Build It Green™
Smart Solutions From The Ground Up

2005 Edition

NEW HOME CONSTRUCTION GREEN BUILDING GUIDELINES

GREEN BUILDING
in Alameda County
www.BuildGreenNow.org

2005 Edition

NEW HOME CONSTRUCTION GREEN BUILDING GUIDELINES

Green Building in Alameda County

Debris from construction, demolition and landscape projects comprises nearly 30% of the materials disposed in Alameda County landfills. To reduce this waste, Green Building in Alameda County has formed a public/private partnership with the construction and building industries. The program serves three target markets: cities and public agencies in Alameda County; design and building industry professionals; and residents of Alameda County.

The key components of Green Building in Alameda County are:

- Guidelines
- Technical Assistance and Grants
- Education
- Partnerships
- Policy Development
- Case Studies and a Product Directory

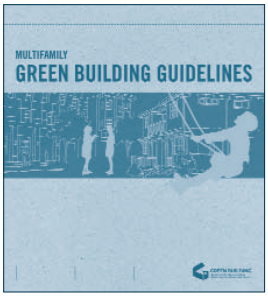
Green Building in Alameda County endorses the use of the following:

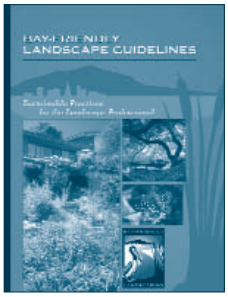
- Alameda County Residential Green Building Guidelines (for New Home Construction, Home Remodeling and Multifamily). *This publication is the 2005 Edition of the Alameda County Green Building Guidelines for New Home Construction. For guidelines for Home Remodeling and Multifamily, the Builders' Guide to Reuse and Recycling, and other resources, visit* **www.BuildGreenNow.org**.
- Bay-Friendly Landscaping Guidelines and Bay-Friendly Gardening Guide. *Builders in Alameda County are encouraged to meet all the Bay-Friendly Landscaping prerequisites and incorporate additional practices to meet the minimum score required for a Bay-Friendly Landscape. Refer to the Bay-Friendly Landscape Plan Review and Scorecard at* **www.BayFriendly.org**.
- US Green Building Council's Leadership in Energy and Environmental Design (LEED™) Green Building Rating System for commercial and civic buildings. *To learn more, visit www.usgbc.org.*

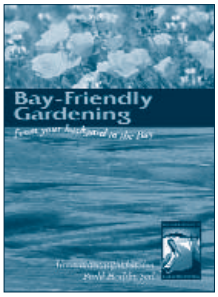
Bay-Friendly Landscaping

Bay-Friendly Landscaping is a whole systems approach to the design, construction and maintenance of the landscape in order to support the integrity of one of California's most magnificent ecosystems, the San Francisco Bay watershed.

A well-designed and maintained Bay-Friendly Landscape can cost less to maintain in the long run by consuming fewer resources. Bay-Friendly Landscapes embody community values for health, wildlife and the environment, while providing benefits to the homeowners, such as lower water or garbage bills.







StopWaste.Org Disclaimer: *GreenBuilding in Alameda County* and *Bay-Friendly Landscaping* are programs of StopWaste.Org, which is the Alameda County Waste Management Authority and the Alameda County Source Reduction and Recycling Board operating as one public agency. The information provided in these Guidelines should be considered by contractors, architects and other professionals, as well as owners, in the course of designing and constructing new or modified structures. These Guidelines are provided as a public service byGreenBuildinginAlamedaCounty, in conjunction with Build It Green, in an attempt to provide environmental benefits to the public. The Guidelines are not a substitute for the exercise of sound judgment in particular circumstances and are not intended as recommendations for particular products or processes. The Guidelines are also subject to Build It Green's disclaimer on the following page.

About Build It Green

Build It Green is a professional non-profit membership organization whose mission is to promote healthy, durable, energy- and resource-efficient buildings in California. Supported by a solid foundation of outreach and education, Build It Green connects consumers and building professionals with the tools and technical expertise they need to build quality green homes. Build It Green fosters collaboration with key stakeholder groups to accelerate the adoption of green building standards, policies, and programs.

In addition to providing these Guidelines for educational purposes, Build It Green offers the following companion resources at www.BuildItGreen.org:

- Green Points calculator
- List of references for all Guidelines measures
- Innovation checklist for approaches beyond the measures described in the Guidelines
- Cross-referencing with other residential initiatives (e.g. ENERGY STAR® Indoor Air Package, LEED-H, CA Green Builder and the NAHB Guidelines)
- Addendums that explain how to use the Guidelines in conjunction with other programs
- Information about new practices and materials or corrections that are identified after publication

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RESOURCES

Materials Database

Locate green building products, local suppliers and service providers that correspond with the measures listed in the green building guidelines. The database is continuously updated based on the local availability of products and development of new materials. It is searchable by product categories, product names, and green building measures. Available at www.BuildItGreen.org

Ask an Expert

Have a green building question? The Ask an Expert hotline is a FREE service that provides homeowners and building professionals with unbiased, technical information for their green project.

Call today!
888-40-GREEN (888-404-7336) or
www.BuildItGreen.org

Builders' Guide to Reuse and Recycling

A directory of local facilities, vendors and service providers to help Alameda County builders, contractors and residents reuse and recycle construction and demolition materials.

Available at www.BuildGreenNow.org in the Design & Building Professionals section under Construction & Demolition Recycling.

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Foreword

These residential Guidelines were developed for the following reasons:

- To provide local governments with an educational tool for city staff, builders and homeowners interested in green residential construction
- To present a range of voluntary measures for builders to choose from when constructing a green home in California
- To create a policy foundation for local governments interested in implementing a green building program
- To establish regional consistency in green building guidelines to increase predictability for builders
- To integrate varying residential initiatives in order to achieve greater simplicity and local applicability
- To offer a set of guidelines developed by an independent, third-party source.

Guidelines Development Process

The New Home Construction Guidelines were developed through a collaborative process that included the following steps:

These guidelines are based on the Alameda County New Home Construction Green Building Guidelines, which were first developed in 2000 through a collaborative process and public-private partnership among builders, green building experts, and local government staff in Alameda County. Representatives from major production builders, including Centex Homes, Greenbriar Homes, Ponderosa Homes, Pulte Homes, Shea Homes, Signature Properties, Silverwood Homes, and Toll Brothers, provided input and direction in the development of the original Guidelines.

The Guidelines were updated in 2005 to expand its applicability throughout California, address changes in Title 24, and incorporate measures from other residential green building initiatives such as the California Green Builder program, National Association of Home Builders guidelines, and the pilot draft LEED for Homes checklist.

The Green Residential Environmental Action Team (GREAT), a task force of state agencies including the California Integrated Waste Management Board, California Energy Commission, Office of Environmental Health Hazard Assessment, Office of the State Architect, Department of General Services, Department of Water Resources, and California Air Resources Board, provided technical expertise and input in the update of these Guidelines.

Build It Green—a professional non-profit organization whose mission is to promote green building in California—expanded and facilitated the stakeholder process to include input from its various councils, including the Public Agency Council, Builders Council, Non-Profit Network, and Suppliers Council.

Publicly available information, scientific data, and third-party standards were referenced in the development of these Guidelines. The Guidelines are intended to be a living document, and will be regularly updated as additional technical and quantitative information becomes available, measurement tools such as Life Cycle Assessment become more accessible, and new green measures are developed.

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Chapter One:
Overview of Green Building

"As our population along the coast increases, our resources are decreasing and it is only responsible to build homes that use less water and energy if the technology is available and cost-effective."

—**Amy Christopherson Bolten, Christopherson Homes**

Overarching Principles of Green Building

1 **Build for the long-term**
Build durable homes & livable communities.

2 **Build for our children**
Make their homes, communities & environment safe.

3 **Build for the planet**
Use natural resources wisely.

Introduction

In response to growing concerns about building quality, health, quality of life, energy costs and dwindling natural resources, an increasing number of California homebuilders are embracing "green building." This holistic approach to homebuilding emphasizes quality construction, energy efficiency, good indoor air quality and livable neighborhoods. As you'll discover in these Guidelines, green building provides myriad benefits to California's homebuilders, homeowners and communities.

Does green building really matter?

Green building means improving our design and construction practices so that the homes we build today will last longer, cost less to operate, and won't harm people's health. It also involves protecting natural resources and improving the built environment so that people, communities and ecosystems can thrive and prosper.

With the budget and time pressures we're all under today, is it really worth the extra effort? Increasingly, builders, developers, real estate professionals, policy-makers and homeowners agree that it is worth the effort. Better homes, it turns out, are also better for business. Developers, builders and other real estate professionals who follow "building as usual" practices may find themselves at a competitive disadvantage as regulatory and market forces shift the industry toward built environments that are healthier, more resource efficient and less polluting.

Green building is gaining momentum in California, and for good reason. To meet expected population growth between now and 2020, approximately 220,000 housing units need to be added annually. That's 3.3 million homes over the next 15 years.

Imagine the demands that all those homes will put on our water and energy supplies, forests, farmlands, recreational areas, roadways and municipal infrastructure.

Green building offers solutions to meeting those demands while minimizing environmental impacts. By building durable, healthy homes that consume less energy, water and other resources, today's green homebuilders are helping to safeguard the well-being and prosperity of Californians today and for decades to come.

Fundamental Objectives of Green Building

There's nothing mysterious about green building—it's really just applied common sense. To move forward with greening your construction project, it is helpful to think of green building as quality design and construction achieved through the convergence of four fundamental objectives:

1. Conserve natural resources
2. Use energy wisely
3. Improve indoor air quality
4. Plan for livable communities

Conserve natural resources

Conventional building construction and operation consumes large quantities of wood, water, metals, fossil fuels and other natural resources. Even though the majority of the materials used to build a home are put to good use, vast quantities of resources are wasted. In fact, building an average 2,000-sq. ft. house produces about 7,000 pounds of waste.

Much of this waste is avoidable. Careful management of the construction process makes a big difference. There are also many well-established homebuilding practices that help protect natural resources. For example, advanced framing techniques can substantially reduce lumber requirements without compromising structural integrity. Using engineered lumber and wood products certified by the Forest Stewardship Council can help protect old-growth forests.

There are many effective building strategies that conserve natural resources, as well as provide benefits such as cost savings. These include using durable products such as roofing materials with 40- or 50-year warranties, and specifying recycled-content products that divert waste from landfills. Recycled-content decking, reclaimed lumber and other products put waste to good use, while providing quality and durability that often exceed conventional materials. For example, decking materials made of recycled plastic mixed with wood waste fibers can last up to five times longer than wood decking, and never needs to be treated or painted.

Water is another critical resource. California residences use 5.6 million acre-feet of applied water annually. Our prosperity and ability to meet the needs of our growing population hinge on having adequate supplies of clean, fresh water. Homes built and landscaped to use water wisely make a tremendous contribution to protecting our shared resources. An added benefit is lower expenses for the homeowner. Today's builders can take advantage of a new generation of cost-effective, high efficiency appliances and landscape water management systems.

Use energy wisely

New houses in California must be built to the most stringent energy code in the country, but given the state's projected population growth, even this may not be enough to keep demand for energy in check. Generation and use of energy are major contributors to air pollution and global climate change. With homes accounting for roughly 31% of the electricity consumed in the state, it is clear that homebuilders have a significant role to play in helping our society address energy-related concerns now and in the coming decades.

Energy efficiency is the cornerstone of every green home. Improving energy efficiency and using renewable energy sources are effective ways to reduce the potential of energy supply interruptions, improve air quality, reduce the impacts of global warming, and slow the rate at which we need to build new power plants.

Energy efficiency also makes good sense for home-owners: an energy-efficient house saves money by reducing utility bills year after year, and provides other valuable benefits. Better insulation, for example, reduces uncomfortable drafts, and double-pane windows make for a quieter home.

Improve indoor air quality

On average, Americans spend 90% of their time indoors, yet the air in new homes can be ten times more polluted than outdoor air, according to the U.S. Environmental Protection Agency. Children are particularly vulnerable when it comes to air pollution. A report in the New England Journal of Medicine states that 40% of children will develop respiratory disease, in part due to the chemicals in their homes.

A common source of indoor air pollution is the off-gassing of chemicals found in many building materials. Kitchen cabinets, countertops, shelving and furniture may be made from particleboard or medium density fiberboard. These pressed-wood products are typically made with adhesives that release urea formaldehyde—a known human carcinogen—into the home for years after installation. Also, many paints, floor finishes, adhesives and sealants emit unhealthy volatile organic compounds (VOCs). That "new house smell" is a telltale sign that there are harmful chemicals in the indoor environment.

Fortunately, the building products industry is responding to these indoor pollution problems by developing safer products, including low-VOC paints, cleaners and adhesives. These products are now commonly available from most major suppliers at costs comparable to conventional products. California also now has specifications available for some materials to assure that they are low emitting and safe.

Poor indoor air quality is also often caused by biological contaminants, such as mold that grows as a result of moisture infiltration due to inadequate ventilation, poor design and maintenance, and other factors. Dust, another major source of air pollution inside homes, can be reduced by installing permanent front door walk-off mats and by using hard surface flooring materials such as natural linoleum, bamboo, wood or wood alternatives, or concrete.

Pleasant Hill CoHousing Common House, Pleasant Hill, CA.

Plan for livable communities

California's homebuilders and homebuyers are making decisions today that will affect the quality of our lives for decades to come. New construction, whether of a single home or a large development, contributes to the state's economic vitality and helps meet our pressing need for more housing. At the same time, every new home places additional demands on our supplies of land, water and energy, and on our infrastructure of roads, sewers and other services.

Green building offers homebuilders, community leaders and California residents sensible solutions that improve an individual home's performance and provide broad-based community benefits. These benefits range from cleaner air to reduced traffic congestion, from more appealing recreational opportunities to greater economic vitality.

For local municipalities, green building can provide many economic benefits. Developments designed to reduce dependence on cars help ease traffic congestion, which can improve business productivity. Mixed-use developments encourage economic vitality and a diversified municipal tax base. Infill projects help revitalize older urban areas and allow public funds to be used for upgrading existing services such as schools, transit and sewers, rather than diverting limited funds to the development of new services.

For California residents, developments designed to cluster homes help preserve open space for recreation, views and natural habitats. Pedestrian- and bicycle-friendly neighborhoods provide people with opportunities to exercise and get to know their neighbors. Higher density urban infill developments allow people to live closer to where they work, shop and go to school, which means less time spent driving and more time for family, community and personal activities.

Clearly, green building cannot solve all the social, economic or environmental challenges facing California's communities. Still, green building gives homebuilders a valuable set of strategies for meeting residents' expectations for livable, healthy, sustainable communities.

Centex Homes, PowerSave Plus home at Lunaria in Windemere, San Ramon.

The House as a System

A house is an intricate system made up of interdependent components. Changing one aspect of this system can create a ripple of effects in other areas. Builders were reminded of this when they began building tighter houses in the 1970s in response to rising energy costs. Tightly sealing the thermal envelope reduced heating and cooling costs but sometimes had unintended results, such as increased indoor air pollution due to inadequate ventilation or problems with mold due to moisture trapped within the structure.

The solution was not to return to the days of leaky, uncomfortable houses that wasted energy. Instead, what grew out of this experience was a new approach to home building, called the whole-house systems approach. In collaboration with building-science researchers, home-building associations and government agencies such as the U.S. Department of Energy's Building America program, many home builders across the nation are now successfully using this approach. It emphasizes strategic planning, systems analysis, and testing and verification to ensure that improvements in one area won't jeopardize health, safety, affordability, durability, profitability and other vital concerns.

Ideally, home builders should incorporate green building into their practices as part of this whole-house systems approach. This requires taking into account the interaction of many factors: the building's structure and thermal envelope; heating, cooling, water heating and electrical systems; renewable energy systems; the site's climate, topography, landscaping and surrounding structures; aesthetics; health and safety requirements; and how the occupants will use the house.

For example, a green builder concerned with improving the performance of the whole house will not merely select a more energy-efficient heating and cooling system and call it a day. Instead, the builder will look for opportunities to improve the thermal envelope and decrease heating and cooling loads, such as by reducing air leakage, designing and locating ductwork to minimize energy losses, increasing insulation, and choosing low-e windows. These improvements may allow the use of significantly smaller—and less costly—heating and cooling systems. Properly sized HVAC systems also lower the owner's energy costs and provide greater comfort.

According to Building America, a whole-house systems approach can reduce the energy consumption of new houses by as much as 40% with little or no effect on the cost of construction. Usually the decisions made as part of a whole-house approach yield multiple benefits.

For example, framing the home with 2x6 studs spaced at 24 inches allows increased insulation compared to conventional 2x4 studs spaced at 16 inches. Increased insulation saves heating and cooling energy and improves comfort. Also, as mentioned above, it may allow the downsizing of heating and cooling equipment. What's more, the 2x6 framing technique reduces wood use and labor costs.

The whole-house systems approach requires that the design and construction process be highly integrated. This involves:

- Careful planning and attention to detail from the outset of design through all the phases of construction.
- Understanding of building science principles, including the principles of air, heat and moisture flow.
- Good communication among the entire team, including the developers, architects, engineers, builders, trade contractors, and material suppliers.
- Proper sequencing of decision-making and building activities throughout the entire design and construction process.
- Adequate training and supervision to ensure quality construction.
- Testing and verifying performance during and after construction, and establishing a feedback loop to improve future designs based on the testing results.

Building America provides detailed information about the whole-house systems approach on their website, www.eere.energy.gov/buildings/building_america.

It's no coincidence that green homes designed with a whole-house systems approach are better homes. Improving building performance takes time and care, but can significantly reduce energy needs, improve health and comfort, and reduce builder risk and cost.

