



# **COURSE 962571**

## **Residential Rehabilitation**

### **Part 3 - Building Interior**

#### **Review Material**

**Uscontractorlicense LLC**

PO Box 268 / Platteville, Wisconsin 53818 / 608.348.6688 / [www.uscontractorlicense.com](http://www.uscontractorlicense.com)



This course is a distance learning or e-learning course, which allows the attendee to complete the course on their time schedule.

### **Course Outline**

This course is a distance learning or e-learning course, which allows the attendee to complete the course on their time schedule.

Building Interiors  
Basement or Crawl Space  
Interior Spaces, General  
Bathrooms  
Kitchens  
Stairs And Hallways  
Laundries and Utility Rooms  
Fireplaces and Flues  
Attics and Roof Truss and Joist Spaces  
Asbestos  
Lead  
Radon  
Tornado Safe Room

### **Exam**

120 questions related to the reference materials are used to test the attendee on their comprehension of the materials. A 70% score will need to be attained in order to pass this course.

### **Answer Sheet(s)**

1 bubble style answer sheets are included. When you are finished with the exam, you may return the answer sheets for grading to:

By Mail: Uscontractorlicense LLC  
PO Box 268  
Platteville, Wisconsin 53818

By Email: michael@uscontractorlicense.com

By Fax: 608-571-0096

Once we get the answer sheets back, we will grade them, enter your hours into the attendance portal and email or mail you back your certificate of completion(s). You will be responsible for renewing your license with the DSPS at [www.license.wi.gov](http://www.license.wi.gov) website.

Any questions, please contact us at 608.348.6688

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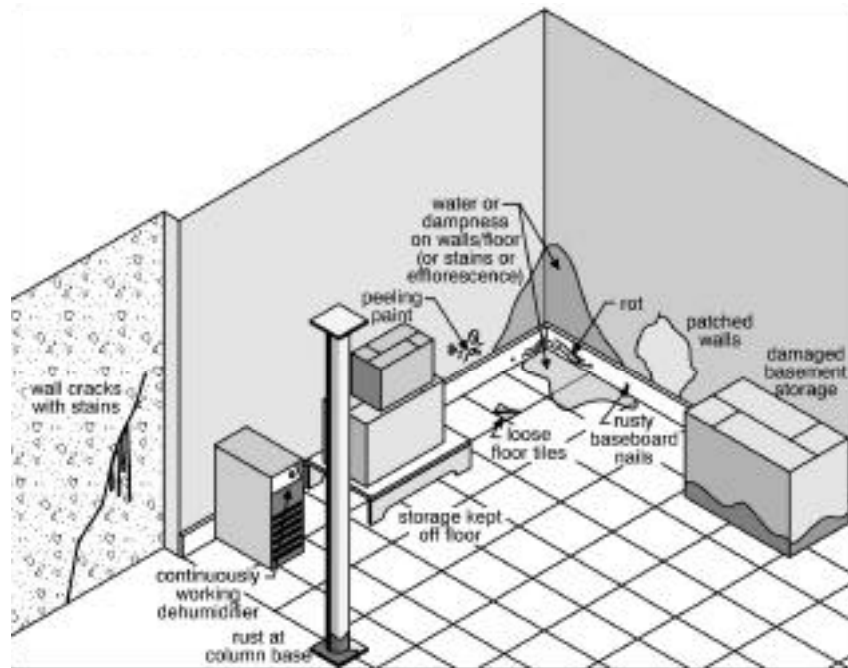
### 3 Building Interior

Following the inspection of the site and the building's exterior, move indoors and systematically inspect all interior spaces, including basement or crawl space, finished rooms, halls and stairways, storage spaces, and attic. Begin either at the lowest level and work up or at the attic and work down. Examine the overall quality and condition of the building's construction and finish materials. If the interior has unique woodwork or other stylistic features, consider how these may be incorporated to best advantage in the building's reuse. Look for patterns of water damage or material deterioration that indicate underlying problems in the structural, electrical, plumbing, or HVAC systems. These systems will be inspected separately after the interior inspection has been completed.

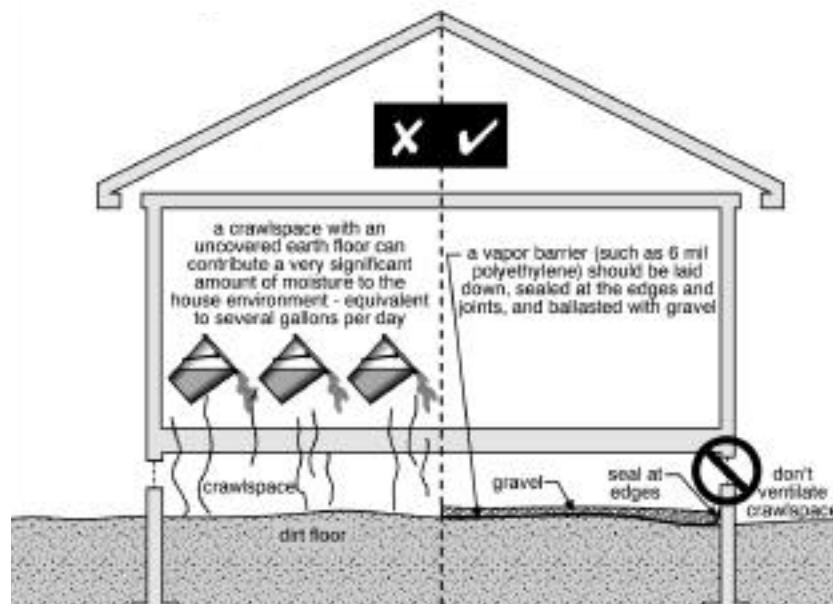
When universal design is a part of a rehabilitation project, consult HUD publication *Residential Remodeling and Universal Design* for detailed information about doors, kitchens, bathrooms, laundry areas, closets, stairs, windows, and floor surfaces.

#### 3.1 Basement or Crawl Space

The basement or crawl space is often the most revealing area in the building and usually provides a general picture of how the building works. In most cases, the structure is exposed



*Clues to water problems in basements*



*An uncovered earth floor in a crawl space can significantly increase moisture within the building.*



*Termite infestation is most common in basements and crawl spaces, particularly near foundation walls. Probe all suspect areas thoroughly.*

overhead, as are the HVAC distribution system, plumbing supply and DWV lines, and the electrical branch circuit wiring.

