U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

# Residential

## Rehabilitation Inspection Guide

PATH
Partnership for Advancing Technology in Housing

U.S. Department of Housing and Urban Development

PD&R
Office of Policy Development and Research

# Residential
# Rehabilitation Inspection Guideline

**Prepared for the**
**U.S. Department of Housing and Urban Development**
**Office of Policy Development and Research**

**by the National Institute of Building Sciences, Washington, D.C.**
under Contract C-OPC-21204

February 2000

**PATH (Partnership for Advancing Technology in Housing) is** a new private/public effort to develop, demonstrate, and gain widespread acceptance for the "Next Generation" of American housing. Through the use of new and innovative technologies the goal of PATH is to improve the quality, durability, environmental efficiency, and affordability of tomorrow's houses.

**Initiated at the request of the White House,** PATH is managed and supported by the U.S. Department of Housing and Urban Development. In addition, all Federal Agencies that engage in housing research and technology development are PATH partners, including the Department of Energy, the Department of Commerce, the Environmental Protection Agency, and the Federal Emergency Management Agency. State and local governments and other participants in the public sector also are partners in PATH. Product manufacturers, home builders, insurance companies, and lenders represent private industry in the PATH partnership.

**To learn more,** please contact: PATH, Suite B133, 451 Seventh Street, S.W., Washington, D.C. 20410; fax 202-708-4250; e-mail pathnet@pathnet.org.

# Foreword

An important factor in making the best use of our nation's housing stock is accurately assessing the condition, safety, usefulness, and rehabilitation potential of older residential buildings. The *Residential Rehabilitation Inspection Guide* provides step-by-step technical information for evaluating a residential building's site, exterior, interior, and structural, electrical, plumbing, and HVAC systems.

First published by the U.S. Department of Housing and Urban Development in 1984 as the *Guideline on Residential Building Systems Inspection*, the guideline has found widespread use and acceptance among architects, engineers, builders, realtors, and preservationists.

Now, for the Partnership for Advancing Technology in Housing (PATH) program, the guideline has been updated and expanded to include current assessment techniques and standards, information about additional building materials, and a broader coverage of hazardous substances and the effects of earthquakes, wind, and floods. HUD is pleased to reissue this important and time-tested publication, knowing that it will prove a valuable resource for preserving and reusing our nation's building stock.

*Susan M. Wachter*
*Assistant Secretary for Policy Development and Research*

## Acknowledgments

The National Institute of Building Sciences (NIBS) produced the original edition of this guideline for the U.S. Department of Housing and Urban Development in 1984. It was written by William Brenner of Building Technology, Incorporated, with supplementary material and photographs provided by Richard Stephan, Ken Frank, and Gerard Diaz of the University Research Corporation. Technical reviewers were George Schoonover, Eugene Davidson, Joseph Wintz, Richard Ortega, Nick Gianopulos, Robert Santucci, James Wolf, and Thomas Fean.

This revised edition of the guideline was produced in 1999 by NIBS and updated and expanded by Thomas Ware and David Hattis of Building Technology, Incorporated. Technical reviewers were William Asdal, Neal FitzSimons, Wade Elrod, Hal Williamson, Paul Beers, John Bouman, Raymond Jones, Dan Kluckhuhn, Joe Sherman, William Freeborne, and Robert Kapsch. The graphic designer was Marcia Axtmann Smith. Selected illustrations are excerpted with permission from The Illustrated Home by Carson Dunlop & Associates (800-268-7070) and the material in Appendix C is used with the permission of the National Association of Homebuilders. William Brenner directed the project for NIBS and Nelson Carbonell was the HUD project manager.

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## Introduction

The *Residential Inspection Guideline* is designed to help evaluate the rehabilitation potential of small residential buildings and structures. It may be used by contractors, builders, realtors, home inspectors, and others with a basic knowledge of building construction.

When used in conjunction with the local building code, the guideline can assist in identifying unsafe or hazardous conditions and uncovering functional deficiencies that should be corrected. It does not establish rehabilitation standards or address construction, operation, and maintenance costs.

## Preparing for the Inspection

Before visiting the site, check with the local jurisdiction to determine:

- the site's **zoning, setback, height, and building coverage requirements, grandfathered uses and conditions, proffers, liens, and applicable fire regulations**.
- if the site is in a **seismic zone**.
- if the site is in a **hurricane** or **high tornado-risk region**.
- if the site is in a **flood plain** or other **flood-risk zone**.
- if there is any record of **hazards** in the soil or water on or near the site.