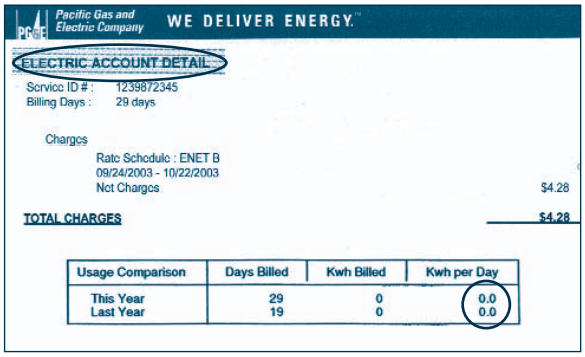
Cost Considerations

There are many reasons to build green. These include concern for the environment, desire for higher quality buildings, health considerations and interest in creating an environmentally friendly image for your business. Although some individual green building strategies may cost more, the benefits of adopting a green approach to homebuilding are remarkable.

Balancing costs and benefits

These Guidelines recommend methods and materials that range in cost—some of them cost no more or even less than conventional options. In fact, when a home is designed from the outset to be green, it need not cost more than a conventionally built home. While not all measures recommended in these Guidelines will be applicable to your project, the measures included are relevant and reasonable for residential developments built today.

Some of the recommended measures do cost more initially, but this additional cost needs to be evaluated in the context of the longer-term benefits provided: utility cost savings, better indoor air quality for residents, healthier jobsites for workers, and longer building life. When considering green building measures, it is very important to balance upfront design, product and construction costs with these other significant benefits.


Pacific Gas and Electric Company WE DELIVER ENERGY.

ELECTRIC ACCOUNT DETAIL

Service ID # : 1239872345
Billing Days : 29 days

Charges
Rate Schedule : ENET B
09/24/2003 - 10/22/2003
Net Charges $4.28

TOTAL CHARGES $4.28

Usage Comparison	Days Billed	Kwh Billed	Kwh per Day
This Year	29	0	0.0
Last Year	19	0	0.0

Sample utility bill for a zero net energy home.

How green building can reduce costs

While the health and environmental benefits of green building are well established, many people still assume that green building costs more. But taking a whole-house systems approach to green building, as described on the previous page, can actually reduce construction and operating costs compared to standard practice. This integrated approach to green building can help steer the design away from expensive solutions and toward cost-effective ones.

During schematic design, for example, the team might consider strategies such as simplifying a building's wall structure by changing the wall articulation to a flat wall with bolted-on overhangs and thick trim. Such a change can often save money and materials, but would be costly to do once construction documents were underway.

To give another example, a design team that takes a whole-house systems approach might recommend increasing the exterior wall thickness to accommodate more insulation, which could result in reducing the size and cost of the heating system.

The key to reducing costs is to evaluate opportunities as early as possible in the design process because the range of cost-effective solutions narrows as the design progresses. Consider framing techniques. During schematic design, the design team might decide to incorporate advanced framing techniques. These techniques, as described in the Guidelines, reduce wood and construction costs while maintaining structural integrity and meeting building code. But if framing changes aren't considered until much later in the design or construction process, significant cost- and resource-saving opportunities may be missed.

Green building is pushing the design and construction industry to do things that may be new, such as taking a whole-house systems approach to design and construction. Learning new practices sometimes involves an initial outlay of time and money. But green buildings are more than just buildings. They are the end result of a collaboration between people on all levels of design and construction who are committed to improving on past practices and improving homes for today and the future.

Chapter Two:
How to Start Building Green

These Guidelines are for developers, builders and homeowners planning to construct a single-family residential project in California. The Guidelines provide a range of green building practices that can be implemented by people who are new to green construction as well as those aiming for higher levels of building performance.

"Ponderosa Homes believes green homes are kinder to the environment and provide substantial economic and comfort benefits. Homeowners can expect lower utility bills, higher resale values and reduced maintenance."

—**Dennis Swickard, Ponderosa Homes**

How to Start Building Green

For building professionals, building green involves new ways of thinking about common building practices. Generally, it is best to build from your existing market base, adding green features as the market evolves and matures. If you start gradually, you are less likely to make expensive mistakes. It is critical to carefully consider the changes you make and the additional costs you might incur. The earlier you start integrating green strategies into your building process, the less it may cost you and the consumer in the long run.

Local governments can facilitate green building by providing educational opportunities and considering incentives for better quality construction. Builders value incentives that save them time in the development process or allow them to differentiate their homes in the marketplace. Incentives can include streamlined or expedited permitting, offering community recognition or partnering with organizations that offer consumer marketing programs.

Taking steps toward building green

The measures in these Guidelines range from basic, common sense recommendations such as venting bathroom fans to the outside, to more sophisticated strategies such as installing renewable energy systems.

No matter where you are on the green building spectrum—from novice to expert—you will find resources, design ideas, and real-world advice that you can put to use today.

If you are new to green building, you can start taking steps right away toward creating healthier and more energy- and resource-efficient homes. Inside these Guidelines, you'll find many strategies that are easy to implement and add virtually no cost.

As your team's experience with green building grows, you'll likely find yourselves scaling up to even healthier and more effective design and construction practices. The Green Points checklist described in Chapter Three provides a very convenient way for you to track green features in a particular project, as well as benchmark your progress over time as you and your company gain experience with green building.

If you are experienced with building green homes, some of the approaches and practices recommended here may already be part of your daily practice. In that case, these Guidelines will help you employ more advanced green-building strategies that will reinforce your organization's leadership position.

What's Inside the Guidelines

The measures in these Guidelines are listed in the Green Points checklist (Chapter 3) and described in detail in Chapter 4. The measures are grouped into sections corresponding to the various stages of construction. This organization will help you understand which green building measures can be incorporated at various points of a construction project. However, it's essential that each measure be considered and planned for holistically prior to designing a home.

The Guidelines include a few sidebars titled "Building Basics." These are green building practices that are required by California or local codes. They are included for educational purposes and are not listed in Green Points.

The sections are briefly summarized here:

Community Design and Planning. These measures are not part of the Green Points checklist because they may not be in the developer's or builder's control. This section include strategies to help preserve open space; promote social interaction, physical activity and community safety; and make homes more accessible to people of all physical abilities.

A. Site. Site measures include recommendations for managing the construction process to minimize disruptions to the building site, reduce waste, and prevent pollution of air, soil and waterways.

B. Landscaping. These measures offer strategies to keep pollutants out of waterways, reduce water use, promote healthy soils, create fire-safe landscaping, and reduce excessive outdoor lighting.

C. Foundation. New-home builders have the opportunity to make the buildings green from the ground up. This section includes suggestions for incorporating recycled flyash in concrete, using frost-protected shallow foundations in cold climates, and installing radon-mitigation measures where appropriate.

D. Structural Frame. These measures address the building's structural frame, including the walls, floors and roof. Following these recommendations will result in more durable buildings that use energy and other resources more efficiently.

E. Exterior Finish. This section focuses on siding, roofing and decking materials that will hold up well for decades and help protect the home from moisture damage, fire, and general wear-and-tear.

F. Plumbing. This section addresses ways in which builders and homeowners can save water and energy by designing the plumbing system to reduce hot-water runs, insulating hot water pipes and installing water-efficient toilets.

G. Appliances. High efficiency residential appliances can significantly cut a home's energy and water use. This section recommends choosing dishwashers, clothes washers, and refrigerators that exceed minimum federal efficiency standards.

H. Insulation. The measures in this section encourage proper insulation installation techniques, and the use of insulation products with recycled content and low or no formaldehyde emissions.

I. Heating, Ventilation and Air Conditioning. These measures provide two main, and complementary, benefits: energy efficiency and better indoor environmental quality. Houses with high-efficiency heating and cooling equipment tend to be more comfortable. Effective ductwork and ventilation provide better indoor air quality.

J. Building Performance. This section provides cost-effective recommendations for designing and building high performance homes that meet or exceed the state's building energy efficiency standards.

K. Renewable Energy. These measures describe solar hot water systems that reduce water heating energy costs, and photovoltaic systems that generate electricity from sunlight.

L. Finishes. Many conventional interior materials, including particleboard, paints and sealants, offgas noxious chemicals into the home. Most of the measures in this section describe healthier options for paints, trim, cabinets and countertops that perform well and are readily available. Other measures promote environmentally preferable materials for interior finishes.

M. Flooring. This section provides recommendations for a wide range of finish flooring materials that are attractive, long-lasting and environmentally friendly.

N. Other. This section encourages innovative approaches to green building that go beyond the basic measures described in these Guidelines.

Chapter Three:
New Home Green Points

The Green Points checklist offers builders, homeowners and municipalities a tool to assess how environmentally friendly or green a home is. Green Points was developed with the cooperation of local builders, city planners and building officials. Each green measure has been assigned a Green Points value based on its benefits to the homeowners and the environment, as well as its ease of implementation. In the future, the checklist may be adjusted to reflect current best practices as well as new products and technologies.

"Centex Homes continues to pursue sustainable building methods and practices in all our Northern California neighborhoods. The Green Points Checklist provides a meaningful way to gauge our progress."

—**Jeff Jacobs, Centex Homes**

The Green Points checklist is based on the various green features incorporated into the home. A home can be considered green if it earns 50 points or more, and meets the following minimum points per category: Energy (11), Indoor Air Quality/Health (5), Resources (6), and Water (3). Additional points can be achieved from any category to add up to a total of 50.

POINTS PER CATEGORY	Community	Energy	IAQ/Health	Resources	Water
A. Site					
1. Protect Native Soil and Minimize Disruption of Existing Plants & Trees					
a. Protect Native Topsoil from Erosion and Reuse after Construction	1				1
b. Limit and Delineate Construction Footprint for Maximum Protection					1
2. Deconstruct Instead of Demolishing Existing Buildings On Site				3	
3. Recycle Job Site Construction Waste (Including Green Waste)					
a. Minimum 50% Waste Diversion by Weight (Recycling or Reuse)				Pre	
b. Minimum 65% Waste Diversion by Weight (Recycling or Reuse) (total 2 points)				2	
c. Minimum 80% Waste Diversion by Weight (Recycling or Reuse) (total 4 points)				2	
4. Use Recycled Content Aggregate (Minimum 25%)					
a. Walkway and Driveway				1	
b. Roadway Base				1	
Site=Total 12	**1**			**9**	**2**
B. Landscaping					
1. Construct Resource-Efficient Landscapes					
a. No Invasive Species listed by Cal-IPC are Planted					1
b. No Species Will Require Shearing				1	
c. 75% of Plants are California Natives or Mediterranean Species					1
2. Use Fire Safe Landscaping Techniques	1				
3. Minimize Turf Areas in Landscape Installed by Builder					
a. All Turf Will Have a Water Requirement Less than or Equal to Tall Fescue					2
b. Turf Not Installed on Slopes Exceeding 10% or in Areas Less than 8 Feet Wide					2
c. Turf is <33% of Landscaped Area					2
d. Turf is <10% of Landscaped Area (total 4 pts)					2
4. Plant Shade Trees		1			1
5. Implement Hydrozoning: Group Plants by Water Needs					1
6. Install High-Efficiency Irrigation Systems					
a. System Uses Only Low-Flow Drip, Bubblers, or Low-flow Sprinklers					1
b. System Has Smart (Weather Based) Controllers					2
7. Apply 2 inches Compost into the Top 6 to 12 inches of Soil					2
8. Mulch All Planting Beds to greater of 2" or Local Water Ordinance					1
9. Use Salvaged or Recycled-Content Materials for Non-Plant Landscape Elements (50% of elements use 50% or more recycled/salvaged material)				1	
10. Reduce Light Pollution from Site Lighting by Shielding Fixtures and/or Directing Light Downward	1				
Landscape=Total 23	**2**	**1**		**2**	**18**
C. Foundation					
1. Incorporate Recycled Flyash in Concrete					
a. 20% Flyash (total 1 points)				1	
b. 25% Flyash (total 2 points)				1	
2. Use Frost-Protected Shallow Foundation in Cold Areas (Climate Zone 16)				3	
3. Use Radon Resistant Construction (In At-Risk Locations Only)			1		
Foundation=Total 6			**1**	**5**	

POINTS PER CATEGORY	Community	Energy	IAQ/Health	Resources	Water
D. Structural Frame and Building Envelope					
1. Apply Optimal Value Engineering (Advanced Framing)					
a. 2x4 Studs at 24-Inch On Center Framing				1	
b. Door and Window Headers Sized for Load				1	
c. Use only Jack and Cripple Studs Required for Load				1	
2. Use Engineered Lumber					
a. Beams and Headers				1	
b. Insulated Engineered Headers		1			
c. Wood I-Joists or Web Trusses for Floors				1	
d. Wood I-Joists for Ceilings				1	
e. Engineered or Finger-Jointed Studs for Vertical Applications				1	
3. Use FSC Certified Wood					
a. Dimensional Studs (Minimum 40% - 2 pts; Min. 75% - 4 pts)				4	
b. Panel Products (Min. 40% - 1 pt; Min. 70% - 2 pts)				2	
4. Design Energy Heels on Trusses (75% of Attic Insulation Height at Outside Edge of Exterior Wall)		1			
5. Design Trusses to Accommodate Ductwork		1			
6. Use Oriented Strand Board (OSB)					
a. Subfloor				1	
b. Sheathing				1	
7. Use Recycled-Content Steel Studs for 90% of Interior Wall Framing				1	
8. Use Solid Wall Systems (Includes SIPs, ICFs, and Any Non-Stick Frame Assembly)					
a. Floors		2		2	
b. Walls		2		2	
c. Roofs		2		2	
9. Thermal Mass Walls: 5/8-Inch Drywall on All Interior Walls Weigh More than 40 lb/ft^3		1			
10. Design and Build Structural Pest Controls					
a. Install Termite Shields and Separate All Exterior Wood-to-Concrete Connections by Metal or Plastic Fasteners/Dividers				1	
b. All New Plants Have Trunk, Base, or Stem Located At Least 36" from Foundation				1	
11. Reduce Pollution Entering the Home from the Garage					
a. Tightly Seal the Air Barrier between Garage and Living Area			1		
b. Install Separate Garage Exhaust Fan			1		
12. Install Overhangs and Gutters					
a. Install 16-Inch Overhangs and Gutters (total 1 points)				1	
b. Install 24-Inch Overhangs and Gutters (total 2 points)		1			
Structural Frame and Building Envelope=Total 38		**11**	**2**	**25**	
E. Exterior Finish					
1. Use Recycled-Content (No Virgin Plastic) or FSC-Certified Wood Decking				2	
2. Install a Rain Screen Wall System				2	
3. Use Durable and Non-Combustible Siding Materials				1	
4. Select Durable and Non-Combustible Roofing Materials				2	
Exterior Finish=Total 7				**7**	
F. Plumbing					
1. Distribute Domestic Hot Water Efficiently					
a. Insulate Hot Water Pipes from Water Heater to Kitchen					1
b. Insulate All Hot Water Pipes or Install On-Demand Hot Water Circulation System in Conjunction with F.I.a.		1			1
c. Locate the Water Heater within 25 Feet of All Fixtures					1
d. Use Engineered Parallel Piping		1			
2. Install Only High Efficiency Toilets (Dual-Flush or <=1.3 gpf)					3
Plumbing=Total 8		**2**			**6**

POINTS PER CATEGORY	Community	Energy	IAQ/Health	Resources	Water
G. Appliances					
1. Install ENERGY STAR® Dishwasher					
a. ENERGY STAR®		1			
b. Dishwasher Uses No More than 6.5 Gallons/Cycle		1			1
2. Install ENERGY STAR® Clothes Washing Machine with Water Factor of 6 or Less		1			3
3. Install ENERGY STAR® Refrigerator					
a. ENERGY STAR®: 15% above Federal Minimum		1			
b. Super Efficient Home Appliance (SEHA) Tier 2: 25% above Federal Minimum		1			
4. Install Built-In Recycling Center				2	
Appliances=Total 11		**5**		**2**	**4**
H. Insulation					
1. Install Insulation with 75% Recycled Content					
a. Walls and/or Floors				1	
b. Ceilings				1	
2. Install Insulation that is Low-Emitting (Certified Section 01350)					
a. Walls and/or Floors			1		
b. Ceilings			1		
3. Pre-Drywall Inspection Shows Quality Installation of Insulation		1			
Insulation=Total 5		**1**	**2**	**2**	
I. Heating, Ventilation & Air Conditioning					
1. Design and Install HVAC System to ACCA Manual J, D, and S Recommendations		4			
2. Install Sealed Combustion (Direct Vent) Units in Conditioned Space					
a. Furnaces			2		
b. Water Heaters			2		
3. No Fireplace or Sealed Gas Fireplace with Efficiency Rating not less than 60%			1		
4. Install ENERGY STAR® Ceiling Fans with CFLs in Living Areas and Bedrooms		1			
5. Install Ventilation System for Nighttime Cooling					
a. Whole House Fan		1			
b. Automatically Controlled Integrated System		2			
c. Integrated System with Variable Speed Control		3			
6. Install Air Conditioning with Non-HCFC Refrigerants	1				
7. Design and Install Effective Ductwork					
a. Install HVAC Unit and Ductwork within Conditioned Space		3			
b. Use Duct Mastic on All Duct Joints and Seams		1			
c. Install Ductwork under Attic Insulation (Buried Ducts)		1			
d. Pressure Balance the Ductwork System for Master Bedroom		1			
e. Protect Ducts during Construction and Clean all Ducts before Occupancy			1		
8. Install High Efficiency HVAC Filter (MERV 6+)			1		
9. Install Zoned, Hydronic Radiant Heating with Slab Edge Insulation		1	1		
10. Install Mechanical Ventilation System					
a. Any Whole House Ventilation System That Meets ASHRAE 62.2		1	2		
b. Install ENERGY STAR® Bathroom Fan			1		
c. All Bathroom Fans Are on Timer or Humidistat			1		
11. Use Low-Sone Range Hood Vented to the Outside			1		
12. Install Carbon Monoxide Alarm(s)			1		
HVAC=Total 34	**1**	**19**	**14**		
J. Building Performance					
1. Design and Build High Performance Homes (2 pts each 1% energy efficiency above T-24)		30			
2. House Obtains ENERGY STAR® with Indoor Air Package Certification			5	2	
3. Inspection and Diagnostic Evaluations					
a. Third Party Energy and Green Building Review of Home Plans		1	1	1	
b. Blower Door Test Performed		1			
c. House Passes Combustion Safety Backdraft Test			1		
Building Performance=Total 42		**32**	**7**	**3**	