■ **Moisture.** One of the most common problems in small residential structures is a wet basement. Examine walls and floors for signs of water penetration such as dampness, water stains, peeling paint, efflorescence, and rust on exposed metal parts. In finished basements, look for rotted or warped wood paneling and doors, loose floor tiles, and mildew stains.

Determine the source of any moisture that may be present. It may come through the walls or cracks in the floor, or from backed-up floor drains, leaky plumbing lines, or a clogged air conditioner condensate line.

If moisture appears to be coming through the walls, re-examine the roof drainage system and grading around the exterior of the building (the problem could be as simple as a clogged gutter). Recheck the sump pump, if there is one, to be sure the discharge is not draining back into the basement. Look for unprotected or poorly drained window wells, leaking exterior faucets, and signs of leakage in the water supply line near the building. See Section 6.2 for water distribution system problems. If foundation walls are cracked, examine them in accordance with Section 4.4.

Check the elevation of an earthen floor in a crawl space. If the water table on the site is high or the drainage outside

the building is poor, the crawl space floor should not be below the elevation of the exterior grade.

If the basement or crawl space is merely damp or humid, the cause simply may be lack of adequate ventilation, particularly if the crawl space has an earthen floor.

Check the ventilation. By measurement and calculation, compare the free area of vents with the plan area of the crawl space. The free vent area to crawl space area ratio should be 1 to 150 in a crawl space with an earthen floor and 1 to 1,500 in a crawl space with a vapor barrier of one perm or less over the earthen floor. If the calculated ratio is less, consider adding ventilation, particularly in hot and humid climates, and especially if moisture is present.

Check the location of the vents through the foundation or exterior wall. There should be one vent near every corner of the crawl space to promote complete air movement. Check vents for screens. They should have corrosion resistant mesh in good condition with maximum 1/8-inch (3.2 mm) openings. If the ventilation appears to be inadequate and additional vents cannot be cut in the foundation or exterior wall economically, consider adding a vapor barrier and mechanical ventilation.

■ **Fungal and insect infestation.** Look for signs of fungal growth on wood, particularly in unventilated crawl spaces.

Inspect all foundation walls, piers, columns, joists, beams, and sill plates for signs of termites and other wood-inhabiting insects in accordance with Section 4.7. Also see Appendix B, Wood Inhabiting Organisms.

- **Thermal insulation.** Examine the amount and type of insulating material, if any, above unheated basements and crawl spaces. Determine the amount of insulation required for the space and whether additional insulation can or should be added. Check for adequate vapor barriers.

- **Structural, electrical, plumbing, and HVAC systems.** Understand enough about the layout of each system to make an informed inspection of the remainder of the building's interior. A more complete assessment of these systems will be performed later.

□ **Note the type of structural system** (wood frame, masonry bearing wall, etc.). Locate main support columns and posts, major beams, and bearing walls.

□ **Find the main electrical panel box**, if it is in the basement, and note how the branch circuits are generally distributed. Note also the type of wiring that is used.

□ **Trace the path of the main water supply** line and check the composition of all piping materials.

□ **Observe the general location of the heating/cooling unit**, if it is in the basement, and the general layout of the HVAC distribution system.

□ **Locate the access to the crawl space**, check that it is large enough for a person to enter, observe the interior of the crawl space, and if mechanical equipment is located inside, check that access is large enough for any required maintenance.

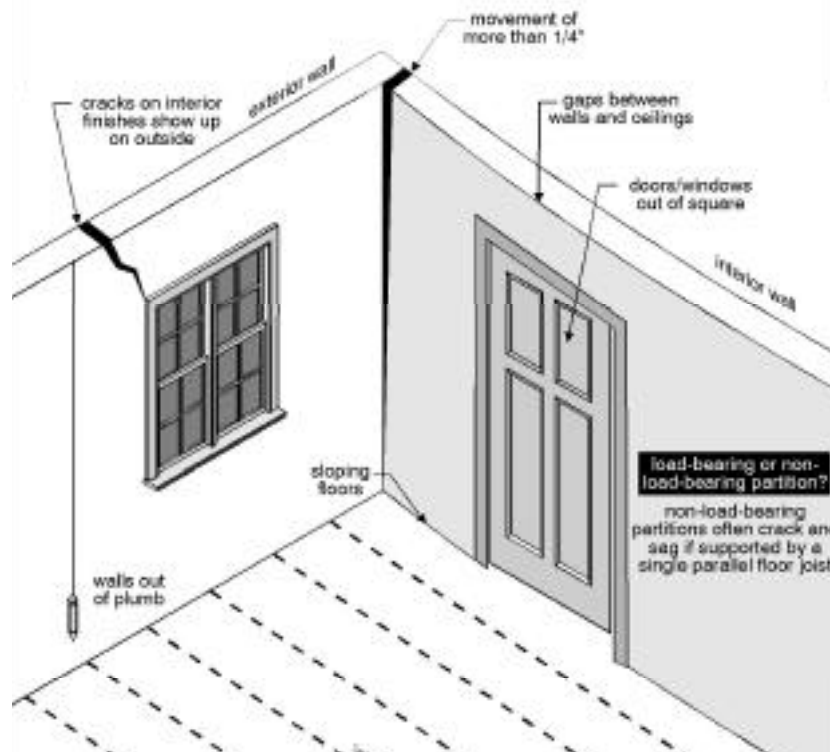
- **Walls and ceilings.** Check the general condition of all surfaces, ignoring cosmetic imperfections. Look for cracks and peeling paint or wallpaper. Note signs of exterior water penetration or interior leakage. Whenever possible, probe behind wallpaper, paneling, ceiling tiles, and other coverings for problems that may have been concealed but not corrected.

Look for sags and bulges in old plaster work. Gently tap and push on the plaster; if an area sounds hollow or feels flexible, it is a good indication that the plaster has separated from its backing. If such areas

### 3.2 Interior Spaces, General

This section deals with inspection procedures that are common to all interior spaces, including finished attics and basements.