## Conducting the On-Site Inspection

Once at the site, conduct a brief walk-through of the site and the building. Note the property's overall appearance and condition. If it appears to have been well maintained, it is far less likely to have serious problems. Note the building's style and period and try to determine when it was built. Next, examine the quality of the building's design and construction and that of its neighborhood. There is no substitute for good design and sound, durable construction. Finally, assess the building's functional layout. Does the building "work" or will it have to be significantly altered to make it usable and marketable?

Look for signs of dampness and water damage. Water is usually a building's biggest enemy and a dry building will not have problems with wood decay, subterranean termites, or rusted and corroded equipment.

After completing the initial walk-through, begin the formal inspection process:

- **Inspect the site, building exterior, and building interior** in accordance with Chapters 1, 2, and 3. Use the tests described in Chapters 2 and 3 when appropriate. Record pertinent information as needed.
- **Inspect the structural, electrical, plumbing, and HVAC systems** in accordance with Chapters 4, 5, 6, and 7. Use the tests described in each chapter as necessary. Record the size, capacity, and other relevant information about each system or component as needed.

While most inspections consist of observing, measuring, and testing building elements that are exposed to view, there are conditions that require the removal of some part of the building to observe, measure, or test otherwise concealed construction. Such intrusive inspections require some demolition and should be performed only with the permission of the owner and by experienced, qualified mechanics.

The building inspection forms in Appendix E may be copied for use during on-site inspections. Record general building data and site layouts, elevations, and floor plans first. This information will form the basis for later rehabilitation decisions. Then record the **size, capacity**, and **condition/needed repairs** information for each building component. This will highlight what needs to be repaired or replaced.

The inspection may be completed in one visit or over several visits, depending on the property's condition, the weather, problems of access, and the need for testing or expert help.

## More Information

Appendix A provides information on assessing the effects of fire on wood, masonry, steel, and concrete structural systems. Appendix B can be used as an aid in the identification of wood-inhabiting molds, fungi, and insects. Appendix C lists the average life expectancies of common housing materials, components, and appliances. Appendix D provides ordering and Internet access information for the publications and standards referenced herein as well as a listing of applicable publications on building assessment, energy conservation, and historic preservation.

Use the *Secretary of the Interior's Standards for Rehabilitation* when dealing with historic properties. They are available full text online at http://www2.cr. nps.gov/tps.

When a property is rehabilitated for resale or when a contractor or builder is rehabilitating a property for its owner, consider using the *Residential Construction Performance Guidelines*. These were developed by the National Association of Home Builders' Remodelers Council, Single Family Small Volume Builders Committee.

When assessing the tornado risk at a site, consider using *Taking Shelter from the Storm: Building a Safe Room Inside Your House*, available from the Federal Emergency Management Agency (FEMA).

When assessing the flood risk at a site and before undertaking any applicable rehabilitation measures, consider using *Design Manual for Retrofitting Flood Prone Residential Structures*, available from the Federal Emergency Management Agency.

When inspecting a building located in a region of high seismic activity or in a hurricane region, additional information on vulnerability assessment and retrofit options can be found in *Is Your Home Protected from Earthquake Disaster?* and *Is Your Home Protected from Hurricane Disaster?* Both documents are available from the Institute for Business and Home Safety or can be viewed full text online at http://www.ibhs.org.

For those interested in working with local officials to make building codes more amenable to rehabilitation work, see the U.S. Department of Housing and Urban Development's *Nationally Applicable Recommended Rehabilitation Provisions*.

# 1
# Site

Begin the rehabilitation inspection by thoroughly examining the property's drainage, site improvements, and outbuildings. Although their condition may have a profound impact on the total costs of the rehabilitation project, they are often overlooked or not fully considered in the initial building assessment. Tree removal, the replacement of sidewalks and driveways, and the repair of outbuildings can add substantially to rehabilitation expenses and may make the difference between a project that is economically feasible and one that is not.

**Earthquake.** Check the slope of the site. Buildings constructed on slopes of 20 degrees or more should be examined by a structural engineer in all seismic regions, including regions of low seismic activity. See Section 4.1, Seismic Resistance.