POINTS PER CATEGORY	Community	Energy	IAQ/Health	Resources	Water
K. Renewable Energy					
1. Pre-Plumb for Solar Hot Water Heating		4			
2. Install Solar Water Heating System		10			
3. Install Wiring Conduit for Future Photovoltaic (PV) Installation and Provide 200 square feet of South-facing Roof		2			
4. Install Photovoltaic (PV) Panels (1.2kw - 6 pts; 2.4kw - 12 pts; 3.6kw - 18 pts)		18			
Renewable Energy=Total 34		**34**			
L. Finishes					
1. Provide Permanent Walk-Off Mats and Shoe Storage at Home Entrances			1		
2. Use Low/No-VOC Paint					
a. Low-VOC Interior Wall/Ceiling Paints (<50gpl VOCs - Flat; <150gpl VOCs - Non-Flat)			1		
b. Zero-VOC Interior Wall/Ceiling Paints (<5gpl VOCs - Flat)			3		
3. Use Low VOC, Water-Based Wood Finishes (<150gpl VOCs)			2		
4. Use Low-VOC Construction Adhesives (<70gpl VOCs) for All Adhesives			2		
5. Use Recycled-Content Paint				1	
6. Use Environmentally Preferable Materials for Interior Finish: A) FSC-Certified Wood, B) Reclaimed Lumber, C) Rapidly Renewable D) Recycled-Content or E) Finger-Jointed					
a. Cabinets (50% Minimum)				1	
b. Interior Trim (50% Minimum)				1	
c. Shelving (50% Minimum)				1	
d. Doors (50% Minimum)				1	
e. Countertops (50% Minimum)				1	
7. Reduce Formaldehyde in Interior Finish (Section 01350)					
a. Subfloor (50% Minimum)			1		
b. Cabinets (50% Minimum)			1		
c. Interior Trim (50% Minimum)			1		
d. Shelving (50% Minimum)			1		
8. After Installation of Finishes, Test of Indoor Air Shows Formaldehyde Level <27ppb			3		
Finishes=Total 22			**16**	**6**	
M. Flooring					
1. Use Environmentally Preferable Flooring: A) FSC-Certified or Reclaimed Wood, B) Rapidly Renewable Flooring Materials (Cork, Linoleum, Bamboo, Natural Fiber Carpet), C) Recycled-Content Ceramic Tiles, D) Exposed Concrete as Finished Floor or E) Recycled-Content Carpet					
15% of Floor Area				1	
30% of Floor Area				1	
50% of Floor Area				1	
75% of Floor Area				1	
2. Floors Provide Thermal Mass: Use Tile or Concrete for Floors		1			
3. Flooring Meets Section 01350 or CRI Green Label Plus requirements (50% Min.)			2		
Flooring=Total 7		**1**	**2**	**4**	
N. Other					
These points are given for innovative approaches or local priorities not listed above. Points will be evaluated and awarded by the municipality where project is located					
1. Incorporate Green Points Checklist in Blueprints	Pre				
2. Develop Homeowner Manual of Green Features/Benefits		1	1		1
3. Community Design Measures and Local Priorities: Maximum of 20 points.	20				
4. Innovation: List innovative measures that meet the green building objectives of the Guidelines. Maximum of 20 points total.	20				
Other=Total 43	**20**	**1**	**1**		**1**

	Community	Energy	IAQ/Health	Resources	Water	Total
Total Available Points	24	107	45	64	31	292
Points Required from Specific Categories	-	11	5	6	3	25
Additional Points from Any Category						25
MINIMUM POINTS REQUIRED						**50**

Chapter Four:
Green Building Measures

Every green feature in these Guidelines benefits the builder, homebuyer and the environment. This chapter lists each feature, discusses the conditions under which it should be used, and describes the benefits. A few green building practices are required by California or local codes. These "Building Basics" are included for educational purposes and are not numbered or listed in the Green Points Checklist.

"Green Building is about combining land use planning and building construction to create communities that are better for people. It is time for homebuilders to combine stewardship of the environment with economic growth to create a healthier and more environmentally sustainable future."

—**Don Babbitt, Heartwood Communities**

Community Design and Planning

Community design and planning measures have a substantial influence on the overall environmental impact of a home. The following green building practices are recommended in the Guidelines but not listed separately in Green Points because they may not be in the developer's or builder's control. Projects may receive points for these measures in Section N of Green Points.

1. Develop Infill Sites

Description:

Infill development reduces pressure to develop greenfields such as open space and farmland by reclaiming abandoned and underutilized sites and buildings.

Application:

When selecting a development site, choose built urban settings where public infrastructure is already in place. Give preference to locations that are: in a downtown area; targeted for revitalization; close to major employment centers; and/or within an urban growth boundary or designated for development by the local jurisdiction. Also, locate the project within walking distance of a major transit stop; look for locations where good transit service already exists or work with officials to bring public transit to the area.

Benefit:

Urban infill allows public funds to be used for maintaining or upgrading existing services such as schools, transit and sewers, rather than diverting limited funds to the development of costlier new services.

2. Cluster Homes and Keep Size in Check

Description:

On a given site, there are often many options for placing and orienting homes. Paying careful attention to land use and home size can help conserve natural resources.

Application:

A. Cluster Homes for Land Preservation

Two strategies for minimizing developed areas are clustering homes and building upward instead of outward. Besides preserving open space, certain clustered designs also use building materials and energy efficiently due to shared walls or roofs.

B. Conserve Resources by Increasing Density

Developments that allow for more households on a given site reduce pressure to develop greenfields or open space. Where there is access to public transit or commercial activities, dense developments offer the advantage of shorter commutes, less dependence on cars, and walkable communities.

C. Design Homes for Reasonable Size

Homes can be designed to be comfortable and spacious without being excessively large; smaller, more compact homes conserve land, building materials and energy.

Benefit:

Minimizing the development footprint and providing permanent open spaces can help protect the local ecosystem and enhance the community. Homes that are clustered and not overly large may cost less to build.

3. Subdivision Layout and Orientation

Description:

Summer temperatures in neighborhoods that have large expanses of pavement exposed to the sun can be several degrees warmer than neighborhoods with shaded pavement. Homes that are oriented without regard to solar access may require excessive energy to heat and cool. Planning strategies that take solar access into account can address these concerns.

Application:

Plan streets and lot layouts to provide for shading of streets by trees to reduce this "heat island" effect.

Keeping streets narrow will make them easier to shade by trees and will contribute to traffic calming, improving safety.

Orient homes on an east-west access to facilitate passive solar design, reduce heating and cooling energy use, and facilitate placement of rooftop solar electric and solar thermal systems. Use alley ways, greenbelts, and other methods to provide good solar access to the homes.

Benefit:

Planning for solar access and shading can create more pleasant neighborhoods, lower homeowners' energy bills, and reduce reliance on fossil fuel-based energy.

4. Design for Walking and Bicycling

Description:

Walking and bicycling are inexpensive, healthy forms of transportation but they are often incompatible with conventional car-based development patterns. Convenience, safety and aesthetics are key factors in promoting travel by foot and bicycle.

Application:

A. Provide Pedestrian Access to Neighborhood Services

Build pedestrian-friendly communities that combine residential and commercial spaces so that people can shop, play and meet their daily needs close to where they live.

B. Include Pedestrian Pathways that Connect to Recreation

Many new home developments include plans for new roadways and pedestrian paths. Where applicable, connect walkways to places of interest, such as parks, stores, and recreation areas. Use landscaping buffers to separate sidewalks from roadways.

C. Design Traffic-Calming Elements to Encourage Walking and Bicycling

Design 10-foot vehicle travel lanes, rather than the standard 12-foot lanes, to discourage fast driving. Use the remaining right of way for bike lanes. Consider rumble strips, bulbouts and raised crosswalks to reduce speeding.

Benefit:

Walking and bicycling are inexpensive, healthy forms of physical activity, transportation and neighborhood interaction. Traffic-calming measures reduce pedestrian injury rates and increase neighborhood economic activity and public safety.

5. Design for Safety and Social Gathering

Description:

Design buildings and landscapes to deter crime and promote safety through casual observation and community interaction.

Application:

Design all home entrances so that outside callers can be seen from inside the home. Place tall windows with low sill heights at front doors, or use transparent panels in the doors so any occupant, including children and the disabled, can view all visitors.

Orient porches to streets and public spaces to provide natural surveillance. Help keep the community safe and neighborly by orienting windows so that residents can easily view and feel comfortable using nearby areas such as outdoor benches, pathways, pocket parks, children's play areas and other features that promote socializing.

Benefit:

While it may be possible to deter some crime with tall fences, gates, video surveillance and bright lights, these elements also deter outdoor play and neighborliness. Creating a greater sense of community in residential areas results in safer and more inviting living.

6. Design for Diverse Households

Description:

Simple universal design elements make it much more likely that residents can remain in their homes as they age, if they become temporarily or permanently disabled, or if they wish to have elderly relatives join their household.

Application:

Design homes so that at least one prominent entrance (not from a garage) has a zero-step clearance, with less than 1/2-inch difference in height. Design all main-floor interior doors and passageways to have a minimum 32-inch clear passage space to accommodate disabled persons. Locate at least a half-bath on the ground floor with blocking in the walls for grab bars. Ideally, also locate a bedroom on the ground floor. Consider providing a full-function, independent unit that would allow extended family members to reside at home yet maintain independence.

Benefit:

Over the long term, money can be saved and remodeling waste minimized if homes are designed from the outset to accommodate changing occupant needs and a wider range of physical abilities.

Sacramento Street Cohousing, Berkeley.

1. Protect Native Soil and Minimize Disruption of Existing Plants and Trees

Description:

Soil is a valuable, living resource that should be protected. Through careful planning and construction practices, valuable soil as well as mature trees and other plants can be preserved and incorporated into new landscapes and neighborhoods.

Application:

Complete a landscape survey to determine the feasibility of preserving or relocating mature trees, shrubs and native vegetation. Protect trees and shrubs from construction equipment by placing temporary fencing beyond their driplines. Create or preserve wildlife corridors adjacent to open space, wild lands and creeks.

Evaluate the soil. Design for minimum building and hardscape footprints and little or no grading. Limit and delineate the construction footprint; restrict heavy equipment that compacts soil, including cars, to areas that will be paved or built over. When grading is unavoidable, existing horticulturally suitable topsoil shall be stockpiled and re-spread during final landscape grading. Identify areas to be paved as a place to store native topsoil during construction. Protect stored soil from erosion, amend with compost, and re-spread after construction. Any new soil shall be similar to existing soil in pH, texture permeability, and other characteristics, unless evidence is provided that a different type of soil amendment approach is justified.

Benefit:

Healthy soils can significantly reduce storm runoff, reduce fertilizer

BUILDING BASICS | Incorporate Passive Solar Design

Passive solar heating involves storing the sun's energy during the day in building materials that have high thermal mass; those materials later convey their heat to interior spaces, reducing the need for furnace operation. Passive cooling involves using overhangs and other exterior window shading to keep the sun out in summer, taking advantage of thermal mass to moderate temperature swings, ventilating the home with cool night air, and other practices to reduce or eliminate air conditioner operation.

Some of the energy benefits derived from passive strategies can be evaluated using California Building Energy Efficiency Standards (Title 24) compliance models. Consider implementing these passive strategies:

a. Plan subdivision lots and street layout to optimize solar access for all homes. See *Subdivision Layout and Orientation* in Community Design and Planning.
b. Orient the home with the long axis running east-west and minimize east- and west-facing windows to improve passive solar performance.
c. Use wall and floor materials that improve thermal mass. For additional information, see *Provide Thermally Massive Walls* in Section D: Structural Frame and Building Envelope and *Provide Thermally Massive Floors* in Section M: Flooring.
d. Design windows to catch prevailing breezes and provide cross ventilation. Install high windows, skylights or cupolas with securable low windows to create a stack effect that exhausts rising hot air and draws in cooler outdoor air.
e. Incorporate roof overhangs, awnings, trellises and shade trees to selectively control solar heat gain through windows. See *Plant Shade Trees* in Section B: Landscaping.
f. Reduce solar heat gain through exterior surfaces by using light exterior colors or paints with reflective pigments, ENERGY STAR® roofing materials, and/or radiant barrier roof sheathing. Roofing materials are available that have a reflectance greater than 0.75 and an emittance greater than 0.70. See Building Basics in Section J: Building Performance for application details.
g. Install energy-efficient windows (double-paned, low-conductivity frames and low-e coating). There are two types of low-e glazing. One is heat rejecting (hard coat) and the other is heat receiving (soft coat). The recommended south glazing for passive solar buildings is low-e hard coat, heat receiving glazing with a U-factor of .33 and a solar heat gain coefficient (SHGC) of .65 See Building Basics in Section J: Building Performance for additional information about windows.

and pesticide requirements, improve water quality and conserve irrigation water. Protection of existing mature landscape features helps prevent soil erosion, maintains sources of natural cooling, diverts waste from landfills, preserves nature and adds value to the community.

2. Deconstruct Instead of Demolishing Existing Buildings

Description:

Deconstruction of existing buildings is a good way to salvage quality building products that have not yet reached the end of their usable life, even if the building or part of it has. Salvaged materials are often less expensive to purchase than new materials, and may be of higher quality, especially salvaged wood.

Application:

Whole house deconstruction requires a team of workers experienced in dismantling buildings. Locate a demolition contractor who offers deconstruction services or an organization specializing in salvaged materials. In some cases, deconstruction may cost more than traditional demolition, but donating the salvaged materials to a nonprofit or charity may result in a substantial tax deduction that can offset the cost.

Common salvageable materials include timber, doors, sinks, fencing, bricks, tile, pipes, hardware and light fixtures. Reclaimed lumber, in the form of studs, beams, flooring and trim, is among the most valuable and available of salvaged building products.

Benefit:

Reusing building materials typically generates less waste and pollution than recycling does.

3. Recycle Job Site Construction Waste

Description:

Each year over 4,000,000 tons of construction and demolition (C&D) debris is disposed of in California landfills. This represents 21% of the statewide waste stream, but in newer communities C&D waste sent to landfills can be as high as 50%. Construction waste generally consists of wood, drywall, metal, concrete, dirt and cardboard. It can also include plant debris (green waste) from the landscape. Much of this material can be reused or recycled.

Application:

Identify the types and quantities of materials generated at the job site and reuse or recycle at least 50% of the construction debris, including green waste. Allocate space for recycling bins and containers on the job site and train workers. Separate green waste from other materials. Contact the California Integrated Waste Management Board at www.ciwmb.ca.gov for more information on recycling facilities.

Benefit:

Reuse and recycling of construction debris conserves natural resources and slows the rate at which landfills reach capacity. In addition, builders can save money by lowering disposal fees.

4. Use Recycled-Content Aggregate for Walkway, Driveway and Roadway Base

Description:

Virgin aggregate comes from sources such as riverbeds and quarries where mining activities may disturb the environment. Recycled aggregate consists mainly of crushed concrete and crushed asphalt pavement. Recycled concrete and asphalt crushed to 3/4-inch meets the California Department of Transportation's (CalTrans) specification for Class 2 Aggregate Base.

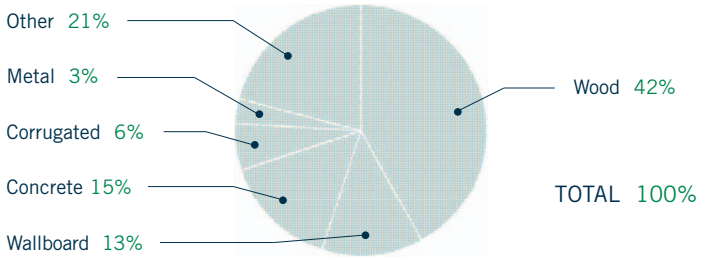
Application:

Use wherever Class 2 aggregate is specified; for example as drainage backfill, and under driveways, sidewalks and building slabs.

Benefit:

Recycled aggregate puts waste materials to good use.

Construction Waste Generated from a 2,000-Square-Foot New Home



Source: Based on waste generation studies for three residential developments in Alameda County (1999–2004) and compiled by Matthew J. Southworth, P.E. – Civil Engineer

BUILDING BASICS | Control Stormwater Runoff

Land development and construction activities can significantly alter natural drainage patterns and pollute stormwater runoff. Excessive stormwater runoff can erode residential landscapes and local streams, and stress local stormwater drainage systems, increasing flood risks. Keeping sediment and pollutants out of storm drains helps protect local creeks, reservoirs and the ocean. Increases in impervious surfaces are directly related to reductions in water quality in nearby creeks, rivers, lakes and bays.

Because controlling stormwater runoff is critical to protecting water quality, many projects will need to file a Notice of Intent (NOI) and prepare a Stormwater Pollution Prevention Plan (SWPPP) per the State General Construction NPDES Permit. Be sure to contact your local municipality for during-construction and post-construction stormwater quality control requirements.