Examine the following elements and conditions of interior spaces:



Interior clues to structural problems

are found, it may be best to replaster or overlay the wall or ceiling with wallboard.

Wall and ceiling cracks are usually caused by building settlement, deflection, warping of wood structural elements, or small seasonal movements of building components due to temperature and humidity variations. Seasonal movements will make some cracks regularly open and close; these may be filled with a flexible, paintable sealant, but otherwise cannot be effectively repaired. Cracks due to settlement, deflection, or warping can be repaired if movement has stopped, as is often the case.

Large wall and ceiling cracks may indicate structural problems. See Sections 4.3 through 4.5 for cracks associated with masonry wall problems and Section 4.7 for cracks associated with structural wood framing problems.

Inspect drywall-covered walls and ceilings by checking for nail popping, joint cracks, and other signs of deterioration or failure, such as rust stains at fasteners and corner beads.

Examine paneled walls by pushing or tapping on the paneling to determine if it is securely attached. Look for delamination of veneers. If the

paneling is obviously not original, try to look behind it to see what problems may be covered up.

Lift suspended ceiling panels and observe above them. Check the condition of the original ceiling, if any. Tiled ceilings should be examined similarly. On top floors, inspect for ceiling penetrations that may form thermal bypasses to the unconditioned spaces above.

- **Exterior walls.** In buildings built after 1960, try to determine if the exterior walls are insulated and contain a vapor barrier. Vapor barriers should be placed on the interior side of the insulation in cold climates and on the exterior side of the insulation in warm, moist climates.

- **Floors.** Examine the floor's finish or covering. Inspect hardwood floors to determine if they will need cleaning or sanding. If sanding is required, be sure to check (by removing a floor register or piece of baseboard trim) how much the floor thickness has been reduced by previous sandings. Too much sanding will expose floor nails and, if present, tongue-and-groove joints.

Inspect resilient floors and carpeting for their overall condition and quality. If they are to be replaced, check that their floor underlayment is sound.

If the floor feels springy, sagging, or unstable, inspect it in accordance with Section 4.7.



*Check the heating source in every room. This particular heater, when tested, was operable and safe.*

■ **Interior doors.** Inspect the condition of doors and door frames including the interior of entrance doors and storm doors. Check hardware for finish, wear, and proper functioning. Binding doors or out-of-square frames may indicate building settlement. See Section 4.4.

■ **Windows.** Inspect window sash and frames for damage and deterioration. Operate each window, including storm windows and screens, to determine smoothness, fit, and apparent weathertightness. Pay particular attention to casement windows. When open they are easily damaged by wind and hinge damage may keep them from closing properly. Also carefully check casement operating hardware to be sure it operates smoothly and easily. Note the type and condition of glass in each window and assess its effect on energy use. If possible, determine if the window has a thermal break frame. Check for the presence and adequacy of security hardware. Examine the functioning of sash cords and weights in older double hung windows. Open windows above the ground floor (or others not fully inspected from the outside) and check their exterior surfaces, frames, sills, awnings, and shutters, if any.

*Test: Air infiltration through windows and doors can be checked by the test method described in ASTM E783, Standard Test Method for Field Measurement of Air Leakage Through Installed Windows and Doors.*

The test should be performed by an experienced technician.

*Test: Water penetration through windows and doors can be checked by the test method described in ASTM E1105, Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Curtain Walls, and Doors by Uniform or Cyclic Static Air Pressure Difference. The test should be performed by an experienced technician.*

Consider window-related code requirements for natural light, ventilation, and egress capability. Most codes require the following:

□ **Natural light.** Habitable rooms should be provided with natural light by means of exterior glazed openings. The area required is a percentage of the floor area, usually eight percent.

□ **Ventilation.** Habitable rooms should be provided with operable windows. Their required opening size is a percentage of the floor area, usually four percent. A mechanical ventilation system can be provided in lieu of this requirement.

□ **Egress.** Every sleeping room and habitable basement room should have at least one operable window or exterior door for emergency egress or rescue. Egress windows should have a minimum net clear opening of 5.7 square feet (0.53 m<sup>2</sup>), with a clear height of at least 24 inches (610 mm), a clear width of at least 20 inches (510 mm), and a sill height not more than 44 inches (1120 mm) above the floor. Emergency egress or rescue windows and doors should

not have bars or grilles unless they are releasable from inside without a key, tool, or special knowledge.

■ **Closets.** Inspect all closets for condition and usability. It is best that they have a clear depth of at least 24 inches (610 mm). Check all shelving and hanging rods for adequate bracing. Check for proper type and location of closet light fixtures; lights positioned close to shelves present both a hazardous condition and an impediment to the use of shelves.

■ **Trim and finishes.** Examine baseboards, sills, moldings, cornices, and other trim for missing or damaged sections or pieces. Replacement trim may no longer be readily obtainable, so determine if trim can be salvaged from more obscure locations in the building.

■ **Convenience outlets and lighting.** Look for signs of inadequate or unsafe electrical service as described here and in Chapter 5. Generally speaking, each wall should have at least one convenience outlet and each room should have one switch-operated outlet or overhead light. Examine the condition of outlets and switches and feel them for overheating. Make sure they are mounted on outlet boxes and that light fixtures are securely attached to walls or ceilings.

Operate switches and look for dimmed or flickering lights that indicate electrical problems somewhere in the circuit.

The electrical system will be re-examined more thoroughly later in the inspection. Also check the light switches for sparks (arcing) when switches are turned on and off. Switches that are worn should be replaced.

- **HVAC source.** As described here and in Chapter 7, locate the heating, cooling, or ventilating source for every room. If there is a warm air supply register but no return, make sure doors are undercut one inch (25 mm) for air flow.

With the HVAC system activated, check the heat source in each room and make sure it is functioning. The HVAC system will be more completely examined later in the inspection.

- **Skylights.** Examine the undersides of all skylights for signs of leakage and water damage. Inspect skylight components for damage, deterioration, and weathertightness. Operate openable skylights to determine their smoothness of operation, fit, and apparent weathertightness.

### 3.3 Bathrooms

Examine bathrooms in accordance with the procedures for other interior rooms, and additionally inspect:

- **Electrical service.** Wherever possible, switches and outlets should not be within arm's reach of the tub or shower. Consider installing ground

fault interrupters (GFIs) in the outlets. See Chapter 5.