**Wind.** If the site is in a hurricane or high wind region, it should be examined for loose fences, tree limbs, landscaping materials such as gravel and small rocks, and other objects that could become windborne debris in a storm. See Section 4.2, Wind Resistance.

**Floods.** Five major flood-risk zones have been established to define where floods occur, and special flood resistance requirements have been created for each zone. Check with local authorities. See Section 1.5, Flood Regions.

**Lead.** Consider checking for the presence of lead in the soil, which can be a hazard to children playing outdoors and can be brought indoors on shoes. Lead in soil can come from different sources such as discarded lead-based paint, lead-based paint chips near foundations from when exterior walls were scraped and painted, leaded gasoline (now banned) on driveways where car repairs were made, leaded gasoline from car exhaust, and old trash sites where lead-bearing items were discarded. Check the site for evidence of any of these conditions and if found, consider having the soil tested for lead content.

**Wildfires.** In locations where wildfires can occur, some jurisdictions have requirements for hydrant locations and restrictions on the use of certain building materials as well as restrictions on plantings close to a building. Check with the local building official and the fire marshal for such requirements.

**Building Expansion.** If a rehabilitation project includes expanding a building or outbuilding, an assessment of the site for this work is critical. There is also a complementary need to examine zoning regulations to establish allowable coverage and setbacks. The use of available land may be restricted by coverage and setback requirements that define the areas on the site that can be used for new construction.

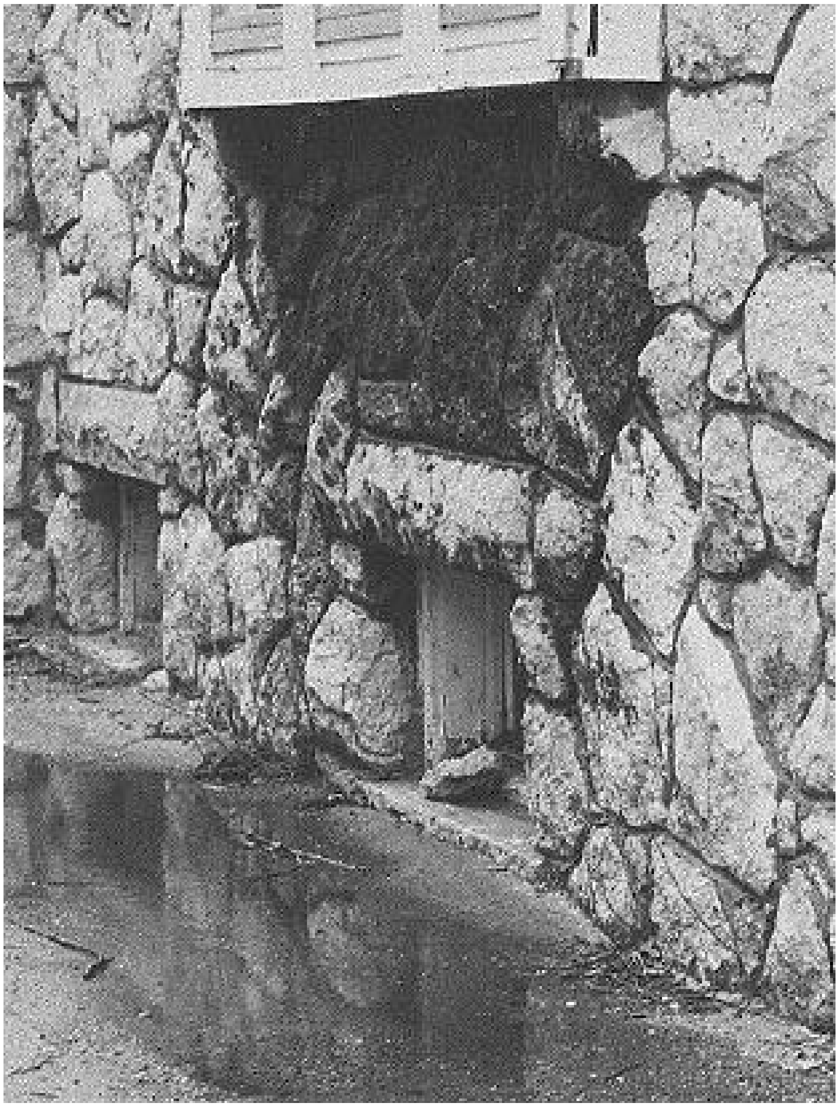
**Site Restrictions.** Homeowner association bylaws and deed covenants sometimes include requirements that can affect changes or additions to a building or outbuilding. These documents should be carefully examined to determine their impact.

