



CITY OF PORTLAND

Greening Portland's Affordable Housing



*A Resource Guide to Improving Environmental
Performance, Tenant Health and Long-Term
Durability in Affordable Housing*



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Performance, Tenant Health and Long-Term
Durability in Affordable Housing*

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Introduction

The City of Portland has established new guidelines to increase the environmental performance and durability of all City-funded affordable housing projects managed through the Portland Development Commission (PDC). The City makes significant annual investments in affordable housing that serves Portland residents that make up to 60% of median income. This resource guide identifies cost-effective strategies that go beyond current practice, protecting and enhancing the City's investment in developing permanent affordable housing stock. Buildings designed and built using these standards will become models for healthier, environmentally responsive design and construction where residents collectively enjoy the benefits of decent and healthy housing, regardless of income level.

This resource manual provides affordable housing developers, designers and builders with information about local products, building materials, construction practices, vendors, and services needed to successfully execute a green project. Best practices are always changing. To keep up with new technologies and practices, visit our website at www.green-rated.org.

Sustainable Development

The negative environmental impacts of buildings is becoming more widely and better understood by building designers, operators, and owners. The statistics are compelling. The construction and operation of buildings consume 35% of total U.S. energy output. More than 60% of the electricity generated in the U.S. is consumed by buildings, accounting for at least 35% of all carbon dioxide (CO₂) emissions. Buildings use over 35% of all materials produced in the U.S. and more than 25% of the world's harvested wood. More than 210 million tons of solid waste is generated and disposed of annually, a substantial portion of which is attributed to construction site and building use waste. In the Portland region, delicate wetland areas are being eliminated by construction at the rate of one acre per day. Portland is one of the first metropolitan areas in the country to be challenged with an Endangered Species Act listing within its urban core, further challenging the building industry to reduce impacts on salmon habitat.

Designing, building, and maintaining buildings that are sustainable is an ambitious goal that will require a long-term process of rethinking building design and construction. In most instances this is a common sense approach to development that prevents further depletion of natural resources, water quality, air pollution, and global warming.

These guidelines were developed to help affordable housing providers set measurable goals and performance specifications to better design and evaluate projects. With very limited funds and resources, it is important to invest in practices and technologies that measurably improve buildings' health and durability over the long term.

Guiding Principles for Green Affordable Housing

- Durable and long lasting.
- Cost effective to build and practical to maintain.
- Use natural resources and materials efficiently; spec materials and products with minimum life-cycle environmental impacts.
- Conserve water usage and reduce stormwater runoff.
- Maximize energy conservation and efficiency.
- Reduce building footprints, simplify building shapes, and maximize space efficiency.
- Optimize building orientation; integrate natural daylight and ventilation.
- Eliminate toxic and harmful materials and finishes.
- Supports transportation alternatives.
- Reduce, reuse and recycle materials in all phases of construction and deconstruction.
- Implement maintenance and operational practices that reduce or eliminate harmful effects on people and the natural environment.
- Design for future flexibility, expansion, and building deconstruction.

Integrated and Total Systems Approach

The most important element to constructing a building that achieves environmental goals in a cost-effective manner is applying an “integrated” or “total systems” approach during design and construction. These guidelines solidify this approach by organizing goals into strategies that should be addressed from the moment the developer hires the architect, engineer, and contractor. Strategies should be integrated into the building’s RFP bid process, design strategies, and construction schedule and specs. By developing goals early, first costs can be better contained by making appropriate trade-offs that reduce the likelihood of sensible strategies being value engineered out later. To be successful:

- Retain a professional development team (developer, architect, engineer, landscape architect, contractor, and project manager) committed to applying environmentally sensitive building principles and practices;
- Integrate planning and design activities; and
- Select qualified contractors by developing a selective bidding process.



Execution

The guidelines are broken into six major categories with 66 strategies. While not a complete resource, the guide is designed to help affordable housing providers develop strategies for greater successes. The range of strategies gives developers a variety of options to choose from that don't preclude rapidly changing technologies & practices. Each strategy indicates whether or not it is **Threshold** or **Voluntary**. If it is a Threshold strategy, it is now required for all projects seeking funding from PDC. The Voluntary strategies are just that. However, the city encourages all project teams to implement as many strategies as economically possible. Like PDC's other performance criteria, the more strategies incorporated into a proposed project, the more likely that a project will receive funding.

Criteria Categories

Design & Site: Sustainable design and site planning integrates design and construction strategies to minimize environmental site impacts, reduce construction costs, maximize energy and resource conservation, improve operational efficiencies, and promote alternative transportation.

Energy Conservation: Energy conservation helps maximize tenant comfort and reduce utility bills. Conservation measures slow the accumulative impacts of energy production and delivery; extraction of non-renewable natural resources; degradation of regional air quality; global warming; and increasing concentration of pollutants.

Water Conservation: Water conservation practices reduce both resident utility costs and the energy consumed to deliver and heat water. Water conservation cuts down on the amount of water discharged from a building, lessening the likelihood of untreated discharges into the Columbia and Willamette Rivers and stress on the City's wastewater treatment facilities.

Conserving Materials & Resources: Reducing, reusing, and recycling building materials conserves local and regional natural resources. There are many "green" building products on the market and techniques (like advanced framing) that contribute to more durable and less resource intensive and toxic buildings.

Enhanced Indoor Air Quality: Minimize exposure of workers and residents to toxic materials. Use safe, biodegradable materials and alternatives to hazardous materials. Require and monitor safe handling and disposal of all hazardous materials.

Operations & Maintenance: The most overlooked elements of green building are operations and maintenance (O & M) practices. O & M practices impact the building owner's costs and residents' health, comfort, and safety. Green O & M practices enhance tenant health and operational savings. Effective practices include: maintaining proper building temperature and humidity; promoting the ventilation, dilution, and removal of airborne contaminants; eliminating the use of toxic cleaners and pesticides; and providing appropriate lighting and acoustic separation.

Green Building Criteria for Affordable Housing

Page	Category	Strategies	New	Rehab	Code Required	CSI Division
ENHANCED DESIGN AND SITE						
14	Site Inventory	1. Threshold: Complete a comprehensive site inventory.	X	X		02
15	Soil & vegetation protection	2. Threshold: Perform level 1 site assessment to determine soil conditions.	X			02
		3. Threshold: Preserve existing trees and shrubs on site, including street trees.	X	X	X	02
		4. Do not apply herbicides or pesticides during site prep.	X	X		02
		5. Create landscaping plan that provides for bird and insect habitat, west and south facing building shading, and resident gardening. Create native plant associations and communities.	X	X		02
19	Building design & orientation	6. Threshold: 1. For new construction, design roof eaves to overhang exterior walls and exterior surfaces (12" minimum). 2. For rehab, construct patios, decks, windowsills, and thresholds to properly drain water away from buildings.	X ⁽¹⁾	X ⁽²⁾		02 06 07 09
		7. Threshold: Orient building to maximize solar exposure in winter and shading in summer.	X	X		02,06 07,09
		8. Reuse and recycle parts or all of existing building during renovation or redevelopment.		X		02,06 07,08 09
		9. Reduce building footprint, simplify building shapes, and maximize space efficiency.	X			02



Page	Category	Strategies	New	Rehab	Code Required	CSI Division
22	Stormwater management and water pollution	10. Threshold: Maximize on-site drainage and water catchment capacity. Design on-site stormwater facilities to City of Portland's Stormwater Manual specifications.	X	X	X	02
		11. Threshold: Protect site from runoff erosion during construction. Design site erosion control plan based to City of Portland's Erosion Control Manual specifications.	X	X	X	02
		12. Specify and install permeable surfaces and paving in low traffic areas.	X	X		02,03 04
24	Transportation access	13. Threshold: Provide secure bicycle parking.	X	X	X	02
		14. Size parking capacity to meet minimum local zoning requirements.	X	X	X	02
		15. Site building within 1/4 mile of mass transit and 1/2 mile of stores and services.	X			02
ENERGY CONSERVATION						
30	Building envelop & weatherization	1. Threshold: In new construction, install high recycled-content insulation with following R values: R-38 ceilings/R-21 walls/R-30 floors/R-15 slab edge. Rehab insulation values depend on preexisting conditions.	X	X	X	07
		2. Threshold: Specify and install double glazed, low-e windows and sliding doors with U value 0.35 or less.	X	X		08
		3. Threshold: Flash and seal all penetrations between interior spaces and outside. Seal all penetrations for ducting, wiring, plumbing, lights, and fans.	X	X		07
		4. Perform blower door test to determine cost-effective air sealing and combustion safety.	X	X		06 07
		5. Increase insulation and reduce heat loss on one- and two-story walls with normal loads by using 2x6 @24" on center framing module for exterior walls.	X			06 07
		6. Specify and install exterior insulated core doors.	X	X		08
		7. Specify and install insulated concrete forms.	X			03,07

Page	Category	Strategies	New	Rehab	Code Required	CSI Division
		8. Insulate perimeter edge of concrete slab floor with code approved foam board. Insulate between heated space and garage slab.	X			03 07
		9. Thermally separate living areas from less energy consuming zones like entry, storage, mechanical, and utility areas.	X			03 07
36	Heating systems	10. Threshold: Install radiant or hydronic heating with digital thermostat located in main living area. Systems may include: hydronic baseboard, radiant cove heaters, water heater /water boiler supplied room heaters. (i.e. "Turbonics"). Size heat supply based on weatherization measures (natural gas fuel preferred).	X	X		11 15 16
		11. Preferred Alternate: Install high efficiency gas sealed combustion forced air furnaces (minimum 92% Efficiency Rating) with digital thermostat in main living area. Systems may include gas furnace, gas furnace with integrated water heater. Size heat supply based on weatherization measures.	X	X		11 15 16
		12. Install ductwork inside conditioned space OR seal ductwork in crawls and attics with mastic. Design short runs. Use flex only for straight runs; otherwise use metal.	X	X		15
38	Electrical & lighting	13. Threshold: Specify and install Energy Star™-rated appliances, fixtures and lighting systems.	X	X		11,12 15,16
		14. Threshold: Specify and install efficient outdoor lighting (30 lumens per watt or better) with low temperature ballasts. Install lamps with automated controls, including but not limited to photo sensors, timers, and motion control sensors.	X	X		16
39	Renewables	15. Install solar water heating system.	X	X		10,11 15,16
		16. Purchase green power.	X	X		15,16
WATER CONSERVATION						
46	Plumbing	1. Threshold: Install water conserving plumbing fixtures: 2.0 gpm showerheads & 1.5 gpm faucet aerators.	X	X		15

Page	Category	Strategies	New	Rehab	Code Required	CSI Division
		2. Threshold: Install high energy factor water heater (.60 for gas, .93 for electric).	X	X		15 16
		3. Threshold: Insulate bottom of hot water tank. Set electric tank on foam board. Set gas tank on raised platform. Insulate hot water pipes.		X		07
48	Irrigation	4. Threshold: Use only native, hardy plant materials for landscaping, except for edible landscaping, street trees, and lawn. Minimize total area of turf.	X	X		02
		5. Install high-efficiency drip irrigation system.	X	X		02,15
		6. Install rainwater catchment system for non-potable water reuse.	X			02 15
CONSERVING MATERIALS & RESOURCES						
54	Waste management & recycling	1. Threshold: Develop a waste minimization plan, establishing targets for demolition and construction waste recycling by types of materials (goal: 80% total waste reuse and recycling by weight).	X	X	X	01 02
		2. Minimize non-recyclable/non-reusable packaging during construction.	X	X		01
55	Foundation	3. Specify concrete mix with 25-50% fly ash substitution for Portland cement. Specify recycled aggregate base.	X			03
56	Framing	4. Threshold: Specify engineered structural lumber.	X	X		06
		5. Threshold: In wood framing, employ 24"advanced framing modules and box headers.	X	X		06
		6. Specify salvaged, recycled, and/or certified sustainably harvested wood products. Do not specify old growth lumber, other than "recovered" or "reused" materials.	X	X		06
		7. Specify regionally manufactured building materials when possible (within 500 miles).	X	X		01
60	Roof & skin	8. Threshold: Specify durable and recycled content roof and siding materials with a 25 - 50 year lifetime warranty.	X	X		07

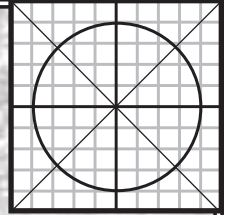
Page	Category	Strategies	New	Rehab	Code Required	CSI Division
60	Materials & finishes	9. Threshold: When dropped ceiling panels are specified, install recycled content panels.	X	X		09
		10. Install formaldehyde-free or low-formaldehyde underlayment, cabinets and storage units. Replace particleboard with plywood or MDF.	X	X		09 10 12
		11. Specify sustainably certified wood for finish woodwork.	X	X		12
		12. Specify low-toxic, decay-resistant, outdoor materials. When possible, consider patio treatment instead of decking.	X	X		02,03 04,06 09
		13. Specify recycled content drywall. Install hard surface drywall in high-wear areas.	X	X		09
64	Flooring	14. Threshold: Specify natural linoleum, tile, or other vinyl alternative in kitchen and bathrooms (if vinyl is necessary, specify vinyl composition tile).	X	X		09
		15. Threshold: Specify solid floor finishes and/or nylon or PET carpeting with fiber or waffle pad.	X	X		09

ENHANCED INDOOR AIR QUALITY

74	Finishes	1. Threshold: Specify solvent free, no VOC or low VOC (below 50 g/liter) paints and primers. Specify water-based wood finishes.	X	X		07,09
		2. Threshold: Specify low toxic adhesives and sealants.	X	X		07,09
75	Fresh air ventilation	3. Threshold: Install continuous exhaust ventilation OR central exhaust fan ducted to bath. Provide make-up air vents. Specify fans with delayed timer controls. Install medium efficiency air filters in ducted forced air systems.	X	X		15 16
		4. Install kitchen range hood or ceiling exhaust fan to remove excess moisture and odors OR install multi-port attic fan to exhaust kitchen and bathroom.	X	X		15 16
		5. Threshold: Properly ventilate building prior to occupancy.	X	X		01
		6. Use operable windows AND mechanical ventilation systems to assure ample fresh air for building occupants.	X	X		08 15

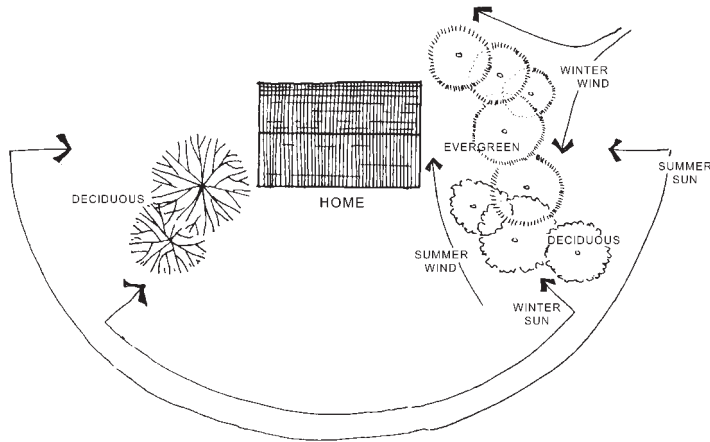


Page	Category	Strategies	New	Rehab	Code Required	CSI Division
		7. Encourage a "no smoking" policy for building (during construction & occupancy).	X	X		01
OPERATIONS & MAINTENANCE						
80	O & M Planning	1. Threshold: Develop maintenance and tenant operating manuals with specific actions.	X	X		01
		2. Threshold: Develop O & M plan for scheduled maintenance of vents, filters, plumbing, and combustion equipment.	X	X		01
81	O & M Practices	3. Threshold: Provide adequate space for comprehensive resident recycling.	X	X		01
		4. Threshold: Eliminate pesticides and herbicide use on and around building.	X	X		01
		5. Threshold: Use low-toxic or citrus-based cleaning supplies. Eliminate use of solvents.	X	X		01
		6. Threshold: Design properly ventilated separate storage area for cleaning supplies and paints.	X	X		01
		7. Threshold: Eliminate wet carpet cleaning (steam OK). Use HEPA filters on vacuum cleaners.	X	X		01



Design & Site

An effective site analysis is the first step in delivering more cost effective, healthy, and durable projects. Mapping the site's existing conditions provides the baseline information needed to make smart decisions related to building siting, building design, parking, landscaping, and stormwater management. A comprehensive site inventory also reduces risk by identifying potential regulatory and environmental liabilities such as soil contamination, zoning restrictions, or easement conflicts.



Site analysis includes sun and wind patterns — information that influences site and building design. For example, well-placed landscaping can block winter winds, channel summer winds, and shade buildings from hot summer sun.

SITE INVENTORY

1

THRESHOLD: Complete a comprehensive site inventory.

CSI
02

WHY:

- A thorough site inventory identifies design and construction opportunities and barriers.
- Solar and wind exposure affects building performances, including; resident comfort, energy costs, and building functionality.
- Accurate identification of easements, utilities, and other right-of-way issues reduces potential conflicts and unforeseen project costs.

HOW:

- Perform comprehensive site inventory and create schematic site plan.
- Include the following information: zoning, solar access & building orientation; seasonal wind patterns; soil types and surface water drainage patterns; environmental features (i.e. streams, vegetation, wetlands); and adjacent and on-site buildings and infrastructure, including easements (i.e. structures, storm and sanitary sewer, water lines, streets, curb cuts, and sidewalks).
- **SEE ALSO Design & Site criteria #2. >>>**

COST:

- No additional cost. This measure, when properly implemented, can result in savings through reduction of design fees, energy use, and maintenance costs.



SOIL & VEGETATION PROTECTION

2

THRESHOLD: Perform level 1 site assessment to determine soil conditions.

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02

- WHY:**
- Level 1 site assessment is a records investigation of the site's geotechnical conditions, often performed before purchase of the property. The assessment should include; water table, underground water streams, drainage conditions, compaction, and overall soil quality and/or fill capacity for supporting structural footings, slabs, new drainage, and surface pavement.
 - Level 2 site assessment is a physical, on-site survey, performed if a Level 1 site assessment indicates potential geotechnical risk.
 - A geotechnical (soil) survey identifies soil conditions — soil drainage conditions, compaction, underground water sources, and bearing capacity — underneath major proposed structures. It is performed after preliminary schematic architectural design.
- HOW:**
- Consult a licensed geotechnical engineer for geotechnical (soil) survey, level 1 and level 2 site assessments.
 - It is not sufficient to use an earlier survey for your project—a geotechnical investigation is relevant only to the proposed building and site design. Site conditions may have changed since the last study (e.g. soil may have been contaminated with hazardous materials).
 - The studies should clearly assess all major portions of a site to avoid problems in the construction phase. For example, if the soil is found to be of poor quality (infiltration and compaction) during foundation excavation, bringing in new fill will add significant costs to the project.
- COST:**
- Geotechnical (soil) surveys are approximately \$2,000 for a single-family lot; \$4,000 for a one-acre multi-family site; and \$10,000-15,000 for a five-story mid-rise structure with adjacent party wall(s).
 - A level 1 site assessment, often required by lenders, costs approximately \$2,000-3,000.



3

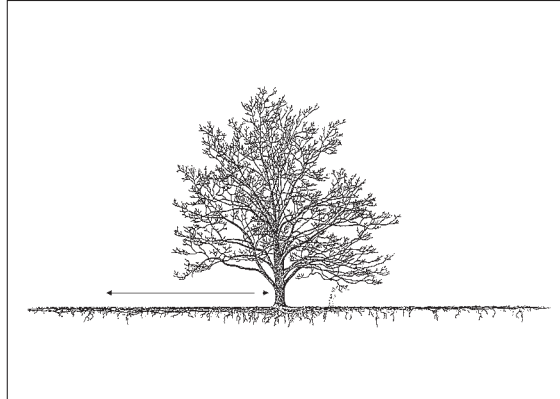
THRESHOLD: Preserve existing street trees and shrubs on site, including street trees.

