

PDH Academy

Green Building Guidelines for New Home Construction

**3.0 PDH / 3.0 CE Hours / 3 AIA LU/HSW
AIAPDH184**

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Green Building Guidelines for New Home Construction

Final Exam

Chapter One: Overview of Green Building

INTRODUCTION

ABOUT GREEN BUILDING

1. Green building is a__approach to the design, construction and operation of buildings
 - a. Partial
 - b. Controversial
 - c. Whole systems
 - d. Wasteful

FUNDAMENTAL OBJECTIVES OF GREEN BUILDING

2. Which of the following is NOT one of the three fundamental objectives of green building:
 - a. Dissipate natural resources
 - b. Increase energy efficiency
 - c. Improve indoor air quality
 - d. All of the above are objectives

BENEFITS OF GREEN BUILDING

3. Which of the following is a reason to build green:
 - a. A concern for the environment and health considerations
 - b. An interest in building more efficiently
 - c. A desire to create an environmentally friendly image for your business
 - d. All of the above are reasons

HOW TO START BUILDING GREEN

4. Ranked second only to location,_____is the next most influential factor when buyers buy new homes.
 - a. Price
 - b. History
 - c. Quality
 - d. Reputation

GREEN BUILDING PACKAGES

5. Which of the following “Green Building Packages” includes fluorescent light bulbs and insulated foundation, among other features:
 - a. Natural Resource Package
 - b. Energy Efficiency Package
 - c. Indoor Air Quality Package
 - d. None of the above

Chapter 3: Green Points

GREEN POINTS

6. A score of _____ points or more constitutes a “green home.”
 - a. 25
 - b. 30
 - c. 40
 - d. 50

7. According to the Green Points Table, the exterior finish of a home has _____ available resources green points.
 - a. 5
 - b. 8
 - c. 10
 - d. 12

A. SITE

8. Each year ___ of tons of construction and demolition debris are disposed of at county landfills in California.
 - a. Thousands
 - b. Millions
 - c. Billions
 - d. Trillions

9. _____ results in the following benefits: prevent soil erosion and maintains existing sources of natural cooling.
 - a. Protecting native soil
 - b. Protecting water quality with landscape design features
 - c. Designing resource-efficient landscapes and gardens
 - d. Minimizing destruction of existing plants and trees

10. Which of the following about aluminum forms is true:
 - a. They produce a textured finished surface on the concrete
 - b. They are less expensive than wood
 - c. They can be used repeatedly
 - d. None of the above

B. STRUCTURAL FRAME

11. Solid sawn lumber in sizes of _____ or greater typically comes from old-growth forests.
- 4x12
 - 4x6
 - 2x4
 - 2x10
12. Wood I-joists use _____% less wood fiber to perform the same structural function as similar sized solid sawn lumber and will never twist, warp or split.
- 10
 - 25
 - 50
 - 75
13. Steel studs often contain ____% or higher recycled content.
- 30
 - 55
 - 75
 - 80

C. EXTERIOR FINISH

14. Regarding *Exterior Finish*, there are two types of recycled content decking: plastic lumber and _____ lumber.
- Virgin
 - Laminated
 - Exterior grade
 - Composite
15. ACQ and Wolman Natural Select use copper as their main component, and are a better alternative to lumber treated with chromium and arsenic, particularly for:
- Animals
 - Children
 - Adults
 - Construction workers

D. PLUMBING

16. New high-efficiency toilets use _____gpf (gallons per flush) or less.
- 1.6
 - 1.8
 - 2.0
 - 2.2

E. ELECTRICAL

17. Compact fluorescent light bulbs screw in like conventional bulbs but consume up to _____ of the electricity used by incandescent bulbs to produce an equivalent amount of light
- $\frac{1}{2}$
 - $\frac{3}{4}$
 - $\frac{1}{4}$
 - $1\frac{1}{2}$

F. APPLIANCES

18. ENERGY STAR® dishwashers use water and energy more:
- Efficiently
 - Wastefully
 - Expensively
 - Quickly
19. ENERGY STAR® refrigerators can save over _____% of the total annual electrical bill.
- 5
 - 10
 - 15
 - 20

G. INSULATION

20. According to a survey, consumer's top energy efficiency feature is:
- ENERGY STAR® Certification
 - High-efficiency furnaces
 - Insulation above code
 - Passive solar features
21. _____ is a highly effective insulation made out of recycled newspaper.
- Structural insulated panels (SIPs)
 - Foam board or ridge foam
 - Insulating concrete forms (ICFs)
 - Cellulose

H. WINDOWS

22. In the winter, windows can account for as much as _____% of the heat loss.
- 10
 - 15
 - 20
 - 25

I. HEATING, VENTILATION AND AIR CONDITIONING (HVAC)

23. Duct tape loses its effectiveness in _____ years.
- 1-2
 - 2-4
 - 3-5
 - 4-7

24. _____ heating forces hot water through radiators located in different areas or zones throughout the house and is typically installed as baseboards or in floors
- Install zoned
 - Hydronic
 - Radiant
 - Filter

J. RENEWABLE ENERGY AND ROOFING

25. Solar hot water systems can pay back in as little as _____ year and reduce the use of gas or electricity for water heating.
- 7
 - 8
 - 9
 - 10

K. NATURAL HEATING AND COOLING

26. Regarding *Natural Heating and Cooling*, passive solar systems provide heat to the structure through south facing windows in conjunction with:
- Forced air heat
 - Electrical resistance coils
 - Thermal mass
 - Insulation

L. INDOOR AIR QUALITY AND FINISHES

27. According to a survey, the majority of consumers said _____ should be in the standard for improved indoor air quality features.
- Formaldehyde-free insulation
 - Low VOC paints
 - Heat recovery ventilation unit
 - None of the above

Chapter Five: Selling Green Homes

MARKET DIFFERENTIATION

28. Buyers are becoming very _____, as publications like *Better Homes and Gardens*, *Redbook*, *Family Circle*, *Sunset*, and home improvement magazines are featuring more green building stories and products.
- Overwhelmed
 - Disordered
 - Sophisticated
 - Confused

HIGHER QUALITY, ENVIRONMENTALLY SOUND PRODUCTS

29. Which of the following is a high quality, environmentally sound product:

- a. Wood I-joists
- b. Solvent-free adhesives
- c. FSC Certified wood framing
- d. All of the above

30. The public health community has identified homes as one of the most significant threats to _____ health.

- a. Dog's
- b. Children's
- c. Adults
- d. None of the above

INTRODUCTION

Across the country, in response to buyer demand, homebuilders are constructing homes that are more energy-efficient, healthier and more durable – better known as “green building.” Builders are changing the way they design and build, while enjoying increased market share and faster sales.

ABOUT GREEN BUILDING

Green building is a whole systems approach to the design, construction and operation of buildings – from the early stages of development through the final finishes in the home. This approach benefits both builders and homeowners by reducing resource consumption and improving livability.

Green building benefits are spread throughout the systems and features of the home. Green buildings use recycled-content building materials, consume less energy and water, have better indoor air quality and use less wood fiber than conventional homes. Green homes reduce potentially carcinogenic volatile organic compounds and formaldehyde from the interior, and construction waste is often recycled and remanufactured into other building products.

Every builder struggles for market differentiation. Building green is a practical way to address issues buyers really care about. A green building dimension to your business adds a strong selling point. Building green is good for both the economy and the environment.

In response to growing interest in green building, a variety of public and private entities, including homebuilder associations and state and local governments, are creating partnerships to help build and sell green homes and communities. These efforts help market the benefits of green building and recognize builders who are constructing healthier, more durable homes.

Home-buyers increasingly see the added value in a green home. For some, it’s energy savings and lower utility bills. For others, it’s saving old-growth forests. For still others, it’s knowing that their home is a healthier place for their children.

These *Green Building Guidelines* were developed to bring technical and marketing expertise to Sonoma County builders. The Guidelines are the result of a collaboration among developers, builders, purchasing agents, sales staff, architects, building officials, green building experts, and staff of the Alameda County Waste Management Authority and Recycling Board.

FUNDAMENTAL OBJECTIVES OF GREEN BUILDING

Green building is applied common sense. To demystify the process and move forward with your construction project, it is helpful to think of green building as the convergence of three fundamental objectives:

- 1 **Conserve natural resources**
- 2 **Increase energy efficiency**
- 3 **Improve indoor air quality**

Natural Resource Conservation

Conventional building practices consume large quantities of wood, plastic, cardboard, paper, water and other natural resources that lead – unnecessarily – to their depletion.

For example, wood is one of the most common building materials, but is often used wastefully. We have already harvested 95% of the nation’s old-growth forests – a trend that simply cannot continue. Engineered lumber products such as wood I-Joists, wood fiber laminates and oriented strand board, utilize fast growing farm trees as an alternative to old-growth forests. These products can use as little as 50% of the wood fiber to perform the same structural functions and are typically stronger, straighter and lighter than solid-sawn lumber.

Builders have a rapidly expanding range of green building materials from which to choose. Recycled content decking, reclaimed lumber and other products divert waste from landfills, while providing quality and durability that often exceed conventional materials. For example, decking material made out of recycled plastic resins mixed with wood waste fibers can last up to five times longer than wood decks, and never need to be treated or painted.

Water conservation is another important issue. Wise water usage reduces the strain on resources while lowering expenses. Today, builders can take advantage of a new generation of high-efficiency appliances and landscape water management systems.

Energy Efficiency

Energy efficiency is a cornerstone of any green building project. Generation and use of energy are major contributors to air pollution and global climate change. Improving energy efficiency and using renewable energy sources are effective ways to reduce the potential of energy supply interruptions, improve air quality, and reduce the impacts of global warming.

Improving energy efficiency is also an economically



Using Solvent-Free Adhesives

effective choice for consumers. Lowering utility expenses allows homeowners to enjoy the financial benefits year after year.

The first steps to increase energy efficiency are to add insulation wherever possible, install double-glazed/ low-E windows and upgrade to high-efficiency appliances. Other energy upgrades include installing solar water heaters and photovoltaic panels.

Indoor Air Quality

The United States Environmental Protection Agency (EPA) reports that the air in new homes can be ten times more polluted than outdoor air. According to the *New England Journal of Medicine*, 40% of children will develop respiratory disease, in part, due to the chemicals in their homes. Poor indoor air quality is caused by the off-gassing of chemicals found in many building materials as well as mold and mildew that build up in poorly designed and maintained heating and cooling systems.

One of the most common indoor pollutants is formaldehyde, a suspected human carcinogen. Kitchen cabinets, countertops, shelving and furniture are typically made from particleboard held together by formaldehyde-based adhesives. The formaldehyde is released into the home for years after these products have been installed. Many paints and floor finishes also contain unhealthy volatile organic compounds (VOCs). That “new house smell” is actually the odor of these volatile compounds offgassing and is a telltale sign that there are harmful chemicals in the indoor environment.

The building products industry has responded to these indoor pollution problems by developing alternative paint, finish, and adhesive products. For example, solvent-free adhesives used in flooring and countertops can eliminate many of the suspected and known human carcinogens. Paints, varnishes, and cleaners that contain less volatile compounds are now commonly available from most major manufacturers at costs comparable to conventional products.

BENEFITS OF GREEN BUILDING

There are many reasons to build green. These include a concern for the environment, an interest in building more efficiently, health considerations or a desire to create an environmentally friendly image for your business. By applying a sustainable perspective to design, construction and remodeling, green building brings the benefits of resource conservation, energy savings and healthy living.

Each of the features listed in these Green Building Guidelines benefits the environment by addressing: resource conservation, energy efficiency or indoor air quality.

Review Questions

ABOUT GREEN BUILDING

1. Green buildings use:
 - a. Recycled-content building materials
 - b. Consume less energy and water
 - c. Have better indoor air quality
 - d. All of the above

FUNDAMENTAL OBJECTIVES OF GREEN BUILDING

2. Builders have a rapidly _____ range of green building materials from which to choose.
 - a. Expanding
 - b. decreasing
 - c. lighter
 - d. None of the above

3. The first steps to increase energy efficiency are to:
 - a. Decrease insulation wherever possible
 - b. Install double-glazed/low-E windows
 - c. Put in low efficiency appliances
 - d. Uninstall solar water heaters
4. With regards to Indoor Air Quality, the United States Environmental Protection Agency (EPA) reports that the air in new homes can be _____ times more polluted than outdoor air.
 - a. Two
 - b. Five
 - c. Twenty
 - d. Ten

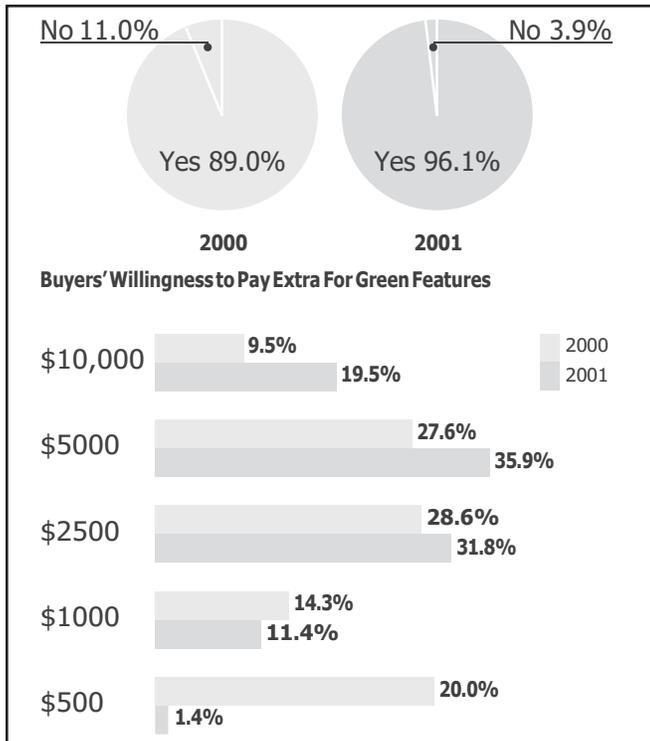
survey says...

“The State of Green Building 2001,” an on-line green building survey conducted by Cahners Residential Group (publisher of *Professional Builder*), is referenced throughout the Guidelines. The survey targeted consumers and builders. Complete survey results are available at www.housingzone.com.

References are also made to qualitative, focus group research conducted by the Alameda County Waste Management Authority in October 2002.

Cost Considerations

In the Survey, consumers were asked if they were willing to pay for green options, and if so, how much. Responses were:



How Much Extra Buyers are Willing to Pay

The above results are also reflected in an East Bay Area survey conducted in 2002 by American Lives, Inc. of selected new home-buyers.

- ◆ Approximately 70% of the respondents indicate that it is essential or very important for new home communities to be developed with green/energy efficient materials and techniques
- ◆ Approximately 50% of respondents would pay \$25-\$124 or more in added monthly mortgage payments for a low energy home equating to \$4,000 to 27,000 higher on the purchase price (at 7% interest rate)

While green building and its environmental benefits are becoming more mainstream, it is commonly assumed that green building features and products translate into additional costs. What is often overlooked is the added value that green building contributes to the home; energy efficiency, improved indoor air quality, healthier homes for the family, and durability. These Guidelines recommend methods and materials that range in cost – some of them cost no more or even less than conventional options.

When green building is designed into the project from the beginning it need not cost more than conventional methods. Often, the homeowner and builder focus on the “up-front” costs (materials and installation) to incorporate green features into a home. When other factors are considered, such as lower maintenance and operation costs, many of the recommended strategies in these Guidelines offer tangible economic benefits to the homeowner. Energy upgrades alone usually result in a payback through lower monthly energy costs.

When considering green building measures, it is very important to balance product and installation costs with other significant benefits such as energy savings, increased durability, enhanced air quality and healthier homes.

Chapter Two: How to Start Building Green

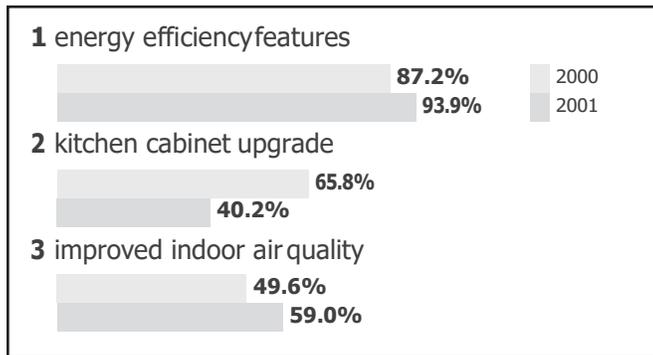
Building green means new ways of thinking about common building practices. Generally, it is best to build from your existing market base, adding green features as the market evolves and matures. If you start gradually, you are less likely to make expensive mistakes. It is critical to carefully consider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

HOW TO START BUILDING GREEN

Getting Started

A strategic way to start building green is to develop green options, and then describe the environmental features and benefits to the home-buyer. Giving your customers a choice allows you to refine your product and market approach. Home buyers speak their own language, and understand and embrace green building only when it is explained in their terms. Energy efficiency, improved indoor air quality, water conservation and saving old-growth forests are terms that may have different meanings to different buyers. All these things together mean a new home that offers more value and a more comfortable and healthier living environment.