**Accessibility.** When universal design is a part of a rehabilitation, consult the HUD publication *Residential Remodeling and Universal Design* for detailed information about parking, walks, and patios.

## 1.1
## Drainage

Observe the drainage pattern of the entire property, as well as that of adjacent properties. The ground should slope away from all sides of the building. Downspouts, surface gutters, and drains should direct water away from the foundation. Check the planting beds adjacent to the foundations. Plantings are often mounded in a way that traps water and edging around planting beds acts like a dam to trap water. Most problems with moisture in basements are caused by poor site drainage.

The ground also should slope away from window wells, outside basement stairs, and other areaways. The bottom of each of these should be sloped to a drain. Each drain should have piping that connects it to a storm water drainage system, if there is one, or that drains to either a discharge at a lower grade or into a sump pit that collects and disperses water away from the building. Drains and piping should be open and clear of leaves, earth, and debris. A garden hose can be



*Poor site drainage leads to a variety of problems, in this case a wet basement.*

used to test water flow, although its discharge cannot approximate storm conditions.

Where a building is situated on a hillside, it is more difficult to slope the ground away from the building on all sides. On the high ground side of the building, the slope of the ground toward the building should be interrupted by a surface drainage system that collects and disposes of rainwater runoff. There are two general types of surface drainage systems: an open system consisting of a swale (often referred to as a ditch), sometimes with a culvert at its end to collect and channel water away, and a closed system consisting of gutters with catch basins. Combinations of the two are often used. The locations and layout of culverts, gutters, drains, and catch basins should be such that if they became blocked and overflowed no significant damage will occur and that any resultant ice conditions will not pose a danger to pedestrians or vehicles. The design of surface drainage systems is based on the intensity and duration of rain storms and on allowable runoff. These conditions are usually regulated by the local building code, which can be used to check the adequacy of an existing surface drainage system.

In some locations, especially where slopes lack vegetation to slow water flow, it may be possible to reduce rehabilitation costs by diverting rainwater into a swale at or near the top of the slope and thereby reduce the amount of rainwater runoff handled by a surface drainage system. This swale, of course, must be within the property on which the building is located.

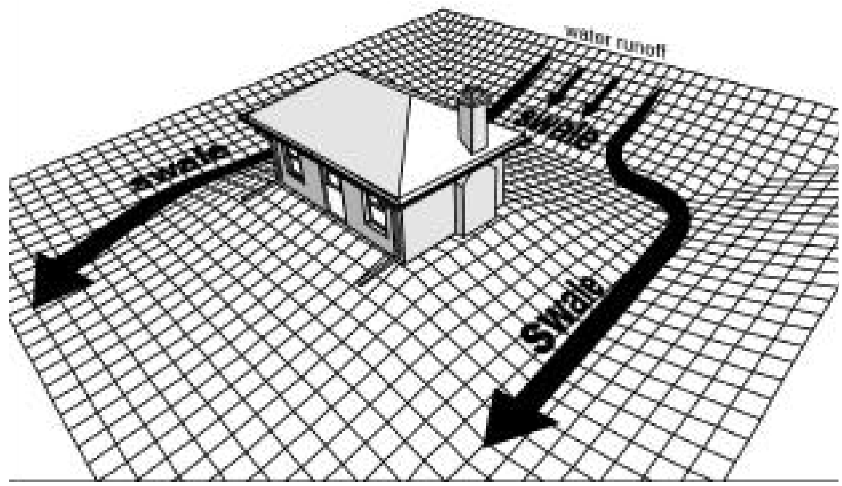
The ground beneath porches and other parts of a building that are supported on piers should be examined carefully. It should have no low areas and be sloped so that water will not collect there.