During construction and grading, use stormwater Best Management Practices (BMPs) to control erosion and to prevent sediment and pollutants from entering storm drains. Erosion control protects the soil surfaces whereas sediment control traps soil particles after they have been dislodged. Consider implementing these BMPs during the construction stage:

a. Schedule grading so that disturbed slopes are stabilized and revegetated during the non-rainy season. Minimize and delineate the area to be disturbed.

b. Trap sediment on site using a combination of effective erosion and sediment control measures. Place barriers around storm drain inlets to pond water and allow sediments to settle out.

c. Cover construction materials and stored topsoil exposed to rain; store wastes under cover and dispose of properly.

d. Install temporary concrete washout areas for use by contractors to prevent pollution from entering storm drains.

e. Educate on-site workers to practice good housekeeping practices and implement best management practices to prevent stormwater pollution.

f. Inspect and maintain control measures before and after each rainstorm.

Post-construction activities include protecting the stormwater by implementing permanent stormwater controls. Consider incorporating the following BMPs into your project:

a. Minimize the total amount of impervious paved area used for roadways, driveways, walkways, and patios by avoiding large expanses of contiguous impermeable surfaces.

b. Install gravel, porous concrete and permeable pavers that allow stormwater to percolate through and infiltrate into subsurface drainage systems or the ground. This reduces stormwater runoff and filters out sediments.

c. Direct stormwater runoff from hardscapes toward adjacent landscaped areas that are graded to receive the excess water; this will help recharge groundwater, filter pollutants, and water vegetation.

d. Construct rainwater catchment systems such as ponds, cisterns and other rainwater collection basins. Stormwater ponds collect, retain and filter runoff during and after a storm. The pond's natural chemical, physical and biological processes remove suspended solids, metals and dissolved nutrients.

e. Create a biofilter, such as a swale, to slow the flow of stormwater into storm drains and allow pollutants to settle and decompose. This will reduce sedimentation and other pollutants in the water. Large planting beds designed as swales can absorb stormwater from a building's downspouts.

1. Construct Resource-Efficient Landscapes

Description:

Conventional landscapes are mono-cultures that require high inputs of water and chemicals and are often planted without regard for climate and soil conditions. California native plants are adapted to our soils, wildlife, rainfall and climate. Invasive plants used in landscaping often escape into natural areas, where they can spread rapidly, out-compete natives, degrade wildlife habitat, and increase the wildfire fuel load.

Application:

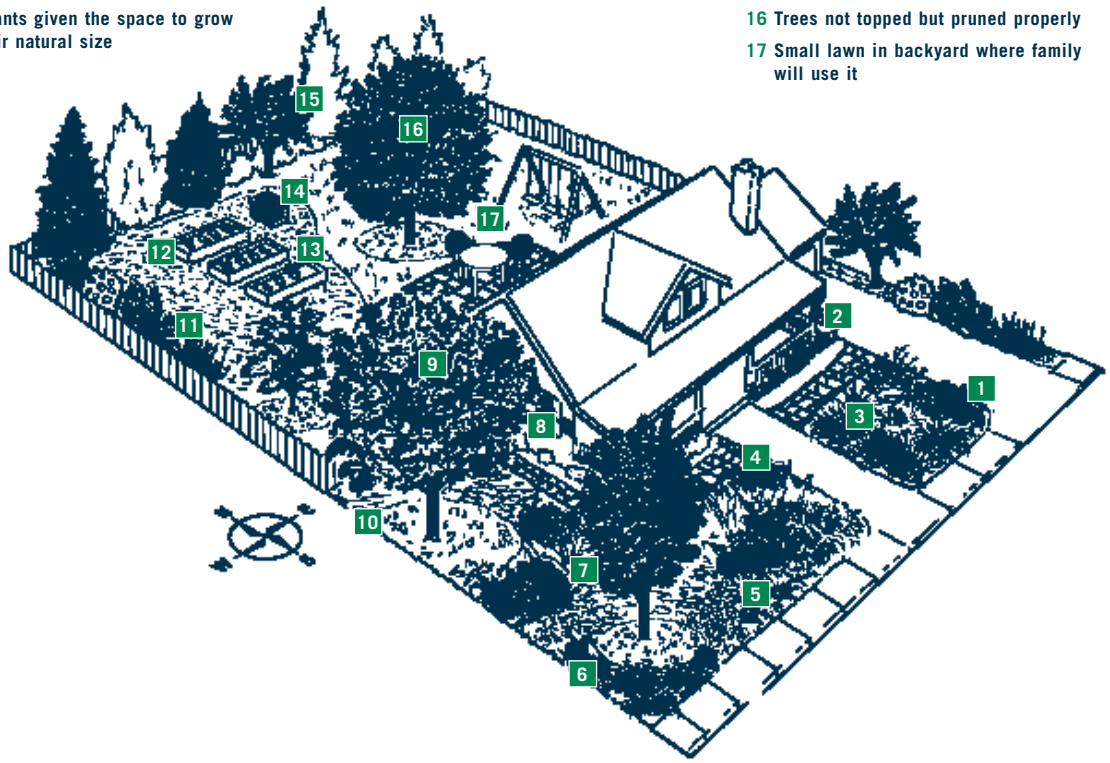
Evaluate the climate, exposure, and topography of the site and assess the soil. Select drought-tolerant, California native or other Mediterranean species that are appropriate for the site soil and microclimates. Plant a variety of trees, shrubs and other perennials and limit annuals. Give plants plenty of room to mature, reducing the need for pruning and shearing. Prune and water appropriately. Limit turf to the smallest area that will meet recreational needs.

Include a site for composting and mulching plant debris. Find out which invasive species are problematic locally; do not include them in the planting palette and eliminate any from the site before planting. (See www.Cal-IPC.org for a list of local invasive species for your area.)

Benefit:

A diverse landscape of native species supports beneficial birds, bees and other insects and may resist disease and other pests better than one with little variety. Choosing plants appropriately will also reduce the amount of plant debris sent to landfills.

1 Permeable paving on driveway and walkway to front door
2 Water from roof channeled to cistern
3 Water for wildlife habitat
4 Pavers with spaces and low water use plants between
5 Front lawn replaced by diverse plantings with many California native groundcovers, shrubs and trees, but no invasive species
6 All plants given the space to grow to their natural size
7 Plants selected to match the microclimates
8 Irrigation controller waters hydrozones according to plant needs, soil moisture and weather
9 Deciduous trees placed to the west & southwest of the house & patio for summer cooling
10 Repository for leaves to collect under trees as mulch
11 Mulched paths keep soil covered
12 Drip irrigation for vegetable beds, shrubs, trees and elsewhere where feasible
13 Raised beds are constructed from plastic or composite lumber
14 Compost bin recycles plant and kitchen debris
15 Evergreen windbreak blocks north winter winds
16 Trees not topped but pruned properly
17 Small lawn in backyard where family will use it



2. Use Fire-Safe Landscaping Techniques

Description:

California's hot, dry climate makes fire protection an important consideration for landscape design, especially because new home developments are increasingly located adjacent to areas that may be prone to wild-fires. Simple landscaping design practices can help defend the homes by reducing fuel accumulation and interrupting the fire path.

Application:

Determine whether the site is in a high-risk area. Map the site, identifying exposure to prevailing winds during the dry season and steep slopes that can increase wind speed and convey heat. Identify adjacent wildlands or open space, as well as south- and west-facing slopes and their vegetation, particularly species that burn readily.

For sites adjacent to fire sensitive open space or wildlands, create defensible space around buildings; this is an area where vegetation is modified to reduce fuel load and allow firefighters to operate. Use irrigated, low-growing, fire-resistant vegetation, patios, paving stones and other low-risk features in the zone immediately surrounding the structure. Specify plants with low fuel volume and/or high moisture content. Avoid plants with high oil content or that tend to accumulate an excessive amount of dead wood or debris.

Do not plant trees and shrubs at distances where limbs and branches will reach the house or grow under overhangs as they mature. To minimize fire ladders, do not plant dense hedges or space tall vegetation too closely together. Use mulch (except fine shredded bark) and decomposed granite to control weeds and reduce fuel for fires. Construct roofs, siding and decks with fire-resistant materials. Consider alternatives to wood fences, such as rock walls.

Benefit:

Fire-safe landscaping and building reduces risk of harm to residents and firefighters, and protects valuable personal and community assets.

3. Minimize Turf Areas

Description:

Lawns (or turf) are useful for recreation and relaxation, but turf requires frequent watering and application of fertilizers or other chemicals to stay green during California's long dry season.

Application:

Replace decorative lawns with water-conserving California native groundcovers or perennial grasses, shrubs and trees. If lawns are desired, plant in small areas where they are most likely to be used for play and relaxation. Choose plant species that have a water requirement less than or equal to tall fescue. Avoid planting turf on slopes greater than 10% or in irregularly shaped areas that cannot be irrigated efficiently. Avoid turf in isolated areas (driveway strips) or other areas less than 8 feet wide on the shortest side, unless irrigated with subsurface irrigation or micro spray heads.

Benefit:

Minimizing turf conserves water. If a 1,000-square-foot lawn needs 1 inch of water per week, reducing it to 500 square feet can save approximately 10,000 gallons of water per dry season. Chemical use may also be decreased, thereby protecting the quality of local waterways and aquifers.

4. Plant Shade Trees

Description:

During summer months, the sun heats up homes, which makes air conditioners work harder and drives up peak utility demand. Large shade trees keep direct sun off the roof, walls and windows in the summer, thereby lowering cooling costs and increasing comfort while providing an attractive landscape.

Application:

Augment the existing tree cover on the site, particularly to the west of the building, by planting drought-tolerant, California native or other Mediterranean tree species that are appropriate for the site soil and microclimates. Plant trees to shade walls, windows and paved areas. If the building design includes passive solar heating, do not plant trees too close to the home's south side. Avoid planting trees too close to utilities. Plant a variety of deciduous trees and give them plenty of room to mature, reducing the need for pruning and shearing.

Benefit:

Shade trees can create a microclimate that is up to 15°F cooler than the surrounding area, and can

reduce summer air-conditioning costs by 25 to 40%. Peak utility demand is at its highest during late afternoons in the summer; shade trees play an important role in reducing this demand. Trees provide numerous additional benefits including cleansing the air, creating habitats for birds, providing play places for children, making neighborhood more beautiful and increasing property values.

5. Implement Hydrozoning: Group Plants by Water Needs

Description:

Different plants have different water requirements. Dividing the landscape into low, medium and high water-use zones prevents overwatering.

Application:

Group plants by water needs, creating irrigation zones based on the plants' water requirements and their exposure. Delineate each hydrozone on the site, irrigation and planting plans. Place thirstier plants in relatively small, highly visible areas and if possible, in spots that naturally collect water. Plant the larger perimeter areas with drought-adapted species. Install separate irrigation valves for different zones. Consider that some California natives do not tolerate water in the summer after they are established; be sure to separate them from plants that need irrigation.

Benefit:

Hydrozoning matches irrigation to the plants' water requirements, conserving water and fostering resistance to pests. Plant mortality is also reduced, saving time and money.

6. Install High Efficiency Irrigation Systems

Description:

With increasing demand on our water resources, efficient irrigation is vital to California landscapes. Drip and bubbler irrigation technologies apply water to the soil at the plant root zones at the rate the soil can absorb it, and are often more appropriate than overhead sprinklers in areas that are narrow, oddly shaped or densely planted, or in areas such as parking lots and medians. Low-flow sprinkler heads apply water uniformly and slowly.

Application:

Design the irrigation system to meet the requirements of your local water conservation ordinance. Install drip, subsurface drip or low-flow sprinklers in place of standard sprinkler systems for all landscape applications.

Upgrade to new "smart" (weather-based) irrigation controllers that have at a minimum the following capabilities: 1) water budgeting feature, 2) automatic periodic adjustments to the irrigation program, accomplished through external sensors, internally stored historical weather data or a provider-supplied signal, 3) multiple start times, 4) run-times able to support low-volume applications, 5) irrigation intervals for days of the week or same-day intervals, and 6) more than one operating program (for example, A=turf, B=shrubs, C=water features). If necessary, turn off the irrigation system or valve for the landscape or hydrozone that includes all California natives, once the plants are established.

Benefit:

High efficiency irrigation systems minimize overspray and evaporation and reduce runoff, dramatically reducing landscape water use while preventing disease and minimizing weed growth that results from overwatering.

7. Apply Compost to Promote Healthy Topsoil

Description:

A robust, living soil with sufficient organic content is the foundation of a water-conserving, resource-efficient, low-impact landscape. Adding good quality compost before planting brings life to the soil and feeds existing soil organisms, fueling many natural processes that supply nutrients, minimize disease and improve soil quality.

Application:

Assess the soil quality on site: have the soil professionally analyzed for texture, nutrient and organic matter content and pH, especially if the topsoil was not protected during construction. Request the laboratory recommendations be made for organic or environmentally friendly amendments.

Incorporate 2 to 4 inches of compost into the top 6 to 12 inches of soil, or as much as is required to bring the soil organic matter content to 3.5% for turf and 5% for planting beds, except for plant species that will not thrive in such soils. Use fully stabilized, certified compost as a soil amendment where appropriate. Loosen all planting and turf areas to a minimum depth of 6 inches prior to final landscape grading.

Topdress with compost around established shrubs and trees and on turf.

Benefit:

Compost can increase permeability, water-holding capacity, and plant nutrient availability and improve the ability of the soil to filter pollutants. This encourages healthy plant growth, improves water quality, reduces the need for irrigation, and lowers water bills.

8. Mulch All Planting Beds

Description:

Mulch is any material spread evenly over the surface of the soil. Organic materials, including chipped landscape debris, are preferable over inorganic materials because they supply nutrients over time and provide wildlife habitat.

Application:

Apply and maintain a minimum of 2 inches of natural mulch to all soil surfaces or at least until plants grow to cover the soil. Do not place mulch directly against any plant stem or tree. Designate areas under trees and away from hardscapes or storm drains as repositories for fallen leaves to remain as mulch. Buy mulch produced from urban plant waste debris, or from local suppliers within a 150-mile radius.

Benefit:

Mulch can conserve water, reduce weed growth and simplify maintenance operations.

9. Use Salvaged or Recycled-Content Materials for Landscape Elements

Description:

Landscaped elements present many opportunities for using salvaged or recycled materials. Recycled plastic or recycled composite lumber makes a very durable landscape edging; broken concrete can make a very attractive retaining wall or path and tumbled glass cullet a beautiful walkway.

Application:

Use salvaged or recycled-content materials for hardscapes (planting beds, patios, decks, walls, walkways and driveways) and other landscape features (for example, edging, benches, play equipment). If recycled plastic or composite lumber is not appropriate, use sustainably harvested wood (FSC certified).

Benefit:

For landscaping and hardscaping, recycled plastics or composites are generally much more durable than wood because they do not rot, crack or splinter or require ongoing wood treatments.

10. Reduce Light Pollution

Description:

Light pollution occurs when outdoor light fixtures let excess light escape onto neighboring properties and into the night sky.

Application:

Avoid outdoor lighting where it is not needed. Use motion and photosensor lights for security, rather than all night illumination. Exterior lighting that provides low contrast on critical areas, such as sidewalks and home entrances, is better for visual acuity than overlighting. Eliminate all unshielded fixtures, such as flood-lights. Look for fixtures certified by the Dark Sky Association for light pollution reduction (www.darksky.org).

Benefit:

Reducing light pollution minimizes neighborhood or wildlife habitat disruption and saves energy.

Landscape before and after an upgrade that reduced lawn size, increased diversity, improved property values, cut water bills by 50% and reduced maintenance costs by 20%.

C. Foundation

1. Incorporate Flyash in Concrete

Description:

Flyash is a byproduct of coal-burning power plants. It is typically landfilled, but can be an inexpensive and quality substitute for a portion of the Portland cement in concrete. Concrete suppliers routinely replace 10 to 15% of the Portland cement in their mixes with flyash.

Application:

Typically, up to 50% of cement can be replaced with flyash in residential concrete mixes. However, high-volume flyash mixes may require longer cure times than standard concrete.

Benefit:

Flyash improves the performance of concrete by increasing strength, reducing permeability and reducing corrosion of reinforcing steel. Using flyash also reduces the amount of water and cement needed, thereby decreasing the overall environmental impacts of cement production and water sourcing.

2. Use Frost-Protected Shallow Foundation in Cold Areas (Climate Zone 16)

Description:

Foundations in cold climates are typically quite large, sitting deep below the frost line to reduce the possibility of heaving damage from the freeze-thaw cycle. A frost-protected shallow foundation (FPSF) is surrounded by insulation, which, in effect, raises the frost line to just below the surface, allowing reduced excavation and foundation wall depths.

Application:

Excavate the foundation perimeter to 16 inches rather than the 36 to 48 inches typical for cold climates. Place insulation horizontally 4 feet extending out from the foundation, against the outside face of the foundation wall, and under the entire slab.

Benefit:

An FPSF typically results in a reduction of both concrete use and labor of up to 40%. Reducing excavation minimizes soil compaction and vehicle disturbance. Finally, the insulation under an FPSF can significantly moderate the foundation temperatures, making the home more energy efficient and comfortable.

3. Use Radon-Resistant Construction (in At-Risk Locations Only)

Description:

Radon gas is naturally emitted by some soils and rocks. The U.S. Environmental Protection Agency estimates that exposure to radon may be the second leading cause of lung cancer, after cigarette smoking. In California about 1% of homes have radon levels above the recommended mitigation level (4 picocuries). Most of these homes are located in the Sierra foothills and coastal mountains and foothills.

Application:

Use radon-resistant construction if a home is being built in EPA Radon Zone 1 or identified by the California Department of Health Services as having above average risk (www.cal-iaq.org/RADON). Lay a perforated pipe in a 4- to 6-inch layer of large gravel under the foundation slab. Connect this to a solid pipe running to the attic and through the roof. Attach a fan to this pipe for discharging the radon.