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02

CODE: ● Required by tree preservation and heritage tree ordinances.

WHY:

- Mature trees can provide excellent protection against winter winds and summer sun—improving comfort and lowering energy costs. In addition, trees provide food sources, such as fruits, and cover for wildlife habitat.
- Root systems extend far from the tree's trunk and can be critically damaged during construction by trenching, soil compaction, flooding, and vehicles.



The distance a tree's roots extend from its trunk can be greater than the tree's height. Protect them from damage during development.

HOW:

- To avoid destroying tree root zones during construction, ask a landscape designer or arborist to estimate the range of their root systems and foliage height when mature. Incorporate these estimates into the building and landscape design to limit damage to trees over time.
- Retain trees over 8" caliper unless they're hazardous or cannot be incorporated into site plan. Such trees must be replaced 1-to-1 in landscaping. Trees may be relocated to accommodate new construction.
- During construction, fence drip zones with high-visibility mesh to keep equipment, workers, and excess soil and backfill away from the roots.
- Specify shade trees when appropriate. Also consider incorporating fruit or nut trees into the landscape design. Many dwarf-variety fruit trees are easy to maintain and harvest. However, some varieties of fruit trees are not good shade trees.

NOTE: ● Many native plant species don't grow well in alkaline soils and should not be planted where their root systems will be near concrete.



Bioswales reduce erosion and cleanse stormwater before it enters the water table.

4

VOLUNTARY: Do not apply herbicides or pesticides during site prep.

CSI
02

- WHY:**
- Herbicides and pesticides pose a significant long-term health hazard to people and local ecosystems. Many substances do not safely break down, putting play areas, buildings, and groundwater at risk of contamination. Many products have been banned only after prolonged use and testing reveal long-term hazards. For example, diazinon, a common garden pesticide, was recently banned by the EPA.
- HOW:**
- There are many non-toxic alternatives to most herbicides and pesticides on the market today.
 - To remove invasive species like blackberries, herbicides will rarely be effective—their rootballs must be completely dug out of the ground.



5

VOLUNTARY: Create landscaping plan that provides for bird and insect habitat, west and south facing building shading, and resident gardening. Create native plant associations and communities.

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02

WHY:

- Site development alters natural site conditions. Simple planting choices can support or recreate habitat for birds, insects, and other wildlife.
- Edible landscaping and garden spaces provide opportunities for residents to supplement their diets with fresh and economical food.
- A well-designed landscape allows children to learn about nature through observation of growth cycles and visiting creatures.
- Grass lawns and ornamental plant species are invasive and costly to maintain. They require more water, labor, herbicides, pesticides, and fertilizers to look acceptable.

HOW:

- Develop a permaculture-based landscape plan. Permaculture emphasizes low-maintenance landscaping, where each component serves more than one function (e.g. plants growing in companion “guilds” support one another’s growth and maximize productivity—naturally).
- Apply naturoscaping techniques, including native and drought-tolerant plants.
- Create community or apartment gardens. This can be as simple as setting aside land for resident use, or developing a formal community garden and management plan. Make information on gardening available to residents in their native languages.
- Minimize lawn area. Centralize lawn area into one shared space. Plant low-maintenance, drought-tolerant native grasses and wildflowers.



Community gardening can be as simple as designating land as available for use by residents.

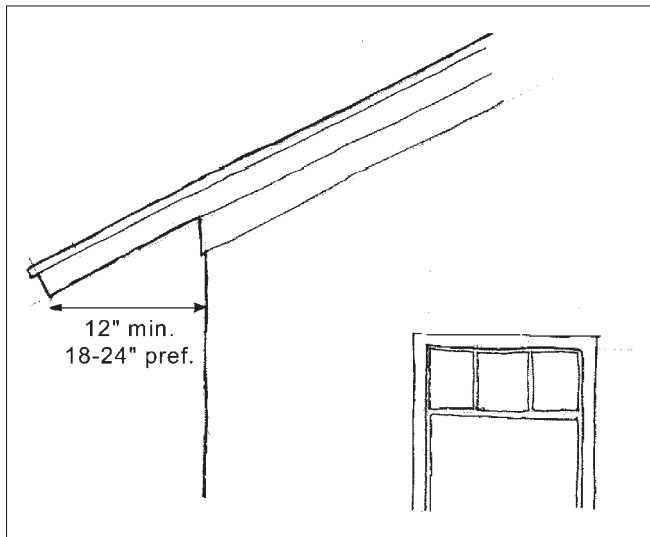


BUILDING DESIGN & ORIENTATION

6 THRESHOLD: 1. For new construction, design roof eaves to overhang exterior walls and exterior surfaces (12" minimum). 2. For rehab, construct patios, decks, window sills, and thresholds to properly drain water away from buildings.

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07 09

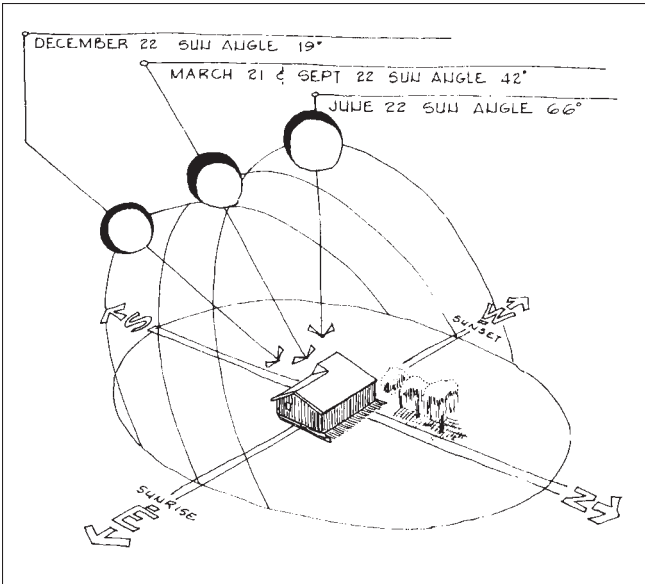
- WHY:**
- In Portland's rainy climate, a substantial roof eave protects buildings against water and sun damage, significantly increasing a building's durability.
 - Generous roof eaves and other water-draining details add to the aesthetic value of the structure, increasing resident pride and neighborhood acceptance.
 - Damage from bulk water entry is a significant problem in housing. Slope walkways, stairs, patios, and thresholds away from the building.
- HOW:**
- Though this criteria only requires a 12" minimum overhang, an 18-24" eave overhang is most effective at draining water away from a structure.
 - Additional architectural features like covered porches and patios greatly increase the usability of limited exterior spaces. Careful architectural detailing and construction supervision ensures proper water drainage.
 - Poor detailing results in water damage from bulk water entry. Slope new and rebuilt walkways, stairs, patios, and thresholds away from the buildings.
- COST:**
- Minimal upfront costs for decking and roofing materials. Trusses that overhang 12" should add little or not cost.
 - Costs are reduced through long-term operations and maintenance savings.



ADAPTED FROM LENNERTZ COYLE & ASSOCIATES

Broad roof eaves improve aesthetics and increase durability by protecting siding against rain and sun.





Solar exposure angles vary throughout the year

7 **THRESHOLD:** Orient building to maximize solar exposure in winter and shading in summer.

CSI
02 06
07 09

- WHY:**
- Maximizing natural ventilation and solar access creates more energy efficient, healthy, and comfortable spaces.
 - Good daylighting has been proven to increase learning and productivity. Sunlight kills pathogens.
-
- HOW:**
- Design roof overhangs and windows to encourage solar access, natural ventilation, and proper water drainage.
 - Passive solar design augments winter heating. For best results, orient the building with the long side of the building within 30 degrees of due south, spec windows to maximize solar gain, and design in adequate thermal mass.
 - Plant trees to shade structure's south and west facing sides. Deciduous vines and trees make excellent seasonal window shading devices.
 - Where possible, locate windows on two sides of room to minimize glare and encourage daylight penetration. Install windows adjacent to walls to help bounce sunlight deep into interior spaces.
 - Design and dimension overhangs and porches to block high summer sun and allow in low winter sun.
-
- COST:**
- No additional costs.



Renovation extends a building's service life, reducing the use of new materials.

8

VOLUNTARY: Reuse and recycle parts or all of existing building during renovation or redevelopment.

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09

- WHY:**
- The energy spent to extract, process, transport, and install materials is significant. Reusing and recycling parts or all of an existing structure saves resources, reduces waste, and saves landfill tipping costs.
 - In the Portland area, construction and demolition (C&D) waste makes up 26% of the total waste sent to landfills.
 - Reusing and restoring older structures supports historic preservation.
- HOW:**
- Evaluate viability of reusing existing structure at the beginning of the design process. Review regulatory requirements needed to bring structure up to current codes.
 - Focus on improving energy efficiency in reused structures. New insulation can be blown into walls, studs can be fired out to allow more room for insulation, or foam panel insulation may be installed under exterior siding.
 - Incorporate salvaged building elements like studs, windows, doors, and hardware into project. Inspect, mark, and warehouse materials to be reused or recycled during demolition. Note: salvaged studs can only be used for non-structural walls unless the lumber is professionally re-graded.
 - Evaluate viability of deconstruction in lieu of traditional demolition. Deconstruction diverts most C & D waste from landfills and is cost competitive.





9

VOLUNTARY: Reduce building footprint, simplify building shapes, and maximize space efficiency.

CSI
02

- WHY:**
- Smaller, more efficiently designed buildings increase materials and systems efficiencies, reduce operations costs, and create more space for playing children, growing food, and on-site stormwater management.
- HOW:**
- Design space-efficient egress and public circulation that maximizes interaction between residents. Design public spaces for flexibility and future adaptation.
 - Avoid excess circulation space, like long hallways. Locate interior doors to direct circulation along perimeters of rooms. Maximize wall space for furniture placement. Locate heating units out of the way of furniture. U- or L-shaped kitchens are preferable to corridor kitchens. Stairways with landings are preferable to straight runs. Incorporate useful storage areas into stairs, wall cavities, and below seating areas. Design floor plans for flexibility and future adaptation. For example, design partition walls for future expansion of units.

STORMWATER MANAGEMENT & WATER POLLUTION

10

THRESHOLD: Maximize on-site drainage and water catchment capacity. Design on-site stormwater facilities to City of Portland Stormwater Manual specifications.

CSI
02

- CODE:**
- All projects are required to implement a stormwater management plan using the City of Portland Bureau of Environmental Services' Stormwater Manual.
 - The City requires all new parking lots to use surface landscaping areas for stormwater management to the maximum extent practicable, and requires mitigation of at least 20% of all newly paved surfaces for projects over 500 square-feet in size.

- WHY:**
- Maximizing on-site treatment of stormwater runoff increases on-site filtration, prevents pollutants from entering waterways, and reduces soil erosion.

- HOW:**
- Use Best Management Practices (BMPs) to mitigate on-site stormwater. Stormwater facili-



Stormwater management can be simple and attractive.



ty design depends on site drainage, soils, and space constraint factors. See BES Stormwater Manual for specific options to meet the city's requirements.

- BMPs include landscape planters, porous pavement, landscape swales, ecoroofs, and roof gardens. Planters and swales should be landscaped with native plants. Roof runoff can also be handled with gutter alternatives.

COSTS: ● Landscape swales, trees, planters, and other BMPs costs vary with the size and complexity of the site.

11

THRESHOLD: Protect site from runoff erosion during construction. Design site erosion control plan to City of Portland's Erosion Control Manual specifications.

**CSI
02**

CODE: ● The City of Portland Erosion Control Manual sets minimum requirements for all development and ground-disturbing activities.

WHY: ● Developers are required to submit an erosion control plan for construction projects. The City requires that "no visible and measurable sediment or pollutant exit the site, enter the public right-of-way or be deposited in any water body or storm drainage system" as a result of construction.

● Erosion control during site development keeps valuable topsoils on site and reduces pollution, stormwater and sediment runoff into local waterways.

HOW: ● Submit a site plan that outlines erosion control mitigation measures with building permit application. The city's Erosion Control Manual provides a menu of Best Management Practices (BMPs) and application instructions.

● BMPs include sediment fencing, gravel construction entrances, covered soil stockpiles, and filter swales.



Bio-filter bags help prevent sediment from polluting waterways during construction.

COST: ● Minimal: For most sites, erosion mitigation strategies are inexpensive. More complicated sites (steep slopes, adjacent to waterways) may have higher costs associated with more sophisticated strategies and monitoring.



12

VOLUNTARY: Specify and install permeable surfaces and paving in low traffic areas (fire access, overflow parking, pathways, etc.).

CSI
02 03
04

- WHY:**
- Permeable surfaces facilitate on-site stormwater infiltration by reducing the percentage of hard surfaces.
- HOW:**
- Permeable surfaces take many forms: special permeable concrete; brick or stone pavers; and manufactured products made of concrete, plastic and/or gravel. Some products support turf growth.
 - When installing permeable parking surfaces, carefully follow manufacturer's installation instructions to ensure proper drainage and durability.
 - Permeable paving is most suitable in areas such as less-used parking areas, footpaths, patios, and common outdoor gathering spaces.

TRANSPORTATION ACCESS

13

THRESHOLD: Provide secure bicycle parking.

CSI
02

- CODE:**
- The City of Portland requires long-and short-term bicycle parking based on number of units in multi-dwelling buildings.
- WHY:**
- Bicycle parking requires only 12-20% of the space and cost of a single auto parking space. Certain zoning allows bike facilities to be applied against parking ratio requirements, freeing up space for development and reduced paving costs.
 - Secure bicycle parking is a popular amenity and keeps bicycles out of living units.
 - Bicycling reduces pollution. The majority of auto trips in a city are less than two miles and could easily be made by bicycle, especially with the aid of bike baskets or trailer.
 - Bicycling is a healthy and cost-effective transportation alternative.
- HOW:**
- Provide convenient and secure long-term bicycle parking sized to the number of units. Include repair work area.
 - Construct well-covered and visible outdoor bicycle parking facilities for residents and guests.



14

VOLUNTARY: Size parking capacity to meet minimum local zoning requirements.

**CSI
02**

- WHY:**
- New parking lots in Portland must mitigate all stormwater on site.
 - It is not an economical or efficient use of land to create surface parking lots. It wastes land that could be used for more homes, playgrounds, and gardens. Roads, parking lots, garages, and driveways cover over 50% of Portland.
 - Parking lots concentrate and deposit toxic “automobile dandruff”—oil, rubber, metals—into soils and local waterways.
-
- HOW:**
- Replace auto parking with bicycle parking. Contact the Office of Planning & Development Review (OPDR) for minimal parking requirements.
 - Survey the tenants’ actual parking needs and parking capacity of the area. Consider sharing parking with other buildings in the area. Petition OPDR to reduce the number of required parking spaces.
 - Consider on-site car sharing program to reduce per unit parking needs.
 - **ALSO SEE Design & Site criteria 13 & 15. >>>**

15

VOLUNTARY: Site building within 1/4 mile of mass transit and within 1/2 mile of stores and services.

**CSI
02**

- WHY:**
- Siting projects within pedestrian and transit-oriented neighborhoods can reduce on-site parking needs and save associated construction costs.
 - Siting development close to transit and services reduces the need to own a car.
 - Pedestrian and transit-oriented neighborhoods provide residents with a range of services, parks and employment opportunities within walking and biking distance. Streets become more populated, friendly, and safe.
-
- HOW:**
- Seek out potential development sites within 1/4 mile of mass transit and within 1/2 mile of stores and services.
 - If the neighborhood is lacking services, evaluate the viability of incorporating commercial, retail, or other community services into the development.



RESOURCES & VENDORS

BROWNFIELD INFORMATION AND ASSISTANCE

Brownfields are development sites believed to be contaminated with hazardous materials. The level of contamination can be determined by a level 1 or 2 site assessment or pollutant mapping.

Portland Brownfield Initiative

City of Portland
Bureau of Housing and Community
Development
421 SW 6th Avenue
Portland, OR 97204
Contact: Dominic Boswell, 503-823-7053
www.brownfield.org

A federal partnership, focused primarily on brownfields in the N/NE Portland area. Implements the Brownfields Cleanup Revolving Loan Fund, a 0-3% interest loan to assist with mitigation measures. Other assistance available as well.

ALTERNATIVES TO PESTICIDES

Common Sense Gardening: A Guide to Alternatives to Pesticides

Metro Regional Government
Recycling Hotline, 503-234-3000
www.multnomah.lib.or.us/metro/rem/garden/pestalt.html

Metro's Guide to Alternatives to Pesticides suggests prevention and control for 33 pests, 10 weeds, and seven plant diseases.

Northwest Coalition for Alternatives to Pesticides

P.O. Box 1393
Eugene, OR 97440
541-344-5044
541-344-6923 fax
info@pesticide.org
www.pesticide.org/factsheets.html#alternatives

NWCAP advocates against widespread and unhealthy pesticide use. Their website is an excellent source of information about non-toxic pesticide alternatives, including strategies for controlling cockroaches.

List of Safer Chemicals

Integrated Pest Management Program
City of San Francisco
www.ci.sf.ca.us/ipm/list2000.htm

HERBICIDES AND PESTICIDES

Biogenic Safety Products

877-723-3345
www.biogenic.com

Herbicides and pesticides made from natural ingredients.

NATURESCAPING

Naturescaping promotes native plants, natural landscape design, and low-water gardening practices.

Berry Botanic Garden

11505 SW Summerville Avenue
Portland, OR 97219-8309
503-636-4112
www.berrybot.org

The Berry Botanic Garden—continuing the legacy of Rae Selling Berry—promotes Northwest native plants, maintains special plant collections, conserves native endangered plants, and offers related educational programs, including naturescaping classes.

Naturescaping workshops

Naturescaping for Clean Rivers
East Multnomah Soil & Water Conservation District
Contact: Linda Robinson, 503-797-1842
naturescaping@yahoo.com
<http://community.oregonlive.com/cc/naturescaping>

Metro Regional Government

Natural and native landscaping techniques
Contact: Glen Anderson, 503-797-1811
Recycling Hotline, 503-234-3000
www.multnomah.lib.or.us/metro/rem/garden/natgar.html



Natural Techniques Demonstration Garden

SE 57th and Cooper Street
Portland, Oregon

503-234-3000

A demonstration project of Metro and Portland Public Schools Green Thumb Horticultural Center. Built on a standard-sized Portland lot (approximately 50-115), the site includes a footprint of a typical house. The lot is landscaped with different gardening themes that residents can create in their own yards: a shade garden, native plants, drought-tolerant and slug-resistant plants, and a raised-bed vegetable garden.

NATIVE AND/OR EDIBLE PLANT NURSERIES

Alderview Natives

28315 SW Grahams Ferry Rd.
Wilsonville, OR 97070
503-570-2894

Bosky Dell Natives

23311 SW Bosky Dell Lane
West Linn, OR 97068
boskydellnatives@aol.com
503-638-5945

Stocks over 200 varieties of seed- or container-grown native plants. Wholesale discounts available to affordable housing developers and community-oriented projects.

Burnt Ridge Nursery & Orchards

432 Burnt Ridge Road
Onalaska, WA 98570
<http://landru.myhome.net/burntridge/>
burntridge@myhome.net
360-985-2873

Stocks native plants as well as low-maintenance edible plants that provide fruits or nuts. Certified organic farm.

Pro Time

Hobbs & Hopkins Seeds

1712 SE Ankeny Street
Portland, OR 97214
www.protimelawnseed.com
lawn@teleport.com

503-239-7518

Carries seeds of native grasses and non-native wildflower mixes. Native wildflower mixes are available occasionally.

Wallace W. Hansen

2158 Bower Court SE
Salem, OR 97301
www.nwplants.com
plants@nwplants.com
503-581-2638

Specializes in plants native to region west of the Cascade Mountains. The website includes information on what plants work in different locations.

