

Chapter 4 Health & Indoor Air Quality

Minimize exposure of residents and workers to toxic materials. Use safe, biodegradable materials and alternatives to hazardous materials.

Health and Indoor Air Quality is a significant green building issue directly affecting residents. The goal of affordable housing is to provide safe, as well as, affordable housing for low-income residents. Safety includes using materials that do not cause negative health impacts for residents, especially for the more sensitive groups such as children, seniors and those with existing respiratory problems.

Materials

4-1

Essential: Use least-toxic, decay-resistant, outdoor building materials. No CCA (Chromated Copper Arsenic).

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 dispose. CCA lumber leaches these toxins 6-24 inches into surrounding soil. Do not use for raised beds. CCA is most toxic up to three weeks after treatment, when solution remains on the surface of wood. CCA treated lumber is not recyclable.

- 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 above-ground and ground-contact applications and less toxic than CCA.

- Specify plastic lumber for applications where humans will contact 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.

- Plastic lumber is 2 to 3 times more expensive than conventional materials (\$1.85 per linear ft. for 1x6 HDPE formulation). Differential cost offset by longer service life and lower/easier maintenance.

- Similar to plastic wood example above. Example, \$1.68 per lin. ft. for 5/4 x 6 inch for TREX (1999). Differential cost offset by longer service



Patio built with 'plastic' lumber and ACQ-treated wood.

4-2

Essential for rehabs: Provide a lead-safe environment.

WHY

Lead abatement protects workers and occupants from associated health risks of lead exposure. Remodeling wastes often include items such as wood trim, siding and other architectural components that have been painted with lead-based paint, especially in facilities built prior to 1978. Lead paint presents problems if it is peeling or in the form of dust or chips, which are toxic to humans if ingested or inhaled.

In addition, proper control and disposal protects against land and water pollution caused by the release of lead into the environment.

HOW

Painting contractors should be experienced in lead-safe practices while painting, cleaning, preparing surfaces and removing paint containing lead.

Contractors should use high efficiency vacuum systems to collect construction dust, blasting materials that encapsulate heavy metals, and paint stripping methods that do not generate dust.

COST

Control costs by being informed about regulations and requirements and know the conditions in your building. Hiring an industrial hygienist to provide a work plan, estimate and specification prior to bidding is recommended.

4-3 Install urea-formaldehyde-free underlayment, cabinets, and storage units.

WHY	<ul style="list-style-type: none"> • Particleboard is made with large quantities of urea formaldehyde binder, and off-gasses formaldehyde, a highly toxic volatile organic compound (VOC). • Particleboard is less durable than plywood or MDF.
HOW	<ul style="list-style-type: none"> • Specify urea-formaldehyde-free plywood or Medium Density Fiberboard (MDF). • When particleboard must be used, thoroughly seal all surfaces and edges with a water-resistant finish to reduce VOC off-gassing. • Consider strawboard products, such as WheatBoard™, made from agricultural waste. Strawboard can be veneered or naturally finished.
COST	<ul style="list-style-type: none"> • Urea-formaldehyde-free cabinets can require up to a 40% cost premium over cheaper products but may have a longer life cycle. A life cycle cost analysis of this component is a good tool to use when making selections.

4-4 Specify *low-toxic*, solvent-free, no-VOC (volatile organic compound) or low-VOC (below 100 g/liter) paints and primers. Specify water-based wood finishes and stains.

WHY	<ul style="list-style-type: none"> • Toxicity is the degree to which a substance or mixture of substances can harm humans, animals, or the environment. A “low-toxic” chemical or mixture is one that does not bear warning labels, such as “Danger,” “Warning,” or “Caution.” Definitions of low-toxic vary, but generally it means that the product does not contain chemicals considered toxic under federal OSHA and SARA guidelines. • Volatile organic compounds (VOCs) are chemicals that contain carbon molecules that are volatile enough to evaporate from material surfaces into indoor air at normal temperatures (referred to as off-gassing). Paints and primers off-gas VOCs that are health hazards to residents and workers.
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	<ul style="list-style-type: none"> The ability of VOCs to cause health effects varies greatly from those that are high risk, to those with no known health effect. About 50 VOCs, some of them common in construction materials, are known to cause cancer. Different products contain different types and levels of VOCs. Low-VOC products contain lower levels of VOCs than comparable products.
HOW	<ul style="list-style-type: none"> Specify low-toxic, 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 100 g/L (grams per liter)
COST	<ul style="list-style-type: none"> No- or low-VOC paints typically cost 0-15% more than regular paints.

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

4-5	Specify low-toxic, low-VOC adhesives and sealants.
WHY	<ul style="list-style-type: none"> Adhesives and sealants may off-gas toxic chemicals, including VOCs long after installation.
HOW	<ul style="list-style-type: none"> Select products labeled low-toxic, low-VOC, environmentally friendly, or worker-safe. Ask manufacturers for MSDS sheets and check for
COST	<ul style="list-style-type: none"> No additional cost.

4-6 Avoid carpets on slab-on-grade.