Check the condition and operation of all switches, outlets, and light fixtures.

If there is an exhaust fan, check its operation. It should be properly ducted to an attic vent or the building's exterior.

- **Plumbing.** Examine all exposed plumbing parts for leaking or signs of trouble or deterioration. Inspect the lavatory for secure attachment and support. Check the operation of all fixtures and decide which fixtures and trim should be replaced.

Check the condition of all plumbing fixtures by examining for chipping, scratches, mold, stains, and other defects.

Check the condition and operation of the lavatory, toilet, tub, and shower.

A common problem in bathrooms is leakage around tubs and showers. If possible, inspect the ceiling below each bathroom for signs of water damage or recent patching and painting.

Whirlpool baths should be operated for at least 20 minutes. Check how well a constant water temperature is maintained. Examine jets for evidence of mold and mildew and determine if the piping should be flushed out.

Determine the flushing capacity of the toilet. If it is not a water-saving fixture, consider replacing it with a water-saving toilet with a 1.6 gallon (6 L) flushing capacity. Operate the toilet. Assess its bowl

cleaning ability, especially if it is a water-saving fixture.

Pressure assisted toilets use water pressure to compress air in a tank that makes the 1.5 to 1.6 gallon (5.7 to 6 L) flush very effective in cleaning the fixture bowl and preventing buildup in the soil pipe. Operate the toilet. Listen for excessive noise from vibration due to loose pieces of equipment, check for leaks, and look for rust on the tank and piping.

Check for a faulty shower pan by covering the shower drain tightly and filling the shower base with about an inch of water. Let stand for at least an hour, if possible. Look for signs of water leakage on the ceiling below. The presence of excessive sealant around the shower base or drain may indicate attempts to remedy a shower pan leak by preventing water from reaching the pan. This is only a temporary solution and the pan should be properly repaired.

If there is a medicine cabinet, check its condition and check its door fit and operation.

- **Tub and shower enclosures.** Check the condition, fit, and operation of tub and shower enclosures. Note whether any glazing is safety glazing, as required by the building code for new installation and replacement.
- **Ceramic tile.** Look for damaged or missing tiles, or tiles that have been scratched, pitted, or dulled by improper cleaning. Check the condition



*This kitchen cabinetry is plain but adequate.*

of all grouted and caulked joints. If a portion of the tile is defective or missing, all tile may have to be replaced since finding additional tiles of matching size, color, and texture may be impossible.

■ **Ventilation.** The bathroom should be ventilated by either a window, an exhaust fan, or a recirculation fan. Poor ventilation will be indicated by mildew on the ceiling and walls.

### 3.4 Kitchens

Examine kitchens in accordance with the inspection procedures for other interior rooms, and additionally inspect:

■ **Counters and cabinetry.**

Check countertops for cracks or food traps and examine kitchen cabinets carefully for signs of vermin infestation. Look for missing, broken, or damaged hardware and cabinet parts. Check doors and drawers for fit and smooth operation, and wall cabinets for secure attachment. Compare the cost of replacement to the cost of reconditioning.

■ **Electrical service.** Determine the adequacy and safety of electrical service to the kitchen, as described here and in Chapter 5. As a guide, new residential buildings are usually required to have a ground fault interrupter (GFI) of at least one 20 amp/120 volt circuit in all outlets over a countertop used for portable kitchen appliances. Separate circuits are also required for each major appliance as follows:

Refrigerator	20 amp/120 volt
Dishwasher	20 amp/120 volt
Garbage disposal	20 amp/120 volt
Range	40 to 50 amp/ 240 volt

Operate all electrical appliances simultaneously, including exhaust fans, to determine that they are connected and can run steadily without overloading their circuits.

- **Plumbing.** Visually inspect the condition of the sink for chipping, scratches, stains, and other defects. Decide whether it should be replaced. Check faucets for corrosion and proper operation. Make sure an air gap exists between the faucet and the flood rim to prevent possible back-siphoning. See Chapter 6.

Turn the faucets on and off several times and look for

drips and leaks in both the supply and drainage lines. Fill the sink and check that it drains promptly. Operate the disposal and dishwasher listening and watching for smooth operation. Look for leaks in plumbing connections. Check for the existence of an air vent for the dishwasher unless there is no disposal or unless the dishwasher pumps to the top outlet of the disposal. Check the spray hose. Decide whether either appliance should be replaced.

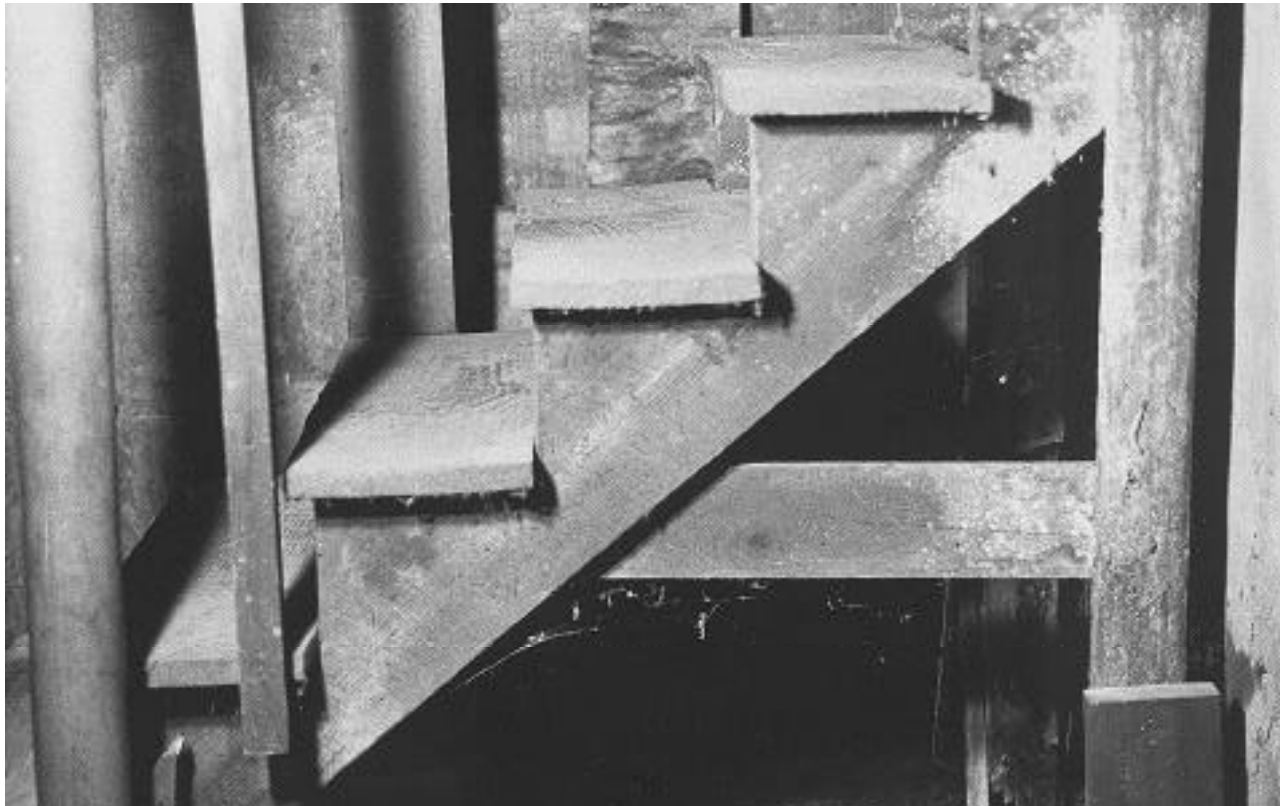
- **Ventilation.** See that exhaust fans and range hoods are ducted to the outside and not to a