Quail Ridge Nursery

33689 S. Ball Road
Molalla, OR 97038
503-829-3105

SOLAR ENERGY INFORMATION

Oregon Office of Energy

Solar Energy Home Page
www.energy.state.or.us/renew/solar/index.htm

Good information source for solar electricity, not water, and space heating. Additional vendor list and info on residential tax credits up to \$1500.

Solar Energy Assoc. of Oregon

503-231-5662
solaror@teleport.com
<http://solaror.org>

Local advocates of solar power. Website provides technical resources.

DEMOLITION ALTERNATIVES

Deconstruction Services of the ReBuilding Center

Contact: Jim Primdahl, 503-331-9875

Full service deconstruction company. Tax-deductible donations for salvaged materials.



STORMWATER MANAGEMENT

City of Portland Stormwater Management Manual

Bureau of Environmental Services
Contact: Steve Fancher, 503-823-7126

Available at the Office of Planning and Development Review for \$10. Manual is also available on-line at www.enviro.ci.portland.or.us/swm2.html

City of Portland Erosion Control Manual

Office of Planning and Development Review
1900 SW 4th Avenue, Suite 500
Portland, Oregon 97201
503-823-6892
Contact: George Helm, 503-823-7201

Created in conjunction with City of Portland Bureau of Environmental Services, Office of Transportation, and Bureau of Water Works.

ROOF RAINGUTTER ALTERNATIVES

Rainhandler

Bridgeport, Connecticut
800-942-3004
203-382-2995 fax

Replaces rain gutters with a louver system designed to evenly distribute rainwater away from the structure and directly onto the ground.

PERMEABLE PAVING

There are several permeable paving products available that differ in cost, aesthetic qualities, and infiltration properties. They include porous concrete pavers and permeable asphalt alternatives that don't leach harmful chemicals and interlocking plastic systems that support turf.

Porous Concrete

Concrete Network

www.concretenetwork.com/concrete/porous_concrete_pavers/

Installation information and project specifications guide for porous concrete.

Modular Concrete Porous Grid Pavers

Uni Eco-Stone

Mutual Materials
503-285-3336

Oriana Pavers

Seattle, Washington
206-860-5867
saya@mac.com

Sod-Covered systems

Grasspave2

Invisible Structures, Inc.
Aurora, Colorado
www.invisiblestructures.com
sales@invisiblestructures.com
Contact: Chris Spelic
800-233-1522 x214
100% post-consumer recycled plastic.

Geoblock

Soil Stabilization Products Company, Inc.
Merced, California
www.sspco.com
info@sspco.org
800-523-9992
Up to 50% recycled content polyethylene.

Asphalt Alternatives

Road Oyl

Soil Stabilization Products Company, Inc.
Merced, California
www.sspco.com
info@sspco.org
800-523-9992
Non-toxic petroleum alternative paving resin. It is costlier than asphalt but less than concrete. Depending on aggregate used, you can create different shades.



Energy Conservation

Everyone deserves a comfortable and healthy home. An efficient building envelope and heating system provides these benefits. By investing in a well-insulated and well-sealed building envelope, a developer can save money on heating equipment systems while residents will save money on heating bills. A well-constructed building envelope also contributes to residents' health through improved indoor air quality.

With energy costs rising and the negative impacts of producing it becoming more understood, strategies to increase energy efficiency should be of utmost concern.



BUILDING ENVELOPE & WEATHERIZATION

1 THRESHOLD: In new construction, install high recycled-content insulation with the following R values: R-38 ceilings/R-21 walls/R-30 floors/R-15 slab edge. Rehab insulation values depend on preexisting conditions.

**CSI
07**

- | | |
|--------------|--|
| CODE: | <ul style="list-style-type: none"> ● Code sets minimum standards for energy efficiency. However, code requirements are not always the optimal solution. For example, code requires R-25 insulation in floors over unconditioned spaces; today R-30 is cost-effective. If energy costs double in the near future, “beyond code” will become standard practice. |
| WHY: | <ul style="list-style-type: none"> ● Minimizes cost of energy to occupants and housing agencies, without sacrificing comfort or livability. ● Eliminates or reduces mold and mildew problems. ● Reduces noise transmission. ● Reuses waste materials like scrap paper and glass. |
| HOW: | <ul style="list-style-type: none"> ● Consider blown-in options like Dense-pak or BIBS (Blow-in Blanket System™) that achieve high R-values and cut air leakage by completely filling cavities and hard-to-reach areas. ● Specify recycled content insulation: <ul style="list-style-type: none"> ■ Cellulose from scrap paper or fiber (available with up to 95% recycled content); ■ Fiberglass with more than 20% post-consumer glass content; ■ Rock wool; or ■ Standard batts. ● When installing: avoid crushing; cut and fit carefully; face-staple flanges; and fill all gaps. |
| COST: | <ul style="list-style-type: none"> ● For new construction, installation of “wet” sprayed-in cellulose can cost twice as much as fiberglass batts, but saves the labor costs of thorough air sealing and prevents air leaks that reduce R-value. ● For rehabs, blown-in cellulose insulation is competitive with blown-in fiberglass. ● New R-21 fiberglass batt insulation costs 20-25% more than a comparable R-19 product. |

NOTE: All of the following references to Oregon energy code in this section refer to state code requirements for most residential structures under four stories. Specifically, Oregon Energy Code for One- and Two-Family Dwellings and Structural Specialty Code for Group R buildings three stories and less in height: Path 1 (most cost-effective) compliance.

2

THRESHOLD: Specify and install double glazed, low-e windows and sliding doors with U-value = 0.35 or less.

CSI
08
09

CODE: ● Oregon energy code requires windows with U-value = 0.40 (which is the same as R-2.5).

WHY:

- U-value measures the rate of heat flow through a window. A lower U-value means lower heat loss in winter or heat gain in summer.
- When heat loss is reduced, the inside surfaces of the window stay warmer. That translates to improved resident comfort, reduced condensation or “sweating,” and savings on heating costs.
- Changing from U = 0.40 to U = 0.35 seems like a small change, but represents a 15% improvement in performance.



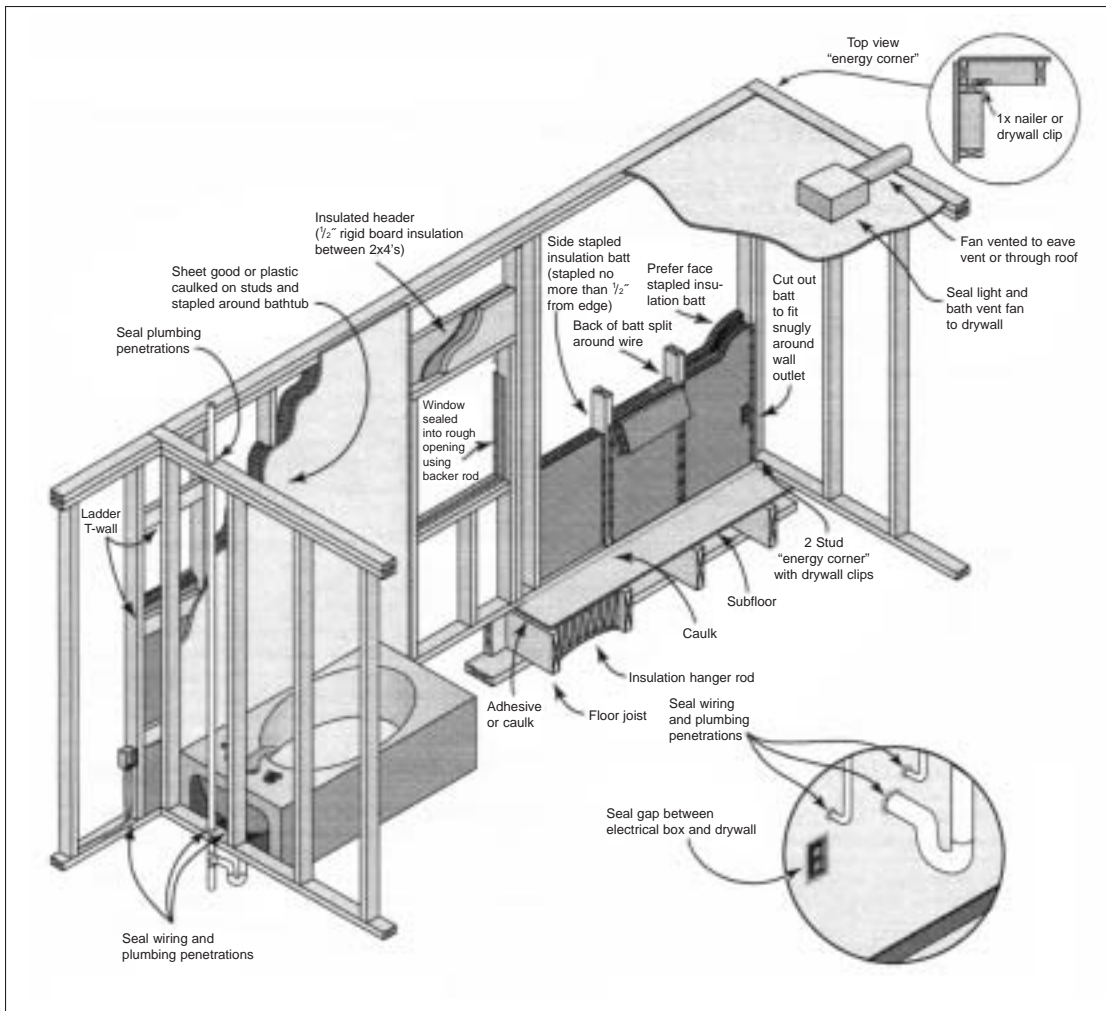
Purchasing a window with a U-value of 0.35 cuts heats loss by 15% compared to code

HOW:

- Windows with U = 0.35 are readily available from most manufacturers and commonly used in this market.
- Another important rating is the solar heat gain coefficient (SHGC), which measures the amount of solar heat that a window allows to pass. A low SHGC (0.40 or less) would be desirable on west-facing façades to reduce overheating. A higher SHGC (0.60 or less) may be suitable on the south- and east-facing facades for passive solar heating.
- When installing vinyl windows, use a low-expanding foam and do not nail top flanges. High-expanding foam and top-flange nailing will not allow the vinyl frame to expand/contract as it needs to, creating future air gaps and compromising the window frame (and possibly violating window manufacturer’s warranty).

COST:

- U = 0.34 or 0.35 windows cost approximately 15% more than similar U = 0.40 windows.
- Windows with strong fiberglass frames are energy efficient and likely to operate indefinitely with little or no maintenance. High initial cost may be offset by energy savings and reduced maintenance and repair.



Sealing air leaks significantly reduces heat loss.

3 THRESHOLD: Flash and seal all penetrations between interior spaces and outside. Seal all penetrations for ducting, wiring, plumbing, lights, and fans.

**CSI
07**

- WHY:**
- Flashing reduces rain and bulk water penetration in exterior walls, helping prevent moisture damage and expensive repairs.
 - A well-sealed “tight” building envelope conserves energy and improves indoor air quality. Conversely, a “leaky” building envelope may lose up to 20% of its overall



insulation value to air infiltration. Buildings may also lose heat through unsealed penetrations to unheated attics or crawl spaces. In addition, ventilation systems will be more effective when installed in a tight building envelope.

● **SEE ALSO Enhanced Indoor Air Quality for other benefits. >>>**

- HOW:**
- On plans and documents, clearly detail flashing and air sealing. Show how building wrap is fastened at window and door openings.
 - The insulation contractor is responsible for air sealing to meet the energy code. The general contractor should seal remaining penetrations prior to insulation installation in order to ensure a thorough treatment. A “wet”-type cellulose insulation eliminates the need for this extra step.
 - Specify use of low-VOC and/or non-CFC propellant caulks and sealants.
 - Often overlooked air leakage sites include:
 - Rim joists between conditioned floors;
 - Ceiling recessed light fixtures, unless ICT rated;
 - Drain pipe holes for showers and tubs over crawl space or garage; and
 - Chases for plumbing or ductwork.

4

VOLUNTARY: Perform blower door test to determine cost-effective air sealing and combustion safety.

**CSI
06
07**

- WHY:**
- A blower door test is an excellent diagnostic tool that reveals hidden air and moisture flows and potential problems and costs. Thermal comfort, moisture and mold problems, indoor air quality and combustion hazards can all be understood and evaluated with a blower door. A test is necessary in any dwelling with a gas furnace or water heater to prevent backdrafting and spillage of combustion byproducts.
 - A blower door is useful during renovations to achieve cost-efficient air sealing. Significant leaks can be quickly identified and the crew can be certain that leaks have been effectively sealed. Combustion safety can be documented as well.
 - A similar “duct blaster” test will check the efficiency of heating ducts in attics and crawl spaces. Inadequately sealed ducts lose 20-30% of their heat into unconditioned space, draw in pollutants from attics, and cause pressure imbalances and discomfort in the dwelling.

- HOW:**
- These tests are conducted after drywall is mudded and exterior doors are installed, while leaks can still be sealed.



5

VOLUNTARY: Increase insulation and reduce heat loss on one- and two-story walls with normal loads by using 2x6 @24" on center framing module for exterior walls.

CSI
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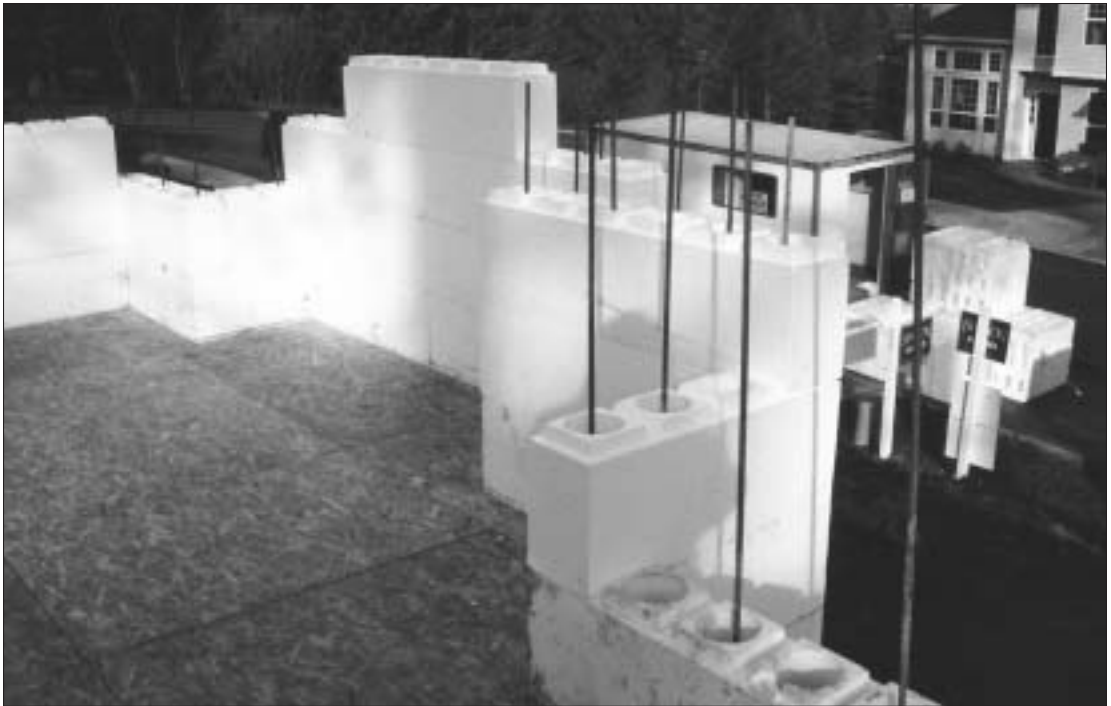
- WHY:**
- 2x6 wood studs have a 5.5 R-value, compared to insulation's R-21 value.
 - Framing studs at 24" OC instead of 16" OC reduces thermal bridging by almost one-third.
 - Use of 24" OC framing can save significant material and labor costs over 16" OC framing.
-
- HOW:**
- CABO I- and 2-Family Dwelling Code has tables showing 24" framing modules are acceptable on normally loaded one and two-story walls (no snow or wind loads).
 - Half-inch drywall is rated by manufacturers to span 24" or drywall can be upgraded to 5/8".
 - Exterior siding rated for 24" spans include APA 303 sheet sidings, Hardiplank cementitious siding, and thicker vinyl sidings (about 0.044 to 0.048 inch thick).
 - If batt insulation is planned, be sure to tell insulation contractor that walls are 24" on-center so that correct size can be ordered.
 - **SEE ALSO** Conserving Materials & Resources and Appendix A [Advanced Framing]. >>>

6

VOLUNTARY: Specify and install exterior insulated core doors.

CSI
08

- CODE:**
- Oregon energy code requires main entry doors with max. U-Value = 0.54 and other exterior doors with U-Value = 0.20.
-
- WHY:**
- Insulated entry doors are important to comfort when entrances face cold east winds.
 - A solid wood door about 2 inches thick has a U-Value = 0.54, equivalent to R-1.8. An insulated core door is about R-5—a 63% reduction in heat loss.
-
- HOW:**
- Specify exterior doors with insulated cores and complete weatherstripping, including the threshold. Note that some door insulation is polyisocyanate foam, which is made with ozone-depleting HCFCs. Metal and fiberglass-clad doors may require less maintenance than solid wood.
 - Installation is standard. Refer to the schematic site plan for identification of exterior doors requiring extra attention due to wind and other climatic conditions.



Insulated concrete forms eliminate the need for formwork and extra insulation.

7

VOLUNTARY: Specify and install insulated concrete forms.

CSI
03
07

- WHY:**
- Insulated concrete form (ICF) systems are available with insulation values from R-17 to R-26. They offer excellent energy efficiency, air sealing, noise control, and structural strength. ICFs are suitable for use in below-grade walls because they eliminate the need for furring out concrete walls for insulation. An ICF system eliminates most of the wood in standard framing.
 - The primary drawback to this system for above-ground exterior walls is that they may be difficult to modify if the units were enlarged or added onto. Also, the production of concrete is energy intensive.
- HOW:**
- An ICF system consists of hollow foam insulation blocks or panels that are filled with reinforcing steel and concrete. A typical ICF block is 10" in width. Blocks and rebar are laid in courses and filled from concrete pumpers. Walls can go up quickly.
 - The ICF system called Rastra combines cement with foam plastic for enhanced insect and fire resistance and bulk water control.



8

VOLUNTARY: Insulate perimeter edge of concrete slab floor with code approved foam board. Insulate between heated space and garage slab.

CSI
03
07

and

9

VOLUNTARY: Thermally separate living areas from less energy consuming zones like entry, storage, mechanical, and utility areas.

- CODE:** ● Oregon energy code requires R-15 insulation of concrete slab floors and between heated and unheated interior spaces.
- WHY:** ● Concrete slabs lose heat at their edges, where the air and soil are coldest. A floor slab should be insulated between heated and unheated areas (e.g. garages).
● Some spaces, such as utility rooms, might be thermally isolated from conditioned living space, reducing the volume of conditioned space in the unit.
- HOW:** ● R-15 edge insulation is 3” thick. For a floating slab inside a foundation wall, a pressure-treated lumber strip can be ripped to fit over the top of the insulation, flush with the top of the slab. On a monolithic slab, the edge insulation can be taper-cut and fitted with flashing.
● Exposed insulation can be coated with stucco to protect from sunlight and other damage.
● A slab floor with radiant heating should be fully insulated underneath the slab as well as at its perimeter.

HEATING SYSTEMS

10

THRESHOLD: Install radiant or hydronic heating with digital thermostat located in main living area. Systems may include: hydronic baseboard, radiant cove heaters, water heater / water boiler supplied room heaters (i.e. “Turbonics”).

Size heat supply based on weatherization measures (natural fuel gas preferred).