Benefit:

Installing a radon mitigation system will significantly reduce the occupants' levels of radon exposure.

BUILDING BASICS | Building Basics: Foundation Drainage System

Without proper rain and groundwater dispersion elements (as well as crawl space sealing techniques), unwanted moisture can easily migrate into the home, basement or crawl space. Once inside, moisture can cause decay of building materials and mold growth, and potentially lead to structural failure and indoor air quality problems.

A properly installed foundation drainage system includes the following:

- Soil grade sloped away from the home.
- Gutter system with downspouts directing away from the foundation.
- Foundation wall drainage panel.
- Footing perimeter drainage system.

Effective water management systems are important elements in maintaining the structural integrity of the home's foundation and reducing opportunities for mold growth within the home. Consult your local jurisdiction to ensure compatibility with stormwater management requirements.

D. Structural Frame and Building Envelope

1. Apply Optimal Value Engineering (Advanced Framing)

Description:

Optimal Value Engineering (OVE) is a set of framing techniques that reduce the amount of lumber used to build a home, while maintaining structural integrity and meeting the building code.

Application:

Implement any number of common OVE techniques including framing on 24-inch centers instead of 16-inch, using right-sized headers, and avoiding unnecessary lumber for sills and excess jack and cripple-studs around doors and windows.

Benefit:

Using OVE techniques saves wood and construction costs without a significant reduction in structural strength, while allowing for more of the wall to be better insulated.

2. Use Engineered Lumber

Description:

Solid-sawn lumber in sizes 2x10 and greater typically comes from old-growth forests. Engineered lumber products, on the other hand, come from small-diameter, fast-growing plantation trees. These products include glued laminated timber (glulam), laminated veneer lumber (LVL), laminated strand lumber (LSL), parallel strand lumber (PSL), wood I-joists, wood floor trusses, oriented strand board (OSB), and finger-jointed studs.

Application:

Substitute solid-sawn lumber with engineered lumber wherever applicable.

A. Beams and Headers

Engineered beams and headers can easily replace any solid-sawn member of similar size or even larger. In addition, solid-sawn lumber is often used for headers and beams when smaller dimension lumber would suffice.

B. Insulated Engineered Headers

Engineered headers with pre-installed insulation are lighter than solid wood headers, do not shrink (reducing cracks in drywall), and are sometimes less expensive than solid wood.

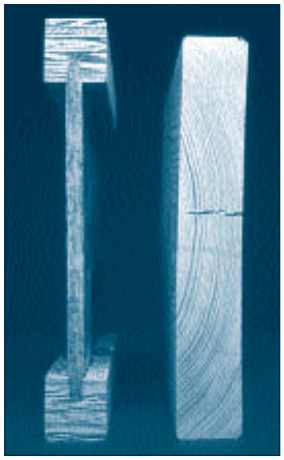
C. Wood I-Joists for Floors and Ceilings

The typical 2x10 and larger solid lumber used for floor and ceiling joists, can be replaced with engineered lumber in most applications.

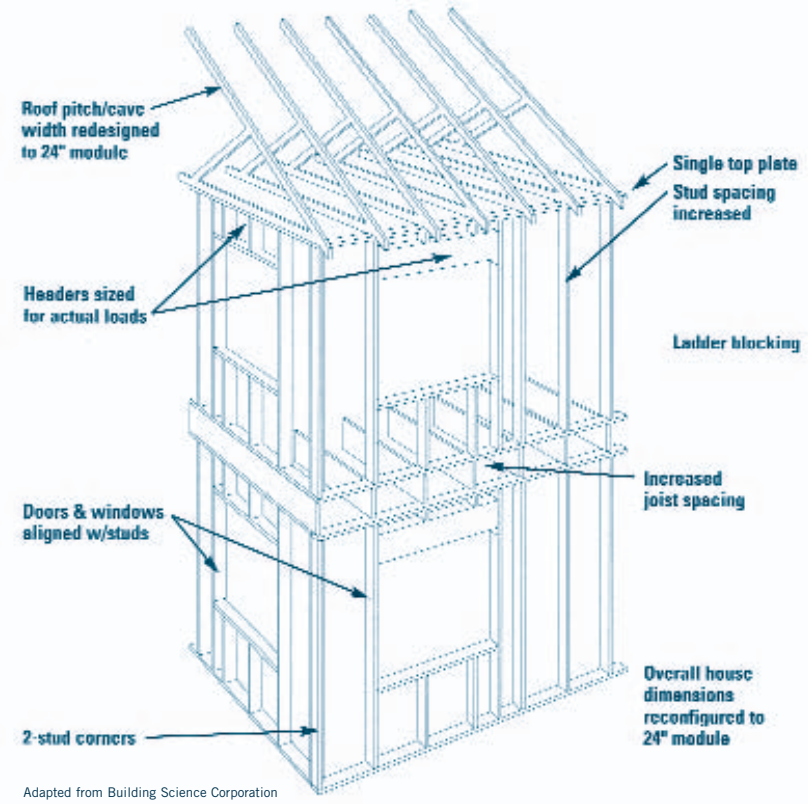
D. Floor Web Trusses

For long-span floor joists use floor web trusses instead of solid-sawn lumber. Not only are web trusses stronger than solid beams, they are lighter, and allow for easy passage of

I-Joists use 50% less wood fiber than solid sawn lumber.



Optimal Value Engineering Techniques.



Adapted from Building Science Corporation

ducts, pipes and wires through them, resulting in quicker installation.

E. Engineered or Finger-Jointed Studs

Use engineered or finger-jointed studs wherever conventional studs are typically used. Finger-jointed studs use short pieces of 2x4 or 2x6 material glued together to form standard stud lengths, while engineered lumber is typically veneers, strands or flakes of wood glued to form studs. These studs are all dimensionally straight and save on labor and material costs associated with culling crooked lumber and shimming and straightening crooked walls.

Benefit:

Reducing demand for large dimensional lumber decreases pressure to cut down old-growth forests. Engineered lumber uses wood fiber more efficiently than conventional lumber. Most engineered wood products are straighter and stronger than solid-sawn equivalents, eliminating crooked walls and squeaky floors, and reducing material waste.

3. Use FSC-Certified Wood for Framing

Description:

Forest Stewardship Council (FSC) certification assures that the forest from which the wood was harvested is managed in an environmentally, economically and socially responsible manner. FSC is the only lumber verification rating that maintains chain-of-custody certification throughout the cutting, milling and final delivery of products, thus ensuring that wood labeled as FSC actually came from a certified sustainably managed forest.

Application:

Use FSC wood where wood framing is required. Certified solid framing and plywood are available from some suppliers.

Benefit:

FSC certification assures that forests are managed in a way that protects the long-term availability of wood resources and the health of old-growth forests.

4. Design Energy Heels on Trusses

Description:

Energy heels raise the height of the truss at exterior wall top plates to accommodate increased insulation at the home's perimeter.

Application:

Install where conventional trusses are used. The increased height may require modifications to exterior soffit and trim details.

Benefit:

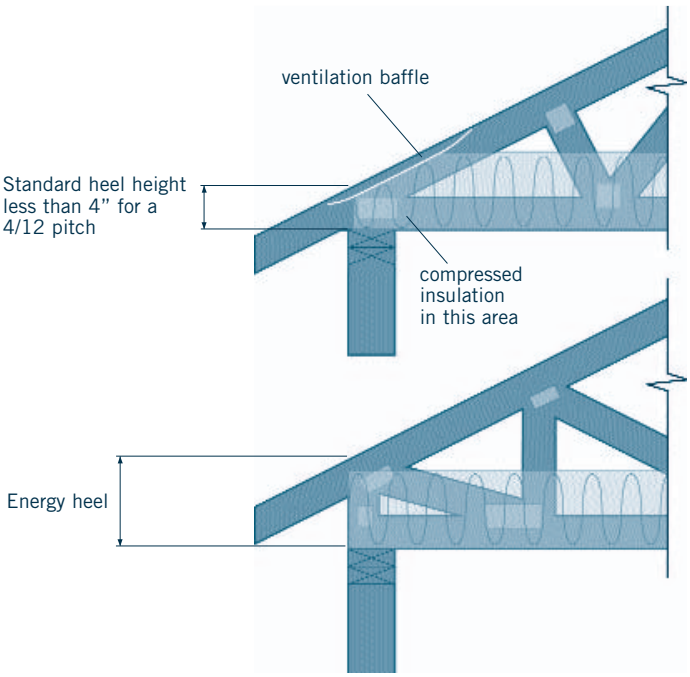
The perimeter intersection between walls and roof framing is often an area of increased heat loss since conventional trusses reduce insulation to less than 6 inches. Raising the heels allows for full insulation around the house, saving energy and money.

5. Design Trusses to Accommodate Ductwork

Description:

One way to include HVAC ducts in conditioned space (see Section I.7.A) is to design trusses with a raised center section that accomodates the ducts. This may add only slightly to the cost of the trusses.

Energy Heels on Trusses Allow More Insulation.



Application:

Coordinate with the HVAC contractor and structural engineer before ordering trusses to identify opportunities for including all ducts in conditioned space. If feasible, order trusses with a plenum space between the bottom truss chord and the ceiling; insulate the plenum and seal it with drywall or another air barrier.

Benefit:

Designing trusses to accommodate ducts can reduce the cost of the duct installation. It also reduces duct heat loss/gain and air leakage to outdoors.

6. Use Oriented Strand Board (OSB) for Subfloor and Sheathing

Description:

OSB is manufactured from fast-growing farm trees. OSB comes in sheets and is used for sheathing and subfloors.

Application:

Use OSB as an alternative to plywood for sheathing or subfloors.

Benefit:

OSB is as strong as traditional plywood sheet materials and is less expensive. OSB reduces the need for large-diameter old-growth trees required for plywood. Some OSB uses lower formaldehyde content adhesives that contribute to healthier indoor air quality.

7. Use Recycled-Content Steel Studs for Interior Framing

Description:

Steel studs can be either stand-alone or contain wood pieces within the "C" channel. Steel studs may or may not be load-bearing, depending on their rating.

Application:

Use in non-insulated interior walls.

Benefit:

In addition to its recycled content, steel provides strength, light weight, exacting specifications, fire- and pest-resistance, and fewer of the twisting, warping and other defects that can plague wood framing.

8. Use Solid Wall Systems

Description:

Solid wall systems include structural insulated panels (SIPs), insulated pre-cast concrete, insulated concrete forms (ICFs), aerated autoclaved concrete (AAC), rammed earth and similar systems.

Application:

Each of these systems entails its own specialized installation techniques. Always follow manufacturer specifications.

Benefit:

These walls replace wood stud construction by including structure, sheathing and insulation in a single durable, energy-efficient system.

9. Provide Thermally Massive Walls

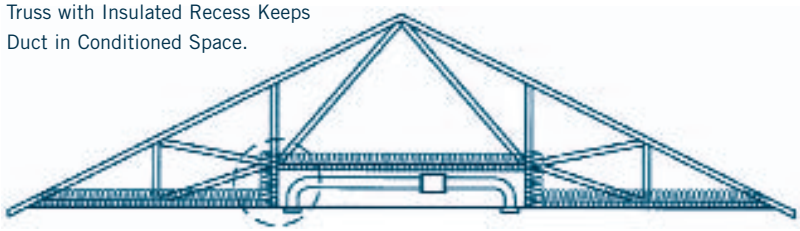
Description:

Use wall materials that improve thermal mass.

Application:

Low cost strategies for thermal mass walls include using 5/8" drywall on all interior surfaces. Less conventional approaches

Truss with Insulated Recess Keeps Duct in Conditioned Space.



Steven Winter Associates

Construction using SIPs.

include using pre-cast insulated concrete walls or insulated concrete forms (ICFs).

Benefit:

Increasing thermal mass will reduce heating and cooling energy use and will moderate indoor temperature swings, keeping the home more comfortable.

10. Design and Build Structural Pest Controls

Description:

Pests are attracted to water, food and rotting wood. Permanent, structural pest controls can stop pests along their typical pathways of entering the home.

Application:

a. Install Termite Shields and Separate All Exterior Wood-to-Concrete Connections by Metal or Plastic Fasteners or Dividers

Install a continuous, durable termite shield around all foundation slab penetrations (such as pipes), at the junction of the foundation or piers and the wall framing, and wherever slab perimeter insulation is installed.

When structural wood elements (such as posts, stairs and decks) are in constant contact with concrete or soil, they remain moist for prolonged periods. Create a separation to allow water to drain and wood to easily dry out.

b. Locate All New Plants At Least 36 in. from Foundation

Maintaining this minimum distance keeps roots away from the foundation, reduces the chance of pests traveling from nearby branches onto the home, and allows the homeowner to more easily inspect for termite tunnels around the home's foundation wall.

Benefit:

Physical pest controls are permanent controls that reduce the need to use unsafe chemicals. They also increase durability of the home's structural elements, reducing the time and money needed for repairs.

11. Reduce Pollution Entering the Home from the Garage

Description:

According to the U.S. Environmental Protection Agency (EPA), an attached garage is the single most significant contributor to poor indoor air quality in a home. Car exhaust contains many known carcinogens and can migrate into living spaces through doors and cracks in walls and ceilings adjacent to the garage. Other pollutants commonly found in garages include benzene from lawn mowers and power tools, pesticides for gardens, toxic cleaning agents, and chemicals in paints and adhesives.

Application:

a. Tightly Seal the Air Barrier between Garage and Living Area

Use foams, weatherstripping and caulking to completely seal garage walls and ceilings adjacent to the interior. Doors should have full weatherstripping and sealed thresholds. Spray-applied foam insulation that creates a complete air barrier is recommended.

b. Install Separate Garage Exhaust Fan

Install an exhaust fan on the opposite wall from the door to the house. It can be wired to an electric garage door or put on a timer to run after door has been opened or closed.

Benefit:

Properly designed garages keep polluted air out of the home.

12. Install Minimum 16-in. Overhangs with Gutters

Description:

Overhangs increase a home's durability by protecting it from the elements and helping regulate the amount of rain striking walls. Overhangs also provide shading for windows. Gutters provide a pathway for water to exit the roof without entering walls and splashing back onto the foundation and siding.

Application:

Design at least a 16-inch overhang with gutters around the building's entire roof. Consider adding deeper overhangs where needed to shade walls and windows to provide cooling during summer. Drain gutters at least 24 inches from the home and into a rainwater cistern or toward adjacent landscaped areas that are graded to receive the excess water so as to recharge groundwater, filter pollutants, and water vegetation.

Benefit:

Overhangs and gutters protect siding, windows and doors from water intrusion, thereby reducing the likelihood of rot and mold issues. Overhangs also provide protection from the sun's harsh UV rays, which can degrade building materials and furnishings.

E. Exterior Finish

1. Use Sustainable Decking Materials

Description:

A home's deck takes more abuse than just about any other building material. Besides being exposed to all the elements, the deck often gets heavy foot traffic.

Application:

a. Use Recycled-Content Decking (Avoid Virgin Plastic)

Use recycled-content decking in all nonstructural deck applications. Recycled plastic lumber contains only recycled plastic, while composite lumber is made by combining recycled wood fiber and recycled plastic. Both can be used in place of old-growth redwood, cedar and pressure-treated lumber. These products accept screws and nails, and cut like wood. Follow manufacturer recommendations closely regarding installation techniques.

b. Use FSC-Certified Wood Decking

FSC-certified lumber comes from forests managed in an environmentally and socially responsible manner. Use FSC-certified lumber for all exterior decking applications or as structural deck members in conjunction with recycled-content decking.

Benefit:

Recycled-content plastic and composite decking is more durable than wood. It doesn't rot, crack or splinter, doesn't require staining, and isn't treated with potentially toxic chemicals. Using recycled-content decking also reduces pressure to harvest old-growth forests. FSC certification guarantees that forests are managed in a way that will assure the long-term availability of wood resources and the health of old-growth forests.

2. Install a Drainage Plane (Rain Screen Wall System)

Description:

A drainage plane or rain screen wall system is an effective envelope solution to external moisture penetration. It allows for an air space between the siding and wall structure, protecting it from damaging rain intrusion.

Application:

Install siding with an air space between it and the wall. Flash all wall openings correctly and create vent strips at the top and bottom of the wall.

Benefit:

This system will significantly help protect a home from rain intrusion and the associated problems with rot and mold in the wall structure.

3. Use Durable and Noncombustible Siding Materials

Description:

Sidings made of metal, stone, brick, stucco and fiber-cement offer a durable and non-combustible home exterior.

Application:

Use in place of conventional wood siding.

Benefit:

Using these siding materials can reduce repainting and other maintenance needs, protect the home from fire, and possibly lower the homeowner's insurance rates, especially in fire-prone areas.

4. Select Durable and Non-combustible Roofing Materials

Description:

Forty- to fifty-year asphalt shingles, tile, slate, fiber-cement, recycled plastic and metal are examples of durable roofing materials. A Class A fire rating offers a home the highest in fire protection.

Application:

Applicable anytime roofing materials are specified. The Class A fire rating is achieved through the roofing material itself or through the roof assembly as a whole.

Benefit:

Short-lived roofing materials result in more waste going to landfills and more money spent on roof replacement. In extreme cases, early failure of a roofing material can allow for water damage and require costly repairs.

BUILDING BASICS | Avoid Moisture Intrusion

Most major building failures and construction defect lawsuits are related to water intrusion into the building's walls, ceilings and floors due to incorrectly installed flashing. Water intrusion leads to rot, mold and mildew, and may eventually result in structural and health problems.

Offer detail drawings on plans that show how moisture drains away from building elements. Show proper shingle-flashing of all penetrations and joints such as chimneys, pipes, roofs, windows, doors, vents and decks. It is a highly recommended practice to provide on-site training for workers.