Knowing about the benefits of resource-efficient construction is one thing; spending money for those same features is quite another. According to the Survey, consumers were asked to choose their three most important upgrades when buying a new home. In top-down order, responses were:



When consumers think about a new home, they think about what it offers them, not necessarily what it does for the environment. Quality always rates highest next to location when buyers buy new homes. Green homes offer higher quality since most products were developed to perform better than the conventional products they replace.

The Guidelines and accompanying resources will assist you in developing and implementing green building packages into your building projects. What makes a home truly green is a combination of all of the features listed in the Guidelines. In this way, the home combines the collected benefits of resource conservation, energy efficiency and good indoor air quality. Offering segregated packages is a starting point to help clarify what your market is most interested in, so you can make the most appropriate incremental steps toward a truly green home.

GREEN BUILDING PACKAGES

Below are samples of the types of “Green Building Packages” that could be developed to respond to consumer demands for green homes.

Natural Resource Package

Natural resource conservation is becoming more important to buyers every year. Saving forests for camping, fishing and hiking is a value that families hold for their children’s future. Conserving resources today by incorporating green alternatives is a great way to get your buyer’s attention. Using recycled content

products in your homes “closes the loop” for families that are committed to recycling. Using water more efficiently only makes sense as population growth puts stress on a limited resource.

Consider offering the following as part of a Natural Resource Package:

- ◆ Engineered lumber – OSB, wood I-joists
- ◆ Recycled newsprint cellulose insulation
- ◆ Water-conserving plumbing fixtures
- ◆ Fiber-cement siding and trim
- ◆ Recycled-content decking
- ◆ Recycled-content carpet
- ◆ Treated wood that does not contain arsenic or chromium

Energy Efficiency Package

Energy upgrades are one of the first things that consumers would pay extra for – \$2,300 on average – if they could expect to see a payback through lower monthly energy costs in four years. According to the Survey, only 2% of the home-buyers said they would not be willing to pay more in up-front costs for energy efficiency upgrades that would reduce monthly utility bills. 83% said that insulation should be above code and 90% or higher efficiency furnace should be standard features in new homes.

Consider offering the following as part of an Energy Efficiency Package:

- ◆ Low-E windows
- ◆ High efficiency (90% or higher), sealed combustion furnace and hot water heater
- ◆ High SEER/EER air conditioning units
- ◆ Fluorescent light bulbs
- ◆ Advanced sealing and caulking to reduce drafts
- ◆ 2x6 wall framing with increased insulation
- ◆ Insulated foundation

Indoor Air Quality Package

While energy efficiency is at the top of the consumer list, improved indoor air quality is also a priority for home-buyers. Almost nine in ten respondents of the Survey are aware of products that emit gas chemicals into their living environments. 75% or those people say it’s extremely or very important to live in a home free of toxic chemicals.

survey says...

“New homeowners were surprised that green building and the use of environmentally friendly products had not been brought to their attention before. They felt that there should be a green option made available by the builder.”

Source: Focus Group Research, Alameda County Waste Management Authority, 2002

Consider offering the following as part of an Indoor Air Quality Package:

- ◆ Formaldehyde-free insulation
- ◆ No or Low-VOC paints
- ◆ Solvent-free wood finishes
- ◆ Less-toxic adhesives
- ◆ Natural linoleum instead of vinyl flooring
- ◆ FSC-certified wood or bamboo flooring instead of carpet
- ◆ Sealed particleboard in cabinets and countertops

Review Questions

GREEN BUILDING PACKAGES

5. Which of the following “Green Building Packages” includes recycled newsprint cellulose insulation, among other features:
- a. Natural Resource Package
 - b. Energy Efficiency Package
 - c. Indoor Air Quality Package
 - d. None of the above

Chapter Three:: Green Points

When building, it is important to look carefully at the type of project and incorporate as many green features as possible. The items listed on the Green Points represent a variety of green building opportunities; however, not all of them may apply to your project.

GREEN POINTS

Green Points is a rating system that has been developed to offer builders, homeowners and municipalities a tool to assess how environmentally friendly or “green”

a home is. The rating system is based on the various green features incorporated into the home. A home that has earned 50 points or more across the 3 main green building categories – Indoor Air Quality, Energy Efficiency and Resource Efficiency – can be considered a “green home”. Total points required may be adjusted in the future. The rating system was developed in coordination with local builders, city planners and building officials. To simplify the system and to avoid double counting, each measure is assigned to one specific category, even though many of them can be placed in multiple categories.

POINTS PER CATEGORY	Resources	Energy	IAQ/Health
A. Site			
1. Recycle Job Site Construction & Demolition Waste – 50% Recycling Rate is Required; 65% = 1 point; 75% = 2 points; 80% = 4 points	up to 4		
2. Donate Unused Materials	4		
3. Protect Native Soil	2		
4. Minimize Disruption of Existing Plants & Trees	1		
5. Implement Construction Site Stormwater Practices	2		
6. Protect Water Quality with Landscape Design	2		
7. Design Resource-Efficient Landscapes	4		
8. Reuse Materials/Use Recycled Content Materials for Landscape Areas	2		
9. Install High-Efficiency Irrigation Systems	2		
10. Provide for On-Site Water Catchment / Retention	2		
Available Points	25		
B. Foundation			

1. Incorporate Recycled Flyash in Concrete – 15% Recycled Flyash = 2 points; Add 1 point for every 10% increase of flyash, up to 5 points	up to 5		
2. Reuse Form Boards	1		
3. Use Aluminum Forms	3		
4. Use Recycled Content Aggregate	2		
5. Insulate Foundation/Slab before backfill		3	
6. Install Rigid Foam, Insulated Concrete Forms (ICFs)		3	
Available Points	11	6	

POINTS PER CATEGORY <i>Continued</i>	Resources	Energy	IAQ/Health
C. Structural Frame			
1. Substitute Solid Sawn Lumber with Engineered Lumber			
a. Floors	1		
b. Headers (non-structural)	1		
c. Structural beams and headers	1		
2. Use FSC Certified Wood for framing (For every 10% of FSC lumber used = 2 points, up to 10)	up to 10		
3. Use Wood I-Joists for Floors and Ceilings	2		
4. Use Steel Interior Web Trusses	2		
5. Design Energy Heels on Trusses	2		
6. Use OSB			
a. Subfloors	1		
b. Sheathing	1		
7. Use Finger-Jointed Studs for Non-Structural Vertical Applications	2		
8. Use Engineered Studs for Vertical Applications	2		
9. Use Recycled Content Steel Studs for Interior Framing	2		
10. Use Structural Insulated Panels (SIPs)			
a. Floors		3	
b. Wall		3	
c. Roof		3	
11. Apply Advanced Framing Techniques	4		
12. Use Reclaimed Lumber for Non-Structural Applications	3		
Available Points	32	11	
D. Exterior Finish			
1. Use Sustainable Decking Materials			
a. Recycled content	3		
b. FSC Certified Wood	3		
2. Use Non-CCA Treated Wood		1	
3. Install House Wrap under Siding		1	
4. Use Alternative Siding Materials			
a. Recycled content	1		
b. Fiber-cement	3		
Available Points	10	2	
E. Plumbing			
1. Insulate all Hot Water Pipes	2		
2. Install Flow Reducers			
a. Faucets (1 point each, up to 2 points)	up to 2		
b. Showerheads (1 point each, up to 2 points)	up to 2		

POINTS PER CATEGORY <i>Continued</i>	Resources	Energy	IAQ/Health
E. Plumbing <i>Continued</i>			
3. Install Ultra-Low Flush Toilets (1 point each, up to 4 points)	up to 4		
4. Install Chlorine Filter on Showerhead			4
5. Install Tankless Water Heater		2	
6. Pre-plumb for Graywater Conversion (check with local code)	4		
7. Install Water Filtration Units at Faucets (2 points each, up to 4 points)			up to 4
8. Install On-Demand Hot Water Circulation Pump	4		
Available Points	16	4	8
F. Electrical			
1. Install Compact Fluorescent Light Bulbs – CFLs. (6 bulbs=2 points, 12=4 points, up to 4 points)		up to 4	
2. Install Air-Tight Insulation-Compatible Recessed Fixtures for CFLs (1 point each, up to 5 points)		up to 5	
3. Install Lighting Controls (1 point per fixture, up to 4 points)		up to 4	
4. Install High Efficiency Ceiling Fans with CFLs (1 point each, up to 4 points)		up to 4	
Available Points		17	
G. Appliances			
1. Offer Energy Star Dishwasher		1	
2. Offer Horizontal Axis Washing Machine		1	
3. Offer Energy-Efficient Refrigerator		1	
4. Install Built-In Recycling Center	3		
Available Points	3	3	
H. Insulation			
1. Upgrade Insulation to Exceed Title 24 Requirements			
a. Walls		2	
b. Ceilings		2	
2. Install Recycled-Content, Formaldehyde-Free Fiberglass Insulation			3
3. Use Advanced Infiltration Reduction Practices		2	
4. Use Cellulose Insulation			
a. Walls	4		
b. Ceilings	4		
Available Point	8	6	3
I. Windows			
1. Install Energy-Efficient Windows			
a. Double-Paned		1	
b. Low-Emissivity (Low-E)		2	
c. Low-Conductivity Frames		2	
Available Points		5	

POINTS PER CATEGORY <i>Continued</i>	Resources	Energy	IAQ/Health
J. Heating Ventilation and Air Conditioning			
1. Use Duct Mastic on All Duct Joints		1	
2. Install Ductwork Within Conditioned Space		3	
3. Vent Range Hood to the Outside			1
4. Clean all Ducts Before Occupancy			2
5. Install Attic Ventilation Systems		1	
6. Install Whole House Fan		4	
7. Install Sealed Combustion Units			
a. Furnaces			3
b. Water Heaters			3
8. Install 13 SEER/11EER or higher AC with a TXV		3	
9. Install AC with Non-HCFC Refrigerants	2		
10. Install 90% Annual Fuel Utilization Efficiency (AFUE) Furnace		2	
11. Eliminate Wood Burning Fireplaces			1
12. Install Zoned, Hydronic Radiant Heating		3	
13. Install High Efficiency Particulate Air (HEPA) filter			4
14. Install Heat Recovery Ventilation Unit (HRV)		5	
15. Install Separate Garage Exhaust Fan			3
Available Points	2	22	17
K. Renewable Energy and Roofing			
1. Pre-Plumb for Solar Water Heating		4	
2. Install Solar Water Heating System		10	
3. Pre-Wire for Future Photovoltaic (PV) Installation		4	
4. Install Photovoltaic (PV) Panels (1.2 kw = 6 points, 2.4 kw = 12 points, 3.6 kw = 18 points)		up to 18	
5. Install Solar (PV) Walkway Lights		4	
6. Select Safe and Durable Roofing Materials	1		
7. Install Radiant Barrier Roof Sheathing		3	
Available Points	1	43	
L. Natural Heating and Cooling			
1. Incorporate Passive Solar Heating		5	
2. Install Overhangs or Awnings on South Facing Windows		3	
3. Plant Deciduous Trees on the West and South Sides		3	
Available Points		11	
M. Indoor Air Quality and Finishes			
1. Install Whole House Vacuum System			3
2. Use Low/No-VOC Paint			1
3. Use Low VOC, Water-Based Wood Finishes			2

POINTS PER CATEGORY <i>Continued</i>	Resources	Energy	IAQ/Health	
4. Use Solvent-Free Adhesives			3	
5. Substitute Particleboard with Formaldehyde-Free Materials			6	
6. Use Exterior Grade Plywood for Interior Uses			1	
7. Use Formaldehyde-Free MDF and Materials			4	
8. Seal all Exposed Particleboard or MDF			4	
9. Use FSC Certified Materials for Interior Finish			4	
10. Use Finger-Jointed or Recycled Content Trim	1			
Available Points	1		28	
N. Flooring				
1. Select FSC Certified Wood Flooring	8			
2. Use Rapidly Renewable Flooring Materials	4			
3. Use Recycled Content Ceramic Tiles	4			
4. Install Natural Linoleum in Place of Vinyl			5	
5. Use Exposed Concrete as Finished Floor	4			
6. Install Recycled Content Carpet with Low VOCs	4			
Available Points	24		5	
Other				
1. Incorporate Listing of Green Features into Cover of Blueprints	1			
2. Develop Homeowner Manual of Green Features/Benefits	1			
3. Offer Coupons for Compost Bins to Homeowners (contact ACWMA, 1-877-STOPWASTE)	1			
4. Energy Ratings— Every % improvement in reducing energy beyond Title 24 Code - 1 point (up to 30 points). Use energy software such as EnergyPro or MicroPas, to show improvement over California Residential Energy Standards (Title 24)			up to 30	
5. Innovation Points— These points are given for innovative approaches, including model zero net energy homes, new materials and methodologies, currently not identified above. These approaches must meet environmental goals identified in the Residential Green Building Guidelines. Innovation Points will be evaluated and awarded by the community/municipality where the project is located.				
MINIMUM OF 50 TOTAL POINTS	Resources	Energy	IAQ/Health	Total
Total Available Points	136	158	63	357
Points Required from Each Category	10	10	10	30
Additional Points Needed from Any Category				20
Minimum Points Required				50
Project must acquire a minimum of 50 points. 10 points must be acquired, for each category. Additional 20 points can be acquired by incorporating any green features listed to reach a total of 50 points. Projects obtaining 60 points or more will receive a “Gold Level Status”. Total points may be adjusted in the future or modified by individual jurisdictions.				

Review Questions

Chapter 3: Green Points

GREEN POINTS

6. _____ is a rating system that has been developed to offer builders, homeowners and municipalities a tool to assess how environmentally friendly or “green” a home is.
 - a. The IRC
 - b. ASHRAE Manual J
 - c. US EPA EM12002-4A7
 - d. Green Points

7. According to the Green Points Table, a double-paned window has _____ energy green point(s).
 - a. 1
 - b. 2
 - c. 3
 - d. 4

8. According to the Green Points Table, a tankless water heater has _____ energy green points.
 - a. 4
 - b. 3
 - c. 2
 - d. 1

Chapter Four: Green Building Methods and Materials

Every green feature listed in the Guidelines benefits the builder, home-buyer and the environment. This Chapter lists each feature, describes the conditions under which it should be used, and the benefits. Identify the features you have incorporated into your homes and use the benefits from the text to develop your sales story.

COMMUNITY DESIGN ISSUES

The following measures should be considered in the initial site planning and community design stages of new home developments. By considering issues such as lot orientation, storm-water management, access to transit, and minimizing street widths early on, many environmental benefits can be accrued at later stages of the project.

The following is a list of approaches that should be considered in the first stages of community design:

- 1. Orient Homes on an East/West Axis for Solar Access**
- 2. Orient Living Rooms and Porches to Streets and Public Spaces**
- 3. Build Mixed-Use, Residential/Commercial, Walkable Communities**

4. Design for Diverse Family Types

5. Provide “Granny Flats” Above Garages

6. Build Within 1 Mile of Public Transit Hub

7. Minimize Street Widths

8. Locate or Cluster Buildings to Preserve Open Space and Wildlife Habitat, Especially Sensitive Areas such as Wetlands.

A. SITE

1. Recycle Job Site Construction and Demolition Waste

Description: Construction waste generally consists of wood, drywall, metals, concrete, dirt and cardboard

– materials that can be reused or recycled if prepared properly. Each year millions of tons of construction and demolition debris are disposed of at county landfills in California.

Application: Identify the types and quantities of materials generated at the job site and recycle at least 50% of the construction/demolition debris. Contact local recycling facilities and haulers to identify fees and conditions required for recycling materials. Allocate space for recycling bins and



Sacramento Street CoHousing, Berkeley, CA



containers. Contact the Sonoma Eco-Desk 565-DESK(3375) for more information.

Benefit: Recycling reduces pressure on landfills, saves money by reducing tipping fees, and provides raw materials for future building products.

2. Donate Unused Materials

Description: Unused or salvaged materials such as surplus wood, windows, doors and other uninstalled materials can be donated to organizations such as Habitat for Humanity or local Youth Build Programs.

Applications: Materials should be clean and in good condition.

Benefit: Donating unused materials reduces landfill deposits and helps local charitable organizations. Donations may be tax deductible. Refer to the Resource List for local organizations.

3. Protect Native Soil

Description: Typically, a building site is cleared of vegetation and the topsoil is removed. After building, sod is laid on subsoil, beginning a cycle of high water and chemical dependency. Ideally, construction is coordinated with a landscape professional to protect the soil, which is a valuable, living resource.

Applications: Design for minimum building & hardscape footprints and little or no grading. Retain native vegetation. Delineate and limit the construction footprint; restrict heavy equipment that compacts soil, including cars, to areas that will be paved or built over. When grading is unavoidable, identify areas to be paved as a place to store native topsoil during construction. Amend soil with compost and respread topsoil after construction.