Water from the roof reaches the ground through gutters and downspouts or by flowing directly off roof edges. Because downspouts create concentrated sources of water in the landscape, where they discharge is important. Downspouts should not discharge where water will flow directly on or over a walk, drive, or stairs. The downspouts on a hillside building should discharge on the downhill side of the building. The force of water leaving a downspout is sometimes great enough to damage the adjacent ground, so some protection at grade such as a splash pan or a paved drainage chute is needed. In urban areas, it is better to drain downspouts to an underground storm water drainage system, if there is one, or underground to discharge at a lower grade away from buildings.

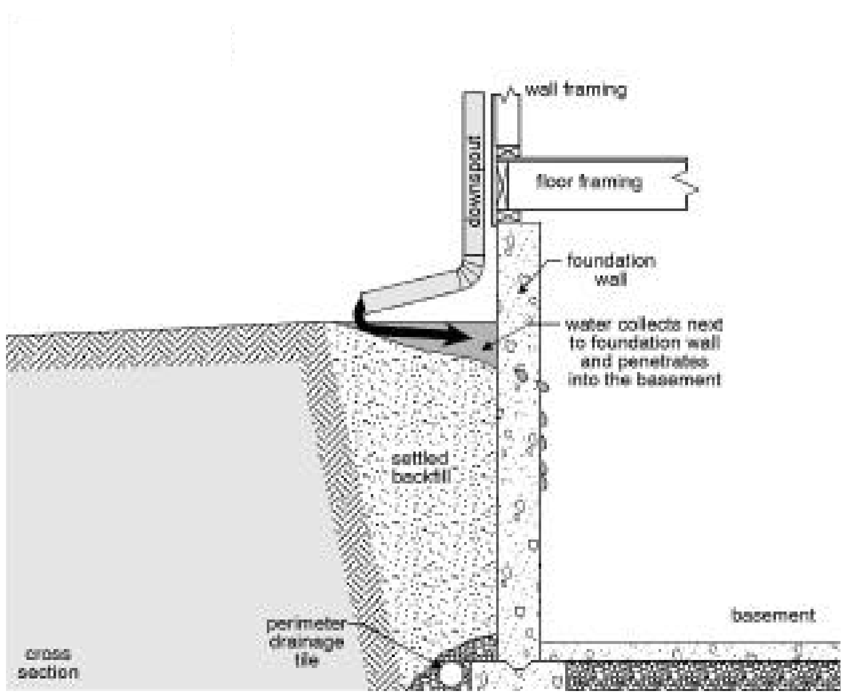
Water that flows directly off a roof lacking gutters and downspouts can cause damage below. Accordingly, some provision in the landscaping may be needed, such as a gravel bed or paved drainage way.

When a sump pump is used to keep a building interior dry, the discharge onto the site should be located so that the discharge drains away from the building and does not add to the subsurface water condition the sump pump is meant to control.

The site should be examined overall for the presence of springs, standing water, saturated or boggy ground, a high water table, and dry creeks or other seasonal drainage ways, all of which may affect surface drainage. It is especially important to inspect the ground at and around a septic system seepage bed, seepage pit, or absorption trenches. See Section 6.7.




*Where a building is situated on a hillside, swales can be used to direct surface water away from the foundation.*




*Settled backfill allows water to collect next to the foundation wall and penetrates into the basement.*

## 1.2 Site Improvements

Well-maintained landscaping and other site improvements are important for the enjoyment, resale, or rental value of a property. Inspect the following:

- **Plantings.** Note the location and condition of all trees and shrubbery. Those that are overgrown may need pruning or trimming; in some cases they may be so overgrown that they will have to be removed. When trees or shrubbery exhibit disease or infestation, consult a qualified expert. Removing large trees may require special expertise and can be particularly costly.

  Check where overhanging branches may interfere with the chimney's draft, damage utility wires, or deposit leaves and twigs in roof gutters and drains.

  Trees and shrubbery that are very close to exterior walls or roofs can cause damage that is sometimes severe, and they can make it difficult to make inspections, do maintenance, and make repairs. Branches in these locations will need to be pruned back.

  Tree roots under paving and stairs can cause damage that is sometimes severe. Roots are usually exposed near the surface and will need to be cut back.

  Tree roots can heave foundations and may cause cracking by pushing against foundations from the outside. If tree roots are under a footing, cutting down the tree can lead to rotting of the roots and subsequent settling of the foundation.