F. Plumbing

1. Distribute Domestic Hot Water Efficiently

Description:

Much of the energy used to heat water for domestic purposes is lost in long piping runs to remote fixtures. Locating the domestic hot water (DHW) source close to usage points reduces heat loss, speeds the rate of hot water delivery to the user, and reduces water waste. Larger houses may require hot water recirculation systems to reduce waiting time, but continuous or timed pump operation wastes an excessive amount of energy. For larger houses that require hot water circulation, an on-demand hot water circulation pump control will reduce this energy use.

Application:

a. Insulate Hot Water Pipes from Water Heater to Kitchen

Follow Title 24 pipe insulation standards; in addition, insulate the length of the hot water pipe from the water heater to the kitchen. A no-cost option for insulating piping run through attics is to bury them in ceiling insulation.

b. Insulate All Hot Water Pipes, or Insulate Pipes to Kitchen and Install On-Demand Hot Water Circulation System

Reduce heat loss by insulating all hot water pipes in the home. If that is not feasible, insulate the hot water pipes from the water heater to the kitchen, and install an on-demand hot water circulation system to shorten hot water delivery times. These systems consist of a recirculation loop and a pump with on-demand controls (pushbutton or motion sensor activated). Only one pump is needed to supply hot water to all fixtures.

c. Locate the Water Heater within 25 feet of All Fixtures

Locate the water heater tank close to bathrooms, kitchen and laundry to shorten pipe lengths. This can be accomplished in a spread-out floor plan by creating a central mechanical space which can also house the furnace, by installing a tankless water heater centrally in the attic, or by using more than one tankless water heater.

d. Use Engineered Parallel Piping

Often termed "home run" or "manifold" piping, this alternative to typical “branched” piping can save water and energy needed for heating water. Small diameter flexible pipes are run from a manifold located near the water heater directly to the fixtures, thereby decreasing the volume of water in the piping and reducing friction loss imposed by elbows and other fittings.

Parallel piping can be implemented using either soft copper or PEX (cross-linked polyethylene). The latter should be used where codes permit because it has a lower heat conduction rate and it costs less. With low-flow fixtures, 3/8” diameter piping may be adequate for sinks; 1/2” piping should be used for other fixtures. To ensure that pipe lengths are kept to a minimum and that sufficient flow will be provided, an “engineered” piping plan should be prepared to show the location and diameter of hot water pipes.

Benefit:

Efficient design and distribution of domestic hot water saves energy, conserves water, uses less piping, and speeds hot water delivery.

2. Install High Efficiency Toilets

Description:

Toilets that use less than 1.3 gallons per flush (gpf) are called High-Efficiency Toilets (HETs). This category of fixture includes dual-flush toilets, 1.0-gpf pressure-assist toilets, and conventional gravity-fed toilets.

Application:

Install HETs qualified as meeting the rigorous performance requirements of North American water agencies. These fixtures are identified as meeting or exceeding a 250 gram waste removal threshold as defined in the Maximum Performance (MaP) testing report. A complete listing of HETs and the MaP report can be downloaded from the product web-page of the California Urban Water Conservation Council: www.cuwcc.org/products_tech.lasso

Benefit:

HETs perform well and allow residents to further reduce their water and sewer costs. Water providers benefit by reducing demand upon their water supplies. Municipalities and wastewater agencies benefit from less wastewater to treat. Check with the local water provider for possible rebates.

Tankless Water Heater. See page 45 for details.

G. Appliances

1. Install ENERGY STAR® Dishwasher

Description:

High efficiency dishwashers use less water and energy than conventional dishwashers. They save at least 25% over the federal minimum standards. Some dishwashers are more water-efficient than others, even among ENERGY STAR®—qualified models. The most water-efficient models use 6.5 gallons or less per cycle.

Application:

Select ENERGY STAR®–qualified dishwashers. They use an internal water heater to boost temperatures inside the dishwasher. This means that household water heaters can be turned down to 120°F, saving water heating costs.

Benefit:

Water-efficient dishwashers reduce water and energy use.

2. Install ENERGY STAR® Clothes Washing Machine

Description:

ENERGY STAR® clothes washing machines use 50% less energy and 45 to 60% less water while performing as well as a standard washer. To maximize water efficiency, choose models with a water factor rating of 6.0 or less.

Application:

Most ENERGY STAR® washing machines save energy and water through a front-loading design (horizontal axis) that tumbles clothes in a small amount of water. Most models also include a high-speed final spin cycle that extracts more moisture than standard washers. Less moisture means less drying time, saving additional energy from the drying operation.

Benefit:

ENERGY STAR®–qualified washing machines use substantially less water and energy than conventional washers.

Horizontal Axis Washing Machines.

3. Install ENERGY STAR® Refrigerator

Description:

Refrigerators and freezers are among the largest users of electricity in most homes. They can account for up to 25% of household energy use. ENERGY STAR® refrigerators save at least 15% over the federal minimum standards. Refrigerators that qualify for the Consortium for Energy Efficiency's Super-Efficient Home Appliances (SEHA) Tier 2 designation save at least 20% over minimum federal standards.

Application:

A. Select ENERGY STAR®-qualified refrigerators. For information, go to www.energystar.gov.

B. Select SEHA Tier 2 refrigerators. For information, go to www.cee1.org/resid/seha/refrig/refrig-main.php3

Benefit:

ENERGY STAR® refrigerators can reduce the total annual electricity bill by more than 10%.

You will find the ENERGY STAR® label on products that exceed energy performance guidelines for energy efficiency. If all consumers, businesses, and organizations in the United States chose ENERGY STAR® products over the next decade, the national annual energy bill would be reduced by about $200 billion. For more information, visit www.energystar.gov.

4. Install Built-In Recycling Center

Description:

Built-in recycling centers provide bins for separated recyclables and trash.

Application:

Recycling and trash bins should be built into kitchen cabinets.

Benefit:

A built-in recycling center provides convenience by locating a recycling bin right next to a trash bin, keeping materials separated and free from contamination.

Built-In Recycling Center.

H. Insulation

1. Install Recycled-Content Insulation

Description:

Nearly all building insulation contains some recycled content. Fiberglass insulation typically contains 30% recycled glass, with a combination of post-industrial and post-consumer content. Materials such as recycled cotton or newspaper insulation contain up to 80% post-consumer recycled materials.

Application:

Choose products with the highest recycled content possible. Give preference to materials with a high level of post-consumer recycled materials. Post-consumer waste is recovered after a product's useful life has ended and the product is ready to be discarded.

Benefit:

Buying products with high post-consumer recycled content reduces reliance on virgin raw materials, closes the loop in the curbside recycling process, and reduces landfill deposits.

2. Install Insulation That Is Low Emitting for Formaldehyde and Volatile Organic Compounds (Certified Section 01350)

Description:

Many insulation products emit formaldehyde and other volatile organic compounds (VOCs). Look for products that have been tested for low emissions by a reputable third-party organization or government agency.

Application:

Select a product that has been tested for low emissions according to the California "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small Scale Environmental Chambers." (For information, go to www.ciwmb.ca.gov/GreenBuilding/Specs/Section01350.)

Benefit:

Minimizing formaldehyde and VOCs in the home improves indoor air quality.

3. Quality Installation of Insulation

Description:

Studies have shown that poorly installed insulation severely decreases the material's insulating value. Ensure quality installation of insulation in walls, floors and ceilings. Consider installing above Title 24 minimum levels.

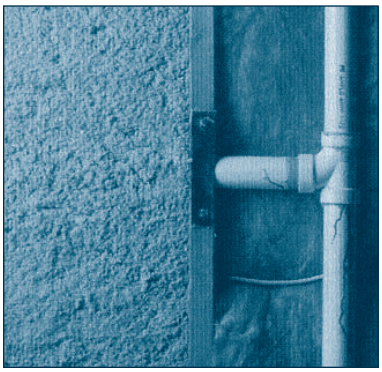
Application:

Pay proper attention to detail and quality assurance. Install insulation with no gaps or voids. Size insulation correctly to fill the cavity side-to-side, top-to-bottom and front-to-back. Cut or fill to fit around wiring and plumbing without compression. Insulate hard to access cavities.

Benefit:

Effectively installed insulation creates a more comfortable home and reduces the owner's utility costs. Lower energy demand reduces pollution and improves public health.

Damp-Blown Spray Cellulose Wall Insulation.



Recycled-Content Batt Insulation.

I. Heating, Ventilation and Air Conditioning

1. Design and Install HVAC System to ACCA Recommendations

Description:

The Air Conditioning Contractors of America (ACCA) has developed a set of calculation manuals—Manuals J, D and S—to determine the appropriate size and design of a home's heating, ventilation and air conditioning (HVAC) system.

Application:

Design and install the HVAC system according to results obtained from Manual J (the home's heat load calculation), Manual D (ductwork design and sizing) and Manual S (equipment selection and sizing).

Benefit:

Doing these calculations correctly and installing the system indicated by the calculations will result in an efficient and effective HVAC system that will deliver comfort and energy savings.

2. Install Sealed Combustion (Direct Vent) Furnaces and Water Heaters

Description:

Sealed combustion furnaces and water heaters duct outdoor air directly into a sealed jacket around the combustion chamber and then vent it directly outdoors, eliminating the use of house air for combustion.

Application:

Install in place of conventional atmospherically vented furnaces or water heaters.

Benefit:

Some gas appliances such as gas dryers and fireplaces require indoor air for combustion and exhaust conditioned air. When a house is negatively pressurized by exhaust fans, dryers or leaky ducts, carbon monoxide can be pulled into the house from the combustion chamber. Sealed furnaces and water heaters eliminate that condition, thereby improving indoor air quality and reducing the danger of carbon monoxide contamination. Sealed combustion furnaces can also be installed (by code) in conditioned indoor spaces in tightly sealed houses, thus reducing heat loss to outdoors.

3. Install Efficient Gas Fireplaces

Description:

Gas fireplaces are installed in a large percentage of new homes mostly for decorative use. Many have very low efficiency (as low as 13%), yet homeowners depend on them to meet some percentage of the heating load. Though there are no U.S. or state standards regulating their efficiency, efficiency listings are required in Canada and are available for many models sold in the U.S.

Application:

Do not install gas fireplaces unless their listed efficiency (from Natural Resources Canada) exceeds 60%.

Benefit:

Efficient gas fireplaces consume less gas and reduce winter heating costs.

4. Install ENERGY STAR® Ceiling Fans with CFLs

Description:

Ceiling fans improve interior comfort by circulating air. Most ENERGY STAR®–qualified models can be adjusted to either draw warm air upward during the summer or push it downward during the winter.

Application:

Preferable locations are areas where occupants tend to spend more time, such as bedrooms and family rooms. Anchor ceiling fans to ceiling joists. To increase efficiency, select models that include ENERGY STAR®–qualified light fixtures.

Benefit:

Ceiling fans can make residents feel more comfortable, thereby reducing the need for air conditioning and heating. Compact fluorescent lighting (CFL) lasts longer and saves money.

5. Install Ventilation System for Nighttime Cooling

Description:

Even when windows are ideally placed to provide natural ventilation, passive air circulation may be inadequate to keep the home cool. Mechanical ventilation cooling systems use nighttime air to cool the home's thermal mass, reducing or eliminating the need for air conditioning.

One type of system—a whole house fan—can provide nighttime cooling if used properly. However, they require open windows to

admit air, and they do not filter the air. Integrated ventilation cooling systems, on the other hand, integrate with heating and cooling equipment, are automatically controlled, do not require the use of windows, and deliver filtered outdoor air.

Application:

Ventilation cooling systems should be sized for four to six air changes per hour, and should have at least two speeds. Integrated ventilation cooling systems that combine with variable speed furnaces or air handlers use less fan energy and offset more air conditioning energy.

Whole house fans should have insulated, tight-sealing shutters and should be installed in a hallway ceiling. To prevent backdrafting, never use a whole house fan with water heaters, furnaces, or fireplaces that rely on indoor air as a source of combustion air. Integrated ventilation cooling systems pressurize (rather than depressurize) the house, so backdrafting is not an issue.

Benefit:

A properly applied ventilation cooling system can reduce total cooling energy consumption by an average of 35% in inland climates and can eliminate the need for air conditioning in coastal climates.

6. Install Air Conditioning with Non-HCFC Refrigerants

Description:

R-22 is a hydrochlorofluorocarbon (HCFC) refrigerant used in residential heating and cooling systems. R-22 contains chlorine, an ozone-destroying chemical. In 2010, under the Clean Air Act, HVAC manufacturers can no longer produce new air conditioners using R-22.

Application:

Install AC units that don't use HCFC refrigerants. Some new AC units already use an alternative to R-22 refrigerant, R-410A. Make sure that refrigerants are handled properly; always select a reputable dealer that employs service technicians who have achieved EPA certification to handle refrigerants.

Benefit:

If the refrigerant leaks during replacement, a non-HCFC refrigerant will not damage the ozone layer.

7. Design and Install Effective Ductwork

Description:

Poorly designed and installed ductwork lowers heating and cooling system efficiency and capacity, and can contribute to poor indoor air quality and comfort problems.

Application:

a. Install HVAC Unit and Ductwork within Conditioned Space

Install HVAC unit and all heating and cooling ductwork inside the insulated envelope of the home. The unit and duct runs may be installed in closets, chases, and soffits purposefully designed to accommodate them, or they may be installed in an attic that is insulated at the roof deck (non-vented attic).

b. Use Duct Mastic on All Duct Joints and Seams

Leaks in the joints between ductwork have been shown to allow, on average, 20 to 30% of conditioned air to leak out. Leaky air ducts can cause negative pressure in the house, which can draw many outdoor and indoor contaminants into the home, including carbon monoxide from gas water heaters and furnaces. Don't use duct tape; it loses its effectiveness in a few years. Mastic maintains a tight seal for decades. Install mastic at every duct joint and seam.

c. Install Ductwork under Attic Insulation ("Buried Ducts")

As a low cost alternative to installing ductwork in conditioned space to improve HVAC system efficiency, the insulation value of ductwork can be significantly improved by burying ducts in loose-fill ceiling insulation. To maximize the effectiveness of this approach, duct connections must be tightly sealed.

Instead of suspending ducts from rafters or trusses, allow ducts to lay over ceiling joists or the bottom chord of trusses and blow insulation over them. To achieve moderate coverage, insulate to at least R-38. Using supply boots with side instead of top connections keeps ducts low and aids burial.

Title 24 credit may be taken for this measure if markers are placed to indicate duct locations and if inspected by a HERS rater.

d. Pressure Balance the Ductwork System

When a bedroom door is closed, it reduces or cuts off the return airflow path. In larger rooms, this restricts air movement, leading to comfort problems and a pressure imbalance, with the bedroom overpressurized and the rest of the house depressurized. This may cause infiltration of contaminated air from the attic or crawlspace, or backdrafting of

combustion appliances. At a minimum, install an additional return duct in the master bedroom and other large rooms that can be closed off with a door. Or install a transfer duct to join grilles between the hall or main living area and these rooms. Make the transfer duct long enough to minimize sound transmission.

e. Protect Ducts during Construction and Clean All Ducts before Occupancy

Debris and dust from construction can lodge in HVAC units and the ductwork, potentially causing occupants to have allergic reactions and reducing the effectiveness of the blower fan and heating/cooling elements. During construction, completely seal off each duct register and the HVAC unit to block out any construction dust. Use methods and materials that will stay in place under the abuse of a typical construction site. After construction is completely finished, vacuum the blower unit and ductwork as necessary.

Benefit:

Effective ductwork practices significantly reduce energy loss, minimize indoor air quality problems and improve occupant comfort.

8. Install High Efficiency HVAC Filter

Description:

MERV, or Minimum Efficiency Reporting Value, is a metric used to measure an air filter's efficiency. The MERV scale ranges from 1 to 20. The higher the MERV number, the more efficient the filter is at removing particles.

Application:

Filters of MERV 6 to 10 are recommended for cleaner air without compromising the performance of standard mechanical systems. Filters with MERV ratings of 10 or more create resistance to airflow, because the filter media becomes denser as efficiency increases. Only use a filter with a MERV of 10 or higher if the HVAC system is specifically designed for it.

Benefit:

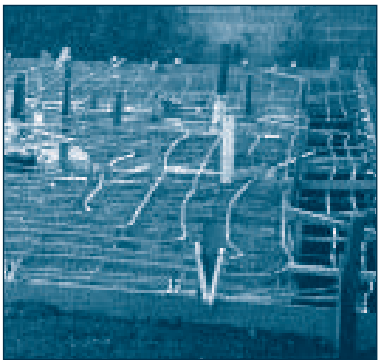
The EPA has identified micro-particulates as a leading cause of respiratory discomfort. By reducing these particles in the indoor air, a high efficiency filter protects the HVAC equipment elements and makes the living space healthier.

9. Install Zoned, Hydronic Radiant Heating with Slab Edge Insulation

Description:

Hydronic heating systems circulate hot water through radiant floor panels, wall radiators, or baseboard convectors located in different areas or zones of the house. Hydronic heating is most practical when installed with radiant heating distribution in slab-on-grade foundations in one-story houses located where cooling is not needed. They can utilize efficient boilers or water heaters that provide hot water for both domestic use and space heating. Install slab edge insulation with a minimum of R-5.

Radiant Floor Heating.



Application:

Use hydronic radiant heating instead of forced air heating where cooling is not needed, or where comfort requirements are rigorous. The system should be designed in accordance with Radiant Panel Association guidelines by an RPA-certified installer.

Benefit:

Hydronic heating systems are more comfortable than forced air heating, save energy by reducing thermal stratification and eliminating duct heat loss, and are easily zoned.

10. Install Mechanical Ventilation System

Description:

Mechanical ventilation systems are used to deliver fresh air in tightly sealed homes. There are several types of mechanical ventilation systems that can be grouped into categories of exhaust fans, systems that integrate with furnaces, and stand-alone balanced ventilation systems.