cupboard, attic, crawl space, or wall. A recirculation range hood fan is acceptable. Check the filter medium. Ducts, hoods, and filters should be free of grease buildup.

Operate exhaust fans and vented range hoods to determine whether they are functional and whether they should be kept or replaced.

### 3.5 Storage Spaces

Inspect all closets and other storage spaces for cleanliness, functionality, proper lighting, and means of adequate ventilation.



*The rotted supports beneath this stair were repaired by scabbing on small blocks of wood, which is insufficient. The supports should be replaced and the source of moisture investigated.*

### 3.6 Stairs and Hallways

Inspect stairs and hallways as follows:

- **Light.** Stairs and hallways should be well lighted and have three-way light controls. Public stair and hallway lights in multifamily buildings should be operated from centralized house controls.

Check the operation of all stair and hallway lights.

- **Smoke detectors.** Stairs and hallways are the appropriate location for smoke detectors. Detectors should be located on or near the ceiling, near the heads of stairs, and away from the corners.

Check the operation of all smoke detectors by activating them with a smoke source or by pushing their test buttons.

- **Stair handrails and guardrails.** Handrails are normally required to be 34 to 38 inches (865 to 965 mm) above the stair nosing on at least one side of all stairs with three or more risers. Guardrails are required on open sides of stairways and should have intermediate rails that will not allow the passage of an object 4 inches (100 mm) in diameter. Shake all railings vigorously to check their stability and inspect their fastenings.
- **Stair treads and risers.** Check that all treads are level and secure. Riser heights and tread depths should be, respectively, as uniform as possible. As a guide, stairs in new residential buildings must have a

maximum riser of 7-3/4 inches (197 mm) and a minimum tread of 10 inches (254 mm).

Inspect the condition and fastening of all stair coverings.

- **Stair width and clearance.** Stairs should normally have a minimum headroom of 6'-8" (2030 mm) and width of 3'-0" (915 mm). For multifamily buildings, check the local housing code for minimum dimensions of public hallways and stairs.
- **Structural integrity of stairs.** Check that all stairs are structurally sound. Examine basement stairs where they meet the floor and where they are attached to the floor joists above. See Section 4.7.

### 3.7 Laundries and Utility Rooms

Laundry areas and utility rooms in small residential buildings are usually located in the basement or off the kitchen. Inspect them as follows:

- **Laundries.** Look for leaks or kinks in plumbing connections to the washer and examine electrical or natural gas connections to the dryer. Inspect dryer venting and make sure it exhausts to the outside and is not clogged or otherwise restricted. Gas dryer vents that pass through walls or combustible materials must be metal.

Examine the laundry tub, if one exists, and decide whether it should be replaced. Check its

plumbing and its capacity to handle discharged water from the washer.

In multifamily laundry areas, examine floors and walls for water damage. The laundry should have a floor drain. Determine whether the laundry is of proper size and in the proper location for the planned rehabilitation.

Operate washers and dryers and observe their functioning. Listen for noise that indicates excessive wear. Determine whether they should be replaced.

- **Furnace rooms.** Rooms containing fuel-burning equipment should not be located off a sleeping room in a single family residence, and must be in a publicly accessible area in a multifamily building. Check local code requirements for applicable fire safety and combustion air criteria.

### 3.8 Fireplaces and Flues

Inspect fireplaces and flues as follows:

- **Fireplaces.** Inspect the firebox for deterioration or damage. If there is a damper, check its operation. Make sure the hearth is of adequate size to protect adjacent combustible building materials, if any. A depth from the face of the fireplace of 20 inches (510 mm) and a width that extends one foot (305 mm) beyond the fireplace opening on either side is a minimum for older fireplaces. Also check local codes.

Burn some newspaper to check the draw. Discoloration around the mantel may indicate a smoky fireplace with poor draw.

- **Flues.** Check the flue lining in masonry chimneys. It should be tight along its entire length. Linings should be intact, unobstructed, and appropriate for the fuel type. It is difficult to properly examine flue linings visually, and a mirror may be helpful. An obstructed flue can usually be opened by a chimney sweep, but consult a chimney expert if the integrity of the flue is in doubt. Analyze unlined chimneys for the possible installation of metal liners. If there is an attic, use it to examine chimney construction more closely. See Section 7.2 for clearances around smoke pipes.
- **Smoke pipe connections.** Check that the smoke pipes from furnaces, water heaters, stoves, and related devices are tightly connected to the chimney and that they do not enter a fireplace flue. See additional requirements in Section 7.2.
- **Ash dump and pit.** If the fireplace has an ash dump at the bottom of the firebox, check the operation, fit, and condition of the door and check the shaft to the ash pit to be certain it is unobstructed and not overflowing with ashes. If the chimney has an ash pit, check the operation, fit, and condition of the pit access door. The fit should be tight enough to prevent dust and ash from escaping.