  Observe the solar shading characteristics of all site plantings. Do they provide protection from the summer sun and allow the winter sun to warm the building? Large deciduous trees located to the south and west of a building can do both, and a special effort should be made to retain and protect such trees where they exist.

- **Fences.** Fences are usually installed to provide physical or visual privacy. Examine their plumbness and overall condition. Inspect wood fences for signs of rot or insect infestation and inspect metal fences for rust. Inspect all gates and their associated hardware for proper fit, operation, and clearance. Fences are often addressed in homeowner association bylaws and deed covenants. These should be checked and their requirements, if any, compared to existing conditions or used for the design of a new or replacement fence. Pay special attention to fence locations and property lines.

- **Lighting.** Examine outdoor lighting elements to determine their condition and functional safety. Turn site lighting on, preferably at night, to check its operation and to determine if the light is adequate for its purpose. Exposed wiring that is not UV- and moisture-resistant should be replaced. Underground wiring should be type UF. Fixtures, switches, and outlets should be properly covered and protected from moisture penetration.

- **Paved areas.** Inspect all walks, drives, and patios for their condition and to make sure paved areas immediately adjacent to a building are sloped away from building walls. Paving that is not sloped to drain water away from a building should be replaced. Inspect paving for cracks, broken sections, high areas, low areas that trap water, and tripping hazards.

  Paved areas that are made of concrete and are in poor condition may have to be replaced. Concrete cannot be repaired by resurfacing with a thin layer of more concrete. Concrete repairs in climates where freezing occurs should be no less than three inches thick. Where there is no freezing weather, repairs that are two inches thick may be used. Cracks in concrete should be cut open and sealed with a flexible sealant compound, which will extend its service life albeit not improve its appearance. Where there is a difference in elevation in a walk or drive that creates a tripping hazard, the higher portion of concrete may be ground down to the level of the lower portion, although the grinding will change the appearance of the concrete. Sunken areas of concrete paving result from failure of the subbase. For sidewalks it may be possible to lift up sections of the paving between construction joints, add to and compact the subbase to the proper elevation, and replace the paving sections.

Failed or sunken areas of asphalt drives and walks usually should be resurfaced or replaced. Sealing asphalt paving extends its life. Examine the paving to determine when sealing is needed. Check asphalt drives and walks for low areas that hold water and freeze in cold climates. Low areas in asphalt paving can be brought to level with an asphalt overlay.

Brick or stone patio paving should be set either on a concrete slab in a mortar bed with mortar joints or in a sand bed that is laid on earth or on a concrete slab. Mortar joints can be tuck pointed and loose bricks or stones can be reset in a new mortar bed. Pavers set in sand can be taken up easily, sand added or removed, and the pavers replaced.

When considering the repair or replacement of such site elements, pay particular attention to existing property lines and easements.

The maintenance, repair, and replacement of sidewalks, drive aprons, and curb cuts at the street may be the responsibility of the local jurisdiction. Check the property's deed or consult local authorities.

- **Stairs.** Inspect the condition of exterior stairs and railings using the current building code as a guide. Every stair with more than three steps should have a handrail located 34 to 38 inches (865 to 965 mm) above the edges of the stair tread. Shake all railings vigorously to check their stability and inspect their fastenings. Stairs that are more than 30 inches (760 mm) above the adjacent grade and walks located more than 30 inches (760 mm) above the grade immediately below should have guards not less than 36 inches (915 mm) high and intermediate rails that will not allow the passage of a sphere 4 inches (100 mm) in diameter. Check wooden steps for proper support and strength and for rot and insect infestation. Inspect steel stairs for rust, strength, and attachment. Deteriorated stairs should be repaired or replaced. Stair treads should be as level as possible without holding water. It is preferable that stairs in walks on site that are accessible to the general public have at least three risers. Stair riser heights and tread depths should be, respectively, uniform.
- **Retaining walls.** Inspect the construction and condition of retaining walls. Retaining walls more than two feet in height should be backed with drainage material, such as gravel. There should be drains at the bottom of the drainage material. The drains should discharge water either at the end of the wall or through pipes set in the wall itself. These drains and the drainage material behind the wall relieve the pressure of ground water on the wall. If possible, weep holes and related drains should be examined closely following a reasonably heavy rain to make sure they are working properly. If they are not discharging water, the drains should be cleaned out and observed again in the next rain. Failure to drain should be remedied by excavating behind the wall, replacing the drainage material and damaged drainage piping, and backfilling. In all but the driest climates, improper drainage of water from behind a retaining wall can cause the wall to fail.