CSI
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and

11

VOLUNTARY: Preferred Alternate: Install high efficiency gas sealed combustion forced air furnaces (minimum 92% Efficiency Rating) with digital thermostat in main living area. Systems may include gas furnace, gas furnace with integrated water heater. Size heat supply based on weatherization measures.

- WHY:** ● Lowest first cost often dictates installation of fan-forced electric resistance heating. However, these systems may negatively impact energy efficiency and long-term maintenance issues. Better quality and more durable systems reduce operating and maintenance costs while improving resident safety.



- HOW:**
- Radiant cove heaters are installed up near the ceiling where they can “shine” heat into the room. Each heater has its own thermostat. The location eliminates conflicts with furniture, window coverings and curious children. Cove heaters are safer by operating at lower temperatures than baseboards or wall heaters. They also provide satisfactory comfort at lower air temperatures, which can reduce costs.
 - Today’s hydronic systems use water heaters, plastic water lines and wall units designed for easy installation. They operate at lower temperatures than standard resistance heaters. By using gas, long-term operating costs may be lower.
 - Sizing calculations are seldom done for residential heating, so that vendors may grossly oversize systems. There is a potential savings available by determining correct sizing based on the actual windows, insulation and air sealing in the envelope and using the ASHRAE 97.5% design temperature of 23°F. Even if a 50% margin of safety is added to the calculated size, the result will probably be more efficient than suggested by “rules of thumb.”
 - **SEE ALSO Appendix B [Heating Systems]. >>>**

- COST:**
- Cove heaters cost more than wall heaters or baseboards, while installation costs are similar. Hydronic systems cost significantly more in the Portland market at present because contractors are as yet unfamiliar with them.
 - Proper sizing and design can save money by matching system size to actual building and climate characteristics.
 - Digital thermostats can save money by giving occupants accurate feedback on temperature settings. Inexpensive thermostats may be off by as much as 10°F and typically allow wide temperature swings.

12

VOLUNTARY: Install ductwork inside conditioned space OR seal ductwork in crawls and attics with mastic. Design short runs. Use flex only for straight runs; otherwise use metal.

CSI
15

- WHY:**
- Field research in the Northwest shows that conventionally sealed ductwork installed in attics, crawl spaces or garages often loses 20 to 30% of conditioned air. Research also shows that duct tape does not effectively seal common duct leaks.
 - Locating ducts inside conditioned space not only eliminates heat loss, the ducts can be shorter. In today’s quality thermal envelope, supply registers can be placed on interior walls or ceilings instead of under windows, saving on duct runs.

- HOW:**
- Consider duct placement during design instead of leaving it up to the heating contractor to determine during construction. Provide chases for runs to and from upper floors.
 - Specify sealing with mastic to significantly reduce air leaks.
 - For highest quality, specify that ducts meet Oregon Office of Energy “Performance-Tested Ducts” standard.



ELECTRICAL & LIGHTING

13

THRESHOLD: Specify and install Energy Star-rated appliances, fixtures and lighting systems.

CSI
11 12
15 16

WHY: ● Energy Star products reduce energy and water consumption, and residents' utility bills.

HOW: ● The Energy Star label is familiar to suppliers and dealers. Currently, Energy Star residential products include refrigerators, dishwashers, clothes washers, thermostats, furnaces, heat pumps, windows, compact fluorescent lighting, outdoor lighting and interior fixtures of all kinds.

● The Oregon Office of Energy publishes an updated list of even more efficient appliances on its website.

● Some of the more efficient washer/dryer units are available in coin-operated models.

COST: ● Many Energy Star products don't cost more than less efficient products.

● The Oregon Office of Energy offers tax credits for the purchase the energy efficient appliances listed on its website.

14

THRESHOLD: Specify and install efficient outdoor lighting (30 lumens per watt or better) with low temperature ballasts. Install lamps with automated controls, including but not limited to photo sensors, timers, and motion control sensors.

CSI
16

WHY: ● With thoughtful design and fixture selection, efficient lighting greatly improves a building's appearance. Outdoor light fixtures, including post- and wall-mounted fixtures, floodlighting, and ground-level walkway lighting, can provide safety and decoration.

● Fluorescent and high-intensity discharge bulbs have long life, high light output, and relatively small size. They can be used for most types of outdoor lighting including large-area floodlighting.

● Automated controls reduce energy consumption and are easier to operate.

HOW: ● Photo sensors may be the lowest-maintenance and most reliable choice of automated control. Timers need periodic resets. Solicit your electrical supplier or contractor's advice and specify an Energy Star system.

● Motion control sensors may be demanding on bulbs and tend to not be very durable in moist climates.

COST: ● Varies widely depending on design and lighting needs.



This Portland family saves about 50% of their energy costs for water heating.

RENEWABLES

15

VOLUNTARY: Install solar water heating system.

CSI
10 11
15 16

- WHY:**
- Water heating is the second largest portion of a residential energy bill after space heating.
 - Non-polluting solar power can be used to supply half or more of the hot water for a home, even in the Willamette Valley.
 - The Oregon Office of Energy (OOE) provides tax credits and instruction on solar water heating systems.
- HOW:**
- Prioritize hot water conservation by designing an efficient system, specifying low flow shower heads and faucet aerators, and installing Energy Star appliances.
 - Conduct site analysis. Vendors of solar systems can help evaluate the suitability of the project for a solar water system. The Oregon Office of Energy maintains a list of knowledgeable contractors. If a solar system displaces planned electric water heat, tax credits are available.
- COST:**
- OOE estimates a system for a family of four in a single-family house costs between \$2000 to \$4000. OOE offers up to a 35% tax credit. Non-profits can obtain the value of this credit by partnering with a tax-liable entity who then passes these credits on to the non-profit. In addition, a solar water system could be funded with a 7.5% Small Scale Energy Loan (SELP) also offered by OOE.





These windmills do not disrupt salmon migration or pollute.

16 VOLUNTARY: Purchase green power.

CSI
15
16

WHY: ● Purchasing green power from your local utility promotes the development of non-polluting renewable energy sources.

HOW: ● Pacific Power has a wind power program known as *Blue Sky*. Your purchase under this program pays for the construction of new wind power plants in the Western United States.

● If your utility provider is Portland General Electric, you can participate in one of three renewable power programs—*Clean Wind Power*, *Salmon-Friendly Power*, and *Solar for Schools*. Your purchase under any of these programs does not go directly to the production of renewable energy, but it does contribute to PGE's overall commitment to purchasing from renewable energy sources.

COST: ● Green power can be purchased from PGE in \$5 blocks. Each \$5 block equals 100 kWh, enough to run a refrigerator for one month. Under the Pacific Power program, consumers can purchase blocks equaling 100 kWh for \$4.75.



RESOURCES & VENDORS

HIGH-RECYCLED CONTENT INSULATION MANUFACTURERS

Cellulose

US GreenFiber

Portland, Oregon

503-286-9987

95% post consumer recycled content.

Call for contractors using their products.

hmi

Twin Falls, Idaho

208-733-9689

info@hmi-mfg.com

www.hmi-mfg.com/index.html

Fiberglass

Mansville

Denver, Colorado

800-644-4013 - Sales

800-644-3103 - Product Information

Certified to contain at least 30% recycled content, including 18% post-consumer glass.

Owens-Corning

Denver, Colorado

800-644-4013 - Sales

800-644-3103 - Product Information

Certified to contain at least 30% recycled content, including 18% post-consumer glass.

INSULATION RECYCLING INFORMATION

Scientific Certification Systems

510-832-1415

510-832-0359 fax

www.scs1.com

Certifies the recycled content in insulation.

LOCAL CELLULOSE INSULATION CONTRACTORS

Total Energy Concepts

800-413-7003

totalencon@aol.com

Vancouver, Washington.

Installs "wet"-type cellulose for new construction.

Typically costs twice as much as batt insulation

because wet-type cellulose is more labor-intensive.

Offers discounts to non-profits.

Western Home Insulation

Portland, Oregon

503-233-7306

Insul-Tech

Vancouver, Washington

360-496-6658

Accurate Siding

Beaverton, Oregon

503-356-0560

MISC. SEALANTS – LOCAL SOURCES

John Latta Associates

1001 SE Division Street

Portland, Oregon 97202

503-238-1253, 800-444-8877

503-231-0162 fax

www.sealantspecialists.com

Stocks solvent-free waterproofing and other sealants.

EXPANDING FOAM SEALANTS – MANUFACTURERS

The following expanding foam sealants do not use any CFCs or HCFCs, which are ozone-depleting and unhealthy for contractors.

Touch'n Seal line (contractor)

Touch'n Foam line (consumer)

Convenience Products

800-325-6180

636-349-5335 fax

www.convenienceproducts.com

First ozone-safe product in the U.S. Formaldehyde-free, Touch n'Foam is solvent-free.





InstaSeal EcoBlend (contractor)
Foam Plus; Great Stuff (consumer)

Instafoam, Div. of
 Flexible Products Co.
 800-800-3626
 www.itsgreatstuff.com

*InstaSeal: low- and full-expanding; Foam Plus:
 full-expanding; Great Stuff: low-expanding.*

CF-128

Hilti, Inc.
 800-879-8000
 918-254-1679 fax
 www.us.hilti.com

*Sells directly to end-users; does not distribute
 through conventional channels.*

Purfil IG 600

Todol Products
 508-651-3818
 508-651-0729 fax
 www.todol.com

BLOWER DOOR TESTS

These contractors are certified by the Oregon Office of Energy. Call 800-221-8035, or visit www.energy.state.or.us for more updates to this list.

When inquiring about a blower door and/or duct blaster test, describe what issues you wish to focus on solving: indoor air quality; energy efficiency; duct leaks; or backdrafts.

Discounts are often available for multifamily housing. Utilities may also offer rebates. Testing services are often cheaper if using the same company for insulation or mechanical services.

Alpha Energy Savers

Clackamas, Oregon
 503-239-6520

HVAC By Terry

Hillsboro, Oregon
 503-649-3458

Blower door and duct blaster tests. Duct cleaning available.

Richart Family, Inc.

Vancouver, Washington
 360-574-5859

Universal Energy

Portland, Oregon
 Contact: Tom Brodbeck, 503-273-6279 page
universalenergy@msn.com

Blower door and duct blaster tests; zonal pressure testing.

OSU Extension Energy Program

310 SW Fourth Avenue Ste 412
 Portland OR 97204
 Contact: Ted Haskell, 503-227-0731 x 22

*Information about blower door and duct testing,
 moisture and air dynamics.*

EXTERIOR INSULATED CORE DOORS

Elite Alterna

Jeld-Wen, Inc
 Klamath Falls, Oregon
 800-535-3936
 541-882-3451
 541-884-2231 fax
 www.doors-windows.com

Elite Alterna is a wood-composite door for exterior applications. Insulated with EPS. 20% more expensive than a steel door, suitable for special entries where wood is appropriate but too expensive and inefficient.

INSULATED CONCRETE FORMS

American ConForm Industries

Contact: Keith Kolbu, 503-968-7208
info@smartblock.com

Insulating Concrete Form Association

847-657-9730
 847-657-9728 fax
icfa@forms.org
www.forms.org/contact/index.html
Industry trade group



RADIANT COVE HEATERS

Creative Business Solutions, Inc.

Contact: J.S. Waldron, 800-635-1211

503-717-0108 fax

www.radiantsystemsinc.com

WATER HEATER / WATER BOILER SUPPLIED FAN ASSISTED HEATERS AND HYDRONIC BASEBOARD (I.E. "TURBONICS")

NW Natural

Contact: Phil Damiano, 503-721-2471

p1d@nwnatural.com

Contact: John Hanton, 503-721-2467

800-422-2012 gen

503-273-4823 fax

Offers consultation on available products and publishes a Multifamily Resource Guide. Financing, rebates and possible grants are available to non-profit affordable housing developers.

Can suggest experienced mechanical contractors certified to install these systems.

Using Water Heaters for Radiant Heat

Article by Bill Clinton, Bay Hydronic

Journal of Light Construction

[www.jlconline.com/jlc/archive/energy/
water/water_heater_heat/index.html](http://www.jlconline.com/jlc/archive/energy/water/water_heater_heat/index.html)

Design and installation of hydronic heating using gas water heaters as source. Note that Oregon code restricts dual-purpose water heaters.

ENERGY STAR-RATED APPLIANCES

Energy Star

www.energystar.org

This website contains a store locator and more information on the Energy Star program. Energy Star is a voluntary partnership between the U.S. Department of Energy, the U.S. Environmental Protection Agency, product manufacturers, local utilities, and retailers. Energy Star labeling standards, however, do not always represent the most efficient products on the market.

Oregon Office of Energy

800-221-8035

www.energy.state.or.us

Offers tax credit program for appliances meeting higher standards than Energy Star. These appliances are listed on their website.

SOLAR WATER HEATING SYSTEMS AND INFORMATION

Oregon Office of Energy

Contact: Christopher Dymond,
technical information

Contact: Sylvia DeLa Rosa, tax credit program

800-221-8035

503-373-7806 fax

www.energy.state.or.us

Offers further information and tax credits for solar water heating.

Solar Energy Assoc. of Oregon

503-231-5662

solaror@teleport.com

<http://solaror.org>

Local advocates of solar power and a great resource for systems.

Sun, Wind and Fire

503-245-2661

800-397-9651

503-245-0414 fax

Portland, Oregon

Packages and sells solar water-heating systems.

SOLAR WATER HEATING CONTRACTORS

Certified by Oregon Office of Energy to streamline the tax credit certification process.

Mr. Sun Solar Enterprises

503-222-2468

Solar Energy Solutions

503-238-4502

Ecosystems

503-382-9002

**Sunbow Solar**

503-640-6165

GREEN POWER**Portland General Electric**

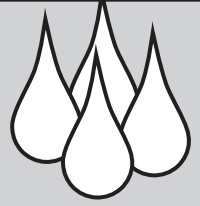
800-542-8818 x 5145

www.portlandgeneral.com

Pacific Power

800-842-8458

www.pacificcorp.com/bluesky.html



Water Conservation

It rains all the time in the Pacific Northwest, so conserving water really isn't important here—right? Wrong. While Portland does receive about 35 inches of rain annually the area periodically experiences water shortages.

Water conservation measures are among the most cost-effective strategies to reduce utility bills. The typical combined water/sewer residential utility bill in Portland often exceeds energy costs. It is therefore important to reduce water use, whether it's used for irrigating a lawn or taking a shower. In addition, reducing hot water use also saves energy.



PLUMBING

1

Threshold: Install water conserving plumbing fixtures: 2.0 gpm showerheads & 1.5 gpm faucet aerators.

**CSI
15**

- WHY:**
- Showers and faucets account for approximately 25% of indoor water use.
 - Water-conserving fixtures can reduce the amount of water used in showers by 75% and sinks by 50% compared to pre-1992 fixtures.
- HOW:**
- Specify 2.0 gpm (gallons per minute) showerhead with on/off toggle for all showers.
 - Specify 1.5 gpm faucet aerators in all sinks.
 - Note: Check packaging—"low flow" can refer to a shower fixture up to 3.5 gpm.
- COST:**
- There is no significant increase in costs for 2.0 gpm showerheads. 1.5 gpm faucet aerators cost less than \$4 each. These measures may save more than \$100 per year in combined water and energy costs.
 - Note: a durable and effective water-conserving toilet typically costs over \$90-130. Less expensive models may be less durable and result in high maintenance costs.

2

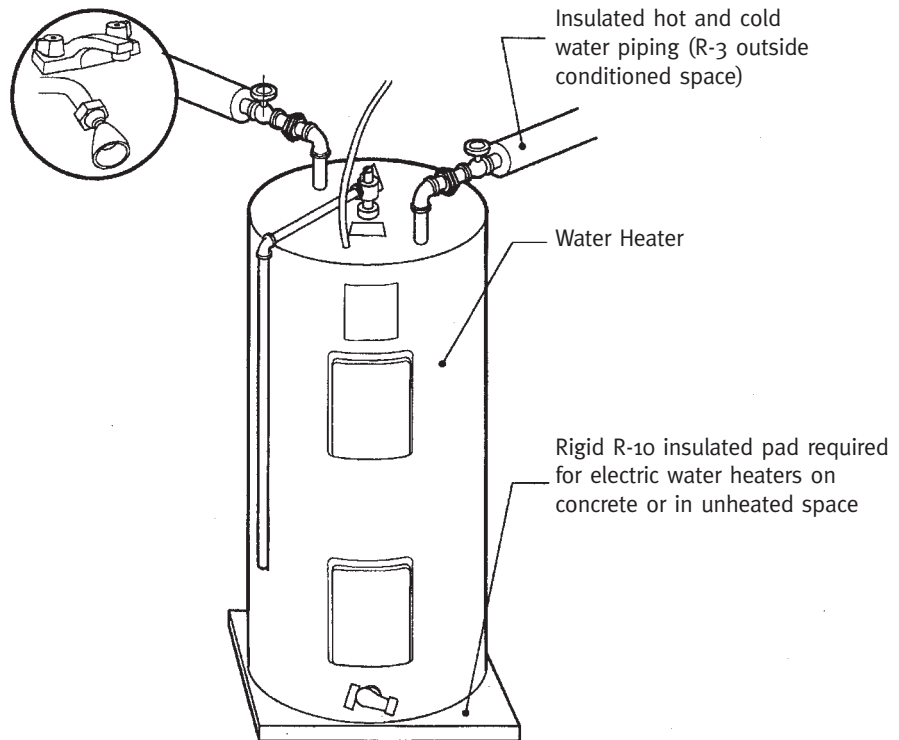
THRESHOLD: Install high energy factor water heater (.60 for gas, .93 for electric).

**CSI
15
16**

- WHY:**
- **SEE ALSO Energy Conservation. >>>**
- HOW:**
- See State of Oregon Energy Office for up-to-date listings of the most energy-efficient appliances. Standard installation.
- COST:**
- No increase in costs.



Water conserving shower and lavatory fixtures required



3 THRESHOLD: Insulate bottom of hot water tank. Set electric tank on foam board; set gas tank on raised platform. Insulate hot water pipes.

CSI
07

WHY: ● A water heater placed directly on an unheated or concrete floor loses heat through the bottom. Copper is a good conductor of heat—therefore, pipes lose heat quickly.

HOW: ● Use Blueboard™ or similar product for electric tank. For gas water heater, set tank on a raised platform. Insulate both hot and cold water pipes, even if the plumber has installed anti-siphon loops.

● To save energy and reduce risk of scalding, water heater tank temperature can be reduced from factory setting of 140° F to 120° F.

COST: ● No significant increase in cost.



Hardy plants can tolerate hot dry summers in the city. These plants are also treating stormwater runoff.

IRRIGATION

4 **Threshold: Use only native, hardy plant materials for landscaping, except for edible landscaping, street trees, and lawn. Minimize total area of turf.**

**CSI
02**

- WHY:**
- Grass lawn is water intensive—needing about 35 inches of water per year to thrive, most of it during the summer. While lawn is appropriate for some landscaping, such as for play areas, it should be minimized wherever possible.
 - Reduce maintenance costs and water use by replacing underutilized turf with native and/or edible landscaping.
 - Native hardy plants have evolved in this climate, requiring less irrigation and fewer hazardous garden chemicals to thrive.

- HOW:**
- Design landscape plan with native hardy and edible plants.
 - Select plants that can adapt to summer heat created by buildings and pavement.
 - Involve landscape designer in architectural design process to identify appropriate areas for landscaping. Consider combining the landscape plan with stormwater facilities.
 - A well designed system will provide stormwater filtration and aesthetic benefits.
 - **See Also (Enhanced) Design & Site #5. >>>**

- COST:**
- This measure can save money by reducing maintenance and irrigation costs. Native plants do not cost more than conventional ornamental planting materials.



5

VOLUNTARY: Install high-efficiency drip irrigation system.