WHY	<ul style="list-style-type: none">• Carpet off-gasses when it is new. In addition, carpets attract allergens such as dirt, pollen, mold spores, dust mites, and other microbes.• Carpets on slab-on-grade contribute to unnecessary and unhealthy moisture in the building; this can lead to mold growth and associated health problems.• Using concrete slab as the finish flooring is resource-efficient because it eliminates use of additional flooring materials and adhesives, increases durability and reduces maintenance. It also provides a long service life.• It provides a healthier living environment because the smooth, hard surface does not attract and retain dust, molds and other indoor pollutants. Nor does it require adhesives generally used to install
HOW	<ul style="list-style-type: none">• Seal the concrete with a low-VOC sealer to avoid off-gassing from chemical additives in the concrete.• For passive solar applications, concrete flooring can function as thermal mass.
COST	<ul style="list-style-type: none">• Special decorative finishes or additives are available at an additional cost.

4-7

Install hard flooring surfaces in living rooms and sleeping areas.

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 can be harmful to humans.

- 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

- Avoid carpet in bedrooms and living areas.

- In high traffic areas, specify solid wood floors, laminated wood floor products, natural linoleum. If using vinyl, vinyl composition tile (VCT) is preferred. Do not use sheet vinyl that is less durable and more toxic than other flooring options. Vinyl is made from PVC, a petroleum-based, highly toxic substance that contains phthalates.

- For common areas on concrete slabs, consider staining and sealing concrete in lieu of installing additional flooring material.

- Certified sustainably harvested 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.

- Hard surfaces may increase noise. Consider related measures that

COST

- Costs vary depending on what flooring systems are used.

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4-8 If using carpet, install Carpet and Rug Institute's CRI IAQ label and low pile or less allergen-attracting carpet and pad. Install carpet by tacking (no glue) and limit use to one-third of the unit's square footage.

WHY	<ul style="list-style-type: none">• Limiting carpet to one-third of the unit's square footage not only provides a healthier indoor environment, wood and tile floors are more durable than carpet, so they cost less per year of use.• Carpets require frequent replacement and are filling up our landfills at an alarming rate.
HOW	<ul style="list-style-type: none">• The Carpet and Rug Institute (CRI) has developed a testing and labeling program to aid in the selection of low-emitting carpet, adhesives, and cushion material. Specify that all carpets used have the CRI IAQ label; this indicates a representative sample of the product has been tested by an independent laboratory to meet the established requirements.• Consider specifying a PET (polyethylene terphthalate) recycled-content or durable nylon carpet over a fiber or waffle pad. Carpet made with Nylon 6 can be recycled by chemically renewing in a de-polymerization process and then manufactured into new carpet fibers. Consider integral cushion recycled-content carpet with a dry, peel-back adhesive that minimizes VOC off gassing. Avoid Olefin™ and other less durable brands.• If space is available, unroll and air out carpet prior to installation.
COST	<ul style="list-style-type: none">• Costs vary depending on what carpets 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.• See also Chapter 4: Health & Indoor Air Quality, Action Item 6.



4-9 Ensure proper installation of under-slab vapor barriers.

WHY	<ul style="list-style-type: none">• Vapor barriers prevent moisture from migrating into the building and they also protect against radon and other unwanted soil gases that may enter the building.
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- HOW**
- If slab is installed, use gravel fill beneath the foundation slab with a poly membrane (minimum thickness of 6mm) or vapor retarder, sealed over the gravel prior to pouring the basement floor. Seal the poly barrier at the edges and seams to prevent moisture and soil gases from entering the building.

Fresh Air Ventilation

4-10

Essential: Provide make-up air.

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 opened. In cold weather the mechanical system can provide fresh air without discomfort or a substantial energy

HOW

- Vent to the outside.

4-11

Essential: At a minimum install medium-efficiency air filters in ducted forced air systems. Option: Use “washable” type air filter.

WHY

- Medium-efficiency filters are inexpensive but effectively remove most common particulate pollutants like dust or pollen. The pleats in the filter remove 40% - 50% of all particulate matter.

HOW

- Specify medium-efficiency filters and make sure information about filter size, type and replacement schedule is included in the O&M Manual.

4-12	<p>Essential: Install kitchen range hood, bath, laundry, or ceiling exhaust fan vented to the outside to remove excess moisture and odors. <u>or</u> Install multi-port attic fan to exhaust kitchen, laundry and bathroom.</p>
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WHY	<ul style="list-style-type: none"> • 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-going cleaning, repainting and repair. • Mechanical ventilation is a good partner with operable windows. In fair weather, windows can be opened. In cold weather the mechanical system can provide fresh air without discomfort or a substantial energy penalty. • This Action Item is not required for rehabs but may be feasible and
HOW	<ul style="list-style-type: none"> • Option 1: Continuous ventilation <ul style="list-style-type: none"> • Always on • Constant low airflow • Quiet • Not dependent on occupants to operate control • Cost-competitive <p>Elements:</p> <ul style="list-style-type: none"> • 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 lifestyle • Fresh air intakes in windows or through outside walls. • Option 2: Intermittent ventilation <ul style="list-style-type: none"> • Provides spot removal of pollutants • Least change from current practice • Can provide acceptable minimum ventilation • Relies on tenant <p>Elements:</p> <ul style="list-style-type: none"> • 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

	<ul style="list-style-type: none"> • Medium efficiency filters: Rated 30% or better on “Dust Spot Efficiency” test • Electrostatic or media filter types acceptable. <p>Vent to the outside.</p>
COST	<ul style="list-style-type: none"> • 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.