Application:

California Title 24 standards require mechanical ventilation when "tight" construction is used for compliance (specific leakage area, or SLA, is less than 3). Design the mechanical ventilation systems to meet established ventilation standards such as in

ASHRAE Standard 62.2. Provide the homeowner with clear information about such systems, so that they can operate and maintain them properly.

When used for whole-house ventilation, exhaust fans should operate continuously and include provisions for filtered makeup air. Integrated systems use the furnace fan to bring in outside air through a dampered duct, and should be equipped with controls to regulate volume of air. Stand-alone systems include heat recovery ventilators (HRV's) and energy recovery ventilators (ERV's) that employ heat exchangers to recover heat and/or moisture. HRV's and ERV's are appropriate for colder climates; their high fan energy use may not justify their use in most California climate zones.

Exhaust all bathroom ventilation fans to the outdoors, not to the attic. Bathroom fans should be controlled by a timer or humidistat to ensure proper run-time to adequately remove moisture from the room. Timers that are triggered when the lights are turned on, and then run for a set time (usually 15 to 30 minutes) work well. Humidistat controllers are even better, as they automatically switch on when moisture in the air reaches a threshold level, and shut down when the moisture level subsides. Look for bathroom fans with 1.5 sones or less for quieter operation.

Benefit:

Mechanical ventilation systems provide today's tighter homes with fresh outdoor air. Whole house ventilation systems improve indoor air quality by diluting pollutants. Properly ventilating bathrooms will reduce the possibility of rot, mold and other moisture problems. ENERGY STAR®–qualified ventilation fans use 65% less energy, on average, than standard models. They also provide better efficiency and comfort with less noise, and use high performance motors that last longer.

11. Use Low-Sone Range Hood Vented to the Outside

Description:

Kitchens produce a lot of moisture that can cause mold growth if not properly ventilated. Gas ovens and cooktops produce carbon monoxide, nitrogen dioxide and other pollutants. Additionally, cooking food produces odors and particulates.

Application:

Exhaust kitchen hoods to the outside, not the attic. Use range hoods that are quiet (less than 4 to 5 sones), so that home occupants will be more likely to use them. Make sure to purchase hoods that are not overpowered and can cause backdrafting of fireplaces.

Benefit:

Excessive moisture resulting from poor ventilation is one of the main causes of mold in buildings. Venting range hoods to the exterior reduces the amount of moisture inside the home, and helps prevent adverse health effects from combustion gases and cooking emissions.

12. Install Carbon Monoxide Alarms

Description:

Carbon monoxide (CO) is emitted from combustion appliances such as stoves, cooktops, water heaters, furnaces and fireplaces, as well as from cars and some landscape equipment. If a home's ductwork is leaking in a tightly built home, it can depressurize the home and reverse the flow of exhaust vent pipes. This can introduce carbon monoxide from these appliances back into the home, a process known as backdrafting.

Application:

Install a carbon monoxide alarm per manufacturer's instructions. Alarms must comply with both UL 2034 and CSA 6.19 standards. Alarms must be replaced every three to five years, as they lose their sensitivity over time.

Benefit:

A carbon monoxide alarm provides an added level of home safety.

BUILDING BASICS | Design Energy-Efficient Homes

In October 2005, revisions to California's Building Energy Efficiency Standards (Title 24) went into effect.

Consider the following energy efficiency strategies to achieve and exceed Title 24 standards.

a. Improve Insulation

Insulation in exterior walls and ceilings can reduce demand for air conditioning and heating and make homes more comfortable. However, if the insulation is not properly installed, the insulation's stated value will not be achieved. Ensure quality installation of insulation. California's Building Energy Efficiency Standards (Title 24) now allows a credit for "quality installation" whereby a certified professional verifies in the field that insulation has been installed well, and with minimal gaps and voids.

b. Install Radiant Barrier Roof Sheathing in Warm Inland Climates

Radiant barrier sheathing is a roof sheathing material with a reflective layer (film or foil) applied to the underside. Use in place of, and install in the same manner as, conventional roof sheathing. Radiant barrier sheathing can reduce attic temperatures by as much as 30 degrees on hot days.

c. Install Energy Efficient Windows

When selecting windows, look for low-e models that have an NFRC label listing a U-value of 0.4 or less and an SHGC of 0.4 or less. The cost premium for low-e glass is minimal and typically pays for itself very quickly. There are two types of low-e glazing: heat rejecting (soft coat) and heat receiving (hard coat). The soft coat low-e is more commonly available, and it is effective as a cooling strategy. However, the hard coat low-e is recommended for south glazing in passive solar buildings. Wood, vinyl and fiberglass frames generally insulate much better than aluminum frames.

d. Install Tankless Water Heaters

The new generation of tankless water heaters can meet the hot water needs of most houses, have no standing pilot, and can reduce water heating gas use by 50% or more. Instead of storing hot water they heat water as needed, thus reducing standby energy use. Install the tankless water heater as close to the points of use as possible, and adjacent to an exterior wall or roof to reduce the cost of venting (stainless steel venting is required). A control that allows the hot water temperature to be varied is recommended. See picture on page 38.

e. Install Water Heater with Energy Factor >0.62

Water heaters with high energy factors use more of the energy for heating the water rather than losing it out of the flue. This also saves money on fuel costs.

f. Install High Efficiency Furnace (AFUE 90 % or higher)

Install a furnace with 90% AFUE (annual fuel utilization efficiency) or greater. A properly sized, high efficiency furnace costs less to operate and reduces air emissions. Furnaces with variable speed fans also use less electrical energy. Check with your local utility company for rebate information.

g. Install High Efficiency Air Conditioner (SEER >13) with a Thermostatic Expansion Valve (TXV)

Air conditioning is the greatest contributor to residential peak loads in California. There are two efficiency ratings, SEER (seasonal energy efficiency ratio), which reflects energy use at 82ºF outdoor temperature, and EER, which is measured at 95ºF outdoor temperature. The higher the SEER and EER numbers, the less electricity is required to provide comfort. Both values should be considered, since most of California's air conditioning occurs at temperatures above 82ºF. TXV is a refrigerant regulation device that can help ensure that the air conditioning system operates at maximum efficiency over a wide range of conditions, and can compensate for incorrect refrigerant charge.

1. Design and Build ENERGY STAR® High Performance Homes

Description:

A home that is designed and built with energy efficiency improvements beyond Title 24 may be eligible for ENERGY STAR® designation.

Application:

To be ENERGY STAR®–qualified, a home must exceed Title 24 by 15% and pass a home performance test conducted by a certified Home Energy Rating System (HERS) technician. Incentives may be available to help offset the cost of the home performance testing.

Benefit:

People living in a high performance home will benefit from increased comfort, lower energy costs, and higher quality construction.

2. Meet ENERGY STAR®'s Indoor Air Quality Package Requirements

Description:

ENERGY STAR®'s Indoor Air Quality Package goes beyond energy efficiency and requires that duct leakage be controlled, the thermal envelope tightened, air pressures balanced, fresh air introduced, pest control measures installed, indoor contaminants reduced, and all major moisture issues managed.

Application:

Fulfill the requirements of the ENERGY STAR® Indoor Air Quality Package, apply for and receive qualification. Fulfilling ENERGY STAR®'s energy-efficiency requirements is a prerequisite for the Indoor Air Quality Package.

Benefit:

These requirements go very far in effectively managing building comfort, health and durability.

3. Third-Party Plan Review and Inspection

Description:

Early review of project plans can help maximize a home's energy efficiency and green building benefits. Homes designed to be very energy efficient may still perform poorly. Diagnostic evaluations and inspections can help uncover errors and fix potential problems.

Application:

Have an experienced and certified green building professional review the home's design for maximum efficiency and interaction of the building elements. The plan reviewer can identify additional green building opportunities for the project and ensure proper installation.

Later, have the home performance tested for thermal envelope and HVAC effectiveness. Inspection and diagnostic evaluations should include the following measures: Use a certified Home Energy Rating System (HERS) technician to test duct system air delivery (CFM); results should be within 10% of design flow calculations. Pressurize ducts and verify that leakage is under 6%. Use a blower door test to estimate the interior air changes per hour (ACH); results should be close to 0.35 ACH. Perform a combustion safety test if needed to ensure carbon monoxide is not backdrafting into the home.

Benefit:

Third-party plan review can lead to additional green building benefits for the project. Third-party home performance testing is vital for ensuring that homes will perform as intended.

K. Renewable Energy

1. Pre-Plumb for Solar Water Heating

Description:

Preparing for the installation of solar water heating will substantially reduce the cost of future installation, and adds little cost during the time of construction.

Application:

Installation of insulated copper pipes and sensor wiring between the attic and the water heater location will facilitate future installation of a solar water heater. To accommodate "active" systems, provisions should also be made for a solar storage tank (with pressure relief drain line) and an electrical outlet for a pump. Provide at least an 8 ft. by 8 ft. clear section of south-facing roof for future installation of solar panels.

Benefit:

Solar hot water pre-plumbing will make it easier and less expensive to install a solar water heater in the future.

2. Install Solar Water Heating System

Description:

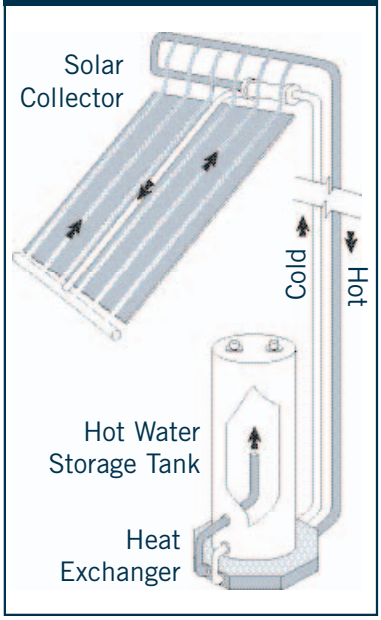
Solar water heating systems use solar panels and water storage to collect and store heat from the sun for domestic hot water use. Water preheated by a solar system is typically used to deliver preheated water to a standard water heater. Solar water heating is more cost effective than ever, as a result of new technologies, reliable products, and rising natural gas prices.

Application:

Use only solar water heaters that are SRCC (Solar Rating and Certification Corp) certified. Provide sufficient south-facing roof area for collectors, make sure the roof structure can accommodate the weight of the system, and make provisions near the conventional water heater for any additional mechanical equipment (such as storage tanks, pumps, pipes and controllers).

Installing Solar Water System.

Solar Hot Water and Space Heating System



Benefit:

Many solar water heating systems can provide all the hot water needed during summer months, and will save more than 50% of the gas normally used for water heating. Solar hot water systems can pay back in as little as ten years and reduce the use of gas or electricity for water heating.

3. Pre-Wire for Future Photovoltaic (PV) Installation

Description:

Making provisions during construction for installing future PV systems can significantly lower the cost when systems are installed later. These provisions include installing conduit from the attic to a location near the electric service entrance/ circuit breaker panel, allowing space for installation of PV modules on south-facing roofs, and ensuring that roof trusses are adequate to accommodate any added roof loads.

Application:

Maintain a 200-square-foot or larger section of south or west roof area clear of vent pipes and other obstructions to allow for the installation of modules. Install 3/4-inch or larger conduit with pull boxes as needed to run wire from the attic to a junction box near the main panel and meter. Provide the owner with a roof plan with the preferred location for PV modules and the conduit location clearly marked, and provide structural information on what added loads the roof can accommodate. (One type of PV systems, called building-integrated PV modules,

typically weigh less than the roof tiles they replace.)

Benefit:

Net metering rules and time-of-use electric rates are improving the economics of photovoltaic systems, which can provide all of the electrical energy needed by a home on a net annual basis. PV-generated electricity produces no air pollution and reduces the need for building new power plants. Photovoltaic panels and systems may drop in price over the next few years, and California incentives may increase.

4. Install Photovoltaic (PV) Panels

Description:

PV systems convert solar energy into electricity when sunlight strikes the PV cells. A number of different products are available for residential applications. One type, "building-integrated" PV modules, are designed to attractively interface with tile roofing systems.

Application:

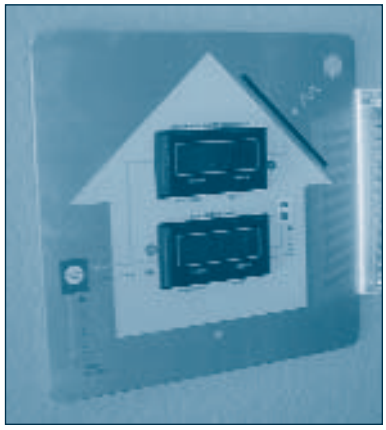
For cost and appearance, the best location for PV modules is flush on south or west-facing roofs. More energy is produced annually by south-facing modules, but west-facing modules can take better advantage of time-of-use rates that are available from some utilities, and help reduce the system peak load. For tile roofs, building-integrated modules are usually easier to install and more attractive. For other roof types, specially designed racks are available for mounting the PV panels.

Current incentives include a California Energy Commission "buy-down" and a federal tax credit.

Benefit:

Benefits include lower utility costs, reduced emissions by fossil fuel—burning power plants, reduced need for the development of new power plants, and improved energy security.

Power meter showing the amount of solar electricity generated and used.



Photovoltaic Panel System, Centex Homes, Livermore.

L. Finishes

1. Provide Permanent Walk-Off Mats and Shoe Storage at Home Entrances

Description:

Up to two-thirds of dust and particulates in houses is tracked in on shoes. The dust contains everything from soil and pesticides to abrasive sand, mold, road grime and bacteria. Once these particulates are inside the home, they can be difficult to get rid of.

Application:

Minimize the amount of contaminants tracked inside the home. For entryways, avoid carpet, and specify easily cleaned flooring with a hard surface, such as hardwood, bamboo, ceramic tile or natural linoleum. Provide features near entryways for removal and storage of outerwear and shoes, such as tiled surface and benches for removing shoes, or a mudroom.

Benefit:

Occupants will have a cleaner home with less outdoor pollution tracked in.

2. Use Low-VOC or Zero-VOC Paint

Description:

Most paint releases volatile organic compounds (VOCs), a major air pollutant, into the home. Once outside, certain VOCs react with other pollutants, producing ground-level ozone (smog) that also affects human health. Low- and zero-VOC paints reduce these sources of pollution.

Application:

Paint with low- or zero-VOCs is available from most major manufacturers and is applied like conventional paint.

Low-VOC paints contain less than 150 grams per liter (gpl) of VOCs for nonflat finishes, and 50 gpl or less for flat finishes. Paints that contain less than 5 gpl of VOCs are classified as zero-VOC.

Benefit:

Low- or zero-VOC paint reduces the emissions of VOCs, improving indoor air quality and reducing the formation of smog.

3. Use Low-VOC, Water-Based Wood Finishes

Description:

Conventional oil-based wood finishes can offgas for months and can be harmful to children and chemically sensitive individuals. Offgassing means the solvents are released into the air, contaminating indoor air quality. Low-VOC finishes, such as waterborne urethane and acrylic, are lower in toxic compounds compared to conventional oil-based finishes while providing similar durability.

Application:

Low-VOC wood finishes (with VOC concentrations of 150 gpl or less) can be used in most applications where oil-based finishes are typically used. If oil-based wood finishes must be used, they should be applied off-site or left to offgas for three to four weeks prior to occupancy.

Benefit:

Using low-VOC wood finishes reduces offgassing into the home, improving indoor air quality and reducing the formation of smog.

4. Use Low-VOC Adhesives and Caulks

Description:

Unlike oil-based adhesives and caulks that offgas toxic compounds for months, low-VOC products reduce toxic gases such as aromatic hydrocarbons or other petroleum solvents that contribute to indoor and outdoor air pollution.

Application:

Use low-VOC products (70 gpl or less) in place of standard adhesives and caulks for all interior applications such as installation of flooring, countertops, trim, wall coverings, paneling and tub/shower enclosures.

Benefit:

Low-VOC adhesives and caulks work as well as or better than conventional products, emit fewer pollutants and reduce the potential of harmful health impacts.

Low/No-VOC paint.

5. Use Recycled-Content Paint

Description:

A number of manufacturers have developed high-quality recycled-content latex paint and primers. The recycled portion (20 to 100%) comes from unused consumer or industrial stock, as well as paint recovered from household hazardous waste collection facilities. The paint is checked for quality and then sent to paint manufacturers for recycling and blending with a portion of new paint.

Application:

Latex paint with recycled content is applied like conventional paint. Due to the blended nature of the paint, it tends to come in a limited range of colors.

Benefit:

Recycled paint is often less expensive than new paint. It also reduces the need to manufacture new paint and supplies a market for unused paint, rather than putting it into the waste stream.

6. Use Environmentally Preferable Materials for Interior Finish

a. Use FSC-Certified Materials

Description:

Forest Stewardship Council (FSC)–certified wood comes from forests managed in accordance with stringent sustainable forestry practices.

Application:

Use FSC-certified materials in any application that normally calls for conventional plywood or stain-grade materials, such as cabinets, trim, doors, shelving and window frames.

Benefit:

FSC certification assures that forests are managed in a way that protects the long-term availability of wood resources and the health of old-growth forests.

b. Use Reclaimed Lumber for Nonstructural Applications

Description:

High quality dimensional lumber in long lengths can often be salvaged from old buildings that are being deconstructed.

Application:

Use reclaimed lumber in place of new material for nonstructural applications, such as mantles, nonstructural beams, casing, trim, cabinets and doors.