CSI
02
15

- WHY:**
- Sprinkler-based irrigation wastes water through evaporation and inefficient distribution. Drip irrigation can cut water use by half or more. Lawn requires different amount and frequency of water than shrubs and flower beds; drip irrigation allows separate irrigation.
- HOW:**
- Drip irrigation lines are easy to install. The system should include a clock timer, filter to prevent clogging and pressure regulator to reduce incoming City water line pressure. To prevent vandalism or accidental damage, lines can be buried 6" below ground. Installers can advise regarding spacing and size of emitters as well as watering schedules.
 - Possible damage by shovels.
 - Less-expensive alternative is installation of above-ground soaker hoses.

6

VOLUNTARY: Install rainwater catchment system for non-potable water reuse.

CSI
02
15

- WHY:**
- Rainwater can be harvested for landscape irrigation and/or for flushing toilets, reducing water/sewer utility bills.
- HOW:**
- The City of Portland has new rainwater catchment guidelines for single-family and duplex units (irrigation and toilet flushing only). See code guide for details.
 - Note: procedures are relatively complex if the catchment system is tied into the potable water system, and much simpler (no code requirements) if used for irrigation only.
 - Consider space constraints for cistern(s).



RESOURCES & VENDORS

GENERAL INFORMATION ON WATER EFFICIENCY

City of Portland Water Bureau

www.water.ci.portland.or.us/

Information: 503-823-7404

WaterWiser – The Water Efficiency Clearinghouse

www.waterwiser.org/

WATER CONSERVATION WORKSHOPS & TECHNICAL ASSISTANCE

For Residents

Community Energy Project

503-284-6827

City of Portland Water Bureau

503-823-7404

www.water.ci.portland.or.us

For Developers & Property Managers

City of Portland Water Bureau

Contact: Don Holmes, 503-823-4724

ENERGY-EFFICIENT APPLIANCES

State of Oregon Energy Office

www.energy.state.or.us/res/reshome.htm

Offers information and tax credits for residential use of energy- and water-efficient appliances.

NATURESCAPING WORKSHOPS

Naturescaping features native plants, natural landscapes, and water-friendly gardening practices. It reduces water usage, can eliminate use of harmful chemicals, attracts beneficial/interesting wildlife, and requires little maintenance, providing direct benefits to you, your tenants, and the environment.

Naturescaping Workshops

Naturescaping for Clean Rivers

East Multnomah Soil & Water

Conservation District

Contact: Linda Robinson, 503-797-1842

naturescaping@yahoo.com

<http://community.oregonlive.com/cc/naturescaping>

NON-WORKSHOP EDUCATIONAL TECHNIQUES/DEMONSTRATIONS

Berry Botanic Garden

11505 SW Summerville Avenue

Portland, OR 97219-8309

503-636-4112

www.berrybot.org

The Berry Botanic Garden, continuing the legacy of Rae Selling Berry, promotes Northwest native plants, maintains special plant collections, conserves native endangered plants, and offers related educational programs, including naturescaping classes.

Metro

Natural and native landscaping techniques

Contact: Glen Andreson, 503-797-1811

Recycling Hotline, 503-234-3000

www.multnomah.lib.or.us/metro/rem/garden/natgar.html

Natural Techniques Demonstration Garden

SE 57th and Cooper Street

Portland, Oregon

A project of Metro and Portland Public Schools Green Thumb Horticultural Center. Built on a standard-sized Portland lot (approximately 50 by 115 feet), the site includes a footprint of a typical house. The lot is landscaped with different gardening themes that residents can create in their own yards: a shade garden, native plants, drought-tolerant and slug-resistant plants, and a raised-bed vegetable garden.



NATIVE AND/OR EDIBLE PLANT NURSERIES

Alderview Natives

28315 SW Grahams Ferry RD.
Wilsonville, OR 97070
503-570-2894

Bosky Dell Natives

23311 SW Bosky Dell Lane
West Linn, OR 97068
boskydellnatives@aol.com
503-638-5945

Stocks over 200 varieties of seed and container-grown native plants. Wholesale discounts available to affordable housing developers and community-oriented projects.

Burnt Ridge Nursery & Orchards

432 Burnt Ridge Road
Onalaska, WA 98570
<http://landru.myhome.net/burntridge/>
burntridge@myhome.net
360-985-2873

Stocks native plants as well as low-maintenance edible plants that provide fruits or nuts. Certified organic farm.

Pro Time – Hobbs & Hopkins Seeds

1712 SE Ankeny Street
Portland, OR 97214
www.protimelawnseed.com
lawn@teleport.com
503-239-7518

Carries seeds of native grasses and non-native wildflower mixes. Native wildflower mixes are available occasionally.

Wallace W. Hansen

2158 Bower Court SE
Salem, OR 97301
www.nwplants.com
plants@nwplants.com
503-581-2638

Specializes in plants native to region west of the Cascade Mountains. Website includes technical information.

Quail Ridge Nursery

33689 S. Ball Road
Molalla, OR 97038
503-829-3105

RAINWATER HARVESTING

Rainwater harvesting provides a simple way to conserve water and prevent runoff by collecting water to be used for irrigation and toilet flushing.

Vendors

Northwest Drainage Masters

360-887-1149

Portland Rainwater Company

503-252-6598

Urban Rain Barrel

503-286-9866

Residential rainwater permits

Office of Planning and Development Review

1900 SW 9th Avenue
Portland, OR 97204
Contact: Lori Graham, 503-823-3448

Technical resources

Austin Sustainable Building Sourcebook

www.greenbuilder.com/Sourcebook/Rainwater.html

Experiments in Sustainable Urban Living

www.rdrop.com/users/krishna/

Texas Guide to Rainwater Harvesting

www.twdb.state.tx.us/assistance/conservation/Cons-image/Downloads/RainHarv.pdf

IRRIGATION GUIDES

Washington State University, “Saving Water: Lawns and Other Turf”

<http://cru.cahe.wsu.edu/CEPublications/ebo684/ebo684.html>



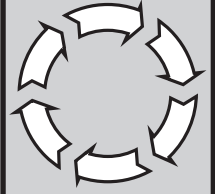
Jess Stryker's drip irrigation installation guideline

www.jessstryker.com/dripguide.htm

Drip irrigation design guidelines

www.dripirrigation.com/cgi-bin/SoftCart.exe/dripstor/prodpages/help/head.htm?L+dripstor+cjzz3710+982377504

www.digcorp.com/comm/tecoo6.htm



Conserving Materials & Resources

Conservation of natural resources is becoming increasingly important as materials become scarcer and more expensive while demand continues to grow. Today, an emerging and cost competitive “green marketplace” of locally available, durable, less toxic, and resource-efficient technologies and products is available.

This section provides an overview of durable products and best practices that minimize environmental and human health impacts. These include renewable, reused and recycled-content materials; advanced framing systems; engineered wood; and low-toxic outdoor wood options.



Deconstruction is an economical alternative to demolition.

WASTE MANAGEMENT AND RECYCLING

1 THRESHOLD: Develop a waste minimization plan, establishing targets for demolition and construction waste recycling by types of materials. (goal: 80% total waste reuse and recycling by weight).

CSI
01
02

- WHY:**
- Construction and demolition (C & D) waste accounts for 25% of the materials sent to local landfills. More than half of this waste comes from the demolition phase.
 - Executing a waste minimization plan and recycling C & D reduces landfill tipping fees.
 - The City of Portland requires all building projects over \$50,000 to recycle rubble, land clearing debris, corrugated cardboard, metals, drywall, and wood.

- HOW:**
- Develop a waste minimization plan. Require in the general and subcontractor's specifications.
 - Set up on-site storage for wood, drywall, metal, cardboard, rubble, and organic debris or contract with recycling provider to handle mixed waste.
 - Hire a deconstruction/salvage contractor for the demolition phase of the project rather than a regular demolition contractor. Since the majority of construction industry waste originates in this project phase, deconstruction is a key element in reaching the 80% total waste reuse and recycling goal.



- Create salvage and recycling staging and sorting area.

- COST:**
- Little or no cost premium. Waste mitigation activities and deconstruction are offset by the reduction in tipping fees.
 - Donations of salvaged materials from deconstruction to a non-profit, such as The ReBuilding Center, is tax deductible.

2

VOLUNTARY: Reduce non-recyclable/non-reusable packaging during construction.

**CSI
01**

- WHY:**
- Packaging adds significantly to the amount of waste generated on-site. Much of it cannot be recycled.

- HOW:**
- Talk to suppliers about using materials with reduced packaging and a take-back policy.
 - Recycle pallets, cardboard, foam packing, and shrink wrap.

FOUNDATION

3

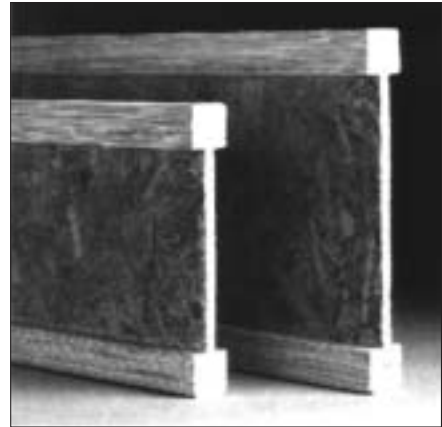
VOLUNTARY: Specify concrete mix with 25-50% fly ash substitution for Portland cement. Specify recycled aggregate base.

**CSI
03**

- WHY:**
- The production of cement is highly energy- and resource-intensive. A typical single-family house foundation produces 25,000 pounds of carbon dioxide (CO₂), a greenhouse gas that contributes to climate change.
 - Substituting fly ash for a percentage of cement strengthens and improves the workability of concrete, reduces CO₂ emissions, and reuses a waste product from coal power plants.

- HOW:**
- Specify a concrete mix with 25-50% fly ash content.
 - Fly ash concrete takes longer to cure to full strength. Using fly ash slows a fast-track pouring and setting schedule. Low-rise construction scheduling should not be affected. A 25% fly ash mix reaches 50% strength in 5 days, 75% strength in 10 to 12 days.

- COST:**
- Fly ash is less expensive than cement.



Engineered structural lumber, such as joists, typically use 50% less wood than solid sawn lumber.

Structural insulated building panels save wood and time.

FRAMING

4 Threshold: Specify engineered structural lumber.

CSI
06

- WHY:**
- Engineered wood utilizes more of the tree and incorporates under-sized or under-valued species that might otherwise go to waste.
 - Engineered joists are lighter weight and more dimensionally stable than traditional joists.
 - Structural insulated building panels (SIPs)—custom-cut wall and roof systems of rigid insulation sandwiched between exterior layers of wood composite board—have excellent air sealing and insulation properties, use less wood, and save installation time. (Note, SIPs cannot be reused or recycled).



HOW: ● Specify the use of engineered floor, roof, and rim joists. Investigate the viability of SIPs.

COST: ● On a per-linear foot basis, engineered joists cost 40% more than solid sawn lumber. Price premiums are offset through reduced labor costs, increased spacing of components, and fewer problems with material flaws.

5 **THRESHOLD:** In wood framing, employ 24” advanced framing modules and box headers.

**CSI
06**

WHY: ● Advanced framing uses 20-30% less wood and reduces labor costs compared to traditional framing practices. 24” o.c. framing; box headers; and three-stud corners provide space for better insulation and increased energy efficiency.

HOW: ● In design and construction documents, specify 24” advanced framing modules and other advanced framing techniques.

● Inform insulation and drywall contractors if 24” o.c. framing is used.

● **SEE ALSO Appendix A [Advanced Framing]. >>>**

COST: ● Advanced framing saves at least 10% on typical framing costs and up to 28% on material costs.



Conventional timber harvest practices fragment landscapes, cause erosion, and accelerate habitat loss.

6

VOLUNTARY: Specify salvaged, recycled, and/or certified sustainably harvested wood products. Do not specify old growth lumber, other than “recovered” or “salvaged” materials.

CSI
06

WHY:

- Less than 10% of the United States’ old growth forest remains.
- Second-growth uncertified lumber material comes from land replanted with a single tree crop, and treated with herbicides and pesticides—it is more a tree “farm” than a forest.
- Salvaged, recovered, and recycled materials are a less expensive and environmentally responsible alternative to virgin materials.
- Sustainably harvested lumber refers to timber that has been certified by an independent, third-party organization such as Rainforest Alliance or Scientific Certification Systems.
- Currently, Forest Stewardship Council (FSC) standards are considered the world’s most stringent. FSC has two types of certification audits—forest management and chain-of-custody. A forest management audit involves reviews of management plans and on-the-ground management practices to assure standards are being met or exceeded. A chain-of-custody audit involves reviewing procedures for tracking certified wood from the forest to the end-use consumer. Annual reviews are conducted to ensure that standards are continually met or exceeded.



- HOW:**
- Specify FSC certified lumber products, including framing material and sheet goods. Note: in Portland, FSC-certified Douglas fir is in short supply. FSC-certified Hemlock fir is more plentiful and less expensive. Order framing material at the beginning of design/engineering process — at least three months in advance of delivery date.
 - Specify recycled content lumber and finish materials.
 - Specify salvaged lumber for interior uses. The ReBuilding Center has quantities sufficient for small projects.
 - Regrade salvaged material for structural use. Contact a lumber grader to learn more about regrading services.

- COST:**
- FSC-certified materials carry a 5-10% price premium.
 - When combined with advanced framing, certified wood products become more cost effective.
 - Salvage lumber can be had for less than half the price of new wood. It must be professionally re-graded for structural use. A lumber grader can grade enough material for a 5000 sq. ft structure per day. Grading costs range from \$300 per half day to \$500 per full day.

7	VOLUNTARY: Specify regionally manufactured building materials (within 500 miles).	CSI 01
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- WHY:**
- Purchasing regionally manufactured materials and products supports the local economy and reduces transportation costs and impacts. (eg. pollution, road maintenance and oil drilling).

- HOW:**
- Develop construction specifications for regionally manufactured building materials.
 - Ask your building material suppliers where products are manufactured. Create a database of regionally manufactured green building products by CSI division.
 - Most materials listed in this resource guide are manufactured in the Pacific Northwest.



ROOF AND SKIN

8

THRESHOLD: Specify durable and recycled content roofing and siding materials with a 25- to 50-year lifetime warranty.

CSI
07

- WHY:**
- Exterior cladding and roofing materials with longer warranties offer better protection from the elements, improving building envelope performance and reducing maintenance costs over the lifetime of the building.
- HOW:**
- Specify roof and siding materials with 25- and 30-year warranty.
 - Specify and install 30-lb. building paper for roof underlayment.
 - Install siding air infiltration barriers such as Tyvek™ or Typar™ per manufacturer's specifications. Follow installation instructions carefully to minimize infiltration rates.
 - Consider specifying Algae Block™, a product that mixes copper granules in composition roofing to protect against algae growth.
 - Establish guidelines within the operations and maintenance manual for annual or biannual cleaning of the roof. Specify that no bleach or other harmful cleaning solutions are used. Such solutions poison adjacent soils and plants.
 - Consider specifying cementitious siding such as Hardiplank. When properly installed, cementitious siding can last three times longer than wood siding and takes paint well.
- NOTE:**
- Cementitious siding requires additional installation time. Algae Block™ effectiveness is greatly reduced after 10 years.
- COST:**
- There is a slight cost premium for 25- to 30-year roof and siding products over products with a 15- to 20-year warranty.
 - Algae Block™ is mostly available in architectural shingles. A few manufacturers make this product in three-tab shingles (20% cost premium).

MATERIALS AND FINISHES

9

THRESHOLD: When dropped ceilings are specified, install recycled content ceiling panels.

CSI
09

- WHY:**
- Ceiling panels make up a large part of the waste stream of commercial tenant improvement projects.
 - Recycled content ceiling tiles are becoming industry standard, making them easy to specify and install.



- HOW:**
- Specify ceiling tiles with post-consumer recycled content.
 - For rehab projects, remove and recycle old ceiling tiles. Armstrong will pick up ceiling tiles from a job site if properly bundled on palettes. Call Armstrong for details.
-
- COST:**
- No cost premium.



Straw, an agricultural waste product, can be made into construction materials.

10

VOLUNTARY: Install formaldehyde-free or low-formaldehyde underlayment, cabinets, and storage units. Replace particleboard with plywood, MDF, or strawboard.

CSI
09 10
12

- WHY:**
- Particleboard is made with large quantities of urea formaldehyde binder, which off-gasses and creates a highly toxic volatile organic compound (VOC).
 - Particleboard is less durable than plywood or MDF.
-
- HOW:**
- Specify plywood or MDF (e.g., Medite II or Medex).
 - When particleboard must be used, thoroughly seal all surfaces and edges with a water-resistant finish to reduce VOC offgassing.
 - Consider strawboard products, such as WheatBoard™, made from agricultural waste. Strawboard can be veneered or naturally finished.



11

VOLUNTARY: Specify sustainably certified wood for finish woodwork.

CSI
12

- WHY:**
- Slow-growing hardwoods have been overharvested.
 - Sustainably forested lumber is certified as sustainably managed by an independent, third-party certification organization. Currently, Forest Stewardship Council (FSC) standards are considered the most rigorous certification standards.
- HOW:**
- Specify certified sustainably harvested finish wood materials. There are many certified solid and veneered products available locally.
 - **SEE ALSO Conserving Materials & Resources criteria #6. >>>**



Patio built with “plastic” lumber and ACQ-treated wood.

12

VOLUNTARY: Specify low-toxic, decay-resistant, outdoor building materials. When possible, consider patio treatment instead of decking.

CSI
02 03
04 06
09

- WHY:**
- CCA pressure treated lumber (the most commonly used wood treatment) contains arsenic and chromium — two highly toxic compounds that leach into surrounding soils. CCA is hazardous to manufacture, handle and cannot be recycled. CCA is most toxic up to three weeks after treatment, when solution remains on the surface of wood.



- Effective alternatives include ACQ (Ammonium Copper Quaternary) treated wood and plastic lumber.

- HOW:**
- Specify the use of ACQ-treated wood where pressure-treated wood cannot be avoided (mud sills, deck framing, etc.). ACQ is effective in aboveground and ground-contact applications and less toxic than CCA.
 - CCA (pressure-treated) lumber leaches toxins 6-24 inches into surrounding soil. Do not use for raised beds.
 - Specify plastic lumber for applications where humans will come in contact with the wood and where food will be eaten and grown (decking, picnic tables, benches, handrails, play equipment, raised garden beds). Plastic lumber contains post-consumer recycled polyethylene. A variety of products are available, including some that contain wood or fiberglass to improve their structural capabilities.

- COST:**
- ACQ-treated lumber has a \$75-\$100 per 1000 b.f. premium over CCA pressure treated lumber.

13

VOLUNTARY: Specify recycled-content drywall. Install hard surface drywall in high-wear areas.

**CSI
09**

- WHY:**
- Recycled-content drywall contains “synthetic” gypsum, a waste byproduct of flue gas scrubbers, and reduces the demand for virgin gypsum mined from the ocean floor.
 - Use of hard-surface drywall in heavily trafficed common areas can reduce maintenance costs. Note: hard-surface drywall is not as easily recyclable as regular drywall.

- HOW:**
- Specify drywall with “synthetic” or recycled gypsum.
 - Note: all gypsum manufacturers use recycled facing paper on drywall. Not all suppliers carry recycled-content drywall. Ask for recycled gypsum content or “synthetic” gypsum rather than “natural” gypsum.

- COST:**
- Recycled content drywall is readily available and cost-competitive with non-recycled content products.
 - Hard surface drywall has a slight cost premium. However, it reduces long term maintenance costs in high-wear areas like common hallways and utility rooms.



FLOORING

14

THRESHOLD: Specify natural linoleum, tile, or vinyl alternative in kitchen and bathrooms. If vinyl is necessary, specify vinyl composition tile.

**CSI
09**

WHY:

- Sheet vinyl is less durable and more toxic than other flooring options. It is made from PVC, a petroleum-based highly toxic substance contains phthalates (known endocrine disrupters). It impacts indoor air quality, off-gassing VOCs long after installation is complete.
- Natural linoleum and tile are made from natural and abundant materials and are extremely durable.

