Dallas, Texas
(800) 933-8453
www.daltile.com

Terrazzo Tile

Recycled-glass content

Wausau Tile
by Wausau Tile Inc.
Wausau, Wisconsin
(800) 388-8728
www.wausautile.com

Ceramic Tile Adhesive Setting Materials

Low or non-VOC setting compounds

Safecoat 3 in 1 Adhesive
by American Formulating and Manufacturing
(800) 239-0231
www.afmsafecoat.com

D-5 Premium Thin-Set Mortar
D-40 Duraflex
by Bostik Findley
Middleton, Massachusetts
www.bostik-us.com

Composite Flooring

Composite laminate flooring

Stratica
by Amtico International
Atlanta, Georgia
(800) 404-0102
www.stratica.com

Recycled wood-composite tile

Madera Tile
by Madera Tile
(800) 767-4495
www.maderatile.com

Strip Flooring

Hardwood flooring

Forest Stewardship Council (FSC) "chain of custody" wood certification
FSC-US
(877) 372-5646
www.fscus.org
www.certifiedwood.org

Connor Sports Flooring
by Connor Floor
Arlington Heights, Ilinois
(800) 283-9522
www.connorfloor.com

CollinsWood
Collins Companies—Kane Hardwood
Kane, Pennsylvania
(814) 837-6941
www.collinswood.com

Muskoka hardwood flooring
by Muskoka Prefinished Hardwood Flooring
Huntsville, Ontario, Canada
www.muskokaflooring.com
(800) 461-5386

Bamboo flooring

Teragren bamboo flooring
by Teragren LLC
Bainbridge Island, Washington
(800) 929-6333
www.teragren.com

Laminate flooring

PermaGrain
by PermaGrain Products Inc.
www.permagrain.com

Resilient Sheet and Tile Flooring

Cork tile

Expanko cork flooring
by Expanko Inc.
Coatesville, Pennsylvania
(800) 345-6202
www.expanko.com

Natural Cork cork tiles
by Natural Cork
Augusta, Georgia
(800) 404-2675
www.naturalcork.com

Linoleum sheet flooring

Marmoleum
by Forbo Flooring North America
Hazleton, Pennsylvania
(800) 842-7839
www.forbolinoleumna.com

Marmorette
by Armstrong World Industries
Lancaster, Pennsylvania
(800) 233-3823
www.armstrong.com

Hard rubber flooring

Noraplan, Norament
by Freudenburg Building Systems
Lawrence, Massachusetts
(800) 332-6672
www.norarubber.com

Soft rubber flooring

EcoSurfaces
by Gerbert Ltd.
Lancaster, Pennsylvania
(877) 326-7873
www.ecosurfaces.com

Carpet

Recycled-content or fully recyclable carpet

Wearlon (100% recycled PET soda bottle)
by Image Carpet
Armuchee, Georgia

Envirelon (100% recycled PET soda bottle)
by Talisman Mills
Mequon, Wisconsin and Dalton, Georgia
(414) 242-6183

Encore SD Ultima (recycled content)
by J&J Commercial
Dalton, Georgia
(800) 241-4585
www.jjcommercial.com

Selected C&A carpet
by Tandus
Dalton, Georgia
(800) 248-2878
www.tandusshowroom.com

Selected carpet
by Interface
Atlanta, Georgia
(800) 336-0225
www.interfaceinc.com

Selected carpet
by Shaw Contract Group
Calhoun, Georgia
www.shawcontract.com
(802) 502-7429

Selected carpet
by Milliken Floor Covering
LaGrange, Georgia
(800) 528--8453
www.millikencarpet.com

Rubber Wall Base

Recycled-content rubber wall base

Noraplan, Norament
by Freudenburg Building Systems
Lawrence, Massachusetts
(800) 332-6672
www.norarubber.com

Flooring Adhesives

Waterproof low- or non-VOC

Safe-Set
by Chicago Adhesive
(800) 621-0220
www.chapco-adhesive.com

BioShield Cork Adhesive
by BioShield Paint
Santa Fe, New Mexico
(800) 621-2591
www.bioshieldpaint.com