The structural condition of chimneys should be inspected in accordance with Section 4.6.

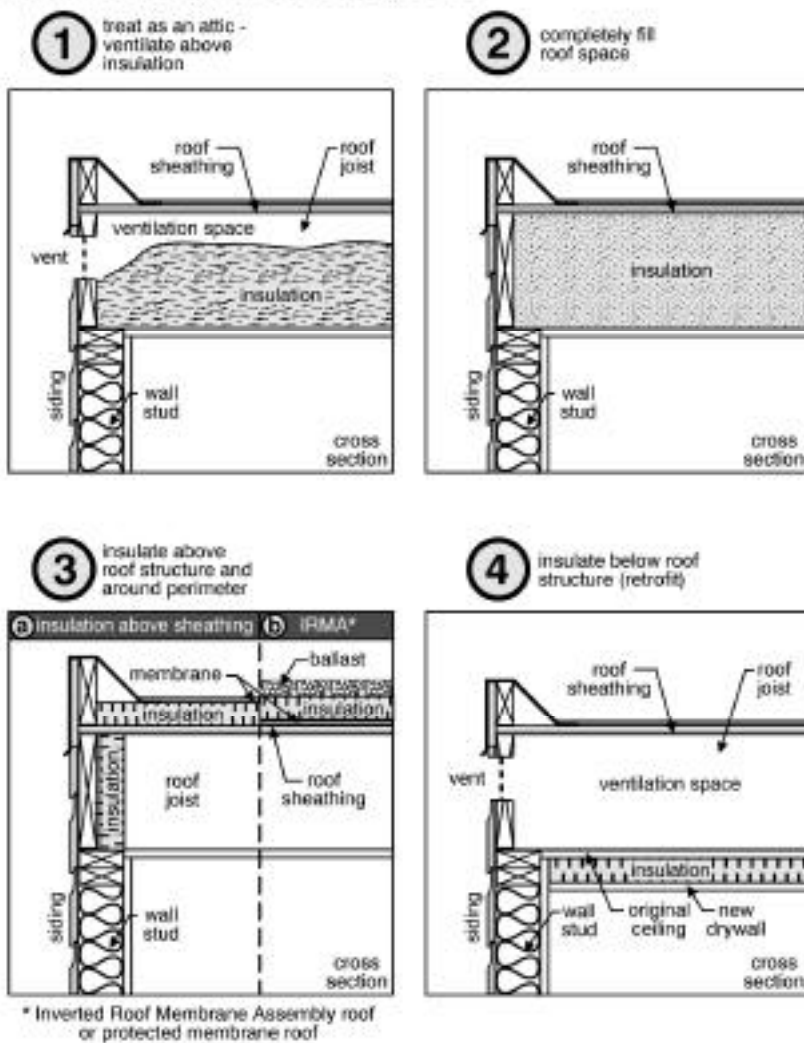
### 3.9 Attics and Roof Truss and Joist Spaces

Attics are defined here as unconditioned spaces between the roof and the ceiling or walls of the building's inhabited rooms. In small residential buildings with pitched roofs, attics are usually partially or fully accessible. In buildings with low-slope roofs, they may be inaccessible or virtually nonexistent. Inspect all accessible attic spaces as follows:

- **Roof leaks.** Look for signs of water leakage from the roof above and try to locate the source of leakage by tracing its path. This may be difficult to do beneath built-up roofs or beneath loosely laid and mechanically fastened single-ply roofs, since water may travel horizontally between layers of roofing materials. Determine the extent of any damage and the probable cost of repairs.
- **Attic ventilation.** Signs of inadequate ventilation are rusting nails (in roof sheathing, soffits, and drywall ceilings), wet or rotted roof sheathing, and excessive heat buildup in attics. Where attics exist but are inaccessible, check if access could be provided through ceilings or gable ends. Check for adequate attic ventilation by calculating the ratio of the free area of all vents to the floor area. Free area of

vents is their clear, open area. If a vent has an insect screen, its free area is reduced by half. The vent free area to floor area ratio should be 1 to 150. If the calculated ratio is less, consider adding ventilation, especially in hot and humid climates. When an attic also contains an occupied space, check that the ventilation from the unconditioned, unoccupied areas at the eaves is continuous to the gable or ridge vents. Also check that the free area of eave vents is approximately equal to the free area of ridge or gable vents. If ventilation appears to be inadequate and additional vents cannot be added economically, consider adding mechanical ventilation.

- **Roof truss and joist space ventilation.** Most buildings with low-slope roofs and some buildings with pitched roofs do not have attics. Instead, these buildings have ceilings at the bottom of joists, rafters, or trusses. The truss space and the space between each joist or rafter and above the ceiling needs ventilation. Look for vents below the eaves and check to see that the ratio of free vent area to roof area is 1 to 150. If the calculated ratio is less, consider adding ventilation. Open one or more of the vents if possible. Probe the ventilating cavity to determine the amount of insulation and free air space and try to assess the general condition of the surrounding building components. It is difficult to inspect for ventilation in these



Methods of insulating and ventilating low-slope roof structures

buildings without removing a part of the ceiling to measure the free depth and width of ventilation space and to determine whether the truss, joist, or rafter spaces contain insulation. If there is no evidence of water damage from condensation, an intrusive investigation is usually not warranted. At ridge, cornice, eave, or soffit

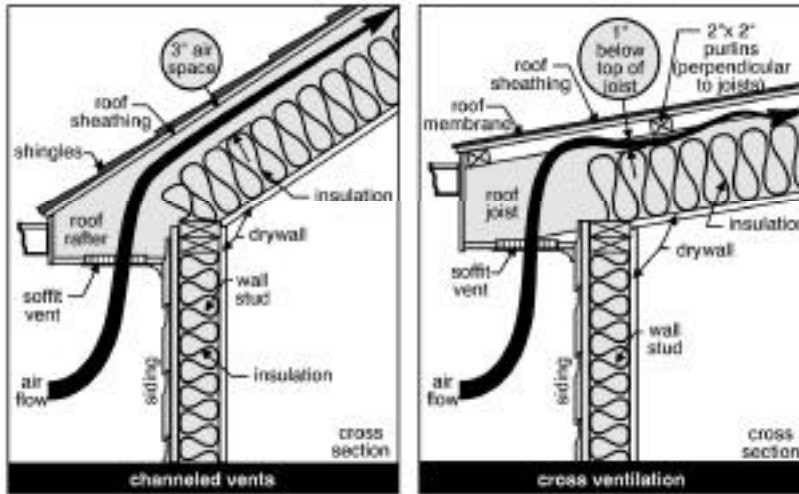
vents, check for the presence of insect screens. If insect screens are present, check their condition.