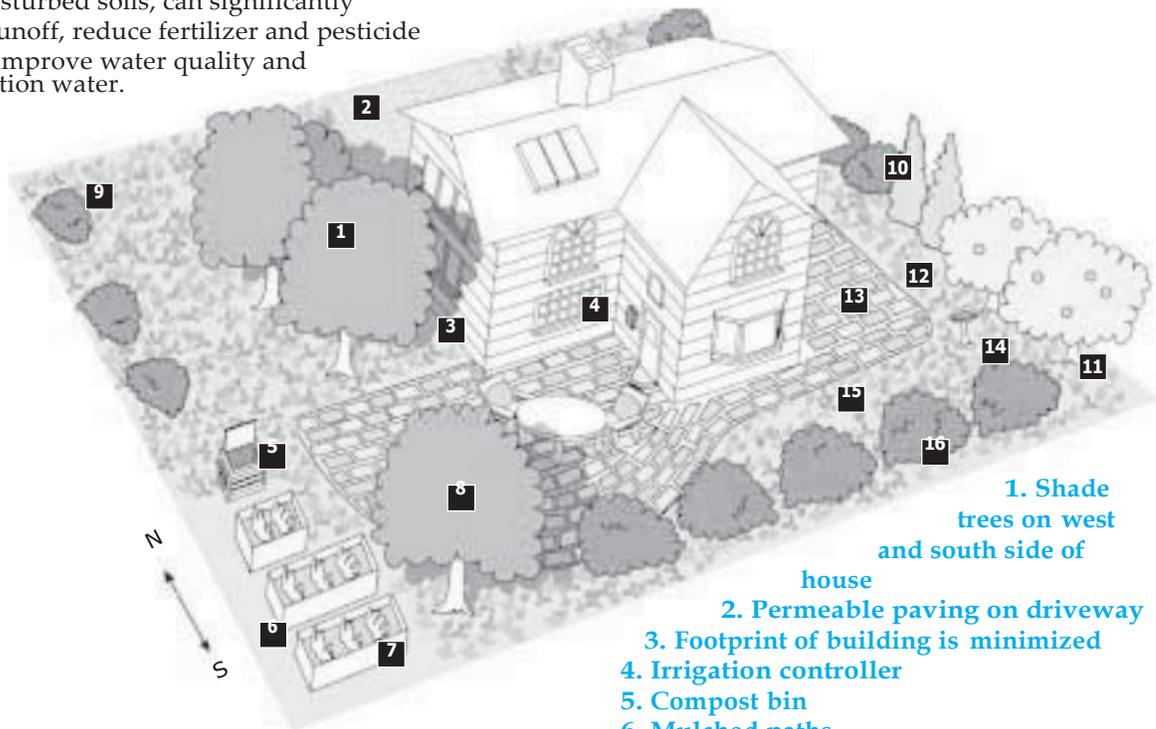
Benefits: Preserving native soils, along with nurturing the health of disturbed soils, can significantly reduce storm runoff, reduce fertilizer and pesticide requirements, improve water quality and conserve irrigation water.

4. Minimize Disruption of Existing Plants and Trees

Description: Through careful planning and construction practices, valuable trees and plants can be preserved and incorporated into new developments and neighborhoods.

Applications: Complete a landscape survey to determine the feasibility of preserving or relocating mature trees and shrubs. Fence trees and shrubs for protection from equipment.

Benefits: Preserving existing, mature landscape features helps prevent soil erosion, maintains existing sources of natural cooling (e.g. shade from a mature tree), diverts waste from landfills, and adds a unique character to the community.



1. Shade trees on west and south side of house
2. Permeable paving on driveway
3. Footprint of building is minimized
4. Irrigation controller
5. Compost bin
6. Mulched paths
7. Drip-irrigated raised beds for vegetables (Trees, shrubs on drip)
8. Deciduous tree for reducing cooling costs in summer
9. Drought-tolerant ground cover and shrubs
10. California natives grouped by water needs and given the space to grow to their natural size
11. Repository for leaves under tree
12. Increased diversity to wildlife habitat
13. Pavers with spaces and unthirsty plants between
14. Bird bath
15. California native ground covers
16. Shade loving plants to fit micro-climate



Job Site Recycling, Foothill Glen Housing, Union City, CA

5. Implement Construction Site Stormwater Practices

Description: Stormwater runoff is part of a natural hydrologic process. However, land development and construction activities can significantly alter natural drainage patterns and pollute stormwater runoff.

Applications: Identify all storm drains, drainage swales and creeks located near the construction site, and make sure all subcontractors are aware of their locations to prevent pollutants from entering them. Train employees not to dump anything down storm drains. Protect all storm drain inlets using filter fabric cloth to prevent sediments from entering the storm drainage system during construction activities. Keep materials out of the rain, and prevent runoff pollution at the source. Store hazardous waste in drums and covered bins and contract a company to dispose of it properly.

Benefits: Properly managing a gallon of water on site saves money in avoided engineering costs downstream. Keeping pollutants out of the storm drains minimizes erosion and water pollution and protects local creeks, reservoirs and the Bay. For more information, visit www.cleanwaterprogram.com or call 888/BAYWISE.

6. Protect Water Quality with Landscape Design Features

Description: Designing landscapes to allow irrigation and stormwater to soak into the soil recharges groundwater systems, and filters out pollutants.



Permeable Pavers

Application: Use permeable paving, which allows water to percolate into the soil, for walkways, patios, and driveways. Install like conventional pavers. Minimize roadway width and avoid contiguous impermeable surfaces. Design infiltration basins and berms.

Benefit: Allowing stormwater percolation reduces the volume of polluted water that flows into rivers or the Bay, while replenishing soil moisture and local aquifers. Additional benefits include reduction in irrigation requirements, non-source pollution as well as lower risk of flooding.

7. Design Resource-Efficient Landscapes and Gardens

Description: Conventional landscapes have high inputs of water and chemicals and are often over-planted or planted without regard for climate and soil conditions. This results in excess water and fuel consumption, water pollution and waste generation.

Application: Specify plants that are appropriate for the climate and soil; select slow-growing, drought tolerant, preferably California native plants. Design with perennials instead of annuals; choose and site trees to reduce building heating and cooling energy. Give plants plenty of room to mature, reducing the need for pruning. Avoid invasive species and hedges that require constant shearing. Limit turf to the smallest area that will meet recreational needs. Recycle yard trimmings by grass-cycling, mulching and composting.

Benefit: Sustainable landscape techniques are in harmony with the local environment and help conserve water, reduce use of chemicals, create healthier soil and plants, and increase bio-diversity in landscape areas. Resource: Bay-Friendly Landscaping Guidelines, call ACWMA, 1-877-STOPWASTE

8. Reuse Materials or Use Recycled Content Materials for Landscape Areas

Description: Plastic or composite lumber makes a very durable landscape edging, broken concrete can make a very attractive retaining wall or path, and ground glass cullet can be used for walkways.

Application: Use salvaged or recycled content materials for hardscapes (patios, decks, walkways and driveways) and other landscape structures.

Benefit: The durability of plastic or composite lumber is greater than wood as they do not rot, crack or splinter. Salvaging or buying recycled content landscaping products conserves natural resources and strengthens markets for recycled materials.

9. Install High-Efficiency Irrigation Systems

Description: New irrigation technologies apply water to the soil at the plant root zones at the rate the soil can absorb it, significantly reducing water waste from overspray.

Application: Install low-flow drip, sub-surface drip, or low-flow sprinklers in place of standard sprinkler systems for all landscape applications. Base watering levels on moisture sensors or weather based controllers. Use captured rainwater. Group plants by water requirements.

Benefit: High-efficiency irrigation systems dramatically reduce landscape water use, and are critical to preventing disease & minimizing weed growth.

10. Provide for On-Site Water Catchment / Retention

Description: Rainwater is channeled through gutters and downspouts to an aboveground cistern or underground gravel dry well. Stored water is used for landscape irrigation.

Application: Install wherever there is guttered roof runoff and room for the cistern.

Benefit: Water catchment reduces the need to use drinking water for irrigation of lawns and gardens.

B. FOUNDATION

1. Incorporate Recycled Flyash in Concrete

Description: Flyash is a by-product of coal burning power plants and can be an inexpensive substitute for a portion of Portland cement used in concrete.

Application: Typically, 15%-50% of cement can be replaced with flyash in residential concrete mixes, however it must be cured longer than standard concrete.

Benefit: Flyash increases the strength and durability of the concrete. Using flyash also reduces the amount of cement needed, thereby decreasing the overall environmental impacts of cement production.

2. Reuse Form Boards

Description: Form boards are often 2x10 or larger solid sawn lumber typically cut from old-growth trees.

Application: Forms are used whenever concrete is poured. By carefully removing and separating the forms, they can be reused several times.

Benefit: Reuse of forms saves money and conserves resources. Solid sawn lumber is becoming increasingly expensive and scarce.

3. Use Aluminum Forms

Description: Aluminum forms come in all sizes and shapes and produce a smooth finished surface on the concrete. They can be used repeatedly.

Application: Aluminum forms can be used in most applications to replace wood forms.

Benefit: Because they can be reused many times, aluminum forms reduce wood use and, despite higher initial cost, pay for themselves quickly.

4. Use Recycled Content Aggregate

Description: Recycled aggregate consists mainly of crushed concrete and crushed asphalt pavement. Most of the recycled material is used as base material for road products. Recycled concrete and asphalt crushed to 3/4" minus satisfies the California Department of Transportation's (CalTrans) specification for Class 2 Aggregate Base.

Application: Use recycled aggregate for applications where CalTrans Class 2 base rock is specified.

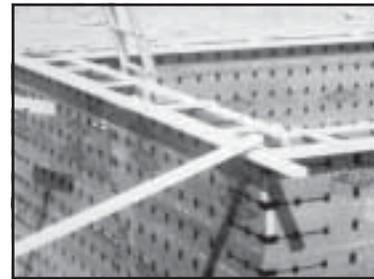
Benefit: Even though a large percentage of asphalt and concrete are recycled, there is still some that end up in landfills. Using recycled instead of virgin materials saves money, natural resources and energy.

5. Insulate Foundation / Slab Before Backfill

Description: All foundations, including slab floors, can be insulated to minimize heat loss.

Application: Insulate foundation with extruded polystyrene insulation of at least R-4 (1" or greater).

Benefit: Insulating the foundation minimizes heat loss from the floors and basement, reduces energy loss and, therefore, reduces utility bills.



Insulated Concrete Forms (ICFs)

6. Install Rigid Foam, Insulated Concrete Forms (ICFs)

Description: Rigid foam forming systems hold concrete in place during curing and remain in place afterwards to serve as thermal insulation for concrete walls.

Application: Use rigid foam forming systems wherever an insulated foundation is desirable.

Benefit: Unlike untreated lumber, ICFs are not subject to rot and result in a better insulated foundation.

C. STRUCTURAL FRAME

1. Substitute Solid Sawn Lumber with Engineered Lumber

Description: Solid sawn lumber in sizes of 2x10 or greater typically comes from old-growth forests. Engineered lumber products, on the other hand, come from small-diameter and fast growing plantation trees. These products include glulams, laminated veneer lumber, wood I-joists, oriented strand board, parallel strand lumber, and other manufactured wood fiber structural materials.

Application:

A. Floor Joist—2x10 and larger lumber are typically used for floor and ceiling joists and some seismic applications. Large size lumber can be replaced with engineered lumber in most applications unless required by seismic codes.

B. Non-Load Bearing Header—Solid sawn 4x6 are

often used for headers when smaller dimension lumber would suffice, such as double 2x6, unless solid 4x6 are required by seismic codes.

C. Structural Headers and Beams— Engineered lumber should be used whenever structural members are required. They substitute for 4x12 in most interior applications such as the structural framing of floors, walls and roofs.

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, resulting in stronger and higher quality homes.

2. Use Forest Stewardship Council (FSC) Certified Wood for Framing

Description: FSC certification assures that the forest from which the wood is produced is managed in a sustainable and socially responsible manner.

Application: Use FSC wood where solid wood framing is required. Certified framing materials and plywood are available at many local suppliers.

Benefit: FSC certification guarantees that forests are managed in a way that will assure the long-term availability of precious woods while protecting old-growth forests.

3. Use Wood I-Joists for Floors and Ceilings

Description: Wood I-joists are engineered to use only the wood fiber necessary for the structural function required. They typically use oriented strand board (OSB) for the web and either laminated veneer lumber or solid sawn lumber for the chords (top and bottom pieces).

Application: Replace solid sawn lumber with wood I-joists for floor and ceiling joists. Often they can be used at 19.2" centers to save material.

Benefit: Wood I-joists use 50% less wood fiber to perform the same structural function as similar sized solid sawn lumber and will never twist, warp or split. They are stronger and lighter than 2x10 or 2x12 and can span greater distances.



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

4. Use Steel Interior Web Trusses

Description: Steel web trusses use wood or laminated veneer lumber top and bottom chords that are connected by steel webbing for structural integrity.

Application: Use primarily for long-span floor joists.

Benefit: Web trusses eliminate waste since they are made to order. They reduce the pressure on old growth forests by replacing 2x10s and 2x12s traditionally used for floor joists.

5. Design Energy Heels on Trusses 6" or More

Description: Energy heels raise the height of the truss at exterior wall top plates to accommodate increased insulation at the perimeter of the house.

Application: Install where conventional trusses are used. They need to be special ordered. 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". Raising the heels allows for full insulation around the house, saving energy and money.

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.

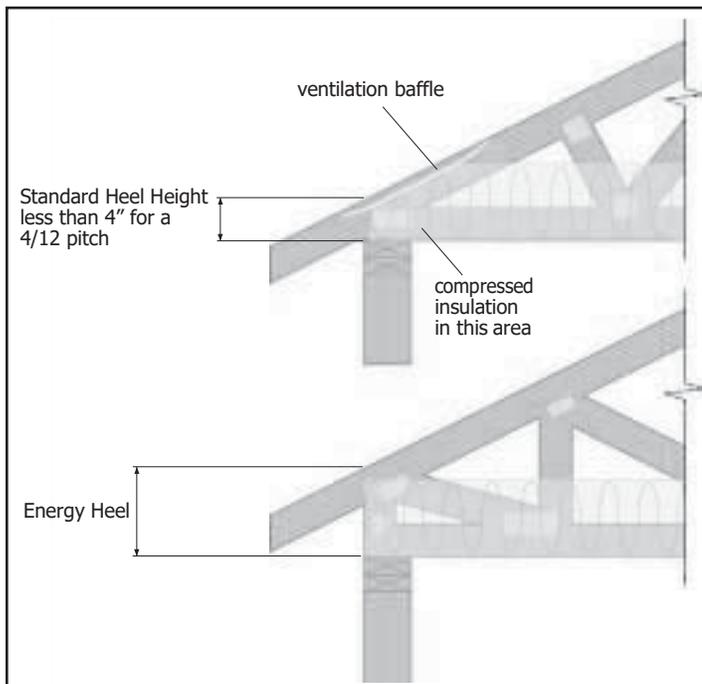
Benefit: OSB is as strong as traditional plywood sheet material and is less expensive. OSB reduces the need for large diameter old-growth trees required for plywood. Some OSB uses lower formaldehyde content adhesives that contribute to healthier indoor air quality.



Oriented Strand Board



OSB for Sheathing



Energy Heels on Trusses Allow More Insulation

7. Use Finger-Jointed Studs

Description: Finger-jointed studs use short pieces of 2x4 or 2x6 material glued together to form standard stud lengths.

Application: Use finger-jointed studs (graded equivalent to full dimensional studs – 1997 UBC Standard, Chapters 23 and 35) wherever conventional studs are typically used, in vertical applications. Use of finger-jointed studs may require code approval by your local jurisdiction, and may need to be submitted to the structural engineer of record for approval.

Benefit: Finger-jointed studs reduce the use of solid sawn wood studs. They are straighter and stronger than solid sawn studs, eliminating crooked walls and reducing material waste.

8. Use Engineered Studs for Vertical Applications

Description: Engineered studs are laminates, like OSB, that are used in vertical structural applications.

Application: Use for interior or exterior wall applications except where prohibited by seismic codes. They are particularly appropriate for tall cathedral wall applications.

Benefit: Engineered studs are straighter than conventional studs and will not deform, twist, split or warp. They save wood by using small laminated pieces.



Steel Studs

9. Use Recycled-Content Steel Studs for Interior Framing

Description: Steel studs can be either standalone or provide a “c” channel over wood studs. Steel often contains 75% or higher recycled content.

Application: For use in non-insulated interior walls.

Benefit: Steel reduces the need for wood and provides strong interior walls.

10. Use Structural Insulated Panels (SIPs) for Walls and Roof

Description: SIPs are high-performance, load-bearing sheets that consist of a core of foam insulation with OSB on either side. SIPs can be used for floors, walls and roofs in residential buildings.

Application: Use SIPs for structural exterior walls and roofs in place of stick framing. SIPs can be designed to meet seismic Zone 4 requirements. Note: It’s important to seal the joints well, to avoid water penetration.

Benefit: SIPs are more energy-efficient, provide excellent soundproofing and reduce infiltration relative to frame construction. They can be erected quickly, allowing for faster construction. They save wood by eliminating much of the conventional framing lumber.

11. Apply Advanced Framing Techniques

Description: Advanced Framing involves framing exterior and interior walls 24” on center.