HOW:

- Specify natural linoleum or tile. Installation requires more labor than sheet vinyl. Linoleum requires an annual application of a sealant. Verify that the moisture content of the substrate (underfloor) meets the linoleum manufacturer's requirements.
- If vinyl is used, specify vinyl composition tile (VCT). It contains fewer VOCs and phthalates than sheet vinyl. Damaged tiles can be replaced individually. "Hot waxing" reduces permeability.

COST:

- Slight premium: natural linoleum costs about \$16-22 sq. yd. Quality sheet vinyl costs about \$16-17 sq. yd. Small rooms can utilize "scraps" or roll ends of linoleum that cost about \$7 sq. yd. Tiles prices begin at \$2 sq. ft. The durability of linoleum and tile make them cost effective over time.



Nylon and PET carpet are less likely to emit harmful vapors.

15 **THRESHOLD: Specify solid floor finishes and/or nylon or PET carpeting with fiber or waffle pad.**

**CSI
09**

- WHY:**
- Carpets are “dirt sinks” - collecting dust, insects, and contaminants that are hard to remove. They are breeding grounds for molds and dust mites. When subject to moisture, carpets grow molds that generate harmful VOCs.
 - Most common types of carpet pad (such as ReBond) generate more VOCs and harbor more mold growth than fiber or waffle pads.
 - The glues used to install carpets off-gas VOCs.
- HOW:**
- Specify a PET (polyethylene terphthalate) recycled-content or durable nylon carpet over a fiber or waffle pad. Consider integral cushion recycled-content carpet with a dry, peel-back adhesive that minimizes VOC off gassing. Avoid Olefin™ and other less durable brands.
 - In high traffic areas, specify solid wood floors, laminated wood floor products (e.g. Pergo), vinyl composition tile (VCT), or natural linoleum.
 - On concrete slab floors, consider staining and sealing concrete in lieu of installing additional flooring materials. When building living spaces on slab, consider radiant floor heat system for increased energy efficiency and tenant comfort.
 - Certified and salvage wood flooring is readily available, durable, and can be refinished repeatedly.
 - Use water-based stains and finishes to reduce off gassing.
 - Laminated wood flooring is a cost-effective wood-floor alternative. Its “floating floor” design allows for easy replacement of damaged tiles and disassembly. Note: While very durable, these systems cannot be refinished and are not recyclable.
- COST:**
- Costs vary depending on what flooring systems are used.
 - PET and nylon carpet are cost competitive with non-recycled content products. Fiber or waffle carpet pads cost about \$2/sq. yd. more than the least expensive pads.





RESOURCES & VENDORS

MATERIALS SELECTION

GreenSpec

BuildingGreen, Inc.
802-257-7300 general
800-861-0954 orders
www.buildinggreen.com/

From the publishers of Environmental Building News. A comprehensive guide of information on over 1200 green building products and materials. This two-part tool features the 300-plus-page GreenSpec Product Directory and more than 135 pages of manufacturers' product literature, organized in a large 3-ring binder. \$99, \$75 for subscribers to EBN.

BEES 2.0 Software

Balancing Environmental and Economic Performance of Building Materials
National Institute of Standards and Technology
www.bfrl.nist.gov/oa/software/bees.html

BEES provides environmental and economic life cycle analysis of 65 building materials. Available as a free download.

CONSTRUCTION PRACTICE INFORMATION

These sources feature information about job-site waste reduction, advanced framing (also known as Optimum Value Engineering,) and a wide range of technical information.

Building Science Corporation

www.buildingscience.com

Publishes Builders Field Guide. Website features bookstore and free articles on construction techniques as well as links to other building organizations.

Efficient Wood Use in Residential Construction, by Ann Edminster and Sami Yassa

Natural Resources Defense Council
Publications Department
40 West 20th Street
New York, NY 10011-4211

212-727-2700

www.nrdc.org/nrcdpro/fppubl.html

Paperback, 112 pages, \$15 + \$3 shipping per copy. An excellent reference, includes information about certified and salvaged wood and detailing for durability.

WASTE MANAGEMENT INFORMATION

Construction Site Recycling Guide 2000

Metro Regional Government
600 NE Grand Avenue
Portland, OR 97232
503-234-3000 Recycling hotline
www.metro-region.org/rem/rwp/constry.html

WasteSpec— Model Specifications for Construction Waste Reduction, Reuse and Recycling

Triangle J Council of Governments
P.O. Box 12276
Research Triangle Park, NC 27709
919-549-0551
CSI-format 16-division specification; also includes detailed instructions for estimating recycling quantities.

DECONSTRUCTION

Deconstruction Services

The ReBuilding Center

503-331-9875
Tax-deductible receipts available for donations of salvaged materials to the ReBuilding Center, a project of Our United Villages.

Soil exchange

Soil Trader web site

www.enviro.ci.portland.or.us/soiltrader/
Pollution Prevention Program
Bureau of Environmental Services
503-823-7623

Mixed construction debris sites

East County Recycling Center

12409 NE San Rafael St.
Portland, OR 97230
503-253-0867



Metro Central Station

6161 NW 61st Avenue
Portland, OR 97210
503-234-3000

Metro South Station

2001 Washington
Oregon City, OR 97045
503-234-3000

Wastech

8600 N. Albina Avenue
Portland, OR 97217
503-285-5261

Willamette Resources

10295 SW Ridder Rd.
Wilsonville, OR 97070
503-570-0626

CONCRETE – COAL FLY ASH

ISG Resources, Inc.

Mercer Island, Washington
800-426-5171
206-232-9501 fax
www.flyash.com
Contact: Skip Huffman

ISG produces/distributes coal fly ash to concrete contractors. ISG can recommend a concrete source in your area. If your contractor does not already use fly ash, then they may contact ISG for a supply and instructions.

ENGINEERED STRUCTURAL LUMBER PRODUCTS

Engineered joists

TJI floor and roof joists

Trus Joist MacMillan
800-562-0931
208-395-2443 fax
www.tjm.com

Structural Insulated Building Panels

A structural insulated building panel replaces conventionally framed exterior walls with a factory-

produced system of two layers of Oriented Strand Board sandwiching rigid foam insulation. Some have experimented with using these panels for roof systems. The advantages of this product include energy efficiency, less wood use, and rapid construction. The tradeoffs include higher initial costs, unsustainable wood sources, and little reusability after deconstruction.

Enercept / Shirey Contracting, Inc.

Issaquah, Washington
Donna Bade Shirey
425-427-1300
425-427-9325 fax
www.shireycontracting.com

Premier Building Systems

Fife, Washington
800-725-7086
fife@pbspanel.com
www.pbspanel.com

SUSTAINABLY HARVESTED LUMBER

Wood Certification Standards

Forest Stewardship Council (FSC)

1134 29th St. NW
Washington, DC 20007
202-467-8391
www.fcus.org

Certified Wood Information

Certified Forest Products Council

14780 SW Osprey Drive, #285
Lake Oswego, OR 97007-8424
888-737-3877
503-590-6600
503-590-6655 fax
info@certifiedwood.org
www.certifiedwood.org



FRAMING LUMBER AND SHEETGOODS

CollinsWood

1618 SW 1st Avenue #300
Portland, OR 97201
800-329-1219
503-417-7755
503-417-1441 fax

This was the first company in the U.S. to be fully certified by the Forest Stewardship Council as sustainable in 1993.

Endura Wood Products

Ed Mays
1303 SE Sixth Avenue
Portland, OR 97214
503-233-7090
503-233-7091 fax
endura@teleport.com
www.endurawood.com

Endura carries a large line of certified wood, including: softwood, hardwood, and exotic lumber; bamboo and salvaged flooring; wheatboard; particle-board; hardwood plywood; cabinetry; and counter-tops. Kitchen counters and cabinets are available through Environmental Building Supply, but contact Endura directly for other materials.

Environmental Building Supplies

1331 NW Kearney
Portland, OR 97209
503-222-3881
503-222-3756 fax
ebs@ecohaus.com

Local supplier of a full line of residential construction materials. Recycled and natural fiber carpet; certified and salvaged flooring; certified lumber; panel material; low- and no-VOC paints and finishes; recycled content tile; Marmoleum; and other materials available.

Parr Lumber

Tami Baker
503-614-3333
tamib@parr.com

CERTIFIED WOOD FLOORING AND OTHER WOOD FINISH MATERIALS

Healthy Forests, Healthy Communities Partnership

Sustainable Northwest
620 SW Main Street, Suite 112
Portland, Oregon 97205
503-221-6911
503.221.4495 fax
info@hfhcp.org
www.hfhcp.org

Columbia International Trading Co.

0547 SW Gaines Street
Portland, OR 97201
888-326-3577
503-279-8165
503-279-8793 fax
Salvage woods, especially Douglas fir

Endura Wood Products

503-233-7090
see listing above

Environmental Building Supply

503-222-3881
see listing above

SALVAGED AND RECYCLED LUMBER

ReBuilding Center

3625 North Mississippi Ave.
Portland, Oregon 97227
503-331-1877
503-331-1873 fax

A project of Our United Villages, the ReBuilding Center sells quality salvaged building materials, including lumber, at 50-90% less than new materials. Non-profits may apply for free materials in advance by submitting a written request, reviewed at the weekly staff meeting. Non-profit developers most often turn to the ReBuilding Center for plumbing fixtures, cabinets, framing lumber, Metro recycled paint, and doors. Many items (i.e. doors) can be used to a developer's advantage by individualizing repeated home plans. In order to use salvaged lumber for structural purposes, it must be regraded.



LUMBER GRADING SERVICES

Lay out all salvage and/or ungraded lumber for grader, who bill in half day increments. A half day will cost about \$300, and a full day \$500. If lumber is well laid out and labor help is on hand, a single grader could grade the lumber package for a 5000 sq. ft. structure in one day.

West Coast Lumber Inspection Bureau

Box 23145
Portland, Oregon 97281
503-639-0651
503-684-8928 fax
info@wclib.org

Western Wood Products Association

Yeon Building
522 SW Fifth avenue
Portland, Oregon 97204-2122
503-224-3930
503-224-3934 fax
info@wwpa.org

ROOFING AND SIDING

Algae Block System Roofing

CertainTeed Corporation

800-233-8990

Malarkey Roofing Company

800-545-1191

PABCO Roofing Products

800-426-9762

Cementitious Shingles

American Roofing Materials

4512 SW Kelly Avenue
Portland, OR 97201
877-276-7663
503-226-6982 fax
www.re-con.com

Cementitious Siding

James Hardie Building Products

www.jameshardie.com
Contact: Todd Johnson, 503-722-9690

RECYCLED CONTENT DROPPED CEILING PANELS

Armstrong Commercial Ceilings

www.armstrong.com
877-276-7876

distributed by:

Jasco Supply Company

2001 NW 19th
Portland, OR 97209-1892
800-935-2726
503-226-2100
503-226-2104 fax

and

Sepia Interior Supply, Inc.

2331 NW 23rd
Portland, OR 97210
503/222-7322
503/222-9814 fax
www.sepiasupply.com

FORMALDEHYDE-FREE COMPOSITES

Straw Paneling

Strawboard is an excellent alternative to particleboard. It utilizes straw, an agricultural waste product, to produce a strong, formaldehyde-free binder. It costs slightly more than particleboard, but is more durable and takes paint better. It can also be laminated.

Isobord Enterprises

Elie, Manitoba
Contact: Phil Carter, 503-242-7345
www.isobordenterprises.com

Hardwoods, Inc.

Vancouver, WA
360-695-6600



Medium Density Fiberboard (MDF)

Medex, Medite II, and Medite FR MDF SierraPine Ltd. (formerly Medite Corp.)

800-676-3339
www.sierrapine.com

*This product is manufactured in Springfield, Oregon
and contains no formaldehyde.*

distributed by:

Hardwood Industries

Tualatin, Oregon
Contact: Paul Zech, 503-692-6620

and

Lumber Products

Tualatin, Oregon
503-692-3322

OUTDOOR WOOD

Recycled fiberglass products

Fiber Core

1120 E. Stevens
PO Box 42
Sultan, WA 98294
360-793-0146
360-793-7955 fax
www.amourfiber.com

Recycled Plastic Lumber Products

Duck's Marine Supply

18699 NE Marine Drive
Portland, Oregon 97230
506-665-6348

*TriMax, a fiberglass reinforced composite that is
structurally rated*

Home Depot

Locations throughout metro area.

Parr Lumber

*Locations throughout metro area. Carries Trex™, a
wood and recycled polyethylene composite.*

ACQ Treated Lumber

JH Baxter

Eugene
541-689-3020

Conrad Forest Products

541-756-2595
Also carries 'Natural Select' wood treatment

Cudahy Lumber

Hillsboro
503-648-0831

Superior Wood Treating

253-863-4495
Distributed by

Manke Lumber

800-426-8488

and

Parr Lumber

and

Tualatin Valley Builders Supply

DRYWALL (GYPSUM BOARD)

Regular drywall – high recycled content

Georgia Pacific

360-904-0142
Made in Tacoma, Washington.
available through:

Knez Building Materials

814 SE Market Street
Portland, Oregon 97214
503-232-6603

Hard-surface drywall – high recycled content

Fyberrock

US Gypsum

Fiberboard

Louisiana-Pacific



FLOORING

Natural Linoleum

Environmental Building Supply

1331 NW Kearney
Portland, OR 97209
503-222-3881
503-222-3756 fax
ebs@ecohaus.com

see previous listing for more details.

Floor Factors

1320 NW 17th Avenue
Portland, Oregon 97209
503-222-9393

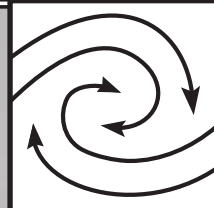
Recycled content PET carpeting

Environmental Building Supply

see listing above

Floor Factors

see listing above



Enhanced Indoor Air Quality

According to the American Lung Association, eighty-five percent of Americans do not realize that the air inside their homes may be hazardous to their health. Lower-income people in particular are often exposed to high levels of environmental pollutants. Poor indoor air quality can cause allergies, asthma, respiratory infections, and can contribute to cancer.

The three keys to healthier indoor air are:

- *Eliminating or reducing sources of pollution;*
- *Providing fresh air ventilation; and*
- *Filtering the air to remove fine particulates.*



FINISHES

1 **THRESHOLD:** Specify solvent free, no VOC (volatile organic compound) or low-VOC (below 50 g/liter) paints and primers. Specify water-based wood finishes.

CSI
07
09

WHY:

- Paints and primers off-gas VOCs that are health hazards to residents and workers.
- VOCs contribute to air pollution, especially ozone depletion.

HOW:

- Specify solvent-free or no-VOC paints and primers. Some paints are labeled “VOC-compliant” because of recent regulations that require lowered levels of VOCs. However, the VOC levels in many paints are still higher than what is healthy.
- Select paints and primers that contain less than 20 g/L (grams per liter) VOCs or have a “Green Seal” rating.

COST:

- No- or low-VOC paints typically cost 0-15% more than regular paints.

2 **THRESHOLD:** Specify low-toxic adhesives and sealants.

CSI
07
09

WHY:

- Adhesives and sealants may off-gas toxic chemicals long after installation.
- VOCs are hazardous to human health. About 50 VOCs, some of them common in construction materials, are known to cause cancer.

HOW:

- Select products labeled low-toxic, low-VOC, environmentally friendly, or worker-safe. Ask manufacturers for MSDS sheets and check for hazardous product contents.



Non-toxic adhesives and sealants are safer for workers and residents.

COST:

- No additional cost.



FRESH AIR VENTILATION

3 THRESHOLD: Install continuous exhaust ventilation OR central exhaust fan ducted to bath. Provide make-up air vents. Specify fans with delayed timer controls. Install medium-efficiency air filters in ducted forced air systems.

and

4 VOLUNTARY: Install kitchen range hood or ceiling exhaust fan to remove excess moisture and odors OR install multi-port attic fan to exhaust kitchen and bathroom.

CSI
15
16

- WHY:**
- Ventilation can reduce or eliminate mold, especially in bathrooms.
 - Ventilation can control odors, stuffiness, and excess moisture, if good fans and controls are selected and installed correctly.
 - Effective ventilation costs more up front but saves on on-going cleaning, repainting and repair.
 - Mechanical ventilation is a good partner with operable windows. In fair weather, windows can be open. In cold weather the mechanical system can provide fresh air without discomfort or a substantial energy penalty.
 - Medium-efficiency filters are inexpensive but effectively remove most common particulate pollutants like dust or pollen.

- HOW:**
- Option 1: Continuous ventilation
 - Always on
 - Constant low airflow
 - Not dependent on occupants to operate controls
 - Cost-competitive
 - Elements:
 - Multi-port fan installed in attic space, vented through roof
 - Pickups located in bath(s) and kitchen to remove moisture and odors quickly
 - Airflow sized to number of occupants or lifestyles
 - Fresh air intakes in windows or through outside walls
 - Option 2: Intermittent ventilation
 - Provides spot removal of pollutants
 - Least change from current practice
 - Can provide acceptable minimum ventilation
 - Elements:
 - Upgraded bath fan(s): 70-90 cfm, 1.5 sones or less
 - Upgraded control: timer switch to ensure adequate run time
 - Kitchen ceiling fan or range hood that exhausts outdoors
 - Kitchen ceiling fan: 90-110 cfm, 2.5 sones or less
 - Fresh air intakes in windows or through outside walls



- Medium efficiency filters: Rated 30% or better on “Dust Spot Efficiency” test
- Electrostatic or media filter types acceptable

COST: ● Higher quality fans cost more than conventional fans. A standard bath fan costs between \$20-\$25, while an upgraded fan costs between \$45-\$65. Fans, controls and fresh air vents may add about \$120-\$200 per unit.

5

THRESHOLD: Properly ventilate building prior to occupancy.

**CSI
01**

WHY: ● Interior air within a new building may be polluted with construction dust, odors and hazardous chemicals.

HOW: ● Protect materials stored on site from moisture to prevent molds from being carried into building.

- Thoroughly ventilate completed building for 72 hours prior to occupancy. Clean all surfaces of construction dust.
- Avoid “bake-outs” that may damage materials and/or drive VOCs into other surfaces.
- If space is available, unroll and air out carpet prior to installation.

COST: ● There is no additional cost associated with this measure.

6 **VOLUNTARY:** Use operable windows AND mechanical ventilation systems to assure ample fresh air for building occupants.

CSI
08
15

WHY:

- Fresh air is essential to residents' health and spirits. To accomplish this, buildings should have both operable windows and a mechanical ventilation system.

HOW:

- Install operable windows throughout units for cross ventilation and cooling.
- Install pinlocks or bolts for security while windows are open.



7 **VOLUNTARY:** Encourage a “no smoking” policy for building (during construction and occupancy).

CSI
01

WHY:

- Cigarette smoke contains chemicals and particulates that accumulate throughout the building and are nearly impossible to remove completely. These compounds create offensive odors and health hazards for all residents.
- Environmental tobacco smoke (ETS), also called “secondhand smoke,” is a major indoor air pollutant and contains about 200 known toxins, including formaldehyde and carbon monoxide, as well as 43 other carcinogens.
- According to the American Lung Association, ETS causes an estimated 3,000 lung cancer deaths and 35,000 to 50,000 heart disease deaths in non-smokers, as well as 150,000 to 300,000 cases of lower respiratory tract infections each year in children under 18 months of age.

HOW:

- Educate residents about the risks of indoor smoking and impacts on children.
- Provide covered exterior space for alternate smoking area.
- Maintain some “smoke-free” units for occupants with compromised health or special needs.



RESOURCES & VENDORS

INDOOR AIR QUALITY — GENERAL INFORMATION

American Lung Association

www.lungusa.org/air/

Many resources, articles, and checklists related to healthier indoor air and the dangers of indoor environmental pollution.