- **Vents.** Check the condition of ridge, gable, cornice, eave, and soffit vents. Look for rusted or broken screens and rusted frames. Make sure openings are clear of dirt and debris. At larger ventilation openings on

a building's exterior and where louvered grilles are used, such as at gables, check for the presence of one-half-inch-square (13 x 13 mm) 14 or 16 gauge aluminum mesh bird screen. If there is none or it is in poor condition, consider having new bird screen installed.

- **Thermal insulation.** Examine the amount and type of existing insulating material. Check to see that insulation faced with a vapor barrier has been installed face-side down with the vapor barrier closest to the conditioned space, and that vapor barriers are properly located between the ceiling and the first layer of insulation. Determine the proper amount of insulation to the attic and whether additional insulation is needed. If attic insulation is placed against the roof sheathing, check for a ventilated air space between the insulation and the sheathing. If there is no air space, check for the presence of moisture and deterioration of sheathing and rafters. Ensure that insulation is held away from recessed lighting fixtures, and inspect spaces around vents, stacks, ducts, and wiring for thermal bypasses. Inspect attic doors or access hatches, heating or cooling ducts that pass through the attic, and whole-house attic fans for thermal bypasses. Check the local jurisdiction for thermal resistance (R) requirements.

for cathedral ceilings and flat roofs the recommended vent area is 1 square foot for every 150 square feet of roof area



open web trusses also permit cross ventilation

Methods of ventilating pitched roof structures over habitable spaces



A split ceiling joist or trust chord can be easily repaired by propping it back in place and attaching new structural pieces to each side.

- **Exhaust ducts and plumbing stacks.** Check that all plumbing stacks continue through the roof and do not terminate in the attic and that they are not broken or damaged. Also check that exhaust ducts are not broken or damaged and do not terminate in the attic but either continue through the roof, gable, or wall or vent directly to a ridge vent.
- **Structural conditions.** Inspect the roof structure in accordance with Section 4.7.

### 3.10 Whole Building Thermal Efficiency Tests

Several whole building tests can be performed to help evaluate the thermal efficiency of the building envelope.

**Test:** A building pressurization test can be used to determine air infiltration and exfiltration. The test is particularly useful for “tightening up” an older building. See ASTM E779, *Standard Test Method for Determining Air Leakage Rate by Fan Pressurization*. A tracer gas test may also be used; see ASTM E741, *Standard Test Method for Determining Air Change in a Single Zone by Means of a Tracer Gas Dilution*. Such tests are usually performed by an energy specialist or an HVAC technician.

**Test:** A hand-held infrared scanner can be used to detect building “hot spots” due to interior air leakage or excessive heat loss through uninsulated building components. This test should be performed in cold weather when the building is heated; the greater the differential between inside and outside temperatures, the more

accurate the results. Infrared scanners are commercially available; their use varies by manufacturer. Thermography can be used for the same purpose, but it requires much more expensive equipment and a trained operator. Thermographic tests should be performed by an energy specialist, mechanical engineer, or others with the proper training and equipment.

### 3.11 Sound Transmission Control Between Dwelling Units

Check the floors and walls between dwelling units for adequacy of sound transmission control using the current building code for guidance. Floors that separate dwelling units, and floors that separate a dwelling unit from a public or service area should have an Impact Insulation Class (IIC) of not less than 45. IIC is determined in accordance with ASTM E492, *Standard Method of Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine*. Walls and floors that separate dwelling units in two-family residences, and walls that separate townhouses, should have a Sound Transmission Class (STC) of not less than 45. STC is determined in accordance with ASTM E90, *Standard Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements*.

Technical data that identifies STC and IIC attenuation for different types of construction is provided by product manufacturers and trade associations, such as the

Gypsum Association or the National Concrete Masonry Association. See the Gypsum Association's publication GA-530, *Design Data—Gypsum Products*, and the National Concrete Masonry Association's *Tek Note 13-1, Sound Transmission Class Ratings for Concrete Masonry Walls*.

### 3.12 Asbestos

Asbestos is a naturally occurring fibrous mineral used in many construction products. It is considered to be a carcinogen. Asbestos has been used in sealant, putty, and spackling compounds; in vinyl floor tiles, backing for vinyl sheet flooring, and flooring adhesives; in ceiling tiles; in textured paint; in exterior wall and ceiling insulation; in roofing shingles; in cement board for many uses including siding; in door gaskets for furnaces and wood-burning stoves; in concrete piping; in paper, mill board, and cement board sheets used to protect walls and floors around wood-burning stoves; in fabric connectors between pieces of metal ductwork; in hot water and steam piping insulation, blanket covering, and tape; and as insulation on boilers, oil-fired furnaces, and coal-fired furnaces. Use of asbestos has been phased out since 1978, but many older houses contain asbestos-bearing products.

Products containing asbestos are not always a health hazard. The potential health risk occurs when these products become worn or deteriorate in a way that releases asbestos fibers into the air. Of

particular concern are those asbestos-containing products that are soft, that were sprayed or troweled on, or that have become crumbly. The Environmental Protection Agency believes that so long as the asbestos-bearing product is intact, is not likely to be disturbed, and is in an area where repairs or rehabilitation will not occur, it is best to leave the product in place. If it is deteriorated, it may be enclosed, coated or sealed up (encapsulated) in place, depending upon the degree of deterioration. Otherwise, it should be removed.

A certified environmental professional should perform the inspection and make the decision whether to enclose, coat, encapsulate, or remove deteriorated asbestos-containing products. Testing by a qualified laboratory as directed by the environmental professional may be needed in order to make an informed decision. Encapsulation, removal, and disposal of asbestos products must be done by a qualified asbestos-abatement contractor.