Application: Framing on 24” centers can replace most conventional 16” on center framing. The expanded centers may reduce some types of siding options.

Advanced framing may also include stacking trusses over studs and using drywall clips.

Benefit: Expanding centers makes the home more energy efficient while saving wood and construction costs. It also allows for a higher percentage of the wall to be insulated reducing frame conduction heat loss.



Construction using SIPs

12. Use Reclaimed Lumber

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

Application: Use reclaimed lumber for nonstructural applications, in place of new material.

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

D. EXTERIOR FINISH

1. Use Sustainable Decking Materials

A. Recycled Content Decking

Description: There are two types of recycled content decking: plastic lumber and composite lumber. Recycled plastic lumber contains only recycled plastic resins, while composite lumber is made by combining recycled wood fiber and recycled plastic resins.

Application: Use recycled content decking in all non-structural deck applications. Both products can be used in place of old-growth redwood, cedar and pressure treated pine. These products accept screws and nails, and cut like wood. Follow manufacturer recommendations closely regarding the amount of expansion that will occur when using plastic lumber.

Benefit: The durability of these materials is greater than wood. They will not rot, crack or splinter, do not require staining and are not treated with potentially toxic chemicals. Using recycled content decking also reduces pressure on old-growth forests.

B. Forest Stewardship Council (FSC) Certified Wood Decking

Description: Certified, sustainably harvested lumber comes from forests managed in an environmentally and socially responsible manner.

Application: Use FSC Certified lumber for all exterior decking applications or as structural deck members in conjunction with recycled content decking.

Benefit: FSC certification guarantees that forests are managed in a way that will assure the long-term availability of precious woods while preserving old growth forests.

2. Use Treated Wood That Does Not Contain Chromium or Arsenic for Decking and Sill Plates

Description: Alkaline Copper Quaternary (ACQ) and Wolman Natural Select are alternative treated woods that do not contain chromium – a heavy metal – and arsenic, which are detrimental to human health.

Application: Use non-chromium/arsenic treated wood for any application that specifies treated lumber including decking, fencing, sill plates, and site furnishings.

Benefit: ACQ and Wolman Natural Select use copper as their main component, and are a better alternative to lumber treated with chromium and arsenic, particularly for children who play on or near decks.

3. Install House Wrap under Siding

Description: House wrap protects the sheathing from moisture and allows vapor from inside to escape.

Application: Install house wrap according to manufacturer's specifications over all sheathing before exterior finish is installed. To provide an effective drainage plane for water, it needs to be lapped and edges should be taped with manufacturer's tape. Special products have been developed for wrapping window and door openings and for stucco applications.

Benefit: House wrap provides a continuous drainage plane that diverts water away from openings and protects the home from mold. It can also help reduce moisture build up in stud cavities by allowing water vapor to migrate through the material.

4. Use Alternative Siding Materials

A. Use Recycled Content Siding

Description: Recycled content siding is often called hardboard. Hardboard includes varying amounts of recycled content materials and looks and performs like wood siding.

Application: Use hardboard where wood siding is installed.

Benefit: Siding that has been manufactured with recycled wood fiber will not crack, split or warp and holds paint longer than solid wood siding, therefore reducing maintenance costs and resources.

B. Use Fiber-Cement Exterior Siding

Description: Fiber-cement siding is composed of cement, sand and cellulose fibers. It is usually textured to look like wood siding or stucco finish.

Application: Fiber-cement siding can be cut with a carbide or diamond-tipped saw blade, snapper shears or with a guillotine cutter. Dust protection

and control are required when cutting with a circular saw.

Benefit: Fiber-cement siding is more durable than wood, termite resistant, noncombustible and warranted to last 50 years. Using fiber-cement siding reduces the demand for old-growth redwood or cedar siding. It may also reduce homeowner’s insurance rates due to fire resistance.

E. PLUMBING

1. Insulate Hot and Cold Water Pipes

Description: Insulating water pipes reduces heat loss or gain in the pipes while the water is standing.

Application: Insulate hot water pipes in all runs through unconditioned spaces: basements, crawl spaces, attics, etc. At a minimum, insulate both hot and cold pipes at least 6 feet from the hot water heater to prevent convective circulation from the heater through the pipes.

Benefit: Insulated pipes save energy and water. The water does not need to run as long to get hot water to a distant faucet, thereby reducing hot water heating costs.

2. Install Flow Reducers in Faucets and Showers

Description: Flow reducers fit into the aerator at the tip of the faucet and reduce the rate of water flow through the faucet. Low-flow showerheads replace standard showerheads.

Application: Specify low-flow water conservation devices according to East Bay Municipal Utility District’s (EBMUD) recommendations:

- ◆ Kitchen faucets ≤2.0 gpm
- ◆ Bathroom faucets ≤1.5 gpm
- ◆ Showerheads ≤2.5 gpm

Limit showerheads to one fixture per shower

Benefit: Flow reducers can cut water usage of faucets and showers by as much as 40% with little noticeable effect.

survey says...

In terms of resource conserving features, consumers’ top choices were:

Water-saving washers and dishwashers.....	84%
Water-conserving faucets and fixtures	64%
Recycled content decking.....	63%
Engineered lumber	62%

Source: The State of Green Building 2001

3. Install Ultra-Low-Flush Toilets

Description: New high-efficiency toilets use 1.6 gpf (gallons per flush) or less. Some manufacturers offer dual flush toilets.

Application: Select a toilet from EBMUD (www.ebmud.com) pre-tested list to ensure the model actually uses no more than 1.6 gpf and performs well.

Benefit: Ultra-Low-Flush toilets reduce the amount of water usage.

4. Install Chlorine Filter on Showerheads

Description: Water filters on showerheads reduce chemicals and particulates from the water stream.

Application: Install the water filter between the pipe and the existing showerhead.

Benefit: Chlorine is absorbed 6 times faster through the skin than through the digestive system. It has been shown that chlorine absorption can have adverse health effects on some people and especially children.

5. Install Tankless Water Heater

Description: Tankless water heaters (flash or on-demand heaters) heat water as needed rather than having a tank in which hot water is stored. Their capacity to provide hot water is virtually unlimited.

Application: Install tankless water heater as close to the point of use as possible. The device should have a variable-set thermostat and be appropriately sized. Gas tankless water heaters typically have more capacity than electric tankless heaters.

Benefit: Conventional water heaters lose 15% of their energy through standing tank losses, whereas tankless heaters use energy only for immediate hot water needs. Tankless water heaters often are quicker and more reliable.

6. Pre-Plumb for Graywater Conversion

Description: Graywater is wastewater from sinks, showers and washing machines that is not contaminated by human waste.

Application: Graywater plumbing separates the waste pipes from sinks, showers, and washing machines from the toilet waste. Graywater drains are run to a holding tank similar to a septic tank which, in turn, is used to water plants, lawns and gardens. Check with your local building department for requirements.

Benefit: Graywater utilization cuts down on the use of potable water for outside irrigation and lawn watering. It is essentially recycling water at home.

7. Install Water Filtration Units at Faucets

Description: Water filtration units can be installed at individual faucets or for the whole house. They reduce chlorine and many other chemicals, particulates and microorganisms.

Application: Whole house filters are for drinking water and plumbing (not for hose-bibs or toilets). Install filtration system between the cold water line and the main drinking water faucets in the house.

Benefit: Agricultural run-off, chemical leaching and microorganisms increasingly contaminate public water systems across the country. House filtration systems reduce the health threat of these contaminants.

8. Install On-Demand Hot Water Circulation Pump

Description: An on-demand hot water circulation pump can send hot water to fixtures in seconds; without wasting water while waiting for it to get hot. It uses a pump to rapidly move water from a water heater to fixtures. It stops when water reaches a pre-set temperature.

Application: Install the pump at the furthest faucet from the water heater. Only one pump is needed to supply hot water to any fixture and can easily be installed.

Benefit: Both water and energy are saved since water doesn't have to be wasted until it reaches the correct temperature for use. Hot water arrives to the fixture 5 times faster than on average.

F. ELECTRICAL

1. Install Compact Fluorescent Light Bulbs (CFLs)

Description: CFLs screw in like conventional bulbs but consume up to one-fourth of the electricity used by incandescent bulbs to produce an equivalent amount of light.

Application: Install CFLs in place of standard incandescent bulbs. CFLs are not recommended for fixtures that are turned on and off many times per day, i.e. a busy bathroom. Choose a CFL that is one-fourth the wattage of the incandescent bulb.

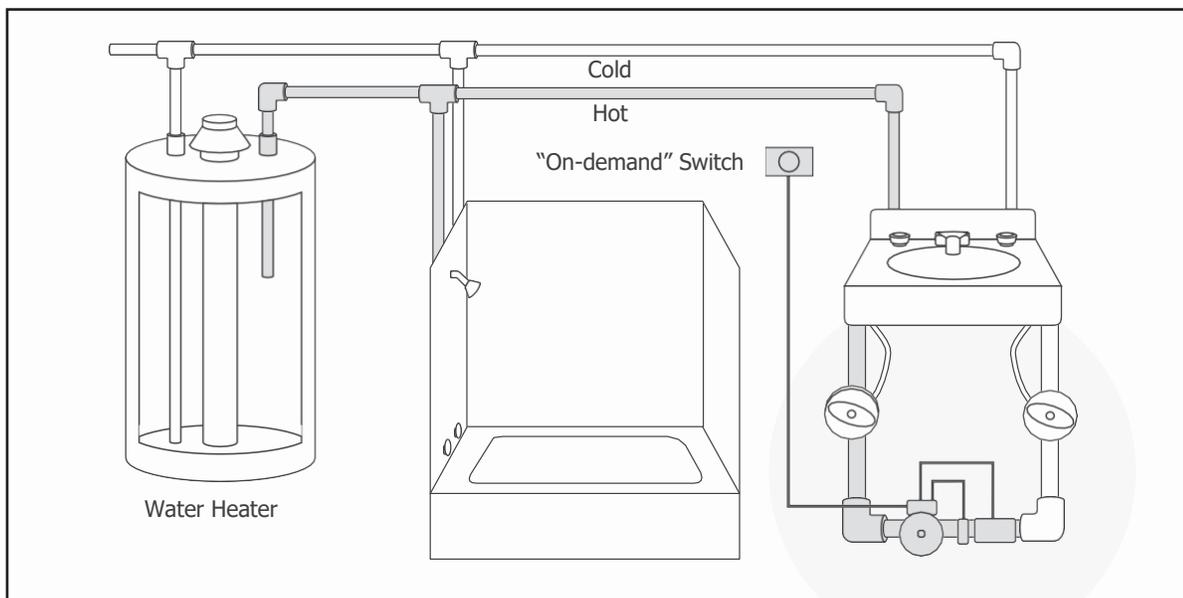
Benefit: Compact fluorescent bulbs are a profitable investment, saving several times their purchase price through reduced electricity bills and fewer replacement bulbs because they last eight times longer.

2. Install Insulation-Compatible (IC) Recessed Lighting Fixtures for Compact Fluorescent Lamps

Description: Conventional recessed fixtures allow heat to be exhausted into the attic space. Air-tight IC fixtures are sealed, allowing insulation to be blown on top to keep the heat in.

Applications: Use air-tight IC fixtures in soffits and under insulated spaces.

Benefits: Typical recessed fixtures lose heat as well as allow hot attic air to infiltrate into the house in summer months. Air-tight IC fixtures dramatically reduce the amount of heat loss/gain through these openings.



On-Demand Water Circulation Pump

ENERGY STAR® qualified compact fluorescent lighting lasts up to eight times longer than incandescent lighting. Save \$22 to \$65 in energy costs over the life of a compact fluorescent bulb. You'll replace an incandescent eight times to match the life expectancy of a single compact fluorescent.



How do you choose the right compact fluorescent bulb? The following is a general guide to assist you:

Source: www.pge.com

Existing Incandescent Lamp	Proposed ENERGY STAR® Compact Fluorescent Bulb	Savings over the life of the bulb
40 - 60 watts	11 - 15 watts	\$22 - \$35
75 watts	16 - 20 watts	\$43 +
90 - 100 watts	23 - 40 watts	\$52 +



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.

3. Install Lighting Controls

Description: Lighting controls use dimmers, sensors and timers to turn lights off in unused areas or during times when lighting is not needed.

Application: Install lighting controls either at specific locations or as a whole house system. Lighting controls are especially applicable for exterior uses. Dimmable CFLs are available at a premium.

Benefit: Lighting controls reduce energy use by having the lights on for shorter periods of time.

4. Install High-Efficiency Ceiling Fans with Compact Florescent Lamps

Description: Ceiling fans improve interior comfort by circulating cold and warm air. They can be adjusted to either draw warm air upward during summer months or push it downward during the winter.

Application: Preferable locations are bedrooms and living rooms where occupants spend time. Ceiling fans must be supported adequately between ceiling joists.

Benefit: Ceiling fans can reduce the need for air conditioning and heating.

G. APPLIANCES

1. Offer ENERGY STAR® Dishwasher

Description: ENERGY STAR® dishwashers use water and energy more efficiently.

Application: Select ENERGY STAR® dishwashers. These dishwashers use an internal water heater to boost

temperatures inside the dishwasher. For this reason, water heaters can be turned down to 120 degrees, saving water heating costs.

Benefit: Water-efficient dishwashers are also energy-efficient because most energy consumed by dishwashers is used to heat water.

2. Offer Horizontal Axis Washing Machine

Description: Horizontal axis machines load from the front, spinning clothes in and out of the water to tumble them clean.

Application: Select ENERGY STAR® horizontal axis washing machines.

Benefit: Horizontal axis machines save resources by using less water and energy. They use up to 40% less water and 50% less energy than conventional top loading washers, translating into lower energy and water bills for the resident. Manufacturers claim that there is less wear and tear on clothes compared to the traditional agitator (top loading) machines.



Horizontal Axis Washing Machines

3. Offer Energy-Efficient 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. New appliances are much more energy-efficient.

Application: Select ENERGY STAR® rated refrigerators.

Benefit: ENERGY STAR® refrigerators can save over 10% of the total annual electrical bill. Check with your local utility company for rebate programs.

4. Install Built-In Recycling Center

Description: Built-in recycling centers provide bins for separated recyclables and food waste.

Application: Recycling bins can be built into kitchen cabinets, as well as standalone units in the garage.



Built-In Recycling Center

Benefit: A built it recycling center keeps materials separated and free from contamination, making it easy and convenient to recycle.

H. INSULATION

1. Upgrade Wall and Ceiling Insulation to Exceed Title 24 Requirements

Description: Insulation in exterior walls and ceilings can reduce the demand for air conditioning and heating and make homes more comfortable.

Application:

A. Wall Insulation

Insulate walls to exceed Title 24 Standards:
Zone 1: Increase R-21 by 20% to R-25.
Zone 2: Increase R-13 by 20% to R-16.

B. Ceiling Insulation

Increase ceiling insulation to exceed Title 24 Standards:
Zone 1: Increase R-38 by 20% to R-45.
Zone 2: Increase R-30 by 20% to R-36.

Benefit: Increased wall and ceiling insulation improves comfort, decreases heating and cooling requirements, saves money, and makes the home quieter.

survey says...

In terms of energy efficiency features, consumers have the following preferences:

Insulation above code	83%
High-efficiency furnaces	83%
Passive solar features.....	76%
ENERGY STAR® Certification	61%

Source: The State of Green Building 2001

2. Install Recycled Content, Formaldehyde-Free Fiberglass Insulation

Description: Many fiberglass insulation products include recycled glass, formaldehyde-free binders, non-asphalt adhesives or colored dyes.

Application: When using fiberglass insulation, specify recycled content and no formaldehyde. Fiberglass insulation can be used for any typical insulation installation.

Benefit: Formaldehyde-free binders reduce indoor air quality problems and insulation may contain up to 30% recycled glass.

3. Use Advanced Infiltration Reduction Practices

Description: Expandable foam and caulk are used to prevent infiltration where wood connections are made or framing is drilled to provide for plumbing and electrical runs.

Application: These methods are especially important when fiberglass insulation is installed, since fiberglass does little to reduce infiltration. Seal holes between floors and between stud cavities around wire runs. Caulk top and bottom plates on all floors.

Benefit: Reduction in infiltration increases comfort and reduces energy bills.

4. Use Cellulose Insulation

A. Walls

Description: Cellulose is a highly effective insulation made out of recycled newspaper. Damp-blown spray cellulose wall insulation is mixed with low toxic binders to adhere to stud and joist cavity surfaces.

Application: This installation is appropriate for new construction. Avoid damp blown cellulose during wet months and install drywall only after testing for 25% (maximum) moisture content. Use boric acid treatment only; avoid ammonium sulfate treated cellulose insulation.

Benefit: Spray insulation completely fills cavities and penetrations, thus reducing air infiltration. The binder in the insulation also reduces the air movement within wall cavities, reducing moisture intrusion and flame spread. Using cellulose insulation makes the home quieter, more comfortable and reduces energy use by 20-40%.

B. Ceilings

Description: Dry-blown or loose-fill cellulose is treated with borates for fire and insect resistance. Cellulose does not contain formaldehyde, which is common in many fiberglass insulations.