965 Flooring and Tread Adhesive
by Johnsonite
Chagrin Falls, Ohio
(800) 899-8916
www.johnsonite.com

#380 All-purpose Flooring Adhesive
by Sinan Company
Davis, California
(530) 753-3104
www.sinanco.com

2051 Acrylic Co-Polymer Wood Flooring Adhesive
by W.F. Taylor Co.
Fontana, California
(800) 397-4583
www.wftaylor.com

Wicanders Series 200 glue-down floors
by Amorim Flooring
Hanover, Maryland
www.wicanders.com

Suspended Acoustic Ceiling Panels

High recycled-content panels, all ceilings except restrooms

Radar Illusion ClimaPlus
by USG
Chicago, Illinois
(800) 874-4968
www.usg.com

Eurostone
by Chicago Metallic
Chicago, Illinois
(800) 323-7164
www.chicagometallic.com

Celotex Acoustical Ceiling Products
by CertainTeed Corp.
(800) 233-8990

Armstrong acoustical ceilings
by Armstrong World Industries Inc.
Lancaster, Pennsylvania
(800) 233-3823
www.armstrong.com

Restroom and shower room ceilings

Clean Room ClimaPlus
by USG
Chicago, Illinois
(800) 874-4968
www.usg.com

Non-vinyl Wallcovering

Class A

Innvironments
(cellulose, wood-fiber, woven-polyester)
by Innovations in Wallcoverings
New York, New York
(800) 227-8053
www.innovationsusa.com

EnVision (nonwoven polyester, cellulose),
by Roos International
Deerfield Beach, Florida
(800) 888-2776

N'Viro (cellulose)
by D.L. Couch Wallcovering Source
New Castle, Indiana
(800) 433-0790
www.dlcouch.com

Non-Class A

Rauhsaser (paintable recycled paper)
by Better Wall System
Kenora, Ontario, Canada
(800) 461-2130

Xorel (woven polyethylene)
by Carnegie
Rockville Centre, New York
(800) 727-6770
www.xorel.com

Selected wallcoverings
by MDC Wallcoverings
Elk Grove Village, Illinois
(800) 621-4006
www.mdcwall.com

South Seas Collection (natural fibers)
by Newcastle Fabrics
Brooklyn, New York
(800) 404-5560
www.newcastlefabrics.com

Duraweave (glass textile fiber)
by Roos International
Deerfield Beach, Florida
(800) 888-2776

Tassoglas & Texturglas (woven glass fiber)
by Roos International
Deerfield Beach, Florida
(800) 888-2776

Duraprene (wood-pulp/polyurethane)
by Designtex
New York, New York
(800) 221-1540
www.thedesigntexgroup.com

Cork wallcovering

ContempoCork cork tiles
by ContempoCork
River Edge, New Jersey
(201) 986-7915

Korq (laminated cotton backing)
by Korq
New York, NewYork
(212) 758-2593

Natural Cork wall tile
by Natural Cork
Augusta, Georgia
(800) 404-2675
www.naturalcork.com

Linoleum wallcovering

Bulletin Board
by Forbo Flooring North America
Hazleton, Pennsylvania
(800) 842-7839
www.forbolinoleumna.com

Wall Covering Adhesive

Non-VOC content

#389 Natural Wallpaper Adhesive
by Sinan Company
Davis, California
(530) 753-3104
www.sinanco.com

Low- or Non-VOC Paints and Coatings

Exterior paints—low-VOC content

Safecoat Enamels
by American Formulating and Manufacturing
(800) 239-0231
www.afmsafecoat.com

Rodda Horizon
by Rodda Paint
Portland, Oregon
(800) 452-2315
www.roddapaint.com

Best Duracryl
by Best Paint Co.
Seattle, Washington
(206) 783-9938
www.bestpaintco.com

Interior paints — low-VOC content

Safecoat
by American Formulating and Manufacturing
(800) 239-0231
www.afmsafecoat.com

Pure Performance
by PPG Architectural Finishes
Pittsburgh, Pennsylvania
(800) 441-9695
www.ppgaf.com

Harmony
by Sherwin-Williams
Cleveland, Ohio
(800) 321-8194
www.sherwinwilliams.com