For more information consult the *Guidance Manual: Asbestos Operations and Maintenance Work Practices*, available from the National Institute of Building Sciences.

### 3.13 Lead

Lead has been determined to be a significant health hazard if ingested, especially by children. Lead damages the brain and nervous system, adversely affects behavior and learning, slows growth, and causes problems related to hearing, pregnancy, high blood pressure, nervous system, memory, and concentration.

■ **Lead-based paint.** Most homes built before 1940 used paint that was heavily leaded. Between 1940 and 1960, no more than half the homes built are thought to have used heavily leaded paint. In the period from 1960 to 1980, many fewer homes used lead-based paint. In 1978, the U.S. Consumer Product Safety Commission (CPSC) set the legal limit of lead in most types of paint to a trace amount. As a result, homes built after 1978 should be nearly free of lead-based paint. In 1996, Congress passed the final phase of the Residential Lead-Based Paint Hazard Reduction Act, Title X, which mandates that real estate agents, sellers, and landlords disclose the known presence of lead-based paint in homes built prior to 1978.

Lead-based paint that is in good condition and out of the reach of children is usually not a hazard. Peeling, chipping, chalking, or cracking lead-based paint is a hazard and needs immediate attention. Lead-based paint may be a

hazard when found on surfaces that children can chew or that get a lot of wear and tear, such as windows and window sills, doors and door frames, stairs, railing, banisters, porches, and fences. Lead from paint chips that are visible and lead dust that is not always visible can both be serious hazards. Lead dust can form when lead-based paint is dry scraped, dry sanded, or heated. Dust also forms when painted surfaces bump or rub together, such as when windows open and close. Lead chips and dust can get on surfaces and objects that people touch. Settled lead dust can re-enter the air when people vacuum, sweep, or walk through it.

If the building is thought to contain lead-based paint, consider having a qualified professional check it for lead hazards. This is done by means of a paint inspection that will identify the lead content of every painted surface in the building and a risk assessment that will determine whether there are any sources of serious lead exposure (such as peeling paint and lead dust). The risk assessment will also identify actions to take to address these hazards. The federal government is writing standards for inspectors and risk assessors. Some states may already have standards in place. Call local authorities for help with locating qualified local professionals. While home test kits for lead are available, the federal government is still testing their

reliability. These tests should not be the only method used before doing rehabilitation or to ensure safety.

For more information on lead-based paint consult the HUD Office of Lead Hazard Control Web site at <http://www.hud.gov:80/lea>.

■ **Lead in drinking water** is a direct result of lead that is part of the plumbing system itself. Lead solder was used in pipe fittings in houses constructed prior to 1988. Lead has been used in plumbing fixtures such as faucets, and in some older homes the service water pipe from the main in the street to the house is made of lead.

The transfer of lead into water is determined primarily by exposure (the length of time that water is in contact with lead). Two other factors that affect the transfer are water temperature (hot water dissolves lead quicker than cold water) and water acidity ("soft" water is slightly corrosive and reacts with lead).

The current federal standard for lead in water is a limit of 15 parts per billion. The only way to find out whether there is lead in the house's water is to have the water tested by an approved laboratory. Two samples should be tested: water that has been sitting in the pipes for at least four hours, and water that has been allowed to flow not less than one minute before the sample is taken. Tests are inexpensive (\$15 to \$25).

If there is evidence of lead in the system, consider having water tested for lead. If the house has a water filter, check to see if it is certified to remove lead.

For more information on lead in drinking water call the Environmental Protection Agency's Safe Drinking Water Hotline: 1-800-462-4791 or visit the Web site of the EPA Office of Water at <http://www.epa.gov/safewater>.

For more information on lead hazards in general, call the National Lead Information Center clearinghouse: 1-800-424-LEAD. For the hearing impaired, call TTY 1-800-526-5456.

### 3.14 Radon

Radon is a colorless, odorless, and tasteless gas that is present in varying amounts in the ground and in water. Radon is produced by the natural radioactive decay of uranium deposits in the earth. Prolonged exposure to radon in high concentrations can cause cancer. The EPA has set guidelines for radon levels in residential buildings.

■ **Airborne radon.** The EPA recommends that mitigation measures be undertaken in residential buildings when radon concentrations are 4 picocuries per liter (4 pCi/L) of air and above.

The radon concentration in a house varies with time and is affected by the uranium-radium content in the soil, the geological formation beneath the house, the construction of

the house, rain, snow, barometric pressure, wind, and pressure variations caused by the periodic operation of exhaust fans, heating systems, fireplaces, attic fans, and range fans. Radon concentrations are variable and may be high in one house and low in an adjacent house. To determine if a house has a radon problem, it must be tested.

*Test: A long-term test is the most accurate method of determining the average annual radon concentration. However, because time is usually limited, there is a three- to seven-day test that uses a charcoal canister. It is available from most home do-it-yourself stores or through radon testing service companies.*

■ **Waterborne radon.** A house's domestic water supply from its well can contain radon. There are locations with well water containing 40,000 or more pCi/L. The health problems from drinking water with radon are insignificant compared to breathing airborne radon, but radon can be released into the air when water is run into a plumbing fixture or during a shower. It takes a high concentration of radon in water to produce a significant concentration in the large volume of air in a house. While there is no maximum established at this time for radon in water, consider removing radon at the water service entrance when the level exceeds 10,000 pCi/L.

*Test: Private well water testing is normally not a part of radon testing. Therefore, if the house has a private well, consult the local health department to determine whether water testing in the house's area is recommended. How this is to be done should be determined by a listed radon mitigation contractor.*

If a building is found to have a radon problem, consult a certified radon mitigation contractor who has met the requirements for listing under the EPA's Radon Contractor Proficiency Program about mitigation procedures.

For more information on radon mitigation see Ventilation for Soil Gases, chapter 7 in *The Rehab Guide*, Volume 1, *Foundations*, available from HUD or full text online at <http://www.pathnet.org>.

### 3.15 Tornado Safe Room

If a building is located in a tornado-risk area, and if it has a tornado shelter or safe room, it should be investigated by a structural engineer for structural adequacy.