4-13

Provide for whole house ventilation with controlled supply and exhaust providing maximum Air Changes per Hour (ACH) for 24 hours per day as required by code.

CODE	<ul style="list-style-type: none"> • Washington State Ventilation and Indoor Air Quality Code (available on line at www.energy.wsu.edu/buildings) prescribes minimum and maximum ventilation rates based on the floor area of the unit or home. In multi-family, the rates are applied to individual units, hall and other common areas are calculated separately (See Tables 3-2 and 3-4 in the Code).
WHY	<ul style="list-style-type: none"> • When set up and operated properly, whole house fans provide consistent fresh air in the unit. They are especially critical in tight
HOW	<ul style="list-style-type: none"> • Installing continuous exhaust ventilation or humidistat control ventilation is preferred. • Whole house fans can be set up either to exhaust air from the unit or to supply fresh air to the interior of the unit. If set up for exhaust, it is essential to provide for outside make-up air to maintain balanced air pressure and prevent backdrafting from fuel burning devices. If set up as a supply fan, provide for either passive or mechanical venting so that air pressure in the building is only slightly positive. If too high, the air pressure in the building will force moisture into and through the walls of the building. • Include proper operating and maintenance information for the whole

4-14	Flush out building prior to occupancy with fresh outdoor air.
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WHY	<ul style="list-style-type: none"> • Interior air within a new building may be polluted with construction dust, odors and hazardous chemicals.
HOW	<ul style="list-style-type: none"> • Protect materials stored on site from moisture to prevent molds and construction dust from being carried into building. • Seal all ducts and protect HVAC equipment until construction and cleaning is complete to avoid contaminating system. • Ventilate during construction. • At a minimum, thoroughly ventilate completed building for 72 hours prior to occupancy. Clean all surfaces of construction dust. • When possible, flush newly built spaces with 100% outdoor air for seven days prior to occupancy, after final paint touch-up and floor-covering installation. Use the full air capacity of the HVAC system or at least 2.5 ACH (air changes per hour), provided by temporary fans if necessary. If possible, do the flush-out before furniture installation, to avoid pollutants being adsorbed into furniture and released later. • 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. • If the buildings' HVAC system is used, replace or clean filters after the flush, and prior to occupancy. Cautions: HVAC systems with minimal outdoor air capacity often require supplemental temporary fans; most with "economizer" capacity can provide 2.5 ACH. • Educate residents about their own furnishings and belongings that may contribute toxic off-gassing into units. Toxic off-gassing materials brought in by the tenants reduces the impact of IAQ measures employed

	<ul style="list-style-type: none"> • A flush-out will have minimal effect on materials with prolonged emissions, such as rubber flooring, carpet backing and wood products with formaldehyde glue. Effectiveness of this Action Item is dependent on what materials you used as noted in previous Action Items 1-9.
COST	<ul style="list-style-type: none"> • There is a small construction management and electricity cost for a flush-out. However, it is an important step for protecting the health of occupants and reducing complaints during the critical early occupancy period. It helps to avoid sick time, disability leave and potential lawsuits. • If occupancy is on a very tight moving schedule, the extra time before moving in may be costly. Benefits and potential consequences should be considered carefully.

4-15 Use operable windows for cross ventilation in combination with mechanical ventilation systems to assure good air flow and ample fresh air for building occupants.

WHY	<ul style="list-style-type: none"> • Fresh air is essential to residents' physical and mental health. To accomplish this, buildings should have both operable windows and a mechanical ventilation system. Tenants appreciate being able to control
HOW	<ul style="list-style-type: none"> • Install operable windows throughout units for cross ventilation and cooling. • Install pinlocks or bolts for security while windows are open.

Education

4-16 Implement a "No Smoking" policy for common areas. Consider designating smoking and non-smoking units, floors or buildings.

WHY	<ul style="list-style-type: none"> • 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
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	<ul style="list-style-type: none">• 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
HOW	<ul style="list-style-type: none">• Educate residents about the risks of indoor smoking and impacts on children.• Maintain “smoke-free” units for occupants with compromised health or special needs.• If there are areas in the building used for smoking, provide adequate ventilation.

4-17

Educate residents on ways to maintain good indoor air quality including minimizing and treating mold, reducing track-in of dirt and the importance of using mechanical ventilation properly.

WHY	<ul style="list-style-type: none">• Informed residents can contribute towards creating a healthier living environment through careful product selection, maintenance, and living practices.
HOW	<ul style="list-style-type: none">• The American Lung Association offers educational events and literature about creating healthy living environments.• Translate educational materials into the languages used by residents in the building.• See also Resources section for more information.