Benefit:

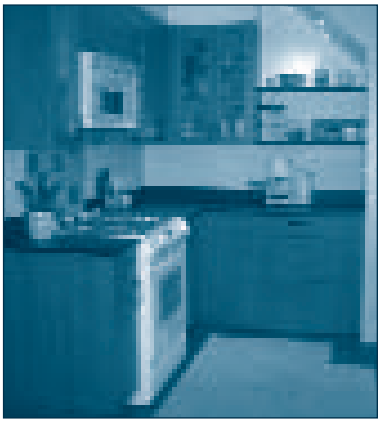
Reclaimed lumber from deconstructed buildings reduces resource consumption and landfill deposits. Reclaimed lumber is often of higher quality than new lumber.

c. Use Rapidly Renewable Trim Materials

Description:

Straw-based MDF and bamboo plywood or laminate are alternatives to wood-based MDF and solid wood for interior trim. Straw is the stalk of any of the common grains such as wheat, rice, barley, etc. This tough material is an annually renewable waste product. Bamboo is a fast-growing grass that can be harvested in three to five years.

FSC-Certified cabinets, countertop made from wood fibers harvested from sustainable forests and linoleum flooring.



Application:

Use these rapidly renewable trim materials in place of conventional solid wood or wood-based MDF.

Benefit:

Rapidly renewable materials are attractive, durable, and reduce pressure to harvest forests. Bamboo is as durable as most hardwoods. Straw-based MDF is equally or more durable than wood-based MDF, and is derived from an annually renewable waste product.

d. Use Recycled-Content Materials

Description:

Some recycled-content trim is made from recycled polystyrene or other plastics. Recycled-content countertops include recycled glass tiles, terrazzo-like materials that

blend recycled glass and concrete, and natural fiber composites derived from rapidly renewable or recycled resources.

Application:

Use recycled-content trim materials in any application where the trim is to be painted. Use recycled-content products in kitchen and bathroom applications such as countertops, backsplashes, shower walls or vanity tops.

Benefit:

Recycled-content products keep valuable resources out of the waste stream. Recycled-content trim materials are often straighter and more stable than conventional clear wood.

e. Use Finger-Jointed Materials

Description:

Finger-jointed trim, studs and fascia are manufactured from short pieces of clear wood glued together to create a finished material.

Application:

Use finger-jointed materials in any application where the materials are to be painted.

Benefit:

Finger-jointed elements are straighter and more stable than conventional clear wood, and use wood more efficiently.

7. Reduce Formaldehyde in Interior Finishes

Description:

Formaldehyde is often used as a binder in home-building products. Formaldehyde glues used in composite wood products come in two forms: urea and phenol. Urea-formaldehyde binders are common in interior-grade products. Phenol-formaldehyde binders are used in exterior applications because they are more water-resistant. The waterproofing quality makes phenolic glues offgas more slowly and in lower quantities than urea glues, reducing some of the harmful effects on indoor air quality.

Application:

Whenever possible, use materials that emit little or no formaldehyde. Select a product that has been tested for low emissions according to the California "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small Scale Environmental Chambers." (For information, go to www.ciwmb.ca.gov/GreenBuilding/Specs/Section01350.)

Benefit:

Reducing formaldehyde exposure helps protect the health of residents, particularly children, who are most susceptible.

8. Test Indoor Air for Low Levels of Formaldehyde

Description:

Formaldehyde is a colorless gas that contributes to indoor and outdoor air pollution. The California Air Resources Board (ARB) has classified formaldehyde as a Toxic Air Contaminant, based on its potential to cause cancer and other adverse health effects. Formaldehyde is usually present at higher levels in indoor air than outdoor air, in part because it is used as a binder and preservative in many common building products. Formaldehyde evaporates from products into the home's interior, often for many years after the product is installed.

Application:

ARB recommends that formaldehyde levels be as low as possible because of formaldehyde's cancer-causing potential, and no greater than 27 parts per billion. Using products with low formaldehyde emissions, such as those mentioned in these Guidelines, will usually lower formaldehyde to this level.

Test the building after installation of all finishes. Home test kits are available that measure the average indoor concentration of formaldehyde.

Benefit:

Reducing formaldehyde can decrease the risks associated with exposure.

Recycled content glass tile and concrete bathroom counters.

M. Flooring

1. Use Environmentally Preferable Flooring

a. Select Forest Stewardship Council (FSC)–Certified Wood Flooring or Reclaimed Wood

Description:

FSC-certified wood flooring comes from forests managed in accordance with stringent sustainable forestry practices. FSC-certified products are available in a wide variety of domestic and exotic species. Reclaimed wood is wood from another building or other use that is salvaged for use in a new application.

Application:

Use FSC-certified or reclaimed wood in place of conventional hardwood flooring.

Benefit:

FSC certification assures that forests are managed in a way that protects the long-term availability of wood resources, the health of old-growth forests, and the economic sustainability of forestry operations and workers. Reclaimed flooring rescues wood from a landfill and gives it a second life.

b. Use Rapidly Renewable Flooring Materials

Description:

Bamboo, cork and natural linoleum flooring are alternatives to hardwood flooring. Bamboo is a fast-growing grass that can be harvested in three to five years. Cork is harvested from the outer bark of the cork oak tree; the tree regenerates its bark within about 10 years. Natural linoleum is manufactured primarily from renewable materials such as cork, wood flour and linseed oil.

Application:

Use these rapidly renewable flooring materials in place of conventional hardwood, carpet or vinyl flooring. Cork can also be used as underlayment for hard-surfaced flooring to reduce impact noise between rooms.

Benefit:

Rapidly renewable flooring materials are attractive, durable, low-toxic, perform well and reduce pressure to harvest old-growth forests. Bamboo is as durable as most hardwoods; cork and linoleum are naturally fire and moisture resistant as well as sound absorbent.

c. Use Recycled-Content Ceramic Tiles

Description:

Recycled-content ceramic tiles can contain up to 70% recycled glass or other materials.

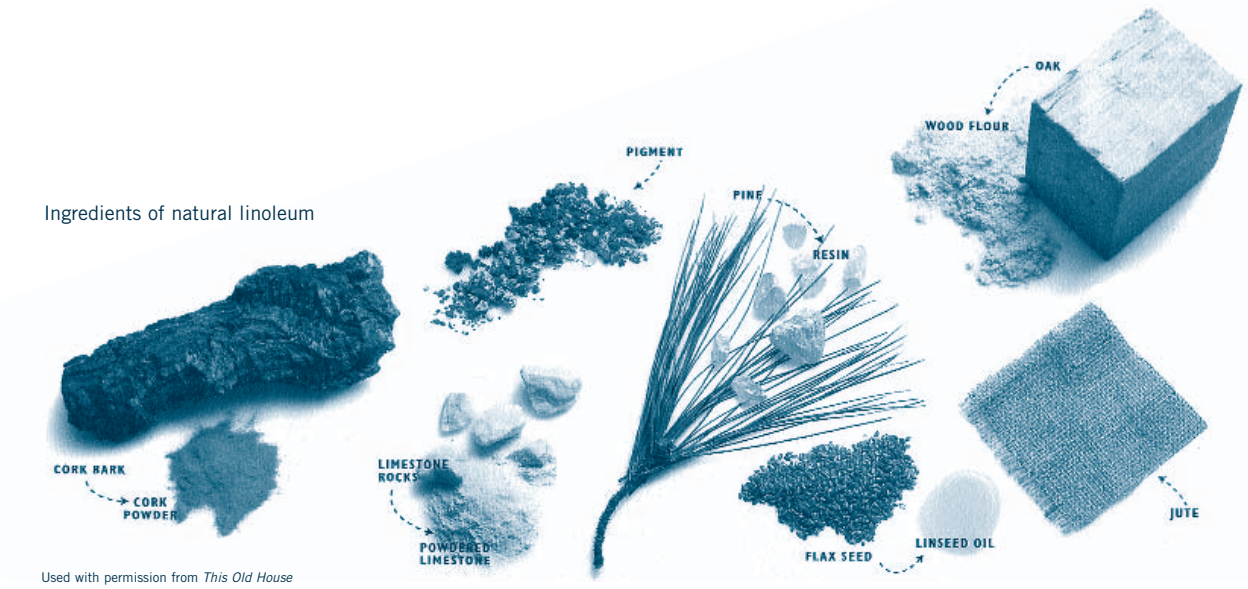
Application:

Install recycled-content tiles wherever conventional tiles are specified.

Benefit:

Some recycled-content ceramic tile is very dense, which significantly reduces the amount of moisture

Ingredients of natural linoleum



Used with permission from *This Old House*

and stains that are absorbed into the tile, making it more durable and easier to maintain.

d. Use Exposed Concrete as Finished Floor

Description:

For slab-on-grade construction, the concrete can be polished, scored with joints in various patterns, or stained with pigments to make an attractive finish floor. This approach is especially appropriate for in-floor radiant heating systems and passive solar design.

Application:

Use this approach for slab-on-grade construction. The finish must be designed and constructed when slab is being poured.

Benefit:

Using the slab as a finish floor eliminates the need to use other flooring materials. It is also durable and easy to clean.

e. Install Recycled-Content Carpet

Description:

Recycled-content carpet is made from recycled plastic bottles, recycled nylon/wool or recycled cotton. Recycled-content carpet is comparable in appearance, performance and price to conventional synthetic carpet.

Application:

Use recycled-content carpet in all applications where conventional carpet is specified.

Benefit:

Recycled-content carpet saves resources and diverts waste from landfills. Approximately 40 two-liter soda bottles are recycled per square yard of carpeting.

Bamboo flooring and recycled-content carpet.

2. Provide Thermally Massive Floors

Description:

Use flooring materials that improve thermal mass.

Application:

Low-cost thermal mass includes using hard floor coverings such as tile and wood. Wood flooring over a concrete slab also provides reasonably good thermal mass.

Benefit:

Increasing thermal mass will reduce heating and cooling energy use and will moderate indoor temperature swings, keeping the home more comfortable.

3. Use Flooring That Is Low-Emitting (Section 01350 or Green Label Plus)

Description:

Flooring products may emit formaldehyde and other volatile organic compounds. Look for products that have been tested for low-emissions by a reputable third-party or government organization.

Application:

Choose carpet that meets or exceeds the CRI Green Label Plus requirements or a flooring product that has been tested for low emissions according to the California "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small Scale Environmental Chambers." (For information, go to www.ciwmb.ca.gov/GreenBuilding/Specs/Section01350.)

Benefit:

Minimizing formaldehyde and volatile organic compounds in the home improves indoor air quality.

1. Include Green Points Checklist in Blueprints

Description:

Attaching the Green Points checklist to the blueprints makes it easier for everyone involved—including the builder, homebuyer and municipality—to see which green features are included in the home.

Application:

In one of the first few pages of the project blueprints, include the Green Points checklist, with the applicable points checked off. To make it easier to verify the Green Points, note next to each Green Point the blueprint page number that corresponds to that particular point.

Benefit:

Including the Green Points checklist in the blueprints raises the visibility of green building. This may encourage builders to incorporate more green features. It also provides a quick reference and benchmark for the builder, buyer and municipality.

2. Develop a Homeowner Manual of Green Features, Benefits and Operations

Description:

A green homeowner manual describes all of the home's green features and their benefits. It also gives important information about best practices for maintaining and operating the home.

Application:

Develop a separate green homeowner manual or include a green section in the standard homeowner manual. A comprehensive manual should include the following information:

- description of the home's green building features
- explanation of importance of maintenance and operations to achieve ongoing green building benefits
- warranty, operation and maintenance instructions for equipment and appliances
- household recycling opportunities
- ways to optimize water and energy use
- clear labeling of safety valves and controls for major house systems
- information about periodically checking crawlspace for termite tubes
- information on organic pest control, fertilizers, and environmental cleaning products
- instructions for keeping gutters clean
- information on proper tree maintenance
- instructions for proper handling and disposal of hazardous chemicals

Benefit:

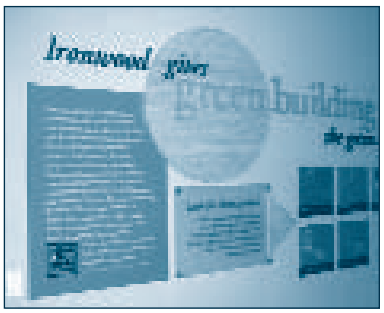
Green homeowner manuals instruct homeowners on best practices to maximize their investment by maintaining their home and its landscaping in a healthy and environmentally responsible manner.

3. Community Design Measures and Local Priorities

Community Design measures are not listed individually in the Green Points checklist, but credit can be taken for these measures in line N.3. Municipalities may also identify selected green features that address unique local priorities. These can be listed in section N.3. as well.

4. Innovation

The Guidelines' measures are not intended to be an exhaustive list of green elements that can be incorporated into a home, but rather a list of field-tested options that are more likely to be used by custom and production builders. An Innovation Checklist with sample measures is available for download at www.BuildItGreen.org



Green Building Showroom, Ponderosa Homes.

Chapter Five: Marketing Green Homes

Every green feature provides your customers with a benefit. Communicating these benefits and conveying the superior value of a green home are key aspects of your marketing effort. Train sales staff to tell the stories behind the features. For example, a buyer is more likely to perk up her ears if you talk about lower utility bills and greater comfort than if you merely tell her that the house is energy efficient.

Depending on which green features you offer, your story may focus on environmental stewardship, greater comfort, lower utility bills, healthier homes and communities, or some combination of these benefits. Remember, the story you tell leaves a lasting impression on all your stakeholders—so take the time to refine your message.

Market Differentiation

In California's hot real estate market, virtually any home will sell, whether it's green or not. But even in a seller's market where homes are sold before they are finished, building green creates a lasting and positive image among buyers, community leaders, government officials and the media. Here are some of the advantages your company will enjoy as a result of your green-building marketing efforts:

- Enhance your reputation for quality. Buyers are becoming more informed as home improvement television shows and mainstream consumer publications like Better Homes and Gardens, Redbook, Family Circle and Sunset regularly showcase green homes and products. As a result, today's buyers are increasingly associating green builders with high-quality construction. What's more, many community leaders and government officials associate green builders with companies that care and that are willing to invest in their community's best interest. A solid reputation for quality and caring will serve your business well over the decades, regardless of market conditions.
- Outshine the competition by offering green amenities. As a green builder, you are not asking your buyers to sacrifice anything. Instead you are offering them additional value—whether it's lower utility bills, the peace of mind that comes with knowing the home was built with healthier products, or the prestige and "bragging rights" of owning an environmentally responsible home. By providing buyers with these valuable amenities, you engender good will and loyalty, which may translate into referrals and repeat sales down the road.
- Reap the rewards of positive media attention. The news and trade media are hungry for positive stories. Green building is still a fresh concept, making your story attractive to them. Media coverage draws public interest and helps you more effectively engage your potential customers. It's possible this positive media coverage may also serve your business well when you are working to gain approval for new developments.

Educate Your Sales Staff

Sales are everything. It doesn't matter how well built or how green your projects are if your sales staff doesn't communicate the value of green to your customers. Your salespeople are your greatest advocates, so take the time to effectively train them and get them excited about the green features and benefits you offer. Providing people with quality homes is a rewarding profession, and adding the green factor gives your sales staff even more reason to be proud of what they do. Once you sell them on the idea that green building is good for business, good for people, and good for the community, they will enthusiastically convey this message to potential customers.

Convey the Benefits

It is important to complement green products and practices with a marketing program that clearly identifies the benefits. Homeowners do not always intuitively grasp how they directly benefit from energy efficiency, improved indoor air quality, or resource conservation. One way to address this in your marketing efforts is to sort the features in terms that are important to the buyer. Use the lists below as a tool to assist you in creating marketing materials and assembling the story of how your homes are different from those built by the competition.

The following is a list of green building features that help convey the benefits of building green:

BENEFITS: Higher Quality, Low Maintenance, Good for the Environment

Most green building products were developed to do something better than their conventional counterparts —they may be stronger, last longer, use resources more efficiently, or manufactured in an environmentally sound manner. Consider offering the following features:

- Durable and noncombustible roofing and siding
- FSC-certified or reclaimed wood
- Engineered wood beams, joists and studs
- Resource-efficient landscaping
- Natural linoleum, cork and bamboo flooring
- Recycled-content ceramic tile
- Recycled-content or composite decking

BENEFITS: Greater Comfort and Lower Utility Bills

Comfort drives high energy use. When it gets hot or cold, we turn on the air conditioning or furnace. By designing the home and its systems properly from the start, you can provide your customers with greater continuous comfort while reducing their utility bills. Emphasize that green doesn't necessarily cost more and will generally save money in the long run. Consider offering the following:

- Passive solar heating
- ENERGY STAR® appliances
- Efficiently designed/installed ductwork
- Whole house fans
- Photovoltaic panels
- Improved wall and ceiling insulation
- High efficiency toilets
- Efficient landscape irrigation systems

BENEFITS: Healthier Products and Practices for Families

What is more important than the health of our families? The public health community has identified homes as one of the most significant threats to children's health. It makes sense to reduce the use of products that are known to have adverse health impacts. Consider offering the following:

- Low and no-VOC paints and adhesives
- Building products with low or no formaldehyde emissions
- Water-based, low-VOC wood finishes
- Exhaust fan in attached garages
- Low-sone range hood vented to outside
- High quality air filters on heating/cooling unit
- Sealed combustion furnace and water heater

BENEFITS: Healthy Communities

Living green should extend beyond the boundary of the individual home to the entire neighborhood. Healthy communities offer residents opportunities to interact with neighbors and watch out for each other, enjoy walks, bike rides and other outdoor recreation, walk to local services, or use mass transit. Consider offering the following:

- Clustered homes for land preservation
- Mixed-use, walkable communities
- Located near a major transit stop
- Pedestrian pathways to open space, parks, and trails
- Home entrances with porches and views of the neighborhood
- Accessible entrances and pathways
- Rental units

GREEN BUILDING
in Alameda County
www.BuildGreenNow.org