NO-VOC AND LOW-TOXICITY PAINTS AND FINISHES

Environmental Building Supplies

503-222-3881

Carries exclusively solvent-free, low-VOC and low-toxic paints (“Best” paint, Safecoat), stains and finishes made by manufacturers that specialize in indoor air quality and environmental concerns.

Miller Paint

503-233-4491

Several locations in the area. Manufactures a “low-biocide, low-fungicide paint.”

Rodda Paint

503-233-6016

Several locations in the area. Manufactures “Horizon,” a low-odor paint with more solids, less binders, and better coverage.

Sherwin-Williams

503-760-8233

Several locations in the area. Manufactures “Health-spec,” a low-odor, solvent-free paint.

Timber-Tek UV Wood Finishes

2232 E Burnside

503-232-1705

A line of natural stains, sealants and urethanes manufactured in Portland.

LOW-TOXICITY ADHESIVES AND SEALANTS

Misc. Sealants – Local Sources

John Latta Associates

1001 SE Division Street

Portland, Oregon 97202

503-238-1253

800-444-8877

503-231-0162 fax

www.sealantspecialists.com

Stocks solvent-free waterproofing and other sealant materials.

Adhesives and Sealants

American Lung Association

www.lungusa.org/air/

Many resources, articles, and checklists related to healthier indoor air and the dangers of indoor environmental pollution.

VENTILATION SYSTEMS AND COMPONENTS

NuTone

QT-80 to QT-100 lines

800-400-1245

www.nutone.com

Widely available through electrical distributors.

Panasonic

FV-05VQ to FV-11VQ lines

(253) 872-8750

www.panasonic.com/building

Available through A-Ball, Gensco and Platt Electric.



Operations & Maintenance

Experience demonstrates that some green design features may not work as intended if they are not used and maintained properly by those who live and work inside the building.

Educating residents and property managers about the building, and involving property managers at the beginning of the design process, has proved to be a wise investment.



O&M PLANNING

1

THRESHOLD: Develop maintenance and tenant operating manual with specific actions.

CSI
01

and

2

THRESHOLD: Develop O & M plan for scheduled maintenance of vents, filters, plumbing, and combustion equipment.

WHY:

- It is essential that the property maintenance team understand the importance of using healthier and environmentally safe products and materials. Property management should understand how each system (plumbing, heating, landscaping, etc.) works to maximize the effectiveness of these systems.
- Residents may also be unfamiliar with the particular systems and principles of green building and need to have the building systems thoroughly explained when moving in.

HOW:

- Establish an environmental mission statement to be agreed upon as early in the development process as possible by developers, designers, contractors, suppliers, and property managers. This statement can be used to inform decisions about what kind of products and materials to employ.
- Compile a collection of building system explanations from manufacturers' literature and the project architect. Thoroughly explain these systems both to property management and residents. For instance, if residents have zonal heating, operating manuals should explain that interior doors should remain shut between rooms with different heating needs.
- Create a residents' operating manual to clearly explain how building systems work and the principles behind them. Make the operating manual available in the residents' native languages.
- Provide an outline of the operating manual with project submittal.

COST:

- No additional cost to construction budget.



Make information available about the landscape.



A well placed and designed recycling system encourages recycling in a compact space.

O&M PRACTICES

3

THRESHOLD: Provide adequate space for comprehensive resident recycling.

CSI
01

- WHY:**
- By making recycling easy, it is less likely that recyclables will end up in the garbage. A well organized recycling system within the dwelling simplifies sorting of materials and takes up little space.
 - Required by code in Portland.
- HOW:**
- Provide a recycling system in each unit in addition to any exterior common recycling containers. Locate waste management systems close to and within sight of residences.
- COST:**
- If designed properly, there is no additional cost.



4

THRESHOLD: Eliminate pesticide and herbicide use on and around building.

**CSI
01**

- WHY:** ● Pesticides and herbicides may not break down before reaching the water table and are harmful to many plants and animal species. While occasional use of these products seems insignificant, the cumulative effect can be devastating.
- HOW:** ● Landscaping with native species should eliminate need for the use of pesticides, fertilizers, and herbicides. Organic gardening techniques can minimize weeding needs.
- COST:** ● No additional cost. Well designed landscapes that don't need pesticides and herbicides can reduce maintenance costs.

5

THRESHOLD: Use low-toxic or citrus-based cleaning supplies. Eliminate use of solvents.

**CSI
01**

- WHY:** ● Toxic cleaning supplies harm human health and cause environmental damage. These products cause indoor air pollution and injuries from inhalation, ingestion and skin contact. They are especially dangerous in households with small children and pets. In addition, when toxic cleaning supplies are flushed down drains, they end up in local waterways.
- HOW:** ● Ask your usual supplier of cleansers which products they carry that are low-toxic or citrus-based.
- Specify that the cleaning supplies used in the housing units be low-toxic or citrus-based. For lighter cleaning, benign household ingredients such as water, baking soda, vinegar, and Borax work well. For heavier jobs, cleansers such as Citrasolve and the LifeTime Solutions line are effective.
- Encourage residents to use these non-toxic cleaning solutions. The simplest cleaning solutions are more affordable to residents than less healthy competitors. Specialized heavy-duty cleaners could be provided through property management with rebates or a similar program.
- COST:** ● No additional costs.

6 THRESHOLD: Design properly ventilated separate storage area for cleaning supplies and paints.	CSI 01
WHY:	<ul style="list-style-type: none"> ● Cleaning and maintenance supplies, with the exception of the non-toxic alternatives discussed in this manual, off-gas many unhealthy substances, including volatile organic compounds.
HOW:	<ul style="list-style-type: none"> ● If integrating a maintenance storage area within the development, locate it away from air intakes and windows, properly ventilate, and thoroughly seal and isolate it from interior living spaces. ● Extra attention should be paid to these safety measures in rehab and smaller projects.
COST:	<ul style="list-style-type: none"> ● As this is already required by code, there are no additional costs.

7 THRESHOLD: Eliminate wet carpet cleaning (steam OK). Use HEPA filters on vacuum cleaners.	CSI 01
WHY:	<ul style="list-style-type: none"> ● Wet carpet cleaning saturates carpet with more moisture than can fully evaporate and traps it below the carpet's surface. This moisture encourages mold growth, resulting in unhealthy indoor air. ● HEPA or Filtreat vacuum filters can trap dust mites and other very fine pollutants when properly used.
HOW:	<ul style="list-style-type: none"> ● When third-party property management companies are employed, call attention to concerns about indoor air quality and do not accept wet carpet cleaning. ● Seek out a high-quality vacuum cleaner with multiple filtration systems that is designed to use HEPA filters. HEPA filters are only effective when used after material has already passed through several pre-filters, and filters must be replaced at least three times per year.
COST:	<ul style="list-style-type: none"> ● Quality HEPA or Filtreat vacuum cleaners cost at least \$400 retail, and their specialized filters cost between \$20-60 each. ● These vacuums and their parts are readily available at most vacuum cleaner retailers.



RESOURCES & VENDORS

RECYCLING INFORMATION

Metro Recycling Hotline

503-234-3000

Metro regional government

Metro has a variety of recycling resources, including literature with design schemes for efficient recycling areas.

ALTERNATIVES TO PESTICIDES AND HERBICIDES

See Enhanced Design and Site – Resources section for information and supplies for alternatives to pesticides and herbicides.

NON-TOXIC CLEANING SUPPLIES AND INFORMATION

Home Ecology

www.homeecology.org

Information on non-toxic cleaning supplies.

LifeTime Solutions

www.lifetime-solutions.com

Manufactures and markets non-toxic all-purpose cleaning solutions.

Hazardless Home Handbook

Metro Recycling Hotline

503-234-3000

Appendix

APPENDIX A: ADVANCED FRAMING

Advanced framing was derived from Optimum Value Engineering, a set of efficient framing practices developed and promoted by the National Association of Home Builders Research Center since 1974. Advanced framing techniques include:

- Designing and engineering structures for efficient use of lumber and wood materials;
- Framing one- and two-story walls at 24" OC rather than at 16";
- Aligning windows and other openings with framing layout;
- Use of box headers designed for loading conditions;
- Eliminating unnecessary studs, such as at corners and T-walls; and
- Eliminating redundant framing such as drywall backer studs and ceiling blocking by using drywall clips.

Advanced framing reduces the amount of framing material used in structures with no sacrifice in structural performance, while creating a more comfortable, durable and energy-efficient building.

DESIGNING AND ENGINEERING FOR MATERIALS EFFICIENCY

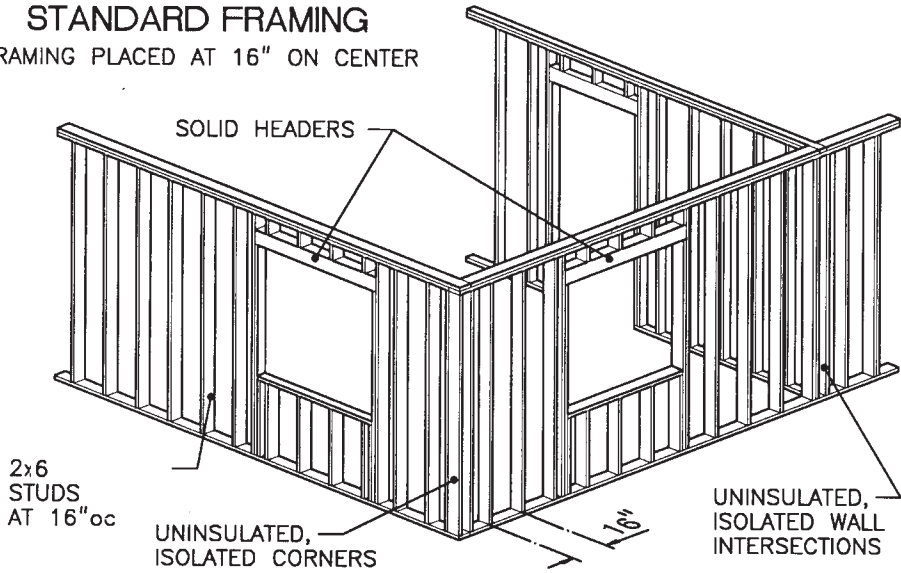
- Designs based on a 24" module will reduce waste from off-cuts. Aligning windows and other rough openings with framing layout can eliminate studs.
- A framing plan can save money on framing costs by clarifying the structure and decisions that otherwise the framing crew may have to make on the job. When in doubt, the job-site solution is usually to add lumber. For example, a plan can show whether headers on gable end walls are necessary, or the number of studs in a column.

FRAMING AT 24" ON CENTER RATHER THAN AT 16"

- 2x6 walls can be framed at 24" on center for the top two floors of construction with normal roof and floor loads. 24" framing reduces material, labor, and energy costs. It saves the most material on long straight wall runs.
- Standard half-inch drywall is span rated for 24". APA 303 rated sheet siding and thicker vinyl siding will span 24". Cementitious siding may span 24" with extra attention.

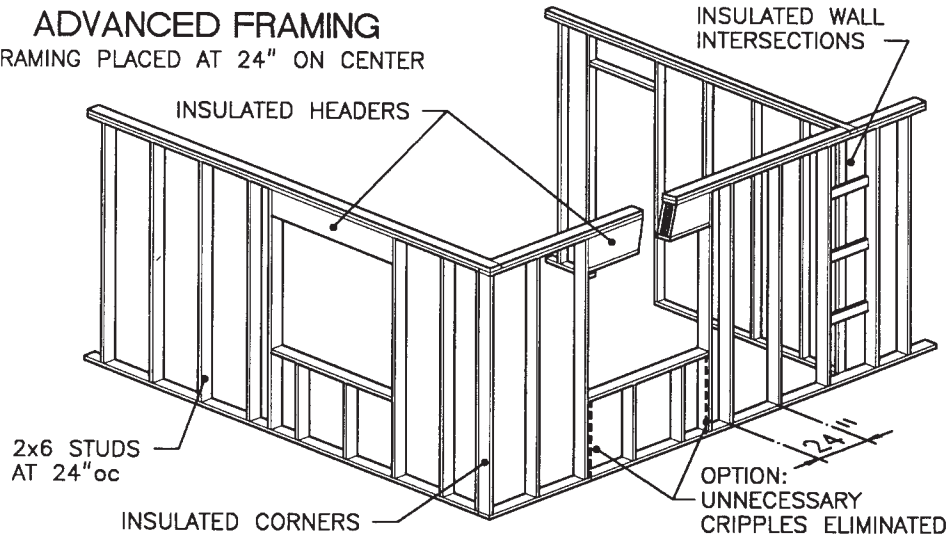
STANDARD FRAMING

FRAMING PLACED AT 16" ON CENTER



ADVANCED FRAMING

FRAMING PLACED AT 24" ON CENTER

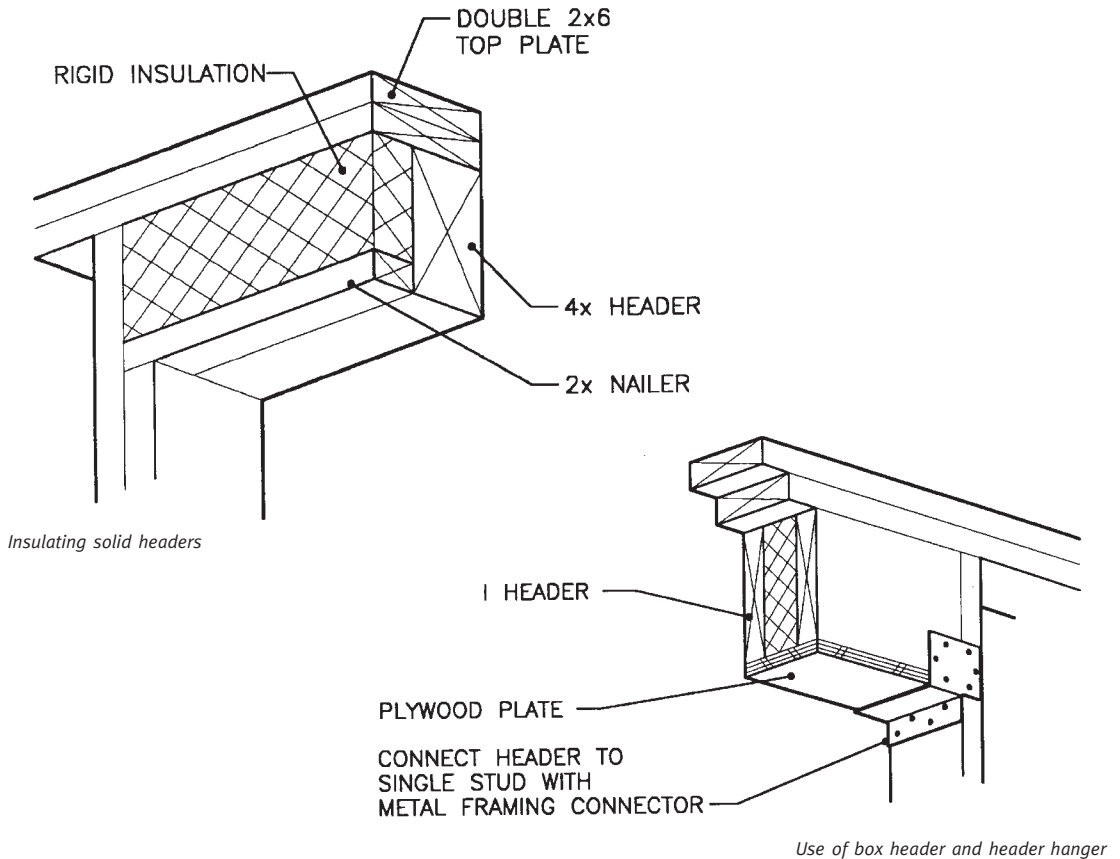


Advanced framing techniques result in labor, material, and energy savings.

- 19.2" or 24" joist spacing with thicker plywood subflooring is a possibility for further savings.

USE OF BOX HEADERS DESIGNED FOR LOADING CONDITIONS

- Headers from solid lumber may be oversized and waste material. Smaller dimensional lumber and plywood can be used to assemble box headers.
- Box headers in exterior walls result in energy savings as well as material savings by creating more space for insulation. Manufactured/engineered insulated headers are easy to cut and very well insulated.
- Headers in non-load bearing walls should be reviewed to determine if they are needed.

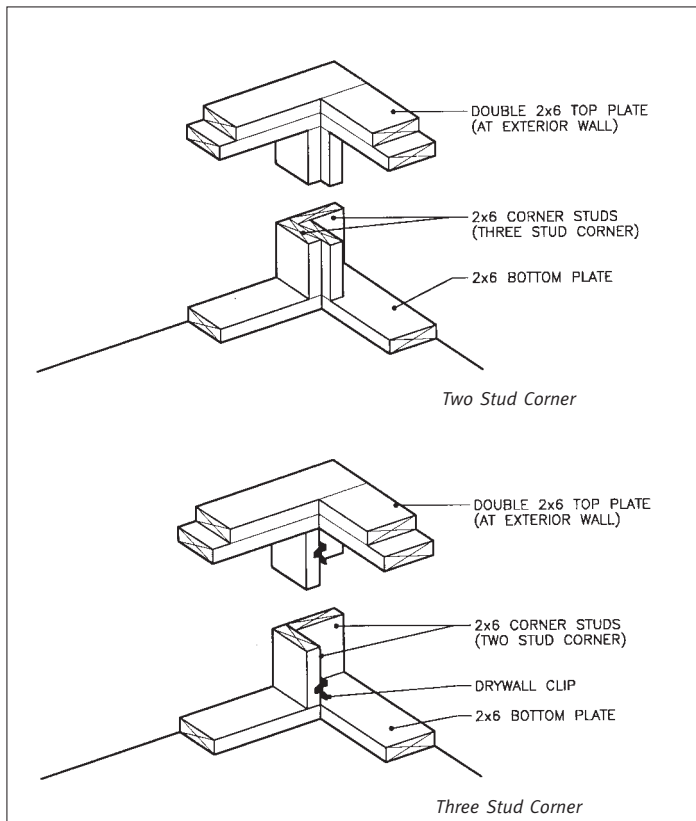


ELIMINATING UNNECESSARY FRAMING AT INTERSECTIONS

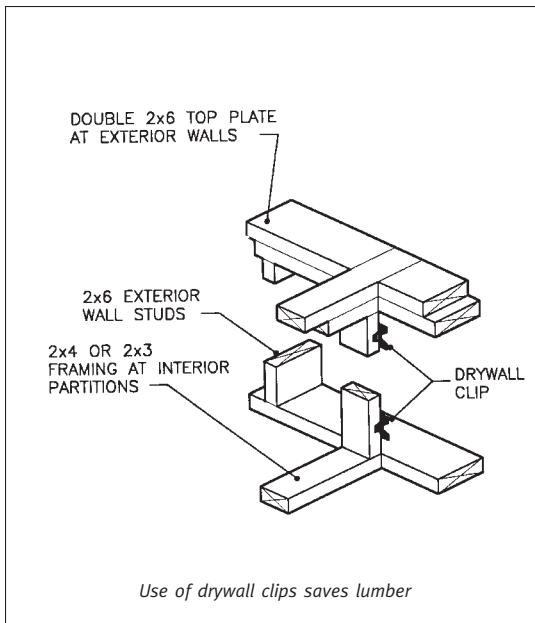
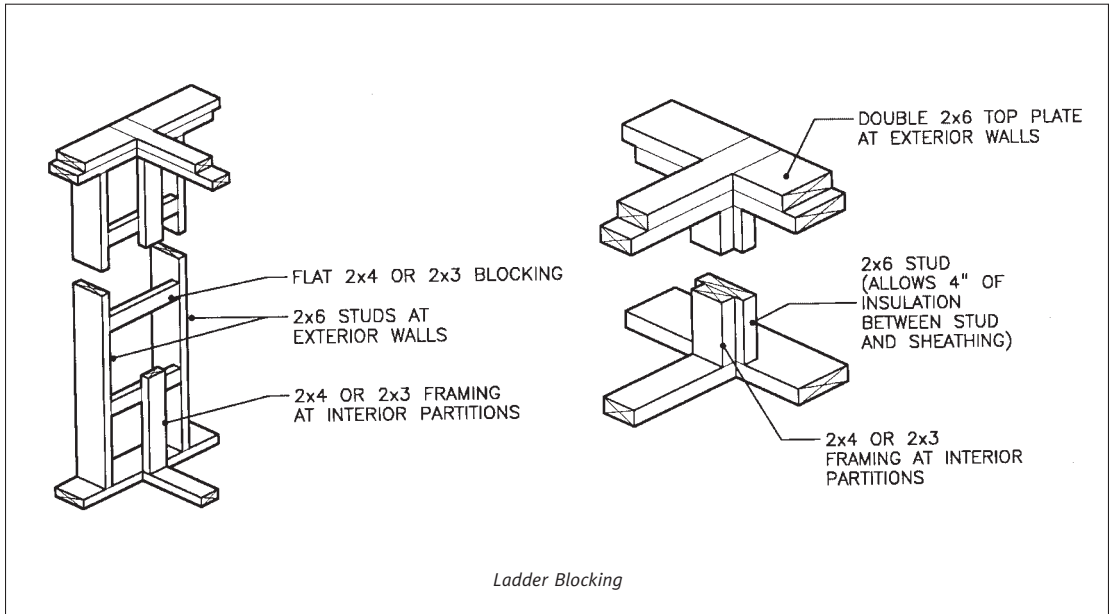
- Three-stud “partition-posts” and stud-block-stud channels at interior/exterior wall intersections are usually unnecessary unless expressly engineered.
- Partitions can be nailed to flat blocks (esp. from off-cuts) inserted between studs or directly to exterior wall studs. This technique, known as ladder blocking, also allows more insulation to be placed in the exterior wall cavity.
- Drywall clips or stops employed at wall and ceiling intersections also reduce the need for wood blocking. They create floating connections that reduce corner cracking caused by wood shrinkage and truss uplift. Drywall clips can save about \$100 per 1000 SF floor area.