Application: Spread cellulose over ceiling joists or blow into tight cavities to increase ceiling R-value. It is important to maintain attic or ceiling ventilation pathways, especially in cathedral ceiling applications. Avoid excessive blown-in cellulose

behind netting as it may make it difficult to achieve flat walls and ceilings with drywall. Best to use 5/8" drywall only over dry-blown cellulose insulation. Use boric acid treatment only, avoid ammonium sulfate treated cellulose.



Damp-Blown Spray Cellulose Wall Insulation

Benefit: Cellulose insulation is formaldehyde-free, provides up to 22-55% higher fire resistance, manufactured with recycled materials. It also reduces air leakage and contributes to a more comfortable and energy efficient home.

I. WINDOWS

1. Install Energy-Efficient Windows

Windows play a big role in the energy efficiency of homes. In the summer, they can allow unwanted heat into the house, and in the winter, windows can account for as much as 25% of the heat loss. When selecting windows, look for models with the following energy saving features:

A. Double-Paneled Windows

Description: Double glazing insulates almost twice as well as single glazing.

Application: Install double-paned windows whenever possible.

Benefit: High quality double-paned windows make the whole house quieter and more comfortable during all seasons, while saving energy and money.

B. Low-Emissivity (Low-E) Windows

Description: Low-E coatings, virtually unnoticeable to the eye, are installed inside the air space of a double-paned window. The low-E coatings help prevent heat from escaping through the glass in winter and block heat from entering the home during summer.

Application: Use low-E, double-paned windows.

Benefit: Low-E windows reflect heat, making the home more comfortable in cold weather and on hot summer days. The cost premium for low-E glass typically pays for itself in a few years. Low-E, double-paned glass coating increases glass R-value to 3 compared to R-1 for single-glazed windows.

C. Low-Conductivity Frames

Description: Most window frames and sashes are made of wood, vinyl, fiberglass

Energy Rating Factors	Residential Rating	Non-Residential Rating	Product Description
U-Factor <small>(Determined in Accordance with NFRC 101)</small>	0.34	0.32	Multi-Pane Control Coat Low-E Argon Filled U-Arg
Solar Heat Gain Coefficient <small>(Determined in Accordance with NFRC 101)</small>	0.31	0.32	
Visible Transmittance <small>(Determined in Accordance with NFRC 101)</small>	0.51	0.55	

1. Look for this label as your assurance that this window has been independently rated using a procedure established by the NFRC. Although other labels may be present, the NFRC label is your best source of energy performance information.

2. U-factor is a measure of heat transferred by the entire window (frame, sash and glass) either into or out of the building. A smaller U-factor will provide a window which is more comfortable on cold days. Try to purchase a window with the lowest U-factor.

3. Solar Heat Gain Coefficient (SHGC) is a measure of the solar energy entering the building through the entire window. A lower SHGC will reduce air conditioning costs and provide more comfort on hot days.

4. Visible Transmittance (VT) is a measure of the amount of visible light entering the window. Try to select a window with a high VT. It will bring more natural day-light into your home.

5. Independent Certification and Inspection Agency (IA) selected by the window manufacturer. All testing is done by an NFRC accredited laboratory, and results are sent to the IA for evaluation. Both laboratories and manufacturers are inspected annually to ensure that NFRC standards are maintained.

6. Name of the window manufacturer.

7. NFRC technical procedures by which the window was evaluated.

8. The NFRC "rating", a numerical value, represents the applicable energy performance characteristic. Residential (or "AA") and Non-residential (or "BB") are NFRC size designations. Representative test sizes are chosen for each product type and identical sizes are compared among different manufacturers.

9. Manufacturer's description of the labeled product.

Source: www.pge.com

or aluminum. Wood, vinyl and fiberglass generally insulate better than aluminum frames.

Application: Consider specifying wood windows as standard window packages.

Benefit: Wood windows create greater comfort and better energy efficiency and are an environmentally preferable material.

J. HEATING, VENTILATION AND AIR CONDITIONING (HVAC)

1. Use Duct Mastic on all Duct Joints

Description: Leaks in the joints between ductwork allow conditioned air to escape into attics and basements. Duct tape loses its effectiveness in 3-5 years. Mastic maintains the seal for decades.

Application: Install mastic at every duct joint and around the bends in elbows. It is important for all ducts to be sealed.

Benefit: Leaky air ducts can cause negative pressure in the house which can allow carbon monoxide from gas water heaters and furnaces into the home. Well-sealed ductwork also keeps the house more comfortable.

2. Install Ductwork within Conditioned Space

Description: Ducts in exterior walls, attics and in uninsulated spaces lose a significant amount of heated or cooled air capacity.

Application: All ductwork for heating or cooling should be run through conditioned space inside the insulated envelope. Duct runs require chases to be designed into the home from the beginning.

Benefit: Locating ducts in the conditioned space significantly reduces energy loss and improves occupant comfort.

3. Vent Range Hood to the Outside

Description: Steam, gases, smoke and other combustion by-products (such as unburned hydrocarbons) can result from cooking. Stovetop range hoods expel these by-products to the outside.

Application: Range hoods are particularly important for gas stoves and can be installed where stoves are adjacent to exterior walls.

Benefit: Range hoods improve indoor air quality, prevent overheating and excess moisture build-up.

4. Clean all Ducts Before Occupancy

Description: Debris and dust from construction can cause allergic reactions in occupants.

Application: Clean or vacuum all ductwork before occupancy to eliminate dust. Clean ducts before carpet is laid and finishes are applied. Reduce dust build-up by temporarily blocking registers at time of duct installation.

Benefit: Children are especially sensitive to micro particulates like drywall dust. Cleaning and vacuuming ductwork reduces dust around the house after occupancy.

5. Install Attic Ventilation Systems

Description: Soffit and eave ventilation and gable/continuous ridge ventilation exhausts excess heat and moisture from attic spaces by natural convection.

Application: Install equal amounts of ventilation between the soffits/eaves and the gables/ridges. The code requirement of 1 square foot of net free area of venting for every 150 square feet of attic floor area should be doubled. Keep insulation from blocking the soffit vents.

Benefit: Attics can reach 140°-160° F on a hot summer day. That heat migrates into the house, exchanging air with the living space. Eave and soffit venting and continuous ridge venting increases comfort, reduces air conditioning costs and reduces problems associated with excess attic moisture.

6. Install Whole House Fan

Description: Whole house fans can cool a house without using an air conditioner by bringing in large volumes of fresh air at night.

Application: The fan must be mounted in a hallway ceiling on the top floor. An insulated, airtight seal is necessary to prevent air leakage in winter. Fans should be sized to produce between 4-5 air changes per hour and should have two speeds: low speed for continuous ventilation and high speed. Keep a window open at night to avoid backdrafting of carbon monoxide in gas appliance flues.

Benefit: An average whole house fan uses one-tenth the electricity of an air conditioning unit. Moving large volumes of air can achieve indoor comfort at higher temperatures without air conditioning.

7. Install Sealed Combustion Furnaces and Hot Water Heaters

Description: Sealed combustion furnaces and water heaters duct fresh air directly into a sealed jacket around the combustion chamber eliminating the use of house air for combustion.

Application: Install in place of conventional furnaces or hot water heaters.

Benefit: Natural gas furnaces and hot water heaters use indoor air for combustion. When a negative pressure situation is created in the home by exhaust fans, dryers or leaky ducts, carbon monoxide can be pulled into the house from the combustion chamber. Sealed furnaces and hot water heaters eliminate that condition, thereby improving indoor air quality and reducing the danger of carbon monoxide contamination.

8. Install 13 SEER and 11 EER or Higher Air Conditioning with a Thermostatic Expansion Valve (TXV)

Description: Air conditioning equipment is one of the greatest loads on power grids. SEER (Seasonal Energy Efficiency Ratio) measures cooling system efficiency at low temperatures while EER (Energy Efficiency Ratio) is a high temperature performance rating. The higher the SEER/EER number the less power is required to provide comfort. This assures that the air conditioning system operates at high efficiency during the full range of summer temperatures. 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.

Application: Higher SEER (13 – 18 SEER) and EER (11 or greater) units are installed like any other AC equipment. Some AC equipment comes with a factory installed TXV and others accept a TXV that can be bolted on. Zoned AC systems allow 2 to 4 zones to be conditioned at different temperatures so only the spaces being used are cooled. These require thermostats in each zone.

Benefit: High SEER units save money and energy and reduce peak load problems for utilities. High EER systems not only save money and energy but offer more cooling when you need it most, on very hot days. Installing air conditioning systems with a TXV lowers utility bills and saves energy.

9. Install Air Conditioning with Non-HCFC Refrigerants

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

Application: Some new AC units already use the alternative to R-22 refrigerant, R-410A, such as the trade brand Puron. Additional care should be taken when handling refrigerants, always select a reputable dealer who employs service technicians that have achieved Environmental Protection Agency (EPA) certification to handle refrigerants.

Benefit: Using alternatives to HCFC refrigerants eliminates depletion of the ozone layer in case of leakage during replacement.

10. Install 90% AFUE (Annual Fuel Utilization Efficiency) or Greater Furnace

Description: High efficiency furnaces convert gas to heat with greater efficiency.

Application: Install high efficiency furnace in place of conventional furnace. Installing the proper size of furnace for the home is just as important as its efficiency. Check with your local utility company for rebate information.

Benefit: A properly sized, high-efficiency furnace costs less to operate. It saves natural resources, reduces air emissions and helps create a cleaner environment.

11. Eliminate Wood Burning Fireplaces

Description: The burning of wood in fireplaces is a major source of air pollution during the winter months, generating up to one-third of the particulate matter on cold evenings.

Application: Install EPA certified wood stoves, fireplace inserts, pellet stoves or natural gas units. These units should have outside combustion air vented directly into the insert or unit.

Benefit: The amount of pollutant particulate matter will be reduced significantly compared to that of a standard wood burning fireplace.

12. Install Zoned, Hydronic, Radiant Heating

Description: Hydronic heating forces hot water through radiators located in different areas or zones throughout the house. It is typically installed as baseboards or in floors.

Application: Use hydronic, radiant heating instead of forced air heating. The system must be designed before construction starts.

Benefit: Hydronic heating is more comfortable and saves energy by heating only the zone that requires heat.



Radiant Floor Heating

13. Install High-Efficiency Particulate Air (HEPA) Filter

Description: HEPA filters remove over 90% of dust and particulates from the air.

Application: HEPA filters are installed in the return air stream at the air handler, which should be sized to handle the reduced air pressure caused by the filter. Some units have an air conditioning setting for the fan that will handle the retrofit filter.

Benefit: The EPA has identified micro-particulates as a leading cause of respiratory discomfort. By removing these particles, the HEPA filter makes the living space healthier.

14. Install Heat Recovery Ventilation Unit (HRV)

Description: An HRV is a mechanical ventilation system that recovers heat from exhausted indoor air and transfers it to the incoming fresh air stream.

Application: The unit should be designed into the HVAC system to capture heat from exhausted air from the house.

Note: Use of this equipment is particularly appropriate with blower door test results of less than .35 Natural Air Changes per Hour (NACH), which measures the air tightness of the house.

Benefit: Air-to-air heat exchangers provide for fresh air in winter while exhausting stale indoor air. Heat is captured from the exhausted air stream and transferred to the incoming air.

15. Install Separate Garage Exhaust Fan

Description: According to the U.S. Environmental Protection Agency (EPA), an attached garage is the single most significant contributor to poor indoor air quality. Car exhaust contains many known carcinogens and can migrate into living spaces through doors and cracks in walls and ceiling adjacent to the garage.

Application: Install 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 for 15 minutes after door has been opened or closed.

Benefit: An exhaust fan creates a healthier indoor environment by reducing the potential hazard of car exhaust from entering the house.

K. RENEWABLE ENERGY AND ROOFING

1. Pre-Plumb for Solar Water Heating

Description: Insulated copper pipes are installed from the attic to a hot water closet or mechanical room

for future solar installation. This option allows the homeowner to install an active solar system at a later date if they desire.

Application: Provide south-facing roof area for collectors and access for piping to a mechanical room.

Benefit: Solar hot water pre-plumbing can save money for the homeowner if, at some point in the future, they want to install a solar system.

2. Install Solar Water System

Description: Solar water heating systems use solar panels to collect heat from the sun. The hot water is stored for use at a later time. Water pre-heated by a solar system can also supplement use of a standard water heater.

Application: Provide sufficient south-facing roof area for collectors, and allow space in a hot water closet for the additional hot water storage tank.

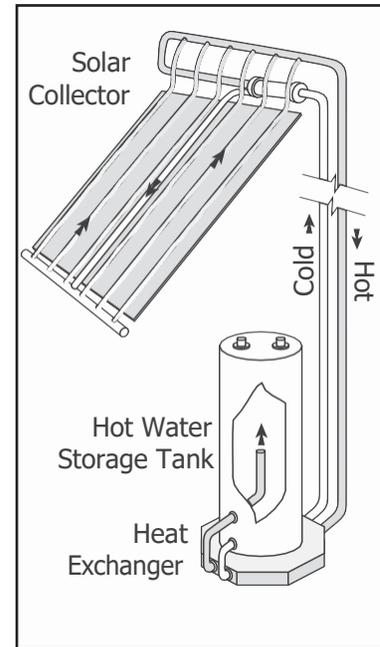
Benefit: Solar hot water systems can pay back in as little as seven years and reduce the use of gas or electricity for water heating.

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

Description: Running wires from the roof to the electric service entrance/circuit breaker panel can save costly installation of photovoltaic panels at a future date.

Application: Run two pair #10 THHN wire plus #8 ground in conduit from the south facing roof to a junction box near the panel (don't wire the panel). East and West facing roofs can work if the south is unavailable or shaded for panels.

Benefit: Photovoltaic panels and systems will continue to drop in price over the next few years. Home-buyers



Solar Hot Water and Space Heating System



Installing Solar Water System

may not be able to afford the system today but may be interested in the future when the price comes down.

4. Install Photovoltaic (PV) Panels

Description: PV panels contain hundreds of small cells that collect the sun's energy and convert it into electricity. Excess electricity can be sent back into the utility grid. The collected energy can also be stored in large batteries to meet the needs of nighttime energy requirements.

Application: Typical PV installations include flat roof, sloped roof, building integrated PV and ground mount. Items to consider when installing PV include: sunlight-minimum of 4 hours required during peak period (8 a.m. to 4 p.m.) with no shade; orientation-anything but North; angle-flat to 60 degrees; adequate roof area-depending on type of PV selected (monocrystal, polycrystal or amorphous).

Benefit: PV panels can be used as a means to decrease reliance on conventional power plants that contribute to air pollution.

5. Install Solar (PV) Walkway Lights

Description: Solar walkway or exterior lighting use photovoltaic cells (PV) to create electricity during the

day and store it in batteries for night time use.

Application: Lights can be placed anywhere without the need to run wires as long as they receive sunlight during the day.

Benefit: PV lighting is cost effective and reduces the need for grid-provided electricity.

6. Select Safe and Durable Roofing Materials

Description: 40-50 year asphalt composition, tile, slate, fiber-cement and metal are examples of safe and durable roofing materials. Avoid cedar and wood shake shingles.

Application: Applicable anytime roofing material is specified.

Benefit: A durable and safe roof is cost effective and reduces landfill deposits.

7. Install Radiant Barrier Roof Sheathing

Description: When radiant energy from the sun strikes a surface, it is converted to heat energy. A radiant barrier reflects radiant heat and does not emit it to the cooler surfaces around it. Radiant barrier sheathing is a roof sheathing material with a reflective layer (film or foil) applied to the underside.

Application: Radiant barrier sheathing can be used in place of conventional roof sheathing. Apply reflective material to the underside of rafters.

Benefit: Radiant barrier sheathing reduces heat build-up in attic spaces by not re-radiating heat from the roof to the attic. It can prevent up to 97% of the sun's radiant heat from entering the home and can bring attic temperatures down as much as 30 degrees on hot days, keeping the whole home cooler and reducing energy consumption for air conditioning.

L. NATURAL HEATING AND COOLING

1. Incorporate Passive Solar Heating

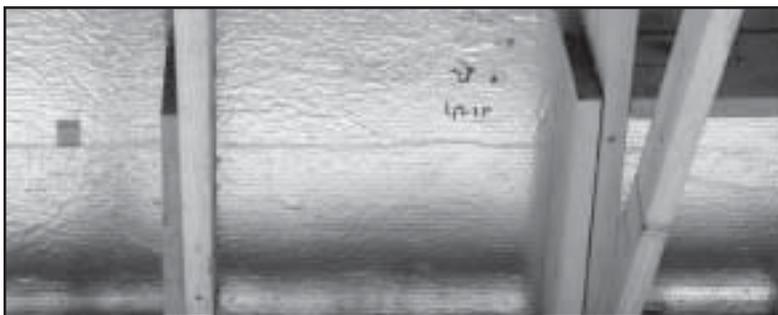
Description: Passive solar systems provide heat to the structure through south facing windows in conjunction with thermal mass.

Application: The house must incorporate windows that face within 30 degrees of due south and have the ability to store excess heat in massive elements such as a slab floor or stone fireplace.