Eco Spec
by Benjamin Moore
Montvale, New Jersey
(800) 344-0400
www.benjaminmoore.com

Wonder Pure
by Devoe
Cleveland, Ohio
(888) 265-6753
www.devoepaint.com

Genesis
by Duron
Beltsville, Maryland
(800) 723-8766
www.duron.com

Glidden Pro-Master
by ICI Paints
Strongsville, Ohio
(800) 834-6077
www.gliddenpaints.com

Exterior transparent finishes—low-VOC content

BioShield
by BioShield Paint
Santa Fe, New Mexico
(800) 621-2591
www.bioshieldpaint.com

ZAR Exterior Polyurethane
by United Gilsonite Laboratories (UGL)
Scranton, Pennsylvania
(800) 845-5227
www.ugl.com

GCP 1000 Polyurethane
by Genesis Coatings
(800) 533-4273
www.genesiscoatings.com

Weather-Bos
by Weather-Bos Finishes
(800) 664-3978
www.weatherbos.com

Timber-Tek UV
by Timber-Tek Finishes
Portland, Oregon
(888) 888-6095
www.timberprocoatings.com

Broda Pro-Tek-Tor
by Broda Coatings
Vancouver, British Columbia, Canada
(888) 311-5339
www.cbrproducts.com

Interior stains—low-VOC content

BioShield
by BioShield Paint
Santa Fe, New Mexico
(800) 621-2591
www.bioshieldpaint.com

#160 Series Natural Stain
by Sinan Company
Davis, California
(530) 753-3104
www.sinanco.com

Interior stains—other

Sherwin-Williams stains
by Sherwin-Williams
Cleveland, Ohio
(800) 321-8194
www.sherwinwilliams.com

Benjamin Moore stains
by Benjamin Moore
Montvale, New Jersey
(800) 344-0400
www.benjaminmoore.com

Interior transparent finishes—low-VOC content

Hard Seal
Safecoat Polyureseal
Acrilaq
Acriglaze
by American Formulating and Manufacturing
(800) 239-0231
www.afmsafecoat.com

Pure Tung Oil
by The Real Milk Paint Co.
Quakertown, Pennsylvania
(800) 339-9748
www.realmilkpaint.com

BioShield

by BioShield Paint
Santa Fe, New Mexico
(800) 621-2591
www.bioshieldpaint.com

OSMO Polyx-Oil (the original Hardwax Oil)

by Environmental Home
Seattle, Washington
(800) 281-9785
www.environmentalhomecenter.com

Land Ark Wood Finish

by Land Ark
North Augusta, South Carolina
(803) 279-4116

Penofin Oil

by Performance Coatings
Ukiah, California
(800) 736-6346
www.penofin.com

Sutherland Welles exterior tung oil

by Sutherland Welles
Morrisville, Vermont
(800) 322-1245
www.sutherlandwelles.com

Tried & True linseed finishes

by Tried & True
Trumansburg, New York
(607) 387-9280
www.triedandtruewoodfinish.com

AQUA ZAR

by United Gilsonite Laboratories (UGL)
Scranton, Pennsylvania
(800) 845-5227
www.ugl.com

Recycled paints

Amazon paints

by Amazon Environmental
Whittier, California
(800) 566-2396
www.amazonpaint.com

EcoPaint

by Atlantic City Utilities Authority
Atlantic City, New Jersey
www.acua.com
(609) 272-6920

E-Coat

by Kelly-Moore Paint
Sacramento, California
(800) 874-4436 x157
www.kellymoore.com

Sealers — low-VOC content

Safecoat Safe Seal

by American Formulating and Manufacturing
(800) 239-0231
www.afmsafecoat.com

SoySolv Soy Seal

by SoySolv
Tiffin, Ohio
(800) 231-4274
www.soysolv.com

Exterior stains

Safecoat DuroStain

by American Formulating and Manufacturing
(800) 239-0231
www.afmsafecoat.com

Bioshield wood stains

by BioShield Paint
Santa Fe, New Mexico
(800) 621-2591
www.bioshieldpaint.com