  Check for bowing (vertical bulges), sweeping (horizontal bulges), and cracking in retaining walls that can be caused by water pressure. Bulging can also be a result of inadequate strength to resist the load of the earth behind the wall. Bowing and sweeping failures may be correctable if found early enough and if the cause is poor drainage.

  Check for other failures of retaining walls. Failure by overturning (leaning from the top) or sliding may be caused by inadequate wall strength. In addition, water behind a wall can create moist bearing, especially in clay soils, and contribute to sliding. Retaining walls also fail due to settling and heaving. The former occurs whenever filled earth below the wall compacts soon after the wall is built, or when wet earth caused by poor drainage dries out and soil consolidates at any time in a wall's service life. Poor drainage contributes to failure in cold climates by creating

*The outward movement of the upper part of this retaining wall can be halted only by structural reinforcement. Simply patching the crack will not solve the problem.*

heaving from frozen ground. Both overturning and sliding may be stabilized and sometimes corrected if the amount of movement is not extreme. Settling may be corrected on small, low walls of concrete or masonry, and heaving may be controlled by proper drainage. Significant failure of any kind usually requires rebuilding or replacing all or part of a wall.

Failing retaining walls more than two feet in height should be inspected by a structural engineer.

- **Buried oil tanks**. Buried ferrous metal oil tanks are common on older properties that have buildings or domestic water heated by oil. The presence of a buried oil tank usually can be determined by finding the fill pipe cover on the ground and the vent pipe that extends above ground to a height of at least four feet. Abandoned and very old buried ferrous metal oil tanks are an environmental hazard. If such a buried tank is located on the property, the soil around it should be tested by a qualified environmental engineer for the presence of oil seepage. If leaking has occurred, the tank and all contaminated soil around it must be removed. If leaking has not occurred, it may still be a potential problem. Even if a tank is empty, it still may have residual oil in the bottom that is a pollutant. Strong consideration should be given to removing the tank or filling it with an approved inert material after pumping out any old residual oil.
- **Aerials.** On-site installations of aerial masts either from the ground or mounted to a tree or building should be assessed for structural stability, especially in high wind areas.

## 1.3 Outbuildings

Examine detached garages, storage sheds, and other outbuildings for their condition in the same way that the primary building is inspected. Check each outbuilding's water shedding capability and the adequacy of its foundations. On the interior, look for water staining on the roof or walls. Wood frame structures should be thoroughly inspected for rot and insect infestation. Check also that all doors function properly and that doors and windows provide adequate weather protection and security for the building. Make sure that small outbuildings have sufficient structural strength to sustain the applicable wind loads or seismic forces.

If the site is in a hurricane or high-wind region, check all outbuildings for their ability to resist a storm without coming apart and becoming windborne debris. Consider consulting an engineer.

## 1.4 Yards and Courts

In urban areas, two or more dwelling units may share a yard or court to provide light and ventilation to interior rooms. The adequacy of the light provided is a function of the dimensions of the yard or court, as well as the color of surrounding walls. Check these characteristics, as well as zoning and building and housing code requirements pertaining to light, ventilation, and privacy screening for yards and courts. Such requirements may affect the reuse of the property and their implications should be understood before the property is altered or purchased.

## 1.5 Flood Regions

The Federal Emergency Management Agency and the National Flood Insurance Program have established and defined five major flood-risk zones and created special flood resistance requirements for each.

Improperly designed grading and drainage may aggravate flood hazards to buildings and cause runoff, soil erosion, and sedimentation in the zones of lower flood risk, the Interflood Zone, and the Non-Regulated Flood Plain. In these locations, local agencies may regulate building elevations above street or sewer levels. In the next higher risk zones, the Special Flood Hazard Areas and the Non-Velocity Coastal Flood Areas (both Zone A), the elevation of the lowest floor and its structural members above the base flood elevation is required. In the zone of highest flood risk, the Coastal High Hazard Areas (Velocity Zone, Zone V), additional structural requirements apply.

Check with local authorities to determine if the site is in a flood-risk zone. If it is, check with local building officials. Higher standards than those set by national agencies have been adopted by many communities.