Benefit: Passive solar design can reduce heating requirements by 30-50%, saving energy and money.



Photovoltaic Panel System



Radiant Barrier Sheathing



Awning and Trellises to Reduce Heat Gain

2. Install Overhangs or Awnings Over South Facing Windows

Description: Properly sized overhangs or awnings on south facing windows are important components of passive solar heating and natural cooling. Overhangs and awnings help keep the heat of the sun from entering the home during unwanted times, but allow heat to enter in the winter. These shade control devices can be oversized roof overhangs, wood trellises/arbores with deciduous plants, or adjustable or demountable awnings made of fabric or metal.

Application: The overhang or awning design should keep out summer sun by shading the entire window during the hottest month(s) of the year. Size overhangs or awnings above south windows so that winter sunlight is allowed into the space, where it can be absorbed by thermal mass, and be re-radiated as heat. Also consider shading devices on the west and east facing windows to protect from morning and afternoon heat, especially in hotter climates.

Benefit: Overhangs, awnings and trellises are an integral part of making passive solar heating and natural cooling work. Removable/retractable fabric awnings offer a low cost solution to reduce heat gain, lower energy bills, and make the home more comfortable in the summer

3. Plant Deciduous Shade Trees on the West and South Sides of the Home

Description: During summer months, the sun shines on the south and west sides of the home causing the home to heat up which in turn makes air conditioners work their hardest. Trees offer the best solution for keeping out low-angle sunlight from west and south windows in summer. The additional cooling demanded by low-angle sun penetration of west windows in late summer afternoons create the most significant summer peak utility costs.

Application: Plant shade trees on the west and south sides of the home to provide shade and summer cooling. The most important areas to shade are windows and paved areas. Keep trees three feet from the foundation to avoid introduction of pests and root intrusions. Avoid planting trees too close to the home or utilities.

Benefit: Planting shade trees can reduce summer air-conditioning costs by 25% to 40%. Trees provide numerous additional benefits to the environment including cleansing the air, creating habitats for birds and play places for children as well as adding aesthetic beauty to the neighborhood. Through shade and evapotranspiration, trees can create a microclimate that is up to 15 degrees cooler than the surrounding area.

M. INDOOR AIR QUALITY AND FINISHES

1. Install Whole House Vacuum System

Description: Whole house vacuums exhaust the dust from the house outside rather than collecting it in a bag that may not filter the dust effectively.

Application: Whole house vacuum systems must be vented outdoors, not into a garage, and not to any area where air may be taken back into the house.

Benefit: New generation portable vacuum cleaners may have HEPA filter that reduce the size of dust particles blown back into the house. Most vacuum cleaners do not filter the dust effectively and merely redistribute the dust that is most harmful to the respiratory system. This can aggravate asthma and other respiratory problems. Whole house vacuums expel the dust outside the house.

2. Use Low/No-VOC and Formaldehyde-Free Paint

Description: Most paint releases volatile organic compounds (VOCs), a major indoor air pollutant, into the home. Once outside, VOCs react with other pollutants, producing ground-level ozone that also affects human health. Often low/no-VOC products are manufactured without mercury or mercury compounds, or pigments of lead, cadmium, chromium, or their oxides.

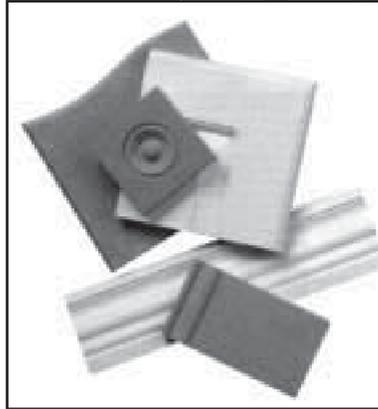
Application: Paint with low/no-VOCs is available from most major manufacturers and is applied like traditional paint products. High washability should be specified for bathrooms, kitchens and children's bedrooms. Every finish and most colors are available in low/no-VOC paints.



Low/No-VOC paint



Certified Wood Cabinets



Formaldehyde-Free
Medium Density
Fiberboard Trim

Benefit: Low/No-VOC paint reduces the emissions of VOCs into the home, improving indoor air quality and reducing the formation of urban smog.

3. Use Low VOC, Water-Based Wood Finishes

Description: Conventional solvent-based wood finishes can “offgas” for months, and can be harmful to children. “Offgassing” means the solvents are continuously released into the air, which contributes to poor indoor air quality. Low VOC finishes, such as water-borne urethane and acrylic, are lower in toxic compounds compared to conventional solvent-based finishes while providing similar durability.

Application: Low VOC wood finishes can be used in most applications where solvent-based finishes are typically used. If solvent-based wood finishes must be used, they should be left to off-gas for three to four weeks prior to occupancy.

Benefit: Using low VOC wood finishes reduces

survey says...

In rating improved indoor air quality features, the majority of consumers said the following should be standard:

Formaldehyde-free insulation	85%
Low VOC paints	73%
Heat recovery ventilation unit.....	70%

Source: The State of Green Building 2001

offgassing into the home, improving indoor air quality, and reducing the formation of urban smog.

4. Use Solvent-Free Adhesives

Description: Unlike solvent-based adhesives that off-gas toxic compounds for months, solvent-free adhesives reduce toxic gasses such as aromatic hydrocarbons or solvents that contribute to air pollution.

Application: Use solvent-free products in place of standard adhesives for all interior applications such as installation of flooring, countertops, wall coverings, paneling and tub/shower enclosures.

Benefit: Solvent-free adhesives are often stronger, emit fewer pollutants, and reduce the potential harmful impacts on the health of the occupants and installers.

5. Substitute Particleboard with Formaldehyde-Free Materials

Description: Particleboard is made from wood fibers and an adhesive that contains urea-formaldehyde, a suspected human carcinogen. The formaldehyde is continuously released, which contributes to poor indoor air quality. Particleboard is typically used for cabinets, countertops, stair treads, and shelving.

Application: Whenever possible, eliminate new particleboard inside houses by using solid wood for stair treads, certified exterior grade plywood or formaldehyde-free medium density fiberboard (MDF)

for shelving, cabinets and substrate for countertops.

Benefit: Elimination of particleboard reduces formaldehyde exposure to residents, particularly children, who are most susceptible.

6. Use Exterior Grade Plywood for Interior Uses

Description: Exterior plywood uses phenolic resins that off-gas much less than interior plywood. Interior plywood typically uses urea-formaldehyde glue which off-gasses into the house.

Application: Substitute interior plywood with exterior plywood for custom cabinets and shelving.

Benefit: Formaldehyde is a suspected human carcinogen and should be avoided whenever possible.

7. Use Formaldehyde-Free Medium Density Fiberboard (MDF) and Materials

Description: Most MDF is made from sawdust and an adhesive that contains urea formaldehyde, a suspected human carcinogen. MDF without formaldehyde binders is now available. Other alternatives include certified plywood and boards made from agricultural waste, such as wheatboard, a strawbased particleboard manufactured with non-formaldehyde and emission-free binders.

Application: Whenever possible, eliminate formaldehyde-based MDF inside the home. MDF is typically used for cabinets, trim, and shelving. Use alternatives such as certified plywood, formaldehyde-free MDF, or wheatboard for shelving and cabinets. Use tile, stone, concrete or natural linoleum for countertops.

Benefit: Reduces formaldehyde exposure to residents, particularly children, who are most susceptible. Some boards made from agricultural waste are superior to wood-based particleboard in moisture resistance and structural properties, and provides for the reuse of a former waste product.

8. Seal all Exposed Particleboard or MDF

Description: Using less-toxic, low permeability paint or sealer to seal exposed particleboard or MDF will reduce the release of harmful gasses and is the next best solution to elimination of particleboard.

Application: Whenever formaldehyde-based MDF or particleboard is used, seal all exposed edges of cabinets, undersides of countertops, stairs, shelving, etc. with at least two coats of less-toxic, low permeability paint or sealer prior to installation.

Benefit: Sealing all exposed particleboard reduces exposure of harmful emissions to residents, particularly children, who are most susceptible.

9. Use Forest Stewardship Council (FSC) Certified Materials

Description: FSC certified materials (e.g. trim, doors, shelving) come from forests that are managed in accordance with sustainable forest practices. It is particularly important to specify certified wood instead of clear, knot-free trim as this material is typically harvested from non-sustainable, old growth forests.

Application: Use FSC certified materials in any application that normally uses conventional stain-grade materials

Benefit: Sustainable forest certification assures that the forest from which the trim is produced is managed in a way that will assure the long-term availability of these precious woods while protecting ancient, old growth forests.

10. Use Finger-Jointed or Recycled Content Trim

Description: Finger-jointed trim is manufactured from short pieces of clear wood glued together to create finished trim. Recycled content trim is made from recycled polystyrene/plastics.

Application: Use finger-jointed or recycled content trim in any application where trim is to be painted.

Benefit: Finger-jointed or recycled content trim is straighter and more stable than conventional clear wood, and uses materials more efficiently.

	
<p>Forest Stewardship Council</p> <p>The FSC logo on a product provides consumers with an assurance that the wood they use comes from forests managed in an environmentally and socially responsible manner.</p>	<p>Smart Wood and Scientific Certification Series</p> <p>These groups verify that forest management is accomplished according to the FSC program.</p>

N. FLOORING

1. Select Forest Stewardship Council (FSC) Certified Wood Flooring

Description: Certified wood flooring comes from forests that are managed in accordance with sustainable forest practices. Certified wood flooring products are available in a wide variety of domestic and exotic species.

Application: Use FSC certified wood in place of conventional hardwood flooring.

Benefit: Sustainable forest certification assures that the forest from which the flooring is produced is managed in a way that will assure the long-term availability of these precious woods while protecting ancient, old-growth forests.

2. Use Rapidly Renewable Flooring Materials

Description: Bamboo and cork flooring are alternatives to hardwood flooring. Bamboo is a fast growing grass that can be harvested in three to five years. Cork is a natural flooring material that is obtained from the outer bark of the cork oak tree that is regenerated every 10 years.

Application: Use these alternative flooring materials in place of conventional hardwood. Make sure that a durable finish is used on the product.

Benefit: Fast growing, rapidly renewable floor substitutes are attractive and reduce pressure on hardwood forests. Bamboo is as durable as wood; cork is naturally fire and moisture resistant as well as sound absorbing.



Bamboo Flooring and Recycled Content Carpet

3. Use Recycled Content Ceramic Tiles

Description: Recycled content ceramic tiles can contain up to 70% recycled glass. Originally developed for high traffic commercial conditions, recycled content tiles are very durable and wear well in residential applications.

Application: Install recycled content tiles wherever conventional tiles are specified.

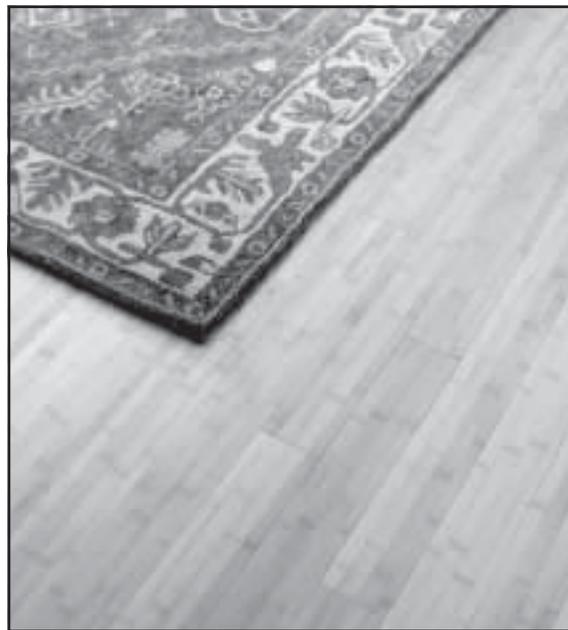
Benefit: Some recycled content ceramic tile is very dense which significantly reduces the amount of moisture and stains that are absorbed into the tile, making it more durable and easier to maintain.

4. Install Natural Linoleum in Place of Vinyl Flooring

Description: Natural linoleum is manufactured from natural materials such as cork and linseed oil. Unlike vinyl, linoleum does not contain petroleum-based products or chlorinated chemicals such as PVC, which may be a source of VOC offgassing. There is also concern of by-products such as cancer causing dioxins, which may be produced during the manufacturing of vinyl.

Application: Use natural linoleum in place of vinyl flooring.

Benefit: Linoleum is low-toxic, easy to repair, durable, and stain resistant. Linoleum can last up to 40 years, whereas vinyl lasts typically 7-10 years.



Bamboo Flooring



Natural Linoleum



5. Use Exposed Concrete as Finished Floor

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

Application: Use this approach for slab-on-grade construction. Finish must be designed and constructed when slab is being poured.

Benefit: When using the slab as a floor finish, it eliminates the need to use other flooring materials. Additionally, it is durable and easy to clean.

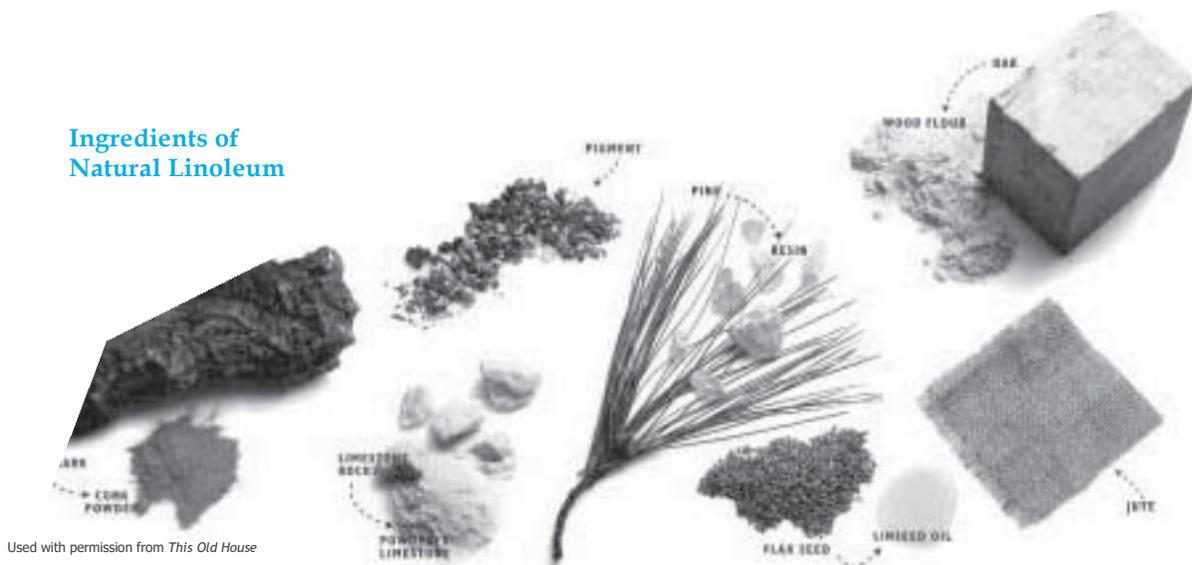
6. Install Recycled Content Carpet with Low-VOCs

Description: Recycled content carpet is made from recycled plastic bottles, recycled nylon/wool or recycled cotton. Recycled content carpet does not differ in appearance or performance and the price is comparable to conventional carpet. The Carpet and Rug Institute (CRI) has a Green Label Indoor Air Quality Test Program which labels the VOC content of carpeting.

Application: Use recycled content carpet in all applications where conventional carpet is specified. Choose carpet that meets or exceeds the CRI Green Label requirements. Resource: www.carpet-rug.com

Benefit: Recycled content carpet saves resources and diverts waste from landfills. Approximately 40 two-liter soda bottles are recycled per square yard of carpeting. Recycled carpet is often more resilient and colorfast than carpet made from virgin fibers.