INTERSECTIONS OF EXTERIOR WALLS



INTERSECTIONS AT INTERIOR PARTITIONS



ADVANCED FRAMING RESOURCES

HUD Partnership for Advancing Technology in Housing

www.remodel.com/products/HTML/NAHBRC/homebase/newtech/ABSTRACT/DESIGNAB.HTM

Cost Effective Home Building

Home Builder Press
 NAHB Research Center
 800-638-8556

Efficient Wood Use in Residential Construction

by Ann Edminster and Sami Yassa
 Natural Resources Defense Council
 212-727-2700
www.nrdc.org

APPENDIX B: HEATING SYSTEMS

DIGITAL THERMOSTAT

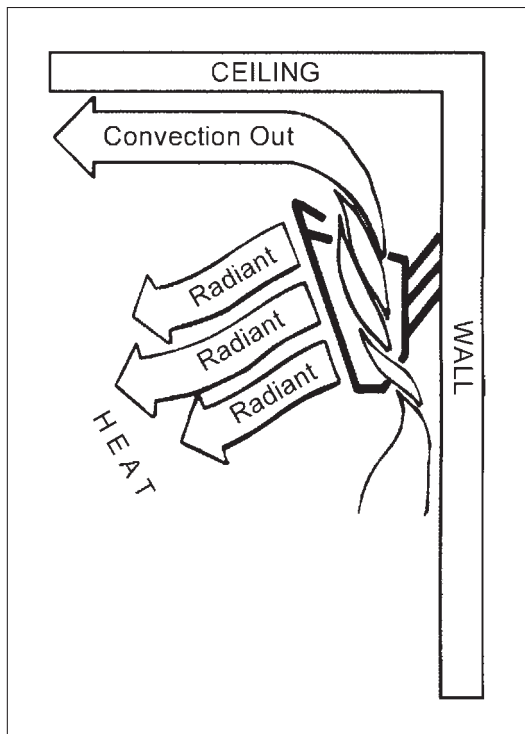
- WHY:**
- A quality digital thermostat allows residents to precisely regulate a home's temperature. Cheaper thermostats typically heat to a temperature up to 5 degrees higher or lower than specified.
 - A digital thermostat is easily programmed to heat the house to different levels at different times depending on residents' needs, potentially lowering heating costs significantly.

- HOW:**
- Specify a high-quality thermostat that is simple to program and explain the system to residents when they move in.

- COST:**
- Approximately \$60-100 per unit.

RADIANT COVE HEATERS

- WHY:**
- These electric systems radiate heat directly to objects in their "line of sight." The heaters are long rectangular metal units that are placed high on a wall, where they are out of the way of furniture, doors and small children.
 - The system is zonal, so the temperature of each room can be independently controlled.
 - People prefer radiant heat from sources like sunshine, fireplaces, wood stoves, or warm floors to other forms of heat. Radiant heat is perceived as comfortable even when air temperatures are low.
 - Radiant cove heaters are an affordable alternative to baseboard or wall heaters. In addition, because the units are located high on a wall and operate at lower temperatures, they are safer than baseboard or wall heaters.



- Radiant heaters can be more energy efficient than other resistance heat because they maintain comfort at lower temperature settings.

HOW: ● Radiant heaters make sense in new or properly weatherized buildings. Radiant cove heaters are easily installed high on the wall of each room in which heating is needed. They can also be readily installed in rehabs where the owner is converting from baseboard or wall heaters.

COST: ● The cost of installing radiant cove heaters is about the same as higher quality wall heaters and slightly more than baseboard heating. However, the system costs 10% to 15% less to operate and maintains acceptable levels of comfort.

WATER HEATER / WATER BOILER SUPPLIED FAN ASSISTED HEATERS AND HYDRONIC BASEBOARD (I.E. “TURBONICS”)

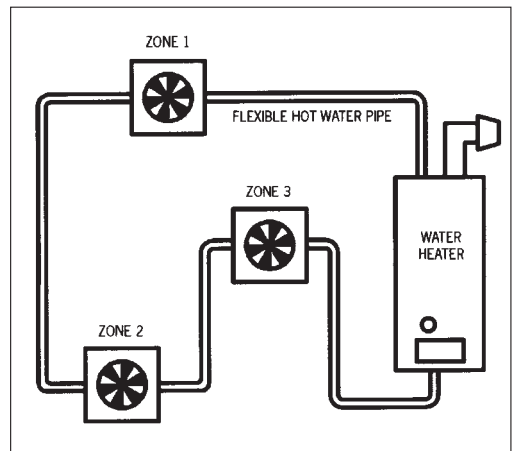
WHY: ● Hydronic heat is:

- Quiet, with no large fans or ducts to transmit noise;
- Clean, gently circulating room air by convection without creating dust or odors;
- Even, warming the full length of cold walls and windows for the greatest comfort;
- Flexible, allowing placement of furnishings without concern for blocking registers;
- Simple to install, particularly for retrofitting existing buildings;
- Efficient, moving warm water through small pipes with less heat loss than ducts; and
- Zoned for room to room control.

HOW: ● Contact Phil Damiano 503-721-2471 or John B. Hanton 503-721-2467 of NW Natural for information on specific systems, their requirements, and qualified contractors.

COST: ● At this time these systems are almost as high in price as forced-air systems, because contractors without experience installing these systems tend to bid high. NW Natural may be able to assist with the costs of these systems for affordable housing development.

- It is expected that the installation costs for these systems in the Portland market will drop dramatically as more contractors become familiar with their installation.



HIGH EFFICIENCY GAS SEALED COMBUSTION FORCED AIR FURNACES

- WHY:**
- “Sealed combustion” means there is little chance of combustion gas spillage or backdrafting, a safety benefit for occupants.
 - All furnaces installed in Oregon must be at least 80% efficient. Sealed combustion furnaces jump to about 92% efficiency.
 - Obviously, the higher efficiency rating translates to lower monthly gas costs. Some furnaces have more efficient blower motors that also reduce electric bills.
 - In rehabs, sealed combustion may avoid the cost of relining a chimney.

-
- HOW:**
- Furnace efficiency is wasted if the unit is tied to an inefficient duct system, which is common. The ducts should be sealed to eliminate air leaks in crawl spaces, attics and garages (where furnaces are located in the garage).
 - Contact Phil Damiano 503-721-2471 or John B. Hanton 503-721-2467 of NW Natural for information on specific systems, their requirements, and qualified contractors.
 - Ted Haskell of the OSU Extension Energy program can provide detail on designing and installing these furnaces and duct systems.

-
- COST:**
- Approximately \$3200 per unit.

Other Resources

CONSTRUCTION MATERIALS

The materials suggested elsewhere in this manual are available at many outlets, but the following local dealers specialize in green building materials and may carry items not easily found elsewhere.

Environmental Building Supplies

1331 NW Kearney
Portland, OR 97209
Contact: Abbey Mages, 503-222-3881
503-222-3756 fax
ebs@ecohaus.com

Local retailer of a full line of residential construction materials. Wholesale discounts available. Recycled and natural fiber carpet; certified and salvaged flooring; certified lumber; panel material; low- and no-VOC paints and finishes; recycled content tile; Marmoleum; and other materials available.

ReBuilding Center

3625 North Mississippi Ave.
Portland, Oregon 97227
503-331-1877
503-331-1873 fax

A project of Our United Villages, the Rebuilding Center sells quality salvaged building materials for 50-90% less than new materials. Non-profits may apply for free materials in advance by submitting a written request, reviewed at the weekly staff meeting. Non-profit developers most often turn to the ReBuilding Center for plumbing fixtures, cabinets, framing lumber, Metro recycled paint, and doors. Many items (e.g. doors) can be used to a developer's advantage by individualizing repeated home plans.

LOCAL INFORMATION RESOURCES

City of Portland Green Building Program

Office of Sustainable Development
1120 SW 5th, # 706
Portland, OR 97204
503-823-7725
503-823-5370 fax
www.green-rated.org

The City of Portland's Green Building Program promotes resource-efficient and healthy building practices for new construction and major renovation projects. Staff provides technical assistance related to design, water and energy conservation, and stormwater management; expedited permit processing; and industry training. Website has many links to other green development resources.

Metro Regional Government

600 NE Grand Avenue
Portland, OR 97232-2736
Contact: Bryce Jacobson, 503-797-1663
Recycling Hotline, 503-234-3000
jacobsonb@metro.dst.or.us

Consults on recycling and waste reduction in construction; deconstruction and salvage operations; hazardous waste disposal; distributes construction site recycling guide; manufactures and distributes recycled paint.

State of Oregon Energy Office

635 Marion Street NE
Salem, OR 97301-3742
Contact: Charlie Stephens, 800-221-8035
www.energy.state.or.us

Technical assistance on energy conservation; group purchase assistance on energy efficient washing machines and refrigerators; tax credits.



Portland General Electric

121 SW Salmon Street
 Mailstop 1WTC0701
 Portland, Oregon 97204
 Contact: Mark Gosvener, 503-464-7710

Free energy audits of electrically heated housing, weatherization rebates and low interest loans.

NW Natural

220 NW 2nd Avenue
 Portland, OR 97209
 contact: Mark Forker, 503-226-4211, ext. 5762

Free energy audits. Periodic rebate program for energy saving measures.

NW EcoBuilding Guild

P.O. Box 58530
 Seattle, WA 98138-1530
 206-575-2222
www.ecobuilding.org

An educational forum focused on encouraging building practices that protect human health, encourage sustainable resource use, and foster long-term economic vitality. Website includes GreenPages directory.

Portland chapter meets every third Thursday of the month at 6:30 pm at Environmental Building Supplies, 1331 NW Kearney Street, 503-222-3881.

Sustainable Communities Northwest

620 SW Main Street, Suite 236
 Portland, OR 97205
 503-417-7999
 503-417-1961 fax
scnw@teleport.com
www.scnwportland.org

Sustainable Communities Northwest creates partnerships with other non-profit housing providers to develop sustainable affordable homes. They also have created a volunteer-based Permaculture Gardening Program and Tenant Services and pursue public education and policy work.

BOOKS AND PUBLICATIONS

The Alternative Building Sourcebook: Traditional, Natural and Sustainable Building Products and Services

Fox Maple Press, Inc.

207-935-3720

www.nxi.com/WWW/joinersquarterly

Unique among green building guides in its exclusive focus on natural building methods, including straw-bale, clay infill, cob, thatch, and timber framing.

Useful information on associated products, services, and tools is also provided. 1998 paperback \$19.95

Efficient Wood Use in Residential Construction: A Practical Guide to Saving Wood, Money, and Forests

Natural Resources Defense Council

212-727-2700

www.nrdc.org/nrdcpro/fppubl.html

Based on case studies and the experiences of builders in the field, the authors describe how to use wood efficiently through more durable and efficient construction techniques, use certified and reclaimed wood, and reduce waste. 1998 paperback \$15.

Environmental Building News

BuildingGreen, Inc.

802-257-7300 phone

800-861-0954 orders

www.buildinggreen.com

The oldest and most respected periodical on green building. News, reviews and feature articles on all aspects of environmentally responsible design and construction. Carries no advertising. A CD-ROM EBN archive with searchable materials database is also available.

Green Building Materials: A Guide to Product Selection and Specification

John Wiley and Sons

800-225-5945

A reference with something for everyone: an introduction to ecological issues, an explanation of how the building procurement process works, and detailed sample language that can be adapted to real-world projects. Particular focus on contract documents and specs, but no listing of specific green products. 1999 hardcover \$64.95.

Green Development: Integrating Ecology and Real Estate

Rocky Mountain Institute

970-927-3851

www.rmi.org/store/pid385.asp

Describes opportunities to create fundamentally better buildings and communities—less wasteful of land and resources, healthier and more comfortable to occupy, cheaper to run, more productive to work in, and ultimately more profitable to build and operate. 1998 hardcover, 550 pages including 150 photos.

GreenSpec Binder

BuildingGreen, Inc.

802-257-7300 phone

800-861-0954 orders

www.buildinggreen.com

From the publishers of Environmental Building News. A comprehensive guide of information on over 1200 green building products and materials. This two-part tool features the 300-plus-page GreenSpec Product Directory and more than 135 pages of manufacturers' product literature, organized in a large 3-ring binder. \$99, \$75 for subscribers.

GreenClips

greendesign.net/greenclips/index.html

A free biweekly e-mail newsletter. Summarizes recent articles in the media on environmentally responsible architecture and related government and business issues.

PATH Technology Inventory

<http://www remodel.com/products/HTML/>

NAHBRC/homebase/newtech/TECHINDE.HTM

A comprehensive description of new cost- and labor-saving technologies that have been evaluated in the HUD Partnership for Advancing Technology in Housing project.

Landscaping for Wildlife in the Pacific Northwest

Russell Link

University of Washington Press

w/ WA Department of Fish & Wildlife

Extensive information and techniques for creating native and habitat gardens in the Pacific Northwest. 320 pp. \$29.95.

Glossary

- Bioswale** - A shallow trench planted with trees, shrubs, and ground cover that detains and filters stormwater before allowing it to infiltrate the groundwater system.
- BTU** (British Thermal Unit) - a unit of heat; can be used to measure heat output or the embodied energy of a material.
- Charrette** - A short and intensive design process that usually involves people from different backgrounds and disciplines in order to gain a broad, integrated perspective on issues at hand. See also *Integrated design*.
- Composting** - A waste management system for plant material (e.g. kitchen scraps and garden thinnings) that involves the biological decomposition of organic material into a rich soil amendment.
- CFC (chlorofluorocarbon)** – A gas often used as a propellant that traps heat in the atmosphere and contributes to global warming.
- Cradle-to-cradle** - An understanding of the life cycle of materials and their embodied energy that accounts for the original extraction or harvest of material to its end-life and eventual reuse.
- Cradle-to-gate** - An understanding of the life cycle of materials and their embodied energy that accounts for the original extraction or harvest of material to the beginning of its first use.
- Ecoroof** - A roof covered with soil mix and vegetation. Stormwater is absorbed by the soil and vegetation, reducing and detaining stormwater runoff.
- Ecosystem** - A complex and interdependent set of natural conditions and elements. Habitat survival depends directly and indirectly on ecosystem health.
- Embodied energy** - A representation of the energy used to grow, harvest, extract, manufacture, transport, and dispose of a material.
- Formaldehyde** - Urea formaldehyde, a harmful VOC, is a binding agent commonly used in composite wood products (OSB, particleboard, etc.). It is a probable carcinogen and poses a range of hazards to human health.
- Fossil fuels** - Non-renewable resources such as coal, oil, and natural gas, the use of which causes pollution and contributes to global climate change.
- Greywater** - Water that has been used within the home and/or roof runoff. Greywater sources do not include sewage. Greywater can be captured, treated, and used as a non-potable water source.
- Habitat** - The place where an animal or plant species lives.
- HCFC** (Hydrochlorofluorocarbon) - Compound used instead of CFC, with approximately one-tenth the environmental damage of CFC.
- Integrated design** - An approach where the design of each system takes into account and balances the design of other systems. Often an interdisciplinary approach, effective integrated design begins at the earliest stage of a project with a guiding set of principles. See also “charrette.”

- Low-e(missivity) windows** – Energy-efficient windows that allow light to pass through but block the flow of heat.
- Sone** - A unit measuring intensity of sound. Select ventilation systems with low sone ratings.
- Sustainability** - One common definition is that of meeting the needs of the present without compromising the ability of future generations to meet their needs.
- Swale** - see *bioswale*
- Microclimate** - A unique set of climatic conditions caused by landscape and/or building features. For instance, a paved parking area will absorb and radiate heat to the areas around it. Vegetation can block heavy prevailing winds or funnel them into a concentrated area.
- Native species** - Native plant species are well adapted to local climatic conditions and can flourish with little or no maintenance or watering. Native species are common to wild areas of the same climate, though the term is often used to include other well adapted species.
- Naturescaping** - Naturescaping features native plants, natural landscapes, and water-friendly gardening practices. It reduces water usage, can eliminate use of harmful chemicals, attracts beneficial wildlife, and requires little maintenance.
- Off-gassing** - Emission of chemical compounds (e.g. VOCs) into the air from newly installed building materials and finishes.
- Passive solar** - Non-mechanical methods of using sunlight to heat the home. Conceptually, sunlight is allowed into the house to heat a thermal mass such as a slab floor, which in turn radiates the heat back into the house when needed at night.
- Permaculture** - A design system that integrates landscape and building issues, permaculture emphasizes low maintenance, edible landscaping, and single design features (including plants) that fill more than one function.
- Phthalates** - Class of chemical compounds used to soften PVC. These compounds are more concentrated in flexible sheet vinyl, for instance, than in vinyl tiles. Phthalates, which are endocrine disruptors and are linked to birth defects, are now being commonly discovered at high levels in tests of humans in the US.
- R-value** - A unit of thermal resistance measuring resistance to heat flow through a single material. The higher the R-value, the greater the insulating properties.
- U-value** - A unit of thermal resistance measuring rate of heat flow through a material assembly rather than a single material. For instance, whereas insulation is measured by R-value, the entire wall assembly is measured by U-value. A lower U-value means better insulating properties.
- VOC** (volatile organic compound) - A class of chemical compounds that can cause short- and long-term health problems. VOCs can be emitted (off-gassed) by many building materials and finishes, including particleboard and solvent-based finishes. *Volatile*: evaporates readily at room temperature; *Organic*: carbon-based; *Compound*: combines two or more elements. Most VOCs are harmless, but the term has come to be applied to those that endanger health.
- Watershed** - Area of ecosystem(s) bounded by the highest topographic points and focused around where water flows and drains. All water in an area—including the pollutants it carries—flows to the lowest point of the watershed.