Ingredients of Natural Linoleum



Used with permission from *This Old House*

Review Questions:

Chapter Four: Green Building Methods and Materials

COMMUNITY DESIGN ISSUES

A. Site

9. Construction waste generally consists of:
- Wood
 - Drywall
 - Metals
 - All of the above
10. Preserving native soils, along with nurturing the health of disturbed soils, can significantly:
- Increase storm runoff
 - Reduce fertilizer and pesticide requirements
 - Worsen water quality
 - Waste irrigation water
11. High-efficiency irrigation systems dramatically reduce landscape water use, are critical to preventing disease and:
- Stabilizing soil
 - Capitalizing waste management
 - Minimizing weed growth
 - All of the above

B. Foundation

12. _____ is a by-product of coal burning power plants and can be an inexpensive substitute for a portion of Portland cement used in concrete.
- Form boards
 - Flyash
 - Aluminum
 - Slab
13. Recycled concrete and asphalt crushed to _____ inch(es) minus satisfies the California Department of Transportation's (CalTrans) specification for Class 2 Aggregate Base.
- $\frac{1}{2}$
 - $\frac{3}{4}$
 - 1
 - 2

C. Structural Frame

14. _____ come from small-diameter and fast growing plantation trees.
- Engineered lumber products
 - Solid sawn lumber
 - Diseases
 - Insulated Concrete forms

15. With regards to certified wood framing, what does the acronym FSC stand for?
- a. Forest Stewardship Council
 - b. Forestry Security Committee
 - c. Factory Safety Corporation
 - d. Fair Sales Company
16. _____ is manufactured from fast growing farm trees. OSB comes in sheets and is used for sheathing and subfloors.
- a. Energy Heels
 - b. I Joists
 - c. Studs
 - d. Oriented Strand Board (OSB)

D. Exterior Finish

17. _____ protects the sheathing from moisture and allows vapor from inside to escape.
- a. Decking
 - b. Sill plates
 - c. House Wrap
 - d. Pipes

E. Plumbing

18. According to a survey, consumers' top choice of resource conserving features is:
- a. Water-saving washers and dishwashers
 - b. Water-conserving faucets and fixtures
 - c. Recycled content decking
 - d. Engineered lumber
19. Conventional water heaters lose _____% of their energy through standing tank losses, whereas tankless heaters use energy only for immediate hot water needs.
- a. 15%
 - b. 20%
 - c. 25%
 - d. 30%

F. Electrical

20. What type of lighting fixtures allow heat to be exhausted into the attic space.
- a. Incandescent
 - b. Compact Fluorescent
 - c. Insulation-Compatible Recessed
 - d. Dimmers

G. Appliances

21. Horizontal axis machines use up to _____% less water and _____% less energy than conventional top loading washers.
- a. 30, 20
 - b. 20, 30
 - c. 50, 40
 - d. 40, 50

H. Insulation

22. Formaldehyde-free binders reduce indoor air quality problems and insulation may contain up to _____% recycled glass.
- a. 30
 - b. 40
 - c. 50
 - d. 60

I. Windows

23. _____ coatings, virtually unnoticeable to the eye, are installed inside the air space of a double-paned window.
- a. Cellulose
 - b. Low-E
 - c. Low Conductivity Frame
 - d. Fiberglass

J. Heating, ventilation and air conditioning (HVAC)

24. _____ measures cooling system efficiency at low temperatures.
- a. SEER (Seasonal Energy Efficiency Ratio)
 - b. EER (Energy Efficiency Ratio)
 - c. TXV
 - d. AC

K. Renewable Energy and Roofing

25. _____ contain hundreds of small cells that collect the sun's energy and convert it into electricity.
- a. Heat Recovery Ventilation
 - b. High-Efficiency Particulate Air
 - c. Space Heating
 - d. Photovoltaic Panels

N. Flooring

26. Recycled content ceramic tiles can contain up to _____% recycled glass.
- a. 80
 - b. 75
 - c. 70
 - d. 65

Chapter Five: Selling Green Homes

Every green product has a benefit for your customers, and selling what you build is an important aspect of building green. The combination of green products and practices you choose creates a “story” of how your homes protect the environment, reduce air pollution, conserve natural resources and save money.

To be a successful green builder, train your sales staff to tell the stories behind the products. Even if the story is just a list of benefits, you leave a lasting impression on your buyers.

MARKET DIFFERENTIATION

While green features don’t always sell the home at first blush, they make buyers think and will often bring them back. Emphasize that green doesn’t necessarily cost more and can often save money in the long run. Buyers are becoming very sophisticated as publications like Better Homes and Gardens, Redbook, Family Circle, Sunset, and home improvement magazines feature more green building stories and products.

Marketing green provides unique opportunities. By distinguishing your company from other builders, you can step into a new arena of recognition. By thinking outside of the traditional marketing box you can engage the public. Even in a seller’s market where homes are sold before they are finished, building green creates a lasting image for the company. Your homes draw public curiosity and interest, and your story is attractive to the news and trade media. People start to identify you as the builder who cares, which engenders loyalty and creates referrals.

EDUCATE YOUR SALES STAFF

Sales are everything. It doesn’t matter how well built or how green the house is if your sales staff doesn’t communicate the value of building green to your customers. Your sales staff are your greatest advocates – take the time to train them about green features and benefits. If they feel confident, and understand that building green adds value to their customers, they will have the tools to close a sale that might otherwise get away.



CONVEY THE BENEFITS

It is important to complement green option packages with a marketing program that clearly identifies the benefits. Concepts such as energy efficiency, indoor air quality, and resource conservation, while easy to describe, do not necessarily address homeowner concerns. One way to address this is to sort the features in terms that are important to the buyer. Use the Green Building Benefits as a tool to assist you in creating marketing materials that address green building features. Each green feature is discussed in detail in Chapter 4. Use these benefits to assemble 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:

HIGHER QUALITY, ENVIRONMENTALLY SOUND PRODUCTS:

Most green building products and materials were developed to do something better than their conventional counterpart. These products usually perform better and are manufactured in an environmentally sound manner, thus protecting and restoring our natural resources. Consider offering the following:

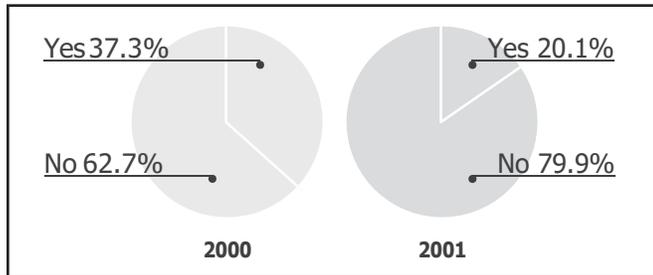
- ◆ Recycled content decking and siding
- ◆ FSC Certified wood framing
- ◆ Engineered lumber
- ◆ Wood I-joists
- ◆ Finger-jointed studs
- ◆ Interior steel studs
- ◆ Solvent-free adhesives
- ◆ Natural linoleum flooring
- ◆ Recycled content ceramic tile



MORE DURABLE/LOWER MAINTENANCE PRODUCTS:

Next to quality, durability and reduced maintenance are very important. There is never enough time to do what needs to be done and home maintenance is never high on the list of how to spend time away from work. Consider offering the following:

- ◆ Fiber-cement siding
- ◆ Recycled content decking and siding
- ◆ Natural linoleum flooring
- ◆ Recycled content ceramic tile
- ◆ Resource-efficient landscapes and gardens



Do New Homes Meet Consumers' Interest in Sustaining the Environment?

PRODUCTS AND PRACTICES THAT PROVIDE GREATER COMFORT AND LOWER UTILITY BILLS:

Comfort is what drives high energy use. When it gets hot, we turn on the air conditioning. By increasing the insulation and providing for natural cooling, the electricity demand can be reduced with no compromise in occupant comfort. Consider offering the following:

- ◆ Foundation/slab insulation
- ◆ Increased wall and ceiling insulation
- ◆ Spray cellulose in walls and ceilings
- ◆ Advanced infiltration reduction
- ◆ Low-e windows
- ◆ Hydronic heating
- ◆ All ducts located in conditioned spaces
- ◆ Ceiling fans
- ◆ Whole house fans
- ◆ Passive solar heating
- ◆ Natural cooling
- ◆ ENERGY STAR® appliances
- ◆ Attic ventilation systems

HEALTHIER PRODUCTS AND PRACTICES FOR FAMILIES

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

- ◆ No-VOC paints
- ◆ Natural linoleum in place of vinyl flooring
- ◆ Elimination of particleboard and medium density fiberboard (MDF)
- ◆ Solvent-free adhesives
- ◆ Water-borne wood finishes
- ◆ Clean ducts before occupancy
- ◆ Exhaust fan in attached garages
- ◆ Range hood vented to outside
- ◆ Whole house water filter
- ◆ HEPA filter on furnace
- ◆ Heat Recovery Ventilator (HRV)
- ◆ Sealing of particleboard and MDF
- ◆ Chlorine filter on showerhead

Review Questions

Chapter five: Selling Green Homes

More Durable/Lower Maintenance Products

27. Compared to 2000, in 2001, _____ consumers' interests in new homes sustaining the environment were met.
- More
 - Less
 - Equal
 - No data

survey says...

"Once the topic of green building was raised, participants were eager to take part in the discussion and many indicated that they would definitely look for green products now that they knew it was a possibility."

Source: Focus Group Research, Alameda County Waste Management Authority, 2002

Chapter Six: Summary of Green Building Benefits

Community Design Issues	Benefits
1. Orient Homes on E/W Axis for Solar Access	Reduces the need for energy and lowers utility bills.
2. Orient Living Rooms and Porches to Streets and Public Spaces	Fosters community living.
3. Build Mixed Use, Residential/Commercial	Creates walkable communities, reduces smog and automobile use.
4. Design for Diverse Family Types	Opens housing market to wider range of buyers.
5. Provide “Granny Flats” Above Garages	Creates more affordable housing.
6. Build within 1 Mile of Public Transit Hub	Reduces dependence on automobiles and reduces smog.
7. Minimize Street Widths	Slows traffic.
8. Locate Buildings to Preserve Open Space and Wildlife Habitat	Preserves habitats, wetlands.

A. Site

1. Recycle Job Site Construction and Demolition Waste	Reduces pressure on landfills, saves money by reducing landfill fees, and provides raw materials for future building products.
2. Donate Unused Materials	Reduces landfill deposits, helps local charitable organizations. Donations may be tax deductible.
3. Protect Native Soil	Reduces storm runoff, fertilizer and pesticide requirements, improves water quality and conserves irrigation water.
4. Minimize Disruption of Existing Plants and Trees	Helps prevent soil erosion, maintains existing sources of natural cooling, diverts waste from landfills, and adds a unique character to the community.
5. Implement Construction Site Stormwater Practices	Minimizes erosion and water pollution; and protects the Bay.
6. Protect Water Quality with Landscape Design Features	Reduces the volume of polluted water flowing into rivers or the Bay.
7. Design Resource-Efficient Landscapes and Gardens	Helps conserve water, reduces use of chemicals, and creates healthier soil and plants.
8. Reuse Materials or Use Recycled Content Materials for Landscape Areas	Conserves natural resources and strengthens markets for recycled materials.
9. Install High Efficiency Drip Irrigation Systems	Reduces landscape water use and lowers water costs.
10. Provide for On-Site Water Catchment/Retention	Reduces the need to use treated, potable water for lawns and gardens.

B. Foundation

1. Incorporate Recycled Flyash in Concrete	Increases the strength and durability of the concrete and reduces the amount of cement needed.
2. Reuse Form Boards	Saves money and conserves resources as solid sawn lumber is becoming increasingly expensive and scarce.
3. Use Recycled Content Aggregate	Saves money, natural resources and energy.
4. Insulate Foundation/Slab Before Backfill	Reduces energy loss and utility bills by minimizing heat loss.
5. Use Aluminum Forms	Reduces wood use, and despite higher initial cost, will pay for themselves quickly.
6. Install Rigid Foam, Insulated Concrete Forms (ICFs)	ICFs are not subject to rot and results in a better insulated foundation.

C. Structural Frame

1. Substitute Solid Sawn Lumber with Engineered Lumber	Reduces demand for virgin lumber, is stronger, straighter, and more durable.
2. Use FSC Certified Wood for Framing	Guarantees long-term availability of precious woods.
3. Use Wood I-Joists for Floors and Ceilings	Uses 50% less wood fiber, will not twist, warp or split, stronger and lighter than 2x10s or 2x12s and can span greater distances.
4. Use Steel Interior Web Trusses	Eliminate waste. Reduce the pressure on old growth forests.
5. Design Energy Heels on Trusses 6” or More	Allows for full insulation around the house, saving energy and money.
6. Use OSB for Subfloor and Sheathing	Reduces the need for large diameter old-growth trees, is as strong as traditional plywood sheet material and is less expensive.

C. Structural Frame, *continued*

BENEFITS

7. Use Finger-Jointed Studs	Uses recycled content materials, is straighter and stronger than solid sawn studs, and eliminates crooked walls, thereby reducing material waste.
8. Use Engineered Studs for Vertical Applications	Engineered studs are straighter, and will not deform, twist, split or warp. They save wood by using small laminated pieces.
9. Use Recycled-Content Steel Studs for Interior Framing	Steel reduces the need for wood and provides strong interior walls.
10. Use Structural Insulated Panels (SIPs) for Walls/Roof	Reduces infiltration relative to frame construction, is energy-efficient, provides excellent soundproofing, is erected quickly, and saves wood by eliminating much of the conventional framing lumber.
11. Apply Advanced Framing Techniques	Makes the home more energy efficient, saves wood and construction costs. It also allows for a higher percentage of the wall to be insulated reducing frame conduction heat loss.
12. Use Reclaimed Lumber	Reduces resource consumption and landfill deposits, and is often of higher quality than new lumber.

D. Exterior Finish

1. Use Sustainable Decking Materials	Contains recycled content materials, is more durable and reduces demand for old-growth timbers.
2. Use Treated Wood that Does Not Contain Chromium or Arsenic	Reduces exposure to chromium and arsenic, which are harmful, particularly to children who play on structures built with treated wood.
3. Install House Wrap under Siding	Diverts water away from openings and protects the home from mold.
4. Use Alternative Siding Materials	Last longer, is fire-resistant, and reduces maintenance costs.

E. Plumbing

1. Insulate Hot and Cold Water Pipes	Saves energy and water, and reduces water heating costs.
2. Install Flow Reducers in Faucets and Showerheads	Saves water and is a low cost option.
3. Install Ultra-Low-Flush Toilets	Saves water.
4. Install Chlorine Filter on Showerhead	Reduces chlorine absorbed by skin.
5. Install Tankless Water Heaters	Saves energy, is often quicker and more reliable.
6. Pre-Plumb for Graywater Conversion	Cuts down on the use of potable water for outside irrigation and lawn watering.
7. Install Water Filtration Units at Faucets	Reduces contaminants in water.
8. Install On-Demand Hot Water Circulation Pump	Deliver hot water quicker to fixture, saving water and energy.

F. Electrical

1. Install Compact Fluorescent Light Bulbs (CFLs)	Lowers energy bills and reduces need for energy production.
2. Install Insulation-Compatible Recessed Lighting Fixtures for CFLs	Reduces the amount of heat loss/gain.
3. Install Lighting Controls	Reduces need for energy and lowers energy bills.
4. Install High-Efficiency Ceiling Fans with CFLs	Reduces the need for air conditioning.

G. Appliances

1. Offer ENERGYSTAR® Dishwasher	Reduces water and energy use, and lowers utility bills.
2. Offer Horizontal Axis Washing Machine	Uses less water and energy than conventional top loading washers.
3. Offer Energy-Efficient Refrigerator	Reduces energy and can save over 10% on utility bill.
4. Install Built-In Recycling Center	Makes it easy and convenient to recycle.

H. Insulation

BENEFITS

1. Upgrade Wall and Ceiling Insulation to Exceed Title 24 Requirements	Lowers utility bills, improves comfort, decreases heating and cooling needs and makes home quieter.
2. Install Recycled Content, Formaldehyde-Free Fiberglass Insulation	Reduces indoor air quality problems due to formaldehyde binders, and can contain up to 30% recycled glass.
3. Use Advanced Infiltration Reduction Practices	Reduces drafts, and makes home more energy-efficient.
4. Use Cellulose Insulation	Increases energy-efficiency, uses recyclable materials, and contains no formaldehyde.

I. Windows

1. Install Energy-Efficient Windows	Increases energy-efficiency, and provides greater comfort.
-------------------------------------	--

J. Heating, Ventilation and Air Conditioning (HVAC)

1. Use Duct Mastic on all Duct Joints	Improves indoor air quality, and keeps the homes more comfortable.
2. Install Ductwork within Conditioned Space	Reduces energy loss and improves occupant comfort.
3. Vent Range Hood to the Outside	Improves indoor air quality.
4. Clean all Ducts Before Occupancy	Reduces dust around the house after occupancy.
5. Install Attic Ventilation Systems	Increases comfort and reduces air conditioning use.
6. Install Whole House Fan	Reduces electricity usage, and moves large volumes of air to achieve comfort at higher temperatures without air conditioning.
7. Install Sealed Combustion Furnaces and Hot Water Heaters	Improves indoor air quality, reduces the danger of carbon monoxide contamination.
8. Install 13 SEER and 11 EER or Higher Air Conditioning with a Thermostatic Expansion Valve	Saves money and energy, and reduces peak load problems.
9. Install Air Conditioning with NON-HCFC Refrigerants	Eliminate depletion of the ozone layer.
10. Install 90% Annual Fuel Utilization Efficiency or Greater Furnace	Reduces air emissions, costs less to operate, and saves natural resources.
11. Eliminate Wood Burning Fireplaces	Reduces pollutant particulate matter.
12. Install Zoned, Hydronic, Radiant Heating	Saves energy by only heating the zone that requires heat.
13. Install High Efficiency Particulate Air (HEPA) Filter	Makes living space healthier, and reduces micro-particulates from the air.
14. Install Heat Recovery Ventilation Unit (HRV)	Improves indoor air quality and reduces energy.
15. Install Separate Garage Exhaust Fan	Creates healthier indoor environments.

K. Renewable Energy and Roofing

1. Pre-Plumb for Solar Water Heating	Saves money should a solar system be installed in the future.
2. Install Solar Water System	Reduces the use of gas or electricity, and pay back in as little as seven years.
3. Pre-Wire for Future Photovoltaic Installation	Allows installation of PV system in the future.
4. Install Photovoltaic (PV) Panels	Decreases reliance on conventional power plants.
5. Install Solar (PV) Walkway Lights	Reduces the need for grid-provided electricity.
6. Select Safe and Durable Roofing Materials	Reduces landfill deposits and saves money on replacement costs.
7. Install Radiant Barrier Roof Sheathing	Keeps the whole home cooler by reducing heat build-up in attic spaces.

L. Natural Heating and Cooling

1. Incorporate Passive Solar Heating	Reduces heating requirements by 30-50%, saves energy and money.
2. Install Overhangs or Awnings Over South Facing Windows	Reduce heat gain, making the home more comfortable in summer.
3. Plant Deciduous Shade Trees on the West and South Sides of the Home	Reduce summer air-conditioning costs while providing numerous benefits to the environment.

M. Indoor Air Quality and Finishes

BENEFITS

1. Install Whole House Vacuum System	Expels dust outside the house, improving indoor air quality.
2. Use Low/No-VOC and Formaldehyde-Free Paint	Improves indoor air quality, reduces smog, and is healthier for installers and occupants.
3. Use Low VOC, Water-Based Wood Finishes	Reduces smog and is healthier for installers and occupants.
4. Use Solvent-Free Adhesives	Improves indoor air quality, and are healthier for occupants and installers.
5. Substitute Particleboard with Formaldehyde-Free Materials	Reduces formaldehyde exposure to occupants.
6. Use Exterior Grade Plywood for Interior Uses	Reduces formaldehyde exposure to occupants.
7. Use Formaldehyde-Free MDF and Materials	Improves indoor air quality.
8. Seal all Exposed Particleboard or MDF	Reduces exposure of harmful emissions to occupants.
9. Use FSC Certified Material	Assures the long-term availability of precious woods while protecting ancient, old-growth forests.
10. Use Finger-Jointed or Recycled Content Trim	Uses material more effectively, saves money and resources, and is straighter and more stable than conventional clear wood.

N. Flooring

1. Select FSC Certified Wood Flooring	Assures the long-term availability of woods while protecting ancient, old-growth forests.
2. Use Rapidly Renewable Flooring Materials	Reduces demand for old-growth hardwood.
3. Use Recycled Content Ceramic Tiles	Uses recycled content materials and is easy to maintain.
4. Install Natural Linoleum in Place of Vinyl Flooring	Reduces exposure to toxins, is durable, and healthier for occupants and installers.
5. Use Exposed Concrete as Finished Floor	Eliminates the need for additional flooring materials, is easy to maintain, and very durable.
6. Install Recycled Content Carpet and Underlayment	Saves resources, diverts waste from landfills, is more resilient and colorfast than carpet made from virgin fibers.

ACKNOWLEDGMENTS

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Alameda County Waste Management Authority & Source Reduction and Recycling Board
www.stopwaste.org

What's Working
www.whatsworking.com

Development Committee

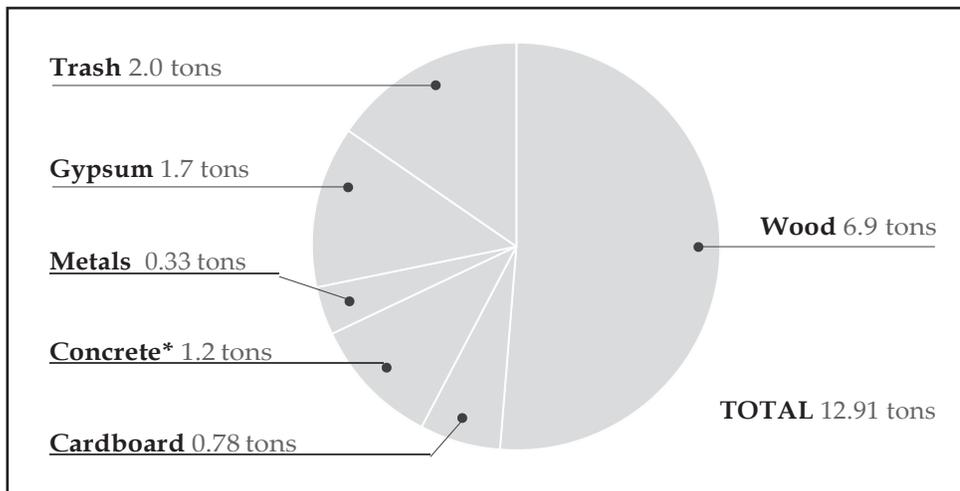
Bill Shipley - *Pulte Homes*; Kevin Ebrahimi - *Greenbriar Homes*; Chris Schimunek - *Silverwood Homes*; Kim Cole - *Centex Homes*; Geoff Olsen - *Signature Properties*; Mark Davis - *Toll Brothers*; Glenn Kirby - *City of Union City*; Nathan Meeks - *Ponderosa Homes*

Additional comments provided by:

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Disclaimer: Thank you to the Alameda County Waste Management Authority and Recycling Board (ACWMA) for offering their guidelines. 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. They are provided as a public service by the Sonoma County Waste Management Agency in an attempt to provide environmental benefits and reduce costs. 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.

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



Source: Alameda County Waste Management Authority Case Study of Citation Homes (1999)

* Concrete figure includes waste generated by sidewalk pour. Data provided by Green Waste Recovery and Zanker Landfill.

Green Building Guidelines for New Home Construction

Review Questions and Answers

ABOUT GREEN BUILDING

1. Green buildings use:
 - a. Recycled-content building materials; correct
 - b. Consume less energy and water; correct
 - c. Have better indoor air quality; correct
 - d. **All of the above; correct, all answer are true to what exists in a green building**

FUNDAMENTAL OBJECTIVES OF GREEN BUILDING

2. Builders have a rapidly _____ range of green building materials from which to choose.
 - a. **Expanding; correct more builders are choosing to build green and they now have many materials to choose from such as, recycled content decking, reclaimed lumber and other products that divert wasted from landfills**
 - b. Decreasing; incorrect there are more and more products being created
 - c. Lighter; incorrect, there are more products now then ever
 - d. None of the above, incorrect, answer a is the correct answer
3. The first steps to increase energy efficiency are to:
 - a. Decrease insulation wherever possible; incorrect, you should increase insulation where possible
 - b. **Install double-glazed/low-E windows; correct, this is very important in energy efficiency in a home**
 - c. Put in low efficiency appliances; incorrect, you would want to install high efficiency appliances
 - d. Uninstall solar water heaters; incorrect, one would want to install solar water heaters to increase energy efficiency
4. With regards to Indoor Air Quality, the United States Environmental Protection Agency (EPA) reports that the air in new homes can be _____ times more polluted than outdoor air.
 - a. Two; incorrect, a home can be 10 times more polluted according to the EPA
 - b. Five; incorrect, a home can be 10 times more polluted according to the EPA
 - c. Twenty; incorrect, 20 times is too much, according to the EPA a home can be 10 times more polluted
 - d. **Ten; correct, According to the New England Journal of Medicine, 40% of children will develop respiratory disease, in part, due to the chemicals in their homes. Poor indoor air quality is caused by the off-gassing of chemicals found in many building materials.**

GREEN BUILDING PACKAGES

5. Which of the following “Green Building Packages” includes recycled newsprint cellulose insulation, among other features:
 - a. **Natural Resource Package; correct, Natural Resource conservation is becoming more important to buyers every year. Saving forests for camping, fishing and hiking is a value that families hold for their children’s future. Using recycled content products in your homes “closes the loop for families that are committed to recycling.**
 - b. Energy Efficiency Package; incorrect, this package focuses more on energy upgrades by consumers to make ones home more energy efficient, such as windows, fluorescent light bulbs, insulated foundation...
 - c. Indoor Air Quality Package; incorrect, this package is focused on indoor air quality, this package would include No or low VOC paints, solvent free wood finishes, and formaldehyde-free insulation

- d. None of the above, incorrect, A is the correct answer

Chapter 3: Green Points

GREEN POINTS

6. _____ is a rating system that has been developed to offer builders, homeowners and municipalities a tool to assess how environmentally friendly or “green” a home is.
 - a. The IRC; incorrect, not part of the rating system
 - b. ASHRAE Manual J; incorrect, not part of the rating system
 - c. US EPA EM12002-4A7, incorrect, not part of the rating system
 - d. **Green Points; correct, this rating system is based on the various green features incorporated into the home.**

7. According to the Green Points Table, a double-paned window has _____ energy green point(s).
 - a. **1; correct, this is an energy point according to the Green Points table**
 - b. 2; incorrect, the answer according to the table is 1
 - c. 3; incorrect, the answer according to the table is 1
 - d. 4; incorrect, the answer according to the table is 1

8. According to the Green Points Table, a tankless water heater has _____ energy green points.
 - a. 4, incorrect, the energy points for a tankless water heater is 2 green points
 - b. 3, incorrect, the energy points for a tankless water heater is 2 green points
 - c. **2, correct, the energy points for a tankless water heater according to the green points table is 2 green points**
 - d. 1, incorrect, the energy points for a tankless water heater is 2 green points

Chapter Four: Green Building Methods and Materials

COMMUNITY DESIGN ISSUES

A. Site

9. Construction waste generally consists of:
 - a. Wood; correct, this is a major construction waste
 - b. Drywall; correct, another major contributor to construction waste
 - c. Metals; correct, more construction waste
 - d. **All of the above; correct all of these are big contributors to construction waste**

10. Preserving native soils, along with nurturing the health of disturbed soils, can significantly:
 - a. Increase storm runoff; incorrect, preserving native soil would decrease storm runoff
 - b. **Reduce fertilizer and pesticide requirements; correct, preserving native soil does reduce the use of fertilizer and pesticide**
 - c. Worsen water quality; incorrect, preserving native soil would typically improve water quality
 - d. Waste irrigation water; incorrect, preserving native soil helps to conserve irrigation water.

11. High-efficiency irrigation systems dramatically reduce landscape water use, are critical to preventing disease and:
 - a. Stabilizing soil; incorrect
 - b. Capitalizing waste management; incorrect
 - c. **Minimizing weed growth; correct new irrigation technologies apply water to the soil at the plant root zones at the rate the soil can absorb it, significantly reducing water waste from overspray.**
 - d. All of the above; incorrect

B. Foundation

12. _____ is a by-product of coal burning power plants and can be an inexpensive substitute for a portion of Portland cement used in concrete.
- Form boards; incorrect; form boards are used whenever concrete is poured, not anything used in concrete
 - Flyash; correct, this increases the strength and durability of the concrete.**
 - Aluminum; incorrect, aluminum is used in concrete forms, not concrete itself
 - Slab; incorrect, this is typically a type of floor
13. Recycled concrete and asphalt crushed to ___inch(es) minus satisfies the California Department of Transportation's (CalTrans) specification for Class 2 Aggregate Base.
- 1/2; incorrect, it must be 3/4"
 - 3/4; correct, using recycled materials instead of virgin materials saves money, natural resources and energy.**
 - 1; incorrect, it must be 3/4"
 - 2; incorrect, it must be 3/4"

C. Structural Frame

14. _____ come from small-diameter and fast growing plantation trees.
- Engineered lumber products; correct, these products include glulams, laminated veneer lumber, wood I-joists, oriented strand board, parallel strand lumber, and other manufactured wood fiber structural materials.**
 - Solid sawn lumber; incorrect, this does not come from fast growing or small diameter trees
 - Diseases; incorrect, not a typical problem
 - Insulated Concrete forms; incorrect, these do not come from trees.
15. With regards to certified wood framing, what does the acronym FSC stand for?
- Forest Stewardship Council; correct, FSC certification assures that the forest from which the wood is produced is managed in a sustainable and socially responsible manner.**
 - Forestry Security Committee; incorrect, this is not who certifies wood framing
 - Factory Safety Corporation; incorrect, this is not who certifies wood framing
 - Fair Sales Company; incorrect, this is not who certifies wood framing
16. _____ is manufactured from fast growing farm trees. This comes in sheets and is used for sheathing and subfloors.
- Energy Heels; incorrect, not manufactured from fast growing farm trees.
 - I Joists; incorrect, wood I-Joists are engineered wood fiber necessary for the structural function required. They use OSB for the web and either laminated veneer lumber or solid sawn lumber for the chords.
 - Studs; incorrect, these are from engineered wood but are used in vertical structural applications, and they don't come in sheets like OSB
 - Oriented Strand Board (OSB); correct, this is an alternate to plywood for sheathing or subfloors.**

D. Exterior Finish

17. _____ protects the sheathing from moisture and allows vapor from inside to escape.
- Decking; incorrect, the deck doesn't protect anything against moisture
 - Sill plates; incorrect
 - House Wrap; correct, this provides a continuous drainage plane that diverts water away from openings and protects the home from mold.**
 - Pipes; incorrect; doesn't allow vapor from inside to escape for protection of sheathing.

E. Plumbing

18. According to a survey, consumers' top choice of resource conserving features is:
- Water-saving washers and dishwashers; correct, 84% say this is the top choice**
 - Water-conserving faucets and fixtures; incorrect, only 64% say this is the top choice
 - Recycled content decking; incorrect, only 63% say this is the top choice
 - Engineered lumber; only 62% say this is the top choice
19. Conventional water heaters lose _____% of their energy through standing tank losses, whereas tankless heaters use energy only for immediate hot water needs.
- 15% correct, tankless heaters use energy only for immediate hot water needs.**
 - 20%; incorrect, it is only 15%
 - 25%; incorrect, it is only 15%
 - 30%; incorrect, it is only 15%

F. Electrical

20. What type of lighting fixtures allow heat to be exhausted into the attic space.
- Incandescent; incorrect, this is a type of bulb, not a fixture
 - Compact Fluorescent; incorrect, again a type of bulb, not a fixture
 - Insulation-Compatible Recessed; correct, typical recessed fixtures lose heat as well as allow hot attic air to infiltrate into the house in summer months**
 - Dimmers; incorrect; not a light fixture but a fixture feature

G. Appliances

21. Horizontal axis machines use up to_% less water and_% less energy than conventional top loading washers.
- 30, 20; incorrect, it is a higher percentage
 - 20, 30; incorrect, it is a higher percentage
 - 50, 40; incorrect, should be vice versa
 - 40, 50; correct, translating into lower energy and water bills for the resident**

H. Insulation

22. In fiberglass insulation, formaldehyde-free binders reduce indoor air quality problems . This type of insulation may contain up to _____% recycled glass.
- 30; correct, fiberglass insulation can be used for any typical insulation installation**
 - 40; incorrect, this is too high a percentage
 - 50; incorrect, this is too high a percentage
 - 60; incorrect, this is too high a percentage

I. Windows

23. _____ coatings, virtually unnoticeable to the eye, are installed inside the air space of a double-paned window.
- Cellulose; incorrect, this is not used in windows
 - Low-E; correct, low-E coatings help prevent heat from escaping through the glass in winter and block heat from entering the home during summer.**
 - Low Conductivity Frame; incorrect, this has to do with the window frame and not the air space of a double-paned window
 - Fiberglass; incorrect, this is a common type of fiber-reinforced plastic using glass fiber. The fibers may be randomly arranged, flattened into a sheet, or woven into a fabric.

J. Heating, ventilation and air conditioning (HVAC)

24. _____ measures cooling system (air conditioners) efficiency at low temperatures.
- SEER (Seasonal Energy Efficiency Ratio); correct, This is important as air conditioning equipment is one of the greatest loads on the power grid.**
 - EER (Energy Efficiency Ratio); incorrect, this is a high temperature performance rating
 - TXV; incorrect, this is a refrigerant regulation device that can ensure that the air conditioning system operates a maximum efficiency over a wide range of conditions
 - AC; incorrect, this is the system that SEER is measuring the efficiency of.

K. Renewable Energy and Roofing

25. _____ contain hundreds of small cells that collect the sun's energy and convert it into electricity.
- Heat Recovery Ventilation; incorrect, does not capture the sun's energy and convert it to electricity
 - High-Efficiency Particulate Air; Incorrect, does not capture the sun's energy and convert it to electricity
 - Space Heating; Incorrect, does not capture the sun's energy and convert it to electricity
 - Photovoltaic Panels; correct, these can be used as a means to decrease reliance on conventional power plants that contribute to air pollution.**

N. Flooring

26. Recycled content ceramic tiles can contain up to _____ % recycled glass.
- 80; incorrect, this is a higher percentage than what is common
 - 75; incorrect, this is a higher percentage than what is common
 - 70; correct, this is correct, some recycled content ceramic tile is very dense which significantly reduces the amount of moisture and stains that are absorbed into the tile, making it more durable and easier to maintain.**
 - 65; incorrect, this is a lower percentage than what is common

Chapter five: Selling Green Homes

More Durable/Lower Maintenance Products

27. Compared to 2000, in 2001, _____ consumers' interests in new homes sustaining the environment were met.
- More; incorrect, fewer consumers interest were met in 2001
 - Less; correct, in 2000 it was 37.3%, in 2001, it was 20.1%**
 - Equal, incorrect, it was less in 2001
 - No data, incorrect, this is included in the course material